The Wild Side of Ecology

Wildlife Education Activities and Resource Materials
for New Mexico Educators, Grades 4-12

Wild Friends Program
University of New Mexico

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Wild Friends Program
The University of New Mexico

Printed June 2007

The Wild Side of Ecology

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Update: April 2012

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Aknowledgements

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This project was made possible by a grant from the Dorr Foundation.

Acknowledgements

The Wild Side of Ecology would not have been possible without the help of a community of dedicated and generous people who support environmental education. On behalf of the Wild Friends Program, I want to offer heartfelt thanks to:

… the Dorr Foundation of Portsmouth, NH for funding this project.

… New Mexico Department of Game and Fish Director Dr. Bruce Thompson and his staff, especially Kevin Holladay, for the use of NMGF wildlife education materials and the department’s video, “What We Do”.

… Selena Connelay, Chief of Education, New Mexico Museum of Natural History & Science and the Sandia Mountain Natural History Center, for allowing us to include some of their educational activities in this manual.

… Robert DeWitt Ivey for permission to reproduce illustrations from his book *Flowering Plants of New Mexico* (2003), RD & V Ivey, Publishers.

… Center for Wildlife Law Director Ruth Musgrave, whose appreciation for the wonders of nature is an inspiration to us all.

… Laura Finley, Wild Friends Intern, for spending her summer lending a helping hand.

… Elodie Collins and Cindy Nee of the UNM School of Law Copy Center for their expert and gracious assistance in producing this work.

Carolyn Byers
Wild Friends Program Director

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Introduction

Welcome to *The Wild Side of Ecology.* This collection of wildlife education activities and resource materials was developed to be a resource aid for New Mexico teachers and sponsors of Wild Friends student groups. The activities and materials are intended to supplement existing science curricula for grades 4 through 12, and for use in after school programs. Most of the activities are designed to stand alone, so it is not essential to do all the activities in order. Activities geared for a specific grade level can be adapted to lower or higher grades.

A unit overview provides general information about the specific topic for that section. Key words are defined in each activity and relevant New Mexico science standards and benchmarks are listed.

The goals of this project are to help young people deepen their appreciation for wildlife and the natural world and to increase academic achievement. We hope that you and your students find *The Wild Side of Ecology* useful and fun to use.

* * * * *

The Wild Friends Program was founded in 1991 at the Center for Wildlife Law at the UNM School of Law's Institute of Public Law. The program combines wildlife science education with civic engagement and youth leadership training. Activities are designed to help educators implement various state standards and benchmarks in Science, Math, Geography, Government and Civics, Language Arts and Art Education.

Discovery Science

"If I had influence with the good fairy who is supposed to preside over the christening of all children, I should ask that her gift to each child in the world be a sense of wonder so indestructible that it would last throughout life." – Rachel Carson

Discovering the natural world through the five senses, as well as observing change over time, are the fundamental ways that all living organisms collect information about their surrounding environments. Scientists use specific thinking processes and activities to collect information, study animals and plants, or develop ideas about the natural world. Scientific discovery is the process of trying to understand the natural world by observing, asking questions, and forming hypotheses about the environment. All activities in science, as well as civics, require students to ask questions about a subject, gather information, and form ideas. Wild Friends students use these skills to research a topic on wildlife and formulate ideas which they then take to the state legislature in the hopes of using those ideas to educate others on a specific issue.

In this unit, students will learn how to observe their surroundings and practice the scientific method. Older students will have the opportunity to apply taxonomic nomenclature to organisms they discover in their local environments. Together, this unit is meant to introduce students to the fascinating world of scientific discovery, and provide a framework for supporting intuitiveness, and creativity in discovery and problem-solving.

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Discovery Science

Practicing Science Skills with a Pencil

Objective
Students will be introduced to the method by which scientists approach the process of inquiry

Key Words
1. *Measure* – to find the size, amount, capacity or degree of something, such as speed or temperature
2. *Observe* – to see or notice something, especially while watching carefully
3. *Question* – to ask for information; something that is asked
4. *Senses* – the abilities of seeing, hearing, tasting, smelling or touching by which a person or animal gets information about the physical world
5. *Hypothesis* – a possible explanation

Background
The scientific method is a procedure used by scientists to test hypotheses by making predictions about the outcome of an experiment before the experiment is performed. The results provide support as to whether each hypothesis is right or wrong.

Materials
Pencil
Metric Ruler
Paper
Practicing Science Skills handout

Advance Preparation
1. Make copies of handout for each student.
2. Explain to students that scientists use the metric system of measurement because it is Understood by scientists in every country.

Instructions
Students will use their imaginations to look at a pencil as if they have never seen one before. They will discover what this “unknown” object is using scientific skills. A “Practicing Science Skills” handout will be given to each child. Following the directions on the handout, the class will proceed through the six steps on the handout. It is important to emphasize that writing everything down that is observed is a basic part of the process. Every detail of the pencil should be noted: color, size, weight, texture, component structures (i.e wood, graphite, metal, plastic, etc).

Option
This activity can be adapted using other common things in the classroom or on the playground.

New Mexico Science Standards
4th grade, I, I, I, 1 and 2

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Discovery Science

The Mystery Box

Objectives

Students will:
1. Learn how to follow a process, such as the scientific method used here
2. Practice making hypotheses and formulating conclusions

Key Words
1. *Conclusion* – a judgment or decision made after careful thought
2. *Hypothesis* – an answer to a question based on an educated guess
3. *Interpret* – to understand or explain the meaning or importance of something
4. *Predict* – to say what is going to happen in the future

Background

Scientists use the scientific method to do experiments and study physical evidence to answer questions about the natural world. To use the scientific method, a scientist will:
1. Observe something he/she is interested in
2. Ask a question based on the observation
3. Develop a hypothesis about it
4. Make predictions based on the hypothesis
5. Test the hypothesis through experiments
6. Interpret the results of the experiments
7. Make conclusions based on experiments

The reliability of the conclusions is based on the ability of other scientists to repeat the experiments and arrive at the same conclusions. Sometimes new hypotheses are made and tested.

Materials

Small boxes with covers
Pencils or pens
Controlled Experiment Organizer
Natural items from campus grounds
Mystery Box Worksheets

Advance Preparation
1. Divide students into pairs or groups for each available box.

2. Make an opening in each box large enough for a hand to be inserted for touch observations. (Students can make the boxes.)

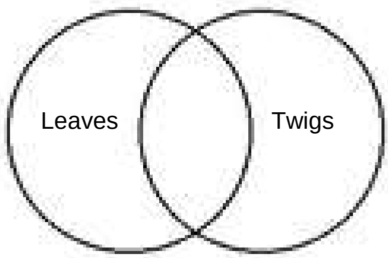
3. Gather enough natural items to put one or two items in each box, and enough extra items to be used for the control models. Be sure that items are from the campus area and are not man-made. Choose at least *three* different kinds of items.

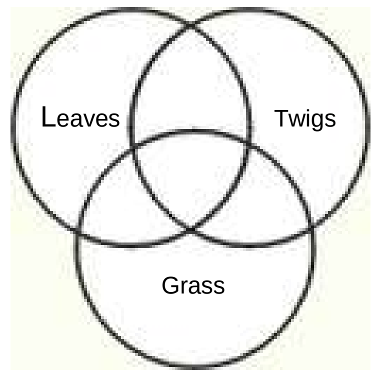
4. Review the *Mystery Box Worksheet* with students.

Instructions
1. Have students explore their boxes and fill in the worksheets.

2. After the worksheets are completed, open the boxes. Have students make some class graphs. They should answer the following questions to make graphs:
   A. How many total number of each of the items *x, y* and *z* were there?
   B. What percentage of the boxes had item *x*? Item *y*? Item *z*?

3. Make some Venn diagrams comparing the items.





New Mexico Science Standards
Grade 4, I, I, II, 1, 2, 3
Grade 5-8, I, I, I, 1, 2, 3, 4, 5
Grade 9-12, I, I, I, 3, 4

Source: Adapted with permission from “Mystery Box”, Electronic Bridge Project, Ecosystems of the Southwest (1996)

Mystery Box Worksheet

Name ____________________________ Date _________________ Box Number ________

Scientific discoveries are usually the result of a step-by-step procedure involving making observations, interpreting information, testing ideas and drawing conclusions. This process is commonly called the Scientific Process or Method. It is used by scientists around the world.

1. IDENTIFY A PROBLEM: What mystery items are in the box?

____

2. RESEARCH/MAKE OBSERVATIONS: Make a minimum of 3 good observations about the contents of your box. Use observational statements that begin with *I hear, I smell or I feel* (for this section, there will be no *I see* or *I taste* observational statements). Be creative and factual, but <u>don't</u> look inside the box.

____

____

____

3. FORM A HYPOTHESIS or *I think* statement (interpret your observations): Make your *best guess* about the contents of your box. Try to determine how many, what types of material, names of items, etc. Try to describe the contents of the box without looking inside. Begin each statement with *I think* …

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4. EXPERIMENT: Test your hypothesis. Experiment with the box and its contents by tipping it in different directions. Try to make a model that duplicates the sound and feel of your box. Make new observations and inferences, if necessary. The model you are duplicating is called the *CONTROL*. You are controlling what you put inside the model box. Controls are standards used for comparison. Write down your new observations here after comparing your control to the original box.

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5. Now look inside the box. Write down exactly what you find.

____

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Draw pictures of the items that are in the box

5. CONCLUSIONS: Now that you have done testing with your Mystery Box, you feel confident about knowing what is inside. You are now ready to write an *I know* statement. Make several *I know* statements describing everything that you know about the contents of the box. Begin each statement with *I know* …

6. Also write some new *I think* statements, such as *I think this item is found on the west side of campus, because* …

Controlled Experiment Organizer

Name ____ Date ______________________

Directions: Use this as a guide to conduct a controlled experiment.

Title:	
Problem:	
Hypothesis	
Procedure(s)	
Independent Variable (the cause)	
Dependent Variable (the effect)	
Control:	
Observation:	
Data:	
Conclusion:	

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Discovery Science

Processing a Penny

Objectives

Students will:

1. Learn how to follow a process, such as the scientific method used here
2. Practice making hypotheses and formulating conclusions

Key Words

1. *Conclusion* – a judgment or decision made after careful thought
2. *Hypothesis* – an answer to a question based on an educated guess
3. *Interpret* – to understand or explain the meaning or importance of something
4. *Predict* – to say what is going to happen in the future

Background

Scientists use the “scientific method” to study the physical world. Scientists look at things in a number of ways. Before making any conclusions about anything, scientists will do several things: sort, collect and organize data; do experiments; make predictions; come up with a hypothesis; and check to see if their hypothesis agrees with the results of the experiments. Then other scientists will repeat the experiments to see if they get the same results

The steps of this “scientific method” are:

1. Observe something in very great detail
2. Ask a question
3. Develop a hypothesis
4. Make predictions based on the hypothesis
5. Test the hypothesis through experiments
6. Interpret the results of the experiments
7. Make conclusions based on experiments

Materials

For each student or group of students:

Processing With A Penny student workbook

18 pennies of varying dates
1 nickel, 1 dime and 1 quarter
Ruler
Eye dropper
Pencil

Vinegar
Vegetable Oil
Dish soap
Lemon juice

Advance Preparation

1. Photocopy and fold the pages of *Processing With A Penny* workbook into a book format.
2. Review the workbook with students.

Instructions

Have students do the experiments and fill in the pages of the workbook.

New Mexico Science Standards
Grade 4, I, I, II, 1, 2, 3
Grade 5-8, I, I, I, 1, 2, 3, 4, 5
Grade 9-12, I, I, I, 3, 4

Source: Adapted with permission from “Processing with a Penny”, Electronic Bridge Project, Ecosystems of the Southwest (1996)

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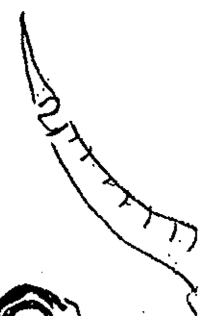
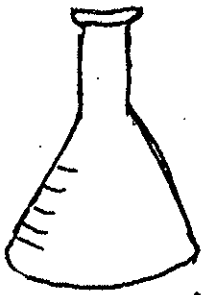
Practicing Scientific Skills

1. Look carefully with your eyes.
   Draw what you are looking at.
   Measure each part.
   Use metric measurement.

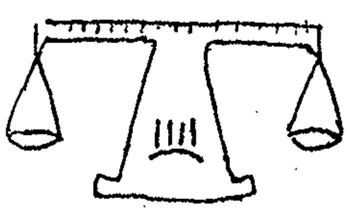


2. Think about what you are looking at.
   Use your other senses to "see"
   different things.
   - Touch
   - Smell
   - Sound
   - Taste (be careful)





3. Ask yourself questions.
   What shape is it?
   What color is it?
   Does it feel heavy? Light?
   Does it feel smooth? Rough?
   Is it thick? Thin? Hard? Soft?
   What does it smell like?
   Does it make any sound?



$E = MC^2$

H_2O

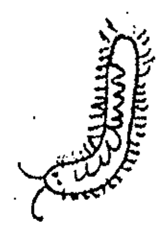
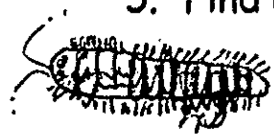
Au

Fe

U_{235}

4. Write down everything you see and think.

5. Find answers to your questions.

6. Share what you have learned.

Created by: Karla and Gary Sampson

Discovery Science

Practicing Science Skills with a Pencil

Objective
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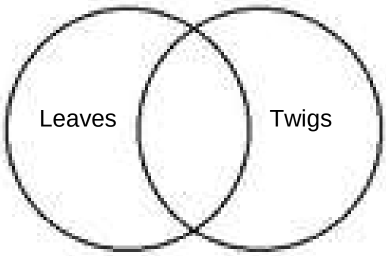

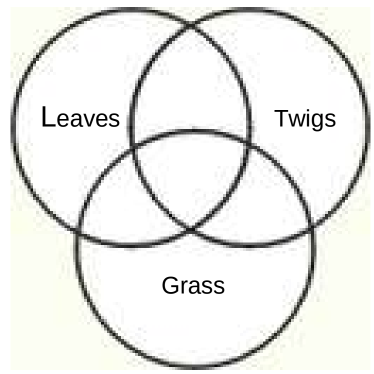

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5. Now look inside the box. Write down exactly what you find.

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Draw pictures of the items that are in the box

5. CONCLUSIONS: Now that you have done testing with your Mystery Box, you feel confident about knowing what is inside. You are now ready to write an *I know* statement. Make several *I know* statements describing everything that you know about the contents of the box. Begin each statement with *I know* …

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6. Also write some new *I think* statements, such as *I think this item is found on the west side of campus, because* …

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Controlled Experiment Organizer

Name ____ Date ______________________

Directions: Use this as a guide to conduct a controlled experiment.

Title:	
Problem:	
Hypothesis	
Procedure(s)	
Independent Variable (the cause)	
Dependent Variable (the effect)	
Control:	
Observation:	
Data:	
Conclusion:	

Discovery Science

Processing a Penny

Objectives
Students will:
1. Learn how to follow a process, such as the scientific method used here
2. Practice making hypotheses and formulating conclusions

Key Words
1. *Conclusion* – a judgment or decision made after careful thought
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3. Develop a hypothesis
4. Make predictions based on the hypothesis
5. Test the hypothesis through experiments
6. Interpret the results of the experiments
7. Make conclusions based on experiments

Materials
For each student or group of students:
Processing With A Penny student workbook
18 pennies of varying dates
1 nickel, 1 dime and 1 quarter
Ruler
Eye dropper
Pencil
Vinegar
Vegetable Oil
Dish soap
Lemon juice

Advance Preparation
1. Photocopy and fold the pages of *Processing With A Penny* workbook into a book format.
2. Review the workbook with students.

Instructions
Have students do the experiments and fill in the pages of the workbook.

New Mexico Science Standards
Grade 4, I, I, II, 1, 2, 3
Grade 5-8, I, I, I, 1, 2, 3, 4, 5
Grade 9-12, I, I, I, 3, 4

Source: Adapted with permission from "Processing with a Penny", Electronic Bridge Project, Ecosystems of the Southwest (1996)

CONCLUSION

What did you learn from your experiment? Write 3 complete sentences:

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PROCESSING

WITH A

PENNY

Name ____________________________________

Date ______________________ Period ________

OBSERVE

Look at a penny very carefully. Write in the missing information on the penny below.

Describe the penny:

____

____

____

CONTROLLING VARIABLES - III

Make 4 different mixtures. Add 8 drops of each substance below to 100 cc of water. Repeat the penny drop experiment with each of the 4 mixtures.

Mixture	Trial #	Prediction	Result
Water	# 1		
+	# 2		
Vinegar	# 3		
Water	# 1		
+	# 2		
Oil	# 3		
Water	# 1		
+	# 2		
Dish Soap	# 3		
Water	# 1		
+	# 2		
Lemon Juice	# 3		

Were your predictions for the mixtures correct?

	YES	NO
Vinegar	_____	_____
Dish Soap	_____	_____
Oil	_____	_____
Lemon Juice	_____	_____

CONTROLLING VARIABLES - II

QUESTION: How many drops of water can fit on a <u>nickel</u> without spilling?

HYPOTHESIS: ____________________

Nickel Data:	Prediction	Results
Trial #1		
Trial #2		
Trial #3		

QUESTION: How many drops of water can fit on a <u>quarter</u> without spilling?

HYPOTHESIS: ____________________

Quarter Data:	Prediction	Results
Trial #1		
Trial #2		
Trial #3		

INFERRING

Take a good look at the penny. Notice every detail. <u>Infer</u> (suggest) some things about the penny based on your observations. Write at least 5 complete sentences.

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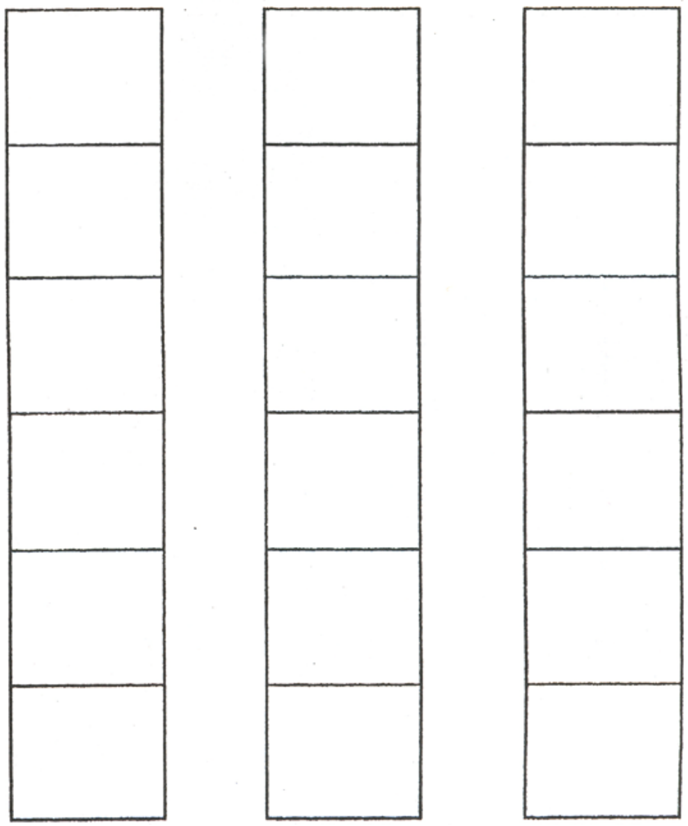
SORTING

Place the pennies in the correct column according to the date on the penny. Trace and date each penny.



______	______	______
19 ___ - 1980	1981 - 1999	2000 – 200_

CONTROLLING VARIABLES - I

QUESTION: How many drops of water can fit on a dime without spilling?

HYPOTHESIS

Based on your knowledge about the number of drops on a penny, hypothesize (predict) the number of drops of water a dime will hold without spilling.

HYPOTHESIS: ___________ drops

WHY? _________________________________

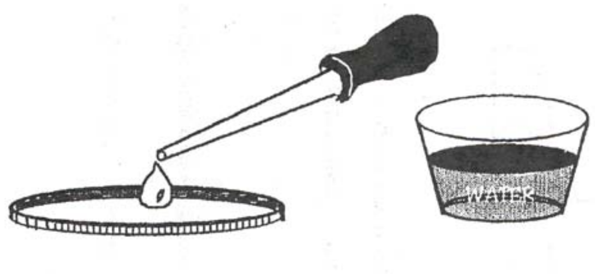
____

Write your predictions below. Then test your hypothesis and fill in the results.

Dime Data:	**Prediction**	**Results**
Trial #1		
Trial #2		
Trial #2		

PREDICTING

CHALLENGE QUESTION: How many drops of water can fit on the top of a penny without spilling?



PENNY DATA

Trial	Prediction	Results
Trial #1		
Trial #2		
Trial #3		

Were your predictions correct? ______________

____

COLLECT AND ORGANIZE DATA

1. Measure the diameter of the penny in centimeters (diameter ↔)

   Diameter = ____________ cm

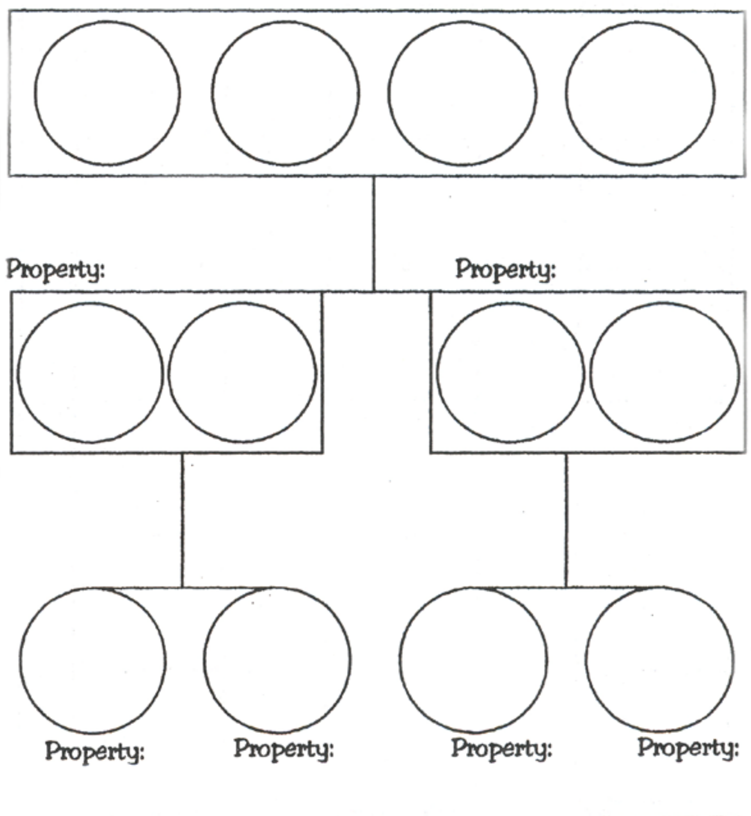
2. How many pennies stacked together ↕ equal 1 cm? ____________

3. Using the penny as a unit of measurement, how many pennies long are the following objects? (If the object is more than ½ penny long, count it as a whole penny).

OBJECT	**# PENNIES**
A. Pencil	____________
B. The length of this paper	____________
C. The length of your shoe	____________
D. The width of this paper	____________
E. The length of your reading book	____________

CLASSIFYING

Place 4 pennies in the top box. Select a property and separate the pennies into two groups: those that HAVE the property and those that DO NOT.



CLASSIFYING - CONT.

Trace the pennies and put them in order from the oldest to the newest penny. Write the date inside each penny.

Trace the pennies and put them in order from the shiniest to the dullest.

Record the number of pennies that have "D" stamped under the date.

Number of pennies with a "D" stamped on them:

____

Number of pennies without a "D" stamped on them:

____

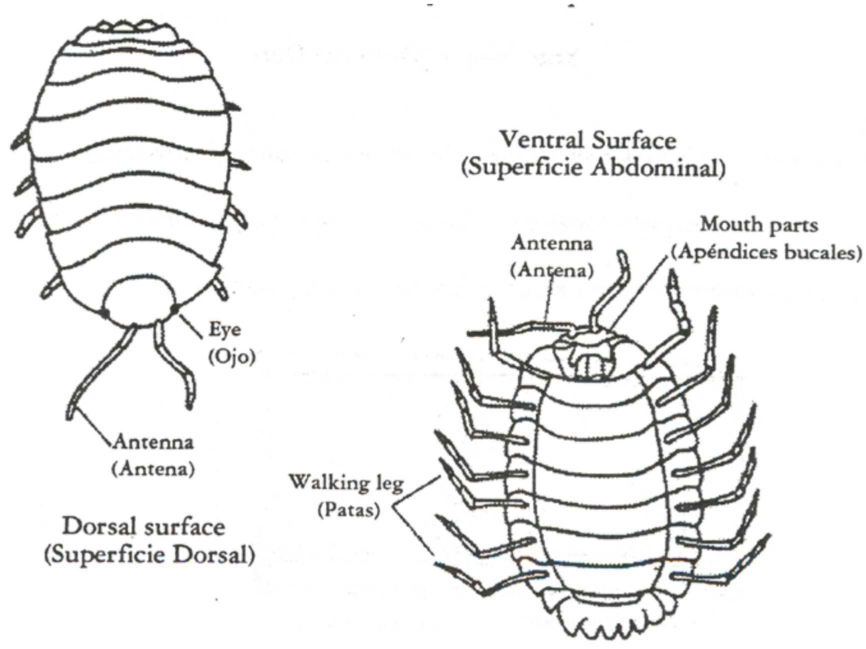
Discovery Science

Roly-Poly Behavior

Objectives
Students will determine what kind of environment isopods (roly-polys) prefer

Key Words
1. *Crustacean* – a hard-shelled creature with several pairs of jointed legs, two pairs of antennae and eyes at the end of stalks.
2. *Decomposer* – an organism that feeds on the dead bodies of other organisms, breaking them down into simpler substances
3. *Environment* – the natural world within which people, animals and plants live
4. *Isopod* – a tiny crustacean animal related to shrimp, crabs, lobsters and crayfish

Background
The isopod is an animal that has many names: roly-poly, sow bug, pillbug and potato bug. Most isopods live in water, but a few kinds live on land. Isopods are crustaceans and are related to shrimp, crabs, lobsters and crayfish. Isopods are unusual because they are one of the few land animals that use gills to breathe. These small animals have seven pairs of legs and two antennae. They live in dark, moist places, especially underneath objects like rocks and wood. Some ispods will roll up into a ball when they are threatened. Isopods are decomposers. They eat decaying wood and leaves. Without decomposers, there would be no way to get rid of the dead plants.



Materials

clock	shoe box	sandpaper
metric ruler	clear cellophane	paper towels
marking pen	magnifying glass	10 isopods (roly-polys)

Advance Preparation
1. Collect a shoe box for the activity.
2. Locate and collect isopods at school or have students bring them from home.
3. Store the isopods in a jar with moist soil and something for them to hide under (rocks, twigs, etc.). Isopods are scavengers so they will eat anything (lettuce, bread, etc.).

Instructions

Part I
1. Ask students these questions:
   What kind of conditions do isopods live in?
   Why do you think they like to live in those conditions?
2. Give each student an isopod to examine with a magnifying glass.
3. Have the student draw a picture of the isopod.

Part II
1. Divide the shoebox into two equal parts using the metric ruler and a marking pen.
2. Place moist (not wet) paper towels in half of the box and dry paper towels in the other half.
3. Place ten isopods in the middle of the box.
4. Have students observe the isopods' locations after 20 minutes.
5. Have students record their observations in Data Table 1.

Part III
1. Put sandpaper in one side of the box and clear cellophane in the other. Smooth the cellophane out so the isopods have a smooth surface and a rough surface.
2. Place ten isopods in the middle of the box.
3. Have students observe the iopods' locations after 20 minutes.
4. Have students record their observations in Data Table 2.

Part IV
1. Ask students the following questions:
   Did most isopods prefer moist or dry conditions?
   How would this relate to the isopods' survival?
   Did most isopods prefer rough or smooth surfaces?
   How would this relate to the isopods' survival?
   What type of environment do isopods prefer?

New Mexico Science Standards
Grades K-4, I, I, I, 1, 2, 3, 4; II, II, II, 1, 2, 3; and III, 1, 2, 3
Grade 6, I, I, I, 2, 3; and II, II, I, 1, 3 and II, II, II, 2
Grade 7, I, I, I, 2; II, II, I, 6 and II, II, II, 10,12
Grade 9-12, I, I, I, 2, 4

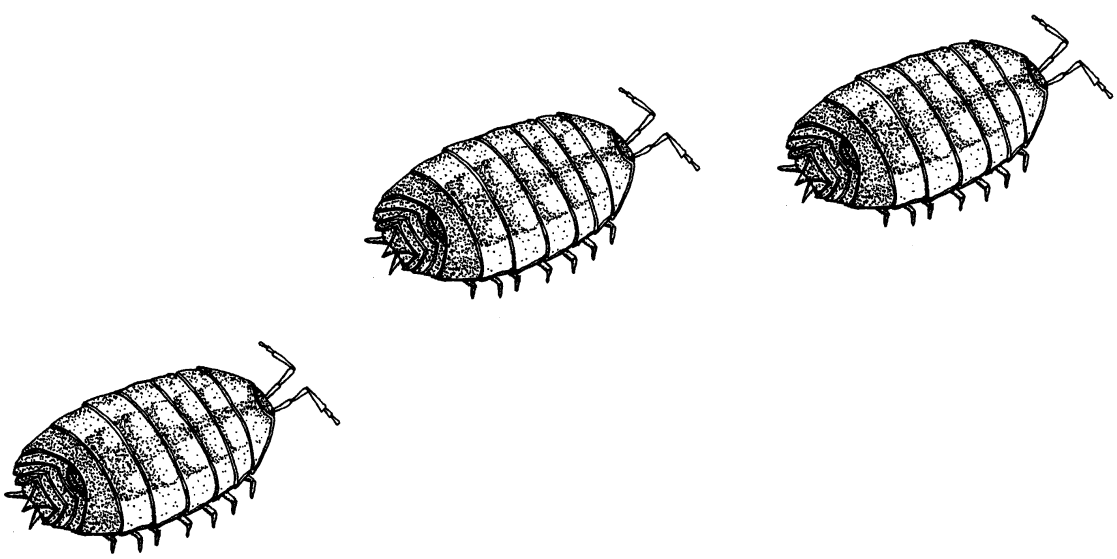
Source: Adapted with permission from "Isopod Behavior", Life Science Curriculum, "Proyecto Futuro" Initiative, New Mexico Musueum of Natural History and Science (1996)

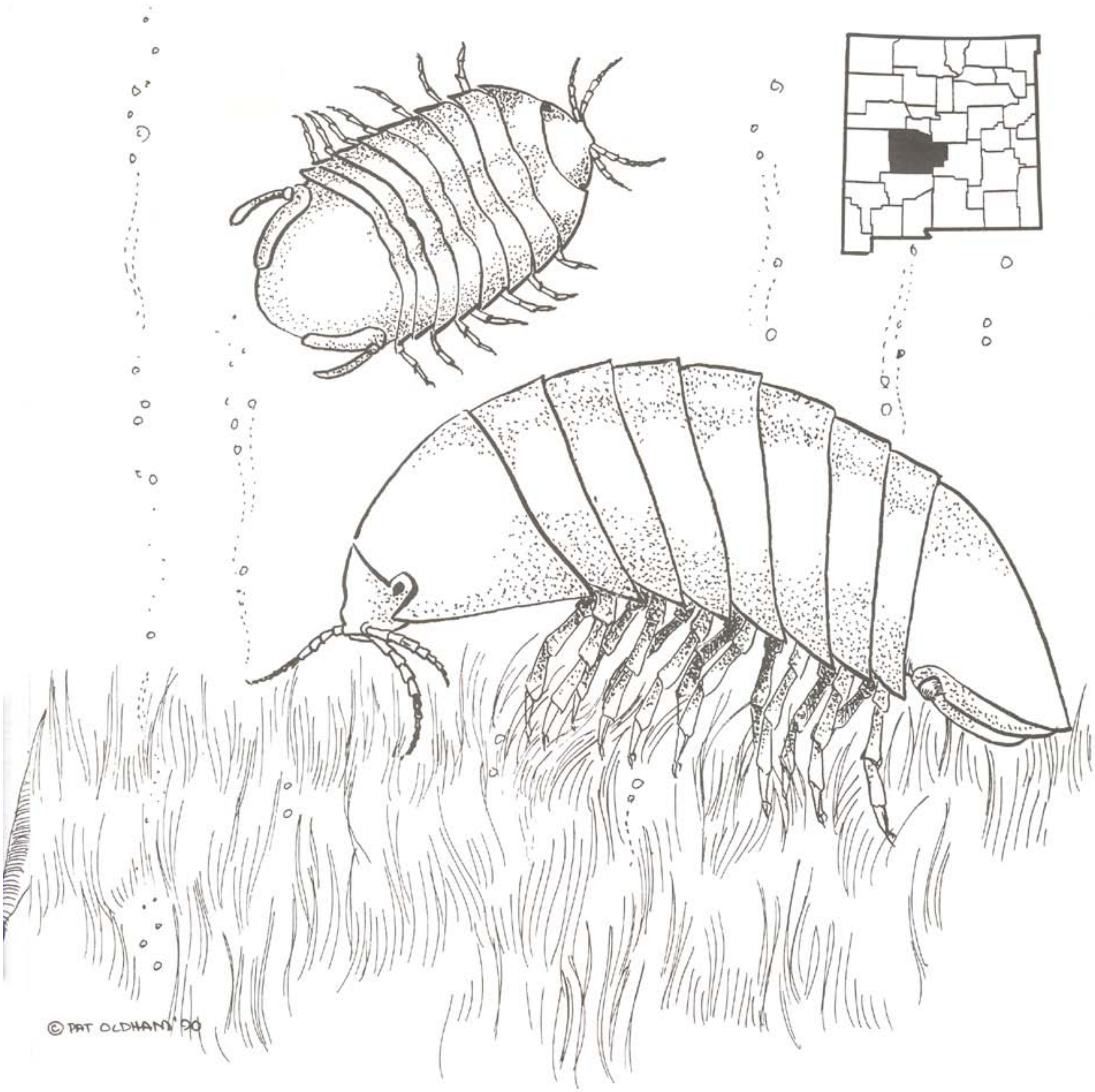
Roly-Poly Behavior Data Table 1.

Environment	Number of Isopods
MOIST	
DRY	

Roly-Poly Behavior Data Table 2.

Environment	Number of Isopods
ROUGH	
SMOOTH	



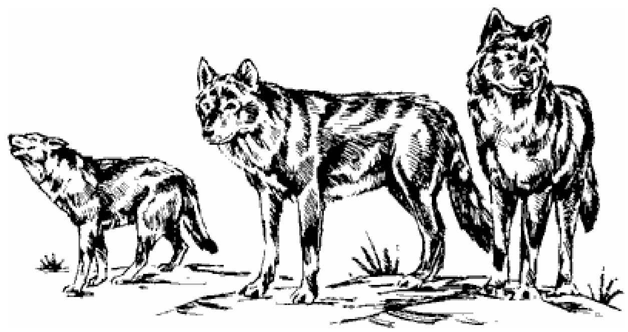


Socorro Isopod

The Socorro isopod is a rare aquatic cousin to sowbugs and pillbugs that live on land. The Socorro isopod lives in hot springs where it swims and crawls about. Socorro ispods get their food from the algae-covered rocks in the hot springs. This rare isopod is confined to the Sedillo Spring west of Socorro, the only natural habitat area for this species in the state. Primary threat is any change to the amount or quality of hot groundwater coming into the spring. The Socorro isopod has been federally listed as endangered since 1994.

Source: "New Mexico Endangered Species Coloring Book", New Mexico Game and Fish Department, www.wildlife.state.nm.us

How Scientists Name Animals



Animals and plants have both common names and scientific names. Most people know the animal in the picture by its common name of “wolf,” which came from “wulf,” the Old English word for the animal. A wolf’s scientific name is *Canis lupus*. The method that scientists use to name animals is called t*axonomy*. It is a way of identifying each animal species. A *species* is the natural grouping of animals which have a common ancestry, a reasonably close physical resemblance, and which breed and produce fertile offspring.

Scientists decided around the end of the Middle Ages to use the Latin language for giving biological names to each species. Latin was a popular language at that time. This custom of giving Latin names has not changed. No matter what language a biologist speaks, when he/she discovers a new animal, the scientist has the right to name that animal. Usually the biologist names it after a physical trait or habit of the animal, but there are no rules to naming. Some animals have been named after the scientist who discovered it, or the scientist's spouse or child or a friend.

The Latin name of a species is always two words. The first name signifies the *genus* – a group of closely related animals. The genus is always capitalized. The second name signifies the particular species. The species name is not capitalized. For example, *Puma concolor* are the genus and species names for mountain lions.

The relationships among various species are shown by grouping them into genera (the plural form of the word *genus*), which are grouped into a *family*, and related families are grouped into an *order*, and the orders are grouped into a *class*. There are 20 orders of mammals recognized today (although that number may also change).

Subdivisions are often used to further separate the relationships of animals. Below is an example of a classification from "class" all the way down to "species" of a common animal we all know, the wolf.

The wolf, or *Canis lupus*, is classified as:		
Class	Mammalia	Animals with milk glands
Subclass	Theria	True mammals
Infraclass	Eutheria	Animals fed through the placenta before birth
Order	Carnivora	Flesh eating animals
Family	Canidae	Coyotes, dogs, foxes, jackals and wolves
Genus	*Canis*	Dog family
Species	*lupus*	Wolf

Discovery Science

Such a 'Genus'

Objectives
Students will:
1. Learn about the scientific criteria for sorting and classifying organisms into separate groups
2. Become familiar with scientific terminology

Key Words
1. *Classification* – a group or category of all living or extinct organisms that share common characteristics. The categories in a classification range from the largest and most inclusive to the smallest and most limited: kingdom, phylum, class, order, family, genus, species and subspecies
2. *Taxonomy* - the branch of biology concerned with identifying, describing and naming organisms

Background
Scientists are people who want to know how the world works. Biologists are people who study living things on our planet. Taxonomy is the branch of biology concerned with identifying, describing and naming organisms. Biologists study how things evolved, how they are related, how they function, and how many different species there are. With the nearly 100 million species on Earth it is very complicated to organize species into their correct groups.

Biologists group animals together using relationships. This organization and classification of living things is called taxonomy. Using this system, every living thing is given a unique classification. Scientific names are internationally recognized names given to organisms based on a system developed by Carl Linnaeus (also known as Carl von Linné or Carolus Linnaeus), who is often called the Father of Taxonomy. Have you ever heard of an animal called a *Canis lupus baileyi*? Maybe not, but you probably heard of its common name of Mexican wolf (or lobo). When naming an organism, first the genus name is given followed by the species name.

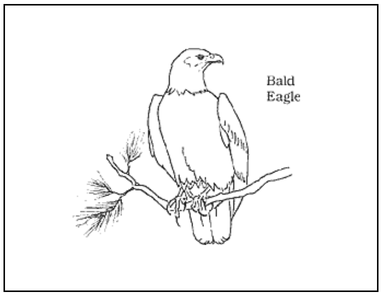
Taxonomists group similar kinds of creatures together based on their evolutionary relationships. This may sound simple, but it is not. The similarities and differences among species can be very subtle. Taxonomy is a crucial part of our understanding of life on Earth; it reveals the order and diversity in the teeming life around us. The system that taxonomists use is based on the relationships of different groups of organisms to each other.

There are seven major levels of classification. These seven major levels (from largest to smallest) are: kingdom, phylum, class, order, family, genus, and species. Each level can be divided into clusters of organisms that are most closely related. These clusters form the next level of classification. For example, each kingdom is divided into smaller phylums, each phylum into classes, each class into orders, and so on all the way down to species. Every species represents a unique and irreplaceable genetic resource.

Materials
Pictures or drawings of animals from magazines, etc. to make animal illustration cards
Double stick tape

Advance Preparation
Have students cut out pictures from magazines or draw pictures of Southwestern species to make animal illustration cards:

Sample Animal Illustration Card



Instructions

Part 1.

1. Give each student a picture of an animal to tape to the back of another student. Students should not tell each other what animal the picture represents.

2. Students should ask other students for clues to identify what animal they are. Students may get only one clue from each person although they may ask as many people as necessary for clues. (Am I a mammal? Do I have horns or antlers? Etc.)

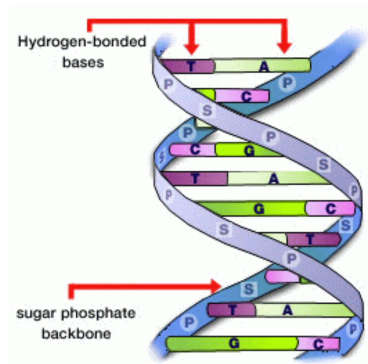
Part 2.

1. Divide class into groups of 2-4 students and give each group a set of the cards.

2. Tell students to sort the animals into groups using any criteria they choose. They can focus on shape, size, pattern, etc.

3. When students are finished sorting their animals they should share with the class the criteria they chose to sort the animals into groups.

4. After all groups share their animal groupings, explain to them that scientists often sort animals based on teeth, tails, feet, coloring, skeletal structure, geographic region, and habitat.



Today, DNA similarities also are being used as a major standard for classification. DNA is short for deoxyribonucleic acid, a molecule that is in the form of a twisted double strand (double helix). It is the major component of chromosomes and carries genetic information.

New Mexico Science Standards
Grade 4, I, I, I, 2 and II, II, I, 1
Grade 5, I, I, I, 1 and I, I, III, 4
Grade 6, I, I, III, 2
Grade 8, II, II, II, 2
DNA Strand
Grades 9-12 II, II, II, 1

Source: Adapted from “Sorting Out Species?”, Carlsbad Caverns National Parks Middle School Biology Curriculum

Discovery Science Crossword Puzzle

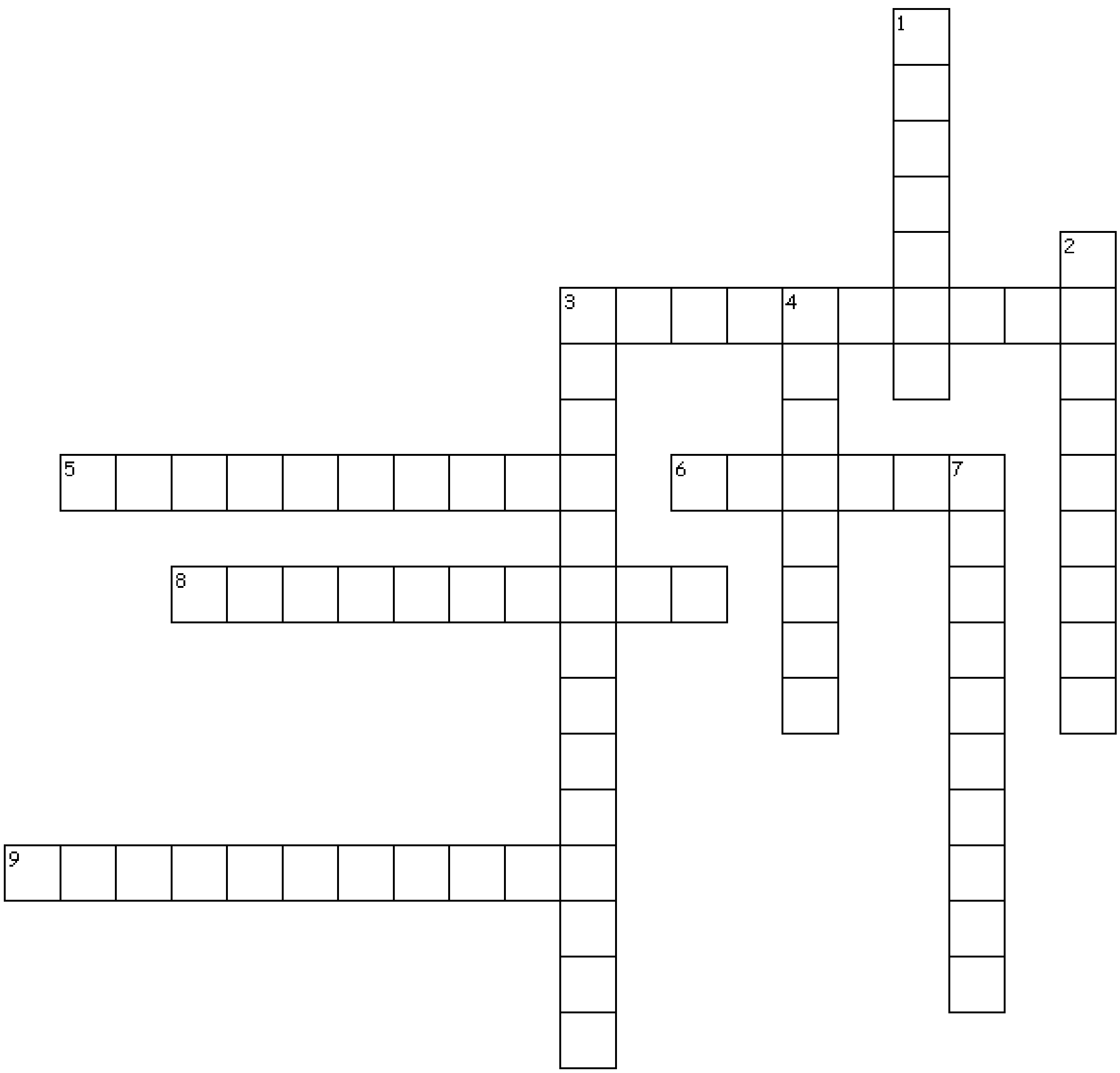
Name ______________________________ Date ________________________

Across

3. a hard-shelled creature with several pairs of jointed legs
5. an answer to a decision based on an educated guess
6. a tiny crustacean animal related to shrimp, crabs, lobsters & crayfish
8. a judgment or decision made after careful thought
9. the natural world within which people, animals, and plants live

Down

1. to say what is going to happen in the future
2. to understand or explain the meaning or importance of something
3. a group or category of all living or extinct organisms that share common characteristics
4. the branch of biology concerned with identifying, describing, and naming organisms
7. an organism that feed on the dead bodies of other organisms



Discovery Science Crossword Puzzle

Solutions

Across

3. Crustacean
5. Hypothesis
6. Isopod
8. Conclusion
9. Environment

Down

1. Predict
2. Interpret
3. Classification
4. Taxonomy
7. Decomposer

Discovery Science

Discovery Journal

Objectives
Students will:
1. Learn about the importance of journals in science by creating individual journals.
2. Practice different journaling methods and recording techniques.

Key Word
Journal – a record of experiences, ideas, or reflections kept regularly for private use

Background
A discovery journal is a simple and useful tool of science. It can be used for both scientific and personal purposes. The Discovery Journal will give students the opportunity to learn both scientific and personal journaling methods. With regular use, students will become more careful observers.

In this activity, students will create their own personalized journal and use the journal for many different types of expression, including record keeping, organization, reflection, and scientific observation. Record keeping is an important component of scientific inquiry. Similar to the way scientists keep careful records of their studies, students will record various ecological ideas in their journals. They can record in it what they see, hear and smell. This data helps students recognize patterns, connections, and trends.

A scientific journal should strive to be objective and accurate. The students record their observations, data, and analysis and reflections. A personal journal includes interpretations and reflections on the emotional impact and philosophical significance of experiences.

Materials
For each student:
Photocopies of Discovery Journal pages or plain paper
Assorted markers, colored pencils, crayons etc. for decorating journals
and
Two 8 1/2 x 11 inch pieces of construction paper (or a 3-ring binder)
A hole punch
2 brads or yarn to bind journal together

Advance Preparation
Gather materials necessary to make journals. Hole punch journal paper. Prepare one journal following the instruction in the procedure to be used as a model.

Instructions

1. Have a class discussion about the value of writing down personal observations, thoughts, and feelings, and how observation journals are used by scientists.

2. Make Discovery Journals. Students can use a 3 ring binder with 10-15 pages inserted.

Or

3. Students can make their own journals. Using construction paper, form a cover and a back page. Punch holes in the top and back pages and use brads or yarn to attach the pages to the top inside of the cover. This way, pages can be easily added. Alternatively, pages can be stapled to the top of the inside of the cover in the same manner as above.

4. Students can personalize their journals by drawing or pasting a picture or photographs on the cover page.

How to Use a Discovery Journal

Choose a natural object that is stationary, such as a plant or a rock, in the school yard or at home to observe over time. Have students observe their object at different times of the day and as seasons change. (What kind of habitat is their natural object in? How could their natural object be used as food or shelter by other animals?) Students should record observations in their journals. Encourage students to perform an ongoing observation at home or in a different environment.

<u>Extension for High School</u>

Have students:

1. Take air and soil temperature and humidity (do web research to get daily information).

2. Make and hange a test strip for ozone (see activity: *Testing the Ozone* in the Global Warming section).

2. Look for evidence of animals, such as trails and scat.

3. Describe vegetation and vegetations changes; note groundcover.

4. Look for nearby watersource.

5. Look for evidence of humans.

New Mexico Science Standards
Grade 4, I, I, I, 2; and II, 1-3
Grade 6, I, I, I, 1; and II, 1-3
Grade 7, I, I, I, 1; and II, 1-3
Grade 9-12, I, I, I, 1-5

Discovery Journal – Sample

Date: 5/11/07 Time of Day: 2:30 pm

	Cottonwood stem with leaves.
	Tree is at the southwest corner of the Zuni Park basketball court in Albuquerque, NM.
	72 degrees F, windy and partly sunny
ứ ứ ứ ứ Ĭ ứ	The tiny new green leaves at the end of the stem are black and curl over. They are shaped sort of like a shepherd's crook.
ứ ứ Ĭ	I wonder what is making the new leaves go black and curly? It's an old tree. I wonder how old it is? How do scientists tell how old a tree is? I like to sit under this tree after basketball practice.

Next, create a drawing of the object or scene. Add labels to identify the parts of the object or the scene.

Fill in page numbers as the journal grows.

Discovery Journal

A Notebook for Recording Your Observations About the Natural World

Discovery Journal

Date: ______________________________

Time of Day: ____________________

ư Ĭ	

Sketch

Discovery Science

Make Your Own Field Guide

Objectives

Students will:

1. Become aware of their natural surroundings by using keen observation skills
2. Discover and use clues to infer what plants and animals live in a certain habitat
3. Learn how to take field notes about what is discovered
4. Learn how to construct a plants and animals field guide

Key Word

Field guide - a book used to identify animals

Materials

Variety of plant and animal field guides
Paper and pens
Cameras (optional)

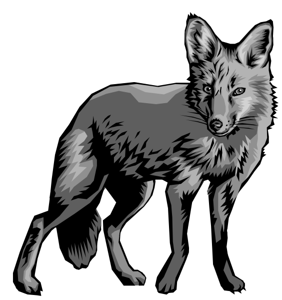
Background

Outdoor experiences are critical to helping students develop personal appreciation for nature. Making a field guide is a way for them to observe, participate, sketch, count, reflect, and write as they interact with nature.

As part of this activity, students should research one plant and one animal to include in a nature guide. Below are two nature guide entries that include the appropriate information and layout. A professional field guide would include a photograph of the plant and animal. If taking photographs isn't convenient, students can cut out pictures from magazines to paste in their field guides, or they can make original sketches and drawings of the animal or plant.

COYOTE

Coyote – *Canis Latrans*



Size: total length about 47 inches, tail about 14 inches; weight, 15 to 45 pounds.

Habitat: almost every life zone and any type of terrain.

Range: throughout most of North America and most common in the Southwest.

Also Known As: prairie wolf, brush wolf, song dog, melon wolf

The coyote looks similar to a medium sized dog, but its muzzle is pointed and its black tipped tail is bushier. The coyote is most active around dawn and dusk, but may be seen throughout the day. Wolves, coyotes, and foxes rarely coexist in any given area. Adaptable and opportunistic, the coyote can survive in almost any habitat.

The coyote earned its scientific name, which means "barking dog" for its diversity and variety of barks, yaps, growls, and howls it uses to communicate with fellow coyotes. Packs usually consist of a breeding pair and their young, but the coyote's social behavior changes with seasons and size of prey. The male assists in raising the pups, supplementing their milk diet with regurgitated food and later with whole animals.

This animal typically hunts alone when small prey is available; they will gather in a pack if needed to catch deer or other large game animals. Their diet consists primarily of fresh meat; however, they do eat a range of other food including carrion, garbage, fruits, and roots.

BUFFALO GRASS

Buffalo Grass – *buchloe dactyloides*

Description: buffalo grass is fine, curly, and has blue-green leaves, and is a native of the Great Plains, but is very common in the Southwest. It forms a fine textured, relatively thin turf with a soft blue-green color. It does not possess underground stems and is vulnerable to being easily destroyed by cultivation. This is a low growing grass, commonly only 8 to 10 inches high. Individual leaf blades may reach 10 to 12 inches in length, but they often fall over giving the turf a short appearance. It is one of the grasses that supported the great herds of buffalo that roamed the Great Plains; it also provided the sod from which early settlers built their houses.

Habitat: This species of grass is perhaps our only true native turf grass. Its tolerance to prolonged droughts and to extreme temperatures together with its seed producing characteristics enables buffalo grass to survive extreme environmental conditions. It's rarely found on sandy soils, the eastern part of the United States or in any high rainfall area. Buffalo grass does not adapt well to sites of heavy traffic.

Advance Preparation

1. Talk about the purpose of the trip with students. They will need to closely observe our surroundings to find clues about the plants and animals that live here.

2. Show the students the field guides and how to use them.

3. Show the students how to set up their field notes and what information to include

Instructions

1. Divide the class into groups of two. Have teams closely observe an area for a given amount of time and take notes, draw pictures or take photos of plants, animals, and things of interest they see.

2. Review with the students what they observed.

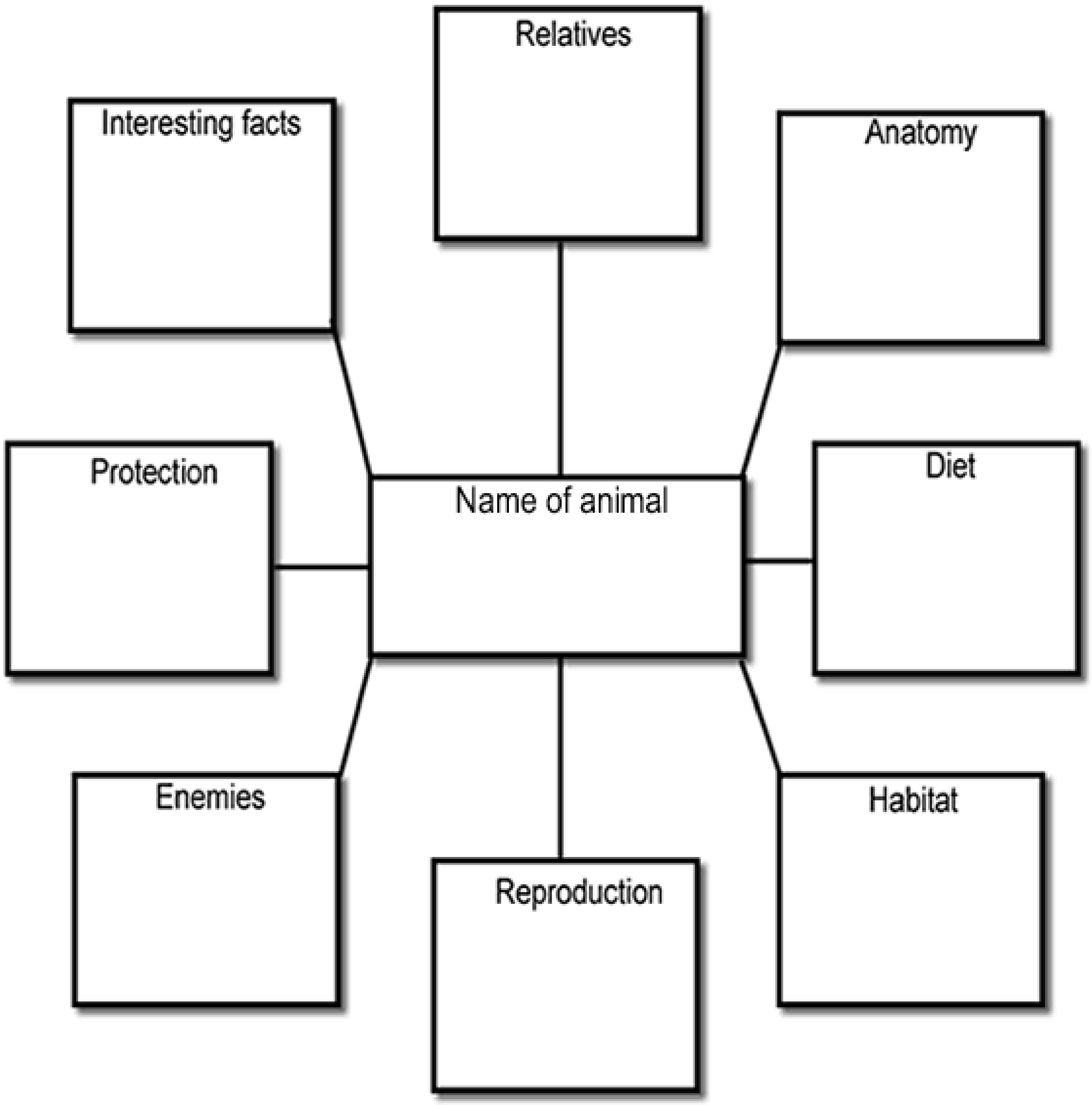
3. Have every student choose a different plant and animal to research and put into a personal field guide. After all of the students have completed their research, assemble their work into one student-produced field guide for the class.

NM Science Standards:
Grade 4, I, I, II, 2
Grade 5, I, I, II, 1
Grade 7, I, I, I, 1 and II, II, I, 1

Source: Adapted from "The Nature Detective", Carlsbad Caverns National Park Biology Curriculum for Middle School

Animal Fact Finder

(for Make Your Own Field Guide Activity)



Ecosystems

When one tugs at a single thing in nature, he finds it attached to the rest of the world“.” – John Muir

Ecosystems encompass all the living organisms in a given area and the abiotic components of their environments. For example, a desert ecosystem found in New Mexico would include cacti and other desert plants, jackrabbits and other desert mammals, as well as the insects found on the ground and the tiniest soil microbes. It would also include the composition of the soil, the amount of water found in the area, and the temperature of the ground throughout the day. Ecosystems studies illustrate the connection between living things and their natural environments, and the importance of keeping the balance between all the characteristics of an ecosystem.

In this section, students will have the opportunity to delve into the conceptual basics of ecosystem studies and apply this information through multiple activities. Students will be introduced to the diverse ecosystems found within their home state, as well as the importance of these ecosystems for different plant and animal species.

Ecosystems

Life Zones of New Mexico

Objective
Students will understand the differences in the characteristics of New Mexico's Life Zones

Key Words
1. *Biome* – a major ecological community that has a certain kind of climate and a certain kind of community of plants and animals
2. *Climate* – the average weather of a region over a long period of time
3. *Life zone* – an area in the western United States having a major plant and animal habitat
4. *Region* – a large area of land which can extend over hundreds or thousands of miles with particular ecological characteristics that distinguish it from other areas
5. *Precipitation* – water reaching the surface of the Earth as rain, sleet, snow, frost or dew
6. *Weather* – the short-term (hourly and daily) state of the atmosphere; weather is not the same as climate

Background
One factor that influences where organisms live is climate. Precipitation and temperature influence both climate and weather. Weather is the result of the day-to-day changes in these factors. Climate is the average of these factors over a long period of time.

A biome is a region characterized by certain kinds of plant life, animal life, and climate. The plants and animals that survive in a biome are adapted to the conditions of that biome. Each biome is described in terms of its climate and its living things. The plants and animals that survive in a biome are adapted to the conditions in that biome.

In the late 1890s, a botanist named Clinton Hart Merriam came up with a way to help identify major plant and animal habitats. He divided the land into seven main groups called Life Zones. The Life Zone system is only used in the western part of the United States. Six of the seven Life Zones are found in New Mexico. They are: Desert Zone, Grasslands/Woodlands Zone, Transition (Mountain) Zone, Coniferous Forest Zone, Subalpine Zone and Alpine Zone.

The **Desert Life Zone** receives less than 10 inches of rainfall each year. Although some people think that the desert is always hot, a desert actually can also be very cold. Desert plants have adapted to living with very little water and a wide range of temperatures. They often have small leaves that help conserve water. Some kinds of desert wildlife that have adapted to this environment are kangaroo rats, lizards, snakes, coyotes, desert bighorn sheep, greater roadrunners and turkey vultures.

The **Grasslands/Woodlands Zone** is a rich and varied zone. Its common characteristics include cold winters, warm summers, and uneven precipitation. In the grasslands, the landscape is mostly flat and open country. Grasses are the main kinds of plant life and many insects live here, including ants, locusts, and grasshoppers. Some of the animals found here include prairie dogs, burrowing owls, hawks, pronghorn and coyotes.

The Grasslands/Woodlands Zone also includes (1) riparian areas (river habitats) with fresh water, food and shelter for many areas, (2) playa lakes, which are lakes that have water in them only after heavy rains, and (3) marshes (low-lying water-logged land). In the Woodlands Zone, trees are more open than forests and are smaller such as pinon-juniper. Other common woodlands trees include cottonwoods, willow, sycamore and walnut. Grasses usually grow beneath the trees. Aquatic species, such as frogs, toads, turtles mallards, herons, and egrets can be found her. Other familiar animals include skunks, raccoons, snakes, wild turkeys, collared peccaries (javelinas),

The **Transition (Mountain) Zone** starts to get much colder and wetter than the lower zones. It gets about 20 to 25 inches of rain and snow each year, and ponderosa pines are the tall trees in its forests. The forests often look like parks. The ground often is very grassy and there are smaller trees and shrubs growing in open areas. Some of the wildlife making homes here include: Abert's squirrel, mule deer, Stellar's jays, porcupines. Mountain lions and Black bears are known to frequent these areas too.

The **Coniferous Forest Zone** receives about 30 to 35 inches of rain and snow each year. Douglas fir trees grow thick and tall in this zone. There are Rocky Mountain maples, Blue Spruce and Aspens here too. Lots of leaves, twigs and logs fall and cover the ground, which makes it hard for plants to grow. In this forest, snow that melts in the spring helps get things growing. There are beautiful open meadows with grasses and wild flowers. A few examples of wildlife that live in this zone are Great horned owls, Northern goshawk, Red foxes, Elk, Mule deer, Black bears and Mountain lions.

The **Subalpine Zone** is covered with 30 to 60 inches of snow six to nine months each year. Shade from the forest and cool temperatures help keep snow on the ground until late spring. Trees and other plants growing here tend to be smaller than those growing in the zones at lower levels. Growing closer to the ground helps protect them from harsh winds. The long-lived Bristlecone pine and dwarf juniper grow here. Some of this zone's animals include elk, mule deer, Rocky Mountain bighorn sheep, snowshoe hare, red squirrels and Clark's nutcracker.

The **Alpine Zone**, known as the arctic-alpine tundra, is the highest, windiest, wettest life zone in New Mexico. The air is thinner because of the high elevation (11,500 to more than 13,000 feet above sea level). There are no trees in this zone. The Alpine Zone can be found in two places in the state: Sierra Blanca and the Sangre de Cristo mountain range. Plants in this habitat often grow in thick little clusters. Some of the wildlife adapted to this cold environment include the American pika, white-tailed ptarmigan, Rocky Mountain bighorn sheep, yellow-bellied marmot and the Sacramento salamander.

Materials

Butcher paper
Drawing materials
Topographical map of New Mexico
(optional) Maps available from U.S. Geological Survey 1-888-ASK-USGS or
http://education.usgs.gov/common/resources/mapcatalog/
http://education.usgs.gov/common/primary.htm#topographic

Life Zones and Habitats of New Mexico (source: New Mexico Department of Game and Fish website: http://www.wildlife.state.nm.us/education)

Instructions

1. Discuss biomes and Life Zones with students. Download a copy of the *Life Zones and Habitats of New Mexico* for students. Examine a topographical map of New Mexico with students and discuss where some of the Life Zones can be found.

2. Divide students into small groups. Give each group a large section of butcher paper. Tell the students to divide that piece of paper into six different sections, one for each of the New Mexico Life Zones.

3. Students should research and decide what should go into each section and why it belongs there. Then they should fill up as much space as possible in each of the Life Zone sections with pictures and facts about plants, animals, and weather characteristics for each particular Life Zone.

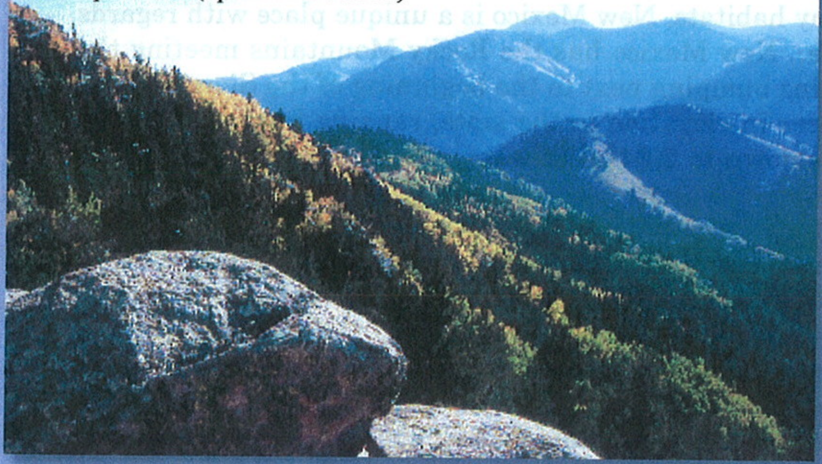
4. Students should present their work to their peers and explain some things that make each Life Zone distinct.

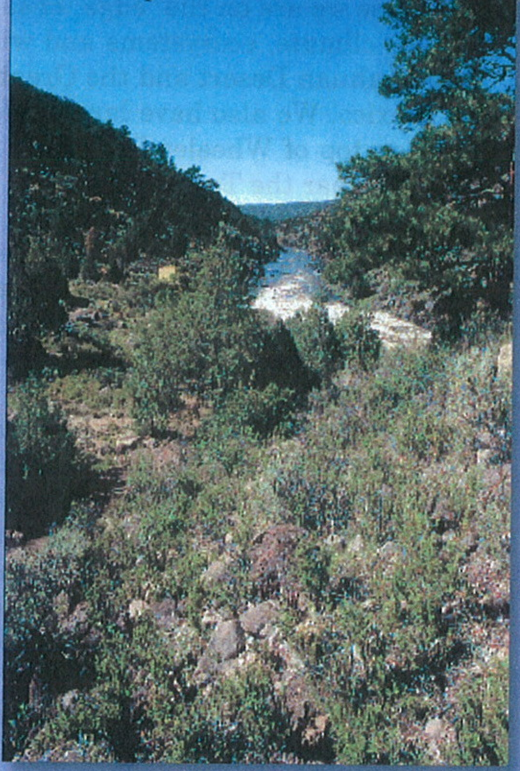
Option

Using the Life Zones of New Mexico maps, have student color code the maps. Add rainfall to each zone. Write on back of maps the key plants and animals for each zone. Describe the producers, decomposers, herbivores, omnivores and carnivores for each zone.

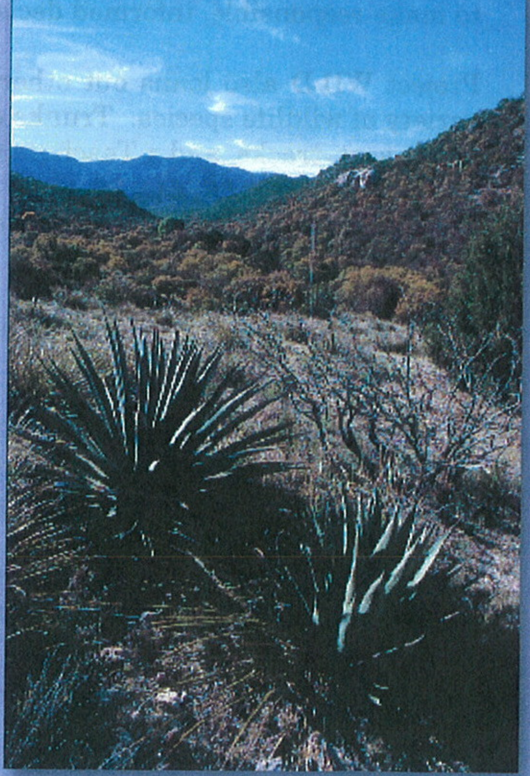
New Mexico Science Standards
Grade 4, II, II, II, 1
Grade 7, II, II, 1, 2
Grades 9-12, II, II, 1, 2

LIFE ZONES and HABITATS of NEW MEXICO


Subalpine Fir (spruce-fir forest)


Piñon Juniper Woodlands


Aspen Woodlands


Desert Grasslands


Grasslands/Playa Lakes

New Mexico has a rich wildlife heritage. Appreciation and awareness of this heritage is important for every generation. As the population of New Mexico continues to grow, the human and management of wildlife habitat is increasingly a focus of discussion and debate.

Because we are on the "edge" of so many habitats, New Mexico is a unique place with regards to our climate, ecosystems and wildlife. New Mexico has the Rocky Mountains meeting the Chihuahuan Desert and the Great Plains bumping next to the beginning of the Sierra Madre of Mexico. We also have large differences in elevation in the state, ranging from over 13,000 feet on top of Wheeler Peak near Taos down to 2,841 feet where the Pecos River exits New Mexico near the Texas border.

In this coloring book you will be introduced to 6 different life zones and 17 examples of habitat types that commonly occur in New Mexico. What is a habitat? A habitat is a natural "home" where certain kinds of animals find what they need to survive. Habitat is more than just food, water, shelter and space. A good habitat must have a climate that suits an animal's physical needs. It must also have a varied *terrain*, room to roam, and a dependable supply of food and water. It should also have safe places for animals to feed, play, hide from predators, be protected from the elements, safely rest and raise their young. A single habitat may not provide everything an animal needs for survival. Because of this, animals may visit more than one habitat on a daily or season basis. Missing habitat components, no matter how abundant the other components may be, will limit the numbers and types of wildlife than can live within this habitat. Habitat loss and degradation continues to be an important factor for the future of many types of wildlife.

This coloring book is part of many activities and programs offered through the Conservation Education Section – Project WILD. Project WILD is an award-winning environmental and conservation education program of instructional workshops and supplementary curriculum materials for teachers of K-12. Project WILD strives to help prepare teachers and students to make responsible, informed decisions for wildlife.

Project WILD also loans out other resources for educators, including Wildlife Trunks on a variety of wildlife species. Trunks often contain videos, skulls, skeletal parts such as antlers, hides, scat, tracks, and a Teachers Guide.

Free publications and posters on New Mexico wildlife are also available to educators:
Coloring Books:

- Aquatic Wildlife of New Mexico
- Endangered Species of New Mexico
- Wildlife of New Mexico

For more information on Project WILD and free workshops and materials on wildlife contact: Project WILD Coordinator, One Wildlife Way, Santa Fe, NM 87507, (505) 476-8000.
Or visit our website, www.wildlife.state.nm.us

Range Maps have been illustrated to show the range of each habitat type mentioned. Glossary words appear in italics throughout the text.

Life Zones and Habitats of New Mexico

Illustrated by
Dyan del Gaudio

Written by
Dyan del Gaudio and Don L. MacCarter

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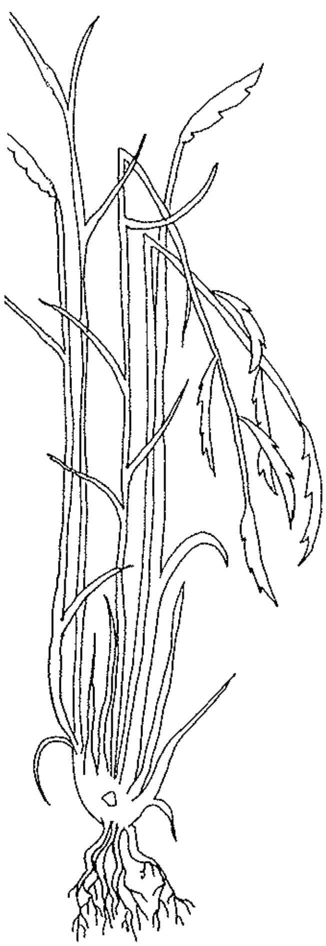
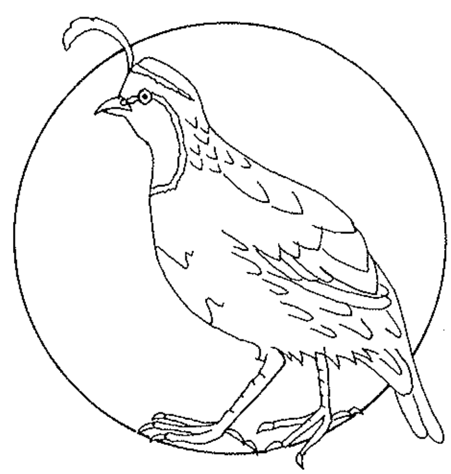
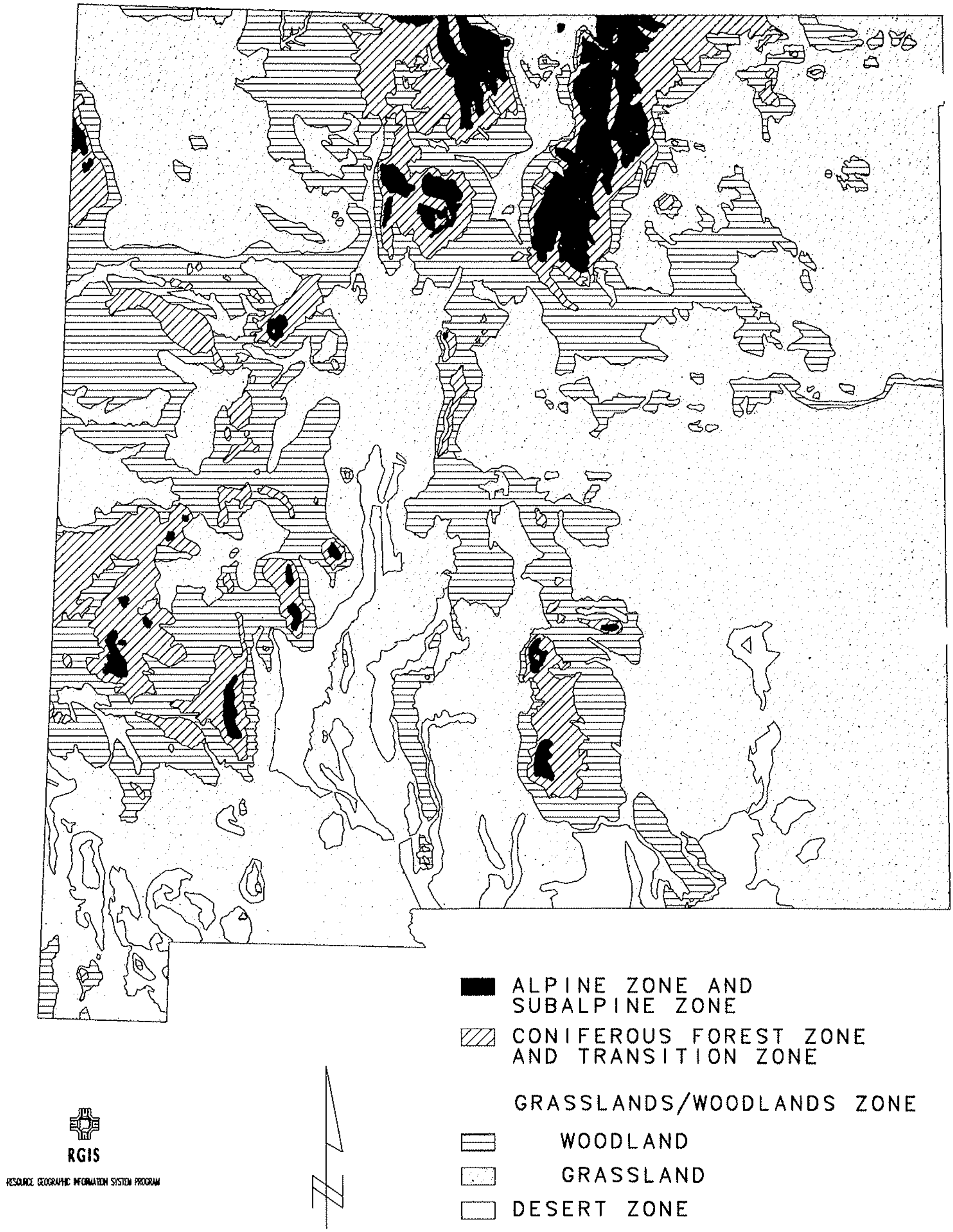
Printed on recycled paper







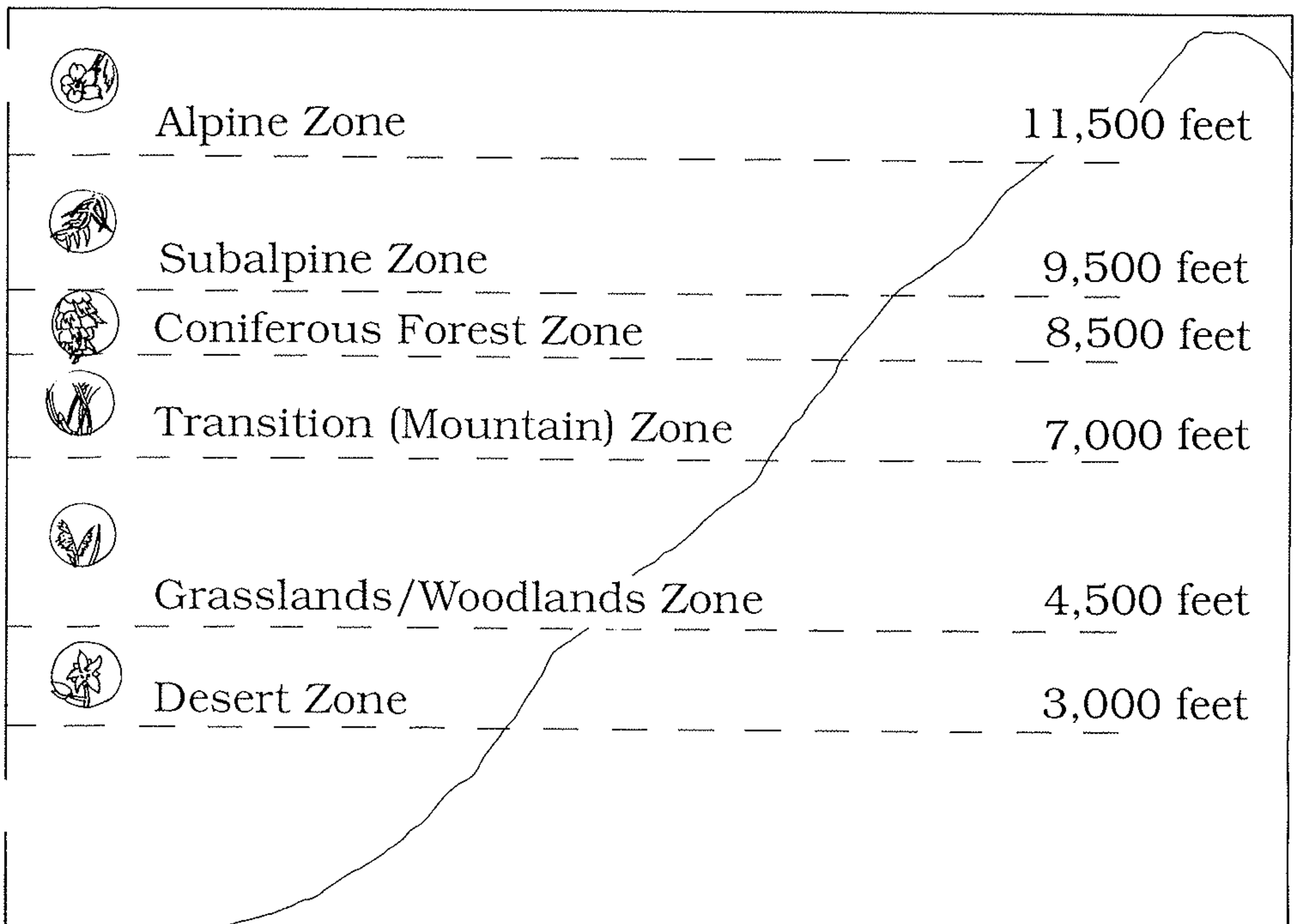
Life Zones of New Mexico

LIFE ZONES

In the late 1890s, a botanist named Clinton Hart Merriam thought of a way to help identify major plant and animal habitats. He divided the land into seven main groups he called Life Zones.

The Life Zone system is only used in the western part of the United States. Six of the seven zones are found in New Mexico. They are outlined in the chart below. Look for the life-zone symbol next to the habitat descriptions throughout this book. In New Mexico, the life zones start at about 3,000 feet above sea level and go up to slightly over 13,000 feet.

Elevation and temperature are two main factors that influence where plants and animals can live. As the elevation goes up, the temperature goes down. The plants and animals that live in higher, colder areas are different from those that live in lower, warmer regions.

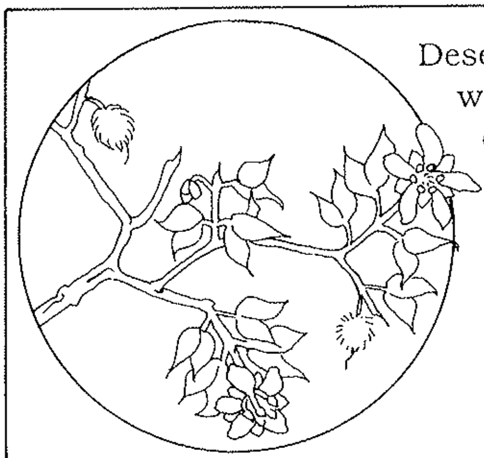


DESERT ZONE

Chihuahuan Desert Scrub

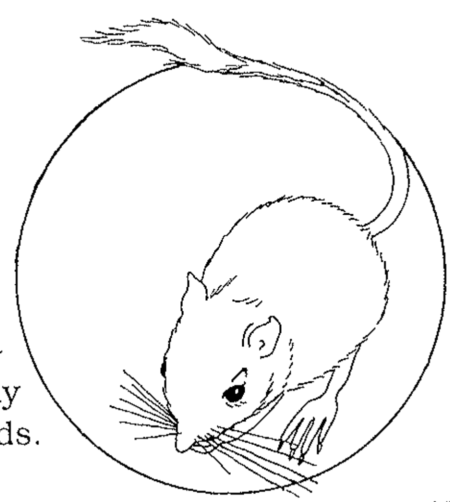
Most of the Chihuahuan Desert lies in Mexico, but a small part of it reaches up into New Mexico. This area makes up New Mexico's Desert Life Zone. It is generally a very hot, dry *terrain*. Like other deserts, the Chihuahuan Desert usually receives less than 10 inches of rain a year, which makes for a very short growing season. It gets most of its moisture during summer rains. These rains help expose wildflower seeds to conditions they need in order to grow.

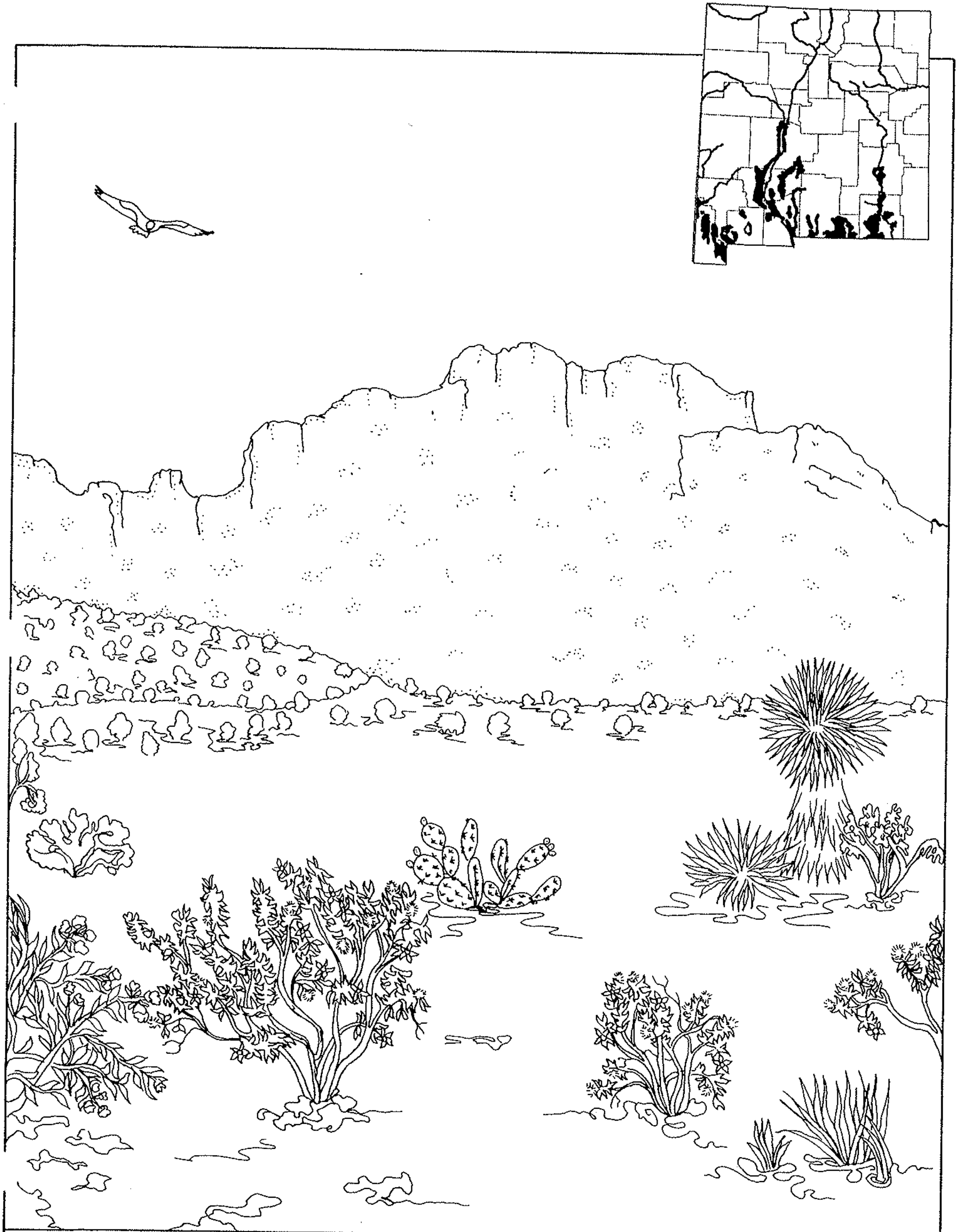
The most common habitat in this life zone is the mixed chaparral shrub. Plants include creosotebush, ocotillo, desert holly, tarbush, whitethorn acacia, tree cholla, and a variety of cacti, such as barrel, hedgehog, and pincushion. Agave lechuguilla can be found in a few of these habitats in southeastern New Mexico. Mostly it is found in large numbers in the Mexican part of the desert. Wildlife, such as whiptail lizards, leopard lizards, coachwhip snakes, green toads, Merriam's kangaroo rats, desert cottontails, common hog-nosed skunks, coyotes, desert bighorn sheep, Brazilian free-tailed bats, scaled quail, zone-tailed hawks, turkey vultures, greater roadrunners, cactus wrens, and other birds make their home in this habitat.



Desert plants often have small leaves that help conserve water. Each leaf on the **creosotebush**, a common desert plant, is actually made up of two small leaflets. They are joined at the bottom like one leaf. A waxy coating on the leaves helps hold in moisture. After a rain, these plants give off a special smell. Small yellow flowers cover the bushes, after which white fuzzy fruits appear.

The **kangaroo rat** is a desert animal that builds its burrow under the creosotebush. The roots of the plant help support the roof of the kangaroo rat's tunnels. The kangaroo rat burrows during the hottest part of the day and can live without drinking any water. It gets its water from a diet of seeds.



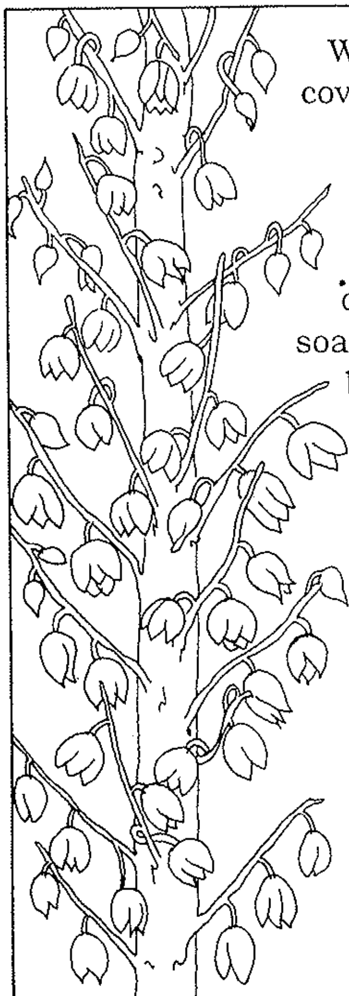


HABITAT: Chihuahuan Desert Scrub

DESERT ZONE

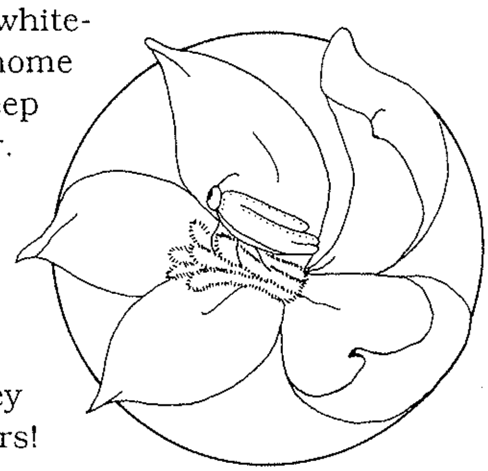
White Sand Dunes

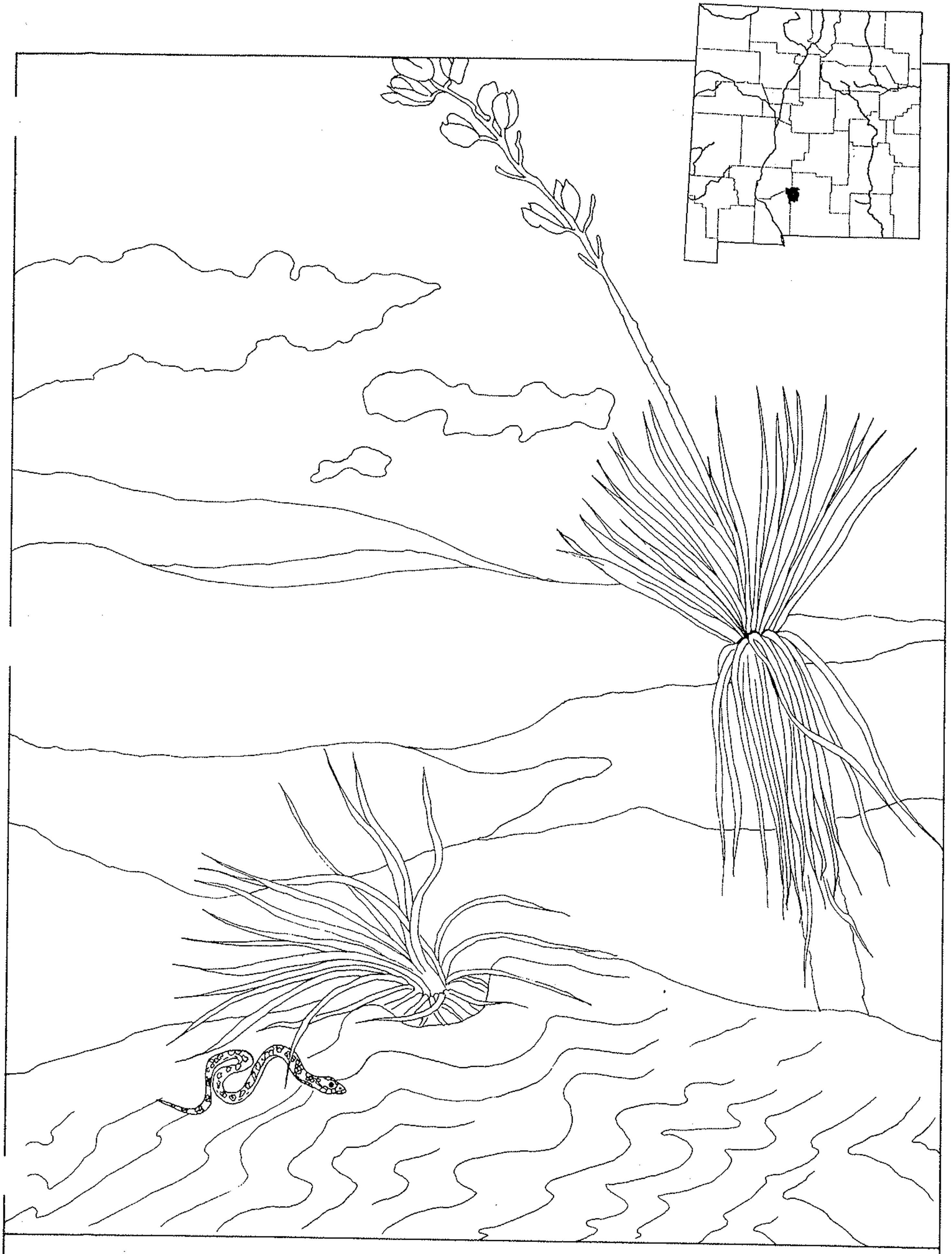
White Sands National Monument is a special place in the Chihuahuan Desert. It is made up of many hills and ridges of sand. These sand dunes are piled up by the wind. The dunes are made up of tiny, broken pieces of the mineral gypsum. The sand acts like a sponge during rains by soaking up water. This helps hold in enough moisture to reach the long, spreading roots of many plants. It is difficult for plants to grow in this type of soil, but there are more than 60 different kinds that live here. Many grasses, small shrubs, and some trees grow here, including Indian ricegrass, rabbitbrush, soaptree yucca, and cottonwood and mesquite trees. Coyotes and kit foxes are residents here, but smaller animals are most common. Kangaroo rats, desert cottontails, greater roadrunners, insects, bleached earless lizards, White Sands prairie lizards, and glossy snakes all make their homes in this habitat.



When the wind blows and moves the sands around, it can cover up plants and kill them. The leaves of the **soaptree yucca** grow especially fast so it can keep its flowering parts above the sand. This helps it continue to live even though part of it might be buried. It sends out many roots that weave through the sand, helping the dunes to become stronger and hold more water. The soaptree yucca is New Mexico's state flower, easily recognized by its tall, slender flower stalk.

The **pronuba moth** is a tiny, white-winged insect that makes its home on the yucca. It lays eggs deep down in the yucca flower. After yucca seed pods form, the insect larvae eat their way out. Yuccas depend on this moth to pollinate it. In turn, the pronuba moth needs the yucca for food. They are truly special partners!





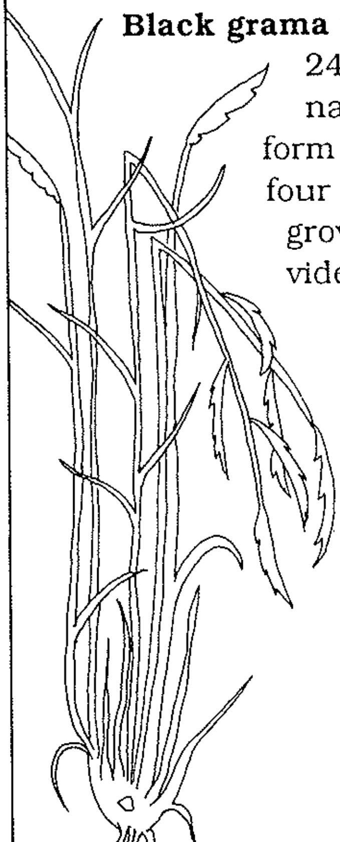
HABITAT: White Sand Dunes

DESERT ZONE GRASSLANDS/ WOODLANDS ZONE

Desert Grasslands

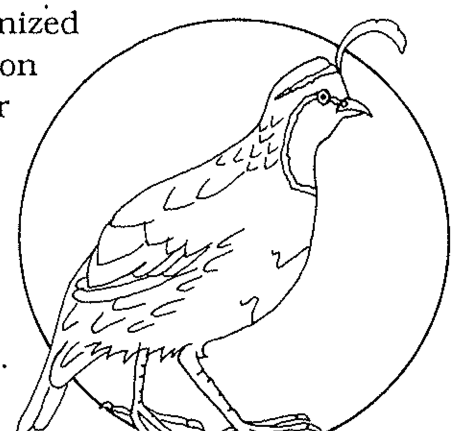
This habitat is a transition between the Desert Life Zone and true Grasslands/Woodlands. It is found at elevations between 4,500 to 7,000 feet. Desert grasslands habitat also exists in the northern part of the state, as well as southern regions of New Mexico. The land is usually rocky or gravelly. Rainfall ranges from about 10 to 20 inches in one year. Snow falls in winter. Much of today's Desert Grasslands occupy areas that had formerly been grasslands with different kinds of plants.

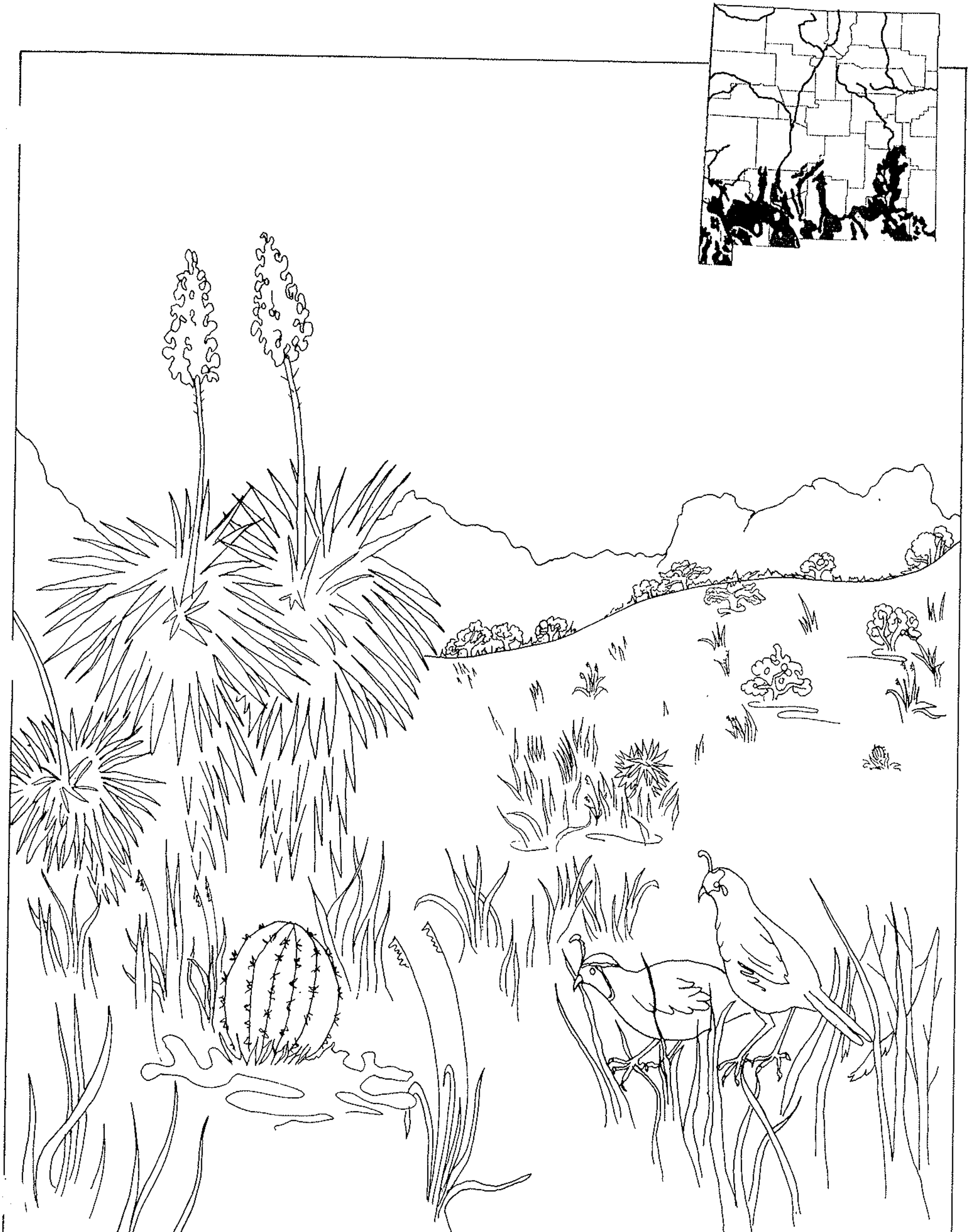
In the southern portion of the desert grasslands, the rainy season is from April through September. The most common plants are grasses and shrubs. Most of these are called "bunch" grasses, because they grow in bunches. They include black grama, bushmuhly, tobosa grass, western wheat grass, cane beargrass, and little bluestem. Shrubs include the century plant, sotols, catclaw, saltbush, yuccas, prickly pear, and cholla cactuses. Trees like the mesquite and desert willow grow in areas that collect water. Wildlife that lives in this habitat includes mountain lions, pronghorn, black-tailed jackrabbits, kangaroo rats, ringtails, coyotes, little brown bats, Harris's hawks, ferruginous hawks, lesser nighthawks, greater roadrunners, Gambel's quail, Great Plains toads, Texas horned lizards, and ornate box turtles.



Black grama is a bunchgrass that grows 12 to 24 inches tall. Its leaves are short, narrow, and gray-green. Flowers form in the fall. Seeds ripen three to four weeks after flowering. New plants grow from the seeds. They also provide food for some animals.

Gambel's quail are easily recognized by their long black plumes on their heads. Like many other animals and plants, they do not recognize the imaginary lines of life zones. That is why you can see them in desert habitats, as well as desert grasslands. These birds are usually seen in family groups.





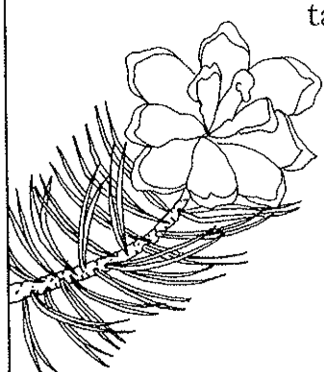
HABITAT: Desert Grasslands

GRASSLANDS/ WOODLANDS ZONE

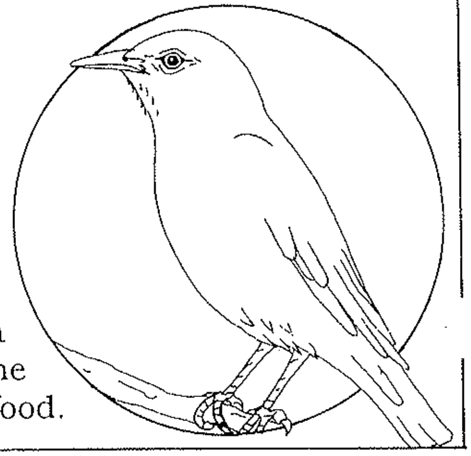
Piñon-Juniper Woodlands

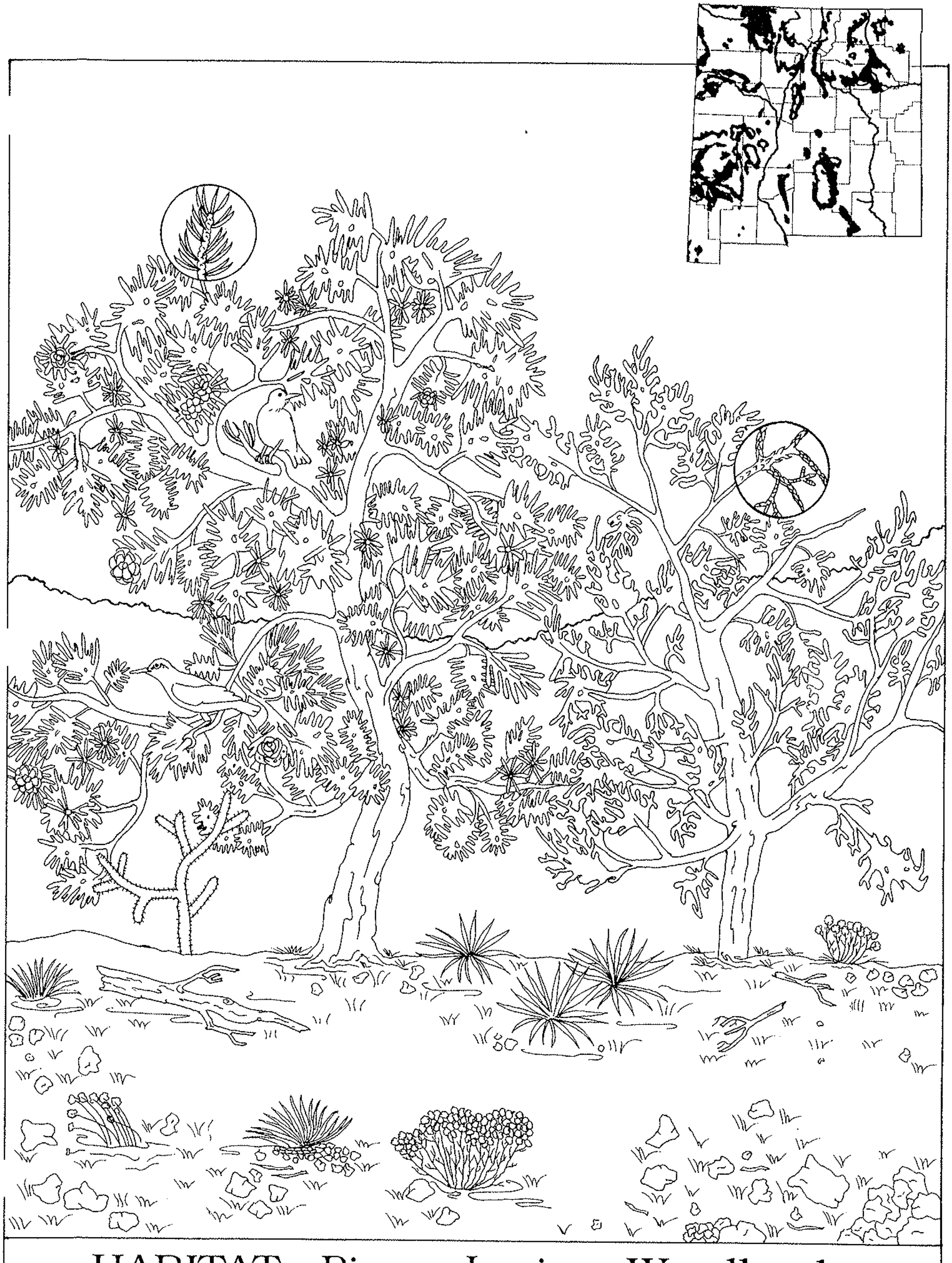
In the piñon-juniper woodlands, piñon and juniper trees grow close together in open, widely-spaced mixed clusters. There are usually more junipers at lower elevations and more piñons at the higher limits. Both usually grow less than 30 feet tall. The landscape is dry and rocky. Most of the 10 to 20 inches of moisture that fall each year is in the form of snow. Other plants growing in these woodlands include mountain mahogany, rabbitbrush (chamisa,) sagebrush, scrub live oak, big bluestem grass, and some prickly pear cactus. The mountain lion, bobcat, pronghorn, turkey vulture, piñon mouse, piñon jay, gray flycatcher, bushy-tailed woodrat, rock squirrel, collared peccary, black-tailed jackrabbit, gray fox, Western spotted skunk, Western meadowlark, mourning dove, barn swallow, black-billed magpie, golden eagle, plateau striped whiptail lizard, collared lizard, gopher snake, pallid bat, and Western rattlesnake all make their home here. Wildlife from higher ranges, like elk and mule deer, often come down into this habitat during winter.

The **piñon pine** is an evergreen tree that grows up to 30 feet tall. Its small cones produce piñon nuts. Humans as well as animals eat these tasty seeds. Native Americans use the piñon nut for many of their ceremonies, as well as for food. The piñon tree's evergreen leaves are called needles because of their shape. The needles usually grow in bundles of two or three. Cones ripen every other year.



Piñon jays live in large, noisy groups in the piñon-juniper woodlands. Their favorite foods are piñon nuts, juniper berries, and insects. They will pick all the seeds from a piñon cone and stuff them down their throats. Then they choose a spot near the trunk of a tree and bury the seeds for winter food.



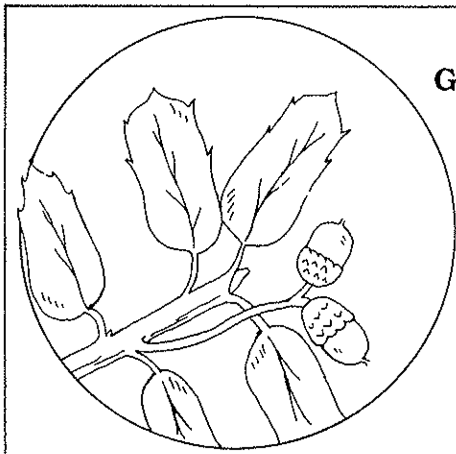


HABITAT: Pinon-Juniper Woodlands

GRASSLANDS/ WOODLANDS ZONE

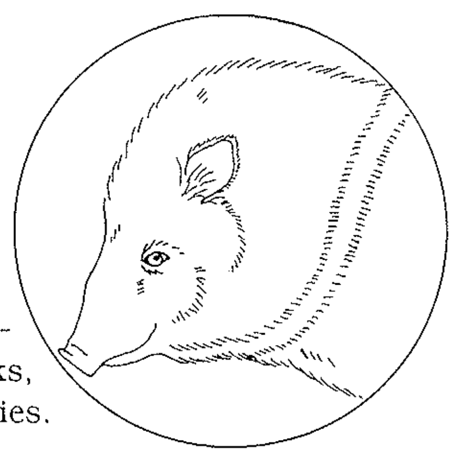
Gray Oak Woodlands

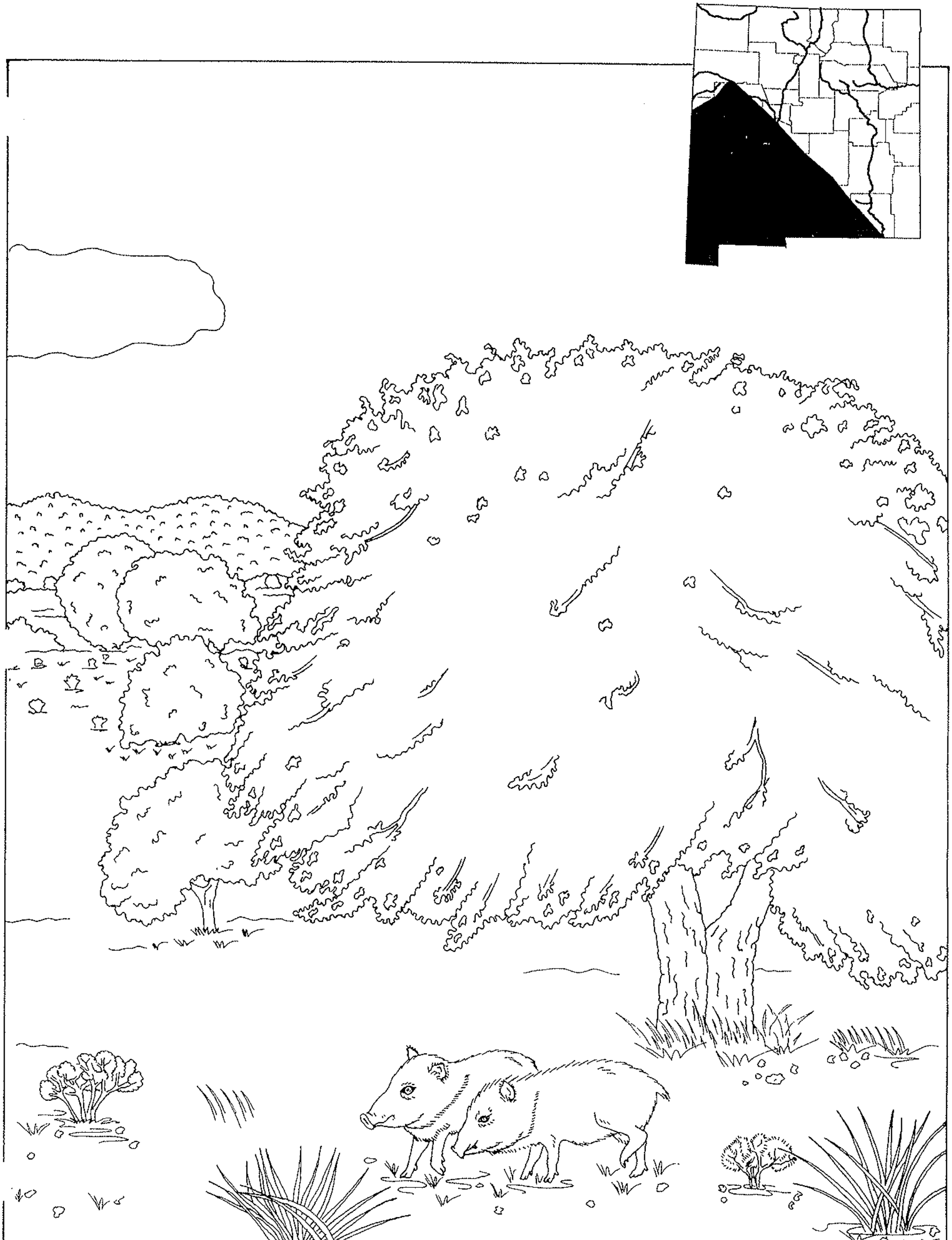
Woodlands are generally more open than forests, and the trees are usually smaller than forest trees. There is a mixture of trees and open areas. There is also a mixture of shady spots near the trees and sunny spots in the open areas. Woodland trees usually have long tap roots to reach deep down for moisture. Grasses usually grow beneath the trees, especially in open areas. Oak woodlands receive 12 to 18 inches of moisture a year, mostly during summer rains. These habitats can be found on foothills and lower mountain slopes. Plants that grow in and around these woodlands include muhly grasses, sideoats grama grass, ricegrass, bullgrass, and barrel, rainbow, and prickly pear cacti. Tree cholla, banana yucca, scrub live oak, and mock orange also grow here. Wildlife includes Coue's white-tailed deer, coatimundis, collared peccaries, Gould's wild turkeys, acorn woodpeckers, black-tailed rattlesnakes, Yarrow's spiny lizards, and canyon treefrogs.



Gray oak woodlands are found in southern and central New Mexico. The gray oak is an evergreen tree. It has small, oval-shaped leaves that are gray-green in color. Many birds and other animals eat its acorns. Mule deer and porcupines often eat the leaves as well. Although usually a small tree, it can grow up to 60 feet tall.

Collared pecarries (javelinas) are pig-like mammals that like to travel in small groups. They have bushy hair, poor eyesight, and a great sense of smell which is used to locate underground plant parts. They use their snouts for digging. Favorite foods include prickly-pear cactus, roots, tubers, and acorns. Because of a band of white hairs around their necks, javelinas are sometimes called collared peccaries.





HABITAT: Gray Oak Woodlands--Southern Region

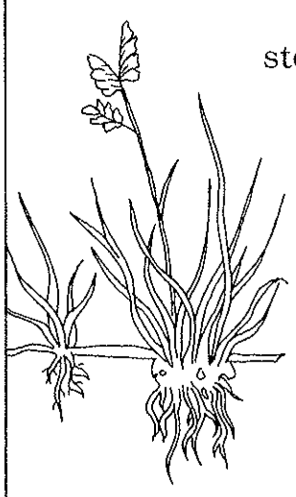
GRASSLANDS/ WOODLANDS ZONE

Plains-Mesa Grassland

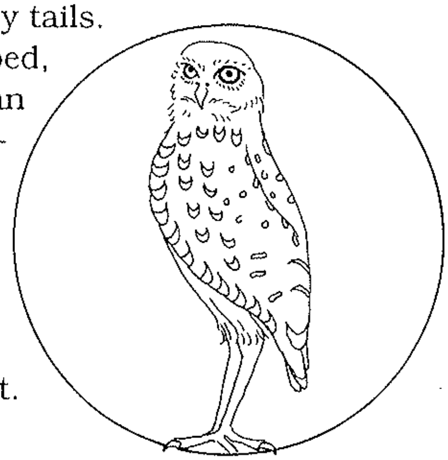
As the elevation increases in this life zone, the short-grass (plains-mesa grassland) prairie becomes a widespread habitat. It is the most extensive grassland in the state. The landscape is mostly flat and open country. It can have long periods of wind in late winter and early spring. A variety of grasses are mixed together in this life zone. The main grasses are blue grama, buffalograss, Indian ricegrass, western wheat-grass, threeawns grass, little bluestem, tobosa grass, and galleta. A variety of shrubs and *forbs* are mixed in with these grasses. They include shinnery oak, four-wing saltbush, wild rose, and rabbitbrush. Prickly pear and strawberry cactus also grow here.

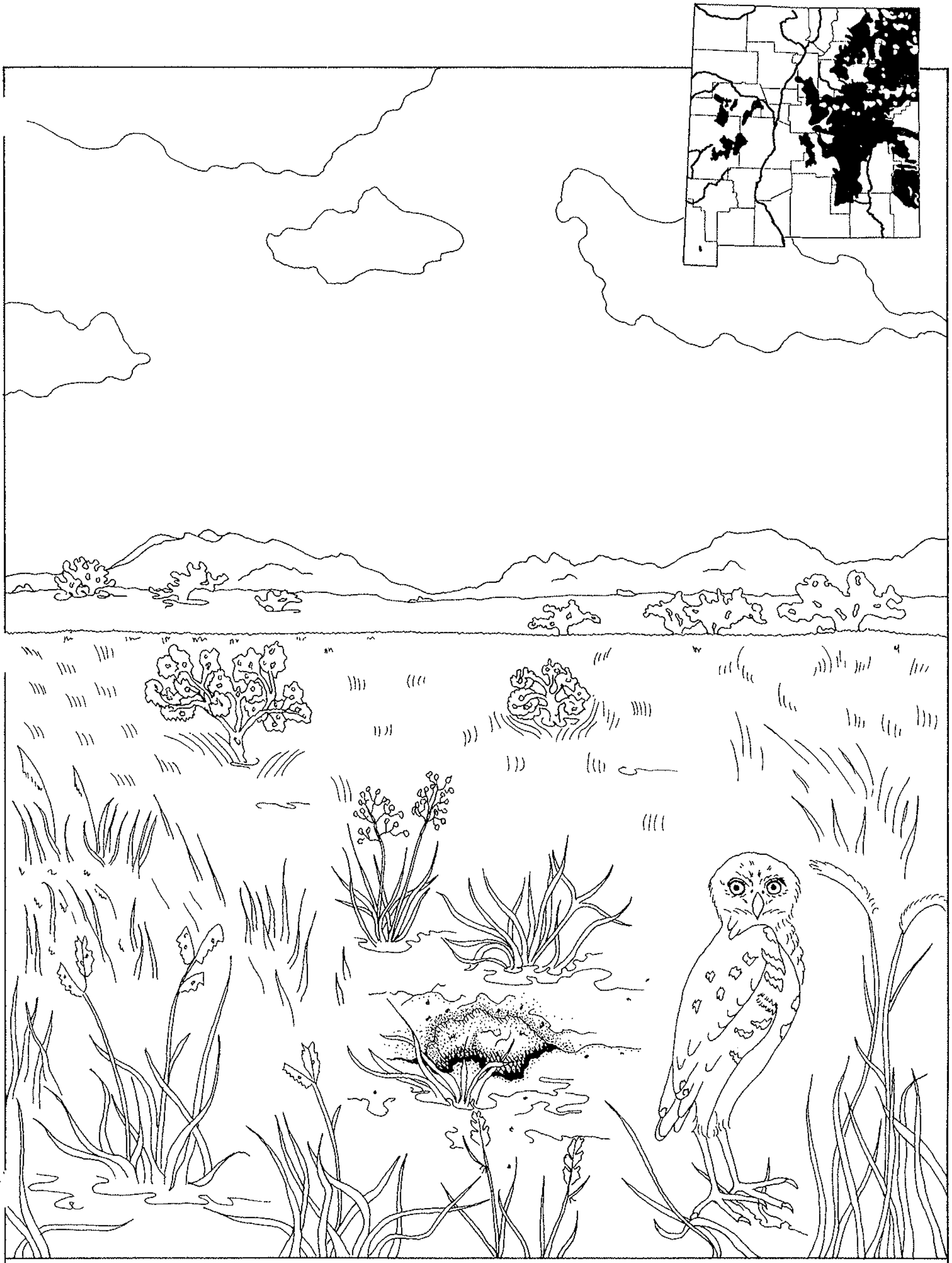
The loose soil and plentiful vegetation make an ideal habitat for burrowing animals, such as black-tailed prairie dogs, pocket gophers, and burrowing owls. Pronghorn are common residents here, as are the kit fox, badger, black-tailed jackrabbit, Eastern cottontail, lesser-prairie chicken, Swainson's hawk, short-eared owl, American goldfinch, grasshopper sparrow, Western hognose snake, and the Plains spadefoot toad.

Buffalograss is a bunchgrass that grows from 4 to 12 inches tall. It forms a thick sod and has deep roots. A wide network of fine roots just below the surface helps absorb water from brief rain showers. This grass reproduces by stolons, which are thin stems that grow along the ground's surface. It becomes dormant during dry periods. When water becomes available, it begins to grow again.



Burrowing owls live in underground burrows or old prairie dog holes. They have long legs and short, stubby tails. When disturbed, these owls can be seen bobbing and bowing. They stand upright and are active by day, as well as by night.



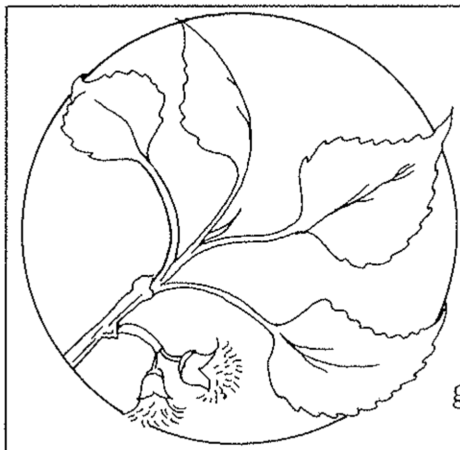


HABITAT: Plains-Mesa Grasslands

GRASSLANDS/ WOODLANDS ZONE

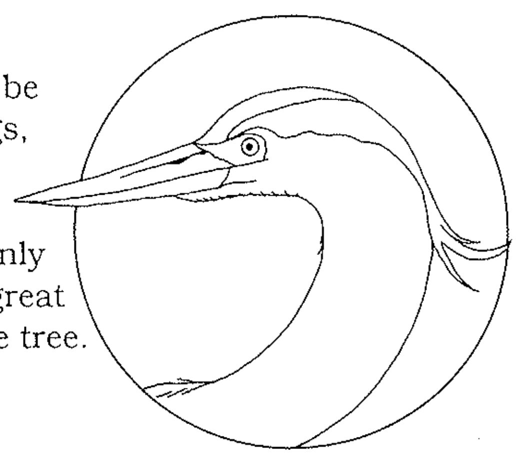
Flood-Plain Riparian

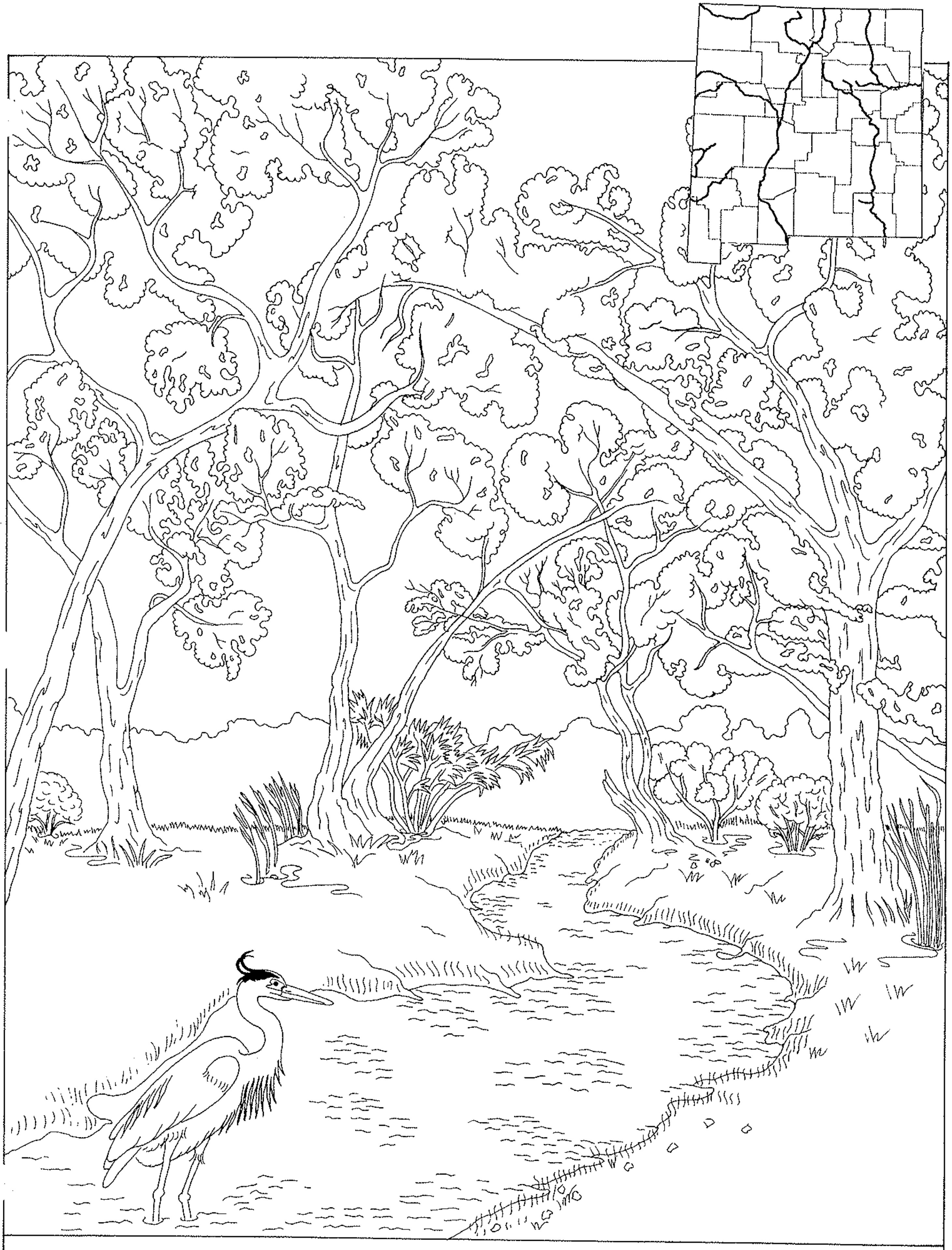
River habitats (*riparian* zones) provide fresh water, food, and shelter for many animals. There are usually twice as many animals here as in surrounding habitats. Tall, wide-leafed trees make up the *canopy*. Lots of plants grow close together in the *understory*. Water levels rise and fall along the river, which can change the shape of the bank. Plants that grow on the streamside are used to being flooded. Some of them depend on this water for their seeds to grow. Insects thrive on the water and wet rocks. They become food for many birds like flycatchers, warblers, and swallows. Other wildlife attracted to this habitat include elk, mule deer, beaver, hoary bats, many species of fish, puddle ducks and diving ducks, great blue herons, least bitterns, belted kingfishers, sandhill cranes, shorebirds, Western painted turtles, Clark's spiny lizards, and yellow-bellied racers. Common trees are Rio Grande, Fremont, and Sargent's (plains) cottonwoods, willow, sycamore, and walnut. Other plants include Russian olive, salt cedar, sedges, and cutgrass.



Fremont cottonwood trees are native to the Gila country and grow where there is a lot of water. They like the moist soil that is found along streams and rivers. They can grow up to 80 feet tall and have a thick, grayish-brown bark. Their flowers bloom before their leaves appear. The seeds are soft and fuzzy like cotton, which is how this tree got its name. Leaves turn a beautiful golden yellow in autumn.

The **great blue heron** is a bird that likes to be near water. These big birds have long legs, necks, and beaks. This makes it easier for them to stalk food, like fish, in shallow water. The long plumes on its head can only be seen during breeding season. Many great blue heron nests can be seen in the same tree.



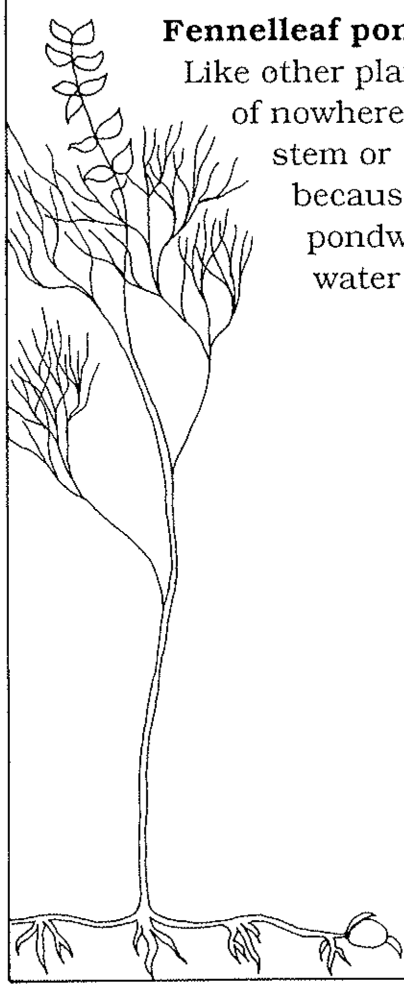


HABITAT: Flood-Plain Riparian

GRASSLANDS/ WOODLANDS ZONE

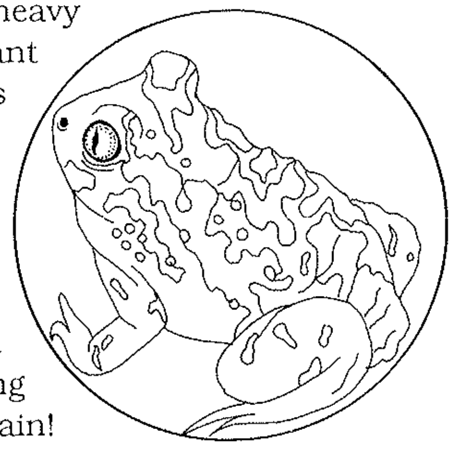
Playa Lakes

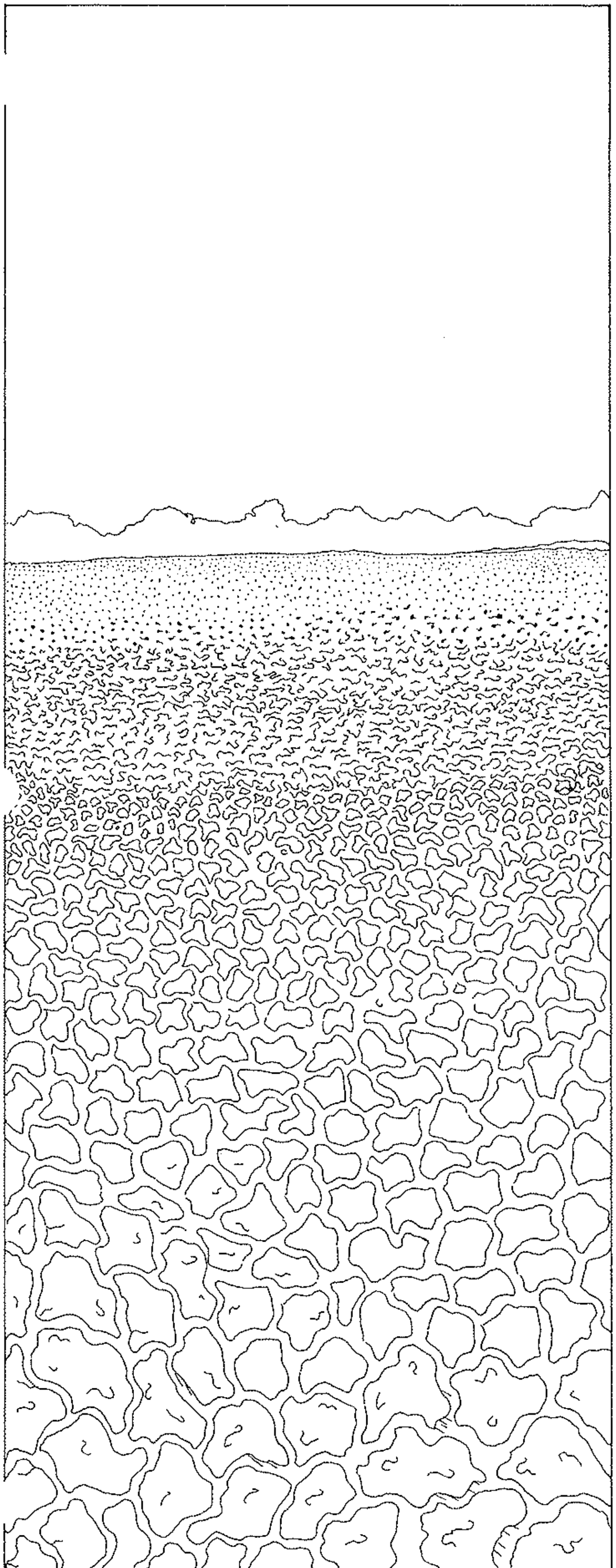
Most lakes have water in them all the time, but there are lakes in the desert and grasslands that only have water in them after heavy rains. They are called playa lakes or dry lakes. There are approximately 4,000 playa lakes in eastern New Mexico. When these playa lakes are dry, they look like large, shallow holes in the ground. After a rain, they become filled with life and provide a habitat for many plants and animals. Playa lakes attract many animals, such as geese, ducks, great blue herons, sandhill cranes, checkered garter snakes, yellow mud turtles, and tiger salamanders. Plants such as horned pondweed, widgeongrass, fennelleaf pondweed, common hornwort, and mud plantain provide food and shelter for animals. The water doesn't always stay in the lake bed very long; during the summer when the temperatures are very hot, the water evaporates quickly, leaving a white residue of mineral salts.



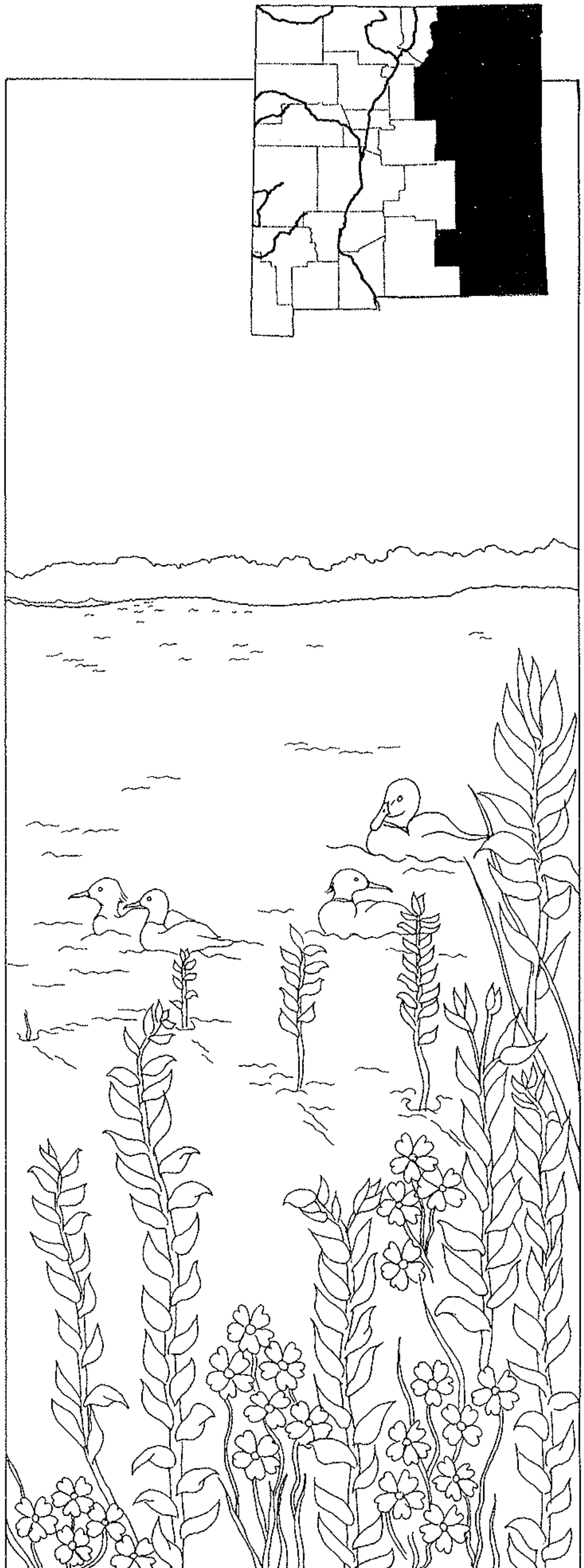
Fennelleaf pondweed is a plant that grows in the water. Like other plants in playa lakes, it seems to appear out of nowhere after a rain. Its flowers grow on a long stem or *spike* above the water's surface. This is because it is pollinated by the wind. Fennelleaf pondweed is a favorite food for ducks and other water birds.

Spadefoot toads mate after heavy rains and lay their eggs on plant stems in playa lakes. The eggs can hatch in less than two days. It takes two-to-six weeks for the tadpoles to become fully grown. These toads burrow underground during dry periods. You can hear them singing a croaking chorus after a heavy rain!





HABITAT: Playa Lake (Dry)

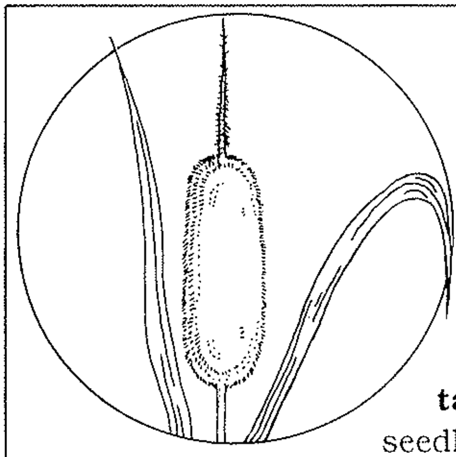


HABITAT: Playa Lake (Wet)

GRASSLANDS/ WOODLANDS ZONE

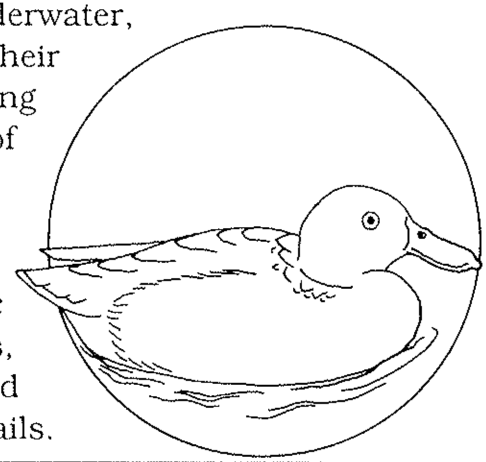
Marshes

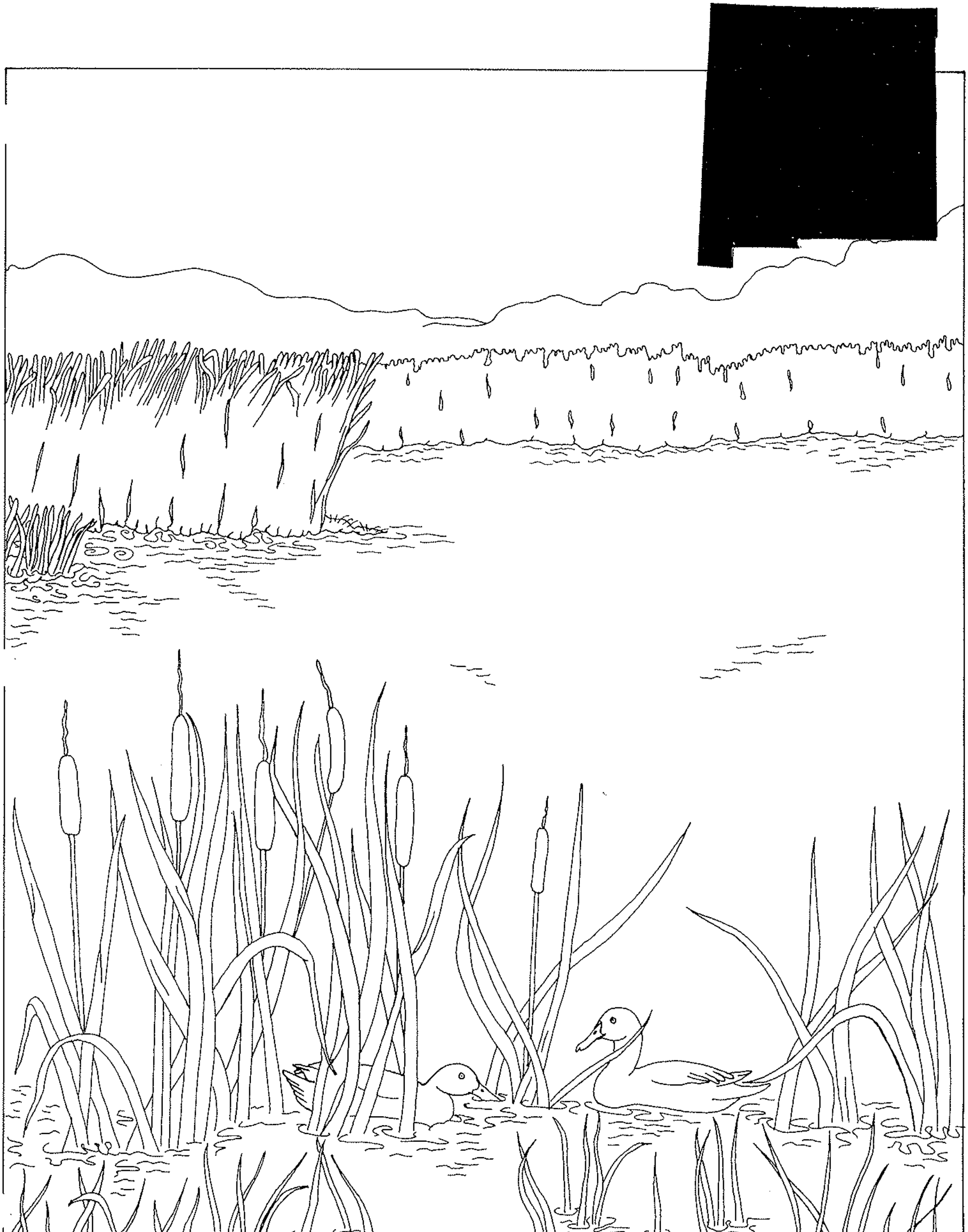
A marsh is an area of land where water has settled and *aquatic* plants have taken root. Marshes can occur in many life zones. Some marshes only have soggy soil, while others can be several feet deep with water. Plants called *emergents* grow in shallow water near the edge. These include grasses, bulrushes, sedges, cattails, and arrowheads. Deep water plants, like reeds and duckweed, have leaves that float. Other plants, like bladderwort, pondweed, and many kinds of *algae* grow entirely under water. Frogs, toads, and insects all lay eggs on plant stems in the marsh. Wildlife, such as mallards and other puddle ducks, black-crowned night herons, American bitterns, yellow-headed blackbirds, shore birds, great blue herons, snowy egrets, white-faced ibis, Western grebes, striped skunks, muskrats, raccoons, jumping mice, bullfrogs, common garter snakes, and Western painted turtles make their home here.



A common marsh plant is the **cattail**. Its seedhead is long and fuzzy like a cat's tail. It can have up to 250,000 fuzzy seeds on it. These seeds can travel by sticking to fur and feathers of animals that brush past them. New plants also grow from underground stems called rhizomes. They shoot out from the base of the cattail. These rhizomes are a favorite food of muskrats.

The **cinnamon teal** is a puddle duck that uses cattails for shelter and food. The male is a beautiful cinnamon color. Females are spotty brown. They eat by "ducking" their heads underwater, with their tails sticking up out of the water. Favorite foods are *aquatic* plants, seeds, and snails.





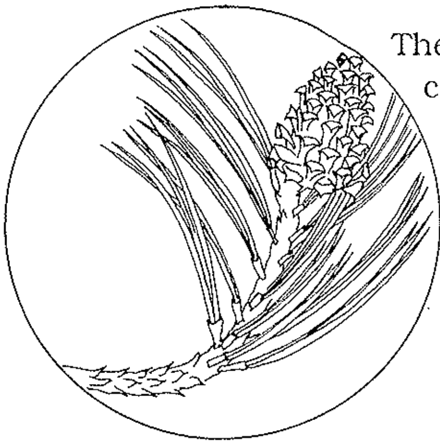
HABITAT: Marshes

TRANSITION (MOUNTAIN) ZONE

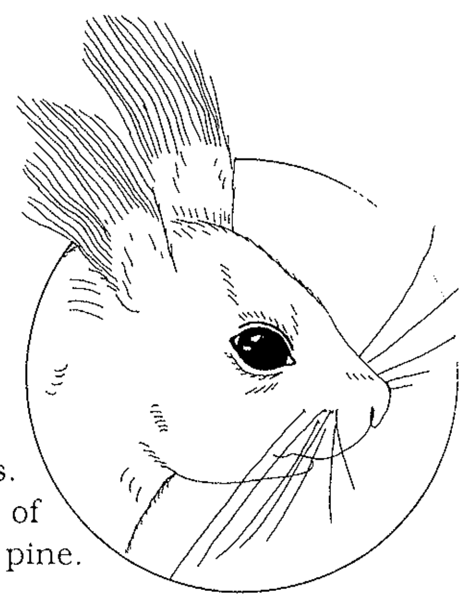
Ponderosa Pine

The Transition or Mountain Life Zone occurs from about 7,000 to 8,500 feet. Ponderosa pines are the first tall forest trees you encounter as you climb the foothills. It starts to get much colder and wetter in this zone, a "transition" from the warmer, drier climate below. About 20 to 25 inches of rain and snow fall each year. This helps many shrubs, vines, and berries to grow in the understory of taller trees.

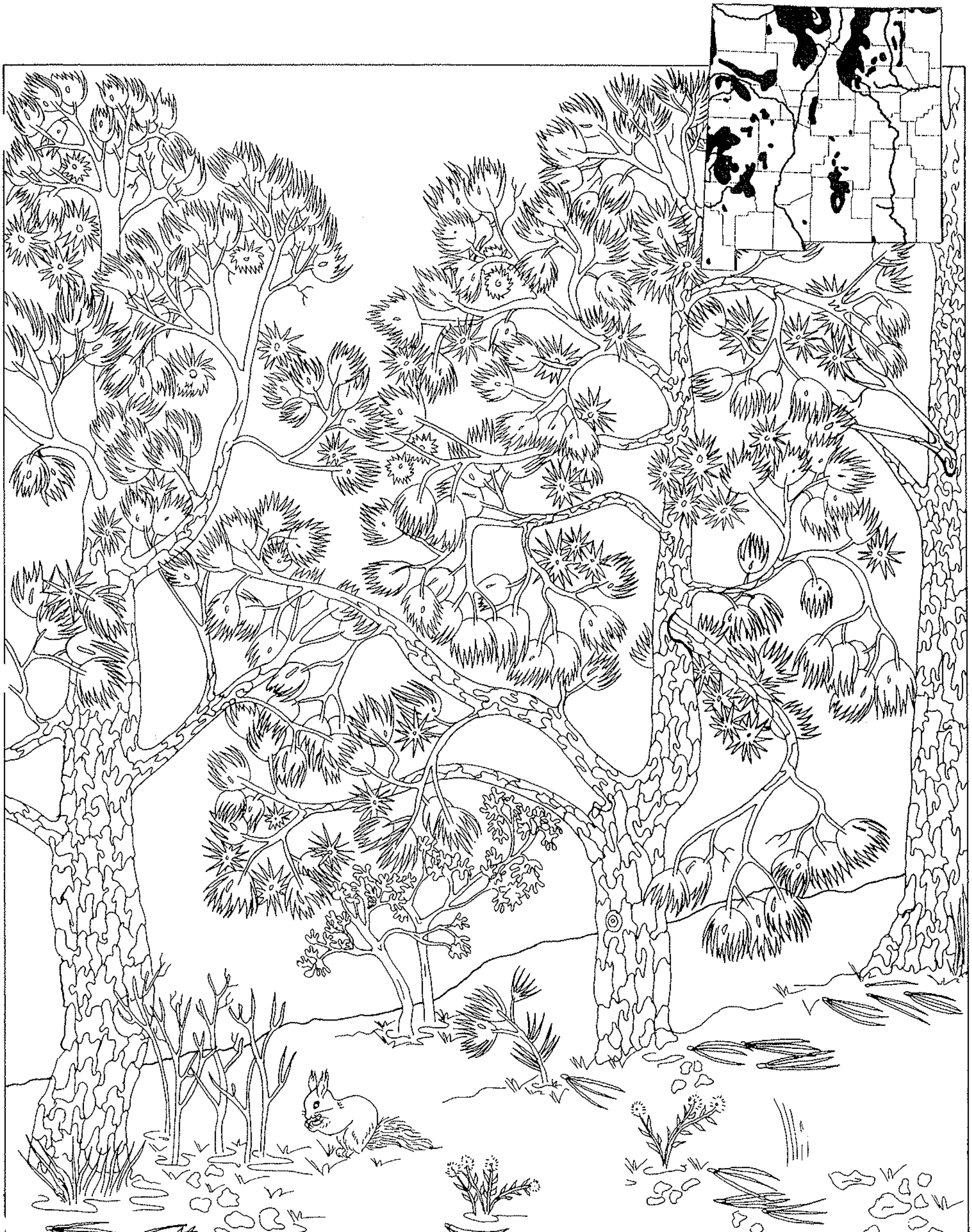
The most common habitat here is the ponderosa pine forest. These forests often look like parks, with younger trees mixed in with the older ones. Often the understory is very grassy with smaller trees and shrubs growing in the open areas. Other trees that may grow here are Gambel and wavy leaf oaks. Other plants include snowberry, skunkbush sumac, wild rose, and golden current. Wildlife that makes their homes here include silver-haired bats, mountain cottontails, porcupines, wild turkeys, Abert's squirrel, mule deer, Western bluebirds, Northern flickers, common ravens, Steller's jays, canyon wrens, great horned owls, flammulated owls, Southern prairie lizards, upland chorus frogs, and tiger salamanders.



The **ponderosa pine** is also called yellow pine because of the color of its bark. As the trees get older, the bark changes from brown to a reddish-yellow color. Needles usually grow three in a bundle and stay green all year round. This pine tree can grow up to 150 feet tall and live for 300 to 500 years.



The **Abert's squirrel** is a regular resident in ponderosa pine forests. You can recognize an Abert's squirrel by the blackish "tufts" of fur on its ears. It uses the ponderosa pine for food and shelter, building its nest in the Y-shaped branches. This tree squirrel eats the cone seeds, inner bark of small twigs, and the flowers of this pine.

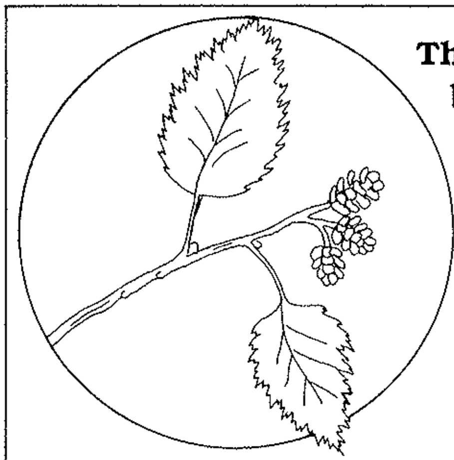


HABITAT: Ponderosa Pine

TRANSITION (MOUNTAIN) ZONE

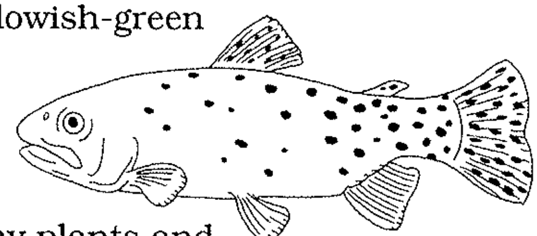
Mountain Riparian

Streams begin to flow year-round in this life zone. As the water flows downstream, swirling *rapids* are followed by calmer water. Twigs, leaves, and insects float along with the current, becoming food for many animals. Stream *algae* grows on top of rocks. Larvae and small insects can live on the undersides of the rocks. Temperatures tend to be warmer in winter and cooler in summer in stream habitats. Common plants are alders, water birch, willows, box elders, mulberry, blue spruce, chokecherry, Gambel's oak, Virginia creeper, sedge-grass, and water-loving wildflowers. Wildlife includes beaver, raccoon, wild turkey, broad-tailed hummingbirds, Western tanagers, ruby-crowned kinglets, violet-green swallows, American dippers, belted kingfishers, wandering garter snakes, brown trout, and cutthroat trout.



Thinleaf alder trees form thickets along many stream banks. They grow in thick stands, often with river birch trees. Several stems grow from one big base. These alders can grow up to 30 feet tall. Bark is a grayish color. Leaves grow two to four inches long and have toothed edges. The female flowers turn into little cones. American beaver, mule deer, and cottontails like the alder's bark. Birds like to eat the seeds.

The **Rio Grande cutthroat trout** is native to New Mexico, as well as New Mexico's state fish. It is a yellowish-green color with black spots. It likes cold, clear water. The female lays her eggs between March and July, making a gravel nest in flowing water. Rio Grande cutthroat trout like to eat insects in summer, as well as tiny plants and animals that live in the stream.

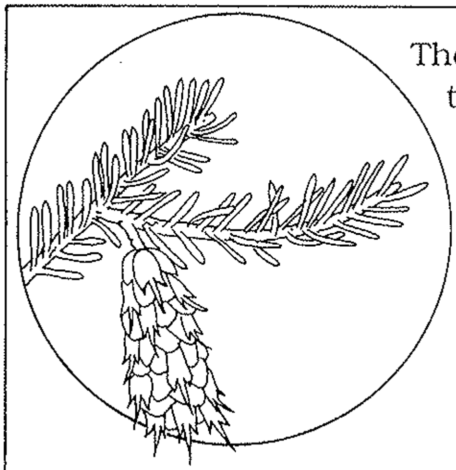


HABITAT: Mountain Riparian

CONIFEROUS FOREST ZONE

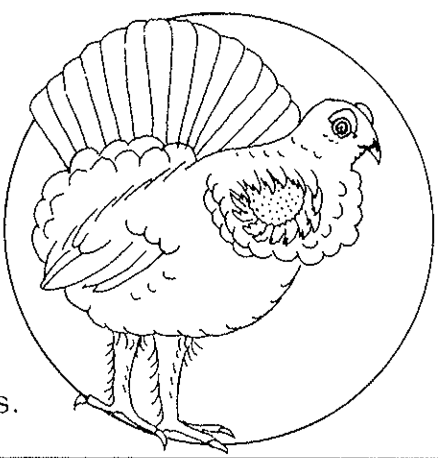
Douglas fir-white fir (mixed evergreen forest)

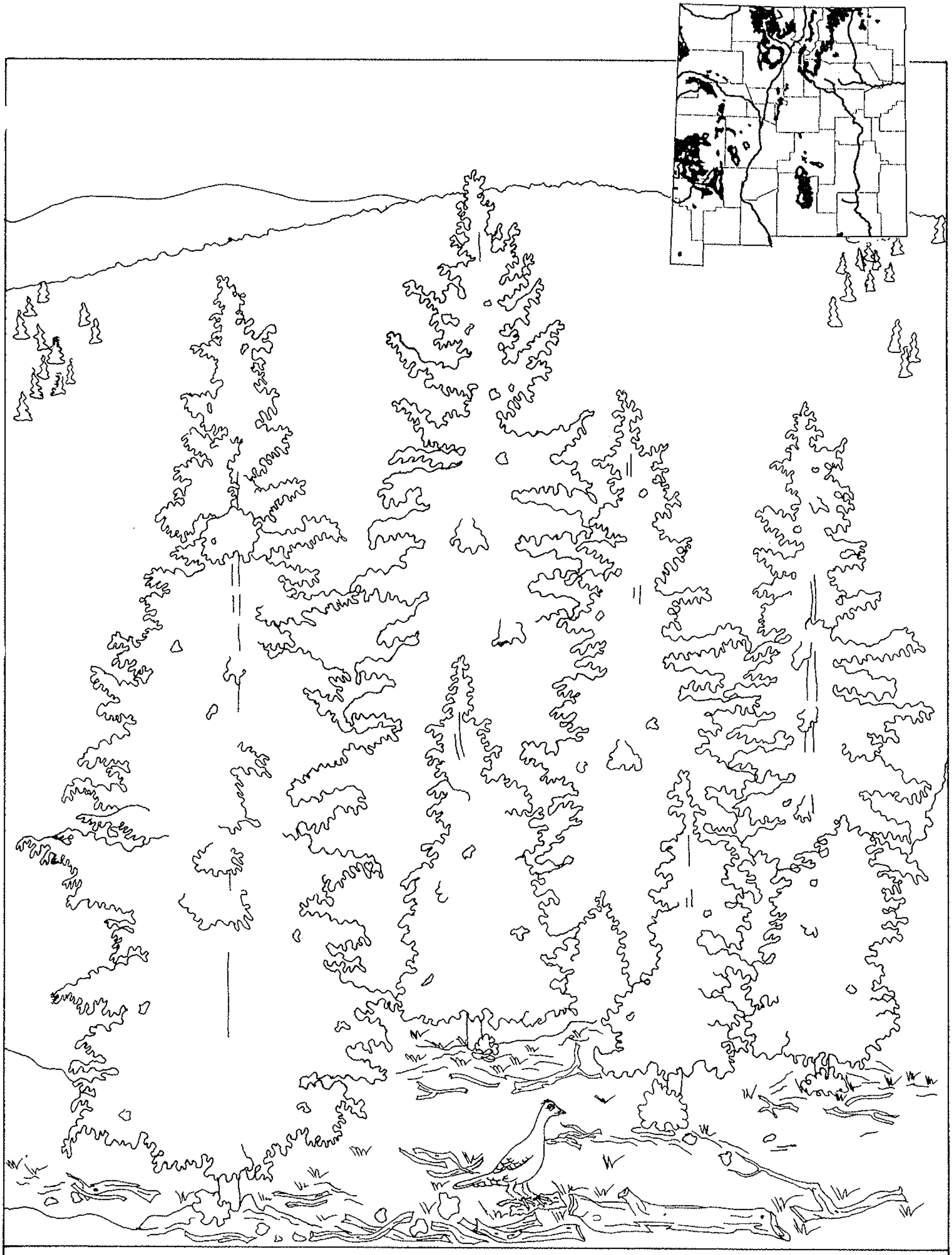
The *Coniferous* Forest Life Zone receives about 35 to 30 inches of rain and snow each year. This *precipitation* feeds the streams that flow into the drier regions. The elevation of this zone is from about 8,500 to 9,500 feet. The Douglas fir/white fir habitat makes a thick *canopy* cover. These trees grow very tall. Lots of leaves, twigs and logs fall and cover the ground. This makes it hard for many plants to grow in the *understory*. Dead fallen trees provide a habitat for many small animals. As they rot, the logs also make a good place for seedlings to grow. Rocky Mountain maples, forest willows, limber pine, blue spruce, and aspens might also grow here. Other plants include huckleberry, strawberry, poison ivy, ferns, lichens, and mosses. Wildlife such as the great horned owl, Northern goshawk, Mexican spotted owl, white-breasted nuthatch, Steller's jay, blue grouse, mountain chickadee, deer mouse, long-tailed weasel, red fox, porcupine, black bear, Jemez Mountain salamander, and the wandering garter snake also make their home here.



The **Douglas fir** is an evergreen tree. It is one of the tallest growing trees, reaching up to 130 feet tall. Needles are flat and bend easily. The pine cones hang down on the branches and have little "rat-tails" sticking out of the cones. Bark is reddish brown and very thick.

The **blue grouse** makes its home here. It has a short, strong bill and short, rounded wings that make it easier for the bird to fly through the dense forest. The males carry out a "hooting" behavior in the spring to attract females (hens). During courtship, males will engorge their yellowish orange combs above their eyes, and expose their bare, reddish neck skin, which is surrounded by a white rosette of feathers.



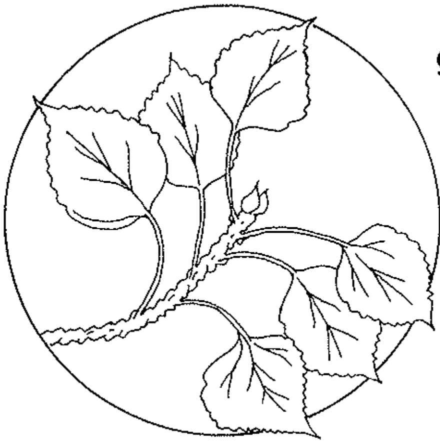


HABITAT: Mixed Evergreen Forest

CONIFEROUS FOREST ZONE

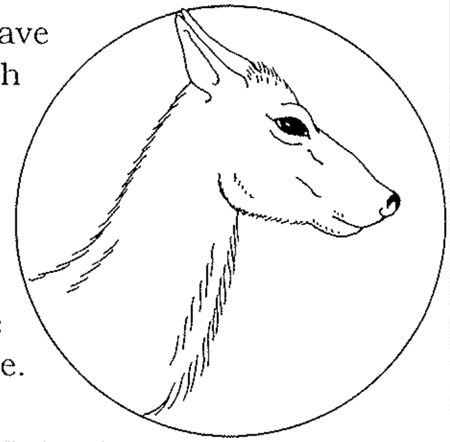
Aspen Woodlands

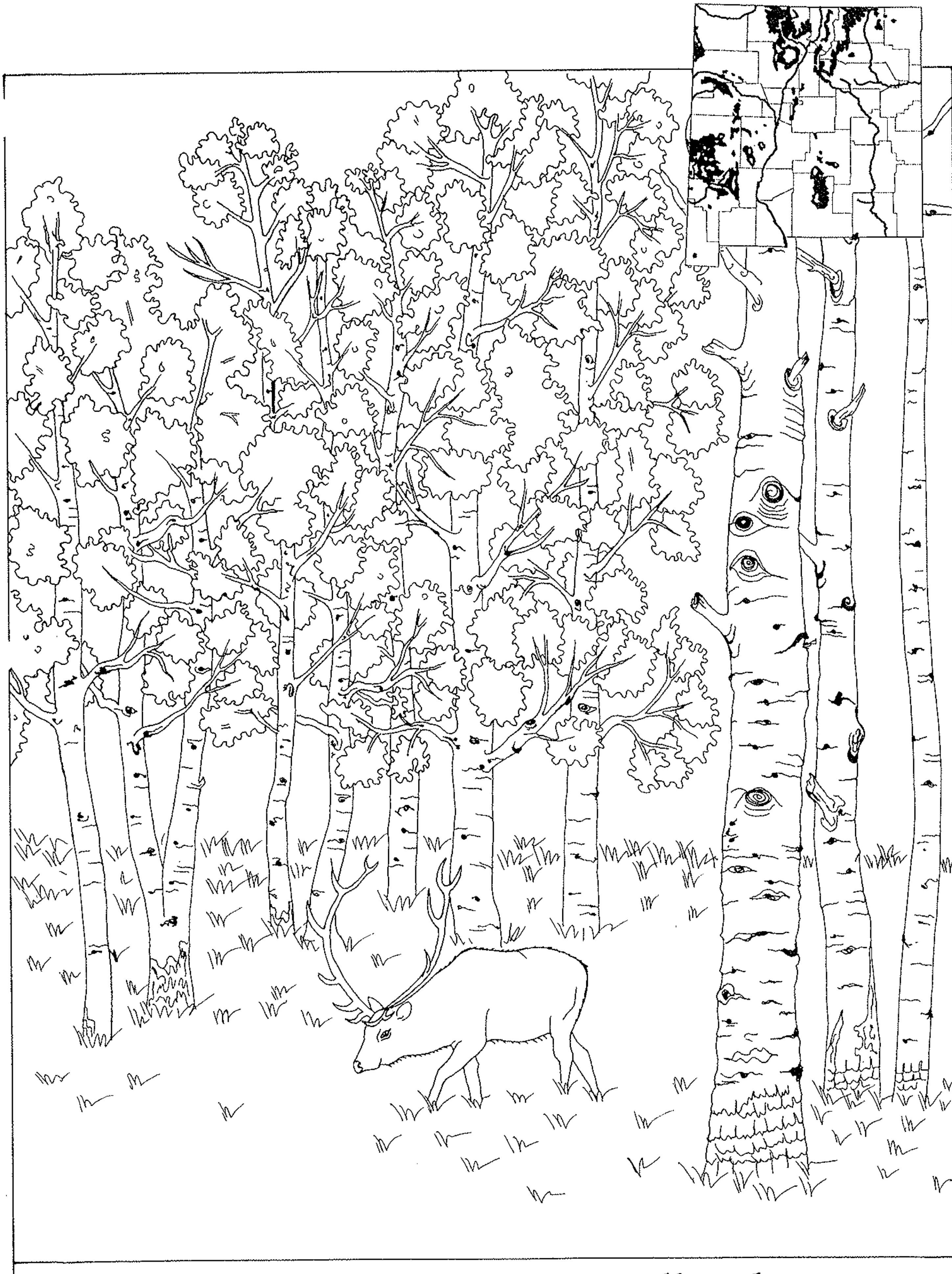
Aspen trees grow in thick stands or groves in the *coniferous* zone, as well as in the life zones immediately above and below. Aspen trees sprout mostly from underground shoots from other aspen trees in areas where evergreen trees have blown down or have been removed because of fire or logging. Aspen tree canopies let in sunshine, which helps encourage a thick undergrowth. Aspen groves provide food and cover for many animals. Elk and deer like to browse aspen trees. Deep snow in winter keeps the soil from freezing, so animals like gophers can burrow all winter. In old aspen stands, many of the older trees are dead. These trees make great homes for woodpeckers, and the insects that eat the dead wood become food for many birds. Other wildlife that lives here are big brown bats, shrews, mountain cottontails, elk, black bears, golden-mantled ground squirrels, wild turkeys, mountain bluebirds, American kestrels, Northern flickers, Northern saw-whet owls, yellow-bellied sapsuckers, and wandering gartersnakes. *Understory* plants that grow here include gooseberries, currants, wheatgrass, bracken fern, and lupines.



Quaking aspens have a greenish-white bark with dark eye-shaped marks. They get their name because their leaves are always fluttering or "quaking" in the wind. Leaves are shiny green until fall when they turn a beautiful gold. Aspens will invade a mixed-evergreen area soon after a burn. There, they will become shade trees to *conifer* seedlings that eventually will replace them.

The **elk** is a large member of the deer family. Males have large antlers. The males (bulls) shed their antlers each winter and grow a new set by the following fall. Females (cows) are smaller than the males. They are most active at dusk and dawn. Food includes grasses, *forbs*, and the leaves and bark of aspen trees. During rut (mating) season, a bull elk can acquire 10 to 40 females in his harem. Calves are born in May and June.



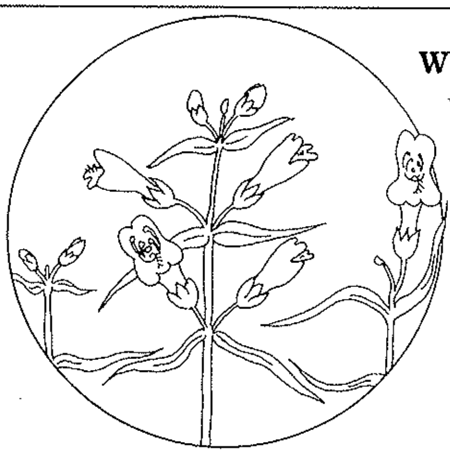


HABITAT: Aspen Woodlands

CONIFEROUS FOREST ZONE

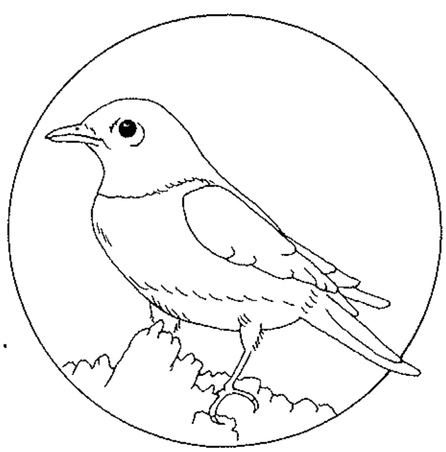
Mountain Meadows

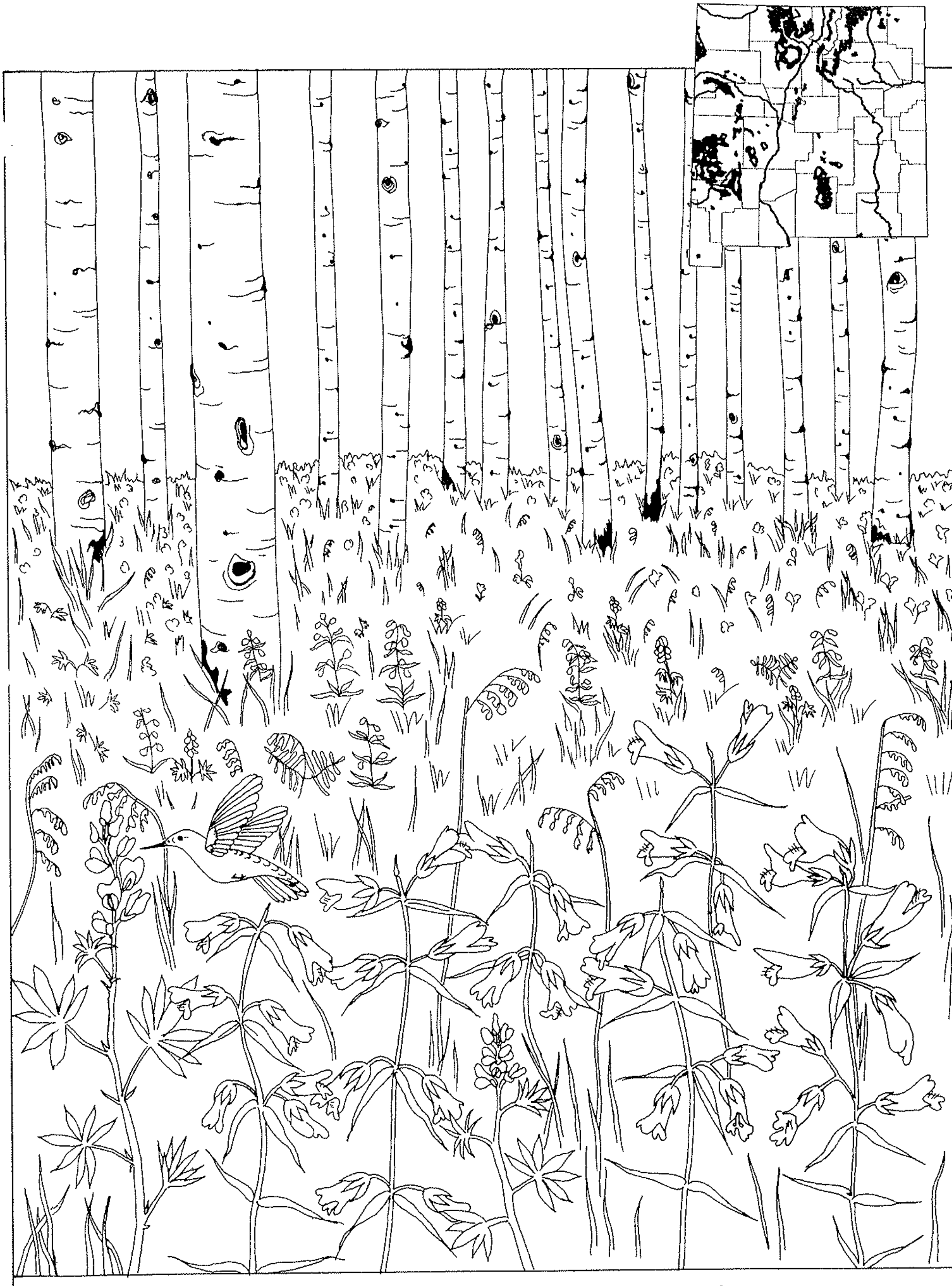
Meadows can occur in many life zones. They are big open spaces, usually without trees. Roots of the many grasses that grow here prevent little tree seedlings from taking root. In the forest life zone, snow that melts in the spring helps get things growing. Burrowing animals help to loosen the soil, which helps hold water in the soil. Many birds and animals use meadows for food. Nearby forests are used for shelter and nesting. Wildlife that can be seen in this habitat include black bear, elk, mule deer, sharp-shinned and red-tailed hawks, Western bluebirds, hummingbirds, silver-haired bats, striped skunks, red foxes, Montane voles, Northern pocket gophers, dwarf shrews, boreal toads, upland chorus frogs, meadow jumping mice, and tiger salamanders. Wildflowers that grow among the grasses and sedges include penstemon, Rocky Mountain iris, yarrow, Indian paintbrush, fleabane daisy, and lupines.



Whipple penstemons like to grow in open meadows in the forest life zone. The whipple penstemon flowers grow mixed in with grasses and other wildflowers. Flowers are a dark purple color. This penstemon can grow up to two feet tall. Penstemons are also called "beardtongues" because of the fuzzy *stamen* that rests on the lower petals.

The favorite habitat of the **Western bluebird** is in open woodlands and meadows. The male is a deep blue with a rust-colored breast. Females are gray with dark blue wings and tail. They make their nests in holes in trees. Favorite foods are insects and fruit.



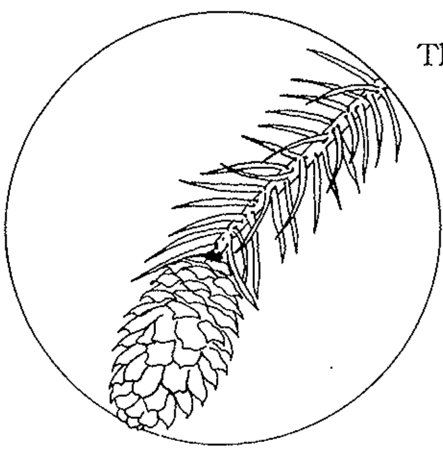


HABITAT: Mountain Meadows

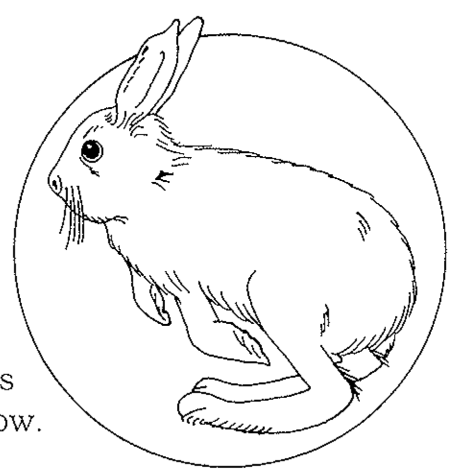
SUBALPINE ZONE

Englemann Spruce-Subalpine Fir (spruce-fir forest)

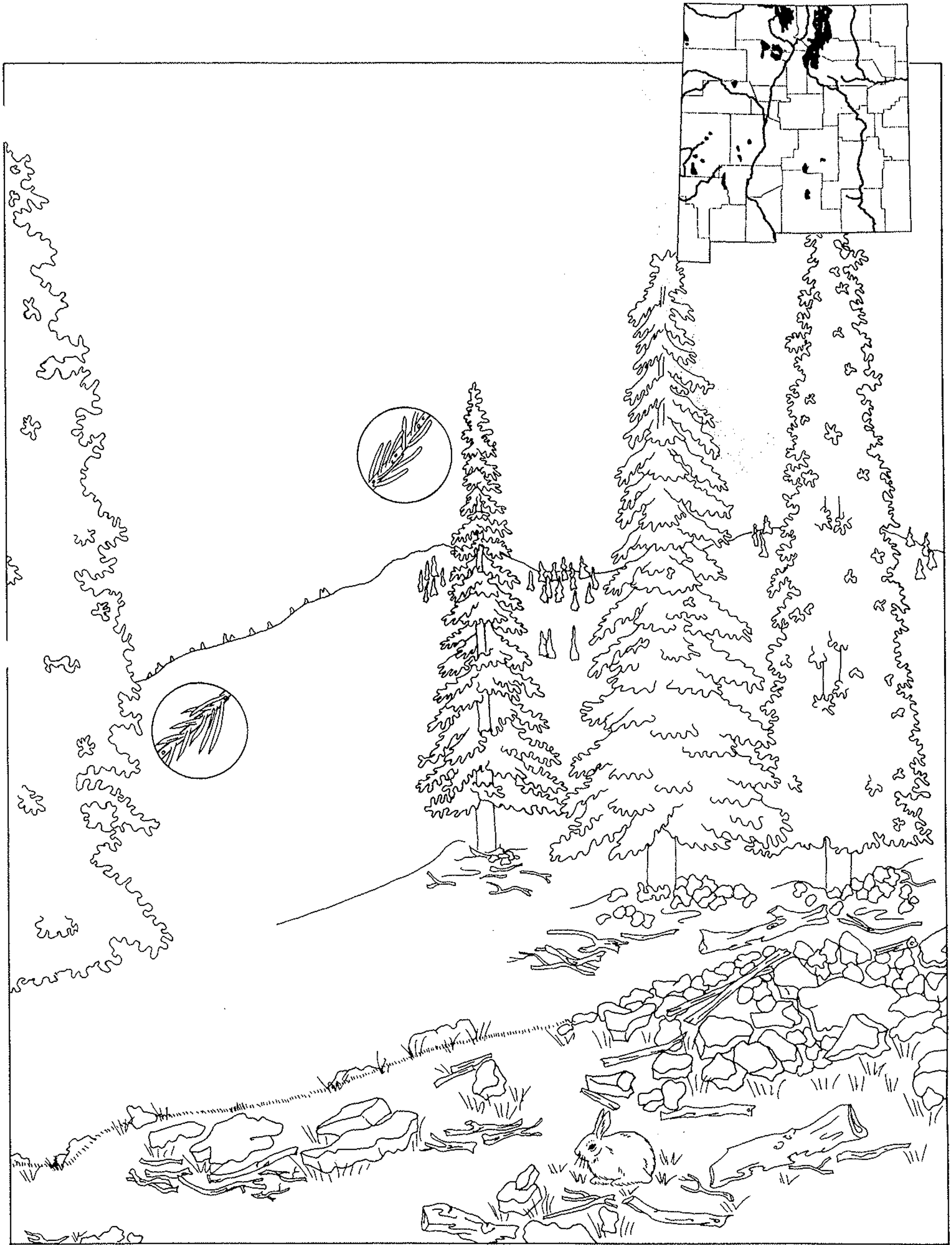
Between 9,500 and 11,500 feet above sea-level lies the Subalpine Life Zone. This is the most *humid* life zone, since it is covered with snow six to nine months each year. Rain and snowfall can be 30 to 60 inches a year. That leaves only about two months for tree seedlings to sprout and flowering plants to produce flowers and seeds. Some places in New Mexico where this life zone exists are Mount Taylor, and the Jemez, Sandia, Sacramento, and Sangre de Cristo mountain ranges. The major habitat in this zone is the Englemann spruce and subalpine fir forest. Shade from the forest and cool temperatures help keep snow on the ground until late spring. Trees, and other plants growing here, tend to be smaller than those growing in the zones below. Growing closer to the ground helps protect them from the harsh winds. Other plants that grow here are corkbark fir, bristlecone pine, dwarf junipers, currants, honeysuckle, huckleberry, alpine clover, and bluegrass. Wildlife making homes here include elk, mule deer, Rocky Mountain bighorn sheep, snowshoe hare, least chipmunk, pine marten, red squirrel, vagrant shrew, blue grouse, red crossbill, pine grosbeak, Northern three-toed woodpecker, Clark's nut-cracker, gray jay, boreal owl, Northern flicker, and Sacramento salamander.



The **Englemann spruce** is an evergreen tree that can grow up to 100 feet tall. This spruce has a real "cone" shape. It is pointed at the top, and little by little, fans out into a wide bottom. Pine cones hang down from the branches. Their scales are very papery and bend easily. Needles are a bluish-green. When they fall off the branches, a rough scar remains on the twigs. Englemann spruce can live up to 500 or 600 years.



Snowshoe hares live in forests with a bushy *understory.* They rest in depressions in the thick cover. In winter, their coats turn white. This protects them by helping them blend in with the snow. Their coats turn brown again for summer. Their hind feet have extra hairs which help them walk on top of the snow.

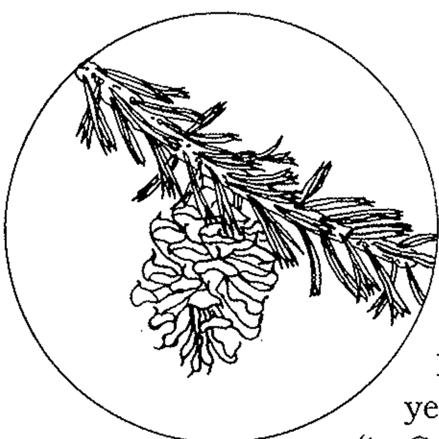


HABITAT: Spruce-Fir Forest

SUBALPINE ZONE

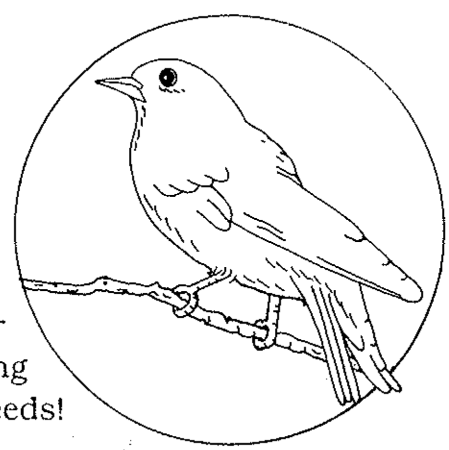
Bristlecone Pine

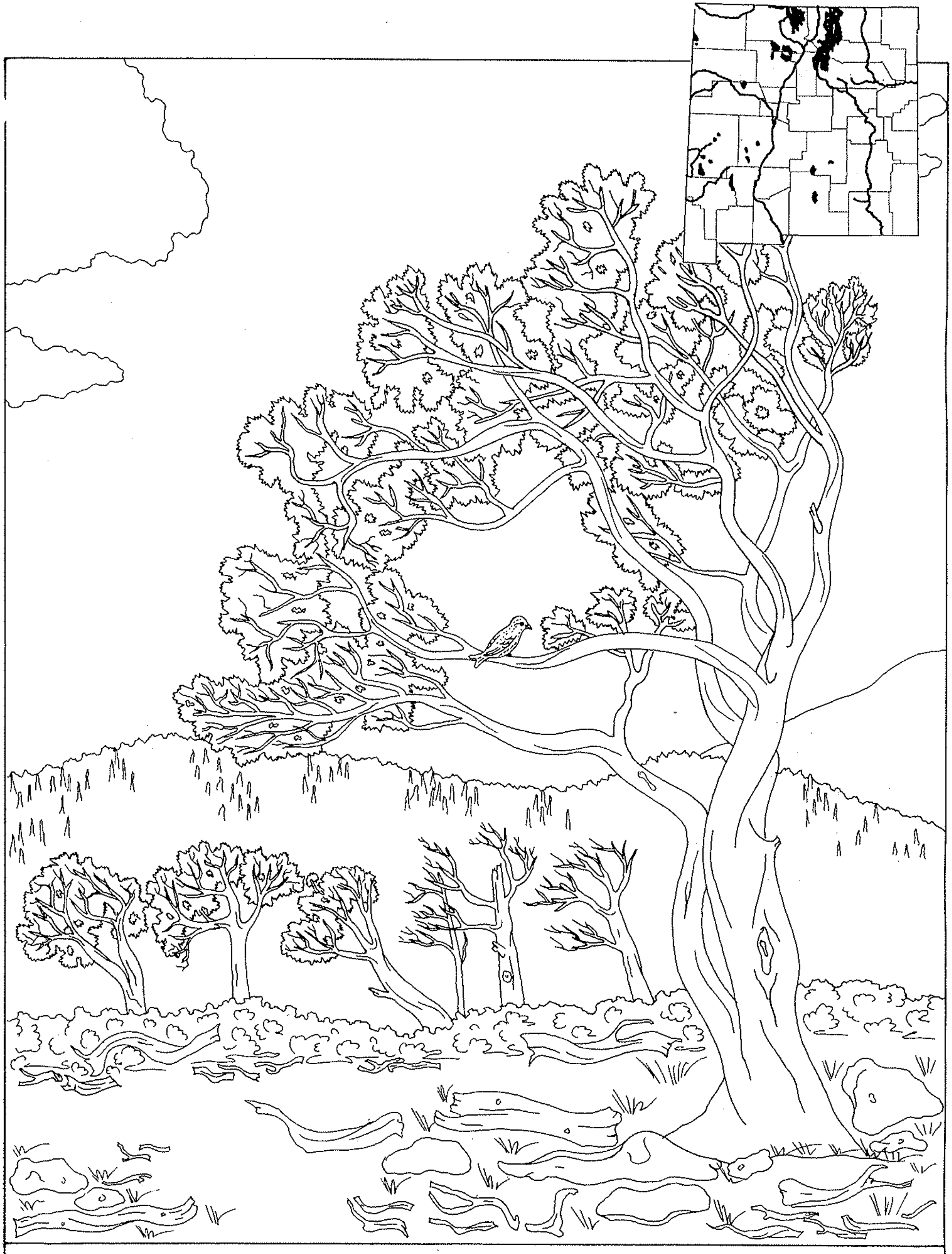
Also common in the Subalpine Life Zone is the bristlecone pine habitat. These trees tend to grow in clumps on gravely or rocky *outcrops*. This helps protect small seedlings from the strong winds, especially near *timberline.* Old dead trees that have fallen down also play a part in nature's cycle. Wind can knock down branches, and ice can wear down the bark. That is why many of these trees have a twisted look. The side facing the wind usually has fewer branches than the other side. As you get closer to *timberline,* trees tend to become smaller and even more twisted. Summer visitors in this zone include elk, mule deer, coyotes, Rocky Mountain bighorn sheep, yellow-bellied marmots, American pikas, Clark's nutcrackers, and rosy finches. The same plants and wildlife from the Englemann spruce and subalpine fir forest can also be found in the bristlecone pine habitat.



Bristlecone pines like to grow in wind-swept places. This often makes them grow very twisted in shape. The tips of their cone scales have sharp "bristles" on them. These dark green pines are some of the oldest living trees on earth. Tree age can be figured out by counting the *annual rings* of the trunk. In New Mexico, some bristlecone pines are known to be 1,000 years old, and the oldest bristlecone pine ever recorded (in California) is 4,600 years old!

The **pine siskin** is a little finch. These birds have yellow streaks at the base of their tails and also on their wing feathers. Their bills are sharp and thin, making it easy to pick out seeds from cones and other seedpods. They can often be seen hanging upside-down while they eat these seeds!

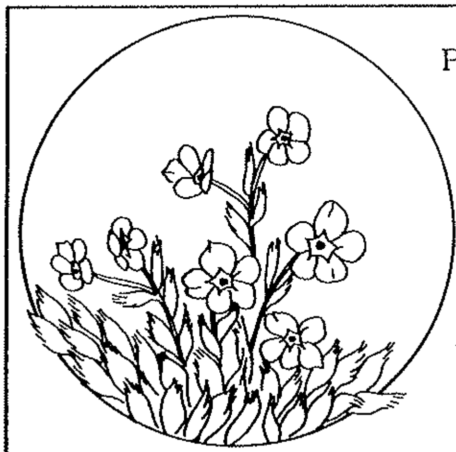




HABITAT: Bristlecone Pine

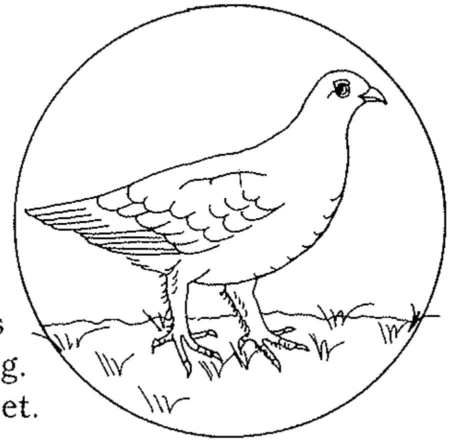
ALPINE ZONE
Tundra

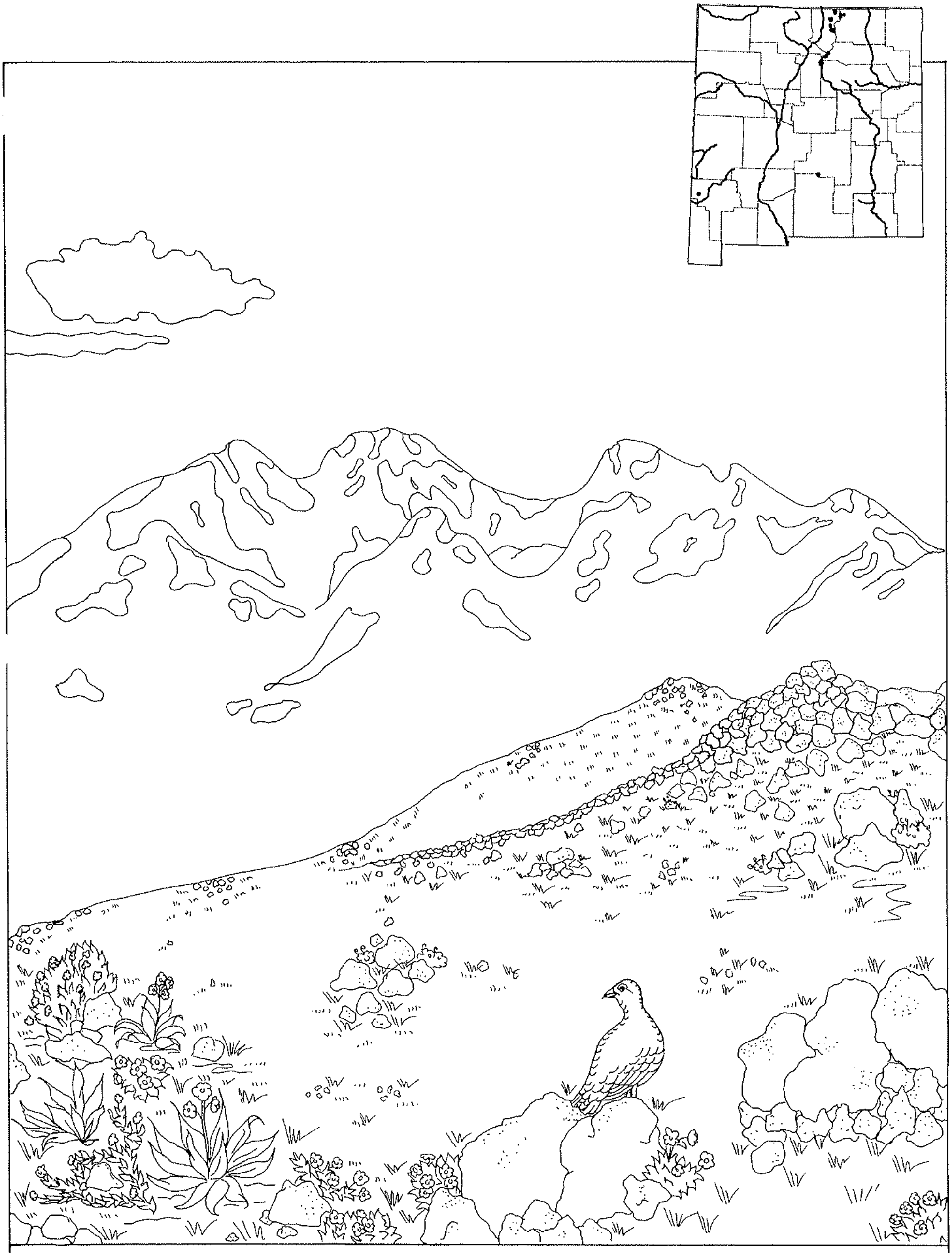
The highest life zone in New Mexico is the arctic-alpine *tundra*. Above *timberline*, this life zone ranges from 11,500 feet to more than 13,000 feet in elevation. This is the wettest and windiest life zone. Here the air is thinner, and temperatures are cooler. There are no trees in this zone. Two places in New Mexico where this life zone can be found are Sierra Blanca and the Sangre de Cristo range. Small, low-growing plants, similar to those that grow in the arctic, are found here. Annual rain and snowfall can accumulate more than 40 inches. Snow that melts in summer feeds streams below, helping to water the land. Common plants include tufted hairgrass, alpine fescue, golden avens, alpine forget-me-not, sedges, spike woodrush, and lichens. Wildlife adapted to this cold environment include the American pika, white-tailed ptarmigan, Rocky Mountain bighorn sheep, deer mouse, masked shrew, Northern pocket gopher, yellow-bellied marmot, horned lark, white-crowned sparrow, rosy finch, golden eagle, and the Sacramento salamander.



Plants in this habitat often grow in thick little clusters. Among these "cushion"-type plants is the **alpine forget-me-not** which grows close to the ground. This plant grows best in open, rocky places in the high mountains. Its flowers are a deep blue, and its hair-covered leaves appear as if they were made of wool.

The **white-tailed ptarmigan** is a bird that is common on rocky alpine slopes and high meadows. It has red "combs" over its eyes. In the winter, this ptarmigan turns white to match the snow. Its upper feathers gradually turn brown, mixed with white in springtime. Its tail and undersides stay white all year long. Feathers cover its legs and feet.





HABITAT: Tundra

CREATE YOUR OWN HABITAT

Plants and animals aren't the only living things that need a place in which to live. Humans are also an important part of nature. We share the land with other animals. In the space provided here, briefly describe what your habitat is like, or what you'd like it to be. Keep in mind that a habitat must have food, water, and shelter in order for your to survive. Draw your habitat on the next page, then color it in.

Pick a favorite plant and draw it in the circle. Describe it in the space below.

Pick a favorite animal and draw it in the circle. Describe it in the space below.

HABITAT:

GLOSSARY

ALGAE — Simple one-celled or many-celled plants; usually aquatic.

AQUATIC — Growing or living part of its life in water.

ANNUAL RING — A layer of wood produced by one year's growth.

CANOPY — Layer formed by the leaves and branches of the forest's tallest trees.

CONIFER — A plant that bears its seeds in cones.

CONIFEROUS — Refers to cone-bearing. Coniferous forests include pines, firs, and spruce trees.

EMERGENT — A plant with its roots in shallow water and most of its growth above water.

FORBS — Low-growing weeds and herbs, not including grasses.

HUMID — Containing a lot of moisture.

LARVAE — The immature form of many insects.

OUTCROP — The part of a rock formation that can be seen above the ground.

PRECIPITATION — Water reaching the ground in the form of hail, mist, rain, sleet, or snow.

RAPIDS — The part of a river where the current is fast.

RIPARIAN — Located or living along or near a stream, river, or body of water.

SPIKE — Flowers growing close together on the long stem of an aquatic plant.

STAMEN — The male part of a plant.

TERRAIN — The physical features of a piece of land.

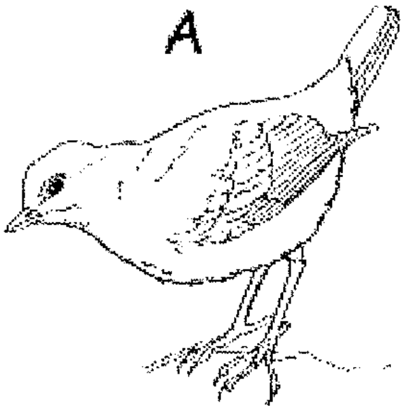
TIMBERLINE — The upper limit of tree growth on mountains.

TUNDRA — Treeless vegetation in regions with long winters and low annual temperatures.

UNDERSTORY — The layer of plants growing under a higher canopy layer of forest trees.

Wildlife for you to identify and color...

A



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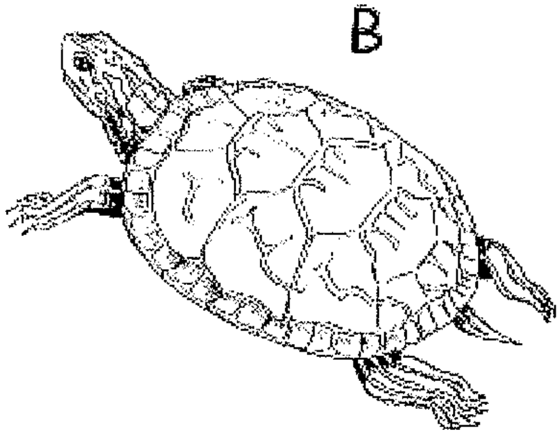

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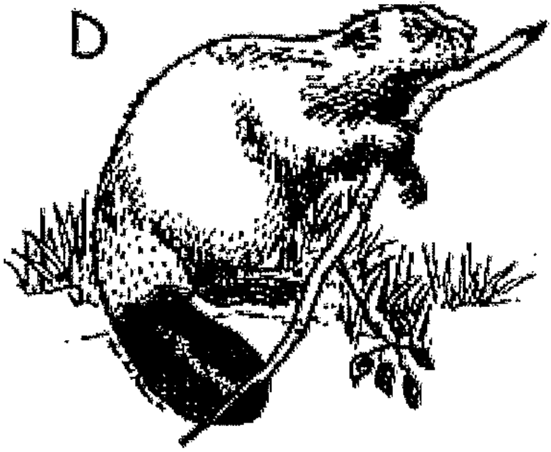

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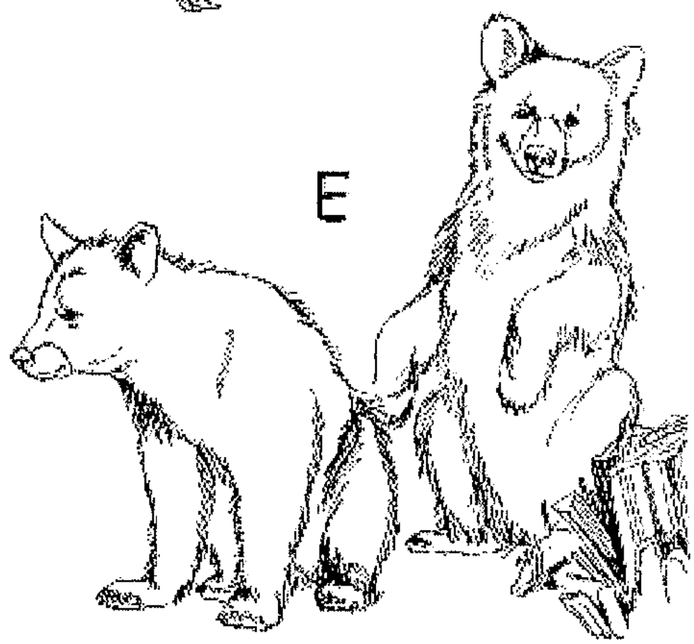
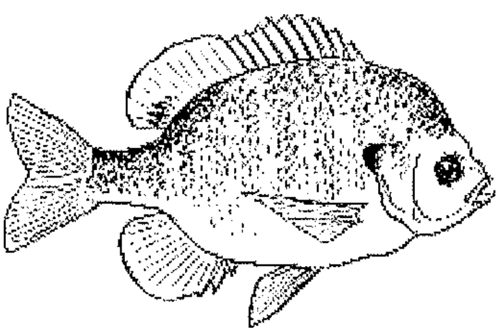




F

G

A-bird, B-turtle, C-prairie dog, D-beaver, E-bear cubs, F-fish, G-shrew

SCHOOLYARD WILDLIFE HABITAT PROJECT

PHOTOS: Kevin Holladay

This is an action oriented project designed by and for students and teachers to establish actual wildlife habitat on or close to school grounds. These areas are outdoor classrooms made up of native plant and animal communities that attract and provide habitat for native wildlife. Some of the many benefits of having Schoolyard Wildlife Habitat areas include:

- Attracting butterflies, hummingbirds, songbirds, lizards, and small mammals. Build bird houses, small wetlands, wildflower gardens, rock shelters for lizards!
- Facilitating interdisciplinary learning opportunities for students. The classroom comes alive!
- Providing an exciting tool for teachers, students, parents, and local businesses to come together in a positive way to revitalize schools and develop civic responsibility.

Regardless of the schoolyard, improvements can be made to increase its value for wildlife and to provide enhanced learning opportunities for students!

For loads of hands-on ideas, suggestions and links to resources for developing, creating and maintaining a Schoolyard Wildlife Habitat please contact:

Project WILD Coordinator
New Mexico Department of Game and Fish
1 Wildlife Way
Santa Fe, NM 87507
(505) 476-8095
www.wildlife.state.nm.us/

Providing New Mexico and it's wildlife
Year-round
Excellent
Services

Ecosystems

Ecotones

Objective
Students will understand the concept of ecotones and the "edge effect" in overlapping ecosystems

Key Words
1. *Bosque* – a Spanish word for forest; in New Mexico, the Bosque (with a capital *B*) refers to the cottonwood forest along the Rio Grande River
2. *Diversity* – a variety of something; biodiversity means a variety of living things
3. *Ecosystem* - all the living things living and growing in a geographical area and the physical environment of the organisms
4. *Ecotone* - an area of transition between two different ecosystems
5. *Edge effect* – the process and results of two individual ecosystems blending together at the edges of each
6. *Habitat* - the place where an organism lives and grows
6. Open Spaces – natural areas protected from development and are managed to conserve natural and archaeological resources, provide opportunities for outdoor education, provide a place for public recreation, and define the edges of the urban environment.
6. *Transition* – when or where something undergoes change, passing from one form to another one

Background
In an ecotone, the area, or edge, where two ecosystems overlap often has a great diversity of plants and wildlife, even more than within each of the individual ecosystems. For example, where a pond and a meadow overlap, it is common to find cattails growing within the ecotones. The process and results of this blending together, or overlapping, of two ecosystems at the edges, is called the "edge effect."

Ecotones usually have more diversity of plants and wildlife because organisms common to both overlapping ecosystems are sharing the same area. Even though you may not see the animal species, they leave behind a lot of evidence, such as footprints, scat (droppings), and feathers. When there is little or no diversity in ecotones, it is often a clue that there are problems. Exploring the edges of ecosystems can help us understand the dynamics of change that take place in wildlife habitats.

In your local neighborhood, there are also areas of overlapping edges. For example, where a road meets a sidewalk or a building meets a parking lot, or where one home's lawn meets another home's desert landscaped (xeriscaped) frontyard. Places to examine edges, such as at city parks, the Bosque, a river bank or an open space, may be within walking distance of your home or school.

Edges attract people. In New Mexico, river banks, the Bosque, open spaces, lake shores and mountain meadows are examples of some of our favorite spots. In such places there is the possibility that humans will change the ecotone with damaging consequences for wildlife and plants. When natural areas are cleared and forests are often cut down to build homes and businesses, native plants and animals lose their habitats. The same is true when rivers are dammed or diverted for drinking water, agricultural use and/or flood control. Human litter and other refuse is often an indicator of other human-created problems. Fish kills and prolonged absence waterfowl in an area may indicate contaminated water or habitat loss.

Materials

Note taking materials or Discovery Journals
Poster or butcher paper
Pens or pencils
Camera (optional)

Advance Preparation

1. Tell students you are soon going to take them to a natural setting where there are places that overlap. They are going to investigate these places.

2. Draw two large overlapping circles on a chalk or eraser board. Put a large number of small squares and triangles in one circle. Do not draw in the overlapping segment. In the second circle, draw many circles and stars; again avoid the overlap area. Ask students to predict the kinds of things they would expect to find in the overlapping circles.

3. Next, draw circles, squares, triangles, and stars in the overlapping segment. Ask students where the greatest diversity exists. Label the original two circles as Ecosystem 1 and Ecosystem 2. Label the overlapping segment the Ecotone (Edge Effect).

Instructions

1. Take the students outside to the school grounds or to a park to discover an ecotone. Choose a place where plants are invading a parking lot or a playing field, or where the edge of a lawn meets a sidewalk or the playground. Ask students to work in teams of two or three to list the things they find on either side of the edge. Each team should examine two different ecosystems, and list and tally different kinds of plants and animals they find, including direct and indirect evidence of life.

2. Next ask them to carefully examine the ecotone area. Have them try to determine how wide the area of blending is. Compare what's inside the ecotone with what is outside it.

3. After returning to the classroom, have student teams write their lists on poster paper. Discuss similarities and differences between plants and animals. How wide is the zone of shared characteristics? Discuss the comparison of what's inside the ecotone with what's outside. Compare and interpret the students' findings.

Options

1. Create an ecosystem map of your community. Show the location of the major ecotones.

2. Working in small groups, discuss the overall health of any ecotones that seem particularly important to the quality of life for species in your community.

3. On a field trip have students bring cameras and take pictures of the edges.

4. Invite a wildlife biologist or talk to the class or show slides on ecotones.

NM Science Standards:
Grade 4, II, II, II, 1, 4
Grade 6, II, II, II, 3
Grade 7, II, II, II, 4, 6
Grades 9-12, II, II, II, 1, 2

Source: Adapted from "Common Ground", *Ecosystem Matters*, United States Department of Agriculture (1995)

Ecosystems

Backyard Ecosystems

Objectives

Students will:
1. Plot out and study small ecosystems on campus and at home
2. Learn that many ecosystems can exist in a relatively small area, depending on the amount of sunlight, moisture and heat each area receives
3. Compare conditions in their ecosystems with those of their peers to determine how diverse the campus and their neighborhoods are

Key Words
1. *Abiotic* – concerning the non-living parts of an ecosystem
2. *Biome* – a major ecological community that has a certain kind of climate and a certain kind of community of plants and animals, such as the Amazon Rainforest or Gobi Desert
3. *Biotic* – concerning the living parts of an ecosystem
4. *Ecosystem* – all the living things living and growing in one geographical area
5. *Sustain* – to make something continue to exist

Background

An ecosystem is the combination of all the living things residing in one area, or a community, and the abiotic, or non-living, environment in which they live and with which they interact. The living and non-living parts of an ecosystem are constantly interacting and affecting one another. The amount of water, sunlight, and heat an area receives directly affects the types and numbers of living things that area will sustain. Soil composition and quality of water and air are some of the other abiotic parts of an ecosystem that impact it. In turn, living things also can have an impact on their non-living environment by affecting water, soil and air quality and composition.

Materials

4 paper clips
string: 5 meters long
thermometer
tin cans (all cans must be the same size)
Backyard Ecosystems Worksheets
1 meter stick
500 ml water
hand lenses

Safety Considerations
1. Remind students about safety with animals. Do not touch insects, spiders or other animals In the study area.
2. Be on alert for any student with allergies
3. Students should wear sunscreen and/or protective clothing

Advance Preparation

This activity should be done after students have been studying the basic principles of ecology. They should be familiar with such terms and concepts as ecology, biosphere, ecosystem, population, community, habitat, niche, predator-prey, food chain, food web, producer, consumer, herbivore, carnivore, omnivore, decomposer, competition, water cycle, carbon dioxide-oxygen cycle, and nitrogen cycle.

1. Gather the materials and assemble a set for each group of 2-4 students.

2. Have students answer the following questions as they do this activity:
   A. How many ecosystems do you think we have on our campus?
   B. How much will the ecosystems differ around campus?
   C. What are some of the biotic and abiotic factors that may contribute to the differences in ecosystems?
   D. Describe your ecosystem and list all of the biotic and abiotic parts you observed.
   E. How are the different plants and animals adapted to their environment?
   F. Are some living things present in all or most of the ecosystems? Which ones?
   G. Are some organisms present in just one or two types of ecosystems? Which ones?
   H. How can you explain these findings?
   I. Which ecosystems' soils absorbed water most/least quickly?
   J. Did this have any correlation with the amount or types of plants found in those ecosystems?
   K. What do you think would happen if we transplanted a plant from a wetter ecosystem to a drier ecosystem? How about the reverse? Explain your answer.
   L. In which ecosystems were there more variety of living things?
   M. Which living thing had the greatest population in your ecosystem? Why do you think that is?
   N. What might happen if an environmental factor were to change?
   O. In what ways might human activity change the ecosystem?

<u>Instructions</u>

1. Read over the Student Activity Sheet with the students and have the students predict the numbers and types of ecosystems and the kinds of living things they will find on campus or in the neighborhood.

2. Remind the students of the safety rules.

3. Divide students into groups and pass out supplies. Encourage the students to select a plot randomly. For example, have a student in each group toss a *pebble* over his/her shoulder. The study plot should be centered where the pebble lands.

4. When the students complete their studies, return to class to compare findings. (See questions listed above for ideas for discussion questions. Have students share their observations.

5. Make charts or graphs based on the information gathered in the study.

6. Make food web drawings for the ecosystems in the study.

New Mexico Science Standards
Grade 4, II, II, II, 1
Grade 5, II, II, III, 3
Grade 7, II, II, I, 1, 3, 4, 6
Grade 8 II, II, I, 3
Grade 9-12, II, II, I, 2 and 3

Source: Adapted with permission from “Small Ecosystems on Campus: It’s a Jungle Out There!”, Life Science Curriculum, *Proyecto Futuro* Initiative, New Mexico Museum of Natural History and Science (1996)

Backyard Ecosystems Worksheets

Name ____________________________________ Date ___________________________

Instructions

1. Find a small ecosystem, measure out a square meter, and then stake out that area using the paper clips to anchor the string into the ground. Be sure that your classmates try to find different types of ecosystems to study.

2. Observe the area that you have staked out. Carefully insert a thermometer about 3 cm into the soil and let it sit for about five minutes before you record the temperature of the soil. Record the temperature of the air at the average height of the plants as well. Notice the dampness of the soil and the amount of light that is reaching the area and the time of day. Describe as many abiotic factors as you can think of that are present in this ecosystem. Fill your information into Data Table 1.

Backyard Ecosystems Data Table 1.

Environmental Factors	**Observations**
Temperature of soil	
Temperature of air	
Dampness of soil	
Amount of light	
Time of day	
Total number of seconds that it took for the water to be absorbed by the soil	

3. Look at the different kinds of plants and animals present in your ecosystem. Count and record the various types of living things that are present. If you don't know their names make drawings. Fill your information into Data Table 2.

4. Find out how quickly the soil can absorb water. To do this, insert one end of your can 3 cm into the soil. Quickly pour the water into the can and time how many seconds it takes for the water to soak into the soil. You will compare your soil's absorption time to those of other students.

Backyard Ecosystems Data Table 2.

Description of Animal	Number Found	Description of Plant	Number Found

Investigating Ecosystems

Objective
Students will become aware of their outdoor environment through self-discovery by finding and identifying the items in a scavenger hunt

Key Words
1. *Ecosystem* - all the living things living and growing in a geographical area and the physical environment of the organisms
2. *Food chain* – transfer of energy from the source in plants through a series of animals, with repeated eating and being eaten
3. *Pollen* – tiny grains that fertilize the female cells of a plant to produce seeds
3. *Predator* – a meat-eating animal
4. *Prey* – an animal that is eaten by other animals
5. *Symbiotic* – a close relationship between two or more different organisms of different species that may, but does not necessarily, benefit each member

Background
The living and non-living parts of an ecosystem are constantly interacting and affecting one another. Ecosystems use energy and raw materials. The energy is usually sunlight, which plants use to make food. The raw materials are water, air and nutrients. Food chains are a primary part of ecosystems. The levels in a good chain are producers (green plants), primary consumers (plant-eaters and meat-eaters) and secondary consumers (animals that eat both plants and meat and meat-eaters).

All animals must eat to survive. Without predators, certain species would drive other species to extinction through competition. Without prey, there would be no predators. The predator-prey relationship is important in maintaining balance among different animal species.

Some interactions in an ecosystem are symbiotic. Sometimes a symbiotic relationship benefits both species, sometimes one species benefits at the other's expense, and in other cases neither species benefits. An example of a symbiotic relationship in which both species benefit is pollination, as when a bee pollinates a flower. A bee goes from flower to flower collecting pollen to take back to its hive. In this process, the bee transfers grains of pollen from plant to plant, making it possible for flowers to produce flower seeds.

Materials
Paper and pencil

Instructions
Part 1.
Working in groups of four, have students search the assigned area for evidence of the following. Have students record their observations.

1. Plants support all forms of animal life, either directly or indirectly.
   How do plants support animal life, either directly or indirectly?
   How do plants support animal life indirectly?
   What evidence did you find?

2. Animals live in or have passed through this area. What animals live here?
How many of these animals live here?
What would happen if more animals moved in?
What would happen if some of the animals moved out?

3. Wildlife and humans share the same environments. What is the significance of the word "share"? What evidence did you find?

4. Wildlife and humans are subject to the same kind of environmental problems.
What problems do they both share? How do the wildlife deal with the problem?
How do humans deal with the problem? What evidence did you find?

5. Wildlife exists in many different colors. Why? What evidence did you find?

. Humans have changed the environment. How have humans changed the environment? How has the environment responded? What evidence did you find?

<u>Part 2.</u>

Ask students the following questions. Have students record their observations.

1. **Predator Prey Relationships:**
What is a predator? What is prey?
What evidence did you find of predator-prey relationships?
How many predators are here? How many prey are here? Why?

2. **Insect Damage:**
What evidence of insect damage did you find?
How did it cause "damage"?

3. **Plant Disease:**
What evidence of plant disease did you find? How did it cause "damage"?
How might the damage also be beneficial for the ecosystem?

4. **Food Chains**
What evidence of food chains did you find?
What was the order of the organisms in this food chain?

5. **Symbiotic Relationships**
What is a symbiotic relationship? What evidence of a symbiotic relationship did you find?
How do the organisms work together? Do both organisms benefit? How?
Does one organism benefit more? How?
Does one organism benefit and the other not benefit? How?

New Mexico Science Standards
Grade 5, II, II, III, 3
Grade 7, II, II, I, 1, 3, 4, 6
Grade 8, II, II, I, 3
Grade 9-12, II, II, I, 2 and 3

Source: Adapted with permission from “Examining Outdoor Ecosystems: An Ecological Scavenger Hunt”, Life Science Curriculum, Proyecto Futuro Initiative, New Mexico Museum of Natural History and Science (1996)

Ecosystems

Where in the World is Our Wild Friend?

Objective
Students will observe the interrelationship among plants, animals, and other environmental factors in a local ecosystem.

Key Words
1. *Ecosystem* - all the living things living and growing in a geographical area and the physical environment of the organisms
2. *Environment* –the natural world, within which people, animals and plants live
3. *Interaction* – when two or more things have an effect on each other

Background
All of the living parts of an environment form a community which is interactive.

Materials

Tag board
String
Markers
Hole punch
Field Guides about local animals
Rewards (teacher discretion)
Clear contact paper or laminating film

Advance Preparation
1. Select a common animal from the local area that will become the "lost" animal.
2. Outline, for clues, the interactions this animal has in its daily living pattern with plants, animals, and other environmental factors. (For example: a horned toad would interact with ants, plants, etc. and a rabbit would interact with hawks, grass, coyotes, etc.)
3. Write clues about the location of the "lost" animal on bright tag board cards. (For example: "Ants are delicious", would be a clue that an anthill would be the location of the next clue.)
4. Prepare a wanted poster, including the offer of a reward (if applicable).
5. Place clue cards in outdoor locations at the hunting site before students arrive.

Instructions
1. Take students to the designated area and explain any applicable rules.
2. Have students examine the wanted poster and follow clues until they guess the name and location of the "lost" animal.
4. Presents rewards (if applicable).

Options
1. Have students develop clue cards and posters for different animals for other games.
2. Have students research the topic animal.

3. Adjust the game for various time periods and repeat the game as the seasons change.

NM Science Standards:
Grade 4, II, II, II, 1
Grade 5, II, II, II, 3
Grade 7, II, II, I, 1, 3, 4, 6
Grade 8, II, II, I, 3
Grade 9-12, II, II, I, 2 and 3

Source: Adapted from "The Lost Critter Game: Ecosystems in Balance", *Hands On/Minds On: Science Activities for Children*, American Indian Science and Engineering Society

New Mexico Life Zones Word Scramble

Name ____ Date ____________________

Unscramble each of the words below.

TOCSYMSEE	
MEVNIORTNEN	
DOATERRP	
PEYR	
BUOSEQ	
COTENOE	
GEDE FEEFTC	
MOSCYIBIT	
CITBOIA	
CIOBIT	

Write five sentences using some of the words above.

1.____

____

2.____

____

3.____

____

4.____

____

5.____

____

New Mexico Life Zones Word Scramble

Answers

ECOSYSTEM

ENVIRONMENT

PREDATOR

PREY

SYMBIOTIC

BOSQUE

ECOTONE

EDGE EFFECT

ABIOTIC

BIOTIC

Community Connections

"See deeply the beauty and interconnectedness of all life; then think, speak and act from what you see." – Maggie Streincrohn Davis

Communities are made up of groups of species of organisms that are connected to and interact with each other in the same environment. For example, in New Mexico, choke cherry trees found in forested areas provide necessary food for the western meadowlarks and other bird species, thus creating community interactions between these species.

Food chains and webs illustrate how energy flows through a natural system. Predator-prey interactions, such as between the coyote and the jackrabbit, are connections that are created between species in an environment. Predator-prey relationships drive adaptation, a living organism's response to environmental pressure. For example, pronghorn antelope have developed the ability to run at high speeds in order to avoid predators such as wolves and mountain lions. Activities in the Community Connections section are designed to help students develop an appreciation of the interactions of living organisms in natural communities.

Food Chains and Webs

Flora and Fauna's Cafe

Objective
Students will understand how food chains work in nature and the importance of these chains in maintaining the balance of nature.

Key Words
1. *Carnivore* – secondary or higher consumer in a food chain that eats other animals
2. *Consumer* – an animal that must eat plants and/or other animals
3. *Decomposer* – organisms that feed on the dead bodies of other organisms, breaking them down into simpler substances
4. *Ecosystem* – all the living things residing in one area, or a community
5. *Food chain* – transfer of energy from the source in plants through a series of animals, with repeated eating and being eaten
6. *Food web* – an interconnected pattern of food chains
7. *Herbivore* – an animal that feeds chiefly on plants
8. *Omnivore* – an animal which eats both plant and animal materials
9. *Photosynthesis* – the process by which green plants use sunlight, water and carbon dioxide to produce food
10. *Producer* – an organism such as a plant that makes its own food

Background
The feeding of one organism upon another in a series of food transfers is known as a food chain. It also can be described as the chain of transfer of energy from the sun that goes from one organism to another. A simple food chain is like the following:

sun – wild rose – aphid – ladybug – lizard -- hawk

All of the organisms in a food chain get energy be feeding on other organisms. Green plants form the first level of the food chain, the producers. They convert energy from the sun into sugar through photosynthesis. Herbivores are the first of the consumers. When they eat plants, they get energy from the plants. Then herbivores are, in turn, eaten by small carnivores, which are eaten by larger carnivores.

In the food chain above, the wild rose plant is the primary producer. The aphid is the first or primary consumer because it sucks the juice from the rose plant. The ladybug is the first or primary carnivore because it eats the aphid. The lizard is a secondary carnivore that eats the ladybug. The hawk is a tertiary (third) carnivore because it eats the secondary carnivore, the lizard. The hawk eventually dies and its remains are broken down by decay-causing bacteria and fungi. Except in certain deep-sea ecosystems, all food chains start with photosynthesis and end in decay.

In an ecosystem there are many different food chains and many of them are interconnected to form a food web. All plants and animals in an ecosystem are part of a complex food web.

Examples of New Mexico Plants and Animals

Producers	Herbivores	Carnivores	Omnivores	Decomposers
Buffalo Grass Ponderosa Pine Juniper Tree Yucca	Jack Rabbit Mule Deer Abert's Squirrel Yucca Moth	Mountain Lion Red-Tailed Hawk Rattlesnake Collared Lizard	Coyote Black Bear Raven Spotted Skunk	Fungus Bacteria

Chart adapted from "Spin a Food Web", Ecosystems Explorations, Sandia Mountain Natural History Center

Materials

Flora and Fauna's Cafe Cards
Yarn
Table

Instructions

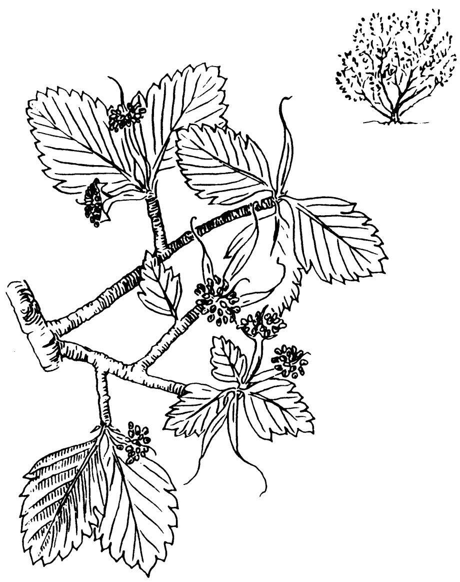
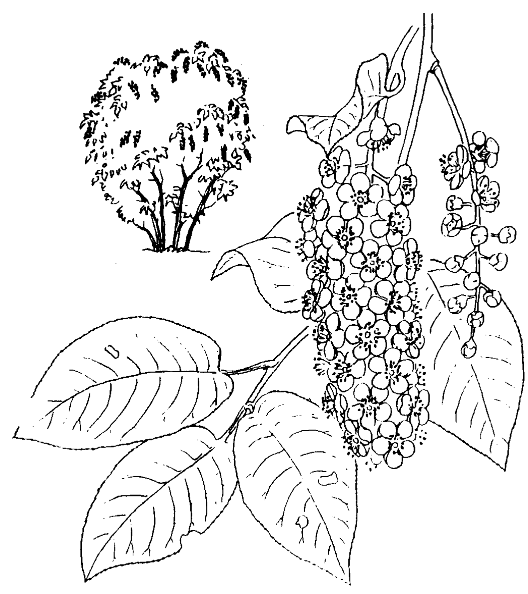
This activity shows how energy flows through an ecosystem.

1. Divide students into small groups and provide each group with a set of *Flora and Fauna's Café* cards.

2. Have student groups build food chains with the cards and yarn. Begin with the plant cards. Information on the backs of the cards will provide clues for developing the chains.

NM Science Standards:
Grade 4, II, II, I, 4
Grade 5, II, II, I, 3
Grade 7, II, I, I, 1-2; and II, I, II, I
Grades 7 and 8, II, II, I, 3
Grades 9-12, II, II, I, 2, 6

Flora and Fauna's Cafe

Mountain Mahogany	Piñon Pine
 Art by R. D. Ivey	 Art by R. D. Ivey
Buffalo Grass	**Choke Cherry**
 Art by R. D. Ivey	 Art by R. D. Ivey

Mountain Mahogany
Cercocarpus montanus

This native to New Mexico can be found throughout the Western U.S. and Mexico and grows at elevations of 3000 to 9500 feet. It usually grows about 15 feet tall and has leathery, aromatic oval leaves and shaggy red bark. Native Americans used the wood for tools. It is an important browse plant for deer, sheep and cattle. Animals also carry the hairy seeds in their coats, helping the seeds disperse over larger distances.

Piñon Pine
Pinus cembroides edulis

The piñon is New Mexico's state tree. It is a slow growing evergreen tree. Like all pines, it produces seeds in its cones. We call these piñon nuts and humans, turkeys, bears, piñon jays, woodrats, and deer eat them. Native Americans use them as food and in their ceremonies. Piñon pine forests provide habitat for mule deer, elk, cottontail rabbits and turkeys. Piñon jay, Steller's jay, scrub jay, and Clark's nutcracker eat piñon nuts, store them in caches and disperse the seeds. New trees grow from these seeds.

Buffalo Grass
Buchloe dactyloides

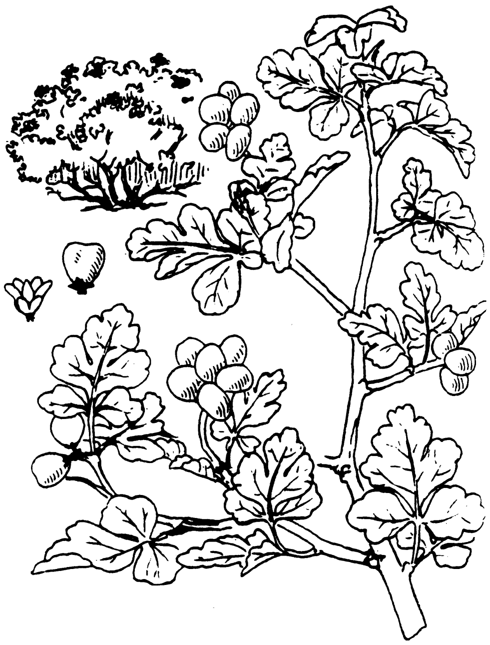
It is called Buffalo grass because it was the main food source for the buffalo when large herds roamed the prairies. This grass is the only indigenous (has always been here) warm season grass in the Southern US. It grows very well in dry climates and it turns lavender in the autumn. It is a good food for livestock, deer, buffalo, pronghorn antelope, jackrabbits, and prairie dogs. Mountain plovers use it to build their nests. This plant grows better after a fire making it a good plant to live in the Southwest.

Choke Cherry
Prunus virginiana

A member of the rose family, this plant has been harvested for its fruit for thousands of years. Many different Native American tribes used chokecherries in cooking and as a medicine. Birds, rabbits, hares, rodents, and bears all like to eat the fruit of the choke cherry. It provides nesting habitat for birds, who disperse the seeds and winter food for deer. It is also resistant to fire, loves the sun and does well in drained soil, which makes it a good plant for the Southwest.

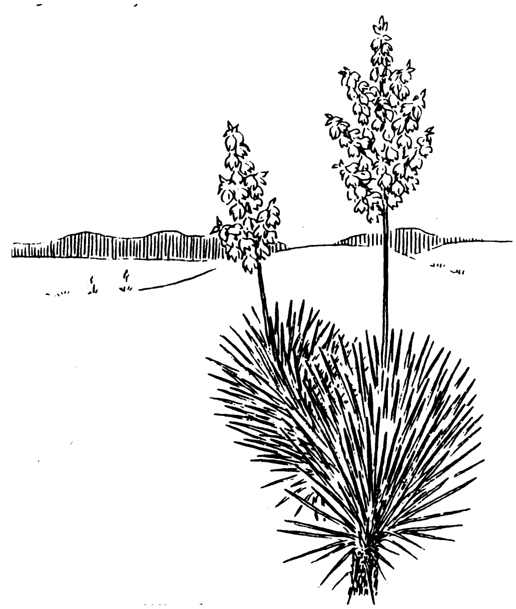
Flora and Fauna's Cafe

Sumac



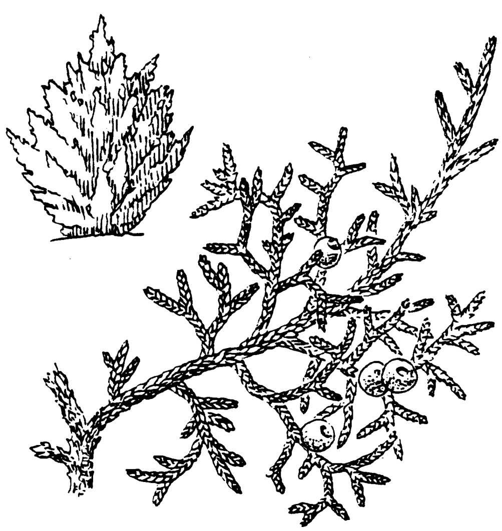
Art by R. D. Ivey

Yucca



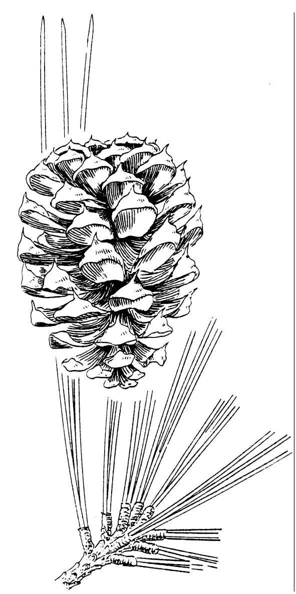
Art by R. D. Ivey

Juniper



Art by R. D. Ivey

Ponderosa Pine



Art by R. D. Ivey

Sumac
Rhus sp.

There are 54 species of Sumac that grow in North America. The smooth sumac or *Rhus glabra L*. is a common species found in New Mexico. Native Americans use sumac as a medicine and as a dye. It is an important winter diet for grouse. Pheasants, quail, turkeys and 300 species of songbirds eat sumac fruit. Deer eat the fruit and stems, while fox, squirrels, and cottontail rabbits eat the bark.

Yucca
Yucca sp.

There are 40-50 species of yuccas in the US. The yucca flower is New Mexico's state flower. The yucca is also known as "Lampras de dios" or "Lamps of the Lord" because of the mass of white flowers produced from the center stalk within the plant. Yucca flowers are pollinated by yucca moths. Native Americans used yucca to make soap, shampoo, dyes, food, as medicine and used the fibers in weaving. Parts of the yucca are eaten by woodrats, jackrabbits, rats, mule deer, and pronghorn antelopes. It also provides cover for small mammals and birds.

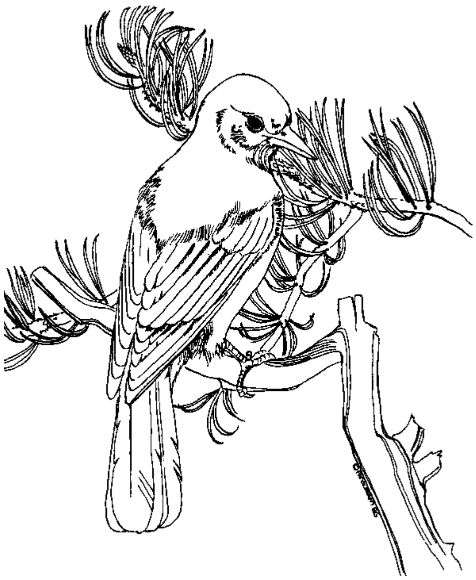
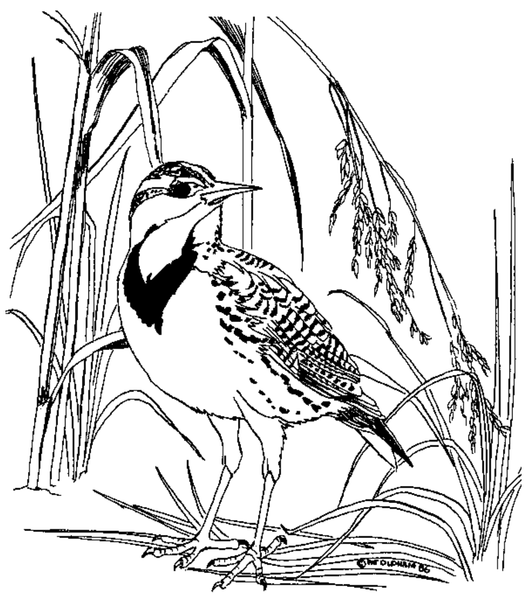
Juniper
Juniperus sp.

There are seven species of juniper found in New Mexico. Oneseed juniper or *Juniperus monosperma* is one of the most common junipers seen in New Mexico. It produces seeds known as juniper berries that are usually blue to dark purple in coloration. Native Americans have used juniper in ceremonies and as medicine. Deer, pronghorn antelope, bighorn sheep and elk all eat the foliage. Birds, rabbits, chipmunks, squirrels, woodrats, coyotes, and foxes all eat the seeds and disperse them over long distances. It also provides good cover for many birds and mammals.

Ponderosa Pine
Pinus ponderosa

This large and long living pine tree is important for birds for cover, nesting, and roosting. The seeds are eaten by birds, turkeys, chipmunks, and squirrels. The pine needles are eaten by grouses. The bark is eaten by beavers. The bark is also used as nesting material fro porcupines, mice and other rodents. The wood is used for building and as firewood. Native Americans used this tree for food, dyes, to make instruments, and to make glue.

Flora and Fauna's Cafe

Pinyon Jay (also Piñon Jay)  Art by Pat Oldham	**Mountain Lion**  Art by Pat Oldham
Western Meadowlark  Art by Pat Oldham	**Abert's Squirrel**  Art by Pat Oldham

Pinyon Jay (also Piñon Jay)
Gymnorhinud cyanocephaus

Pinyon jays are small blue-gray birds that travel in large, noisy groups in forests of piñon pine and juniper. They eat piñon and pine nuts, juniper berries and insects. The young are mostly fed insects. The birds store pine nuts in the fall, burying them underground. Pinyon jays find these food stashes later on. In years of high piñon nut production, their loud 'laughing' call is often heard as the birds fly overhead.

Mountain Lion
Puma concolor

The mountain lion is also known as a cougar, panther or puma. It lives in forests, rocky canyons and deserts. This animal moves mostly at night and feeds primarily on deer, elk and occasionally livestock. After making a kill, it will drag its prey to a secluded spot to eat. It is a secretive, solitary animal that can travel 20 to 30 miles a day in search of food. A mountain lion can reach 9 feet in length from tail to nose and weigh up to 220 pounds. Its range once exceeded that of any other American mammal, from Alaska to southern Chile.

Western Meadowlark
Sturnella neglecta

A meadow lark has a black V on its yellow breast, and likes open country and often will perch on a fence posts. A meadowlark feeds on insects in the summer, such as beetles, caterpillars and grasshoppers. In fall and winter, its diet consists of seeds and grain. A meadowlark builds its nest on the ground in thick grasses. To help protect its eggs and offspring, this bird will create narrow trails heading through the grass to the nest. The song of a meadowlark is one of the loveliest of the western birds.

Abert's Squirrel
Sciurus alberti

The Abert's squirrel can be recognized by the black "tufts" of fur on its ears. It lives and nests some 16 to 90 feet above the ground in ponderosa pine forests. The squirrel eats bark, buds, flowers and seeds of the pines, as well as mushrooms, mistletoe, antlers and bones, acorns, insects, and carrion. Mushrooms provide an important source of moisture. Its young are born in June or July. An Abert's squirrel does not hibernate, but may sleep through long periods of cold. Some people like to hunt and eat this squirrel species.

Flora and Fauna’s Cafe

Mule Deer

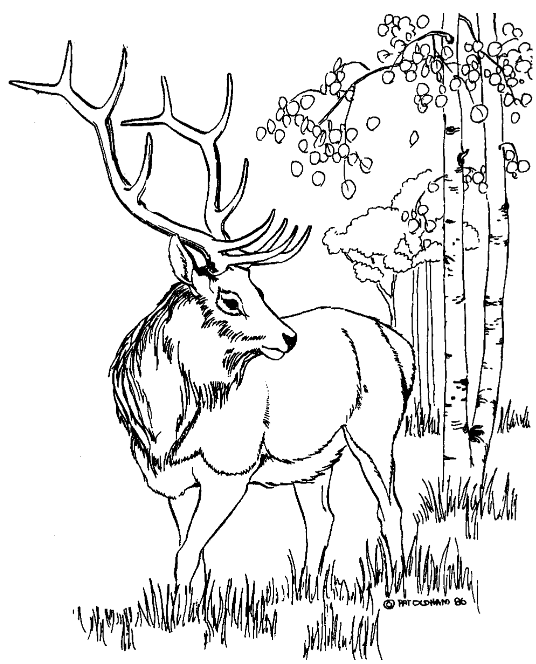
Black Bear

Art by Pat Oldham

Little Brown Bat

Art by Pat Oldham

Elk



Art by Pat Oldham

Mule Deer
Odocoileus hemionus

The mule deer gets its name from its large mule-like ears. It has a large, white rump patch surround-ing a small, black-tipped tail (it's also called a black-tailed deer). A mule deer is dark gray in winter and reddish brown in summer. It runs with a stiff-legged gait in which all four feet leave the ground and land in unison. Mule deer habitat is mostly in the western half of North America. A mule deer is a browser and likes to eat around dawn or dusk. Its diet consists of plants and berries in the summer and cedar and aspen, as well as acorns and apples in the winter.

Black Bear
Ursus americanus

The black bear is New Mexico's state animal. It is a creature of remote wooded areas. Despite its name, the black bear comes in many colors, from white to black. A western black bear will likely be brown rather than black. It will eat almost anything, from nuts berries, roots, carrion, fish and other animals. About 70% of its diet is plants. Bear cubs stay with their mother for about two years and are born in dens in the winter. A black bear can run very quickly; up to 30-40 miles per hour for short distances.

Little Brown Bat
Myotis lucifugus

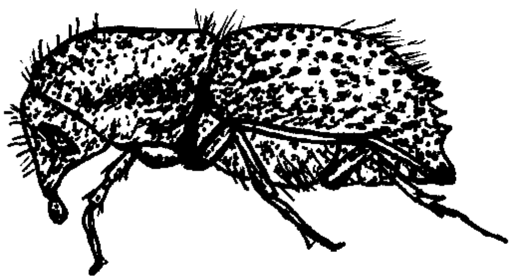
Little brown bats feed upon insects during the night hours. They catch and eat insects while flying by scooping them up with its wing tips and directing the bug to its mouth. A mother can fly and hunt with her pups on board. Bats find both their food and their way by using echolocation. They send out high frequency squeaks and hear the echo bounce back from obstacles. In winter, little brown bats must hibernate in caves, mines or buildings. Bats are the only true flying mammals. Bats make up one fourth of all mammal species. Bats often live over 10 years.

Elk
Cervus elaphus

An elk is a large member of the deer family. It can weigh up to 1000 pounds. It lives in high forests or semi-open woodlands in the summer and migrates to lower elevations in the winter. In the fall in the high country, elk make a loud, whistling 'bugle' call during courtship. An elk feeds mostly on grass but also eats shrubs and plants. A male elk (bull) has antlers which are made of bone and can grow to five feet in length. In early spring, they snap off to the surprise of the bull. Antlers grow back at a fast rate, as much as an inch a day.

Flora and Fauna's Cafe

Ips Beetle

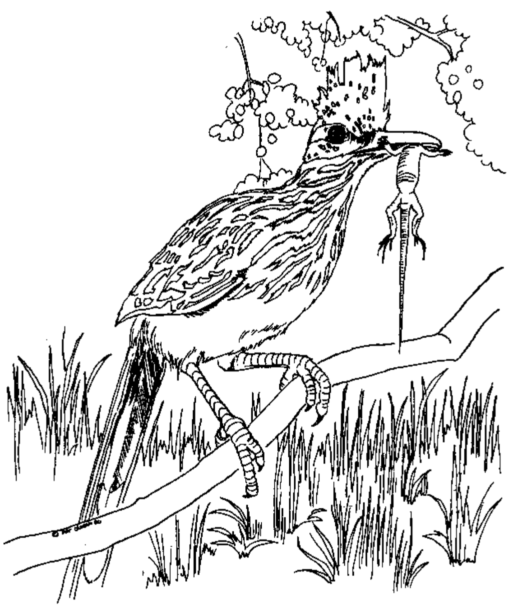


Art by Cindy Nee

Ringtail

Art by Pat Oldham

Roadrunner



Art by Pat Oldham

Collared Lizard

Art by Pat Oldham

Ips (Engraver) Beetle
Ips confusus

Also called the ‘pinyon engraver beetle’, these bugs are 1/8-1/4 inch long and reddish-brown to black. They have a pronounced cavity on the rear end that is lined with 3-6 pairs of tooth-like spines. Larvae are small, legless grubs that are white to dirty gray with dark heads. The larvae develop under the bark of the piñon and produce girdling tunnels that can kill trees. From egg to adult takes 21 to 40 days in summer and several months in winter. The beetles are dormant from November to March. There are two-five generations per year.

Ringtail
Bassariscus astutus

The ringtail is a member of the raccoon family. With its large ears and eyes, it moves by night and pounces on small mammals and birds for its food. It is easily identified by its beautiful black and white ringed tail, which is usually longer that the head and body. It makes dens in caves, crevices, and burrows, as well as rock piles and brush piles, hollows in trees and buildings. It is an excellent climber and travels up and down rock faces with ease. Its hind feet are able to rotate at least 180 degrees, which helps in going up and down steep surfaces.

Roadrunner
Geococcyx californianus

The roadrunner is the New Mexico state bird and it is a member of the Cuckoo family. It lives in open country, suburban areas and parklands and is often seen running very fast (It can zip along at 15 miles per hour) across the road. Although not built for long flights, it can fly short distances. A road- runner eats snakes, lizards, insects, scorpions, tarantulas, eggs and young of other birds. Pairs of road runners live on their territory year round. On cold mornings, they can sometimes be seen standing still warming their bodies with their backs to the sun.

Collared Lizard
Crotaphytus collarisi

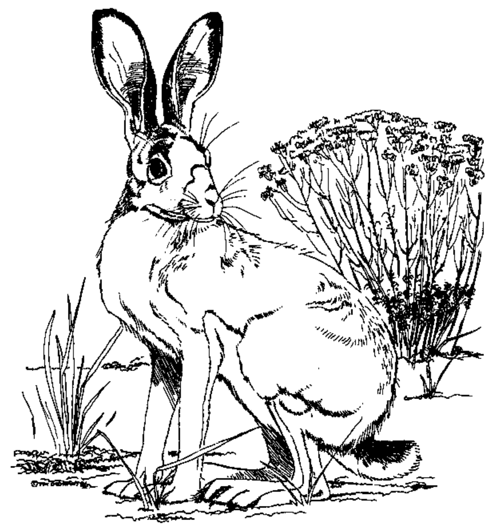
Also called the mountain boomer or lagartija de collar, the adult collared lizard is about 10 inches long, has a large head and two black collars around the neck. The body can be tan, green, olive, brown, bluish or yellowish. The lizard is widespread and can be found in rocky areas, including piñon-juniper, sagebrush, desert scrub and desert grassland. It can run swiftly on its hind legs, with its body held off the ground. It commonly eats grasshoppers, as well as other insects and lizards. It will dive into rocky crevices to avoid predators, such as hawks and roadrunners.

Flora and Fauna's Cafe

Coyote

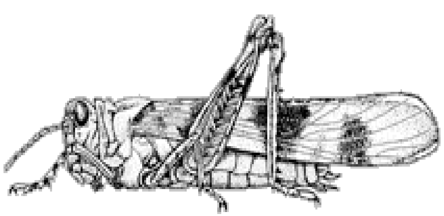
Art by Pat Oldham

Black-Tailed Jack Rabbit



Art by Pat Oldham

Grasshoppers



Band-winged Grasshopper

Ebony Grasshopper
(art by Cindy Nee)

Swift/Kit Foxes

Art by Pat Oldham

Coyote
Canis latrans

These members of the 'dog family' are found throughout the US. Coyotes are almost two feet tall and between 41 to 53 three inches long, and weigh between 20 to 50 pounds. They have bushy tails tipped with black. Most are grey. In some areas, coyotes form extended family groups with brothers and sisters taking care of the pups. They are very adaptable and will eat rabbits, mice, fawns, berries, insects, fruit, domestic cats and dogs, carrion and occasionally livestock. At dawn and twilight, you may hear coyote howls, barks and yelps in a chorus.

Black-tailed Jack Rabbit
Lepus californicus

A black-tailed jack rabbit is not really a rabbit. It's a hare. A hare is larger than a rabbit, doesn't use a den or a burrow and has young that can move about very quickly after birth. The black-tailed jack rabbit has very long ears, and a tail tipped with black. In very hot weather it sends more blood flow to into the ears to carry heat away from its body. The black-tailed jack rabbit gets most or all of its water directly from the bark, buds and grasses that it eats. It can jump 6 feet straight up in to the air and up to 20 feet horizontally. It can run 45 miles per hour.

Grasshoppers
Trimerotropis palliddipennis and
Boopedon nubilum

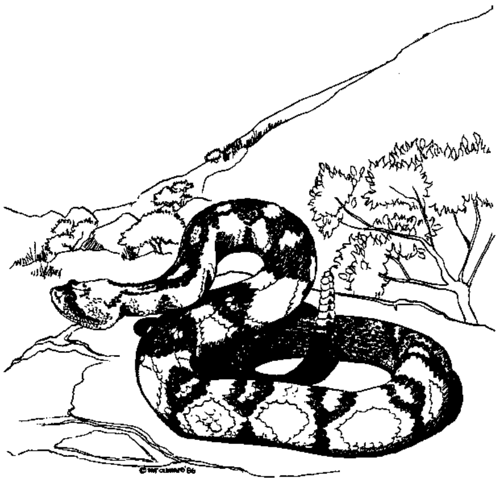
Grasshoppers are herbivorous and they have large hind legs for jumping. Their predators are birds, rodents and other insects. Navajos observed that grasshopper out-breaks often were associated with drought and that the females laid their eggs in the soil. A common New Mexico grasshopper is the "pallid-winged" or "desert band grasshopper" because the males are black and the females are usually green or brown.-winged grasshopper." Another one is the ebony grasshopper, also called "black-males

Swift/Kit Foxes
Vulpes velox

These foxes are very closely related. The swift fox generally lives in the western part of the state and the kit fox lives in the eastern part. Their diet includes rabbits, hares, rodents, birds, lizards and insects. Their dens can have up to 25 entrances and separate chambers for sleeping and storing food. These foxes play an important role as predators on small mammals and many rodents, insects and reptiles use their dens for shelter. Coyotes and eagles are the main predators of these foxes.

Flora and Fauna’s Cafe

Blacktail Rattlesnake



Art by Pat Oldham

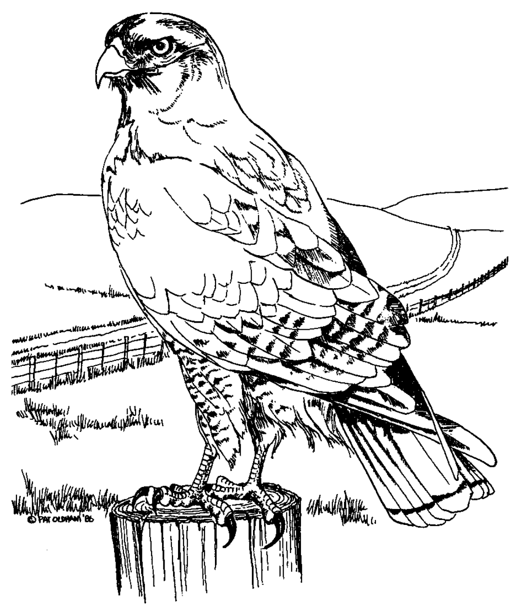
Bald Eagle

Art by Pat Oldham

Deer Mouse

Art by Cindy Nee

Red-Tailed Hawk



Art by Pat Oldham

Blacktail Rattlesnake
Crotalus molossus

The blacktail rattlesnake is one of seven rattlesnake species found in New Mexico. Some people consider it to be the most beautiful of the rattlesnakes. It has background colors of gray, olive, or greenish yellow and a sold black tail. It can grow up to 4 ½ feet long. This rattlesnake is found in a variety of habitats but it prefers lower rocky areas of mountain foothills. Although it is not a very aggressive rattlesnake, it is venomous so it is best to leave it alone. It moves about during the day and night, eating mice and other small mammals.

Bald Eagle
Haliaeetus leucoephalus

The bald eagle is our national bird. It was once endangered, but it is being recovered in New Mexico and the US. Only an adult bird has the striking white head and tail. Bald eagles can be found near rivers and lakes, perching in tall trees that provide lookout sights for prey. They feed on fish, as well as on carrion, waterfowl and jackrabbits. Both parents bring food to the nest, tearing it into small pieces and feeding it directly to the young. Primary threats include loss of wintering habitat, poisoning, shooting, and electrical power lines.

Deer Mouse
Peromyscus maniculatus

Deer mice are found from deserts to grasslands to mountains. They are the most widespread of all North American rodents. Deer mice have a two-toned tail that is dark on top and white below and white feet. The mice are 6 to 8 inches from tip to tail. They are nocturnal and feed on seeds and berries. Their nests can often be found in trees or stumps, and the mice reproduce very rapidly. Deer mice are an important food for many small carnivores, raptors and snakes.

Red-tailed Hawk
Buteo jamaicensis

This large hawk with a reddish brown tail is commonly seen in open country along roads, perching on telephone poles and fence posts. It feeds mainly on mice, rabbits, insects and snakes. The red-tailed hawk nests in trees on cliffs. Males court mates by soaring and making high-pitched cries. Males bring most of the food to the young and the mother tears it in to small pieces for them until they are 4 to 5 weeks old. Like all hawks and owls, red-tailed hawks are completely protected by law from hunting or harassment.

Flora and Fauna's Cafe

Black-tailed Prairie Dog	Western Spotted Skunk
 Art by Pat Oldham	 Art by Pat Oldham
Yucca Moth	**Burrowing Owl**
 Art by Cindy Nee	 Art by Pat Oldham

Black-tailed Prairie Dog
Cynomys ludovicianus

Some scientists believe black-tailed prairie dogs have the most complex social structure of any North American rodent. These heavy-set ground squirrels average 16 inches from tip to tail. They eat grasses, roots, weeds, forbs and blossoms. They are an important keystone species because of their place in the food chain. Many larger birds and mammals hunt them. There has been a tremendous decline in their numbers due to extermination and habitat loss. Their towns once covered thousands of miles. A Texas town reportedly once had almost 400 million prairie dogs.

Western Spotted Skunk
Spilogale gracilis

The western spotted skunk is very small. It is about the size of a half-grown housecat. No two skunks have the exact same pattern of black and white markings. The skunk keeps enemies away by doing a “handstand” on its front paws and spraying intruders as far as 10 feet away with bad-smelling musk. The skunk prefers rocky bluffs and brushy canyon stream beds. It is active only at night, feeding on bird eggs, young rabbits, mice, voles, roots, fruits, berries, grasshoppers and scorpions. The female has a litter of 2-5 kits that are born in April or May.

Yucca Moth
Tegeticula yuccasetla

The yucca moth is found in yucca plants all over North America. In the way that honeybees and flowers need each other, so do yuccas and yucca moths. Female moths use their antennae to inspect flowers for the scents of previous female visitors. The moths have only a few days to deposit about one hundred eggs. They fly around, scattering their eggs onto various yucca flowers. In the process, they pollinate those flowers. Larvae and caterpillars eat the flower seeds. Yucca plants depend on this moth for existence because the moths are the only pollinator of this plant.

Burrowing Owl
Athene cunicularia hypugaea

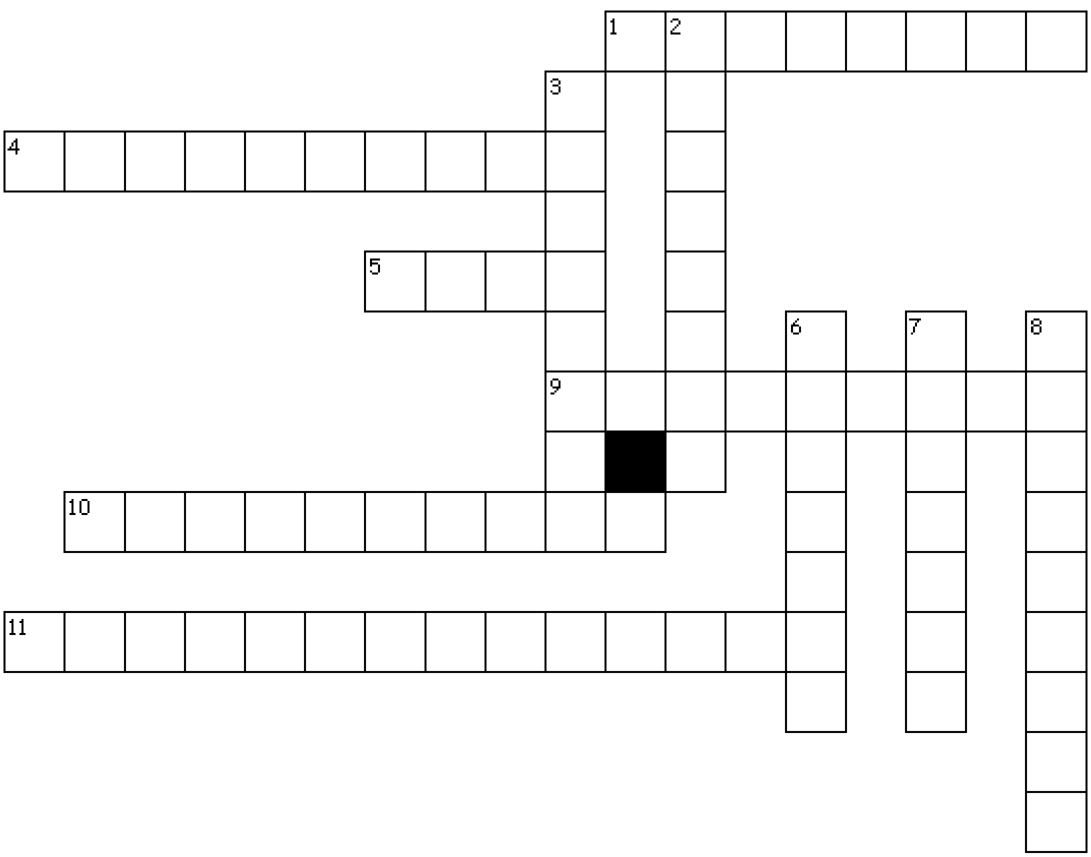
Cowboys called burrowing owls “howdy owls” because they appeared to nod hello from their burrows in prairie dog towns. The owls are 8 to 11 inches tall, with long, bare legs, brown and white bodies and short tails. Active by day and night, they eat arthropods, small mammals, reptiles and amphibians. Their habitat is open grasslands, prairies, farmlands and air fields. Burrowing owls use old burrows dug by prairie dogs, kangaroo rats, ground squirrels or badgers. In urban areas they frequently use golf courses, vacant lots and industrial sites.

Flora & Fauna's Cafe Crossword Puzzle

Name ______________________________________ Date _________________________

Across
1. animals that eat plants and other animals
4. organisms that feed on the dead bodies of other organisms
5. chain transfer of energy from the source in plants through a series of animals
9. secondary or higher consumer in a food chain that eats other animals
10. animals that eat dead animals
11. the branch of science that deals with the conversion of one form of energy to another

Down
2. an animal which eats both plant and animal materials
3. an organism such as a plant that makes its own food
6. the total dry weight of all the organisms at a given level
7. an interconnected pattern of food chains
8. an animal that feeds chiefly on plants



Flora & Fauna’s Cafe Crossword Puzzle

Solutions:

Across

1. Consumer
4. Decomposer
5. Food
9. Carnivore
10. Scavengers
11. Thermodynamics

Down

2. Omnivore
3. Producer
6. Biomass
7. Food web
8. Herbivore

Food Chains and Webs

Riparian Food Web

Objective
Students will identify and role play the components of a riparian food web

Key Words
1. *Aquatic* – a plant or animal that lives or grows in water
2. *Consumers* – animals that must eat plants and/or other animals
3. *Ecosystem* - all the living things living and growing in a geographical area and the physical environment of the organisms
4. *Food chain* – transfer of energy from plants through a series of animals, with repeated eating and being eaten; a system of food chains is a food web
5. Habitat – the place where an organism lives and grows
6. *Producers* –organisms such as a plant that makes its own food
7. *Riparian* – habitat along or near the bank of a body of water

Background
Ecosystems use energy and raw materials. The energy is usually sunlight, which plants use to make food. The raw materials are water, air and nutrients. Food chains are a primary part of ecosystems. The levels in a good chain are producers (green plants), primary consumers (plant-eaters and meat-eaters) and secondary consumers (animals that eat both plants and meat and meat-eaters).

The presence and amount of water determines the type of ecosystem and the kinds of plants and animals that are found there. A dry, arid environment will have animals like lizards, horned toads and pocket mice. A moist environment will have very different plants and animals, and generally there will be a lot more ot them. Fish, frogs, crawfish, ducks and other aquatic animals survive in a riparian environment because there is abundant water. The same is true for plants.

Advance Preparation
Before beginning the game, explain the basic principles and importance of a food chain. Then, explain the rules of the game and assign students to play the different species.

Materials
Large box of breakfast cereal
Cloth strips of three different colors for headbands
1 sandwich bag per student

Part 1. - Demonstration
This is an outdoor game of tag that shows how food chains work in nature. The object of the game is to feed without getting eaten.
1. Spread the cereal over an area of 60 feet by 60 feet. It will represent the aquatic plants.

2. Appoint 10 crawfish, 5 sandpipers, and 2 owls to demonstrate how the game is played.

3. Hand out different colors of cloth for headbands for each species.

4. Have crawfish simulate feeding by picking up aquatic plants (cereal) and putting them into their bags. In the game, sandpipers can only feed on crawfish and owls only on sandpipers.

When a sandpiper catches (tags) a crawfish, that player is out of the game and transfers his/her cereal to the sandpiper's bag. When an owl catches a sandpiper the same procedure is followed.

5. Have demonstrators play until all of the students in one of the consumer groups have been captured. This should only take a few minutes.

6. Next, have the survivors check if they have food in their bags. If not, they have died. Ask the students if this represents a balance of nature. Why or why not? In a balanced community, there are more plants (producers) than plant eaters (primary consumers) than animal eaters (secondary consumers).

<u>Part 2.</u>

1. To begin the game with the entire class, return the cereal to the field.

2. Assign students their roles (Great Horned owls, Western sandpipers, and crawfish) and give them their headbands. There should be about twice as many sandpipers as owls and twice as many crawfish as sandpipers.

3. Release the crawfish first. Wait about a minute before releasing the sandpipers and then the owls. Allow the game to run for a few minutes, but stop playing before any of the groups of consumers is completely captured.

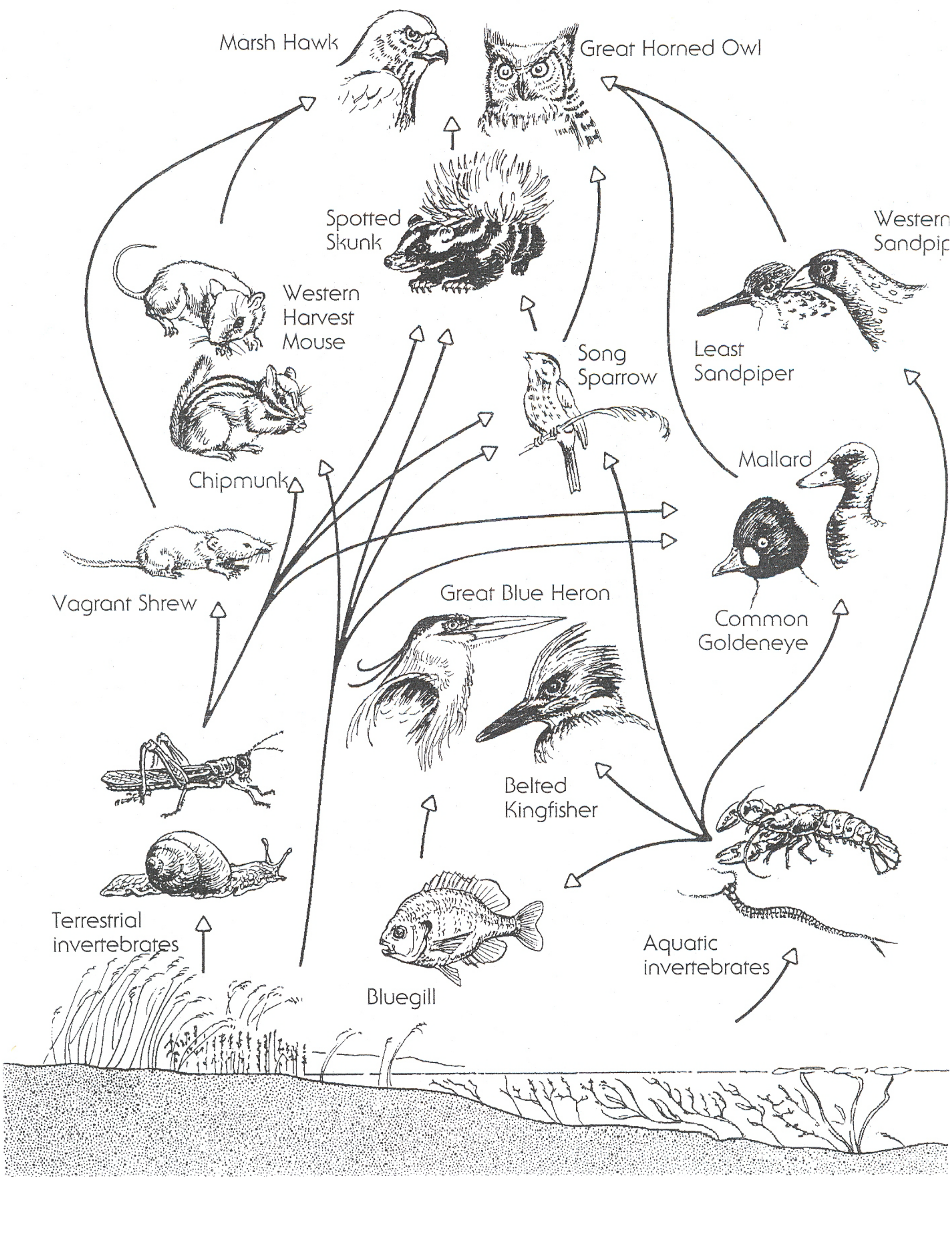
4. Divide the class into survivors and non-survivors. The students who were captured or collected no food are the non-survivors, and those who have food are the survivors.

5. After playing the game, ask students the following questions:
   - A. How many owls, sandpipers, and crawfish survived? Is this a balanced community? Why or why not?
   - B. What would happen if there were not enough aquatic plants?
   - C. In nature, if the crawfish did not survive, what would happen to the aquatic plants?
   - D. If the sandpipers all died, what would happen to the aquatic plants and the owls?
   - E. Do owls need aquatic plants? Why or why not?

New Mexico Science Standards
Grade 4, II, II, I, 4
Grade 5, II, II, I, 3
Grade 7, II, I, I, 1-2; and II, I, II, I
Grades 7 and 8, II, II, I, 3
Grades 9-12, II, II, I, 2, 6

Source: Adapted from "Nature Café", *Arid Lands, Sacred Waters* Student Activity Packet, New Mexico Museum of Natural History, US Geological Survey and USDA Forest Service

RIPARIAN FOOD WEB



Food Chains and Webs

A Desert Food Chain

Objectives
Students will:
1. Identify the components of a desert food chain and
2. Understand the importance of these chains in maintaining the balance of nature

Key Words
1. *Carnivore* – secondary or higher consumer in a food chain that eats other animals
2. *Consumer* – animals that must eat plants and/or other animals
3. *Decomposer* – organisms that feed on the dead bodies of other organisms, breaking them down into simpler substances
4. *Energy* – a source of power that causes something to happen, such as sunlight used by plants to grow and reproduce.
5. *Food chain* – transfer of energy from the source in plants through a series of animals, with repeated eating and being eaten
6. *Food web* – an interconnected pattern of food chains
7. *Herbivore* – an animal that feeds chiefly on plants
8. *Omnivore* – an animal which eats both plant and animal materials
9. *Photosynthesis* – the process of using the sun's energy to turn carbon dioxide and water into sugar
10. *Producer* – an organism such as a plant that makes its own food
11. *Scavenger* – a variety of species, ranging from earthworms, which feed on dead and decaying plant tissue

Background
See article: *The Desert Food Chain*

Materials
Copies of *The Desert Food Chain* article
Information about desert animals (field guides, websites such as www.desertusa.com etc.)

Instructions
1. Read background information to students or together with students.
2. Explain to students that they will be illustrating a desert food chain. To do this, they will need to do research on desert animals.
3. Have students decide which plants (producers) and animals (consumers) that they will include in their illustrations.
4. Have students include labels and/or captions in their food chain illustrations.

New Mexico Science Standards
Grade 4, II, II, I, 4
Grade 5, II, II, I, 3
Grade 7, II, I, I, 1-2; and II, I, II, I
Grades 7 and 8, II, II, I, 3
Grades 9-12, II, II, I, 2, 6

The Desert Food Chain

By Jay W. Sharp

In this article aimed at explaining the desert food chain, we invite you to explore with us the pathway that energy, beginning with sunlight, follows as it flows through communities of plants and animals that make up food chains.

In principal, the food chains of our Southwestern deserts function just like the food chains of forests, grassy plains, swamplands or any other biologically distinctive region.

“Food chain,” as you may know, is the term biological scientists use to describe the sequence of living organisms through which energy passes as it fuels the life of a community of plants and animals. A food chain always begins with the plants, called “producers.” It always ends with the animals, called “consumers.”

Energy

Energy – the capacity for causing something to happen – is used by plants to grow and reproduce. It is used by animals to grow, reproduce and move. It is used by you to grow, run, swim or study.

You can think of energy as existing in two basic states. One is “potential” energy, or energy that is stored, like a savings account, available for spending. Potential energy is stored, for example, in a battery, an apple or an automobile gasoline. The second state is “kinetic” energy, or energy that is being spent to cause something to happen, like growth, reproduction or movement.

You can also think of energy as existing in various forms. For instance, you use chemical energy when you employ a battery to operate your camera, cell phone or electronic game. You use mechanical energy when you peddle your bike. You use electrical energy when you turn on your desk lamp. You use heat energy when you toast your bagel. Your body uses solar energy, or sunlight, to make Vitamin D, a nutrient essential for good health.


Prickly pear with waxy coating that slows evaporation and saves water.

Energy and the Food Chain

Energy – essential for the growth of all organisms, the processes of life and the actions of the animals – enters the food chain through the plants, in the form of light from the sun.

Almost magically, it seems, the solar energy is combined, by the plants, with water and carbon dioxide to create “glucose,” a form of sugar used in reproduction and growth. The process, performed by all plants from the smallest to the largest, is called “photosynthesis,” a word that means “gathering of light.” Plants, the producers, are the first link in the food chain.

Energy begins to flow through the food chain when plant tissue is consumed by animals, for instance, insects such as weevils, reptiles such as turtles, birds such as pigeons, or mammals such as rabbits and deer. Animals that eat only plants are called “herbivores.” They are, obviously, the second link in the food chain.

Energy moves another link through the food chain when herbivores' flesh is consumed by animals such as spiders, snakes, goshawks or shrews. Animals that eat only other animals' flesh are called "carnivores." They are the third link in the food chain.

Energy moves still another link with carnivores that eat other carnivores. These include, for instance, spider wasps, which may hunt tarantulas; snakes, which may eat other snakes; eagles, which may eat goshawks; and gray foxes, which may eat shrews. These carnivores are a fourth link in the food chain.

Ladybird Beetle, feeding on plant-eating insects such as aphids, is a third link in the food chain.

Energy moves in more diverse ways with animals that eat both plants and other animals. These include, for example, earwigs, which eat flowers and flies; collard lizards, which eat various fruits and insects; Gila Woodpeckers, which eat fruits and insects; and coyotes, which eat fruits and small animals. These animals, called "omnivores," can be a second, third or fourth link in the food chain!

Energy moves in yet another direction with animals that feed on dead and decaying organisms. These animals, called "scavengers," include a variety of species, ranging from earthworms, which feed on dead and decaying plant tissue, to Turkey Vultures, which eat dead and decaying animal carcasses.

Energy moves through the final link in the food chain with microscopic animals called "decomposers," which feed on any remaining dead plant and animal tissue and animal waste. With time, these tiny organisms – fungi and bacteria – break down decaying organic matter, converting it into carbon dioxide and water—making them available for plants to use in the process of photosynthesis, making it possible for the cycle of energy to move through a living community all over again.

As you might imagine, energy follows very complex and constantly changing routes through the food chains because communities of plants and animals may consist of tens of thousands of species that change constantly with the seasons and the years. Indeed, you can visualize the process as an interlocking web of food chains.

Our Fragile Deserts

You may think that our Southwestern deserts, with their heat, spiny plants, venomous animals and rocky soils seem hostile and indestructible, but in fact, they rank among the most fragile of all the environments on earth. They produce only a small fraction of the total plant and animal tissue produced by a dense rainy warm forest of comparable size. They support perhaps tens of thousands of species of plants and animals, including the microscopic-sized species. That compares with the hundreds of thousands or perhaps millions of species supported by the dense forest. In a hard world with limited resources, the plants and animals of the desert often find it difficult to rebuild their communities after a major change.

Desert thunderstorm bringing welcome rainfall.

Note: My thanks to Leslie Bergloff, a former teacher and the present New Mexico Farm & Ranch Heritage Museum Education Coordinator for her helpful comments in preparing this article.

Source: With permission from *DesertUSA* http://www.desertusa.com/food_chain_k12/kids_1.html

Food Chains and Webs

New Mexico Food Web

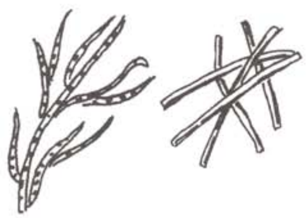
A system made up of many food chains is called a "Food Web." Producers, consumers and decomposers make up links in a food web. Each link is important. If one link is removed, the entire web is affected.

PRODUCERS (MAKERS)

Producers are green plants. Green plants make their own food from sunlight. Plants then release oxygen into the air, which helps animals breathe. In the food web, producers are the first link upon which all others depend.

1. PRODUCERS (MAKERS)

3. DECOMPOSERS (BREAKERS)



2. CONSUMERS (TAKERS)

CARNIVORES

HERBIVORES

OMNIVORES

SCAVENGERS

CONSUMERS (TAKERS)

Consumers cannot make their own food, so they must eat. Different kinds of consumers in the food web include: herbivores (plant eaters), carnivores (animal eaters), omnivores (plant & animal eaters) and scavengers (dead eaters).

HERBIVORES

These animals eat only plants. Examples include deer, rabbits, grasshoppers, mice and beavers.

CARNIVORES

These animals are predators. They eat other animals. Some examples include snakes, cougars, falcons, spiders and some beetles.

OMINVORES

These animals eat both plants and animals. Examples include people and bears.

SCAVENGERS

This "clean up crew" keeps nature free of rotting carcasses that may spread disease. Crawdads, flies and vultures are scavengers.

DECOMPOSERS (BREAKERS)

Bacteria, fungi, some insects and worms help decompose dead plants and animals. By eating dead stuff, they return nutrients to the soil. Without decomposers, plants couldn't grow and consumers would have nothing to eat.

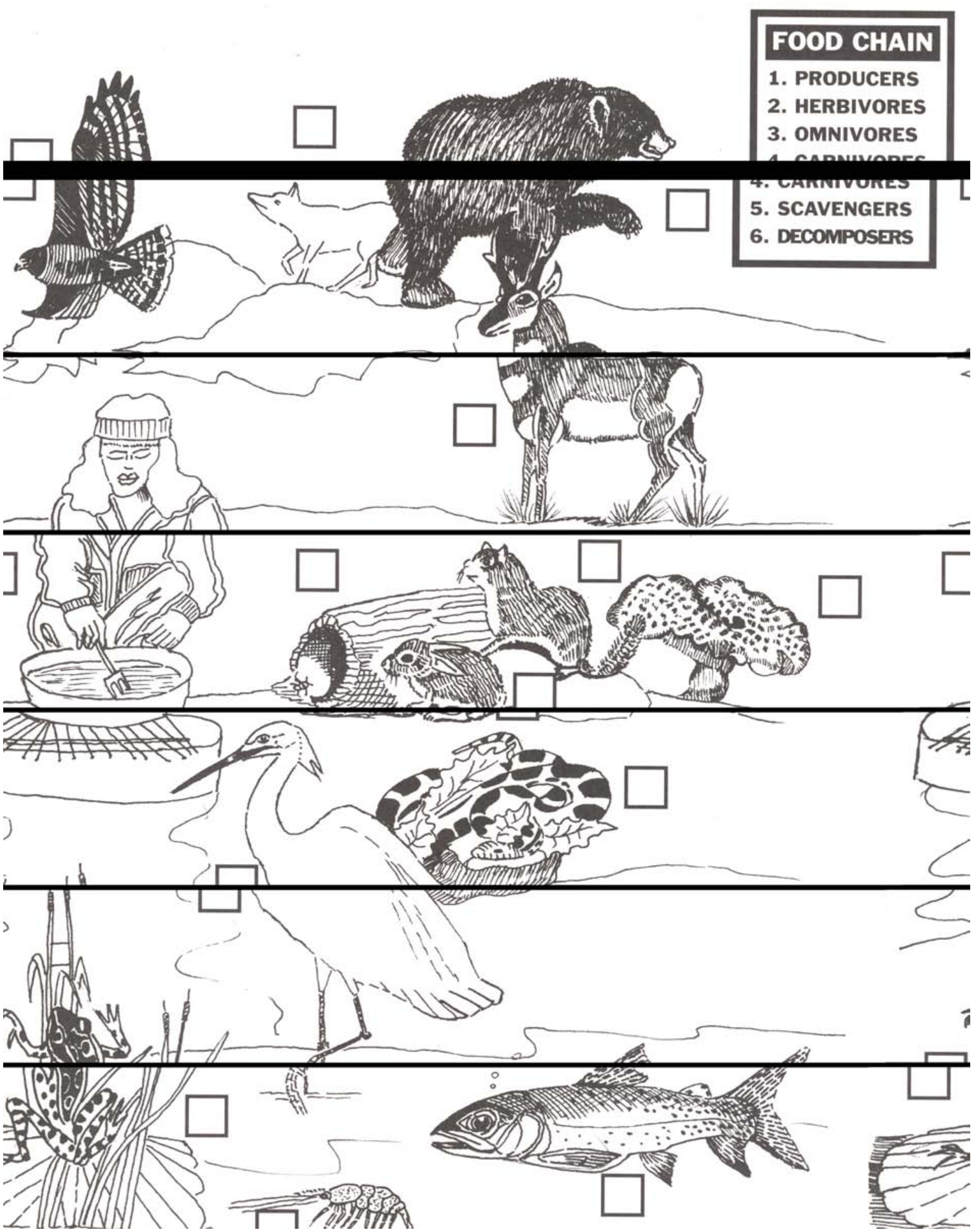
New Mexico Standards
Grade 4, II, II, I, 4
Grade 5, II, II, I, 3
Grade 7, II, I, I, 1-2; and II, I, II, I
Grades 7 and 8, II, II, I, 3

Source: From "Food Web", *Junior Rangers Activity Book*, New Mexico State Parks, New Mexico Energy, Minerals and Natural Resources Department

New Mexico Food Web Worksheet

Name ______________________________________ Date ________________________

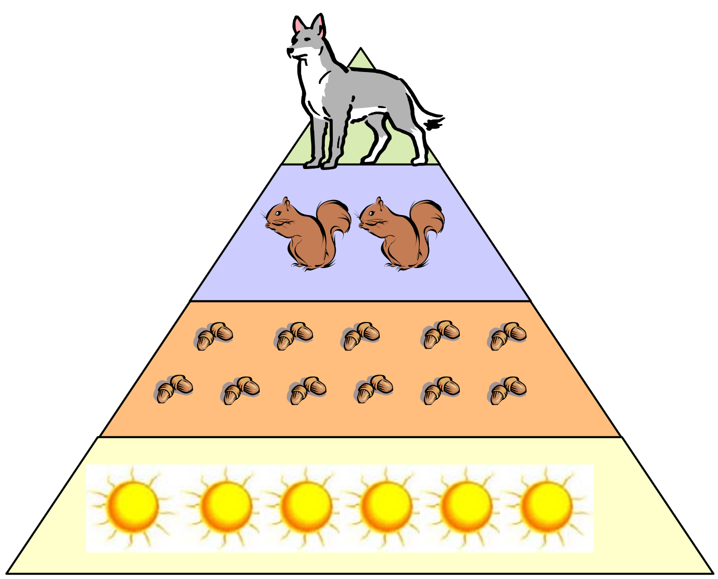
Choose a number from the Food Chain box that identifies the role in the food chain of each creature below. Write that number in the box beside the creature and then color the pictures.



Pyramids

Energy Pyramids

An energy pyramid provides a way to describe the feeding and energy relationships within a food chain or web. Each level of an energy pyramid shows that some energy is stored in newly made structures of the organism which eats the previous one. The pyramid also shows that much of the energy is lost when one organism in a food chain eats another. Most of this energy which is lost goes into the environment as heat energy.   Although a continuous supply of energy from sunlight keeps the process going, this loss of energy determines the end of a food chain.



The Arithmetic of the Food Chain

By Jay W. Sharp

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Believe it or not, arithmetic plays an essential part in understanding the relationships among the levels of the organisms of the food chains of the desert and, for that matter, of the earth itself.

Links and Energy Flow of the Food Chain

We have described a food chain as a sequence of living organisms through which energy passes as the driving force in the life of a community of plants and animals. A food chain always begins with the plants, called “producers.” It always ends with the animals, called “consumers.”

In the process called “photosynthesis,” the plants capture energy from the sun and combine with it water and carbon dioxide to create “glucose,” a form of sugar required for reproduction and growth among the organisms. Plants are the first link in the food chain. The herbivores – animals that eat plant tissue – are the second link. Carnivores – animals that eat other animals – are a third link. Omnivores – animals that eat both plants and animals – can be both second and third links. Scavengers eat dead and decaying organisms. Decomposers – bacteria and fungi – feed on any remaining dead plant and animal tissue and animal waste. They break down the decaying organic matter. They convert it into carbon dioxide and water, making those compounds available to the plants for photosynthesis and beginning anew the cycle of life. You can think of the organic matter that flows through the food chain link by link as blocks of energy used to fuel reproduction, growth and movement and waste production. As it passes through the food chain, much of the energy dissipates into the environment and, ultimately, into space in the form of heat.

The Arithmetic of Energy Flow Through the Food Chain

The plants use only about one percent of the total solar energy that strikes the earth to create living matter through photosynthesis. That means that for every 100,000 units (that is, any increment of measurement) of solar energy available, the plants use only 1000 units.

A legendary small herbivore, the Prairie Dog, which living in vast colonies as favored prey for many carnivores until the 20th century.

The animals in each succeeding link of the food chain convert only about 10 percent of the energy available to them as food into living matter. For example, if herbivores ate 1000 units of energy in the form of plant tissue, they would convert only 100 units into in the form of animal tissue and bone. They spend the other 900 units in the form of waste or dissipated heat. Similarly, if carnivores ate 100 units of energy in the form of herbivore tissue and bone, they would convert only 10 units into new energy in the form of tissue and bone, spending the remainder as waste and heat. If a Golden Eagle ate 10 units of units in the form of another carnivore, it would convert only one unit into energy in the form of eagle tissue and bone.

This means that at least 1000 units of plant tissue energy would be required to support a single unit of carnivore-eating eagle flesh and blood energy, even though the plants are not eaten directly by the eagle. If you think of the links of the food chain as a pyramid, plants would form the base and eagles and other carnivores would form the tip.

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continued …

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The Relative Abundances of Organisms Within the Food Chain
The percentage of solar energy converted into living matter by plants during photosynthesis sets a limit on the total living matter – or "biomass" – on the earth. The percentage of food, or stored energy, that animals can convert into living matter, or newly stored energy, sets broad limits on the biomass at each link of food chain or level of the food pyramid.


The Red-Tailed Hawk, a predator that feasted on ground-dwelling animals, including Prairie Dogs before they were essentially wiped out.

The total biomass on earth equals – according to the Southwest Renewable Energy Agency's Internet site – more than a trillion tons of dry (that is, water-free) organic matter. The plants – the producers – account for well over 90 percent of the earth's biomass. The animals – the consumers – account for most of the remainder. (Bacteria, fungi, protozoa, algae and other life forms make up relatively small percentages of the biomass and the species population.)

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The more complex organisms make up a very small percentage of the earth's biomass. For instance, the earth's human population, with some six and one-half billion individuals, accounts for only a small fraction of one percent of the earth's total biomass. Small, more simple organisms make up a much larger percentage of the biomass. Microbes – ancient microscopic plant and animal organisms that live even in the earth's most extreme environments, including, for instance, the earth's poles, its geysers, its deepest sea floors and its subsea floor structure – may account for as much as 50 percent of earth's biomass.

How small is a microbe? Well, as Hilaire Belloc said in his book *More Beasts for Worse Children:*

The microbe is so very small
You cannot make him out at all,
But many sanguine [optimistic] people hope
To seem him through a microscope

- continued -

continued …

How many microbes are there on earth? The answer is, “an awful lot.” One scientist, Martin Fisk, of Oregon State University, estimates that “there are about 28,000,000,000 microbes in [a single] ounce of mud” on the ocean floor.

All these have never yet been seen –
But Scientists, who ought to know,
Assure us that it must be so...

Relative Abundances of Organisms in Different Environments
Our Southwestern deserts, compared with, say, an equatorial rain forest, seem like biological wastelands, primarily because the productivity and diversity of our food chains is more constrained by the harsh environmental conditions.

In an average year, our deserts receive only a few inches of rain, which fall in a random pattern. We experience evaporation rates that exceed rainfall rates by ten times or more. We have seasons when plants bloom and grow and seasons when, effectively, they sleep. Our daily air temperatures range from mild to blistering hot in the summer and cold to moderate in the winter. Desert soils contain little organic matter, or nutrients. In fact, soils in dry desert lake beds may contain concentrations of minerals, for instance, alkali salts, that are poisonous to most plants.

By comparison, in an average year, a tropical rain forest may receive as much as 20 to 30 feet! of rainfall, which fall more or less uniformly across the region. Water lost to evaporation returns rapidly in the form of rainfall. Located near the equator, rain forests have a never-ending growing season. Air temperatures range from the high 60’s to the low 90’s (in degrees Fahrenheit) throughout the year. Although the rain forest soils contain relatively little organic matter, nutrients from organic matter are freed rapidly by decomposers, allowing it to return to the food chain almost immediately. Additionally, rain forest soils are basically free of harmful minerals.

Because of the differences, the total organic matter, or biomass, produced by the food chains of our Southwestern deserts amounts to no more than a small fraction of that produced in comparably sized tropical rainforests. Moreover, the different species of wild plants and animals supported by our Southwestern deserts are measured in the tens of thousands. The different species supported by the rain forest might number in hundreds of thousands or even millions.

Our desert food chains, with their many spiny plants and venomous animals may appear to be hostile and indestructible, but they are, in fact, among the most fragile on the earth. Given their relatively low productivity and limited diversity in the desert environment, they lack biological and environmental resources to repair themselves when links are damaged or broken.

Already, food chains across the Southwest have been altered by overgrazing, land clearing, municipal and agricultural development, industrialization, road construction, recreational use, human water consumption and invasive plants and animals.

They will never recover.

Source: DesertUSA http://www.desertusa.com/food_chain_k12/kids_1.html

Ecological Pyramids

Objectives

Students will:

1. Understand the concepts of the Pyramid of Numbers and the Pyramid of Biomass
2. Examine and calculate the area of a topographic map
3. Understand how much land area is need to support life at each level of the food chain

Keywords

1. *Ecological pyramids* – graphical representations in pyramid form of the number of individuals in different food levels in an ecosystem
2. *Biomass* – the total dry weight of all the organisms at a given level.
3. *Habitat* – the place where a plant or animal lives; the place having food, water, shelter or cover and space suitable to an animal's needs.
4. *Pyramid of Biomass* – this pyramid shows the total weight (biomass) of organisms in feeding relationships in an ecosystem.
5. *Pyramid of Numbers* – this pyramid shows the feeding relationships in an ecosystem
6. *Topography* – the art of showing in detail on a map the physical features of a place or region

Materials

Ecological Pyramids Lab Sheets

Topographic maps

Source: U.S. Geological Survey 1-888-ASK-USGS or
http://education.usgs.gov/common/resources/mapcatalog/
http://education.usgs.gov/common/primary.htm#topographic

Advance Preparation

Talk about ecological pyramids with the students. The Pyramid of Numbers defines the feeding relationships in an ecosystem. For example, in this activity the Pyramid of Numbers would show how much plant material is needed to feed the number of deer that would be needed to feed one mountain lion. The Pyramid of Biomass would give the total weight of all the plant material that would be eaten by the deer, the total weight of the deer eaten by the mountain lion and, at the top, the weight of one mountain lion.

Instructions

1. Break the class into small groups with no more than four people per group.
2. Give each group their lab sheets and topographic maps.
3. Reading the assumptions aloud. Answer questions 1-3. Answers can be rounded.
4. Using the answer from problem #3 and the topographic map, determine how large an area the maps in each group encompasses.
5. Help students read the scale of the map to calculate the area. Once that is completed, answer questions 1 through 7.

New Mexico Science Standards:
Grade 7, II, I, I, 1-2; and II, I, II, I
Grades 7 and 8, II, II, I, 3
Grades 9-12, II, II, I, 2-6

Source: University of Pennsylvania, http://sftrc.cas.psu.edu/LessonPlans/Wildlife/EcologicalPyramids.html

LAB SHEET: Ecological Pyramids

Name: ______________________________ Date: ____________________________

The ecological pyramids of numbers, biomass and energy provide models for an ecologist to better understand the workings of an ecosystem. In the following exercise, you will have the opportunity to see the relationship between the Pyramid of Numbers and the Pyramid of Biomass. You will be able to apply this information to a real local habitat.

Materials
Topographic map

Assumptions
1. One mountain lion eats approximately 1,125 pounds of venison (deer) each year as well as numerous smaller animals. However, the mountain lion will eat only 50% of each deer that it kills.
2. One deer eats approximately 3,650 pounds of vegetation each year in the form of grasses, nuts and berries.
3. One square mile of deer habitat produces 760 pounds of deer food each year.

Problems
1. How many square miles of habitat are need to support one deer? ________________

2. How many deer are needed to feed one mountain lion for a year if each deers weighs an average of 150 pounds? ________________

3. How many square miles of lion-deer habitat are needed to support one mountain lion? ________________

Instructions
Use the topographic map to determine how large the area is that the map encompasses.
Use the answer from #3 above to determine how large an area of the map this would cover.

Questions
1. How large of an area does the map encompass? ___________________________

2. Does the area needed to support one mountain lion cover: (circle answer)

   a. only a small part of the map c. exactly the same size as the map
   b. half of the map d. an area larger than the map

3. What type of habitat does your area cover?

4. What percent of your habitat is forest? _____________ other? ______________

5. Are there areas of habitat that are not discontinuous (don’t have breaks or gaps)?

6. What effect does this discontinuous habitat have on the deer and mountain lions?

7. How tolerant are deer and mountain lions to human disturbance?

Pyramids

Living within Limits

Objectives
Students will understand the characteristics that make up an individual, a population, a community, and an ecosystem.

Key Words
1. *Community* - all populations of species living in an area
2. *Ecosystem* - an area that contains organisms plants, animals, bacteria interacting with one another and their non-living environment; an ecosystem can be of any size (for example a forest, a meadow, and a log are all ecosystems)
3. *Limiting factors* - resources, such as food, water, shelter, and nesting sites that are in short supply and restrict the population sizes of living organisms
4. *Population* - a group of individuals belonging to the same species

Background
Communities are made up of species that are linked through relationships with each other and the physical environment. Animals in every habitat must solve four important problems: 1) finding enough food and water for themselves, 2) making sure they don't become food for others, 3) finding a place to live and nest, and 4) finding a mate.

Communities and their physical environment make up ecosystems. An ecosystem is a community of interlocking parts, which act upon each other. An ecosystem contains a balanced mix of living things and non-living materials that interact. In every ecosystem there is a one-way flow of energy through living things and a cycling of nonliving materials. Plants and animals are parts of most ecosystems/ Plants use the sun's energy to produce food which, in turn, animals consume to get their energy. Most ecosystems have three nonliving parts: soil, water, and air.

By studying an ecosystem we can see how communities are influenced by their physical surroundings. At the same time, populations alter their physical environment. For example, beavers are physically adapted to the environment along the Rio Grande River, but they also change the environment by cutting down trees along the riverbanks and using the tree cuttings to create dams within the river.

Within each large ecosystem, smaller ecosystems can be found. For example, a decaying cottonwood tree along the river returns to the soil and recycles minerals in a series of processes. Fungi and bacteria permeate and then soften the bark. Insects, such as termites or beetles, attack the heartwood. In turn, animals feed on the insects. Waste materials from the animals are deposited on the ground providing a rich fertilizer for the soil.

Limiting factors control animal population sizes in a given area of habitat. They effect the balance of plants and animals that can survive in an area at one time. Only a certain number of animals and plants can thrive in a limited space -- when there are too many animals the resources are depleted and the animals and environment suffer. The numbers of predator and prey species are closely linked. Predators provide an important check on the population size of their prey and reduce the risk that the prey population will increase to the point that it will exceed the available food. Climate also helps determine the number and kinds of species and plants a given area can support.

Can human population be a limiting factor? The size of the human population affects virtually every environmental condition facing our planet. As human population grows, demands for resources increase; pollution and waste grow as well resulting in millions of plants and animals facing the threat of extinction.

Materials

Poster board
Colored pencils, markers, etc.
Southwest Nature guides or similar resources

Advance Preparation

1. Write four columns on the board with the headings: Individual, Population, Community, and Ecosystem. Define each of these.

2. Have students offer examples of the kinds of plants and animals that live in the desert Southwest. Ask students if they think that the area could support an unlimited number of species. What might limit the number of individual animals and the number of species? What happens to all the populations of plants and animals during the drought? Why are limiting factors are important to a habitat?

3. Discuss with the students the concept of an energy pyramid. Ecologists use an energy pyramid to show how energy flows in an ecological system. For example, more plants are needed to feed the mice that are needed to feed the snakes that are needed to feed one coyote. An energy pyramid shows the species of a habitat in their appropriate hierarchical levels (producer, consumer, etc.)

♦

coyote

snakes-snakes

mice-mice-mice-mice

plants-plants-plants-plants-plants

Instructions

1. Have students work in groups to create an Energy Pyramid poster. Have each group choose an ecosystem found in New Mexico and an individual species they'd like to chart through the relationships of individual, population, and community, ending with the ecosystem.

2. Give each team a poster board, colored pencils, and/or markers to use to make an Energy Pyramid. Or students can use pictures from magazines or printed from the Internet.

3. Have groups present their Energy Pyramids to their peers.

New Mexico Science Standards
Grades 5 and 6, II, II, I, 3
Grade 7, II, I, I, 1 and 2; II, I, II, 1
Grade 7, II, II, I, 5 and II, III, II, 3
Grades 9-12, II, II, I, 3

Source: Adapted from Parts to a Whole, Carlsbad Caverns National Park Ecology Curriculum for Middle School

Predator-Prey Relationships

A predator is an organism that eats another organism. The prey is the organism which the predator eats. Some examples of predator and prey are Mexican wolf and deer, bear and fish, and bobcat and rabbit. The words "predator" and "prey" are almost always used to mean only animals that eat animals, but the same concept also applies to plants: Bear and berry, rabbit and lettuce, grasshopper and leaf.

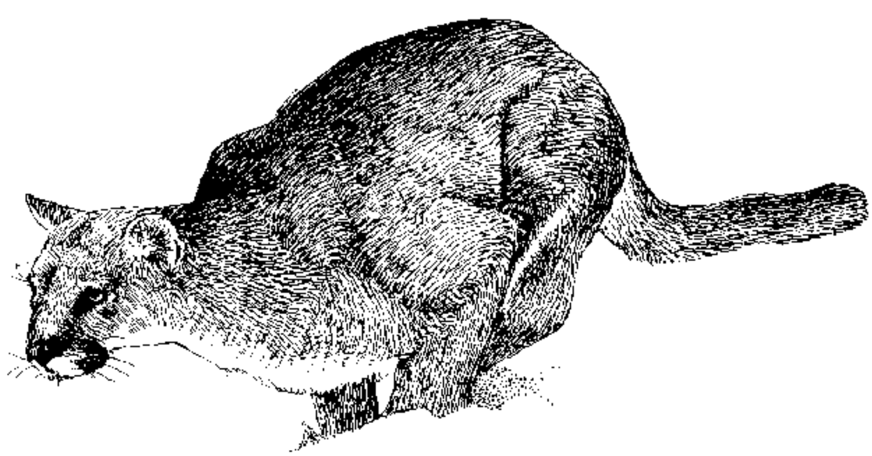
Predator and prey evolve together. The prey is part of the predator's environment, and the predator dies if it does not get food, so it evolves whatever is necessary in order to eat the prey: speed, stealth, camouflage (to hide while approaching the prey), a good sense of smell, sight, or hearing (to find the prey), immunity to the prey's poison, poison (to kill the prey) the right kind of mouth parts or digestive system, etc. Likewise, the predator is part of the prey's environment, and the prey dies if it is eaten by the predator, so it evolves whatever is necessary to avoid being eaten: speed, camouflage (to hide from the predator), a good sense of smell, sight, or hearing (to detect the predator), thorns, poison (to spray when approached or bitten), etc.

Predator-Prey Relationships

All animals must eat to survive. Without predators, certain species would drive other species to extinction through competition. Without prey, there would be no predators. Predators are always on the lookout for a meal. Prey must constantly avoid being eaten. The predator-prey relationship is important in maintaining balance among different animal species. This is often referred to as the “balance of nature”.

“I observe near all the large gangues of Buffalow, wolves; and when the buffalo move those animals follow and feed on those that are killed by accident or those that are too pore to keep up with the gangue.”

William Clark
October 20, 1804
The Lewis and Clark Expedition



Robert Savannah, US Fish and Wildlife Service

Predator-Prey Relationships

The Hunter and the Hunted

Objective

Students will:

1. Simulate predator-prey interactions in an ecosystem
2. Record and graph the numbers of predator and prey populations in the ecosystem

Key Words

1. *Predators* – animals that hunt other animals
2. *Prey* – animals that are hunted

Background

A predator is an organism that eats another organism. The prey is the organism which the predator eats. Some examples of predator and prey are Mexican wolf and deer, bear and fish, and bobcat and rabbit. The survival of predators depends on the availability of prey in the environment.

Materials

200 1-inch squares cut from index cards to represent the prey
50 large squares from index cards cut in half to represent the predators
Predator-Prey Data table
Blank graph paper
Table (to represent the ecosystem)

Advance Preparation

Divide students into groups.

Instructions

1. Place three "prey" squares on the table.

2. Toss one predator onto the table. Try to make the card touch as many "prey" as possible. The predator must capture (touch) at least three prey or die.

3. Remove any captured "prey". Record the number in the data table for Generation 1.

4. The "prey" population should double each generation. Count how many prey squares remain on the table, double the number and add the prey squares to the table. Record This number in the data table under the Generation 2 "number of prey". (It should be twice the number under the "prey remaining" for Generation 1).

5. The predator died during the first round, but a new predator moves in for the second round. Put 1 in the "number of predators" in the data table for Generation Two. This will represent the replacement predator. Repeat the tossing procedure and record the data for Generation 2.

6. Again, the number of prey doubles. If the replacement predator didn't "capture" three prey, it also died. But a new predator moves in for the next round. Keep going, adding to the number of prey each round and recording the data.

7. Eventually the predator will be able to capture enough prey to survive. Guess what happens? The number of predators double. Add to the predator population by adding predator cards. Now when you toss your predators, you will be tossing more than one. Don't forget to remove any "captured" prey.

8. Continue to record the data through 20 generations.

New Mexico Science Standards
Grades 4, II, II, 1, 4
Grade 7, II, II, I, 3, 5, 6; and II, II, II, 10
Grades 9-12, II, II, I, 2 and II, II, II, 12

Source: Adapted from "Predator-Prey Simulation", The Biology Corner www.biologycorner.com/worksheets

Predator-Prey Data Table

Name ____ Date ______________________

Use the data table to construct a graph:
After you have filled in the numbers on the data table below, you will be ready to construct your graph.

	Generations																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Number of Predators																				
Number of Prey																				
Number of Predators Remaining																				
Number of Prey Remaining																				

On the X-axis put Generations 1 through 20. Put the population numbers for each generation (number of predators, number of prey) on the Y axis. Graph the data on blank graph paper. Use one colored line for the predator and another colored line for the prey.

Predator-Prey Relationships

Raptors Get Respect

Objectives

Students will:

1. Learn what a raptor is
2. Identify the characteristics of raptors

Key Words:

1. *Accipters* – woodland hawks
2. *Buteos* – soaring hawks
3. *Diurnal* – birds that hunt during the day
4. *Falocniformes* –the order of 292 species of diurnal birds of prey
5. *Predator* – animals that hunt other animals
6. *Prey* – animals that are hunted
7. *Raptor* – a bird that hunts prey
8. *Strigiformes* – the order of 162 species of owls

Background

The word “raptor” is from the Latin word *rapare*, which means "to seize or grasp." "Raptor" is another word for a bird that hunts prey. Raptors are predators, and they have three main characteristics that differentiate them from other birds. These are:

Hooked beaks

Strong feet and talons

Exceptionally good eyesight

There are approximately 292 species of *Falconiformes* -- commonly called "hawks.” They include vultures, eagles, ospreys, harriers, falcons and kites, as well as two types of hawks known as *buteos* (soaring hawks) and *accipiters* (woodland hawks). These are diurnal birds of prey, which means they are birds that hunt during the day. Each of these groups has adaptations and hunting methods that differentiate them from one another.

There are 162 species of *Strigiformes* -- owls. Some biologists debate whether or not owls should be classified as raptors, because although they share some physical similarities with diurnal birds of prey, they are also very different in many physical ways. However, because of the presence of both predatory characteristics and the three main physical characteristics, biologists have classified the members of both Falocniformes and Strigiformes as birds of prey.

Raptors share some other common characteristics: They have a fleshy covering over their beaks through which their nostrils open. This covering is called a cere. In almost all species, the female is larger and stronger than the male. The nesting and growth time of species is similar, and with the exception of the large vultures and condors, the young of most species are fully grown within six to eight weeks of hatching.

Because raptors are predators, they are carnivores, or meat-eaters. They hunt a wide variety of prey. They range in size from falcons and owls no larger than small songbirds, which feed primarily on insects, to large eagles that can hunt animals such as monkeys. Some species of raptors are generalists and will hunt a wide variety of prey, including insects, birds, rodents, and other mammals. Many species, however, are specialists, and will hunt only one or two prey types, such as wasps, snails, bats, fish, or snakes.

Materials
Pictures of several different kinds of birds including raptors
Pencils, markers or crayons
Paper

Instructions
1. Divide students into groups of three or four.

2. Have students list the characteristics of raptors on a separate sheet of paper. They can include things such as wings and feathers, but they must include the three key characteristics of a raptor.

3. Hand out stacks of pictures of raptors and non-raptors to students.

4. Have students identify each bird picture as a raptor or non-raptor. They should explain Their choices based on the characteristics listed for birds of prey.

NM Science Standards:
Grades 4, II, II, 1, 4
Grade 7, II, II, I, 3, 5, 6; and II, II, II, 10
Grades 9-12, II, II, I, 2 and II, II, II, 12

Source: Adapted from “What is a Raptor?”, The Raptor Center, University of Minnesota

Predator-Prey Relationships

The Big Bad Predator?

Objectives

Students will:

1. Understand the interdependency between predators and prey
2. Learn about the factors that can affect the size of a wildlife population
3. Understand how people's attitudes towards predators may form
4. Describe how predators at the top of the food pyramid function as an ecological barometer.

Key Words

1. *Barometer* – something that gives a clue that changes are happening
2. *Endangered species* – animals and plants that are in danger of vanishing from the planet
3. *Pesticide* – a chemical substance used to kill pests, especially insects
4. *Predators* – animals that hunt other animals
5. *Prey* – animals that are hunted

Materials

Activity 1– Predators, Prey and a Contaminated Food Chain

1. One small paper bag for each student who will represent an insect
2. Food chips – white and colored paper dots, poker chips, etc. (or any other material that Can be easily picked up) 30 pieces per student insect = 20 white and 10 colored pieces
3. One name tag per student

Activity 2 - Predator Populations

One large bag of M &M's candies (enough for each student to have 10 -15 candies)

Activity 3 - Words Can Hurt Wildlife Too!

1. Two or three fairy tales and or myths in which wolves or other predators play a role
2. One copy of Rudyard Kipling's, All the Mowgli Stories
3. One copy of any non-fiction book about wolves
4. Paper and pencil for each student

Background

When it comes to predator-and-prey relationships, most people usually sympathize with the cute, little rabbit or the beautiful, brown-eyed deer that has to live in fear of blood-thirsty killers. Our myths, fairy tales and movies often portray predators as bad or evil. However, it is the predators that are in trouble, not their prey. Many predators have become endangered species.

Understandable, people tend to feel hostile toward animals that kill other animals. Humans have waged wars against predators because they feared would prey upon their families or livestock. As a result, North American predators, including eagles, wolves, mountain lions, and grizzly bears, were hunted almost to the point of extinction.

Today, biologists and others understand that studying and maintaining predator populations and habitats is extremely important. Predators often are a barometer of environmental health and for detecting potential problems before they reach serious levels.

Raptors and other predators at the top of the food chain are especially affected when the food chain becomes unbalanced. For example, the chemical DDT was once widely used in the United States as a pesticide. Insects, mice, and small mammals absorbed the chemical as it washed into the water and food systems. Hawks and other birds then accumulated deadly levels in their bodies as they consumed the poisoned prey. This resulted in high rates of weakened eggshells, inability to reproduce, and death by pesticide poisoning. The bald eagle, brown pelican, and peregrine falcon were placed on the endangered species list because of their severe population depletions. People are now trying to find safer pesticides.

Predators and prey have different food sources that are vital to survival. The differences in food sources are very important. An herbivore (plant-eater) usually has an abundance of food readily available, but it has to eat a large amount to survive. While it is eating, it must avoid predators looking for their own dinner. Predators must work even harder for their food. Prey is much scarcer than plants, and it must be captured and killed to be eaten. Since meat is a more concentrated source of nutrients, carnivores don’t have to eat as often as herbivores.

Prey species must often rely on escape as their best defense. They usually have a well-developed sense of hearing. Eyes of most prey species are located towards the sides of their heads, enabling them to see a broader range. However, they often don’t notice a predator until it moves. Most hunted animals also have a keen sense of smell.

Animals that are preyed upon often live in groups, since there is safety in numbers, especially when feeding. If one animal senses danger, the entire group is alerted and can run for safety or dive into a protective shelter. Some species that are unable to run swiftly have developed other protective physical adaptations.

Predators have a different approach to survival than prey species do. They a have very good sense of smell and sight and tend to be very curious about movement and scent; rather than being afraid, they like to investigate new things. Predators usually have their eyes placed towards the front of their head, giving them three-dimensional, binocular vision, which is vital to their ability to catch prey. Predators also rely on speed and quickness, and their strong jaws and sharp teeth.

Predation is an essential part of the delicate balance of the environment. It is just as important to the prey species as it is to the predators. Hunters go for the easiest meal they can find, so they weed out the elderly, sick, or the young. This makes the remaining population stronger and healthier. Without predators to maintain a proper balance in prey species, their populations would escalate to unnatural levels, and many animals would die of starvation or disease.

In the animal world, the fiercest competition is between members of the same species – between hawk and hawk – rather than between members of different species – hawk and bald eagle. Animals of the same kind need exactly the same kind of food; shelter, nesting areas, and mates – and these resources are limited. When there are more animals trying to live in an area than there are resources available, the competition between them becomes disastrous. Some animals will die of starvation when others take all the food. Some will die of exposure when they are driven from protected territories of their own kind. Overpopulation and severe competition seem to create social problems. Surrounded by too many of their own kind, animals become abnormally aggressive, irritable, may not mate readily, bear fewer and weaker young, sometimes fail to care for their litters, or may even destroy them.

Understanding the relationship of prey to predators and the key part they play in a healthy ecosystem is essential to understanding our natural world.

Instructions

Activity 1 – Predators, Prey and a Contaminated Food Chain

1. Divide the students into three groups. In a class of 26 students, for example, there should be 2 “Red-Tailed Hawks”, 6 “grasshopper mice”, and 18 “insects.” There should be three times as many mice as hawks and three times as many insects as mice. Give each student a name tag that identifies what species he/she is.

2. Give each “insect” a small paper bag, which represents the stomach of whatever species is holding it. Distribute the “food chips” around in a large open space (open area outside, gym floor, or classroom space.)

3. Give the students their instructions. The insects are the first to go looking for food. The hawks and mice are to watch quietly on the sidelines. (The predators are watching their prey.) The insects have 30 seconds to collect as much food as possible and put it in their stomachs (bags).

4. The mice are now allowed to hunt the insects, while the hawks still remain on the sidelines. The amount of time allowed should depend on the size of the playing area; 15 seconds may be enough in a classroom, while 60 seconds could be given in a large playing field. Each mouse should have enough time to catch one or more insects. Each insect that is caught by a mouse (tagged) must give its bag of food to the mouse and then sit on the sidelines.

5. Now the hawks will hunt the mice. The same rules apply, allowing 15-60 seconds of hunting time. All mice that are caught must go to the sidelines. Any mice still alive may continue to hunt for insects, and the remaining insects can continue to gathering food chips. The hawks simultaneously hunt the mice. At the end of the designated time period, all students should gather in a circle with their food bags.

6. Ask all students who are “dead,” having been consumed, to identify what predator ate them. Next ask the hawks to empty their food bags onto the floor and count the number of white pieces and colored pieces that were in their “stomach.” Write down the results. Then have any “living” insects and fish count their food pieces and list these results also.

7. Inform the students that each of the colored food chips represents DDT, a pesticide that was sprayed onto nearby fields to combat insect damage and loss of crops. This pesticide is highly toxic and often is carried into the surrounding water systems, where it enters and accumulates in the food chain. Therefore, all of the insects that were not eaten by the mice may now be considered dead from the pesticide if they have any colored food chips in their stomach. Any mice with half or more of their food supply contaminated are also dead. The hawk’s with the highest number of colored food chips will not die yet; however, it has accumulated so much of the pesticide in its body that the eggshells produced by it and its mate during the next nesting season will be so thin that the eggs will break. The other hawks are not visibly affected at this time, but will continue to accumulate pesticides to toxic levels as long as they eat contaminated prey.

8. Discuss what the students just experienced. What are their observations about the food chain, how it works, how toxic substances can enter the food chain, and how it affects both predators and prey at all levels of the pyramid?

<u>Activity 2 - Predator Populations</u>

1. Explain that each student will represent a hawk, which is a predatory bird. The class as a whole will represent a single predator population.

2. Explain that the hawk has a remarkable capacity for modifying its diet to accommodate local prey sources. In this particular region, the Grasshopper Mouse is the hawk's favorite food to prey on. Show the students a bag of M & M's and explain that the candy represents the Grasshopper Mouse.

3. Give each student 10 M & M's and explain that in this game, hawks reproduce every five minutes, each pair producing one offspring. Students may eat the number of Grasshopper Mice they think are necessary for the hawk to survive. Allow five minutes to eat the prey.

4. After five minutes, see if there are any students who ate no M & M's. These students will represent hawks that die from lack of food. Identify those who ate all or all but one, of their M & M's. They get no more food, as there are no longer any reproducing pairs of prey left. Therefore, the predators will die of starvation. These losses represent the decrease in the hawk population.

5. Those students who ate a limited number of prey are the hawks who will survive. Give them one additional M & M for every two M & M's they still have. This represents the birth of more prey.

6. At this point, it should be clear to students they will survive best if they eat only a limited number of M & M's, if they eat none or all of them, they are out of the game; just as a real predator dies under the same conditions.

7. After the game, discuss what the students have learned. Animals require a minimum number of individuals in a given population in order to reproduce. If animals of a given species become so scarce that they cannot find a mate during the breeding season, the species is doomed. Consequently, predators must not over-hunt their prey when meeting their own energy needs.

<u>Activity 3</u> - Words Can Hurt Wildlife Too!

1. Discuss with students how they think most people form their attitudes about the environment, wildlife and predators.

2. Examine several fairy tales or myths, (i.e., *Little Red Riding Hood*, *Three Little Pigs*, etc.) that involve predatory animals. List words used to describe the animals in the story, both predators and prey (including humans).

3. Make a list of predatory animals such as eagles, hawks, wolves, grizzly bears, mountain lions, bobcats, coyotes, foxes, and sharks. Make a list of prey animals such as rabbits, squirrels, prairie dogs, deer, and elk. Beside each animal, write the words that were used in the stories, as well as the other words that come to mind when thinking about the animal. For example, "sly fox," "savage wolf," "man-eating grizzly," "cuddly bunny," "graceful deer," and "cute squirrel."

4. Discuss the effect these words have upon the opinion of the reader toward predators. For example, was the wolf in "Little Red Riding Hood" represented honestly and accurately in the story?

5. Read the first chapter in Kipling's book All the Mowgli Stories, in which Mowgli, the jungle boy, is first brought to the wolf pack. Again note the words used to characterize wolves. How does the characterization compare with that in the fairy tales? Which is the most accurate? Which is more likely to damage the reputation of wolves and other predators? How do they affect the readers' opinion of predators differently? Can fictional stories about an animal hurt the animal? (For example, could they create a desire in humans to own wild animals as pets? Wildlife rarely does well in captivity and should be left in the wild whenever possible.)

6. Have students research a predator such as a Mexican wolf. Have each of them read aloud a passage describing the predator's family structures and behavior from the non-fiction book. For example, how are wolf packs are organized? How are wolf pups are raised? What do wolves normally eat when the natural food supply is in proper balance.

New Mexico Science Standards
Grades 4, II, II, 1, 4
Grade 7, II, II, I, 3, 5, 6; and II, II, II, 10
Grades 9-12, II, II, I, 2 and II, II, II, 12

Source: Adapted from "Predators, Prey and the Food Chain", The Raptor Center, University of Minnesota

Predator-Prey Relationships

Deer: Predation or Starvation

Objective
Students will graph the predator-prey relationship and discuss issues of wildlife management

Key Words
1. *Balance of nature* – the idea that predators and prey exist in a balance in ecosystems
2. *Predators* – animals that hunt other animals
3. *Prey* – animals that are hunted

Materials
Population Change Table worksheet
Population Change Graph worksheet
Predation or Starvation? worksheet
Graphite pencils and colored pencils

Background
All animals must eat to survive. Without predators, certain species would drive other species to extinction through competition. Prey must constantly avoid being eaten. The predator-prey relationship is important in maintaining balance among different animal species. This is often referred to as the "balance of nature".

Wildlife managers try to maintain a balance in ecosystems. Their many duties include surveying animal populations, collecting age and growth information on species, managing wildlife on public lands, writing detailed reports about their findings and making recommendations to policymakers. At times, wildlife managers must make difficult decisions about which animals and how many animals a habitat can support, and choose whether or not to take some specific actions concerning predator and prey populations.

Advance Preparation
Discuss with students that background information and the Introduction section of the *Population Change Table* worksheet.

Instructions
Have students fill out the *Population Change Table*, *Population Change Graph, and Predation or Starvation?* worksheets.

Option
The *Predation or Starvation?* exercise can be done as a classroom discussion.

New Mexico Science Standards
Grades 4, II, II, 1, 4
Grade 7, II, II, I, 3, 5, 6; and II, II, II, 10
Grades 9-12, II, II, I, 2 and II, II, II, 12

Source: Adapted from "Deer: Predation or Starvation", The Biology Corner, www.biologycorner.com/

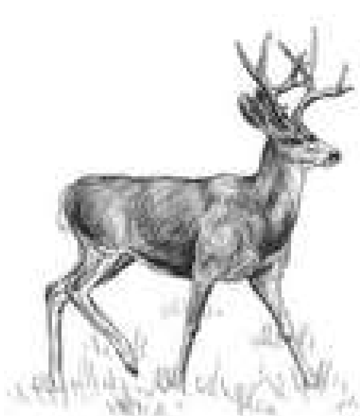
Population Change Table

Name ____ Date _______________________

Introduction
In 1970, the mule deer population of an experimental wildlife refuge about 518 square kilometers in size was about 2,000 animals. The refuge had enough vegetation for feeding, but the food supply had limits. Biologists were concerned that overgrazing might lead to mass starvation of the deer as well as damage to the habitat. They decided to bring in natural predators to control the deer population. They hoped that natural predation would keep the deer population from becoming too large. In 1971, wildlife managers introduced ten wolves into the refuge.

The results of this program are shown in the Population Change Table. The population change is the number of mule deer born minus the number of mule deer that died during that year. Fill out the last column for each year (the first has been calculated for you).

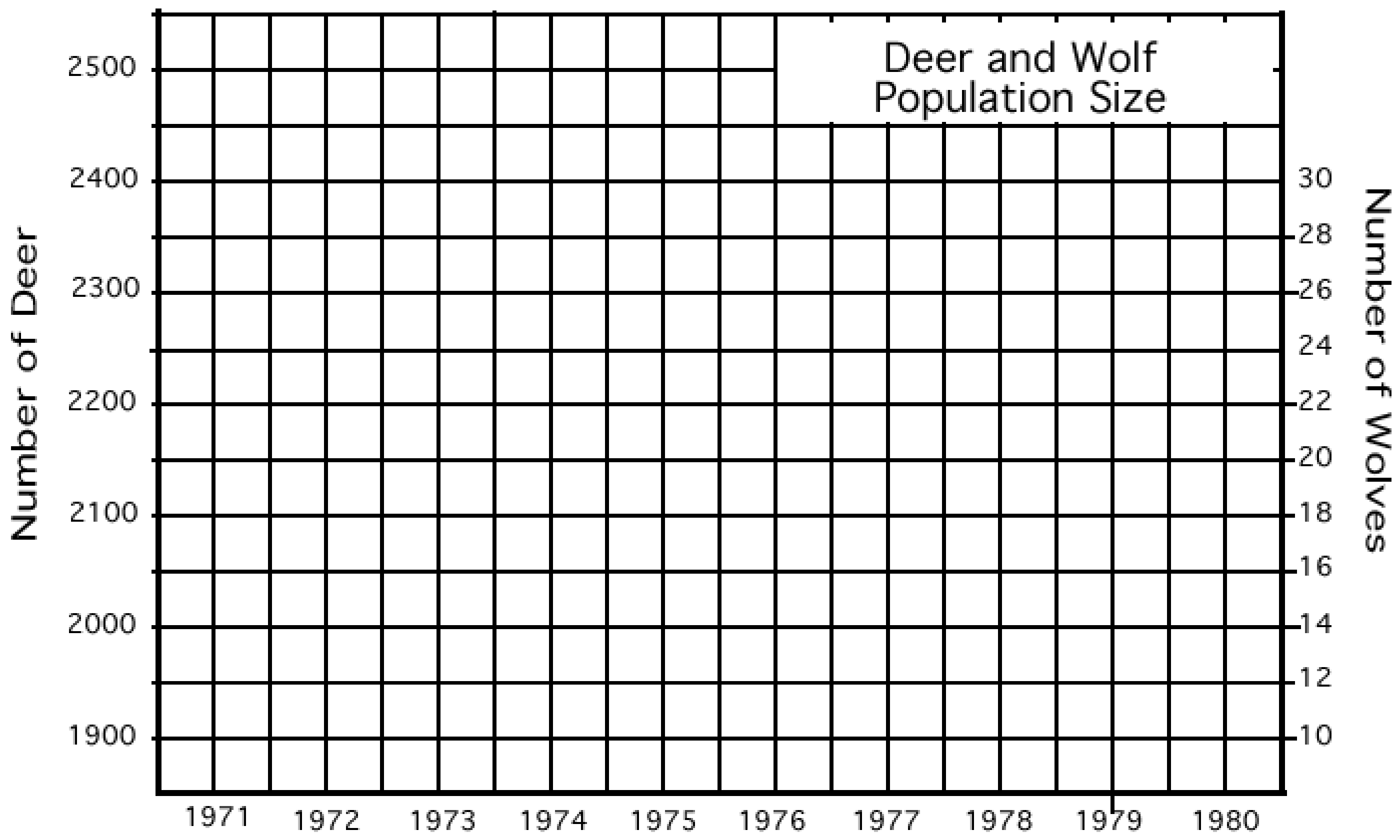
Year	Wolf Population	Mule Deer Population	Mule Deer Born	Predation	Starvation	Deer Population Change
1971	10	2,000	800	400	100	+300
1972	12	2,300	920	480	240	
1973	16	2,500	1,000	640	500	
1974	22	2.360	944	880	180	
1975	28	2,224	996	1,120	26	
1976	24	2,094	836	960	2	
1977	21	1,968	788	840	0	
1978	18	1,916	766	720	0	
1979	19	1,952	780	760	0	
1980	19	1,972	790	760	0	



Population Change Graph

Name ____ Date _______________________

Graph the deer and wolf populations on the graph below. Use one color to show deer populations and another color to show wolf populations.



Predation or Starvation?

Name ____ Date _______________________

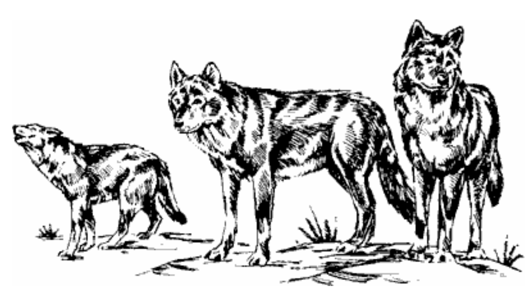
1. Describe what happened to the deer and wolf populations between 1971 and 1980.

2. What do you think would have happened to the deer in the refuge if the wolves had NOT been introduced?

3. Why would death by predators be more natural or "right" then death by starvation?

4. How does one determine when an ecosystem is in "balance"?

5. Would the deer in the refuge be better off, worse off, or about the same without the wolves?
Defend your position.



LIVING WITH LARGE PREDATORS IN NEW MEXICO

Large predators of New Mexico today are mountain lions, black bears, bobcats and coyotes. They are found throughout the state. These large, powerful predators have lived here for eons, feeding on the plentiful prey and playing an important role in the ecosystem. You may live or recreate in habitats used by these predators. Large predators can at times be dangerous. However, with a better understanding of these magnificent and important animals, we can learn to coexist.

BLACK BEAR

Physical Characteristics

Large, powerful animals, black bears (*Ursus americanus*) weigh over 200 pounds. The largest recorded in New Mexico was 495 pounds. A "black" bear can be colored jet black to cinnamon, and there have been blonde-colored bears in the state. They have pointed noses and high-set ears. Claws are long, sharp and curved. Black bears can climb trees. Their lifespan in the wild can be long, and bears have been known to live 25 or 30 years in captivity. Adult female black bears normally give birth every other year to one to three cubs. The cubs, which weigh 8 oz. at birth, are born while the mother is in hibernation. The cubs remain withtheir mother during their first full winter, and disperse the following spring.

Hunting and Feeding Habits

Being omnivorous (feeding on both plants and animals) and opportunistic, the black bear has a diet which varies according to seasonal availability of foods. They eat spring grass, berries, acorns, pinon nuts, and dead animals. Occasionally bears will kill livestock. At times they break into commercial beehives and remove honey and the bees. Rocks and stumps may be overturned in search of grubs, insects or small rodents. Recent research indicates they may also be an efficient predator of large game.

Habitat

Most forested areas of New Mexico are populated by black bears, and it is not uncommon to find them around mountain campgrounds, and even near large population centers. They need woodland cover, as they are shy animals and difficult to locate in the wild. Mixed forest with food-producing trees such as oak or pinon, are good areas in which to find bears. Bears like water to play in and to drink. They frequently wallow in springs and creeks.

MOUNTAIN LION

Physical Characteristics

The lion's scientific name, (*Puma concolor*) means "cat of one color". Mountain lions in New Mexico are usually tawny to light-cinnamon in color with black-tipped ears and tail. Adult cats can weigh from 80 to 150 pounds and measure eight feet long, with the tail included. The fur is short and kept clean by grooming. Mountain lions, even young cats, are easy to distinguish from other wild cats in New Mexico by their long tail.

Female lions generally reproduce when they are about two and a half years old, and give birth to an average of two to three young, called kittens. New born kittens are about a foot long and weigh about one pound. They normally live on the mother's milk for a month, after which they start eating meat she brings to them. The spotted kittens are cute when young, but quickly develop sharp claws and teeth that will serve them well when they grow up.

Hunting and Feeding Habits
Powerful muscles, sharp teeth, keen eyesight and hearing, and genetic makeup give mountain lions the need and the ability to kill prey for food. Most active from dusk to dawn, lions will also travel and hunt in daylight. Lions prefer to eat deer; however, they also kill elk, porcupines, small mammals, livestock and a variety of domestic animals, even pets. It has been estimated that an adult lion can survive well on one deer per week. Mountain lions prefer to kill their own prey. Like most cats, they take their prey by ambush rather than by a long pursuit. Lions usually kill with a powerful bite below the base of the skull, breaking the neck. The unconsumed portions are covered with dirt, leaves or snow and the lion may return to feed on it over the course of a few days. Lions feeding on a kill can be extremely dangerous to people.

Habitat
Historically the mountain lion has occupied all parts of the state except the open, eastern plains. Lions are found in areas of pinon pine, juniper, mountain mahogany, ponderosa pine, oak brush and subalpine meadows. Areas with plentiful populations of deer are likely to have abundant populations of mountain lions. Individual lions range in areas varying in size from 10 to over 300 square miles. Females with young kittens use the smallest areas, adult males occupy the largest areas. Size of the home range depends on the terrain and how much food is available.

COYOTE

Physical Characteristics
More frequently heard than seen, the coyote’s howl is a familiar sound in New Mexico. The coyote (*Canis latrans*) is a wiry, nimble wild dog, built and colored for escaping large enemies as well as stalking nervous prey. A coyote weighing more than 50 pounds is a rarity, the norm being between 25-30 pounds. A mature animal is just two feet high at the shoulder and three feet long, or a foot or so longer when his bushy tail floats out behind while running.

Coyotes are monogamous and a pairing may last for several years, though not necessarily for the life of the coyote. Female coyotes come into heat once a year, usually in the late winter or early spring. An average of six pups are born approximately 63 days later in a burrow constructed by the adults. The young begin to emerge from the den at about two weeks of age, and disperse after six to nine months. Occasionally, some young may remain with the parents, and for a time a small group is formed.

Hunting and Feeding Habits
Although about 90 percent of the coyote’s diet is other mammals, they are opportunistic and depending upon season and availability, consume a wide variety of plant and animal material. When rabbits are in good supply, they are the dietary mainstay. Carrion (dead animals), mice, rats, ground squirrels, marmots, prairie dogs, and other rodents, together with a few birds, make up the remainder of the basic diet.

Coyotes are less social than wolves or domestic dogs; thus they often hunt alone, or a mated pair may cooperate in foraging. A coyote cannot outrun a jack rabbit or a pronghorn fawn that is more than a couple of weeks old, but two coyotes will often pair to kill difficult prey. They run in relays to tire an animal, or one of them waits in ambush while the other drives the victim toward the other.

Habitat
The coyote is widely distributed in New Mexico, and may be seen in almost every life zone and habitat from alpine meadows down to the desert. Despite control programs aimed at reducing their numbers, they are relatively common, due in part to their ability to adapt to changing environments. No other carnivore has increased its range despite the expansion of human activity.

BOBCAT

Physical Characteristics

Bobcats (*Lynx rufus*) are cat-like in appearance, with a short tail and sharp, erect ears. Their stubby tails and bobbing motion identify them in the wild, as do their grey and yellow markings. The coat tends to be spotted on the flanks and striped on the face and legs. A bobcat, even when fully grown, may weigh only 15 to 30 pounds. The bobcat is shy and seldom seen, however, it is a savage fighter when cornered or taking prey.

Bobcats can mate at any time of the year, normally from February to May, and give birth to a litter of one to seven kittens 60 days later. The young don't open their eyes for at least 10 days. Kittens are weaned at two months of age, and they may remain with the female until the fall of the next year.

Hunting and Feeding Habits

Like other cats, bobcats hunt primarily at night, but may also hunt during the day. The bobcat's eyes are admirably adapted to night-hunting. Its pupil which is small and elliptical in bright light becomes large and round in dim light and aids in gathering light. Bobcats are considered to be sight hunters using their eyes to full advantage. Bobcats, like most other cats, hunt by stealth rather than pursuit. The cat may sit by a game trail or other strategicsite until a rabbit passes nearby, and then capture the animal with a pounce or a quick rush. Their diet consists of small and medium-sized vertebrates. Rabbits are favored when common, and rodents, birds, and sometimes reptiles or even insects are taken. Small pets, such as house-cats and small dogs, have fallen prey to these aggressive predators.

Habitat

The bobcat is found throughout New Mexico and is established in every county in the state regardless of terrain. It is found in the river bottoms, the alpine zone of the high mountains, and in the sandy desert areas. It even survives in heavily populated areas. Bobcats are great wanderers, but unlike the far-ranging mountain lion, the bobcat seldom travels more than two miles from its home. Unlike the lion, the bobcat is adapted to settled areas. Even a wooded lot in an agricultural area can sustain at least a pair of bobcats.

When People Encounter Large Predators

Generally, large predators are elusive. They tend to live in remote, rural country. Such conditions exist in mountain subdivisions, urban fringes and open spaces. Consequently, the number of predator/human interactions is increasing. This increase is due to a variety of reasons: more people moving into their habitat, an increase in prey species, drought conditions requiring them to expand their home range, more people using hiking and biking trails in their habitat and a greater awareness of the presence of large predators.

> *Source:* Excerpted from brochure, ***LIVING WITH LARGE PREDATORS IN NEW MEXICO***
> by the New Mexico Department of Game and Fish, www.wildlife.state.nm.us

For more information contact your area's Game and Fish Office:

Main Office
1 Wildlife Way
Santa Fe, NM 87507
(505) 476-8000

Southwest Area Office
2715 Northrise Drive
Las Cruces, NM 88011
(505) 532-2100

Southeast Area Office
1912 W. Second St.
Roswell, NM 88201
(505) 624-6135

Northwest Area Office
3841 Midway Place NE
Albuquerque, NM 87109
(505) 222-4700

Northeast Area Office
215 York Canyon Road
Raton, NM 87740
(505) 445-2311

Adaptations

Adaptations

How to Eat with a Beak

Objective

Students will

1. Learn how bird beaks are adapted for different feeding techniques
2. Understand how feeding habits allow different birds to live together in the same habitat

Key Words

1. *Adaptation* - the development of physical and behavioral characteristics that allow organisms to survive and reproduce in their habitats.
2. *Habitat* – the place where a plant or animal normally lives and grows; the arrangement of food, water, shelter or cover, and space suitable to an animal's needs.

Background

Wildlife refuges are habitat to a variety of birds. So many different birds are all able to live in the same area because their beaks are adapted for different feeding techniques. Hundreds of organisms that birds eat live in the habitats of the refuge (worms, clams, snails, crustaceans). Each bird has a unique diet that depends on its beak type. Bird beaks are adapted to match the type of food they eat. For example, many birds have tweezer-like beaks. A bird with a short "tweezer" beak eats animals that burrow deep into the mud. Some birds have scissor-like beaks that rip their food apart into bite sized pieces while other birds have clothespin-like beaks that are excellent for crushing the hard covering of seeds. Lastly, birds may have a spoon-like beak that can scoop up large numbers of small fish or strain plant material from the mud. The different diets of birds allow them to live in the same area at the same time (coexist). This is why you may see many types of birds feeding together in one area.

Materials

Bird Beaks chart
For beaks: spoons, scissors (younger students can use fingers), tweezers, clothespins
For bird stomach: 1 small paper cup per student
For food: marbles (snails), cut up pipe cleaners (worms), 3/16 metal washers (beetles), etc.
Chalk board or easel paper to keep track of data

Instructions

Ask the students to sit in a circle or two lines facing each other. Begin the activity with a general discussion about bird beak types. Show students the *Bird Beaks* chart What kind of beaks have they seen (long, pointy, short, wide, etc.)? Hold up the beak utensils one at a time and ask the students for examples of birds that have a beak similar to the utensil. Some potential answers are in the following lists. Write the students' ideas on the chalk board or easel.

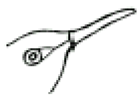
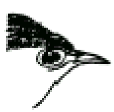
Examples of Birds to Match Beak Types

Spoon beak:	Mallard, Wood duck, Roseate spoonbill, Northern shoveler, White pelican
Scissor Beak:	Northern harrier, Eagle, Kestrel, Red-tailed hawk
Clothespin Beak:	Stellar's jay, Clark's nutcracker, Crow, House wren, American goldfinch
Tweezer Beak:	Great blue heron, Sandpiper, Snowy egret, American bittern

New Mexico Science Standards
Grade 4, II, II, I, 1 and II, II, II, 1-3
Grade 6, II, II, I, 3 and II, II, II, 2
Grades 7, II, II, II, 7, 10 and 12

Bird Beaks

Why Do Bird Beaks Look the Way They Do?

Shape	**Type**	**Adaptation**	**Example bird**
	Spear	Spear-like bill; adapted for fishing.	Herons, Kingfishers
	Probe	Long and slender; used for probing flowers for nectar.	Hummingbirds
	Swiss Army Knife	A multipurpose bill; allows the bird to eat fruit, seeds, insects, fish, and other animals.	Crows
	Cracker	Short, thick conical bill; used for cracking seeds.	Sparrows, Cardinals
	Chisel	Long and chisel-like bills; used for boring into wood to eat insects.	Woodpeckers
	Tweezer	Thin and pointed bills; used to eat insects.	Warblers
	Shredder	Sharp curved bills; used for tearing meat.	Hawks, Owls
	Strainer	Long, flat bill; used to strain small plants and animals from the water.	Ducks

Pictures borrowed from: *The Norman Bird Sanctuary*

Chart Source: Carlsbad Caverns National Parks Middle School Biology Curriculum

Adaptations

Bird Beaks and Feet

Objective
Students will examine types of bird adaptations and draw conclusions about diet and habitat.

Key Words
1. *Inference* – a conclusion drawn from evidence or reasoning
2. *Structural* – the way the parts of something are put together and how they work together

Materials
Types of Birds chart
Beaks and Feet Worksheet

Background
A bird's beak and feet can tell us much about their habitat and lifestyle. Many birds can be classified according to structural similarities between their beaks and feet.

Description	**Function**
Beaks	
short & rounded	multipurpose, eating insects and seeds
spear shaped	spearing fish
chisel shaped, flat & pointed	drilling for insects
flat and square-shaped	straining algae
long and fat, like a scoop	scooping up fish
Hooked	catching and tearing prey
long and tubular	sucking nectar from flowers
Feet	
long muscular legs	running
long skinny legs	wading
short legs with blunt claws	scratching, ground walking
three toes in front, one behind	perching
webbed	swimming
large hooklike claws (talons)	grasping prey
tiny short legs	hovering
two toes in front, two behind	climbing

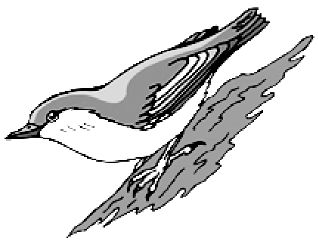
Instructions
Have students examine the charts and images of birds and write their ideas in the *Beak and Feet worksheet* about what different birds eat, and where they live.

New Mexico Science Standards
Grade 4, II, II, I, 1 and II, II, II, 1-3
Grade 6, II, II, I, 3 and II, II, II, 2
Grades 7, II, II, II, 7, 10 and 12

Source: Adapted from "Birds, Beaks & Feet", The biology Corner, www.biologycorner.com/worksheets

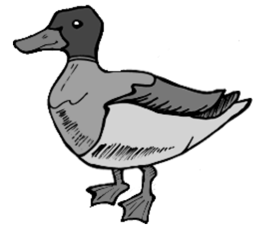
Types of Birds

Western Bluebird



Canyon Wren

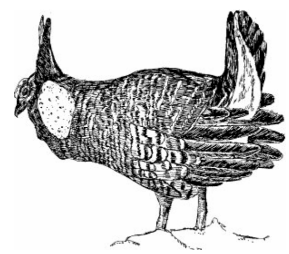
Wood Duck



Eagle

Sparrow

Prairie Chicken

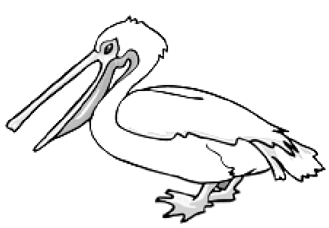


Heron

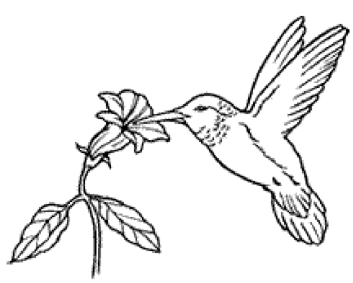
Kingfisher

Owl

Pelican



Hummingbird



Woodpecker

Beaks and Feet Worksheet

Bird	Type of Feet	Type of Beak	Diet	Habitat
Western Bluebird				
Canyon Wren				
Wood Duck				
Bald Eagle				
Prairie Chicken				
Hummingbird				
Heron				
Pelican				
Owl				

1. What features of a hummingbird make it adapted for its style of feeding?

2. Imagine an ideal flying predator. What type of beak and feet would it have?

3. Different birds may have similar beaks and diets. Loons, herons, and kingfishers, for instance, all have long sharp pointed beaks for spearing fish. Their feet, however, are quite different. Describe how the loon, heron, and kingfisher differ in the method by which they hunt for fish.

4. Owls have large eyes that enable it to see well at night. Both the hawk and the owl hunt similar things: small rodents or snakes. How do a hawk and the owl avoid competing with each other?

5. Birds the live on the prairie have short but muscular legs (like the Lesser prairie chicken). Prairies are large grasslands that have few numbers of trees. What do you think the legs of a Lesser prairie chicken are adapted for?

Adaptations

Amazing Avian Adaptations

Objectives

Students will be able to:

1. learn about the advantages of bird adaptations
2. understand the importance of adaptations to birds.

Key Words

1. Adaptation – the development of physical and behavioral characteristics that allow organisms to survive and reproduce in their habitats.

2. *Avian* – belonging to, relating to, or characteristic of birds

Background

Birds have many kinds of adaptations, including different kinds of beaks, feet, legs, wings and colors. These adaptations have evolved so that the bird is better suited to its environment. For example, birds are considered nature's perfect flying machines. Every part of a bird is adapted to flying. Their bodies are as streamlined as an airplane, enabling them to slip easily through the air.

Materials

Paper	Glue
Construction Paper	Pencils, markers, or paints
Clay or similar sculpting material	Pictures of birds, field guides, etc.

Instructions

1. Have a class discussion about bird adaptations.

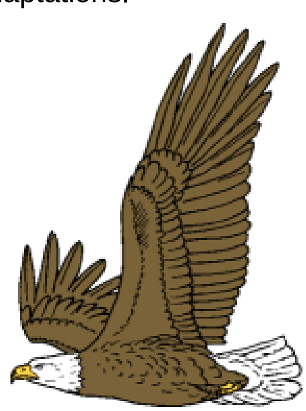
2. Have students design an original bird. It must be well-adapted to its habitat.

3. The student should now be ready to make a drawing or model of the bird.

4. To accompany the drawing or model, students should write a short report about the bird. The report should include: the name of the bird, its food sources, habits, habitat, the list of adaptations, and the reasons for and advantages of the adaptations.

Options

1. Have students put their drawings and reports on posters and have a classroom "Bird Fair"
2. Display students bird creations on a classroom bulletin board.
3. Have students create bird mobiles.



New Mexico Science Standards
Grade 4, II, II, I, 1 and II, II, II, 1-3
Grade 6, II, II, I, 3 and II, II, II, 2
Grades 7, II, II, II, 7, 10 and 12

Adaptations

Desert Jeopardy

Objectives

Students will:

1. Discover that an animal must be physically and behaviorally adapted to the conditions of its environment to survive.
2. Learn how desert-dwelling animals have physical and behavioral adaptations suited to their environment.

Key Words

1. A*daptation* - a physical or behavioral characteristic of an organism that helps it to survive in its habitat
2. *Habitat* -The place where an animal or plant normally lives

Background

For any animal to survive, it must be adapted physically and behaviorally to its environment. Physical adaptations are characteristics such as fur, eye structure, and color. Behavioral adaptation refers to hunting strategies, breeding patterns, and social habits. Desert animals have some impressive ways of handling the challenges of surviving desert life. These adaptations help the animals escape the harsh desert heat, retain water, and maintain their body temperature.

Materials

4" x 6" index cards (three for each student)
Small chalkboards or dry-erase boards and appropriate writing utensils
Reference materials about deserts and desert animals, including library books, encyclopedias, and Internet resources

Advance Preparation

Create a list of desert animals; the number should equal the number of students in the class. Choose animals from these four categories: mammals, birds and fish, reptiles and amphibians, and insects and spiders. Examples include geckos, roadrunners, ravens, turkey vultures, Gila monsters, camels, and iguanas.

Instructions

Part 1.

1. Ask students what they know about deserts, including what people must do to take care of themselves in the desert.

2. Ask students to name deserts in New Mexico; then review their common characteristics:
Deserts receive less than 10 inches of rainfall annually.
Deserts may receive only a few rainfalls in a year.
Deserts are generally very hot in the daytime (often more than 100° F, or about 38° Celsius), Deserts can be cold at night (50° F, 10° Celsius, or below).

3. Assign one animal from your list to each student. Hand out three index cards to each student. Have students write the names of their desert animals on one side of each card. Explain that these cards will be used in a game of Desert Jeopardy,

4. Tell students that they will use reference materials to identify three adaptations for their animals. On the back of each index card, students should write one adaptation and an explanation of how it helps the animal survive. (Example: "This animal sleeps underground during the day, avoiding the extreme heat.")

5. Tell students that these adaptations will be used as clues in the game, so students should NOT reveal the name of the desert animal on this side of the card. Have students hand in their cards at the end of the class period.

Part 2.

1. Make copies of the cards and distribute them to every student. Students should write a paragraph about a day in the life of their animals, including adaptations and why the adaptations are necessary to survive in a desert biome. Tell students they will present their paragraphs during the next class period.

Part 3.

1. Before students share their paragraphs, encourage the class to take notes because they will be using these facts to play the game. After each presentation, write the name of the animal on the board and review its adaptations. After all the presentations, discuss the differences and similarities among the animals.

Part 4.

1. Write four columns on the board: mammals, birds and fish, reptiles and amphibians, and insects and spiders. Tape one index card from each student in the correct category, with the adaptation details visible.

2. Arrange students into groups of four or five. Have the groups take turns trying to name the animal whose adaptation is on the card. Answers should be phrased as questions. (For example, for "This animal has two black collars around its neck ," the correct answer is "What is a collared lizard?") Award 10 points for each correct answer, keeping score on the board. A group controls the board until it gives an incorrect answer. A student receiving his or her own card must pass and play the next round.

NM Science Standards:
Grade 4, II, II, I, 1 and II, II, II, 1-3
Grade 6, II, II, I, 3 and II, II, II, 2
Grades 7, II, II, II, 7, 10 and 12

Source: Adapted from “Biomes: Adapting to Deserts and Other Ecosystems”, DiscoverySchool.com

Adaptations

Surviving in the Desert

Objectives

Students will:

1. Understand how difficult it is for animals to conserve water in a desert environment
2. Observe a model situation and make inferences about real organisms
3. Communicate their observations about organisms adapted to dry desert environments

Key Words

1. *Adaptation* - a behavior, physical feature, or other characteristic that helps an animal survive and make the most of its habitat; the way any living thing is fitted to the life it leads
2. *Conservation* - a scientific discipline that seeks to understand the effects of human activities on species, communities, and ecosystems and to develop practical approaches to 3. preventing the extinction of species and the destruction of ecosystems
3. *Dormant* – an inactive state where growth and activities slow or stop temporarily
4. *Habitat* - the place where an animal normally lives
5. *Microhabitats* – a small, distinctly specialized habitat within a bigger habitat
6. *Nocturnal* - most active at night, sleeps most of the day

Background

A variety of organisms live in almost any habitat you could name. The desert, for example, is a harsh habitat but many plants and animals have adapted and thrived in these arid lands. Each desert organism has adapted its way of life to a different environment from that of organisms in other environments.

Plants and animals also inhabit specific microhabitats within the environment of a general habitat. A microhabitat is a small, distinctly specialized habitat. The microhabitat allows plants and animals to accommodate their needs and survive the harshness of the desert. For example, some animals have a resting place that is the cool interior of a burrow. Rattlesnakes, kit foxes, and kangaroo rats spend most of the day resting in underground burrows. They choose the night for their active period to avoid the intense dehydrating heat of the daytime sun. During the day, the cool microclimate of their burrows helps protect them. While the soil surface up top may be 165 degrees Fahrenheit, their underground dens may be a livable 80 degrees Fahrenheit. In their cozy microhabitat, these animals conserve their energy for nighttime hunting or seed gathering expeditions. Amazingly, over half of all vertebrate animals, including those that live in caves and underground, are nocturnal.

During the dry times, animals such as the Spadefoot Toad, an amphibian that lives in the American Southwest, will stay underground. It digs a burrow dug with its spade-shaped back feet. It will continue to lie dormant until the sound of raindrops hitting the surface awakens the toad. At that point the race is on. Within approximately 8-10 days the cycle of finding a mate to laying the eggs to becoming a toad will be complete.

Some plants use combined strategies of dormancy and an accelerated life cycle. The seeds of the Sand Verbena will remain dormant (sometimes for years) until there is enough rain. When there is sufficient rain, they grow quickly, making their flowers and seeds and then dying all within a period of a few weeks. Some plants bloom at night in order to minimize water loss.
An arroyo, a ditch carved by water in desert regions, makes for the perfect microhabitat for Javelinas. When the steep banks erode, shallow cavities are created that provide warmth in the winter and cool in the summer. The Javelinas will hide in these shallow cavities to prevent water loss and stay cool on hot summer days.

Cave entrances can provide microhabitats for a variety of plant and animal species and provide growing conditions similar to a forest. It is not uncommon to find a fringe of green around the entrances to caves. Upon closer examination, evidence of animals such as birds, snakes, skunks, or mice living in the mouth of the cave can be found.

A variety of microhabitats exist in any environment. Plants and animals find “their place” in logs, under boulders, in cacti, or even under a refuse can. Places such as a shady area under a tree or shrub are microhabitats because they provide a home for shade loving plants or respite for the desert lizards.

Materials
Sponges
Water
Natural desert materials (brush, vegetation, logs, etc. for use as protection from the dry heat)
Balance scales
Field guides or other materials with desert animal profiles
Data sheet

Advance Preparations
Brainstorm with students ideas about what animals do to conserve water. Write a list of the students’ responses. What do desert animals do during the day? How do they escape from the desert heat? What adaptations have they made to survive in the harsh desert climate?

Instructions
1. Divide students into groups of 2 or 3. Give each group a sponge saturated with water. There should also be a control sponge that is left out for the whole time for comparison purposes. Each sponge represents a desert animal with a very limited water supply. The students are to conserve as much of the animal’s water as possible. For a 24-hour period the group should care for the “creature” in a way to achieve this goal using only natural materials. The creature must remain in the open for at least 4 hours (this represents feeding time).

2. The students should weigh their sponge to get a baseline weight of the sponge. They should write this weight down to compare to the ending weight of that same sponge. Students need to develop a strategy to conserve the water in their creature, write it down and make a prediction on what they think will happen. During the 24-hour observation time, the students should write down their observations about what is happening with their animal. At the end of the time the students should weigh their sponges and compare beginning and ending weight. Students should make inferences about the results in relation to real organisms.

3. Students should share their plan, predictions, and results with the entire class. Class can discuss methods, results, and how it all relates to adaptations for desert survival of real living organisms.

New Mexico Science Standards
Grade 4, II, II, I, 1 and II, II, II, 1-3
Grade 6, II, II, I, 3 and II, II, II, 2
Grades 7, II, II, II, 7, 10 and 12

Source: Adapted from “Help! *I’m Dehydrating!”*, Carlsbad Caverns National Parks Middle School Biology Curriculum

Name. ___________________________________ Date. _______________________________

Data Sheet

Sponge	Initial weight	Final Weight
Control Sponge		
My Sponge		

My strategy to conserve water:

____

____

____

____

What I think will happen to my sponge:

____

____

____

____

My observations:

____

____

____

____

My results:

____

____

____

____

How does this relate to real organisms?

____

____

____

____

Adaptations

Create a Hybrid Critter

Objective
Students will design an animal that is native to the Southwest by taking information about a variety of wildlife and incorporating it into one “hybrid” imaginary species.

Key Words
1. A*daptation* – a physical or behavioral characteristic of an organism that helps it to survive in its habitat
2. *Hybrid* – an animal produced from the mating of parents from two distinct species or subspecies.

Background
A hybrid animal is created when one breed or species combines with another. For example, in nature, the cutthroat trout and the rainbow trout produce the *cutbow trout*. A man in Wyoming had some fun with tourists when he made up a very famous imaginary hybrid called the *jackalope* – which supposedly was a cross between a jack rabbit and an antelope. Another example was created by a student at Rio Rancho Elementary School who designed a *skunkalina* –a cross between a skunk and a javelina.

Materials
Paper or posters
Markers, colored pencils, crayons, or paint and brushes.
Clay, play dough, etc.

Advance Preparation
Talk with students about real hybrid animals.

Instructions
1. Have students think of an imaginary cross between two native Southwestern species.

2. Have students design an original hybrid animal. It should be well-adapted to its habitat. Students will need to decide:
   A. Its gender and skin, fins, fur or plumage
   B. Where the creature lives
   C. What it eats
   D. How it moves
   E. Any adaptations necessary for the species (list them)
   F. A made-up scientific name

3. Draw or make a model of the animal and create a fact sheet about it.
   (See sample jackalope fact sheet).

Option
Students can write a short report or a story about their hybrid creation.

NM Science Standards:
Grade 4, II, II, I, 1 and II, II, II, 1-3
Grade 6, II, II, I, 3 and II, II, II, 2
Grades 7, II, II, II, 7, 10 and 12

Fact Sheet - Jackalope

Latin Name: Leapus ridiculicus

Hybrid: cross between a jackrabbit and an antelope

Physical Appearance: Looks like a large jackrabbit with antelope antlers, brown/tan in color, long ears and legs, and a fluffy cotton tail. Antlers get to be 12-18 inches in height, with only the males having antlers. Females have a larger body size.

Diet: Likes to eat shrubs, plants, grasses, fruits, and insects

Habitat: Prefers desert scrubland, prairies, and farms where they can find food easily. Likes to hide in Texas beargrass, creosote bush, snakeweed, sagebrush and juniper brush.

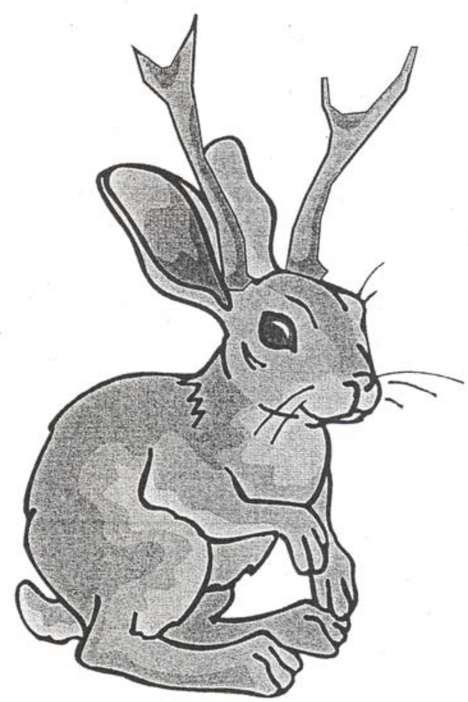
Range: Found in central New Mexico, Texas, the Great Plains, and in California

Mating Season: October – November

Litter Size: generally 4-5 bunny lopes in a litter

Lifespan: 25 years

Other Traits: They are able to mimic human speech patterns and are very fast runners, running at speeds up to 90 mph. They are good at camouflage and are very aggressive when approached.



Human Impact

"A thing is right only when it tends to preserve the integrity, stability and beauty of the community; and the community includes the soil, water, fauna and flora, as well as the people." – Aldo Leopold

The global human population is currently over 6 billion, and is increasing at an overall rate of over 1.6 percent each year. In less than fifty years, the world's population is estimated to reach 12 billion. The increasing human population means an increase in consumption of natural resources, including land, water, oil, gas and food products. Increasing consumption means increase waste products or pollution. It also means loss of habitat as human needs increase for space to live and grow food. The loss or degradation of habitat is the primary reason for increased animal and plant extinctions across the globe.

Specific human activities such as introducing non-native species, pollution, poaching, and wildlife-vehicle collisions have harmful impacts on wildlife populations. It is also important for students to understand the indirect consequences of increasing human populations and increasing overall global consumption of natural resources. Wild Friends activities have consistently focused on issues related to wildlife and human interactions, in the hopes of conserving wildlife for future generations and for all people to have the opportunity to enjoy.

Human Impact

Keep Your Distance!

Objectives

Students will:

1. Understand the possible negative consequences for people and wildlife under conditions of crowding.
2. Identify ways people can behave to help reduce negative consequences of crowding for wildlife.

Key Words

1. *Crowd* – to urge, herd, or force a closely packed group of people or animals into a place
2. *Rookery* – a breeding or living area for large numbers of animals, especially birds or mammals that come together in colonies to nest or breed.
3. *Wildlife manager* – a person whose job is to protect wildlife and its habitat and to educate the public about wildlife.

Materials

Press release: *Wild Babies Do Not Need "Helping" Human Hands*

Background

Wild animals most often are threatened when crowded by humans, even though the humans may mean no harm. Animals may display their discomfort by fleeing, grinding teeth, coiling, hissing, stomping, feet, snarling, coughing, or woofing. They may try new ways of threatening to attack. Wildlife photographers know that they are too close when the wildlife they are photographing begin to act strangely. One way of understanding how a wild animal acts when crowded is to recognize that many animals have certain distances they keep even from their own kind. Wolves may demand large areas of range with no other wolf outside of their own pack (family) may enter. Studies show that certain kinds of finches always leave a certain distance between themselves when they perch on a telephone wire or fence line.

When crowding occurs, many animals react with bizarre, aggressive, disordered behavior, and they may develop skin diseases, like mange. Over time, this may cause them to stop reproduction. In the United States, great blue heron rookeries have been disturbed just by the presence of people. Rookeries are the bird's breeding grounds. Herons live most of the year as lone individuals. Visitors to the Bosque Del Apache National Wildlife Refuge will likely solitary herons because herons live most of the year as lone individual. When the birds do come together to go through courtship and nesting they experience great stress if disturbed by humans. When stressed they may stop breeding, lay few eggs or cause young birds to perish. At a heron rookery in Colorado, wildlife managers have had to establish a 1000-foot limit around the rookery. No human disturbance is allowed close to the rookery. They are not sure this limit will save the rookery from development pressures, but they know any closer range would certainly cause problems. The major purpose of this activity is for students to recognize the possible negative consequences for people and wildlife as a result of conditions crowding.

Advance Preparation

1. Introduce the concept of discomfort from crowding by having students line up in two rows facing each other. Each student in one row slowly approaches the person across from him or her. The stationary person gives a signal to stop when it gets too close. Have them hold their positions and really "feel" the closeness. Look up and down the row. Are some spaces between people bigger than others? Repeat with the opposite row doing the approaching.

2. Ask the following questions: Do you allow strangers to approach you as closely as you do friends or family? Why? How do you feel in the middle of strangers on a crowded bus or elevator? How might your body react in some kinds of crowded conditions? (Nervousness, sweaty palms, hard to breath, can't look at people, etc.)

3. Ask the students why animals in the wild might also be uncomfortable when approached by strangers. (Fear of being attacked, need to protect young, etc.) What other things might increase or decrease fear? (Ability to fly away, climb quickly, run fast, swim fast, animal size, whether the animal is alone or with a group, is on a nest, or has young, etc.)

4. Have the students make a list of wild animals they might encounter in New Mexico. Have them estimate what distance should be maintained for each animal species – both for personal safety and for the comfort and safety of the animal. Emphasize that these are just estimates. It's better to stay farther away than you think is necessary than to get too close.

5. Have students hypothesize about animal behaviors that might indicate discomfort such as foot stomping, teeth grinding, raising up on hind feet, looking around nervously, and eventually flight.

<u>Option</u>

1. Have students mime or role play animals in crowded situations. Classmates can guess the animal they are representing, and the situation.

2. Discuss ways in which wildlife harassment might occur unintentionally such as flying too close in small airplanes, getting to close too photograph, calling or heckling for animals to react (especially at zoos), hiking near a nesting site and using loud vehicles near baby animals or in places where animals are unaccustomed to seeing them. At certain times of the year, some animals may be more sensitive to being disturbed. Mating season or during severe climatic conditions such as heavy winters or drought are examples. (Have students read: *Wild Babies Do Not Need "Helping" Human Hands* press release.) Ask students for their ideas about how communities can minimize disturbances. What can individual people do? Summarize reasons it is important to minimize such disturbance from people for wildlife.

New Mexico Science Standards
Grade 5, II, II, I, 3-4
Grade 7, II, III, II, 3
Grades 9-12, II, II, I, 4

Source: Adapted from "Three's A Crowd", Ecosystem Matters, U.S. Department of Agriculture (1995)
www.na.fs.fed.us/spfo/pubs/misc/eco/

New Mexico Department of Game and Fish
Press Release: MAY 31, 2007

Wild Babies Do Not Need 'Helping' Human Hands

Spring and early summer is the time of year when wildlife give birth to their young. It also is a time when people must remind themselves not to touch or approach young wildlife.

"That deer fawn, elk calf or baby bird may seem to be lost or abandoned," but it is not," according to Darrel Weybright, big-game program coordinator for the Department of Game and Fish. "It is natural for young animals to be left alone so their mothers can feed, and to protect them from predators. If you find one, it's always best to just admire it from a distance and quietly move on."

"That deer fawn, elk calf or baby bird may seem to be lost or abandoned," but it is not," says Darrel Weybright, big-game program coordinator for the Department of Game and Fish. "It is natural for young animals to be left alone so their mothers can feed, and to protect them from predators. If you find one, it's always best to just admire it from a distance and quietly move on."

Every year, the Department receives calls from people who find young wild animals and take them home or to an animal clinic believing they are helping. Actually, that is the worst thing they can do, Weybright said. Young wildlife rarely survives when removed from its natural habitat, and close encounters with humans and their pets can be fatal. Young animals can become stressed and not recover. Too much contact with human and pet scents also may prompt the mother to abandon her young, he said.

In New Mexico, early June is the peak time when deer and elk have their fawns and calves. Weybright said this year's good spring moisture will help young animals survive by providing plenty of foliage where they can hide. "It's exactly what mama wants -- somewhere safe to put the young one while she goes off looking for something to eat."

Deer fawns are born without scent, and their spotted coats are very effective camouflage. Often, fawns will hide motionless for hours before their mother returns from feeding, or after luring predators away from her young. Baby birds often fall from their nests or are pushed out by parents encouraging them to learn to fly. Birds on the ground usually learn to fly quickly. People can successfully return them to their nest if they do it quickly, but it usually is best just to leave the birds alone.

"It's important that people also understand that not all young wildlife survives," Weybright said. "Mortality is natural. The best way we can help them is to leave them be."

Keep Your Distance Word Search

Name ________________________________ Date ___________________

T	D	O	O	D	X	I	N	J	W	L	S	U	R	R
B	L	R	R	G	W	A	F	T	A	X	J	P	V	E
E	K	Y	O	S	N	O	U	I	T	U	M	V	T	L
S	Y	R	T	N	H	I	R	D	A	F	N	T	O	O
E	W	E	A	I	X	T	T	C	X	N	D	R	D	Y
C	O	K	D	Z	S	T	A	C	A	R	W	H	N	Y
O	K	O	E	E	K	R	D	T	I	Q	E	T	A	E
S	M	O	R	V	M	G	E	M	I	L	O	R	L	Y
Y	E	R	P	C	T	X	V	V	Z	B	F	U	D	A
S	E	I	C	E	P	S	E	V	I	T	A	N	O	Y
T	I	Z	X	K	Z	Z	F	O	K	D	Y	H	O	L
E	A	Y	E	L	B	I	T	A	P	M	O	C	W	C
M	E	S	A	X	N	Y	M	H	P	L	M	I	E	G
O	L	S	Q	Q	M	Y	K	H	I	V	V	E	B	X
T	L	J	K	B	E	J	E	Y	I	V	I	A	U	P

BIODIVERSITY
COMPATIBLE
CONFLICTING
CROWD
ECOSYSTEM
HABITAT
NATIVE SPECIES
NYMPH
PREDATOR
PREY
ROOKERY
TERRESTRIAL
WOODLAND

Human Impact

A Home on the Mesa

Objective
Students will:
1. Learn about the habitat requirements of different animals
2. Predict what various changes in the habitat will do to the different animal populations
3. Understand the forces that impact the survival of different species of animals

Key Words
1. *Carrying capacity*- the maximum number of organisms of a given species that can survive in good condition in a particular ecosystem on a long-term basis
2. *Cover* – materials that provide protection to an animal (usually vegetation)
3. Diversity/biodiversity- variety of species present and interacting in an ecosystem and the populations of each
4. Environment – the sum of all the surroundings affecting an organism's life and development
5. Habitat – an area that provides an animal with food, water, shelter, and living space
6. Limiting factors – influences that restrict the growth and reproduction of organisms (for example, food, water, space, shelter, predation, pollution, poaching, accidents, disease, parasites, climate conditions)
7. Hanta virus – a potentially deadly disease found in the local rodent population
8. Population – all organisms of the same species in the same area
9. Predator – an animal that hunts other animals for food
10. Prey – animals that are hunted for food by other animals

Materials
Pencils
Paper
Clipboards
Data Prediction Sheets
Wildlife identification guides

Background

Urban growth and development is occurring rapidly in New Mexico. Many people moving into what was formerly wildlife habitat don't realize the impact on the local wildlife until they discover a bear or a bobcat roaming their neighborhood, or they have to keep small pets indoors to keep them safe from raptors and/or coyotes. This activity encourages students to reflect on how the activities of urban growth impact the native wildlife.

Advance Preparation
Choose an example of a local area being developed. Obtain wildlife resource books that list the kinds of wildlife that would live in the area and the habitat requirements for those animals. Before students go outdoors to do the activity, have them research the information needed for the *Data Prediction Sheets*.

Instructions
Part 1
1. Select a site outdoors for students to observe in silence for at least 15-20 minutes. Have students choose a spot away from other students, and explain that there should be no movement or communication with one another.

2. Have students record all of their observations.

3. Now allow students to move about quietly for another 10 minutes and have them record additional observations.

4. Instruct students to write a poem, song or story to convey their feeling about the experience.

5. Have a class discussion about the experience. Volunteers may share their writings, etc.

Part 2

1. Discuss with students the concepts of carrying capacity and limiting factors.

2. Have students define prey and predator; give examples of each.

3. Review food chains and food webs.

4. Divide student into 6 groups. Give each group 5 minutes to derive a definition for one of the following words: cover, environment, habitat, population, species, and wildlife. Each group will then explain their definition to the rest of the class.

Part 3

1. Keep students in the same groups. Tell them that they are owners of a 100-acre tract of land. Each group should choose four or five animals that inhabit that type of land.

2. Give each group one of the partially completed (see above) Data Prediction Sheets.

3. Assign each group a different event from the list below (or brainstorm additional events) that is going to take place on their tract of land. Ask students to predict the impact the event will have on their different animal populations and record their predictions on their data sheets. Students need to determine which animals will die outright, which can remain on the land, and which will need to find new homes. Students need to be able to justify their decisions.

Events

1. A flash flood passes over the area.
2. The land is cleared for one-acre lot homes.
3. An interstate highway bisects the land.
4. The land is cleared, irrigated and planted in crops.
5. The land is developed into a public school, a shopping mall, a manufacturing plant, or a a movie studio.
6. Hanta virus is found in the local rodent population.
7. A wildlfire burns half the land.
8. The land is sprayed with an herbicide.
9. A long-term drought reduces the availability of water.
10. An airport with runways for jets is constructed.

New Mexico Science Standards
Grade 5, II, II, I, 3-4
Grade 7, II, III, II, 3
Grades 9-12, II, II, I, 4

Source: Adapted from “A Home on the Range”, Teaching Kids About the Environment, Clemson University

Data Prediction Sheet

Name: ____ Date: _____________________

Animal Species Numbers	Beginning Population Numbers	Ending Population Numbers
1. _____________	_____________	_____________
Reason:		
2. _____________	_____________	_____________
Reason:		
3. _____________	_____________	_____________
Reason:		
4. _____________	_____________	_____________
Reason:		
5. _____________	_____________	_____________
Reason:		

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FADING SONGS

New Mexico Species are among 20 in Rapid Decline, Audubon Says

By Polly Summar, Journal Northern Bureau

SANTA FE— Ah, the morning "chick-a-dee-dee," warbles the mountain chickadee. There's nothing sweeter for a wake-up call here in the Land of Enchantment.

Unfortunately, you can kiss those morning warbles goodbye if things progress as they have over the past 40 years, according to an analysis released Thursday by the National Audubon Society.

The reason? Call it urban sprawl, energy development or increases in industrialized agriculture, and throw in the escalating effects of climate change and the demand for corn-based ethanol, according to the society.

The result? "It's the canary in the coal mine," naturalist and writer Scott Weidensaul said in a national teleconference Thursday conduced by the Audubon Society. "The message is that no species is safe from sweeping landscape-level changes."

Teleconference participants were quick to say their list of 20 common birds in decline were not endangered but the downward trend in their numbers is disturbing.

The results came from combining the sighting data in the society's century-old Christmas bird count program with the results of the annual Breeding Bird Survey conducted by the U.S. Geological Survey.

In New Mexico, the top five common birds in decline during the past 40 years are: 1. the mountain chickadee, declined by 83 percent; 2. the horned lark, 81 percent; 3. the loggerhead shrike, 74 percent; 4. the Western meadowlark, 57 percent; and 5. the pinyon jay, 54 percent. "Mountain chickadees are cavity nesters, so they need older-aged trees that produce those natural nesting cavities or they need standing dead trees," said Betsy Daub, director of bird conservation and public policy for Audubon New Mexico, based in Santa Fe.

"Through logging practices or expanding residential development, various kinds of forest fragmentation are probably contributing to their decline."

Daub said the good news is that there's time for New Mexicans to turn it around. "But there has to be the will to address open space preservation and look at farming and grazing practices so birds and farms and cattle can all co-exist," Daub said, "and deciding whether we as citizens want to address global warming and national energy policies so we can have birds and the habitats for them and for the people, as well."

In the teleconference, Weidensaul reported that in other parts of the nation, research showed that, if a farmer "had simply delayed mowing by an extra week in early summer, that allowed enough time for grassland birds to bring off a brood of chicks."

One of the society's efforts in New Mexico is the Important Bird Area program, in which more than 60 sites have been identified as critical bird habitats. The society then works with landowners, municipalities, and state and federal agencies to build awareness of the sites and foster protection of them.

Daub said just naming the five birds in decline can help in increasing the public's appreciation and protection of them.

Even the pinyon jay, considered a bully at many bird feeders, has an important place in the ecosystem of New Mexico.

"In the pinon and juniper woodland, jays gather and hide nuts for later use," Daub said. "They don't always remember where all of their storage areas are, so it's a way for the seed to take root and establish new juniper and pinon trees, and it's also a way for other birds and small mammals to find the caches and use them, as well.

"We consider them (jays) a pretty important indicator of the health of pinon and juniper habitats."

Daub said she wanted to emphasize that "these birds are not rare. These are birds that are giving us a number, a declining number, and we have a chance to heed that warning or not."

TOP 20 COMMON BIRDS IN DECLINE

Northern bobwhite
Evening grosbeak
Northern pintail
Greater scaup
Boreal chickadee
Eastern meadowlark
Common tern
Loggerhead shrike
Field sparrow
Grasshopper sparrow
Snow bunting
Black-throated sparrow
Lark sparrow
Common grackle
American bittern
Rufous hummingbird
Whip-poor-will
Horned lark
Little blue heron
Ruffed grouse

National Audubon Society

N.M. BIRDS IN DECLINE

Top five New Mexico common birds in decline:

Mountain chickadee
Horned lark
Loggerhead shrike
Western meadowlark
Piñon jay

National Audubon Society

HOW TO HELP

You don't have to have a big yard to make a difference, according to the National Audubon Society. Even a small area cultivated in native landscaping can help.

Try doing more of this: using bird feeders, native plants, small water features and nest sites or birdhouses.

And less of this: invasive plants, turf lawn, free-roaming cats and impervious landscaping.

For more information on New Mexico's more than 60 Important Bird Area sites and how you can help protect them, see www.nm.audubon.org or call Audubon New Mexico at (505) 983-4609 in Santa Fe.

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Human Impact

If I Ran the Ecosystem

Objectives

The students will:

1. Learn about food and habitat needs for specific species of wildlife and humans.
2. Understand components of an ecosystem.
3. Discuss effects of different land use choices on the environment and other life forms.
4. Identify land uses that are considered good (compatible) versus those that are considered harmful or less desirable (conflicting).
5. Demonstrate cooperative problem-solving and decision-making skills.

Key Words

1. Amphibian – a cold-blooded vertebrate that spends some time on land but must breed and develop into an adult in water, such as frogs, salamanders, and toads
2. Aquatic – growing or living in or frequenting water
3. Compatible – capable of existing together in harmony
4. Conflicting – fail to be in agreement or accord
5. Decaying – to decrease usually gradually in size, quantity, activity, or force
6. Decision – a report of a conclusion after careful consideration
7. Ecosystem – the complex of a community of organisms and its environment functioning as an ecological unit
8. Environmentalist – a person who voices concerns about the environment.
9. Freshwater – water that is not salty, especially when considered as a natural resource
10. Habitat – the place where a plant or animal naturally or normally lives and grows
11. Mammal – warm-blooded vertebrate animals that feed their young with milk
12. Natural resources – industrial materials and capacities supplied by nature
13. Nymph – any of various immature insects, especially a larva of an insect
14. Predator – an animal that hunts other animals
15. Reptile – an air-breathing cold-blooded egg-laying vertebrate such as the crocodile, tortoise, snake, or lizard, with an outer covering of scales or plates and a bony skeleton
16. Terrestrial - of or relating to the earth or its inhabitants
17. Wildlife – living things, especially mammals, birds, and fishes that are neither human nor domesticated
18. Woodland – land covered with woody vegetation

Materials

Writing materials
The Ecosystem drawing
Role Cards
Optional: overhead projector, overhead transparencies, dry erase markers

Background

Ecosystems can be as small as a tiny pond or as large as an ocean, forest, or desert. The variety of the living species in an ecosystem is known as biological diversity or biodiversity. The nonliving parts of the ecosystem include such things as the surface of the land, such as mountains, rivers and deserts, and constructed features such as highways and railroads. Nonliving parts also include moisture, soil types, and climate.

All of the parts of an ecosystem interact naturally in give-and-take, interdependent ways. In a healthy ecosystem, the native biodiversity is intact and the system operates in ways to maintain that diversity. Some ecosystems have the ability to recover quickly from changes, absorbing much change and impact. Some ecosystems are very fragile. For every change, there is an effect. The loss of one species or the change in one physical factor can make a huge difference. It can even determine whether or not the entire ecosystem can function and survive. In addition to the stresses put on ecosystems through forces of nature, today's growing human population continues to need and want more and different things. Most human needs (food, clothing, shelter, space, etc.) involve the use of natural resources. That means ecosystems are directly affected.

Sometimes, the ways we use natural resources and impact ecosystems are compatible or not destructive to one another. Other times, the ways we decide to use resources conflict and what's good for one part of the ecosystem is not good for another.

Advance Preparation

The proposed changes will be based on specific wildlife, human, or special interest group they represent. Each group needs to consider what they eat, where they live, what materials they need to build homes or other structures, what they need for protection, how long the changes will last, or how the changes will affect the other groups. Students discover that different groups need many of the same natural resources. Some of the natural resource uses will be compatible and others will not be compatible. Each group has a right to present its members' needs. They must listen to the needs of others, and together make a decision as to the best use of the resources.

Advance Preparation

1. Copy one ecosystem drawing for every two to three students and one class copy of both role description pages and role pictures. Copy the pages back-to-back. Cut the role cards apart.

Option

Provide each group with an ecosystem drawing on an overhead transparency. Have students use dry erase markers to mark their changes. The transparency can also be used to make a presentation back to the class.

2. Discuss with students the concept that for every change in an ecosystem there is an effect. Everything in an ecosystem is connected at some level.

3. Discuss "compatible use" with students. Ask them for examples in their personal lives of a common space that is run or managed with many different interests in mind. Have students briefly describe the space and how it is managed (some examples are a school building, community center, park, gymnasium, or a sports complex).

Instructions

1. Students will work in small groups to decide whether or not to make changes to an ecosystem. Divide students into small groups of two to three members. There should be at least eight groups, each of which will represent a different viewpoint: those of farmers, students, environmentalists, ecosystem managers, as well as insects, reptiles, fishes, and birds. Additional groups can represent other wildlife species.

2. Give each group a copy of *The Ecosystem* picture and explain that this is the common space about which they will make decisions.

3. Give a *Role Card* to each group. Have students read the role description on the back of their group's cards, and then answer the following questions in their groups:
   A. What do you eat?
   B. Where do you live?
   C. What are your habits or what do you like to do?
   D. How much space do you need (for example, a large animal may need more space than a small animal, and a school would need more space than a house).
   E. What kind of materials do you need to build a home or shelter?
   F. Where will you get the materials?
   G. What do you need protection from?

4. Each group should:
   A. Talk among themselves about the kind of adjustments or changes they would like to make to the ecosystem. The changes are made from the point of view of the wildlife or human roles they represent. Changes can include planting, building, removing, and other actions that will make their life better. Students can use *The Ecosystem* picture to make a rough copy of the changes.
   B. Decide how long the changes will last, whether they are permanent or temporary, and what effect the change will have on the other groups.

5. Each group should:
   A. Present its proposed changes to the ecosystem to the class, including who is being represented (the *Role Card*) and pertinent information from the card.
   B. Define for the group any vocabulary words that come up in their group that may not be familiar to the class.

6. After the students have all made presentations, the class should work to reach a consensus on changes they will make to the ecosystem. Ask each group to identify:
   A. Who would be affected by their changes
   B. How the ecosystem would be affected by their changes
   C. Which changes are compatible?
   D. Which changes are not compatible?

New Mexico Science Standards
Grade 5, II, II, I, 3-4
Grade 7, II, III, II, 3
Grades 9-12, II, II, I, 4

Source: Adapted from "If You Owned the Ecosystem", *Ecosystem Matters*, US Department of Agriculture (1995)

Human Impact

Native or Not?

Objectives

Students will:

1. Identify some native and non-native animal inhabitants of New Mexico.
2. Learn about the effects that non-native animals species can have on an area where they were not originally found.

Key Words

1. *Introduced species* – a plant or animal species that has been brought into an area from some other place.
2. *Invasive species* – an introduced species that is invading the habitat of native species
3. *Exotic species* – another word for a non-native, introduced species
3. *Migrate* – to move from one place to another in response to changes in season and food supply
3. *Native species* – plants or animals that originated in and are restricted to living in a particular habitat
4. *Non-native species* – plants or animals that have been brought to an area from someplace else.

Background

Live in New Mexico long enough and somebody will ask "Are you a native"? Translated, this means "Were you were born here?". Introduced species are animals and plants that are not native to an area. These species can be introduced into an environment in several ways:

Many species are introduced into an area by people. People often bring the plants and animals from their previous home to a new home. Some of the animals are pets which later escape. Some species are brought for agricultural reasons. Cattle are an example of this. The West has a reputation for being "cattle country". When cows go down to a river or stream to drink, they generally stick to the same path. This can lead to trampled and eroded riverbanks. This change to the natural habitat can cause problems for large animals such as elk and deer.

Some non-native species arrive in an area as hitchhikers. As people travel and explore new lands, animals are brought along accidentally in cargo ships or planes. Non-native wild animals may migrate to a new area to find food, or seeds of a plant may be carried by wind or storms and deposited in a new habitat.

Some species are introduced into an area for public hunting and viewing. In 1969 the oryx was introduced in New Mexico for hunting purposes. The oryx is one of Africa's largest antelopes. New Mexico has the only free-ranging herd of oryx outside Africa. Oryx have adapted well to the state's habitat, which is similar to their native land, and their population has grown.

New Mexico Governor Bill Richardson and oryx. September 2005. Courtesy photo.

No matter how introduced species arrive in their new environment, some of them are harmful to the health of the habitat. The native species did not evolve with the foreign species, so the native species may not have developed defenses against new predators or competitors. New, predators then are either able to hunt and diminish the population of their prey, or they are more successful than native species in obtaining territory, food and other resources. The new species may have no natural predators in their new home.

Non-native plants can choke out native plants species by taking up more space, water, and soil nutrients. The non-native plants may not provide the kind of food or shelter needed by native animals, causing even more problems for the ecosystem.

Introduced species, if successful in a new habitat, can become invasive, causing many problems and damaging the habitat and the delicate balance of the animals living there. There are several plant and animal species that have been introduced and have been causing problems in the Southwest. For example, Conservation International believes that about 60% of the Sonoran Desert in Arizona may be covered by invasive plants rather than native plants.

Materials

Books or magazines on New Mexico plant and animal species
Paper
Poster materials
Pencils, markers, etc.

Instructions

1. Discuss the background information with students.

2. Have students identify two native New Mexico animals.

3. Have students identify two non-native animal species that have been introduced to New Mexico.

4. Ask students:
   - A. What often happens to native animals when an introduced species is very successful in the area? Why?
   - B. Many people believe that the phrase “survival of the fittest” means only the strong survive. Is this correct?

5. List and explain four reasons why animals may be introduced into an area.

6. Have each student choose one native and one non-native animal to research.

7. Have students write short reports based on their research of these animals.

8. Have students make posters that some of the possible before and after effects of introducing non-native species into a habitat.

Background for the Game (ES/MS level)

Have a class discussion about the following: There are more than 90 million pet cats in the U.S. In addition, millions of stray cats roam our cities and rural areas. Scientists estimate that free-roaming cats kill hundreds of millions of birds, small mammals, reptiles and amphibians each year. Many national animal organizations are working to encourage people to keep their pet cats indoors to help solve this problem.

Game Instructions

Students will play a variation of tag. The game should be played in a large outdoor area.

1. Choose one student to be a "cat". The other students will be "birds."

2. Have the birds spread out across the playing area. At the start signal, the "cat" will have one minute to catch as many birds as he/she can. At the one-minute break, any birds that have been tagged will become cats.

3. Continue playing in one-minute cycles for a designated time – or until there are no birds and everyone has become a cat.

(Note: The American Bird Conservancy (ABC) has developed education materials, including fact sheets, posters, a brochure called "Keeping Cats Indoors Isn't Just For The Birds", and an Educator's Guide for Grades K-6. http://www.abcbirds.org/cats/)

NM Science Standards:
Grade 5, II, II, I, 3-4
Grade 7, II, III, II, 3
Grades 9-12, II, II, I, 4

Albuquerque's Environmental Story

Educating For a Sustainable Community

by Larry Caudill et al.

Background and Problems

Before Earth Day 1970 moved the word *ecology* from the biology classroom into common parlance, few people understood the delicate interrelationships that exist in the natural world. Although many still tend to be *anthropocentric*, thinking of everything in terms of human values, and regarding people as the central entity of the universe, we are now generally more aware than we formerly were of the importance of other living things in our environment, and of our interdependence with them. There is increasing evidence that we live in a system that is seeking equilibrium, and that if a change occurs in one sector of that system, it affects all other parts either directly or indirectly. Ecology (*eco*-house, *ology*-study of) is the study of that system and of the interrelationships that occur in it. The largest system, or house, is our planet and its atmosphere. The city of Albuquerque and its environs can be viewed as a microscopic example of the whole house.

Disruption of Equilibrium

As human beings have modified their environment to make it most beneficial in their search for food, shelter, energy resources, waste disposal sites, and recreation, they have contributed to disruption of equilibrium in the natural systems. This imbalance has resulted in two widely divergent consequences--among other changes. One is the extinction, or threatened extinction, of many species, both plant and animal. The other is the proliferation of plants and animals that have been introduced by humans into areas in which they have no connections or natural enemies. Both of these disruptions of natural patterns have resulted as much from ignorance and thoughtlessness as from deliberate decisions to sacrifice natural elements to human wants and needs.

Plants and animals have become extinct or endangered for several reasons. A major cause is indirect extermination, whereby people destroy habitats either directly, when they cut down trees, fill in marshes and swamps, build dams and highways, and develop cities in formerly open areas; or indirectly, when destruction results from overgrazing, soil depletion, erosion, or the pollution of air, water, and food supplies. Plants and animals are also endangered by direct extermination. People kill animals deliberately because they consider them pests, or by collecting living specimens of plants and animals to sell.

Three Categories* of Peril for Plants and Animals

**Different methods of classification are sometimes used.*

The plants and animals whose ultimate survival is imperiled can be grouped in three general categories:

continued …

1. Endangered-species currently in danger,
2. Threatened-species expected to become endangered;
3. Sensitive-species that are rare, sensitive to environmental disturbance, but not in imminent jeopardy.

Roadrunner

Some animals in the Albuquerque area have not been adversely affected by disruption resulting from the growth and urbanization of the past half century. Our state bird, the roadrunner, for example, lives successfully on the lizards, sparrows, and other small animals found in urban rubble, and can frequently be seen sunning itself on concrete pavements. Hummingbirds abound in the valley, mesas, and mountains during the warm months. Kestrels, flycatchers, and nighthawks are widely present and consume huge quantities of insects in the summer. These are all creatures that have effectively adapted when their natural habitats were disturbed and replaced by the built environment.

Other animals, such as the black hawk, have not fared as well when their nesting sites were eliminated from riparian areas by human efforts to control wetlands with salt cedars. These tamarisks, originally imported to reclaim swampy regions, have now been recognized as an uncontrollable species, thereby becoming another example of the danger that accompanies the introduction of exotic (not indigenous) species into a new environment.

Burrowing Owl

Prairie dogs are disrupted and seriously reduced in number as habitable mesas turn into buildings and parking lots. Two animals that depend on prairie dogs are the already endangered black-footed ferret, which feeds exclusively on Gunnison's prairie dog, and burrowing owls, which rely on the colonial animals to provide adequate nesting burrows during the summer months.

Some Species Eliminated, Others Introduced

The kinds and numbers of animals in the Sandias have been changing constantly through the years. Without human interference, these changes occurred slowly. When people became involved, some species, such as the grizzly bear, true wolves or lobos, and pronghorn antelope, were rapidly eliminated. Other animals disappeared from the Sandias and then reappeared, either by coming in from adjacent areas, or when they were reintroduced by human beings. The black bear, Rocky Mountain bighorn, and mountain lion are examples of the latter.

Many animals currently in jeopardy in the Sandias are the same as those found on endangered species lists for the entire state or for the country in general. A list of endangered animal and plant species in the state can be obtained from the New Mexico Department of Game and Fish.

continued …

While most of the Sandia Mountain area is within the Sandia Ranger District of the Cibola National Forest, the Forest Service's district ranger manages only the land and vegetation that feeds and shelters the wildlife. The animals themselves are managed by the state department of game and fish, with considerable interagency cooperation. The Sandias have been designated by the department of game and fish as a wildlife refuge. Although bow hunting of deer is allowed, gun hunting is not permitted in an effort to offer maximum protection to the bighorn sheep herd.

The Sandia Mountains contain several plant species that must be protected. For example, when Tramway Boulevard was widened, the new part went directly through the middle of a population of thirty or forty grama grass cactus plants, already endangered for three of the general reasons cited previously: (1) collection; (2) development; and (3) other forms of habitat destruction such as erosion, soil depletion and overgrazing. In this case, overgrazing reduced the grass cover and enabled rabbits, who like to feed on the grama grass, to find these plants easily. To save the species, road construction was halted until the remaining population could be moved to a safe location.

Among the sensitive or rare plants in the Sandia foothills are the Santa Fe milk vetch (*Astragalus feensis*) and the cyanic milk vetch (*Astragalus cyaneus*). Development and habitat destruction are responsible for their diminishing numbers. Higher up in the Sandias another rare plant, Plank's catchfly (*Silene plankii*), is found. The bighorn or mountain sheep, which are native to this region, browse on these rare plants, but a delicate balance has been maintained. If non-indigenous animals (e.g., the Persian ibex that have been introduced in other New Mexico mountains) were brought in, these sensitive plants might be threatened. Ibex are considered "feeders of opportunity." They do not have their own niches, and tend to eat almost any plant the area provides. The Forest Service has a policy of not permitting introduction of exotics because such animals offer too much competition for native species, and can disturb the natural equilibrium of a region.

The negative consequences of human interference with natural processes have been dramatically demonstrated in the southern part of our state, where Persian ibex and Barbary sheep were brought in to provide more game for hunters. The plan did not work out as projected because these animals are small and difficult for hunters to locate. As a result, they, like other introduced animals lacking natural enemies, proliferated and became a management problem. The food supply is rapidly depleting, and sensitive plants, as well as populations of native animals, can be seriously affected. In an attempt to prevent further spread of Persian ibex and Barbary sheep, the state game commission opened up year-round hunting for these two species in 1985 and increased the bag limit.

The preservation of wildlife in an area like Albuquerque, where the natural world has been encroached on by urbanization has prompted the formation of Wildlife Rescue, Inc., a nonprofit volunteer organization.

The group's motto, "Raise--Rehabilitate--Release," states its three main concerns. It provides care for orphaned, injured, and sick wildlife.

continued …

Every year, the organization receives many creatures during "baby season" and raises them to releasable age. It sponsors classes that offer instruction in the feeding, maintenance and "wilding" of orphaned birds and mammals. The return of a wild creature into its natural habitat is a precious and rare experience. All of the Wildlife Rescue's birds and mammals are returned to the wild as soon as they are self-sufficient and vigorous. This is part of the group's commitment to the preservation of environmental quality in an age in which habitats are diminished.

Activities

1. Discuss the idea that people have a history of thinking of living things as "good" or "bad" for them, and then making decisions based on these judgments.

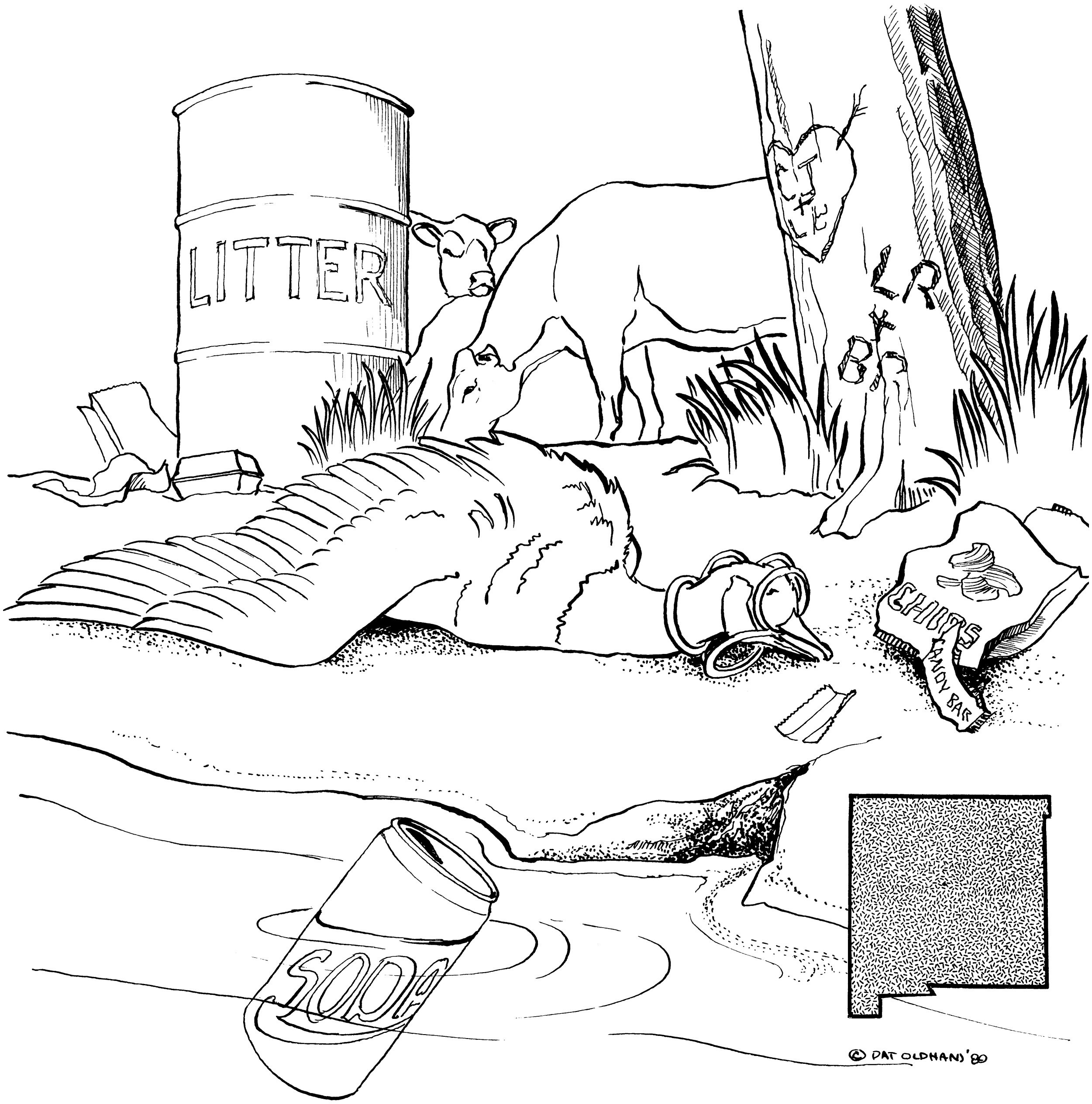
2. Place on the continuum below the general reputation of the following. Discuss.

    - Rattlesnakes
    - Christmas trees
    - rats and mice
    - coyotes
    - ponderosa pine
    - red ants
    - land snails
    - hummingbirds
    - cactus
    - roses
    - mountain lions
    - "stink bugs"
    - tarantulas
    - cockroaches
    - black widow

"When a change occurs in one part of the circuit, many other parts must adjust themselves to it. Change does not necessarily obstruct or divert the flow of energy; evolution is a long series of self-induced changes, the net result of which has been to elaborate the flow mechanism and to lengthen the circuit. Evolutionary changes, however, are usually slow and local. Man's invention of tools has enabled him to make changes of unprecedented violence, rapidity, and scope."
--Aldo Leopold

Source: Albuquerque's Environmental Story: Toward a Sustainable Community, © Hy and Joan Rosner (1996).

New Mexico Science Standards
Grade 5, II, II, I, 3-4
Grade 7, II, III, II, 3
Grades 9-12, II, II, I, 4



A Riparian Tragedy

At one time, this area was alive with abundant grasses, trees, shrubs, and flowers. It provided food, water, protection and cover for many different kinds of wildlife. However human activity in this area, over time, has left the vegetation trampled along the banks, which will ultimately lead to erosion. Damage to these delicate riparian areas has occurred all throughout New Mexico. As a result, many wildlife species are decreasing, no longer able to survive without these beautiful, rich "green zones" we call riparian habitat. Progress is being made and some species are recovering but without everyone's involvement many wildlife species will continue to suffer from unwise human activities on the land.

Source: From "Aquatic Wildlife of New Mexico", a coloring book by Pat Oldham and Don L. MacCarter, New Mexico Department of Game and Fish (1997)

Human Impact

Effects of Oil Pollution on Birds

Objective
Students will learn the impact of oil in our environment on the bird population and habitat

Key Words
1. *Barbs* – the separate strands in a bird feather that are bound together by barbules
2. *Barbules* - rows of tiny stiff hooks that bind the barbs together in a bird feather
3. *Pollute* – to make the environment dirty or impure by introducing damaging substances such as chemicals or waste products
4. *Preen* – to groom feathers with a beak
6. *Toxic* – causing serious harm or death, poisonous
5. *Vane* – the flat part of a feather consisting of interlocking rows of stiff hooks called barbs

Background
See sidebar: *How Oil Pollution Affects Birds and Other Wildlife in New Mexico*

Water runs off a bird's back because the bird is protected by a layer of feathers, overlapping like the tiles on a roof. The fine structure of the feathers makes them waterproof. The separate strands, or barbs, in each feather are bound together by rows of tiny hooks, or barbules, into a tight weave that water cannot permeate. Underneath is a layer of insulating downy feathers that allows the bird's skin to stay warm. Beneath the skin is a layer of body fat that can add some insulation. This waterproof system works like a winter coat whose outer waterproof layer covers a thicker layer of material that traps air, keeping the wearer warm and dry.

The system works well because the bird spends much of its leisure nibbling at its feathers, cleaning off any specks of dirt and rehooking the barbules. This preening keeps the feathers waterproof. It takes very little to disturb the intricate arrangements that make up this feather "coat." Oil destroys the coat by clogging the barbs and barbules, allowing cold water to soak into the insulating down and reach the skin. Even a small amount of oil – a spot no bigger than a quarter – may be enough to kill a bird.

Once the bird is touched by oil, its body heat drains away through the "tear" in its feathers. The bird tries to maintain its body temperature by burning its energy reserves stored as body fat, but these are soon exhausted. When fat reserves are used up, a bird will burn up its flight muscles to maintain body heat. It may try to save itself by spending more even more energy in search of food. It is handicapped by its extra burden of soaked feathers and weakness, and the exhausted bird will soon die.

The bird's other response to oiling is to preen itself to try to restore the feather's waterproofing. As it preens, the bird inhales and swallows toxic compounds in the oil that can damage its liver, lungs, kidneys, intestines, and other internal organs. This poisoning can kill a bird, but it is slower to take effect than is loss of body heat. Oil on the feathers of an incubating bird may also be carried to its eggs, and if the oil soaks through the shell, it can kill the embryo or cause abnormalities in the developing chick.

Materials

Feather	Timer	Oil
Container	Towel	Styrofoam bowl
Liquid Dawn	Water	Egg
Magnifying glass or microscope	Pipette	

Instructions

Part 1

1. Examine a feather with a magnifying glass or a dissecting microscope. Sketch the feather.

2. Use your fingers to rub the feather against the vanes. Now gently stroke your fingers of the feather with the vanes. What happens?

3. Fill a container with water and submerge the feather for 5 seconds. Remove the feather and shake it gently. Compare the feather wet to the way it looks dry.

4. Lay the feather on a paper towel. Record how long it takes for it to completely dry.

5. Now dip the feather in oil. Remove the feather and record your observations. Do you think this bird could fly?

6. Birds caught in oil are washed with liquid Dawn to remove the oil. Wash the feather with one
or two drops of dawn and rinse well. Record your observations.

7. Lay the feather on a paper towel. Record how long it takes for it to dry completely.

8. Why do you think the feather remains wet longer after it has been washed with soap?

9. Do you think a bird after being washed with Dawn will have trouble flying or swimming?

10. What should you do to ensure a bird's survival that has been washed with Dawn?

11. How do you think oil would affect other animals, like fish or mammals. How oil would affect scales and hair?

Part 2

Effects of Oil Spills on the Egg

1. Make a prediction about whether an egg is permeable to oil.

2. Carefully peel the egg that has been soaked in oil. Record your observations.

3. Was the shell permeable to oil?

4. What do you think would happen to the embryo in an egg that has been soaked in oil.

Part 3

Oil, Water and Soap

1. Fill a styrofoam bowl full of water. Using a pipette, drop three or four drops of oil on the surface of the water. Record your observations.

2. Use a pipette to drop a few drops of detergent over the oil. What happens

3. Why do commercials claim that "Dawn Breaks up Grease"? Is this a valid claim?

New Mexico Science Standards
Grade 5, II, II, I, 3-4
Grade 7, II, III, II, 3
Grades 9-12, II, II, I, 4

Source: Adapted from “Oil Spill”, The Biology Corner, www.biologycorner.com/worksheets

How Oil Pollution Affects Birds and Other Wildlife in New Mexico

One way that humans impact the ecosystem is by polluting it with oil. Oil that escapes from ships through accidents or through deliberate dumping has a terrible affect on marine life. Many people are involved in efforts to prevent oil spills and its consequences to wildlife, and to help clean up oil pollution when it occurs.

Oil pollution can also be a problem for birds and wildlife in land-locked oil producing states such as New Mexico. Waterfowl are attracted to the crude oil pits and open tanks used to store and separate oil from produced water. The pits also attract hawks, owls, songbirds, bats, insects, small mammals, and big game. When songbirds and mammals approach oil-covered pits and ponds to drink, they can fall into the pits, or they can become entrapped if the banks of the pits are oiled. Insects entrapped in the oil can also attract songbirds, bats, and small mammals. Hawks and owls in turn become victims when they are attracted by struggling birds or small mammals. The U.S. Fish and Wildlife Service (USFWS) personnel have found waterfowl, songbirds, bats, pronghorn, and deer in oil pits and tanks.

According to the USFWS, in 1997 up to 2 million birds died landing in oil pits to bathe and drink. Placing netting over the pits has improved the situation somewhat. Currently, there are no overall estimates for the number of birds affected by oil and gas spills, and oil and gas extractions (and transport.)

Human Impact

Wildlife and the Border Fence

Objective
Students will learn about the impact on wildlife of human-made barriers placed in wildlife habitat.

Key Words
1. *Endangered* species – plants and animals whose numbers are so few that they are in danger of disappearing from the Earth
2. *Habitat* - the place where an organism lives and grows

Background
See article: *Border Fence Could Threaten Wildlife*

The US government is planning to build a 700-mile long double fence on the US-Mexico border to stop illegal immigration and smuggling across the border. Biologists are very concerned that this fence will harm the region's wildlife by blocking patterns of wildlife movement and cut the animals off from water sources. They are worried that the fence will harm endangered species and fragile habitat, such as jaguars and Mexican gray wolves in New Mexico; the cactus pygmy owl and Sonoran pronghorn in Arizona; the flat-tailed horned lizard and bighorn sheep in California; and the Rio Grande ocelot in Big Bend National Park in Texas; also migratory birds such as Gray and Swainson hawks and Rufous hummingbirds. Many biologists believe that the fence also will prevent movement of snakes and turtles, as well as wild turkeys and roadrunners.

Many biologists think that the many bright lights that will be placed along the fence will add to the overall problem. They predict that Insects will be attracted to the lights rather than pollinating the cactus plants. A lot of migratory birds migrate at night, using the moon and starts to navigate. Scientists are worried that the lights atop the fence will disrupt the ability of various birds to navigate and their patterns of feeding and resting.

Materials
Books, magazines and Internet resource information about Southwestern species
Writing materials

Instructions
1. Review with students the newspaper article, *Border Fence Could Threaten Wildlife.*

2. Have each student select and write about a Southwestern animal.

3. Have each student write a report or a short story about the fence problem from the point of view of one of the species that would be affected by such a fence.

Options
1. Have students create an original play.

2. Have students write poems about the issue.

2. Have a class debate about the issue.

Albuquerque Journal May 29, 2007

Border Fence Could Threaten Wildlife

By Lynn Brezosky
The Associated Press

ERIC GAY/THE ASSOCIATED PRESS

Wildlife outreach specialist Nancy Brown walks a trail at the Santa Ana National Wildlife Refuge in Texas this month.

ALAMO, Texas — Nancy Brown drives the government truck slowly past mossy ponds, thick shrouds of beard-like Spanish moss and majestic ebony trees, gleefully identifying the song of the kiskadee and the gurgling call of the chachalaca.

As the truck rounds a bend near the greenish-brown Rio Grande, a bobcat scampers ahead, disappearing into the lush subtropical foliage. Lizards dart about. A tortoise lazes in the sun. Somewhere [redacted] camouflaged by evolution, are ocelots and jaguarundi both of them endangered species of cats.

These are some of the natural wonders in the Rio Grande Valley that Brown and other wildlife enthusiasts fear could be spoiled by the fences and adjacent roads the U.S. government plans to erect along the Mexican border keep out illegal immigrant and smugglers.

Environmentalists have spent decades acquiring ar preserving 90,000 riverfro acres of Texas scrub and forest and protecting their wildlife. Now they fear the hundreds of miles of borde fences will undo their worl and kill some land animals by cutting them off from tl

Rio Grande, the only source of fresh water.

A fence could prevent the ocelots and other animals from swimming across the water to mate with partners on the other side.

"If you have a fence that runs several miles long, if you are a tortoise or any animal that can't fly over or go through it, then you have a pretty long distance that you have to go to get water," said Brown, an outreach manager at the Santa Ana National Wildlife Refuge, 225 miles south of San Antonio, Texas. Also, "any destruction of any brush is very damaging."

In addition, some worry that the barrier — described in some plans as triple-layer metal fencing — will damage the tourism industry along the Rio Grande.

The wild cats, reptiles and at least 500 species of birds attract visitors from around the world who bring the impoverished region $150 million a year. Depending on how far inland the fence is built, it could create a no man's land north of the river.

While the Department of Homeland Security said it has not made any final decisions on where the fence will go, meetings this week with the Border Patrol have wildlife officials convinced that some of the 70 miles planned for the Rio Grande Valley will be erected on the string of wildlife refuges along the border.

Homeland Security spokesman Russ Knocke said environmental concerns will be taken into account in the final decisions.

President Bush called for about 700 miles of fence along the U.S.-Mexico border, and Homeland Security is committed to completing 370 miles by the end of 2008. Congress has budgeted $1.2 million for the fences.

Close to $100 million has been spent creating, restoring and maintaining the refuges, wildlife officials said.

"The bottom line is the wildlife corridor took us many years to put together," said Karen Chapman of Environmental Defense.

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New Mexico Science Standards
Grade 5, II, II, I, 3-4
Grade 7, II, III, II, 3
Grades 9-12, II, II, I, 4

Human Impact

The Poaching Problem

Objective
Students will:
1. Learn about the poaching problem and the scope of illegal trade in wildlife
2. Prepare a poster about Operation Game Thief

Key Words
1. *Illegal* – forbidden by law
2. *Poaching* – illegally catching live animals or killing animals a person who illegally kills wildlife is called a poacher
3. *Profit* – to make money on something
4. *Trafficking* – illegally selling things like drugs, weapons and animals

Materials
Writing materials
Library materials
Internet sites such as
www.wildlife.state.nm.us and www.wildlife.state.nm.us/publications/documents/blackbears.pdf
www.nwf.org (enter "poaching" in the search box)
www.hsus.org (enter "bear poaching" in the search box)
www.worldwildlife.org (enter "poaching" or "bear poaching" in search box)
www.fws.gov (enter "poaching" in the search box)

Background
See sidebar: *The Bear Parts Market*

The illegal killing of wildlife, otherwise known as *poaching*, has become the world's most profitable crime activity behind drugs and guns. A person who kills wildlife illegally is commonly called a poacher. Poaching has driven many species to the point of extinction. Because wildlife belongs to all of us, poachers are stealing something of enormous value from us all. Under federal law, the maximum penalty for trafficking in endangered wildlife, such as black bears, is five years in prison and a $250,000 fine.

In New Mexico and throughout the Southwest, mammals such as black bear, deer, elk, pronghorn, big horn sheep, oryx, ibex and javelinas (peccaries. Poachers are interested in selling animal parts to make money. For example, antlers can be sold as trophies, or used to make furniture, or ground up and used in traditional folk medicines. Around the world, many people believe that particular animal parts possess healing properties. Bears are in especially high demand for this purpose.

Reptiles and amphibians also are poached. Belts, boots and purses made from reptiles are very popular with some people. Snakes, lizards, tortoises and lizards are also taken from the wild to be sold as pets.

The three basic types of poaching are:
1. Subsistence poaching for food and basic survival. This happens mostly in very poor countries.
2. Commercial poaching for profit. Organized crime (the "Mafia") is often involved in commercial poaching.

3. Trophy poaching for thrill and profit. Some hunters are willing to break the law to get the biggest and best heads, antlers, skulls, hides, etc., for bragging rights or to sell them for thousands of dollars. Poachers make lawful hunters very angry.

Operation Game Thief is a New Mexico Department of Game and Fish program, which pays rewards to citizens who turn in poachers. Begun in 1977 here in New Mexico, Operation Game Thief or a similar program has now been adopted by nearly every other state. Operation Game Thief is crime-stoppers for wildlife. The program was modeled after the original crime-stoppers program started by the Albuquerque, New Mexico Police Department.

Anyone having information relating to a wildlife law violation can contact the Operation Game Thief hotline, which is toll-free within New Mexico at 1-800-432-4263, or submit an on-line report. All information about the incident is taken and the caller is assigned a code number; The information is relayed to an officer who immediately initiates an investigation;

If a poacher is arrested or issued a citation on the basis of information provided by the caller, a reward is authorized;

Rewards can be paid in cash, check or money order and the payment is arranged to protect the anonymity of the caller;

Most wildlife enthusiasts don't except the reward -- they just want the criminals stopped!

The key to success and catching poachers is to report the information as quickly as possible. It is also helpful to give as much detailed information as possible. A checklist is provided at www.state.nm.us/enforcement/operation_game_thief/index.htm.

Advance Preparation

Discuss the background information with students.

Instructions

1. Have the students use the library to find recent newspaper and magazine articles on poaching and the wildlife trade.

2. Have students write TV news spots about poaching in New Mexico to perform for their classmates.

3. Have students prepare colorful posters about Operation Game Thief to place in public places, such as libraries and community centers.

New Mexico Science Standards
Grade 5, II, II, I, 3-4
Grade 7, II, III, II, 3
Grades 9-12, II, II, I, 4

The Bear Parts Market

Bear parts are especially in high demand around the world. For thousands of years, bear parts have been used as cures in traditional Chinese medicine. Nearly every part of the bear has medicinal use. In Korea, bear paws have been considered an exotic delicacy since the ancient dynasties. Today, a bowl of bear paw soup can cost as much as $1,000. By far, however, the gall bladder is the bear's most valuable part. In traditional Chinese medicine, bile and galls are used as remedies for an array of illnesses such as fever, swelling, cancers, burns, internal bleeding, ulcers, pain, heart and liver disease. A gall can command up to $10,000 in East Asia. Globally, the market in bear parts is estimated at $2 billion.

> *". . . Amid the clamor and bustle of an urban Asian market place, on a street lined with elegant shops, is an unadorned but conspicuous booth. Surrounded by a crowd, a vendor hawks his inventory of live mammals and reptiles, elephant tusks, rhinoceros horns, elk antlers, and the gall bladders and paws of bears. The vendor is a link in the international wildlife trade. Many Asians believe that particular animal parts possess healing properties. Medicinal use of these animal parts is leading to the endangerment of several local and regional animal species." – Excerpt*: *Black Bears of New Mexico,*
> New Mexico Department of Game and Fish Brochure

Bears inhabit every continent except Australia and Antarctica. Five of the eight bear species in the world are endangered. In Korea, where they were ounce abundant, black bears are virtually extinct. The population of bears in Russia is dwindling rapidly as a result of gall trafficking by the Russian Mafia. As bear populations decreased in Asia, more poachers are turning to North America where there are a considerable number of bears.   In the Arctic, polar bears are also being taken by poachers.

Human Impact

"Buses and Trucks and Cars – OH MY!"

Objective
Students will learn about the effects of roads and highways on wildlife populations

Key Word
Wildlife crossings – special places on roads and highways where wildlife can cross safely, such as underpasses and overpasses

Materials
Buses and Trucks and Cars – OH MY! Skit
Information about animals in the skit: *New Mexico Wildlife Fact Sheets*
Website resources:
Defenders of Wildlife at www.defenders.org/habitat/highways/
Humane Society of the U.S. at www.hsus.org/wildlife/issues_facing_wildlife/
Tijeras Canyon Safe Passage Coalition at www.safepassagecoalition.org/

Background
Being struck by cars and trucks on roads and highways is the number one way that animals are killed in the US. Deer, elk, cougars and bears are some of the large wild animals that get hit, but smaller animals and raptors are also frequent victims. Wildlife-related collisions injure and kill people too. These kinds of accidents are common in New Mexico because much of the state is wildlife habitat. Thousands of deer are struck by vehicles every year. Does are more likely to be hit, so the impact on reproduction can be substantial.

States are trying to solve this problem using a variety of methods, such as installing special fences and building underpasses and overpasses for wildlife to use to cross highways.

Advance Preparation
Review with students the background information and the article, *Danger Areas Mapped Out*.

Instructions

1. Choose students for all the roles.

2. Pass out copies of the skit to the actors and copies of the directions to everyone.

3. Have the actors highlight or underline their parts.

4. Give the students a few minutes to read their part and to plan.

5. Have students perform the skit.

6. Relate the skit to real life.

New Mexico Science Standards
Grade 5, II, II, I, 3-4
Grade 7, II, III, II, 3

Danger Areas Mapped Out

Animals May Get Fences, Passages

BY KATIE BURFORD
Journal Staff Writer

The most critical places to address the impact of New Mexico highways on wildlife are Tijeras Canyon, Raton Pass, San Augustin Pass on U.S. 70 and N.M. 90 near the Burro Mountains in the Gila National Forest.

That list of priority areas was one of the outcomes of a novel workshop that took place last week in Albuquerque. Participants said it was one of the first to bring together ecologists, conservationists and highway officials for the purpose of devising ways to reduce the impact of roads on animal habitat.

The student group Wild Friends has been an outspoken proponent of measures such as fences and passageways to protect wildlife and make roads safer for motorists. The group, which is organized through the University of New Mexico's Center for Wildlife Law, successfully pushed for a memorial that encourages the state departments of Highway and Transportation and Game and Fish to work together in the long-term planning of road projects.

Workshop organizer Mark Watson, a Game and Fish habitat specialist, said further studies are needed to be done to determine precisely where passageways will be most effective.

Interstate 40 through Tijeras Canyon, a route heavily used by commercial truckers, is especially damaging to wildlife because it inhibits animals' movement between the Sandia and Manzano mountains. Among those most affected are mountain lions, black bears and mule deer, which require large areas to breed and forage for food.

"Tijeras Canyon is probably the most critical right now," Watson said.

Some other areas of concern are:

- Interstate 25 from Las Vegas to Glorieta.
- N.M. 60 through Abo Pass between Sevilletta National Wildlife Refuge and the Manzano Mountains.
- N.M. 126 in the Jemez Mountains.
- U.S. 64 through Taos Canyon.
- U.S. 54 near Corona in Lincoln County.

Albuquerque Journal, July 3, 2003
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“Buses and Trucks and Cars – OH MY!”

A Skit

Adapted from a 2004 play written by Longfellow Elementary School Wild Friends

<u>Roles:</u>

<u>Animals</u>
Mother Bear
Bear Cub
Mule Deer
Coyote
Bobcat
Cougar

<u>Humans</u>
Lou Kingood, TV Reporter
Lotto Piñon, Tijeras Resident
Mark Fields, Habitat Specialist, NM Dept. of Game & Fish
Mia Camino, Highway Engineer, NM Dept. of Transportation
4 Wild Friends Students (Fill in your students’ names for the script)

1. ____________________________________
2. ____________________________________
3. ____________________________________
4. ____________________________________

<u>Nonspeaking Parts</u>
TV Camera Person
Vehicles (cars, buses and trucks)

“Buses and Trucks and Cars – OH MY!”

SCENE 1: *On the shoulder of Interstate-40 in Tijeras Canyon. In the background, the Vehicles “drive” back and forth constantly. Cub is on the opposite side of the Vehicles from Mother Bear.*

Lou Kingood, TV Reporter: *(Standing in front of the TV camera)*
This is Channel WILD reporting live from I-40 in Tijeras, New Mexico, where a small bear cub is trying to cross the interstate highway to get to his mother. Bears, cougars, coyotes, bobcats and hundreds of deer have been getting hit on this road by passing cars and trucks. I have with me some people who want to do something to cut down on these kinds of accidents.

Lou Kingood, TV Reporter holds out a microphone to Lotto Pinon, the Tijeras Resident.

Lotto Piñon, Tijeras Resident: I grew up in Tijeras. I’ve seen so many changes since I was a kid. There are so many more people now. Growing population, urban sprawl and more traffic are having a huge effect on the wildlife. There is just less and less area available for animals to find food, and mates and to have their babies and keep them safe. We need to do something to help the wildlife.

Mark Fields: I’m a habitat specialist with the New Mexico Department of Game and Fish. People have been building homes and businesses in what used to be wildlife habitat. Bears and other wildlife are attracted to fruit orchards, garbage cans, pet food and bird feeders. Sometimes when the people see bears near their home they get scared and try to shoot them. Some people call New Mexico Department of Game and Fish to capture and relocate them.

Lotto Piñon: When Game and Fish relocates bears that have been bothering us, the bears often try to return to their original homes. If their home happens to be on the other side of the freeway, they get hit trying to cross it.

Wild Friend 1: I’m a student who loves animals. It’s not just the bears that are having problems. The Sandia and Manzano Mountains are part of a chain of mountains that runs down the continent. It’s called the “spine of North America” and it connects wildlife habitat from Canada to Mexico. Lots of animals – like deer, elk and cougars – migrate up and down this mountain chain. But now their migration path is cut by Interstate 40.

Wild Friend 2: We need to provide some places where wildlife can cross the highway safely so that they can keep migrating as they always have. The Interstate is a barrier for mule deer, cougars, black bear, skunks, coyotes and other wildlife that travel between the Sandias and Manzanos. Just last week, a cougar was killed on I-40 in Tijeras Canyon.

Mia Camino: I’m a highway engineer with the New Mexico Department of Transportation. This is a safety issue for people too. Wildlife-related accidents are very dangerous for drivers. People are being injured and killed.

Wild Friend 3: And even when the drivers aren’t hurt, their cars are damaged. The auto insurance companies pay millions of dollars in claims every year for these kinds of accidents.

Wild Friend 4: This year's drought is making life hard for the wild animals around here. There hasn't been enough water for them to drink and there's been so little rain that the berries and seeds they eat are not as plentiful. We've had a lot of wildfires too. The animals try to cross the highway to find food, water and safety. Even raptors are being struck by cars, trucks, and buses. The birds get hit while trying to pick up litter or small rodents lying on the road.

Cub runs up to the side of the road where the vehicles are going back and forth. On the other side of the vehicles, Mother Bear paces anxiously back and forth.

Mule Deer, Coyote, Bobcat and Cougar: *Speaking loudly together and swaying in agitation*. Buses and trucks and cars – OH MY! Buses and trucks and cars – OH MY!

Lou Kingood: The cub is trying to cross the Interstate to try to get to the mother bear!

After several attempts to cross the traffic, running back and forth, Cub has a close call with one of the Vehicles. Cub gives up and runs away shaking and whimpering. "Vehicle" shakes too.

Wild Friend 1: *Breathes a loud sigh of relief, and shakes head sadly.*
That bear cub and the drivers were lucky this time! Often it ends in tragedy. Over a million vertebrates get hit on roads every year in the U.S. People die in some of the collisions. There are ways to to prevent many of these accidents, which would save people and wildlife.

Mother Bear: *Howling mournfully, she runs up to the TV Reporter.*
Oh what am I going to do? My beautiful cub was almost hit by a car. Please, can you people help us!

Mule Deer, Coyote, Bobcat and Cougar: (More softly *this time)*
Buses and trucks and cars – OH MY! Buses and trucks and cars – OH MY!

Wild Friend 2: My teacher told me, "Never doubt that a small group of thoughtful, committed citizens can change the world. Indeed, it's the only thing that ever has." Let's all work together to do something about this. Maybe the Transportation Department can help us. Other states have special wildlife fences and equipment, and even some overpasses and underpasses for wildlife so they can safely cross the roads.

Mark Fields: That sounds great. And right now, New Mexico Game and Fish officers will help get the cub safely back to Mother Bear.

SCENE 2: *On the shoulder of Interstate-40 in Tijeras Canyon Two Years Later. The cast stands next to the Lou Kingood, TV Reporter*

Lou Kingood: This is a big day for wildlife and drivers! We're standing along a section of highway that's been the scene of hundreds of wildlife-related accidents. People and wildlife are now going to be safer because a group of citizens got together to do something about it. Mark, can you tell the audience what has changed here?

Reporter holds out the microphone to Mark Fields

Mark Fields: Thanks to the efforts of the people you see with me, cameras, warning lights and miles of fence – some of it electrified – are being put here to keep large animals, especially deer, away from the road, where they are often killed and are a danger to drivers.

Mia Camino: We're also doing some work to improve the culverts so that animals such as bears and cougars can go under the highway, and we're installing some warning lights that are connected to cameras. The cameras will detect the movement of large animals, which will set off lights to warn drivers to slow down.

Wild Friend 3: What you are doing is awesome! I'm so happy that my family and friends will be safer driving through Tijeras Canyon and I'm happy that the wildlife will be safer too. As humans, it's our responsibility to protect our natural resources and our wild animals who can't speak for themselves.

Mia Camino: You should all give yourselves a pat on the back. Once you made us aware of the problem and we began to look for solutions, it turned out that many of the obstacles that hamper safe wildlife crossings turned out to be pretty cheap and simple to fix. The fencing will help funnel wildlife to existing highway underpasses. Local citizens helped clear the underpasses of non-native brush so that wildlife would use the passageways.

Lou Kingood: What kinds of plans do you have for the future?

Mark Fields: The City of Albuquerque is lending a helping hand. The City just bought some land near Tijeras to preserve as Open Space. The land is a critical crossing point for deer, bears and other game looking to migrate between the Sandias and Manzanos. Developing the area would have prevented the populations from expanding and maintaining genetic diversity.

Mia Camino: And the purchase will allow the state to build an important underpass along here to help with wildlife passage.

Lotto Piñon: We really appreciate the work you've been doing here to make people and animals safer. It's a much better place to live now.

Wild Friend 4: It looks like we <u>can</u> change the world!

Wild Friend 1: Now our animal friends are much safer from buses …

Wild Friend 2: and trucks …

Wild Friend 3: and cars!

Animals: ALL RIGHT!!!

Wild Friends: Students Who Write Laws for Wildlife

Every year, New Mexico students in grades 4-12 write laws to save wildlife. They vote by ballot to choose their own subject, research it, and then get wildlife lawyers to help them write a bill or a memorial. Many of them travel to the state legislature in Santa Fe to convince the lawmakers to pass their legislation. They are called Wild Friends.

Wild Friends have been helping wildlife since 1991. They have written four bills and 12 legislative memorials requesting the state to act on issues that affect wildlife. For example, in 2007, Wild Friends students tackled global warming with a memorial asking that New Mexico take specific actions for energy conservation.

The Wild Friends' lawmaking efforts have ranged from taking on wildlife poachers to getting a State Butterfly. The lawmakers respond to them because they know that the young people speak from their hearts out of true love for animals. "I felt I was doing something very important by telling the legislators about the cold fish dying in warm water and the polar bears and global warming," commented a middle school Wild Friend. Through their projects, the students have learned about animals such as bears, elk, deer, prairie dogs, whooping cranes, mountain lions, trout, bald eagles, hawks, snakes, and bighorn sheep.

Wild Friends is a program of the Center for Wildlife Law at the University of New Mexico School of Law. Information about the program is available at http://wildfriends.unm.edu, or contact:

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Endangered Species

"What is man without the beasts? If all the beasts were gone, men would die from a great loneliness of spirit. For whatever happens to the beasts, soon happens to man. All things are connected." – Chief Seattle

One of the major consequences of human impacts on wildlife and plants has been the increase in the overall number of endangered species, both in the United States and across the world. Endangered species are loosely defined as animals and plants that are so rare that they are in danger of becoming extinct. Throughout history, there have been species that have gone extinct, but the overall extinction rate of species around the world has increased dramatically in the last fifty years. Many countries, such as the United States, have specific laws that govern and protect endangered species, and other organizations, such as the International Union on the Conservation of Nature, protect endangered species on a global scale.

Within the United States, each state has a list of endangered species that may or may not be listed as endangered in the rest of the country. In this section, students will be explore the issue and learn about endangered and threatened species in New Mexico.

What are Endangered and Threatened Species?

Overview

A century ago, there was a bird called the passenger pigeon that people often saw in great flocks flying overhead. The flocks contained thousands, even millions, of birds. Today, there is not a single passenger pigeon left. What happened?

The passenger pigeon became extinct. All living passenger pigeons disappeared from the earth entirely. This happened for two reasons. First the forests where the pigeons lived were cut down to make way for farms and cities. Second, many pigeons were shot for sport and because they were good to eat. At that time, there were no hunting laws to prevent endangered species as there are now.

The passenger pigeon is one of the many creatures, as well as plants, that have become extinct. For example, dinosaurs, mammoths, and saber-toothed tigers all became extinct long ago. More recently, the dodo bird and the sea mink also have disappeared. Extinction has been going on since life began on Earth. But today, extinction is happening faster than ever before.

There are more than 1,300 endangered or threatened species in the United States today. Endangered species are those plants and animals that are so rare they are in danger of becoming extinct. Threatened Species are plants and animals whose numbers are very low or decreasing rapidly. Threatened species are not endangered yet, but are likely to become endangered in the future.

How Does Extinction Happen?

Species disappear because of changes to the Earth caused either by nature or by the actions of people. Sometimes a terrible natural event, like a volcano erupting, can kill an entire species. Or extinction will happen slowly as nature changes our world. For example, after the Ice Ages, when the great glaciers melted and the Earth became warmer, many species died because they could not live in a warmer climate. Newer species that could survive a warmer environment took their places.

People can also cause the extinction of plants and animals. The main reason that many species are endangered or threatened today is that people have changed or destroyed the habitats upon which these species depend. A habitat includes not only the other plants and animals in an area, but all the things needed for species' survival, from sunlight and wind, to food and shelter. The United States has many habitats, from ocean beaches, to mountain tops, to deserts, to grasslands. Every species requires a certain habitat in order to live. A cactus, for example, needs the sunny, dry desert in order to grow. A polar bear, on the other hand, would not live in a desert, because it could not find enough food and water.

Pollution can also affect wildlife and contribute to extinction. The Nashville crayfish is endangered mainly because the creek where it lives has been polluted by people living nearby. Pesticides and other chemicals can poison plants and animals if they are not used correctly. The bald eagle is one bird that was harmed by pesticides. In the past, a pesticide called DDT was used by many farmers. Rains washed the pesticide into lakes and streams where it

- continued -

poisoned fish. After eating the poisoned fish, the eagles would lay eggs with very thin shells. These eggs were usually crushed before they could hatch. Today, people are not allowed to use DDT, and the numbers of bald eagles have slowly begun to increase.

People can also endanger plants and animals by moving, or introducing, new species into areas where they do not naturally live. Some of these species do so well in their new habitat that they endanger those native species already living there. For example, when some fish are introduced into a lake or stream, they may prey upon, or eat the food of the native fish. The native species may then have to find a new source of food or a new home, or face becoming endangered or extinct.

Another way that people harm animals and plants is by taking them from the wild. Some people might catch an insect such as the Mission Blue Butterfly for a butterfly collection. Others might capture a wild animal for a pet, or pick a flower because it's pretty. In addition, some people illegally hunt animals for food, skins, or fur. In the past, lots of American crocodiles were killed so that their skins could be made into shoes and other clothing. This crocodile is now an endangered species.

Why Protect Endangered and Threatened Species?

Can you imagine walking in the woods without hearing birds singing in the trees, or picture what a field would be like without wildflowers blooming in the grasses? Our plants and wildlife make the world a more interesting and beautiful place. More importantly, all living species, including people, depend on their species for survival. For example, if a fish, such as the short-nose sturgeon becomes extinct, all of the species that rely on it for food may become threatened or endangered.

We all depend upon plants and wildlife. From studying them, we have learned new ways of growing foods, making clothing, and building houses. Scientists have discovered how to use certain plants and animals as sources of medicines. If we fail to protect threatened or endangered species, we will never know how they might have improved our lives.

Endangered and threatened species need our help. Government agencies, such as the U.S. Environmental Protection Agency, the U.S. Department of Agriculture, the U.S. Fish and Wildlife Service, and the National Park Service, along with state fish and wildlife agencies and private groups are making information available so people can better protect endangered and threatened species and their habitats. To do your part, contact these agencies for information and join the challenge in helping to protect endangered and threatened species, and all wildlife, from extinction.

Source: U.S. Environmental Protection Agency (EPA), http://www.epa.gov/espp/coloring/especies.htm

Bald Eagle

Federally Listed Threatened and Endangered Species in New Mexico (Listed as of June 28, 2007)

Animals	Status
Amphipod, Noel's *Gammarus desperatus*	E
Bat, lesser long-nosed *Leptonycteris curasoae yerbabuenae*	E
Bat, Mexican long-nosed *Leptonycteris nivalis*	E
Bear, grizzly *Ursus arctos horribilis*	T
Chub, Chihuahua *Gila nigrescens*	T
Chub, Gila *Gila intermedia*	E
Curlew, Eskimo *Numenius borealis*	E
Falcon, northern aplomado *Falco femoralis septentrionalis*	E
Flycatcher, southwestern willow *Empidonax traillii extimus*	E
Frog, Chiricahua leopard *Rana chiricahuensis*	T
Gambusia, Pecos *Gambusia nobilis*	E
Isopod, Socorro *Thermosphaeroma thermophilus*	E
Jaguar *Panthera onca*	E
Minnow, loach *Tiaroga cobitis*	T
Minnow, Rio Grande silvery *Hybognathus amarus*	E
Owl, Mexican spotted *Strix occidentalis lucida*	T
Pikeminnow *Ptychocheilus lucius*	E
Rattlesnake, New Mexican ridge-nosed *Crotalus willardi obscurus*	T
Shiner, Arkansas River *Notropis girardi*	T
Shiner, beautiful *Cyprinella formosa*	T
Shiner, Pecos bluntnose *Notropis simus pecosensis*	T
Snail, Pecos assiminea *Assiminea pecos*	E
Spikedace *Meda fulgida*	T
Springsnail, Alamosa *Tryonia alamosae*	E
Springsnail, Koster's *Juturnia kosteri*	E
Springsnail, Roswell *Pyrgulopsis roswellensis*	E
Springsnail, Socorro *Pyrgulopsis neomexicana*	E
Sucker, razorback Xyrauchen texanus	E
Tern, least *Sterna antillarum*	E
Topminnow, Gila (incl. Yaqui) U.S.A. only *Poeciliopsis occidentalis*	E
Trout, Gila *Oncorhynchus gilae*	E
Wolf, gray Southwestern Distinct Population Segment *Canis lupus*	E

Plants	
Poppy, Sacramento prickly *Argemone pleiacantha* ssp. *pinnatisecta*	E
Milk-vetch, Mancos *Astragalus humillimus*	E
Thistle, Sacramento Mountains *Cirsium vinaceum*	T
Cactus, Lee pincushion *Coryphantha sneedii* var. *leei*	T
Cactus, Sneed pincushion *Coryphantha sneedii* var. *sneedii*	E
Cactus, Kuenzler hedgehog *Echinocereus fendleri* var. *kuenzleri*	E
Fleabane, Zuni *Erigeron rhizomatus*	T
Wild-buckwheat, gypsum *Eriogonum gypsophilum*	T
Pennyroyal, Todsen's *Hedeoma todsenii*	E
Sunflower, Pecos *Helianthus paradoxus*	T
Ipomopsis, Holy Ghost *Ipomopsis sancti-spiritus*	E
Cactus, Knowlton *Pediocactus knowltonii*	E
Cactus, Mesa Verde *Sclerocactus mesae-verdae*	T

Source: U.S. Fish and Wildlife Service

[Editor's Note: The U.S. Fish and Wildlife Service announced the removal of the Bald eagle from the Threatened and Endangered Species list on June 28, 2007.]

New Mexico Endangered Species Trading Cards

Common Name of Animal

Scientific Name of Animal

Habitat

Predators

Prey

Reason Why Endangered

Common Name of Animal

Scientific Name of Animal

Habitat

Predators

Prey

Reason Why Endangered

Common Name of Animal

Scientific Name of Animal

Habitat

Predators

Prey

Reason Why Endangered

Common Name of Animal

Scientific Name of Animal

Habitat

Predators

Prey

Reason Why Endangered

Endangered Species

Endangered New Mexico Animals Poster Project

Objectives

Students will:
1. Identify some endangered species in New Mexico
2. Understand some of the causes of species decline
3. Gain perspective on the impact of human activities on New Mexico wildlife

Key Words
1. *Endangered* species – plants and animals whose numbers are so few that they are in danger of becoming extinct
2. *Extinct* – having no living members
3. *Threatened* species – plants and animals whose numbers are very low or rapidly decreasing and they are likely to become endangered in the future

Background

See sidebar: *What Are Endangered and Threatened Species?*

Human populations and activities in New Mexico and elsewhere in the world will continue to grow, putting pressure on all natural habitats. This will have the effect of forcing more plant and animal species on the ever increasing endangered species list. The National Wildlife Federation (NWF) claims that plant and animal species are disappearing worldwide at least 1,000 times faster than any other time in the last 65 million years, and that habitat loss is accounting for almost 75 percent of the extinctions occurring now.

Materials

What Are Endangered and Threatened Species? sidebar
Resources for information about endangered and threatened animals in New Mexico
Items for creating posters (paper, markers, tape, etc.)
Endangered Species Profile
Endangered Species Word Scramble

Some possible Internet research sites are:

www.kidsplanet.org/factsheets/map.html
www.audubon.org/campaign/esa/index.html
http://eelink.net/EndSpp/
www.fws.gov/endangered/
http://fguardians.org/es/new_mexico_species_protection.asp
www.sierraclub.org/wildlife/species/map/southwest.asp
www.worldwildlife.org/endangered
nwf.org/wildlife
endangeredspecie.com
biologicaldiversity.org/swcbd
www.state.nm.us/education
www.desertusa.com

Advance Preparation

Have a class discussion. Ask the following questions:
1. Is the world a safe place for animals and plants? Why or why not?
2. What does it mean for a species to be endangered?
3. What animal or plant species do you know of that are endangered or extinct?
4. Why do you think species are endangered?
5. What, if anything, happens when an animal or plant species becomes extinct?
6. How do you think this situation can be realistically improved?
7. Why should it be improved?
8. What is the difference between a threatened species and an endangered species?

9. Why should we protect endangered species? Some possible answers might include:
   A. Saving species preserves ecosystems: species are an important part of what make up ecosystems; maintaining healthy ecosystems ensures a healthy biosphere;

   B. Practical uses of species: when species become extinct, we may lose a potentially valuable product; and

   C. Aesthetic reasons: when species become extinct, we lose objects of fascination, wonder, and beauty.

10. How can individuals help? Some possible answers might include some of the following:
    A. Support zoos, nature centers, nature reserves, or botanical gardens by volunteering time, money, and/or ideas.
    B. Start a native plants garden or use a spot in your backyard to attract wildlife.
    C. Avoid buying products made from endangered animals.
    D. Keep learning about plants and animals and share what you've learned with others.

Instructions

1. Have students find and research an endangered Southwestern animal that they would like to work towards saving. For fun, students can fill out the *Endangered Species Word Scramble*

2. Have each student fill out an *New Mexico ndangered Species Profile form* sheet about his/her chosen animal. The profile should include basic information about the animal, important facts and statistics about its status, and the student's ideas on effective ways to get the public's attention about this endangered species.

3. Next, have students create a colorful, interesting, and informative poster. Posters are a form of advertising, so students should consider what would the be the most interesting, persuasive, enlightening, and effective way to reveal their chosen endangered animal to the public. Posters and profiles could include eye-opening statistics and other related scientific data. They also could present some special aspects about the animal that are appealing to humans. Posters should include the following information:
   A. Both common and scientific names of animals
   B. Brief description of its habitat
   C. Description of the main reason why the animal is endangered
   D. Drawing or pictures of the animal

4. Have students do classroom and/or public presentations with their posters.

Option

1. Students can be divided into teams for this activity.

2. When all the posters are completed, the class can decide whether to display the posters at a community center, school, or other public place; host an Endangered Species Fair at their school, or send them as a group to a real state or national wildlife organization for possible use in its publicity campaigns.

New Mexico Science Standards:
Grade 4, II, II, II, 1 and III, I, I, 1
Grade 5, II, II, I, 3
Grade 6, II, II, II, 2
Grade 7, II, II, II, 12 and II, III, II, 3
Grades 9-12, II, II, I, 3 and III, I, I, 13

Source: Adapted from "Why are Species Endangered?", http://sciencenetlinks.com/lessons

New Mexico Endangered Species Profile

Name: ___________________________________ Date: ______________________________

Directions: Fill in the blanks with the appropriate information ideas and suggestions about your chosen Save Our Animals species.

Species Common Name:	**Scientific Name:**
Description of Habitat:	**Interesting facts about the species:**
Population estimates or survival trends of species:	**Reason(s) why this species is endangered:**
Reasons why it is important to save the species:	**Possible solutions to help this species survive**
Potential consequences if this species were to become extinct:	

Endangered Species Word Scramble

Name ____ Date ____________________________

Unscramble the words below that go with endangered species.

dalb geela	
gajaur	
ysvirle wnonmi	
dgeir sonde ettarlkneas	
glon soned tba	
ytcheflacr	
liag utrot	
slate rent	

Write four sentences using some of the words above.

1.____

____

2.____

____

3.____

____

4.____

____

Endangered Species Word Scramble Solutions

Answers:

Bald eagle
Jaguar
Silvery minnow
Ridge-nosed rattlesnake .
Long-nosed bat
Flycatcher .
Gila trout .
Least tern

Endangered Species

“If You Hear a Hoot, the Site is Kaput”

Objective

Students will learn about the1973 Endangered Species Act; about governmental agencies and different organizations and their theories on how best to protect these species; and how self-interest plays a role in each group's policies.

Key Words

1. *Critical habitat:* includes
   (a) areas within a listed species current (at time of listing) range containing the physical or biological features that are essential to that species’ conservation or that for some reason require special management; and
   (b) areas outside the species’ current range determined to be essential to its conservation.
   Economic impacts must be taken into account when designating critical habitat.

2. *Defendant* - a person, party, or company required to answer criminal or civil charges in a court of law.

3. *“God Squad”* - the government’s Endangered Species Committee is known informally as the "God squad".

4. *Listed species* - a species that has been determined by the Secretary of the Interior to be either "endangered" (in danger of extinction throughout all of a significant portion of its range, excluding pest insects) or "threatened" (likely to become an endangered species within the foreseeable future). When this determination is made, the species is added to the federal list of endangered or threatened wildlife and plants.

5. *Plaintiff* - a person, party, or company who begins a lawsuit against another person (defendant) in a court of law.

6. *Take* - In the Endangered Species Act, the term "take" means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct". While a wide variety of activities have been ruled by courts as "takes," probably the most important idea is that destruction of critical habitat is included in the definition.

Background

Have a classroom discussion about the Endangered Species Act.

Materials

The Endangered Species Act Summary
Legal Eagles Square Off Over One Troublesome Bird article

Advance Preparation

1. Have students read the summary of *The Endangered Species Act of 1973*.
2. Have students read the *Legal Eagles Square Off Over One Troublesome Bird* article

The Endangered Species Act of December 28, 1973

The Endangered Species Act (ESA) stands out as one of the most powerful and significant environmental laws of the 20th century. It has dramatically altered the way that the federal government protects biodiversity in the United States.

The ESA is important for four reasons:

1. The ESA establishes specific and enforceable requirements for protecting all species that the Secretary of Interior lists as threatened or endangered.
2. The ESA requires the federal government to protect endangered species regardless of the economic consequences.
3. The ESA places new limits on the use of private property.
4. The ESA allows for citizen litigation whenever a federal action threatens an endangered or threatened species.

The stated purposes of the ESA are: to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, to provide a program for the conservation of such endangered species and threatened species, and to take such steps as may be appropriate to achieve the purposes of the treaties and conventions (on international trade in endangered species). Both animals and plants are covered by the Endangered Species Act.

The Endangered Species Act must be renewed by the US Congress every five years. The U.S. Fish and Wildlife Service at the Department of the Interior is the primary government agency for enforcing the ESA. The National Marine Fisheries Service at the Department of Commerce holds responsibility for certain marine species. Ultimate responsibility lies with the Secretaries of the Interior and Commerce. The Secretary of the Treasury has additional enforcement responsibilities.

The ESA establishes guidelines for categories and listing rules for endangered and threatened species. In addition, the act defines the concept of critical habitat. Federal agencies are required to (a) actively promote the conservation of listed species and (b) avoid any actions that would have negative effects on listed species and their critical habitat, the ESA provides matching federal funds for some state actions in support of the act and authorizes the acquisition of land for plants and animals.

Amendments (changes) to the ESA were passed in 1978, 1982, and 1988:

A 1978 amendment set up a cabinet-level committee, the Endangered Species Committee, which is informally known as the “God Squad.” The Committee is authorized to exempt federal agencies from regulations under specific circumstances.

A 1982 amendment provided for designating "experimental" (or reintroduced) populations. This has led to the establishment of Safe Harbor Agreements, under which the good intentions of groups and individuals attempting to help conserve or reintroduce native species can be taken into account when determining later limitations on land use.

Some 1988 amendments provided for monitoring of candidate and recovered species, enacted several changes for recovery plans and related reports (such as requiring recovery plans to be subject to public review), and allowed for federal protection for endangered plants only when destruction takes place on federal land or violates state law.

Legal Eagles Square Off Over One Troublesome Bird

By Jim Nintzel

In the following article, "Legal Eagles Square Off Over One Troublesome Bird," you will learn that the urban-sprawling town of Tucson, Arizona has a school district on the northwest side of town with a high school that can operate effectively with just over 2,000 students. It now has over 3,000 students. The district bought a 40-acre parcel a few years ago to build a new high school to alleviate the overcrowding problem at the one high school; however, an endangered species may be living on the property.

The endangered cactus feruginous pygmy owl got its day in federal court last week, when the Defenders of Wildlife faced the Amphitheater School District.
For Amphi [Amphitheater School District], the trial was the culmination of a long year which found the district struggling to build a school on a parcel of land which wildlife experts identify as prime pygmy owl habitat.

Representing the plaintiffs were John Fritsche and Eric Glitzenstein, two Washington, D.C., attorneys. Fritsche is the in-house counsel for the Defenders of Wildlife, while Glitzenstein is a seasoned hand at endangered species legislation who successfully stalled the University of Arizona's plan to build telescopes on Mount Graham over issues related to the endangered red squirrel. Unable to win in court, the UA ultimately had Congress pass a law to allow construction of the scopes.

Put simply, Fritsche and Glitzenstein's case was, "If you hear a hoot, the site is kaput." They called as witnesses a team of state, federal and private wildlife biologists who testified that they believed, based on their experience and the available evidence, that a pygmy owl was using a portion of Amphi's property.

Amphi's defense, meanwhile, might be summarized as, "If it doesn't nest, you can't contest." Attorney Denise Bainton of the DeConcini-McDonald law firm persuasively argued that the burden was on the Defenders of Wildlife to prove that an owl would be harmed, and because surveys have failed to detect on owl on the Amphi property, there's no evidence that construction of the school would do that.

"The plaintiffs will put forth evidence involving maybe's, might be's, could be's, I don't know's," Bainton said in her opening remarks, establishing the theme she would hammer home in her cross-examination of the biologists.

This was a court fight Amphi would have preferred to avoid altogether. The district had hoped the pygmy owl's proximity would prove to be no hinderance to the school's construction, although wildlife officials now say they had warned the district since spring of last year that the project was in trouble.

Because the district planned to alter a wash on the property, Amphi needed a 404 permit from the Army Corps of Engineers. But when Amphi officials began the 404 permit process, the U.S. Fish and Wildlife Service indicated that building a school could harm the owl.

In late summer of last year, the district entered into formal consultations with the Fish and Wildlife Service. Although records of those meetings are sealed, it's clear something went awry, because after a couple of months, Amphi officials backed out of the consultation process and announced they would seek to purchase additional land and reconfigure the project so that the large wash would remain untouched and they would not longer need the 404 permit.

In March, with no formal announcement, the district began plant salvage on the property. The next day, the Defenders of Wildlife filed suit and got an injunction to stop construction until the matter could be hashed out in court.

Because the precise location of the pygmy is sensitive information, much of the trial took place with the attorneys, witnesses and judge studying a map.

With a low-key, methodical approach, Fritsche asked the biologists about the pygmy owl. They described a very secretive bird, about four inches tall--six if you include the tail--that generally nests in sagauro cavities. It seems to feed primarily on lizards, as well as other birds. In southern Arizona, the owl appears to prefer a thick mix of ironwoods, palo verdes and mesquite trees, which provide cover from predators and a home for prey.

But other questions about the owl--its range, for example--remain mysteries.

"There's just almost nothing known about it," says Scott Richardson, an urban wildlife specialist with the Arizona Game and Fish Department who testified at the trial.

Richardson has been studying the pygmy owl since 1994. In 1996, he's regularly detected at least one owl in two different locations adjacent to the proposed school site. In 1997, his surveys weren't as successful, although he believes he heard an owl near the site earlier this year. "There's just no reason biologically why a bird that would be using an area on two sides of that property would not go on the property," Richardson says. "It's not going to stop at the road. The habitat is uniform across there."

Richardson has drafted the aid of several people living next to the school district's property to record "detections"--moments when they have seen or heard the owl. Several of the neighbors testified in court that they had seen the owl frequently in 1996 and occasionally heard them in 1997 and in 1998. One witness, Linda Snodgrass, said she had even seen the owl on the Amphi property.

Under cross-examination, Snodgrass admitted she didn't care much for develoment. She described a nearby project as "armpit houses...Houses so close to together you can lean out on window and shake hands with the guy next door, and smell his armpit."

But for all their anti-development bias, Richardson testified that he believed the neighbors were credible, adding he believed construction of the school would harm the bird.

"You're talking about a species, based on what we know, with a pretty small home range," Richardson said in an interview after the trial. "With any species with a small home range, you come in with a project like a high school that you plop down in a very significant portion of its home range, you just can't help but have an impact."

Besides the removal of the natural habitat, Richardson says building the school will increase activity levels in the owl's range. The commotion accompanying the construction could ultimately disturb the owl enough to force it to abandon its territory. A bird on the move is vulnerable to predation, and if it should move into another pygmy owl's home range, the territorial birds could end up fighting it out for the area.

But on the stand, Richardson--and the other biologists--had to concede under Bainton's skillful cross-examination that they could not be absolutely certain an owl was using Amphi's property because they had never seen one there.

"Biology is not a science that produces concrete answers," Richardson says. "You're dealing with living creatures in an ever-changing environment, and you just don't ever come up with, 'Well, we studied it here and this is what it did and that's how it always reacts.' You just don't do that with wildlife. There's so many different variables. Legally, I think they're looking for that concrete evidence that says, 'Well, this bird lives here and here and tell me with 100 percent certainty that the bird is on the site without having seen it.' You can't do that biologically."

Throughout the trial, Judge Zapata stayed alert and attentive, closely studying the map and occasionally asking questions of witnesses. In his rulings, he showed no clear bias one way or the other. Only a hint of his opinion came when the plaintiffs rested their case on Thursday afternoon.

When it came time for Amphi to begin its defense, Bainton moved for a directed verdict, arguing that the plaintiff's had failed to prove their case.

"There has been no evidence presented that there is an owl there," Bainton argued. "There comes a point where the best evidence available isn't good enough."

Zapata rejected the request, although he said he was disturbed by the fact that no one had testified that an owl was nesting on the property and that none of the birds seemed to be using a narrow corridor the district had agreed to leave untouched.

"I have some very serious concerns about the evidence that has been presented," Zapata said. While some courtroom observers thought Zapata's stinging comments suggested he was leaning toward the school district's side, others suggested he might have been sending a subtle message to the plaintiff's attorneys regarding a way to strengthen their case.

When the closing arguments were completed late Friday afternoon, Zapata praised both attorneys on a job well done and promised he would rule quickly.

"Now the hard work falls onto me," Zapata said, "and I will do that as quickly as I can."

Instructions:

Have students do role-playing to replicate the Tucson issue. Select and research an endangered species from the Southwest. Select student groups from the list below to represent the following interests.

1. Students at the overcrowded high school
2. Parents of students at the overcrowded high school
3. Residents in the neighborhood who are opposed to the high school
4. Residents in the neighborhood who are in favor of the high school being built
5. School board members
6. Defenders of Wildlife
7. A developer
8. Wildlife biologist

Instructions to Student Groups

Come up with a list of costs and benefits for building a new school from your group's point of view. For each item in your list, identify the timing of each. For instance, does a particular benefit occur immediately, or does it lie in the distant future? Have a member of your group state its point of view before the entire group.

Some possible Internet research sites are:
http://biologicaldiversity.org/swcbd
http://eelink.net/EndSpp/
http://endangeredspecie.com
http://fguardians.org/es/new_mexico_species_protection.asp
http://nwf.org/wildlife
http://www.audubon.org/campaign/esa/index.html
http://www.fws.gov/endangered/
http://www.kidsplanet.org/factsheets/map.html
http://www.sierraclub.org/wildlife/species/map/southwest.asp
http://www.worldwildlife.org/endangered

New Mexico Science Standards
Grades 9-12, III, I, I, 9 and 11-13

Source: with permission from National Council of Economic Education http://www.econedlink.org/lessons/index

Endangered Species

What's a Citizen to Think?

Objective

Students will:

1. Learn the difference between opinion and fact
2. Research an environmental issue, find facts and express their opinions orally and in writing

Key Words

1. *Attitude* – a position or feeling with regard to person or thing
2. *Belief* – confidence in the truth or existence of something not susceptible to rigorous proof
3. *Bias* – prejudice; a personal and sometimes unreasoned judgment
4. *Common ground* – mutual interest or agreement
5. *Controversy* – dispute concerning the matter of opinion
6. *Fact* – something that exists or has happened based on actual experience or observation
7. *Judgment* – the ability to form sound opinions and make sensible decisions
8. *Knowledge* – body of truths or facts accumulated over time
9. *Objective* – not influenced by personal feelings, interpretations, or prejudices; based on fact; unbiased
10. *Opinion* – a belief, judgment, or conclusion that certain ideas are likely to be so, but not absolute (certain)
11. *Point of View* – an opinion, attitude or judgment
12. *Prejudice* – an unfavorable opinion formed without knowledge, thought or reason
13. *Subjective* – based on somebody's opinions or feelings rather than on facts or evidence
14. *Truth* – actual state of the matter, existence; an accepted fact

Materials

Writing materials
Issue Facts and Opinions worksheet
Issue Investigation worksheet
Points of View worksheet

Background

By law, decisions about endangered species and habitat issues are supposed to be based on the best available scientific research as well as take into account human economic and social considerations. It is important for citizens to learn all they can about endangered species issues and it is also important for citizens to communicate their concerns to policymakers such as elected officials.

Being a responsible citizen requires knowledge, involvement, and the ability to take action. Being well-informed is necessary in order to take effective action. Citizens can have their voices heard by writing letters to and talking with elected officials. Public opinion is also important to most businesses and organizations.

Controversial issues are rarely simple or limited to two sides. When issues involve the interrelationships of ecosystems and human populations, they frequently become very complex and often emotional. In examining a controversial issue, students should be able to identify objective facts, opinions, and opinions stated as facts. Facts are neutral statements and can be proven to be true. Opinions, on the other hand, are points of view, judgments, or conclusions. Generally, opinions are drawn from facts but that does <u>not</u> make them facts.

It is important for students to understand that different techniques are used in the discussion of controversial subjects. Issues can be sidestepped rather than directly addressed. Sometimes, responses are designed to have a certain emotional appeal that may make it difficult to find common ground based on factual information.

Instructions
Copy a set of the three worksheets to have available for each student or team of students.

Part 1. - Issue Investigation
1. Take a class survey to discover which current issues involving endangered species, ecosystems, people, and/or their interrelationships students are aware of. Brainstorm some issues and list them on the board.

2. Have students classify these issues according to whether they are local, statewide, national, or international issues. Some issues may fit in all the categories.

3. Ask students to rank the issues according to how much they personally know about an issue. In a separate ranking, ask them to list the issues according to their own level of interest in each one.

4. Compile the ranking information for both categories using the top three issues from Each student's list.

5. Decide as a class which issue(s) to investigate for a class action project. Explain that student's will be conducting research and gathering information to better understand an issue. Ultimately, they will each form their own opinion about the issue and write a letter expressing it.

(Note: In choosing, an issue, take into account which issues are the best understood by students, easiest to research, and generate the most interest. For older students, each student can choose an issue and work individually. Another option is to have students work in pairs or have those who share an interest in the same issue work together in small groups.)

6. Have students begin collecting and reading sources of information about the issue(s) for session three. Discuss and explain possible sources of information newspapers, radio, magazines, interviews, council meetings, newsletters, brochures, television, etc.).

7. Distribute the *Issues Investigation* worksheet to students to complete during their research.

Part 2. - Issue Facts and Opinions
1. Discuss briefly with students the information they have gathered on their *Issue Investigation* worksheets. They can continually add to their worksheets as they collect information about their issue.

2. Assess students' knowledge of facts and opinions. Define and discuss the differences.

   For example:

Fact:	Wildlife need access to fresh water.
***Opinion*:**	I think wildlife have access to as much water as they need.
***Opinion stated as fact*:**	It is more important for urban areas to have priority in water use decisions.

3. With older students, discuss the use of the techniques of sidestepping an emotional appeal. An example of sidestepping is talking about increased pollution levels of water in general, when the issue is competition for a water source used by wildlife persons.

   An example of emotional appeal is presenting an agricultural producer who had a mental break down when he lost his great-grandfather’s farm due to receiving no water. The issue is prioritization in the distribution of water.

4. Distribute the Issues *Facts and Opinions* worksheets to students to complete. Have them give personal examples of a fact, opinion, and opinion stated as a fact about their issue. As homework, students can gather and record more examples.

<u>Part 3 - Points of View I</u>

1. Discuss with students the information recorded on their *Facts and Opinions* worksheets.

2. Help students understand that there are often many sides or positions about an issue. Have students refer back to their Issue Investigation worksheets and ask:
   A. Are there more than two sided to your issue? How many positions are there?
   B. What are some of the different positions on your issue?
   C. Exactly what are the differences about which individuals or groups find it difficult to reach an agreement?

3. Students may need assistance identifying individuals, groups, and organizations involved in their issue. It may not be critical for them to identify all the parts involved in the issue, however at least two parties are essential. Make sure students take the necessary time to do their research and understand the history leading up to the controversy.

<u>Part 4 - *Points* of View II</u>

1. Distribute the *Points of View* worksheets to students. Have them use their previous two worksheets to assist in identifying and stating at least two different positions held by others about the issue for the *Points of View* worksheet. Explain to students that it is important for them to understand, as fully as possible, other points of view to better be able to form their opinion about the issue.

2. Encourage students to begin forming their own opinion about the issue, if not already formed, for the “My Point of View” side of the *Points of View* worksheet.

<u>Part 5 - *Points* of View III</u>

1. Discuss briefly with students the information recorded on their *Points of View* worksheets.

2. Have students complete their Points of View worksheets in preparation for writing their letter. Students’ opinions may be similar to or a combination of another point of view.

<u>Part 6 - *Letter* Writing</u>

1. Have students compose a draft letter expressing their opinion about the issue. The letter can be addressed to a public official, group, or organization holding a similar or opposing point of view. The letter may also be addressed to an uninvolved public official, group, or organization in order to bring the issue to their attention and/or to ask what their position is on the issue. Ask students what they think effective letter writing techniques are and introduce any effective points of view they didn’t cover. You may want to record the techniques in a visible place for easy reference.

2. Have students peer edit the draft letters first for clear understanding, a statement of opinion or resolution, good letter writing techniques, punctuation, grammar, sentence structure, etc.

Part 7 – Summarize

When the editing process is complete, have students write the final drafts of their letters. Mail the letters and wait for a response. Encourage students to share letter responses with the rest of the class and continue to track the progress of their issues.

2. Ask students the following questions:
   A. What is the most useful thing you learned researching your issues? Least useful?
   B. What is the most interesting thing you learned conducting your research? Least interesting?

3. What surprised you the most?

4. How can what you learned in research help you get involved in other issues?

5. What other issues interest you?

6. In what other ways can you get involved in issues besides writing letters?

7. Is writing letters an effective way to get involved in issues? Why or why not?

Options

1. Make a bulletin board display by posting all the gathered research information. Post copies of the students' letters and the responses they receive.

2. Have students gather the names and addresses of public officials at the local, county, state, and national levels. Publish a directory for any future letter writing to be completed by the students, their families, other students. Put a copy of the directory in the school library.

3. Invite an elected official or his or her representative to speak to the students about the importance and influence of citizen voices in the public decision-making process.

4. Videotape a debate of students representing various sides of a controversial issue. Based on assigned roles, students research, clearly state their positions, and offer a resolution.

5. Give students some basic information about a real or imaginary controversy. Have them write two newspaper articles, one factual and one slanted or opinionated. Discuss the differences.

6. Research an issue in history that was decided based on the influence of a vocal, mobilized, and informed citizenry.

New Mexico Science Standards
Grades 9-12, III, I, I, 11

Source: Adapted from, "to Whom it May Concern", *Ecosystem Matters*, US Department of Agriculture (1995)

THEIR POINT OF VIEW	MY POINT OF VIEW
Name: Date:	Name: Date:
Issue I am researching:	Issue I am researching:
The position of _________________________________ is:	My opinions about this issue are:
The position of ________________________________ is:	My opinions are based on the following facts:
The position of _________________________________ is:	My conclusion is:

ISSUE INVESTIGATION

Name: ____ Date __________________________________

Issue I am researching: ____

What I personally know about this issue	My sources of information for research	Individuals and groups involved in this issue	Who or what this issue affects	History of this issue

ISSUE FACTS AND OPINIONS

Name: ___________________________________ Date ______________________________

Issue I am researching: ____

Facts about this issue: (neutral statements that can be proven)	Opinion about this issue: (points of view, judgments, conclusions, etc.)	Opinions stated as facts about this issue:

Endangered Species

Mexican Wolf - Facts or Opinions?

Name: ______________________________ **Date:** _________________

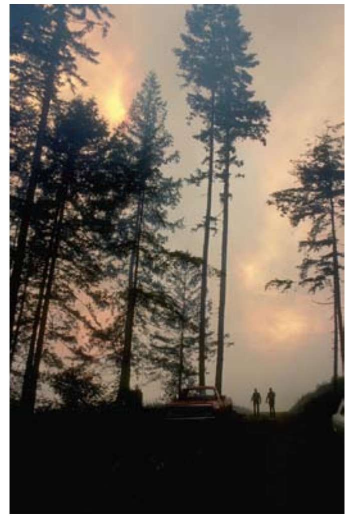
Subject: Mexican Wolf (*Canis lupus baileyi*)

People make decisions about whether wildlife should be protected based on both facts and opinions. A **fact** is a statement that can be proved to be true. An **opinion** is what someone thinks or feels about something.

Below are statements taken from newspaper articles, fact sheets and other sources.
Read each sentence below. Decide if it is a fact (F) or an opinion (O).
Write in your choice of F or O on the blank line.

1. __________ Predators are animals that eat other animals.
2. __________ Predators are always dangerous to humans.
3. __________ An example in New Mexico of a predator that is an endangered species is the Mexican gray wolf.
4. __________ Many ranchers are against the program to bring back Mexican gray wolves in the wild because wolves kill cattle.
5. __________ Wolves have a long history of killing cattle so they should all be shot.
6. __________ Ranchers should be paid for any of their cattle that are killed by wolves.
7. __________ Some ranchers are afraid that wolves will attack their children.
8. __________ A healthy male Mexican wolf usually weighs up to 100 pounds.
9. __________ Mexican wolves are more dangerous than other wild wolves because they are not scared of people.
10. __________ Currently there are about 50 wild Mexican wolves in areas of Southeastern Arizona and Southwestern New Mexico.

Fire



Forest fires are a natural occurrence throughout much of the west, and contribute to the healthy characteristics of forests in New Mexico. Without fire, forests lose much of their plant diversity. Many tree species, such as the Ponderosa Pine, have developed specific characteristics to live in an environment frequented by fire.

In the southwest, most fires are caused by lightening strikes, and as droughts intensify within New Mexico, the possibility of forest fires increases. Fires may seem disruptive to wildlife, but many species, such as the black bear, thrive in areas that have recently had forest fires. A forest fire opens the canopy of a forest and allows more plants to grow on the ground, providing more food for black bears and other forest-dwelling animal species.

New Mexico's Most Famous Bear: Smokey The Bear

In 1950, some careless person started the terrible Capitan Gap wild fire on the Lincoln National Forest in New Mexico. When a strong wind suddenly swept the fire toward a group of courageous firefighters, 24 of them had to run to a rock slide, lay face down, and cover their faces with handkerchiefs to escape the deadly flames. They emptied their canteens over their clothes and swatted their burning clothes. After an hour, the fire moved on. All 24 survived. When the smoke cleared and they caught their breath, they saw a scorched hillside where once a great forest stood.

Amongst the smoldering ashes was a tiny black bear cub, burnt and afraid, clinging to a tree. The cub was nicknamed "Hotfoot Teddy." They searched for the cub's mother, but could not find her. The cub needed veterinary aid for the burns on his paws and hindquarters, so he was flown to Santa Fe to receive professional treatment. While his wounds were healing, he stayed at the home of Ray Bell, the game warden who flew him to Santa Fe. Ray's daughter Judy befriended the little bear and helped nurse him back to health.

The little bear had gained nationwide attention and was soon renamed Smokey after the symbol for fire prevention. Smokey was presented by the New Mexico State Game Warden to the Chief of the Forest Service to be used to aid the fire prevention program.

Now the question was, "Where will Smokey live?" Little cubs grow up very fast, and Ray Bell's house was no longer an option as the bear's home. It was decided that Smokey's permanent home would be the National Zoo in Washington, D.C. Smokey became the most popular exhibit at the Zoo. Two other bears, both from New Mexico, eventually joined Smokey in Washington. Goldie, a female black bear, was introduced in 1962 as a possible mate for Smokey. However, no cubs were born of the two so Smokey II was introduced to carry on for Smokey in his old age. The original Smokey retired from the public display in 1975, after 25 years of service. He passed away later that year. His adopted son carried on for him until 1990. The character of Smokey lives on, a reminder to people across the world of the dangers of fire.

If you would like to learn more about Smokey the Bear, visit the national website at: www.smokeybear.com/.

Source: www.fs.fed.us/r9/wayne/facts/smokey_bear.html

Fire

The Fire Triangle

Objective
Students will understand the three ingredients of fire and the chemical reaction that causes rapid oxidation – combustion.

Key Words
1. *Combustion* - a chemical process in which a substance reacts vigorously with oxygen to produce heat and light, seen as a flame
2. *Dehydrate* – to lose water
3. *Fuel* - any material that is combustible
4. *Oxidation* - a chemical reaction in which oxygen is added to an element or compound

Materials
Copies of *Ingredients of Fire Worksheet*
Candles set in aluminum pie pans or tin foil
Matches
Glass jars that fit over the candles

Background
In the Southwest, the main cause of fire is lightning strikes from thunderstorms. No matter what the cause every fire needs three ingredients—fuel, oxygen and heat.

Fuel: The typical climate of the area includes long, dry summers with very little rain. These conditions increase the temperature of the ground and the fuels there, making it easier for the fuel to ignite and burn. Shrubs and dead grasses provide "dry fuel" that burns very easily. When years go by with no fire this dead plant material builds up, so when fire occurs, there is ample fuel to burn. This dry fuel ignites easily from sources such as lightning, a campfire, a burning cigarette butt, or a match.

Oxygen: Wind is a typical occurrence in nature. The wind not only increases the oxygen supply and dries out the fuels it also influences the spread of fire. Shrubs are more quickly ignited when their small leaves are surrounded by plenty of oxygen.

Heat: Fire is a chemical reaction. When combined, the ingredients work together in this way. Start with a fuel, such as dry shrubs, which contains hydrogen and carbon atoms. When the summer sun hits the shrub, it raises the temperature of the shrub, drying it out. When an ignition source such as lightning contacts the shrub, it breaks the bonds between the carbon and the hydrogen. This allows them to react with oxygent (O_2) in the air, releasing carbon dioxide (CO_2,) water (H_2O), and heat-oxidation. Oxidation releases heat, which triggers more bonds, and more heat in a positive feedback cycle. This is known as combustion (burning).

Lightning Caused Jemez Falls Fire

It was a lightning strike, not people, that caused a fire in the Jémez Falls Campground on Wednesday night, the Forest Service announced today.

The fire, which spread to 12.6 acres before it was contained, was originally thought to have been caused by a campfire or other human activity. The fire was fully contained Thursday, with firefighters working to cool hot spots. A tree with a fresh lightning strike was found Thursday morning.

No one was injured in the fire, located about four miles northeast of Jemez springs. Campers and hikers were evacuated Wednesday, and the 52-unit campground remained closed Thursday. All other campgrounds and picnic areas were reopened to the public.

Albuquerque Journal, 6/06/07
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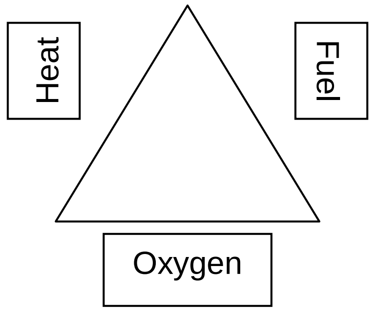
Fire Triangle



The reaction, represented by the fire triangle, shows that fuel, heat, and oxygen are necessary to create fire. If any one of them is missing, there can be no fire.

Instructions

1. Ask students what a fire needs to burn. What if one of the ingredients is missing? Can you still have a fire?

2. Divide the students into small groups and pass out the materials needed for the lab.

3. Light the candle.

4. Have the students observe the burning candle for three to five minutes. Then have them answer questions 1-5 on the Ingredients of Fire worksheet.

5. Students now place the glass jar over the burning candle until it rests on the table. Students observe the reaction and answer questions 6-7.

6. Have the students research the answers to sections B and C on the Ingredients of Fire worksheet.

New Mexico Science Standards
Grade 4, II, I, II, 1
Grades 9-12, II, I, I, 13

Source: Above material adapted from “Fire 101”, Carlsbad Caverns National Park Middle School Ecology Curriculum

Option - Modeling Forest Fires

This is an outside activity for high school students that **MUST** be done under close supervision.

Materials

12” x 12” block of clay
12” x 12” plywood square or cookie sheet
Dried grasses
Rocks
Wooden match sticks
Small fan

Instructions

1. Arrange match sticks in rows and columns 1/8” apart on flat surface.

2. Ask students to predict the time it will take for all the matches to light.

3. Light matches and record time it takes for all to light.

4. Change the number of match sticks and repeat above steps.

5. Set clay block at an angle to model trees growing in a canyon. Have students make predictions and record actual time matches take to light.

6. Put in rock barriers, grass, underbrush. Repeat the steps.

7. Use a fan to model windy conditions. Repeat the steps.

8. Have students describe the most dangerous conditions for forest fires.

New Mexico Science Standards
Grades 9-12, II, I, I, 13

Ingredients of a Fire Worksheet

Name: ________________________________ Date: __________________________

A. Observe the burning candle.

1. What is the source of fuel?

____

2. What is the source of heat?

____

3. What is the source of oxygen?

____

4. What is the evidence of oxidation?

____

5. What color represents the hottest area of the flame?

____

6. What happened when you eliminated one of the three ingredients of fire? Why?

____

____

7. Explain the chemical reaction that took place:

____

____

B. Why are more fires likely to burn during hot weather than during cool weather?

____

____

C. Why would plants with smaller leaf surfaces burn faster than those with larger leaf surfaces?

____

____

Ingredients of a Fire Worksheet

Name: ______________________________ Date: ________________________

A. Observe the burning candle.

1. What is the source of fuel?

____

2. What is the source of heat?

____

3. What is the source of oxygen?

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4. What is the evidence of oxidation?

____

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____

____

7. Explain the chemical reaction that took place:

____

____

B. Why are more fires likely to burn during hot weather than during cool weather?

____

____

C. Why would plants with smaller leaf surfaces burn faster than those with larger leaf surfaces?

____

____

Fire

The Pros and Cons of Wildfires

Objective
Students will:
1. Understand the benefits and problems associated with wildfires
2. Recognize the role that fire plays in maintaining healthy ecosystems

Key Words
1. *Fire triangle* - the three things (fire triangle") that must be present for a wildfire to burn: a fuel source, such as wood, coal, gas, or other fossil fuel, dry trees dead trees, leaf litter and dry grass; oxygen; and a heat or ignition source, such as a match or lightning.
2. *Pathogens* – something that can cause disease, such as a bacterium or a virus
3. *Prescribed burn* – wildfires purposefully set by foresters and park officials
4. *Surface fire* – wildfires that occur naturally; they are not set by humans

Materials
Paper and pencil or pen

Background
Throughout the Southwest, wildfires occur naturally every year. Often, they are started when lightning strikes. A fire that primarily burns undergrowth is called a surface fire. Scientists who study wildfires believe that frequently occurring surface fires help prevent larger, more dangerous fires from happening. When national or state forest officials are concerned that an area needs a surface fire for human safety and ecosystem health, they frequently will try to create a manmade surface fire, called a "prescribed burn".

Fires help ecosystems in a variety of ways. By burning undergrowth, fires release nutrients faster than normally occurs. Fires help reduce disease and insects, such as the highly destructive piñon tree borer. Some kinds of pinecone seeds and other plant seeds won't germinate at all until they are heated to extremely high temperatures. Fires can create or help maintain the kinds of habitat needed by animals such as deer and elk, and smaller animals. By thinning sections of the forest, fires open sections of the forest that create space for plants that need more sunlight. The total result over time for an ecosystem often is a wider diversity of plant and animal species.

Fire: Pros and Cons

Pros	Cons
Energy for cooking	Harms people, livestock and pets
Home heating	Damages/destroys communities
Power for machines	Damages/destroys homes
Use in religious and cultural ceremonies (i.e. Olympic flame)	Destroys ecosystems
Destroys disease and harmful insects	Leaves vast areas of land blackened and scarred for years.

Advance Preparation

1. Discuss with students the positive and negative aspects of fire for humans.

2. Ask students to describe the three things that must be present for a wildfire to burn
   A. A fuel source, such as dry or dead trees, leaves and/or grass;
   B. Oxygen
   C. Heat source, such as lightning or a campfire.

Instructions

1. Have students discuss the differences between a natural wildfire, a wildfire caused by human accident, by arson (burning of a building or other property for a criminal or malicious reason), and a fire set by the US Forest Service.

2. Have students debate the Forest Service policy of intentionally setting fires for human safety and ecosystem health.

3. Ask students what weather conditions affect the size and strength of a forest fire. How do these same weather conditions affect the efforts of firefighters?

4. A majority of the world's scientists believe that global warming Is occurring because of excess carbon dioxide released into the atmosphere by the burning of fossil fuels and forests. Scientists are predicting more drought conditions for the Southwest.
   A, Ask students what they think the implications will be for the number and size of forest fires in our region.
   B. Ask students what they think will be the implications for forest ecosystems?

New Mexico Science Standards
Grade 4, II, I, II, 1
Grades 7 and 8, II, III, II, 3
Grades 9-12, II, II, I, 1 and 4

Wildfire Word Scramble

Name ____ Date ____________________________

Unscramble the words below.

COOSUNIBMT	
LUFE	
YGENXO	
RIDPESERCB NUBR	
COHNORNOYLOREDGD	
IWFLERDI	
OURDTHG	
EHTA	

Write four sentences using some of the words above.

1.____

____

2.____

____

3.____

____

4.____

____

Wildfire Word Scramble

Answers

COMBUSTION

FUEL

OXYGEN

PRESCRIBED BURN

DENDROCHRONOLOGY

WILDFIRE

DROUGHT

HEAT

Fire

Tree Rings: Diary of a Forest

Objectives

Students will:

1. Learn how scientists use Dendrochronology
2. Understand the importance of tree rings
3. Examine tree rings for age and significant events that have affected the tree's growth (fire, drought, etc.)
4. Debate the controversial issue of prescribed fire

Key Words

1. *Dendrochronology* – the science of studying the past by looking at tree rings.
2. *Prescribed fire* - a fire conducted under controlled conditions and monitored by professional fire teams for the purpose of restoring an out-of-balance ecosystem.
3. *Wildfire* - a fierce fire that spreads rapidly, especially in an area of wilderness.

Materials

Copies of *Tree Rings Handout*
Copies of *Reading Rings Worksheet*
Pencils
Tree ring sample (optional)

Background

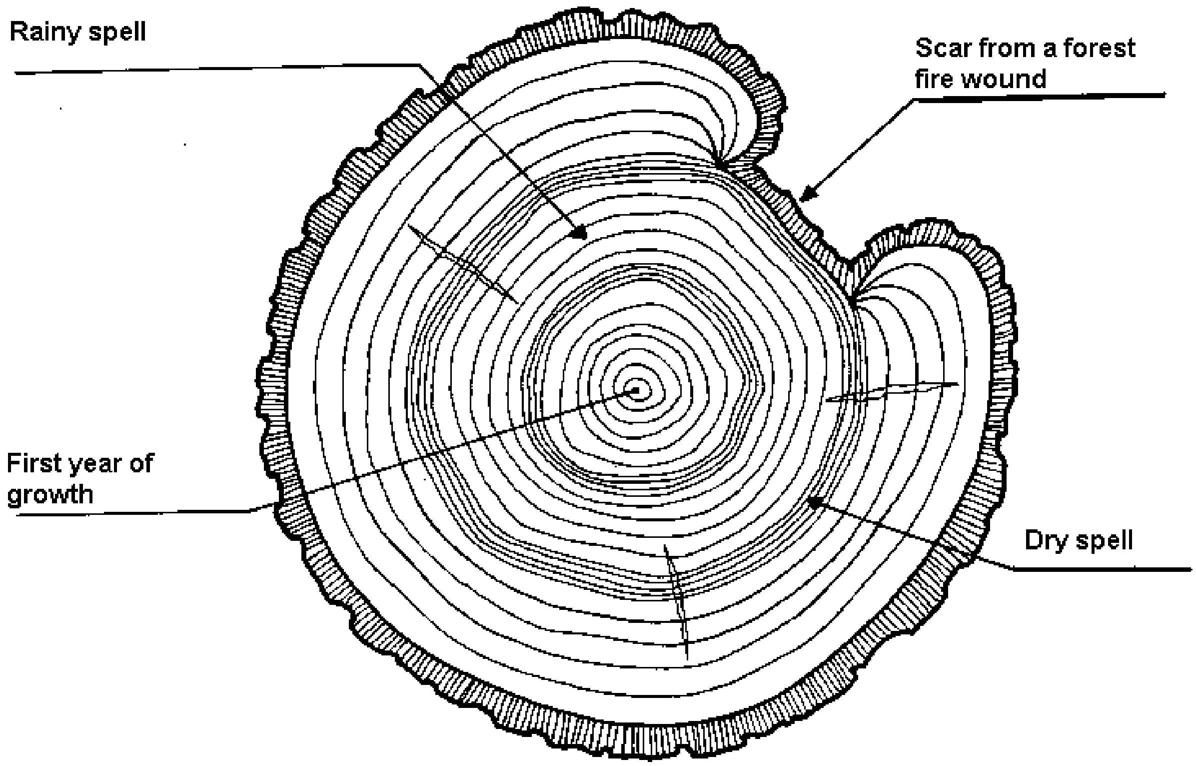
The major cause of wildland fires in the Southwest is lightning strikes during summer thunderstorms. These wild fires are well documented in historical records. Tree ring studies have documented fire scars hundreds of years back. The science of studying the past by looking at tree rings is called dendrochronology. Scientists can learn a great deal from studying tree rings. They can learn how old a tree is, when a fire occurred in the area, and they can also learn about the climate of an area.

Fire is the most influential ecological disturbance of plants and wildlife. Fire has played a major role in shaping many of the area's grasslands. Very aggressive wildland fire suppression and extensive grazing of cattle and other domestic animals have drastically altered this grassland ecosystem. For example, in Carlsbad Caverns National Parks, grazing and fire suppression have favored the increased abundance and distribution of shrubs and succulent desert plants. Therefore, the animal population has changed because of the new plant community reducing biodiversity in the area.

Prescribed fire is an essential tool for restoring this out-of-balance ecosystem. First, some of the naturally ignited (lightning) fires are allowed to burn when certain predefined conditions (prescriptions) of wind speed and direction, relative humidity, and fuel moisture are met. Second, prescribed (controlled) fires are ignited at planned locations by trained fire personnel. These prescribed fires are conducted under controlled conditions and monitored by professional fire teams.

By studying a tree trunk, scientists can determine more than a tree's age. They can also learn about the weather in past years from its effects on the tree. Annual rings vary in width. Growth is much slower during periods of drought. A lack of water causes an annual ring to be narrow. A year in which the temperatures are warmer than usual can have a long growing season. A longer growing season would provide a wider annual ring.

Below is a labeled tree ring.



Advance Preparation

1. Ask students what they can learn from a tree. Write responses on the board and discuss.
2. Discuss the background information for this lesson.
3. Pass out *Reading Rings Worksheet*. Have students match the event on the right with a sample tree ring on the left. The tree rings can be used more than once.

Instructions

1. Pass out the *Tree Ring Handout*. Have the students cut out the core samples at the bottom. They need to be sure they leave the letter on the core sample so they will know which sample they are using.

2. Have the students decide which core sample matches the tree ring sample. They do this by laying the core sample across the tree ring looking for a matching pattern of lines. (Be sure that the students understand that core samples do not go farther than the core of the tree, so the core sample should not cross the center of the tree.) Ask students which core sample is the one that matches the tree ring.

3. Have the students examine the *Tree Ring Handout*. Have them assign dates to the important events in the tree's life. What year did fire scar the tree? (1915) How many years did it take the tree to grow around the remains of a dead branch? (10 years) How long did the drought that began in 1912 last? (2 years).

4. Have students complete the *Reading Rings Worksheet*.

5. Discuss the need for fire in an ecosystem and how it brings balance to an unhealthy ecosystem. Discuss the pros and cons of prescribed fires.

<u>Options</u>

1. Obtain sample tree rings* with evidence of a variety of events (fire, drought, etc.) and create a lab worksheet. (Local contacts for tree ring samples are Extension Agents, National Park Office, or US Forest Service Office.) Arrange the tree rings around the room. Have the students examine them and complete the lab questions (teacher created).

   *An online commercial source for tree ring cross-sections is Outsource Solutions at http://www.outsourcesolutionsllc.com/science.html. The company website says that discounts are available to educators. E-mail, <u>outsource@compufort.com</u>. Mention of this source in *The Wild Side of Ecology* is not an endorsement or recommendation of the company or its products.

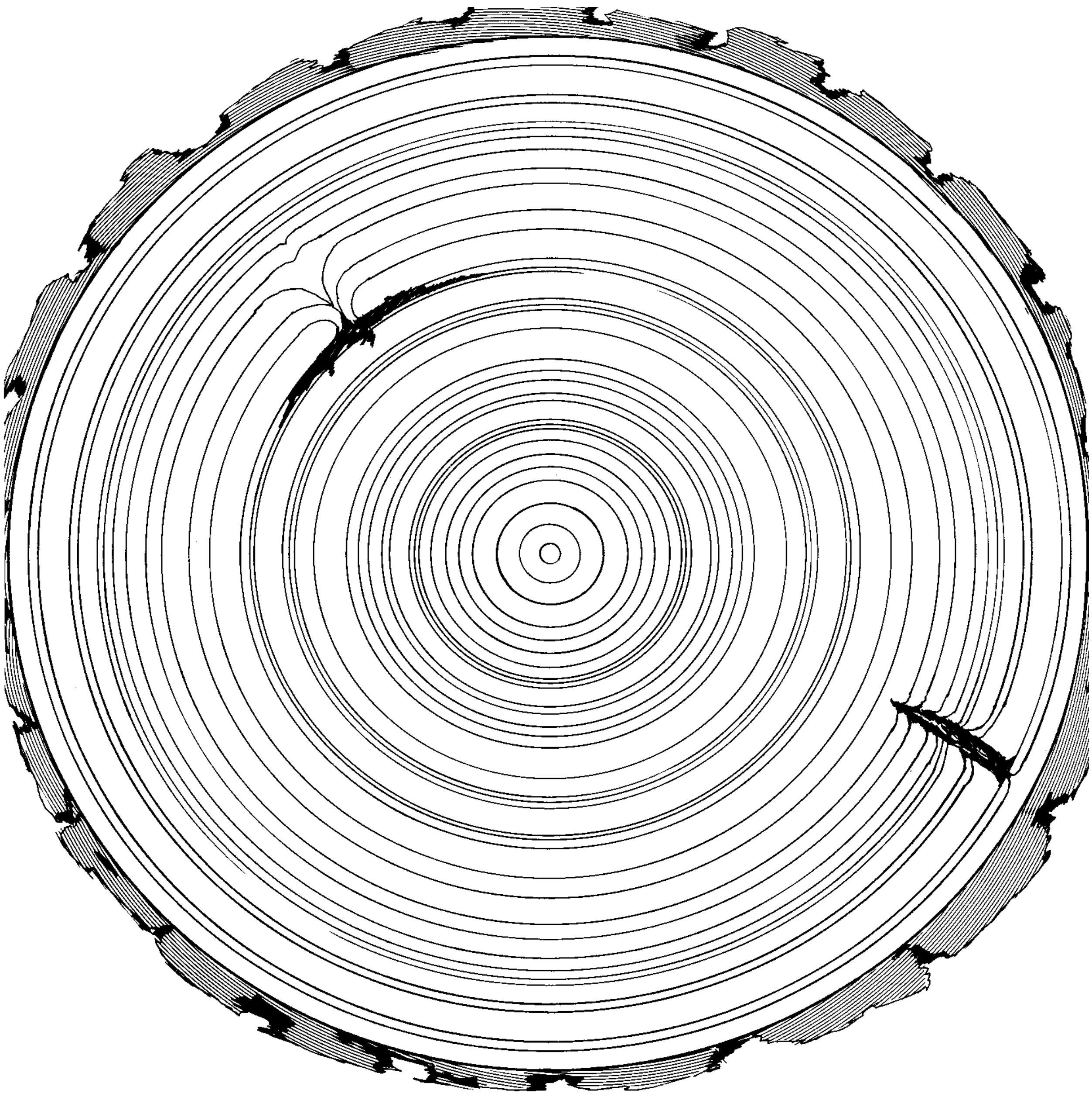
2. Take the students on a field trip to the bosque or a similar area. Have the students look for signs of a fire in the area's past. Have them write down any evidence they find that indicates that a fire has burned in the area.
3. Ask a firefighter from the local National Park to come to class and discuss the effects of wildfire and prescribed fire in National Parks. Some questions they should cover include: Are all wildfires bad? Do they let some wildfires burn? Why or why not? What is a prescribed fire? Why do they have prescribed fires? What considerations do they have to look at before, during, and after a prescribed fire?

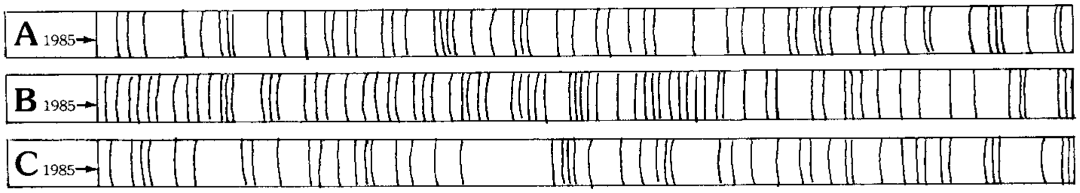
New Mexico Science Standards
Grade 4, II, II, II, 1-3
Grade 5, II, II, I, 3 and 4
Grade 6, II, II, I, 3
Grade 7, II, II, I, 5 and II, III, II, 3
Grade 8, II, II, I, 3
Grades 9-12, II, II, I, 3

Source: Adapted from Tree Ring Mysteries, Carlsbad Caverns National Park Ecology Curriculum for Middle School

Tree Ring Handout

Directions: Cut out the core samples labeled A-C at the bottom of this page. Be sure that you do not cut off the letter or dates on the core samples. Match the core sample to the tree ring sample by laying the core sample across the tree ring sample. Be sure that the core sample does not go further than the core of the tree.





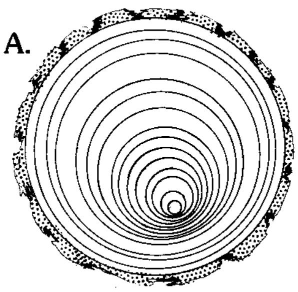
Worksheet adapted from: Ranger Rick's Nature Scope: Trees are Terrific!

Reading Rings Worksheet

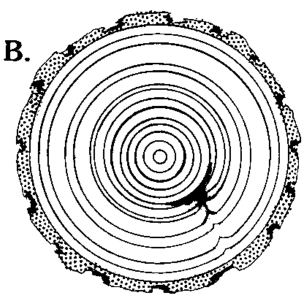
Name: ________________________________ Date: _______________________

Directions: Carefully observe the rings on this worksheet and match them to the events on the opposite side. The rings may be used for more than one event.

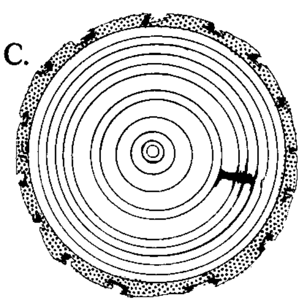
A.



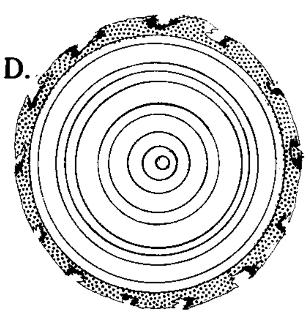
B.



C.



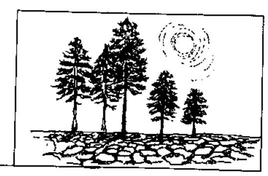
D.



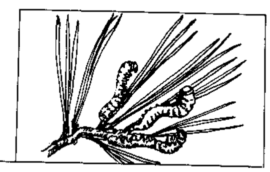
1. *Fallen tree* ________

2. *Fire* ________

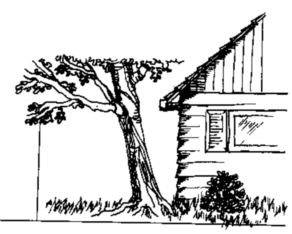
3. *Drought* ________



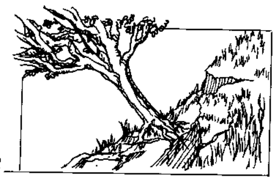
4. *Insect attack* ________



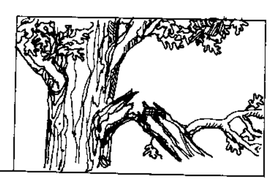
5. *Construction* ________



6. *Growing on slope* ________



7. *Dead branch* ________



"Fire on Trial"

A Play

Source: *Ecosystem Explorations*
Sandia Mini-Curriculum
http://www.nmnaturalhistory.org/edu_smnhcurriculum.html

Third Edition, 2005
By Joan Doyle, Kristen L. Gunckel, John Haskell,
Yvette Martinez, Christopher M. Pecnik
Third Edition Editors Helen Haskell and Susan Davis

Sandia Mountain Natural History Center
505-281-5259
New Mexico Museum of Natural History & Science
1801 Mountain Road NW
Albuquerque, New Mexico 87104
www.nmnaturalhistory.org

New Mexico Science Standards
Grade 4, II, II, II, 1 and 2
Grade 5, II, II, I, 3 and 4; II, II, I, 1; and III, I, I, 1
Grade 6, II, II, II, 2
Grade 7, II, II, II, 10 and 12
Grades 9-12, II, II, I, 1, 3 and 4; and III, I, I, 9, 12 and 13

Fire On Trial

Objectives
Students will:

1. Realize that some ecosystems have adapted to and benefit in many ways from forest fire (fire ecology)
2. Learn some of the natural history of the Sandia Mountains

Background
Some ecosystems in New Mexico (including mountains and grasslands) have adapted to fires; occasional fires replenish a healthy New Mexico mountain or grassland ecosystem. Fires today are often so harmful because we've prevented areas from burning as often as they normally would. This causes the fuel (bushes, other wood, and plant parts) to build up, making the fires burn higher and hotter than normal.

Instructions

1. Choose 13 witnesses and two attorneys (preferably good readers and enthusiastic actors) from the class. The remaining students will be the jury.

2. Pass out copies of the script to the actors and copies of the directions to everyone.

3. Have the actors highlight or underline their parts if you haven't done it already.

4. Place a desk or chair at the front of the room to serve as a witness stand. Make sure students understand their parts and what to do.

5. Perform mock trial and vote.

6. Conclusion: relate it to real life.

Introduction
Hand out copies of the script to the actors with speaking parts and give the directions to all students. Apart from a judge (yourself), you will need 13 witnesses, the Defense Attorney, and the Prosecuting Attorney. Mouse is the only gender-specific character; she should be female if possible. The rest of the students are the jury. Give the students a few minutes to read their part and plan. You may want to check with the students who have actions to make sure they know what to do (the two attorneys, Coyote, Woodpecker, Bark Beetle, Piiion Pine, and Fish). Students without speaking parts ("the jury") may help one of the (speaking) actors learn his or her part. Then begin the trial. Stay in character the whole trial if possible. If students start getting too wild, you can call the court to order, threaten to hold them "in contempt of court" and such things. You may want to remind your students at the beginning of the trial that it is good to have fun but they need to remain non-disruptive and respectful, and that your classroom rules still apply. Call each character to the "stand" (a desk or chair up front), or have them testify from their seats if needed (to save time).

Fire on Trial

Summary

Students and teacher act out a mock trial of forest fire.

Objectives

1. Students will realize that some ecosystems have adapted to and benefit in many ways from forest fire (fire ecology).
2. Students will learn some of the natural history of the Sandia Mountains.

Standards

Science: Strand II, Standard II (Life Science), BMI, PS3: Know that changes in the environment can have different effects on different organisms; PS4: Describe how human activity impacts the environment. Strand III (Science and Society), Standard I, BMI, PS1: Describe the contributions of science to understanding local or current issues.

Social Studies: Strand II (Geography), Standard II, BMII-C: Understand human impacts on environments and predict changes; BMII-D: Explain how physical processes shape the earth's surface patterns..., (PS1); BMII-F, PS1: Understand how resources impact daily life.

Language Arts: Strand I (Reading and Listening for Comprehension) Standard I, BM I-A, PS1: Active and critical listening; PS4: Follow oral instructions; BM I-B, PS 1: Understand concept of primary source; BM I-C, PS2: Evaluate usefulness and quality of information; PS4: Make informed judgments about bias...and media techniques; PS6: Distinguish between fact and opinion; BM I-D: Competent reading, BMII-A, PS1: Read aloud.

Career Readiness: Standard IV (Responsible and ethical workplace behaviors), BMI: Demonstrate positive behaviors ...and manners; and BMIII: Demonstrate understanding of ethical behavior and its importance; Standard V (Effective leadership, interpersonal, and team skills), BM I: Explore positive and negative implications of teamwork, BMII: Recognize that individual differences affect school and workplace behavior; and BMIII: Demonstrate teamwork through effort, sharing, conflict resolution....

Time

30 minutes

Materials

Per student: A copy of the directions

For actors and teacher: a copy of the script (16 total)

Background Information

Some ecosystems in New Mexico (including mountains and grasslands) have adapted to fires; occasional fires replenish a healthy New Mexico mountain or grassland ecosystem. Fires today are often so harmful because we've prevented areas from burning as often as they normally would. This causes the fuel (bushes, other wood, and plant parts) to build up, making the fires burn higher and hotter than normal.

Procedure

1. Choose 13 witnesses and two attorneys (preferably good readers and enthusiastic actors) from the class. The remaining students will be the jury.
2. Pass out copies of the script to the actors and copies of the directions to everyone. Have the actors highlight or underline their parts if you haven't done it already.
3. Place a desk or chair at the front of the room to serve as a witness stand.
4. Make sure students understand their parts and what to do.
5. Perform mock trial and vote.
6. Conclusion: relate it to real life.

Introduction

Hand out copies of the script to the actors with speaking parts and give the directions to all students. Apart from a judge (yourself), you will need 13 witnesses, the Defense Attorney, and the Prosecuting Attorney. Mouse is the only gender-specific character; she should be female if possible. The rest of the students are the jury. Give the students a few minutes to read their part and plan. You may want to check with the students who have actions to make sure they know what to do (the two attorneys, Coyote, Woodpecker, Bark Beetle, Piñon Pine, and Fish). Students without speaking parts ("the jury") may help one of the (speaking) actors learn his or her part. Then begin the trial. Stay in character the whole trial if possible. If students start getting too wild, you can call the court to order, threaten to hold them "in contempt of court" and such things. You may want to remind your students at the beginning of the trial that it is good to have fun but they need to remain non-disruptive and respectful, and that your classroom rules still apply. Call each character to the "stand" (a desk or chair up front), or have them testify from their seats if needed (to save time).

Fire on Trial

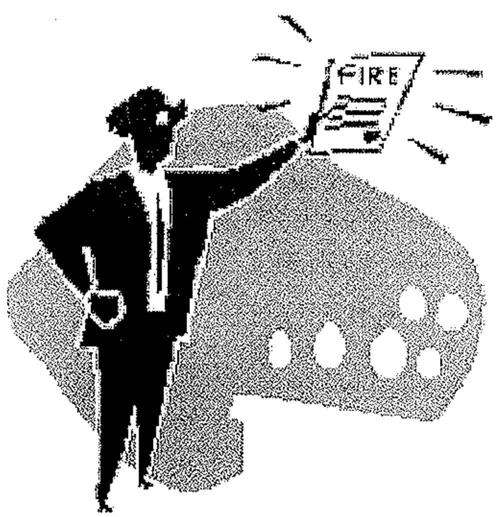
Directions for the Trial:

ALL students please read all directions carefully!

Witnesses and Attorneys: You will be given a script. You will have a few minutes to read your script. Make sure you know what to say and do. When the judge calls you to testify go up to the "stand" to speak your lines.

The things in [ ] are **not** read aloud, but tell you how to **act.**

Attorneys, please wait until the witness is on the stand to question him or her.



Actors will **also** become jury members at the end of the trial and will **vote** (as yourself, not as your character). Be prepared to explain why you voted the way you did.

Judge, Prosecuting Attorney (PA), and **Defense Attorney** (DA): You may need to adjust your part slightly according to the gender of the actors (male or female).

Jury Members: Students who are not witnesses or attorneys are the **jury.** Your job is to determine guilt or innocence. Listen closely to the trial. When it is over you will vote. Be prepared to explain why you voted the way you did.

Fire on Trial
Script

Clerk or judge: All Rise!

Judge: This court will now come to order!

Clerk or judge: Be seated.

This court of ___________ Elementary, under the jurisdiction of ___________ (your school district or county), will now try Mr. / Ms. Forest Fire, for crimes committed against the people, plants, animals, and other inhabitants of the state of New Mexico (in other words, the Ecosystem).

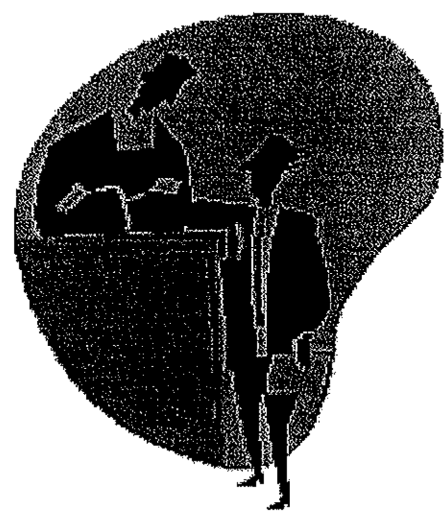
In a moment the charges will be read. You will then be presented with witnesses and arguments for and against the accused, and will be asked to submit a judgment at the end of the trial: guilty or innocent. I remind you to use all of your reasoning skills, seriously consider the evidence presented, and make the most accurate and reasonable judgement you can. **You** are responsible for the fate of this prisoner, and, perhaps, even the fate of the Land. I remind you to follow the rules of order of the court at all times [*insert a consequence here if needed by your class*]. At the end of the trial each one of you (the jury and witnesses) will vote and should be able to explain or defend your position. Students who are witnesses will vote as they truly believe, <u>not</u> as their character would vote.

We will now take the jury oath.

All rise!

Raise your right hand and repeat after me.

[***Judge*** *reads and* ***all*** *repeat a line at a time.*]



I do solemnly promise

To listen when others speak,

to respect and obey the judge in all reasonable requests,

to play my part accurately,

to make a fair and honest judgement,

and to contribute in any way I can to this trial effort.

Judge/teacher: Thank you. You may be seated. Are there any questions before we begin the trial?

[*Take any questions. When you think all the students understand the activity, continue.*]

Prosecuting Attorney, please state the charges.

PA: This is the trial of The Ecosystem vs. Fire.

My client, The Ecosystem, is charging Fire with causing widespread destruction of forest and land, severely injuring the Ecosystem, and just being completely destructive.

Judge: The ACLU has provided Fire with a Defense Attorney, who will argue the case for Fire.

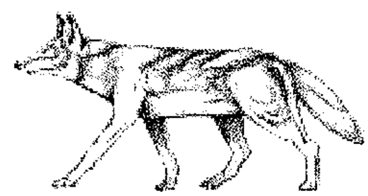
All witnesses please stand, raise your right hand for the oath of truth, and repeat after me. I promise to tell the truth, the whole truth, and nothing but the truth.

[*All* **witnesses** *stand, raise hand, and repeat oath.*]

Judge: You may be seated. Our first witness is Cody Coyote. Cody, please take the stand.

PA: [*Waits for Cody to take the stand.*] Cody Coyote, please tell us what happened to you on the night of June 22, 2003.

Coyote: Well, I was just minding my own business, eating piñon nuts, stealing a bird egg here or there, and all of a sudden my tail started getting hot. I felt a wind and before I knew it I was running with other animals from Fire, who was trying to consume us! I was so scared! I escaped, but my tail got singed. To this day the tip is still black!



PA: Had you done anything to anger Fire?

Coyote: No, nothing!

PA: No further questions, your honor.

Judge: Defense Attorney, you may cross-examine the witness.

DA: [*approaches the witness*] Is it true that you, after Fire had gone, stole some of its prey by digging out a rabbit that Fire had killed and...**ate** it!?

Coyote: Well, yes, I was rather hungry after all that running and...

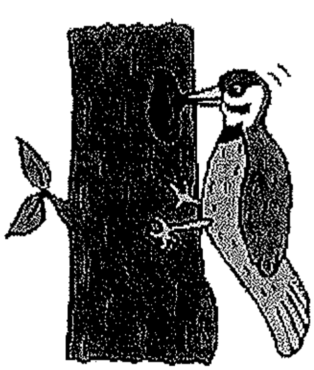
DA: [*interrupting*] HA! So you actually **benefited** from Fire!

Coyote: Well, I, uh... yeah, I guess so. But it was still scary, and Fire **owes** me!

DA: No further questions.

Judge: All right coyote, you're done, thank you. [***Coyote*** *slowly returns to seat.*] Next witness! Young Stevie Woodpecker, please take the stand.

[***Coyote*** *sniffs the air towards* ***Woodpecker*** *and bites in woodpecker's direction. Woodpecker yelps, startled, and scurries to the stand, away from Coyote.*]



Judge: Mr./Ms Coyote! Take a seat.

PA: [*Waits for witness to sit*] Is it true that Fire pursued you, chasing you out of your home, on June 2, 2002?

Woodpecker: [*sniffling, as if it's been crying*] Uh-huh... it was horrible! My whole family had to leave our home.

DA: And was it difficult to find a home and food after the fire?

Woodpecker: It sure was!

DA: Remember you're under oath!

Woodpecker: Well, actually, after the fire there were lots of nice soft charred trees to carve out homes in. And in the dead trees there are usually lots of yummy insects to eat, some of them even nicely roasted!

Judge: Thank you, Stevie. Our next witness is San D. Mousy, Field Mouse. [*Quietly, to the jury*] The mouse is still a bit upset, so please be as quiet and considerate as possible.

PA: What can you tell us about Fire?

Mouse: [*Clearly still a little scared*] Well, it chased me, and I ran! As fast as my little gray legs could run! Fire caught my brother. It wanted to eat me—to **consume** me!

PA: No further questions for this **poor** witness, your honor.

DA: Miss Mousy—Can you describe the environment where you live and eat?

Mouse: Oh, yes. I live in this pretty little field. There are wildflowers all over and yummy grasses and little green plants to eat. Oh, and lots of yummy seeds, and good places to hide in the grass.

DA: Would you be able to live as well, say, in a dry forest where there are not many plants or seeds on the ground?

Mouse: Oh, no. My cousin Jen lives in a forest and she says field mice die all the time because there's not enough to eat!

DA: Well, without Fire, your pretty field would **become**... a **FOREST**! Fire keeps trees from blocking the sun so that the little plants you like to eat can grow. You actually have Fire to **thank** for your home and food!

Mouse: Oh! I didn't know **that!**

Judge: Thank you, Mouse. Next on the witness stand is a flying scavenger: Villus Turkey Vulture (a creature who also goes by the alias of Buzzard).

Vulture: My friends call me T.V., and whatever the rest of 'em say, I love fire! Tastiest feast I ever had was the fire of 2004! You know that my preferred meal is dead stuff. Fire does my work for me. Some of the animals don't make it out and I can feast for **weeks** off the remains! It's **GREAT!**

Judge: Thank you, Villus. Let's hear what Frankie / Frannie Fish has to say.

Fish: Fire is pretty tough on me. When a lot of trees die their roots don't hold the soil in and it runs downhill into my pond. This makes the water so cloudy that I can't see well to hunt or forage for food. Sometimes I even have trouble breathing.

Judge: DA, Prosecuting Attorney, any questions? [*They both shake their heads no.*]. Thank you, Mr./Ms. Fish. You may swim back to your desk.

[***Fish** makes swimming motions while returning to desk.*]

Judge: I'd like to call Bark Beetle to the witness stand.

PA: Mr. / Ms. Bark Beetle, please tell us about your experiences with Fire.

Bark Beetle: Well, he's a terrible mischief-maker! Burns me out of my home, kills my family members and friends. Why, we were having a grand party one time… in this delicious Piñon tree. It was starving for water and weak, so it couldn't get rid of us. Heh-heh-heh [*evil laugh*]. I called all my buddies until all of us—just **hundreds** of beetles—were eating away at this defenseless tree! It was great! Until Fire came along and **killed** most of my buddies!

And that's not even the worst thing! It cleared out trees around that one and the extra room and water made that old tree strong. After Fire came through we couldn't get into it anymore!

DA: Won't the trees you kill burn easily and make Fire more likely?

Bark Beetle [*sadly*]: Well, I guess so. [*Happier*] Unless the People never let Fire burn!

DA: No further questions, your honor. I'd like to call some other witnesses to testify.

Judge: Go ahead.

DA: First I'd like to call cousins Ponderosa and Piñon Pine.

DA (again): [*after the trees take the stand*] Please tell us what you know of Fire.

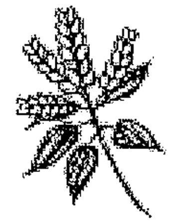
Ponderosa Pine: Fire used to be a friend of mine. It clears out other trees. I'm always ready for its visit. I keep no lower branches for it to burn, have nice thick bark so I don't get burned, and deep roots. I haven't seen it in so long, even though I leave needles on the ground for it to burn. All of us trees are crammed in to such a little space, and we have to share the same minerals and the same water. I can't stretch out!

Piñon Pine: Yeah, fire keeps us from overcrowding; my buddy Jenna is being choked out by a Juniper! It's growing right in her branches. Imagine! I miss Fire even more because I've got all these horrible bark beetles eating away at me.

[***Bark Beetle** heads over and SILENTLY PRETENDS to gnaw at **Piñon Pine** until the end of the paragraph when Piñon pushes him/her away.*]

Piñon Pine: [*while GENTLY pushing **Bark Beetle** away.*] Ow! There's another one! Rotten pests! Fire used to kill them for me. [**Bark Beetle** returns to seat.] Of course, if there was a fire, with all these little bushes and dead branches around Fire would be so strong it'd probably kill us all! That's not its fault; that's just how it is. The more there is for it to consume, the bigger and hotter it grows.

DA: Thank you, trees. Now we'll hear from several plants. [***Wildflower** and **Plant 2** take the stand.*] Wildflower, why don't you tell us how fire affects you?



Wildflower: Oh, Fire's great, every once in awhile. A lot of things die... but the babies do so well after a fire! And fire clears out the shady trees so we get enough **sun**! Why, I don't think I could live in New Mexico, if it weren't for fire! Don't you think my blue flowers look beautiful in a field?

Plant 2: Yeah, sure. If it weren't for Fire none of us little plants would be able to grow. We'd all be choked by pine needles, and the soil wouldn't be nutritious enough for us! The soil is so delicious after a fire: all that dead stuff on the ground goes back into the soil as ash. Yum! [***Wildflower** and **Plant 2** return to their seats.*]

DA: Humans are part of the Ecosystem, too. How does fire affect them? Let's hear from some. First, a person who gets their food by hunting and gathering:

Native American / Frontiersman: The fields Fire makes are so good for big game like deer and buffalo. Great hunting! If there hasn't been Fire in awhile the hunting gets bad and we get **hungry**! Sometimes we even start Fire so the hunting will improve. But Fire can change direction and burn us or our homes if we're not careful.

DA: Thank you, hunter/gatherer. Next we'll hear from a Forest Manager. [*After Forest Manager is on the stand*] Tell us what you know of Fire.

Forest Manager: It's my job to make sure the forest is healthy and taken care of. The way we've controlled fire is by keeping the fuel down. We thin the trees—cut out the little ones so the ones that are bigger can grow, have enough of what they need, and be healthy. And then we set control burns. We let fire out, but give it boundaries. Keep it away from houses and structures that can be damaged by Fire.

PA: How's that working?

Forest Manager: Well, better than suppression—which means not letting fire burn at all. We have to be careful that Wind doesn't cause problems. She tends to egg Fire on, whipping it up into more of a blaze than is safe. There was that time up by Los Alamos Fire got out of control. It's always a dangerous thing to let out. But if we prepare well and are careful, it actually seems helpful to the environment around here.

Judge: Lastly, let's hear from Fire itself. [*After Fire has taken the stand*] What do you have to say for yourself?

Fire: Well, I just eat what I can, when I can. Just like anything else does. The Ecosystem and I grew up together. We used to work together. It was all going fine until humans stopped me and the forest grew crowded and unhealthy! I can be destructive, but I also help the Ecosystem.

Judge: Thank you, witnesses. Prosecuting Attorney, Defense Attorney, you may go ahead with your concluding remarks.

PA: Fire is **DANGEROUS!** It's killed millions of creatures. It's injured the ecosystem. We must lock it up and never let it out!

DA: Fire **IS** dangerous, I won't deny it. But also **very** important to the health of the Ecosystem. Fire gets rid of dead plant material on the ground, restores the soil, makes fields for plants, deer, rabbits, and mice, and the predators benefit from those fields with easy hunting. Fire should be let out in a controlled manner. The Ecosystem <u>NEEDS</u> fire!

Judge: At this time we will take a vote. I remind you to carefully consider all the things you have heard and make the best decision you can **based on the evidence** given by the witnesses. Jury and witnesses, please put your heads down on your desks. All those who vote that Fire is **INNOCENT** of the charges of causing widespread destruction of forests and land, and just being <u>completely</u> <u>destructive</u> raise your hand (and keep it up).

[*Teacher counts.*]

All those who believe that fire is **GUILTY** of causing widespread destruction of forests and land and being completely destructive raise your hand (and keep it up).

[*Teacher counts.*]

The jury may now raise their heads.

Conclusion

Announce the results. If you choose to, call on a few students to defend their position. Tell the students that, while this was a pretend trial, the information about how fire affects the ecosystem is true and use the discussion questions to lead a discussion. Emphasize that fire is neither all good nor all bad, but many New Mexico ecosystems have adapted to it as a normal part of the ecosystem.

Discussion Questions

1. Witnesses, raise your hands if you benefited from fire.
2. Witnesses, raise your hands if you could have been harmed by fire.
3. Do you think fire is dangerous?
4. Do you think fire helps the ecosystem? How?
5. Why are fires often so big and severe today?

Modifications

1. Let the students ask questions of any witness before voting (or while they're still on the stand). This may take some time.
2. Assign the last two or three discussion questions as written work.

Extensions

Have the students make or gather props or partial costumes for themselves (for instance, nametags of some type, paper flames for Fire, a partial exoskeleton for Bark Beetle, branches for the Pines, ties or a skirt-suit for the Attorneys.)

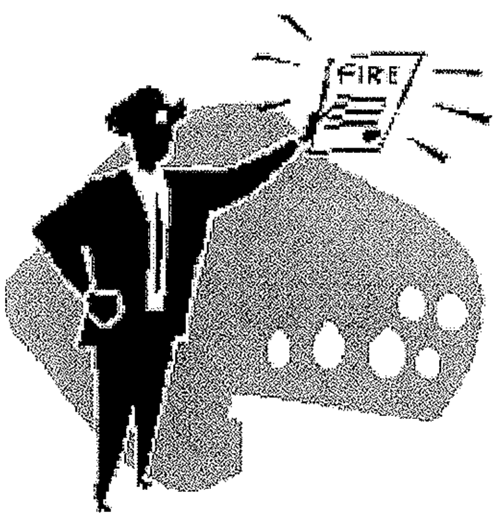
El Fuego va a Juicio

Instrucciones para el Juicio: A TODOS los estudiantes, ¡favor de leer con mucho cuidado!

Testigos y Abogados*:* Se les dará un guión o parte de un guión. Se les dará unos minutos para leer su guión. Deben asegurarse saber lo que tienen que decir y hacer. Cuando el juez los llame para atestiguar, se llegan hasta la "tribuna" para leer sus líneas.

Las palabras que ven dentro de [ ] **NO** se leen en voz alta. Éstas sólo son las indicaciones de actuación.

Abogados, por favor esperen hasta que el testigo esté en la tribuna antes de comenzar a hablar.



Los actores también harán el papel de los miembros del jurado al final del juicio y votarán (como ustedes mismo y no como su personaje). Estén preparados para explicar el por qué votaron en la manera en que lo hicieron.

El juez, el fiscal (abogado acusador) y el abogado defensor (AD): es posible que tengan que ajustar un poco su papel según el género (masculino o femenino) de los actores.

Miembros del Jurado: Los estudiantes que no sean testigos, el fiscal, o el abogado defensor, son los miembros del **jurado**. Su deber es determinar culpabilidad o inocencia. Presten atención al juicio. Una vez que acabe el juicio, ustedes votarán. Estén listos para explicar el por qué votaron como lo hicieron.

El Fuego va a Juicio
Guión

Clérigo o Juez: ¡Todos de pie!

Juez: La corte del Honorable Juez entra en sesión.

Clérigo o Juez: Pueden sentarse.

Esta corte de __________ Elementary, bajo la jurisdicción de __________ (el nombre del distrito de tu escuela o condado), ahora someterá a juicio al Señor/la Señora Fuego de Bosque por crímenes cometidos contra el pueblo, las plantas, los animales y otros residentes del estado de Nuevo México (en otras palabras, el Ecosistema).

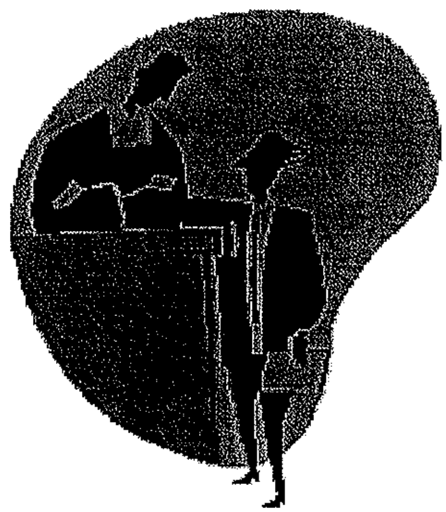
En pocos momentos se leerán los cargos. Luego se les presentará a los testigos que están a favor y en contra del acusado y tendrán que proponer una sentencia al final del juicio: culpable o inocente. Les recuerdo utilizar todas sus destrezas de razonamiento, denle seria consideración a las declaraciones que se les presentará y, por último, den la sentencia más rasonable y exacta que puedan. **Ustedes** son responsables por el destino del prisionero y, tal vez, hasta sean responsables por el destino de la Tierra. Les recuerdo seguir las reglas del órden de la corte [*introduce una consequencia aquí si así lo necesitara tu clase*]. Al final del juicio, cada uno de ustedes (el juzgado y los testigos) votarán y deberán explicar o defender su punto de vista.

Ahora prestaremos juramento:

¡Todos de pie!

Levanten la mano derecha y repitan conmigo.

[*El juez lee y todos repiten un renglón a la vez*]



Prometo solemnemente

escuchar mientras que otros hablen,

respetar y obedecer al juez en toda petición sensata,

jugar mi papel con presición,

dar una sentencia honesta y justa,

y contribuir en cualquier manera posible al esfuerzo de este juicio.

Juez/maestro(a): Gracias. Se pueden sentar. Antes de comenzar el juicio, ¿tienen alguna pregunta? [*Acepta cualquier pregunta. Cuando creas que todos los estudiantes comprenden la actividad, cintinúa.*] Fiscal, por favor, lea los cargos.

Fiscal: Este es el juicio del Ecosistema contra El Fuego.

Mi cliente, El Ecosistema, acusa al Fuego de ocasionar inmensa destrucción a los bosques y a la tierra, de dañar severamente al Ecosistema, y de ser completamente destructivo.

Juez: El ACLU ha proevido al Fuego con un Abogado Defensor quien disputará el caso por el Fuego.

Todos los testigos, por favor, pónganse de pie, levanten su mano derecha para prestar juramento y repitan conmigo:

Juro decir la verdad, toda la verdad y nada más que la verdad.

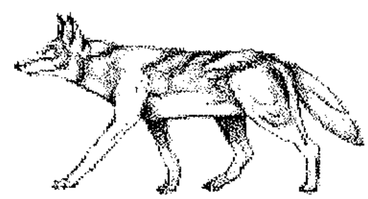
Se pueden sentar.

Juez: Nuestro primer testigo es el Coyote Cody. Cody, por favor tome puesto en la tribuna.

Fiscal: [*El abogado acusador espera a que Cody tome su puesto en la tribuna*] Coyote Cody, por favor cuéntenos lo que le sucedió la noche del 22 de junio de 2003.

Coyote: Bueno, yo andaba por ahí, sin meter las narices en asuntos ajenos, comiendo semillas de piñón, robándome un huevo de pájaro por aquí y por allá, cuando de pronto sentí que mi cola comenzó a ponerse caliente. Sentí un viento y antes de que pudiera darme cuenta, otros animales y yo tratabamos de escaparnos del Fuego, ¡quien trataba de consumirnos a todos! ¡Sentí tanto miedo! Yo logré escaparme del Fuego pero no la punta de mi cola, la cual se quemó. ¡Hasta el día de hoy tengo la punta negra!

Fiscal: ¿Hiciste algo para enfurecer al Fuego?



Coyote: No, ¡nada!

Fiscal: No tengo más preguntas, Señor Juez.

Juez: Abogado Defensor, ahora puede interrogar al testigo.

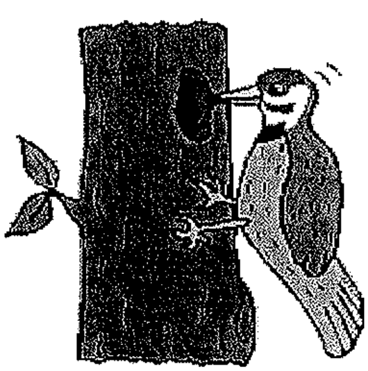
Abogado Defensor: [*El abogado defensor se le acerca al testigo*] ¿Es cierto que después que el Fuego se marchó usted se robó una de sus presas cuando excavó un conejo de la tierra que el Fuego había matado y... ¡se lo **comió**!?

Coyote: Bueno, sí, yo quedé hambriento después de tanto correr y...

Abogado Defensor: [*interrumpiendo*] ¡Ajá! ¡Así que en realidad te **beneficiaste** del Fuego!

Coyote: Bueno, yo, eh... pues sí, supongo que sí. Pero igual así fue algo espantoso y el Fuego ¡me la **debe**!

Abogado Defensor: No tengo más preguntas.



Juez: Bueno Coyote, hemos terminado con usted. Gracias. ¡El próximo testigo! La jóven Stevie Pájaro Carpintero, por favor, tome puesto en la tribuna.

[*El coyote olfatea el aire hacia el Pájaro Carpintero y muerde en el aire en la dirección del Pájaro Carpintero. El Pájaro Carpintero aulla, asustada, y se apresura a la tribuna, lejos del Coyote.*]

Juez: ¡Señor/a Coyote! Tome asiento.

Fiscal: [*Espera a que el testigo se sienta*] ¿Es cierto que el

Fuego la persiguió, que la acosó fuera de su casa el 2 de junio de 2002?

Pájaro Carpintero: [*aspirando por la naríz, como si hubiera estado llorando*] Pues sí... ¡fue horrible! Toda mi familia tuvo que irse de casa.

Abogado Defensor: ¿Y le fue difícil encontrar una casa y comida después del Fuego?

Pájaro Carpintero: Sí, ¡fue muy difícil!

Abogado Defensor: ¡Recuerde que está bajo juramento!

Pájaro Carpintero: Bueno, en realidad después del fuego quedaron muchos árboles carbonizados en los que pudimos tallar nuestras casas fácilmente. Y en los árboles muertos por lo general se pueden encontrar muchos insectos sabrosos que comer, ¡algunos están hasta asaditos!

Juez: Gracias, Stevie. El próximo testigo es la señorita San D. Mousy, Ratón del Campo. [*Con cuidado, al jurado*] Esta ratoncita aún está perturbada. Por lo tanto, por favor, permanezcan lo más callado y sean lo más considerados posible.

Fiscal: ¿Qué nos puede decir del Fuego?

Ratoncita: [*Indiscutiblemente con miedo aún*] Bueno, me persiguió y ¡yo corrí! ¡Corrí lo más rápido que mis paticas grises me lo permitieron! El Fuego atrapó a mi hermano. Y me quiso comer – ¡me quiso **consumir**!

Fiscal: No tengo más preguntas para esta **pobre** testigo, Señor Juez.

Abogado Defensor: Señorita Mousy – ¿Nos puede describir el ambiente en que vive y come?

Ratoncita: Oh, sí. Yo vivo en un pequeño y lindo campo. En este campo hay flores silvestres por todas partes y pequeñas plantas verdes que comer. Oh, también hay muchas semillitas ricas y muchos lugares buenos donde me puedo esconder en el pasto.

Abogado Defensor: ¿Podrías vivir de la misma manera, dígamos, en un bosque donde no haya muchas plantas en la tierra?

Ratoncita: Oh, no. Mi prima Jen es una ratoncita del bosque y ella dice que allí los ratones mueren constantemente porque ¡no hay sufciente para comer!

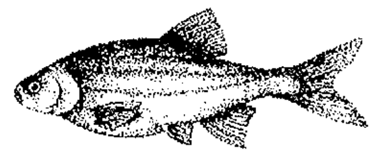
Abogado Defensor: Bueno, sin el Fuego tu lindo campo se **convertiría**... en un ¡**BOSQUE**! El Fuego no deja que los árboles obstruyan el sol para que las pequeñas plantas que tanto te gustan comer puedan crecer. Por lo tanto, ¡en realidad le debes **agradecimiento** al Fuego por tu casa y tu comida!

Ratoncita: ¡Oh! ¡Yo no sabía **eso**!

Juez: Gracias, ratoncita. El próximo en la tribuna de juramento es el basurero volador— Villus Turkey Vulture (una criatura a quien también se conoce por el nombre de Buzzard [buitre]).

Buitre: Mis amigos me llaman T.V. Y no me importa lo que diga otra gente pero, ¡a mí me encanta el fuego! El banquete más gustoso que me he dado fue después del fuego del 2004. Ustedes saben que mi comida favorita es la muerta. El Fuego hace mi trabajo por mí. Algunos de los animales no longran salvarse y yo me doy banquete con los restos ¡por semanas! ¡Es **FANTÁSTICO!**

Juez: Gracias, Villus. Escúchemos lo que tiene que decir el pez Frankie/Frannie.



Pez: El Fuego es bastante duro conmigo. Cuando muchos árboles mueren, las raices no mantienen la tierra en su lugar y ésta se desliza loma abajo hasta llegar a mi laguna. Esto hace que el agua de mi laguna se ponga tan turbia que no me permite ver para cazar o para buscar comida. A veces hasta paso trabajo para respirar.

Juez: ¿Fiscal, Abogado Defensor, tienen preguntas? [*Ambos dicen que no con la cabeza*]. Gracias Señor/Señorita Pez. Puede nadar de regreso a su puesto.

Pez: [*regresa a su puesto haciendo movimientos como los que hacen los peces*]

Juez: Quisiera llamar a la tribuna al Escarabajo Horador. [*El escarabajo horador ataca la corteza de los árboles.*]

Fiscal: Señor Escarabajo Horador, por favor, cuéntenos de sus experiencias con el Fuego.

Escarabajo Horador: Bueno, ¡él es un terrible malicioso! Me obliga salir de mi casa con sus llamas, mata a mi familia y a mis amigos. Una vez, estabamos pasándolo de maravilla en una fiesta... en un delicioso árbol de Piñón. El árbol estaba sediento por agua y estaba débil, así que no se podía deshacer de nosotros. Já, já, já [*con una risa maldita*]. Yo llamé a todos mis amigos hasta que todos—¡éramos **miles!**—comenzamos a comer pedazo por pedazo al pobre árbol indefenso. ¡Fue una maravilla! Hasta que el Fuego llegó y ¡**mató** a casi todos mis amigos!

¡Pero esto no fue lo peor del caso! El Fuego se deshizo de muchos árboles que rodeaban al árbol indefenso, el espacio extra, más agua, hicieron que el árbol viejo se fortaleciera. Después que el Fuego pasó por ahí, ¡no pudimos entrarle al árbol otra vez!

Abogado Defensor: ¿No es cierto que los árboles que tú matas se queman más fácimente y atraen al Fuego?

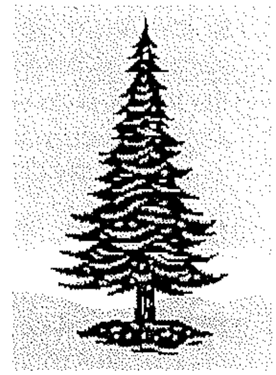
Escarabajo Horador [*con tristeza*]: Bueno, sí, supongo que sí. [*Más contento*] ¡Al no ser que la Gente nunca permitiera que el Fuego comenzara!

Abogado Defensor: No tengo más preguntas, señor Juez. Me gustaría llamar a otros testigos para oir sus declaraciones.

Juez: Adelante.

Abogado Defensor: Primero quisiera llamar a los primos Ponderosa y Pino Piñon.

Abogado Defensor (de nuevo): [*después que los árboles toman su puesto en la tribuna*] Por favor, cuéntenos lo que saben sobre el Fuego.



Pino Ponderosa: El Fuego y yo éramos amigos. Él se deshace de otros árboles. Yo siempre estoy listo/a para su visita. Yo no mantengo ramas bajas para que él las queme, mi corteza es gruesa y saludable por lo tanto no me quemo y tengo raíces profundas. Hace tiempo que no veo al Fuego aunque dejo agujas en la tierra para que él las queme. Nosotros los árboles estamos apretados en un pequeño espacio y tenemos que compartir los mismos minerales y el agua. ¡Yo no puedo extirarme!

Pino Piñón: Sí, el Fuego nos ayuda a no amontonarnos; ¡a mi amiga Jenna la está asfixiando un enebro! El enebro está creciendo en sus ramas. ¡Imagínense! Yo echo de menos al Fuego aún más porque estoy lleno/a de estos horribles escarabajos horadores quienes están comiéndome vivo.

Escarabajo Horador: [*se inclina y* <u>*SILENCIOSAMENTE*</u> *PRETENDE mordisquear al Pino Piñón hasta llegar al final del párrafo donde* ***Piñón*** *lo/la aparta.*]

Pino Piñón: [mientras que DELICADAMENTE aparta al escarabajo horador] ¡Uy! ¡Aquí hay otro! ¡Insecto dañino desagradable! Antes el Fuego los mataba. [*El escarabajo horador regresa a su asiento.*] Claro está, si hubiera un incendio con todos estos pequeños arbustos y ramas muertas, ¡el Fuego sería tan fuerte que probablemente nos matara a todos! Y esto no es su culpa; simplemente es como son las cosas. Mientras más haya que consumir, lo más grande y más caliente que crecería el fuego.

Abogado Defensor: Gracias árboles. Ahora escucharemos el testimonio de diferentes plantas. [*Flor Silvestre y Planta 2 asumen su puesto en la tribuna.*] Flor Silvestre, ¿por qué no nos cuentas cómo te afecta el Fuego?

Flor Silvestre: Oh, el Fuego es fantástico siempre que sea de vez en cuando. Muchas cosas mueren... ¡pero los pequeñuelos se benefician tanto después de un fuego! ¡Y el fuego despeja los árboles que causan sombra para que <u>nosotras</u> recibamos suficiente **sol**! ¡Yo no podría vivir en Nuevo México si no fuera por los fuegos! ¿No creen que mis florecitas azules lucen bonitas en el campo?

Planta 2: Sí, claro. Si no fuera por el Fuego ninguna de nosotras las plantas pequeñas creceríamos. Nos afixiariamos todas con las agujas de los pinos, ¡y la tierra no sería nutritiva lo suficiente para nosotras! La tierra es tan deliciosa justo después de un fuego: toda la materia en la superficie de la tierra regresa a la tierra como ceniza. ¡Qué rico!

Abogado Defensor: Los humanos también son parte del Ecosistema. ¿Cómo es que les afecta un fuego? Escuchemos lo que ellos tienen que aportar. Primero, escuchemos de alguien quien recibe su alimento de la caza y de la recolecta:

Nativo Americano / Habitante de la Frontera: El campo que el Fuego deja es excelente para la caza de venado y de búfalo. ¡La caza es estupenda! Si no hay fuegos en largo tiempo, la caza sufre y ¡<u>nosotros</u> pasamos hambre! A veces nosotros mismos provocamos un Fuego para mejorar la caza. Pero a veces el Fuego cambia de dirección y si no tenemos cuidado nos quema, al igual que a nuestras casas.

Abogado Defensor: Gracias, cazador/colector. A seguir escucharemos la declaración del Administrador de Bosque. [*Después que el Administrador del Bosque toma puesto en la tribuna*] Díganos lo que sabe sobre el Fuego.

Administrador de Bosque: Es mi responsabilidad mantener el bosque saludable y bien cuidado. Con el control del uso de combustibles hemos controlado los Fuegos. Nosotros también talamos los árboles – cortamos los árboles pequeños para que los que ya son grandes puedan crecer, para que tengan más de lo que necesitan, y para que estén saludables. Y entonces hacemos incendios controlados. Dejamos que el Fuego se propague, pero le ponemos límites. Lo mantenemos lejos de las casas y de estructuras que puedan ser perjudicadas por el Fuego.

Fiscal: ¿Y cómo les va con eso?

Administrador de Bosque: Bueno, mejor que la supresión – en otras palabras, impedir que el fuego no se propague. Tenemos que ponerle atención y cuidar de que el Viento no cause problemas. El viento tiene la costumbre de provocar al Fuego, haciendo que éste sea más que sólo una llamarada, lo cual es peligroso. Una vez hubo un fuego cerca de Los Alamos el cual estubo fuera de control. Esto siempre es algo peligroso. Pero si nos preparamos bien y tenemos cuidado, realmente el fuego parece ser útil para el medio ambiente.

Juez: Por último, escuchemos lo que tiene que decir el propio Fuego. [*Después que el Fuego tome puesto en la tribuna*] ¿Qué tiene que decir en su defensa?

Fuego: Bueno, yo sólo como lo que puedo, cuando puedo. Como mismo lo haría cualquier otra cosa. El Ecosistema y yo crecimos juntos. Antes trabajabamos juntos. Todo marchaba bien hasta que los humanos me comenzaron a controlar y el bosque comenzó a amontonarse y comenzó a ponerse riesgoso. Yo <u>puedo</u> ser destructor, pero también puedo <u>ayudar</u> al Ecosistema.

Juez: Gracias testigo. Fiscal, Abogado Defensor, pueden ya hacer sus comentarios finales.

Fiscal: El Fuego es algo **¡PELIGROSO!** Ha matado a millones de seres vivientes. Le ha hecho daño al Ecosistema. ¡Tenemos que encerrarlo y no dejar que salga!

Abogado Defensor: El Fuego **ES** peligroso, no lo voy a negar. Pero también es **muy** importante para la salud del Ecosistema. El Fuego se deshace de la materia de plantas muertas en la tierra y restaura su condición, crea campos para las plantas, venados, conejos y ratones, de lo cual se benefician los depredadores en cazar fácilmente. Al Fuego se debe dejar crecer bajo control. ¡El Ecosistema NECESITA el Fuego!

Juez: Llegó el momento de votar. Les recuerdo que tomen en cuenta todas las cosas que han escuchado y que tomen la mejor decisión que puedan. El jurado y los testigos, por favor, agachen sus cabezas sobre sus escritorios. Todos ustedes que voten a favor del Fuego, que lo encuentren **INOCENTE** de los cargos de causar extendida destrucción de los bosques y de la tierra, y de simplemente ser <u>completamente</u> <u>destructivo</u>, levanten sus manos (y dejenla arriba).

[*Maestro/a cuenta*]

Todos ustedes que creen que el Fuego es **CULPABLE** por causar extendida destrucción de los bosques y de la tierra, y de ser <u>completamente</u> <u>destructivo</u>, levanten sus manos (y dejenla arriba).

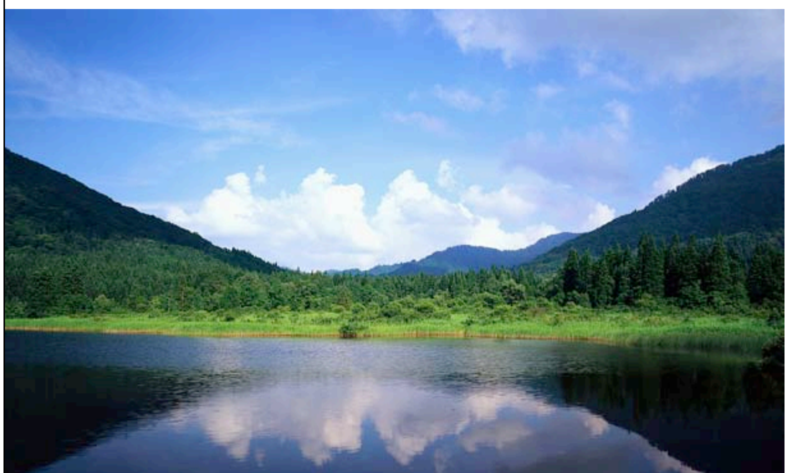
[*Maestro/a cuenta*]

El jurado ya puede levantar la cabeza.

(El juez anuncia el resultado del veredicto)

Water

Water in the state of New Mexico drives the composition of natural communities, including human settlements such as Albuquerque and Santa Fe. The diversity of plants and animals found along the Rio Grande bosque (forest) is a perfect example. The organisms thrive because water is readily available for growth and nutrition. Although some organisms such as cacti, have developed ways to exist with minimal water supply, all living organisms need water at some point in their lives. Humans need water not only for existence, but water is also important to people for recreational and cultural reasons.



New Mexico has the lowest percentage of surface water of any state in the country. Increasing human consumption and drought conditions contribute to decreasing water resources throughout much of the state. As human population increases, it becomes more important for New Mexicans to be aware of the importance of water conservation and clean water to all communities and species throughout the state.

Water

An African Water Song

Objective
Students will create music and perform a song or create a play about water.

Key Words
1. *Catchment area* – an area of land that drains rainfall into a river or lake; a drainage basin
2. *Conserve* - to use something sparingly so as not to exhaust supplies

Background
Some students in Kenya wrote a song in their native language of Swahili about water. Their ideas about water also apply to us in the United States and especially the Southwest. Their song is called "Maji ni uhai" , which means "Water Is Life" (Maji ... is pronounced maa-jee, ni sounds like knee, and uhai sounds like oo-high).

"Maji ni uhai" (Water is Life)

Water is important
Water is life
Without water brother, we can't live
Sing goodness conserve those areas
Chemical containers and papers should not be thrown in water
Because they are killing creatures
We should not cut down trees and burn them
Because they are destroying catchment areas
Navigation depends on water
Power production depends on water
Cooking at home depends on water
Various things depend on water
Construction depends on water

Materials
Musical instruments (homemade or other), paper and pens

Instructions
1. Create music to go with the words and perform this song with band for a group at school.

2. Create a similar song using Southwestern themes.

3. Create a play using the message of the song.

New Mexico Science Standards
Grade 5, II, III, II, 3 and III, I, I, 1
Grade 6, II, II, I, 1
Grade 7, II, I, I, 1; II, I, II, 1; II, II, I, 1, 5; and II, III, II, 3
Grade 8, II, III, II, 2
Grades 9-12, II, II, I, 3; II, III, II, 9, 12; and III, I, I, 12, 13

Source: Adapted from "Terrestrial Life and Ecosystem Lesson Plans", http://www.earthwatch.org

Water

How Much Water Is There?

Objectives
Students will:
1. Recognize that there is a lot of water in the world but only a small fraction can be used for drinking water and other water supply needs
2. Recognize that groundwater is a very small percentage of the Earth's water
3. Understand how important it is that we take care of our ground water

Key Words
1. *Groundwater* - water that fills the spaces between rocks and soil particles underground
2. *Water cycle* - series of movements of water on and below the Earth's surface; includes storage, evaporation, precipitation and runoff

Background
From looking at maps and satellite photographs we know that about 3/4 of the Earth's surface is covered in water. 97% of the water on the Earth's surface is salty (unusable) ocean water while the remaining 3% is fresh water. Most of that fresh water, only 2%, is frozen in the ice caps and glaciers where it is unavailable for human use. Only 1% of all water is found in lakes, rivers, and underground aquifers.

The source of all groundwater is precipitation. When rain falls, plants and soil absorb some of the rainwater, some of it drains into streams, some evaporates, and the remainder moves downward recharging aquifers. Groundwater moves through the water cycle as part of a dynamic system from recharge areas (caves, sinks, fractures, and partings) to areas of discharge that flow into streams, lakes, wetlands, or the ocean. Streams that flow during periods of little rainfall are fed or produced by a groundwater system.

Materials
5 gallons of water
5-gallon aquarium
Blue food coloring
Ice tray
Dropper
6-ounce see through contain
1 large graduate liquid measuring pitcher or three 1-cup measuring cups

Advance Preparation
Have five gallons of water in an aquarium. Tell students that this represents all the water in the world. Have the students predict the percentage this water represents. Have students write down their predictions.

Ocean:…………………………………………….... 97.2%
Groundwater:………………………………………. 0.397%
Surface water:……………………………………… 0.022%
Ice Caps/Glaciers:………………………………….. 2.38%
Atmosphere:……………………………………….0.001%

Instructions

1. Tell the students that the five gallons of water represents all the water in the world. Remove 18 ounces of the water from the aquarium with the measuring cup. Use the blue food coloring to color the remaining water in the aquarium. Tell the student that the water in the aquarium represents all the water on Earth that is held in the oceans. The water in the measuring cup represents all the water that is <u>not</u> ocean.

2. Pour 15 ounces of the water from the measuring cup into the ice tray. This water represents the water held in glaciers and ice caps. This water is not readily available for use.

3. The remaining 3 ounces of water represent the world's available fresh water. Of this amount, only a fraction of an ounce is held in the world's fresh water lakes and rivers. Place this water (only one dropper of water) into a student's hand.

4. The remaining 2.5 ounces of water represents ground water. Pour this remaining water into a cup of sand and explain that this is what is referred to as groundwater. This is water that is held in pore spaces of soil and fractures in the bedrock.

5. Discuss what the students learned from the lesson and discuss the actual percentages of water resources.

6. Ask the students:
   A. Why isn't all fresh water usable? (Some water is not easy to access; it may be frozen or trapped in unyielding soils or bedrock fractures. Some water is too polluted to use.)

   B. Why do we need to take care of the surface/ground water? (Water is very important for humans, plants/crops, and animals. If we waste water or pollute it, we may find that there is less and less of it available for us to use.)

New Mexico Science Standards
Grade 5, II, III, II, 3 and III, I, I, 1
Grade 6, II, II, I, 1
Grade 7, II, I, I, 1; II, I, II, 1; II, II, I, 1, 5; and II, III, II, 3
Grade 8, II, III, II, 2
Grades 9-12, II, II, I, 3; II, III, II, 9, 12; and III, I, I, 12, 13

Source: Adapted from "All the Water in the World", Carlsbad Caverns National Park Middle School Ecology Curriculum

How Much of New Mexico is Water?

What percent of New Mexico do you think is covered in water? Which state has the highest percentage of water area? Is the West really "drier" than the rest of the country? The table below shows the total land area of each state, the water area, and the percent of total area that is water.

These data represent only "inland" water – water that is surrounded by lands of the United States. Areas, such as the Great Lakes, are excluded.

State	Land area (sq. miles)	Water area (sq. miles)	Percent of state that is water	State	Land area (sq. miles)	Water area (sq. miles)	Percent of state that is water
Rhode Island	1,212	158	13.0%	Kentucky	40,410	740	1.8%
D. C.	69	6	8.7%	Alabama	51,705	938	1.8%
Florida	58,664	4,511	7.7%	Texas	266,807	4,790	1.8%
North Carolina	52,669	3,826	7.3%	California	157,706	2,407	1.5%
Maine	33,265	2,270	6.8%	South Dakota	77,116	1,164	1.5%
Louisiana	47,752	3,230	6.8%	Georgia	58,910	854	1.4%
Maryland	10,460	623	6.0%	Idaho	83,564	1,153	1.4%
Minnesota	84,402	4,854	5.8%	Illinois	56,345	700	1.2%
Massachusetts	8,284	460	5.6%	Montana	147,046	1,658	1.1%
Delaware	2,045	112	5.5%	Missouri	69,697	752	1.1%
New Jersey	7,787	319	4.1%	Mississippi	47,689	457	1.0%
Vermont	9,614	341	3.5%	Pennsylvania	45,308	420	0.9%
New York	49,108	1,731	3.5%	Nebraska	77,355	711	0.9%
Alaska	591,004	20,171	3.4%	Oregon	97,073	889	0.9%
Utah	84,899	2,826	3.3%	Wyoming	97,809	820	0.8%
New Hampshire	9,279	286	3.1%	Ohio	41,330	325	0.8%
Wisconsin	56,153	1,727	3.1%	Hawaii	6471	46	0.7%
Connecticut	5,018	147	2.9%	Indiana	36,185	253	0.7%
South Carolina	31,113	909	2.9%	Kansas	82,277	499	0.6%
Michigan	58,527	1,573	2.7%	Nevada	110,561	667	0.6%
Virginia	40,767	1,063	2.6%	Iowa	56,275	310	0.6%
Washington	68,139	1,627	2.4%	Colorado	104,091	496	0.5%
Tennessee	42,144	989	2.3%	West Virginia	24,232	112	0.5%
Arkansas	53,187	1,109	2.1%	Arizona	114,000	492	0.4%
North Dakota	70,702	1,403	2.0%	**New Mexico**	**121,593**	**258**	**0.2%**
Oklahoma	69,956	1,301	1.9%				
United States	3,618,770	79,481	2.2%				

Data is from the U.S. Geological Survey: Statistical Abstract of the United States, 1987

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Personal Water Use Audit

Keep track of how many times you do each activity in 1 day. Keep a running tally throughout the day and then calculate your total times and gallons used at the end of the day.

Activity	Tally times doing activity	Total number	Estimated Water Use (multiply total number by the amount listed to get total gallons)
Washed hands			**0.1 gallons =__________gallons**
Showered (regular showerhead)			**30 gallons =__________gallons**
Showered (low-flow showerhead)			**15 gallons =__________gallons**
Tub bath			**20 gallons =__________gallons**
Brushed teeth			**0.2 gallons =__________gallons**
Drank a glass of water			**0.008 gallons =__________gallons**
Boiled pot of water for cooking			**0.25 gallons =__________gallons**
Flushed toilet (conventional toilet)			**5 gallons =__________gallons**
Flushed toilet (ultra-low flush toilet)			**1.6 gallons =__________gallons**
Washed a load of dishes in dishwasher			**15 gallons =__________gallons**
Washed a load of dishes in sink (not running the tap)			**10 gallons =__________gallons**
Washed load of laundry in conventional machine			**40 gallons =__________gallons**
Washed load of laundry in high efficiency washer			**25 gallons =__________gallons**
Washed a car			**15 gallons =__________gallons**
Other activity:			
Other activity:			
Other activity:			
Total daily gallons			

Adapted from WaterPartners International "Tap Tally Sheet" (**http://water.org/assets/PDF/ODsplishsplash.pdf**)

Water

Do You Use Too Much Water?

Objectives
Students will:
1. Identify ways in which water is used
2. Analyze a family's water use

Key Word
Conservation - a scientific discipline that seeks to understand the effects of human activities on species, communities, and ecosystems and to develop practical ways of preventing the extinction of species and the destruction of ecosystems.

Background
From looking at maps and satellite photographs we know that about 3/4th of the Earth's surface is covered in water. 97% of the water on the Earth's surface is salty (unusable) ocean water while the remaining 3% is fresh water. Most of that fresh water (2%) is frozen in the ice caps and glaciers where it is unavailable for human use. Only 1% of all the water is found in lakes, rivers, and underground aquifers.

People that live in the desert need to be extra careful with water use. We only have a limited supply of fresh water to drink and use. That is why it is important that we use water wisely and protect our water supplies whenever and wherever possible. If we each save a small amount of water each day, our combined savings will add up to millions of gallons each year.

Unlike traditional desert people, most of us tend to take water for granted. We turn on the tap and it is always there. We wallow in hot baths, take long showers, and water our lawns to an unnatural perfection. We are probably the most profligate users of water in the world; yet it is estimated that between a third and a half of all that water is wasted.

Materials
Personal Water Use Audit Worksheet

Instructions
1. Have students predict how much water their family uses in one week. Have them write their predictions on a piece of paper.

2. Hand out a copy of the water usage worksheet. Students will be conducting the survey at home for a full week. Explain how to fill out the survey by making tally marks each time the activity takes place. After the surveys have been completed discuss the results.

3. Have students look at their water usage worksheets and consider what their family could do to reduce the amount of water they use.

New Mexico Science Standards
Grade 5, II, III, II, 3 and III, I, I, 1
Grade 6, II, II, I, 1
Grade 7, II, I, I, 1; II, I, II, 1; II, II, I, 1, 5; and II, III, II, 3
Grade 8, II, III, II, 2
Grades 9-12, II, II, I, 3; II, III, II, 9, 12; and III, I, I, 12, 13

Source: Adapted from "How Much Water Do You Use?", Carlsbad Caverns Ecology Curriculum for Middle School

Water

Desert Animals and Water

Objectives

Students will:

1. Understand how difficult it is for animals to conserve water in a desert environment
2. Observe a model situation and make inferences about real organisms
3. Communicate their observations about organisms adapted to dry desert environments

Key Words

1. *Adaptation* - a behavior, physical feature, or other characteristic that helps an animal survive and make the most of its habitat; the way any living thing is fitted to the life it leads.
2. *Conservation* - a scientific discipline that seeks to understand the effects of human activities on species, communities, and ecosystems and to develop practical approaches to preventing the extinction of species and the destruction of ecosystems
3. *Microhabitats* - a small area where an organism lives that has different conditions from another small area that might be right next door.
4. *Nocturnal* - most active at night, sleeps most of the day

Background

A variety of organisms live in almost any habitat you could name. The desert, for example, is a challenging habitat for the plants and animals that live there. Yet for thousands of years plant and animal species have adapted and thrived in these arid lands. How? Each organism has its own way of life which often requires a different environment from that of other organisms. Plants and animals inhabit specific microhabitats within the environment of a general habitat. This microhabitat allows them to accommodate their needs and survive the harshness of the desert. A microhabitat is simply a small, distinctly specialized habitat.

For some animals their respite is the cool interior of a burrow. Rattlesnakes, kit foxes, and kangaroo rats spend most of the day resting in underground burrows. They choose the night for their active period to avoid the intense dehydrating heat of the daytime sun. During the day, the cool microclimate of their burrows helps protect them. How cool is it? While the soil surface up top may be 165 degrees Fahrenheit, their underground dens may be a livable 80 degrees Fahrenheit. In their cozy microhabitat, these animals can conserve their energy for nighttime hunting or seed gathering expeditions. Astonishingly, over half of all vertebrate animals, including those that live in caves and underground, are nocturnal.

During the dry times, animals such as the Spadefoot Toad, an amphibian that lives in the American Southwest, Can be found in a burrow dug with its spade-shaped back feet. It will continue to lie dormant until the sound of raindrops hitting the surface awakens the toad. At that point the race is on. Within approximately 8-10 days the cycle of finding a mate to laying the eggs to becoming a toad will be complete.

Some plants use combined strategies of dormancy and an accelerated life cycle. The seeds of the Sand Verbena will remain dormant (sometimes for years) until there is enough rain. When there is sufficient rain, they grow quickly, making their flowers and seeds and then dying, all within a period of a few weeks. Some plants bloom at night in order to minimize water loss.
An arroyo, a ditch carved by water in desert regions, makes for the perfect microhabitat for Javelinas. When the steep banks erode, shallow cavities are created that provide warmth in the winter and cool in the summer. The Javelinas will hide in these shallow cavities to prevent water loss and stay cool on hot summer days.

Cave entrances can provide microhabitats for a variety of plant and animal species and provide growing conditions similar to a forest. It is not uncommon to find a fringe of green around the entrances to caves. Upon closer examination, evidence of animals such as birds, snakes, skunks, or mice living in the mouth of the cave can be found.

A variety of microhabitats can be found in any environment. Plants and animals find "their place" in logs, under boulders, in cacti, or even under a refuse can. Places such as a shady area under a tree or shrub are microhabitats because they provide a home for shade loving plants or respite for the desert lizards.

Materials

Data sheet Water
Sponges Balance scales
Information about desert animals (field guides, etc.)
Natural desert materials (brush, vegetation, branches, etc.)

Advance Preparations

1. Brainstorm with students ideas about what animals do to conserve water. Ask them these questions:
   A. What do desert animals do during the day?
   B. How do they escape from the desert heat?
   C. What adaptations have they made to survive in the harsh desert climate?

Instructions

1. Divide students into groups of two or three. Give each group a sponge saturated with water. This sponge represents a desert animal with a very limited water supply. The students are to conserve as much of the animal's water as possible. For a 24-hour period the group should care for the "creature" in a way to achieve this goal using only natural materials. It must remain in the open for at least 4 hours (this represents feeding time).

2. The students should weigh their sponge to get a baseline weight of the sponge. Write this weight down to compare to the ending weight of that same sponge. Students need to develop a strategy to conserve the water in their critter, write it down and make a prediction on what they think will happen. During the 24 hour observation time the students will make and write down observations as to what is happening with their animal. At the end of the time the students should weigh their sponges and compare beginning and ending weight. Students should make inferences about the results in relation to real organisms. (There should be a control sponge that is left out for the whole time for comparisons).

3. Students should share their plan, predictions, and results with the entire class. The class can discuss methods, results, and how it all relates to adaptations for desert survival of real living organisms.

New Mexico Science Standards
Grade 5, II, III, II, 3 and III, I, I, 1
Grade 6, II, II, I, 1
Grade 7, II, I, I, 1; II, I, II, 1; II, II, I, 1, 5; and II, III, II, 3
Grade 8, II, III, II, 2
Grades 9-12, II, II, I, 3; II, III, II, 9, 12; and III, I, I, 12, 13

Source: Adapted from "Help! I'm Dehydrating!", Carlsbad Caverns National Parks Middle School Biology Curriculum

Data Sheet

Name. ______________________________ Date. ___________________________

Sponge	Initial weight	Final Weight
Control Sponge		
My Sponge		

My strategy to conserve water:

____

____

____

____

What I think will happen to my sponge:

____

____

____

____

My observations:

____

____

____

____

My results:

____

____

____

____

How does this relate to real animals?

____

____

____

____

Water

How Wetlands Help Wildlife Survive

Objectives

Students will:

1. Describe relationships of precipitation and runoff to wetlands
2. Understand the importance of wetland functions in New Mexico

Keywords

1. *Playa lake* – the lower part of an inland desert drainage basin that is filled with water only certain times of year; the lakebed generally is empty during dry periods.
2. *Runoff* - rainfall that does not soak into the soil but flows into surface waters
3. *Wetland* - an area of land where the soil near the surface is saturated or covered with water, especially one that forms a habitat for wildlife
4. *Water* - the clear liquid, essential for all plant and animal life, that occurs as rain, snow, and ice, and forms ponds, streams, rivers, lakes, and seas.
5. *Water quality*- the level of purity of water; the safety or purity of drinking water

Background

Wetlands are essential for the survival of many animals. They are one of the richer environments, providing food, water and shelter for a variety of species. New Mexico's wetlands include forested wetlands, bottom-land shrublands, marshes, fens, alpine snow glades, wet and salt meadows, shallow ponds, and playa lakes. Riparian wetlands and playa lakes are especially valuable to migratory waterfowl and wading birds.

Today, many of these wetlands are in danger. They are being destroyed by polluted water and drained for agriculture, development and other human uses. When a wetland is destroyed, so is the habitat for many animals. Wetlands reduce the effects of flooding, decrease erosion and filter pollutants from the water. In the Southwest, when a wetland is destroyed, water from a heavy downpour passes rapidly and destructively through the area, carrying with it soil, plants, trees, animals and sometimes cars and houses. By keeping wetlands healthy, we are also helping to keep our water quality healthy and preventing the destructiveness of flooding.

Materials

Modeling clay
Long shallow pan
2 sponges
Watering can
Cup of soil
Jar of muddy water
Types of Wetlands: Their Value and Hazards Information Sheet

Advance Preparation

1. Talk with students what they know about wetlands and their functional values.
2. Review the *Types of Wetlands: Their Value and Hazards* Information Sheet

Instructions

Part 1

1. Make a classroom wetland model using a pan with modeling clay. Represent land with clay by covering half of the pan with clay, sloping it toward the bottom of the pan. Do not put clay in the other half of the pan. This model will represent a body of water.

2. Ask the students what will happen when water (as in rain) lands on the land (clay). Pour some water on the clay. (Should run off quickly into the body of water.)

3. Now place a sponge in the pan at the base of the clay to represent a wetland as a buffer zone between the land and the body of water. Pour some water on the land again and ask the students what happens with the wetland added? (The wetland slows the runoff down and it lessens the amount of water reaching the body of water because some water is trapped in the wetland.)

4. Explain that wetlands are shallow basins that collect water and slow the rate of flow down. This slowing process helps prevent flooding and soil erosion.

5. Ask what might happen if a wetland is destroyed and houses or other developments are built in its place.

Part 2

1. Pour the water out of the pan from the last experiment and put in a clean sponge. Spread soil over the clay (land) and pour a jar of muddy water onto the land to represent polluted water. Ask students what happens to the runoff. Have the students compare the water in the jar to the water that ends up in the body of water.

2. Remove the sponge and repeat the experiment. What happens to the runoff?

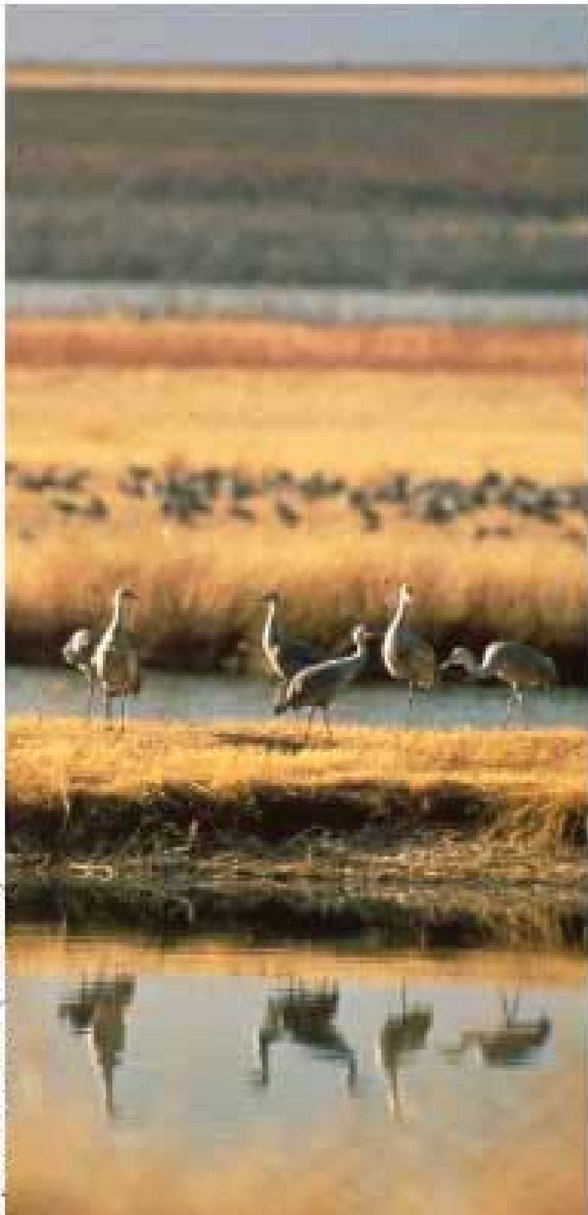
3. Explain that without wetlands, tremendous amounts of silt and pollutants end up in bodies of water.

4. Ask students how muddy water may affect fish, other wildlife and plants. How might the lack of wetlands affect us as people? How can we prevent these undesirable events from happening?

New Mexico Science Standards
Grade 5, II, III, II, 3 and III, I, I, 1
Grade 6, II, II, I, 1
Grade 7, II, I, I, 1; II, I, II, 1; II, II, I, 1, 5; and II, III, II, 3
Grade 8, II, III, II, 2
Grades 9-12, II, II, I, 3; II, III, II, 9, 12; and III, I, I, 12, 13

Source: Adapted from “Wetlands in a Pan”, University of Pennyslvania, http://sftrc.cas.psu.edu/

(Types of Wetlands pdf)


Wyman Meinzer (US FWS)

The Playa Lakes of New Mexico

Playas are typically formed in semi-arid and arid regions of the world. Playa lakes are round hollows in the ground. The largest concentration of playa lakes in the world (nearly 22,000) is on the Southern High Plains of Texas and Eastern New Mexico.

Playa lakes exist only at certain times of the year. Most playas fill with water only after spring rainstorms when freshwater collects in the round depressions of the otherwise flat landscape. The come-and-go nature of playa lakes led to confusion by early European explorers. Some of them described the region as a desert and others described a land of countless small lakes.

There are also a few saltwater-filled playas. These are fed by water from underlying aquifers, which brings salt with it as it percolates up through the soil. As the water evaporates, the salt is left behind in the increasingly salty playas.

There are many theories as to the origin of playas, but the most widely accepted are that playas are either carved by wind or they are sinkholes. Whatever their origin, playas are important to humans, animals and plants of the High Plains.

Playas support an astounding array of wildlife. Dragonflies, salamanders, bald eagles, sandhill cranes, jackrabbits and raccoons are some of the wildlife that be found at playa lakes. Amphibians would not be present in this arid region if it were not for playas. Because playa lakes support such a wide variety of animals, they contribute significantly to the biodiversity of New Mexico.

The Hero Twins and the Swallower Clouds

(Zuni-Southwest)

To the American Indian people of the dry Southwest, few things are more important than rain. The people speak of different kinds of rain: the male rain, which strikes hard on the Earth and washes away; the female rain, which falls gently and steadily, soaking the soil. Many stories are told of the rain, and songs relate to the coming of the rain. One of the corn-grinding songs of the Zuni people praises the mountains, from which the clouds come:

Clouds come rising out my beautiful mountain.
Up in the sky, the rain makers are sitting.
One after another rain clouds are coming.
Over there the flowers are coming.
Here the young corn is growing.

The clouds are powerful and benevolent, connected to the kachinas, those helping spirits of the ancestors. So when the Zuni tell the story of the giant, Swallower of Clouds, they tell of a very terrible monster indeed.

When the world was young, they say, a giant lived in the cliffs above Canon de Chelley. The food he lived on was human beings, and he caught the clouds and squeezed them into his mouth for drink. The people called him Swallower of Clouds, and the bravest of the men tried to destroy him. However, anyone who went out to the kill the giant was never seen again. Before long, he was swallowing all the clouds, the rain no longer came from the west. Because he was swallowing all the clouds, the springs to the south dried up. The crops dried up and died. The people were suffering and some began to die.

The Hero Twins saw what was happening.

“We will go and kill Swallower of the Clouds,” they said. Then they started on their way to the cliffs where he lived. But as they were following the path to the cliffs, they saw a spider web next to the trail.

“Grandmother Spider,” they said, greeting the maker of webs, “Are you well?”

“I am well, Grandchildren,” said the spider. “Where are you going?”

“We are going to kill the giant, Swallower of Clouds,” they said.

“That is good,” Grandmother Spider said, “but first let me warn you. The giant has a trick. He stretched himself out on top of the cliffs. He pretends to be sleeping and then tells whoever comes to pass under his legs, which are arched over the trail. As soon as someone passes under, though, he grabs them and throws them off the cliff.” “Grandmother,” said the Hero Twins, “what should we do?”

“Let me go ahead of you,” said Grandmother Spider. “Wait for a while and then I’ll follow.” Then Grandmother Spider set out. She did not go far before she came to the giant. He was stretched out on top of the cliff with his legs over the trail He was as huge as a hill and his legs were bigger than tree trunks. He pretended to sleep, for he had heard the Hero Twins were coming to fight him. Grandmother Spider though, was so small the giant did not see her. She climbed up a rock behind him and then let herself down on his forehead with a strand of silk. While he kept his eyes closed, pretending to sleep, she wove her we across his eyes so that he could not open them up. Now the Hero Twins, having waited for a while, started on their way. When they came close to the place where Swallower of Clouds lay, they began to sing a war song. “Who is that?” said Swallower

(continued)

of Clouds as the Hero Twins came closer, “I am old and tired, too old and tired to move out of the way. Just pass under my legs.” But when the hero twins came close to the giant, they split up. One ran to the right and one ran to the left. The giant tried to open his eyes to see what they were doing, but he was blinded by the spider web.

“Where are you, Little Ones?” he said, striking at them and missing. “Just pass under my legs.”

Swallower of clouds struck again at the Hero Twins, but he could not see them and he missed. Then the twins leaped up and struck him with their clubs. One struck him in the head. The other struck him in the stomach. They killed Swallower of Clouds with their clubs. Then they threw him over the same cliffs where he had thrown all the people he had killed. Now the clouds were able to pass again through the mountains. The snow returned to the north. The rain came again from the west. The mists formed once more above the mountains to the east. The springs to the south flowed once more. Again the crops of the people grew and the people were well and happy.

It is said that when the giant fell, he struck so hard that his feet fell into the Earth. He still stands there to this day with his blood dried red all along his great stiff body. Though some call that great stone by their names, the Zunis know it is the Swallower of Clouds. When they see it they are thankful for the deed of the Hero Twins and the life giving-rain.

Koluscap and the Water Monster

(MicMac and Maliseet-Nova Scotia)

Once there was a great drought. The rain stopped falling and the Earth became dry. Finally the stream themselves stopped flowing. There was a village of people who lived by the side of a stream, and life now became very hard for them. They sent someone upstream to see why the stream had stopped. Before long, the man came back. “There is a dam across the stream,” he said. “It is holding back all the water for himself.” “Go and beg him for water,” said the elders of the village. “Tell him we are dying without water to drink.” So the messenger went back again. When he returned, he held a bark cup filled with mud.

“This is all the water their chief will allow us to have,” he said. Now the people were angry. They decided to fight. They sent a party of warriors to destroy the dam. But as soon as the warriors came to the dam, a great monster rose out of the water. His mouth was big enough to swallow a moose. His belly was huge and yellow. He grabbed the warriors and crushed them in his long fingers which were like the roots of cedar trees. Only one warrior escaped to come back to the people and tell them what happened.

“We cannot fight a monster,” the people said. They were not sure what to do. Then one of the old chief’s spoke. “We must pray to Gitchee Manitou, “he said. “Perhaps he will pity us and send help. ”Then they burned tobacco and sent their prayers up to the Creator.

Their prayers were heard. Gitchee Manitou looked down and saw the people were in great trouble. He decided to take pity and help them and he called Koluscap. “Go and help the people,” Gitchee Manitou said.

Koluscap then went down to the Earth. He took shape of a tall warrior, head and shoulders taller than any of the people. Half of his face was painted black and half was painted white. A great eagle perched on his right

(continued)

shoulder and by his side two wolves walked as his dogs, a black wolf and a white wolf. As soon as the people saw him they welcomed him. They thought surely he was someone sent by the Creator to help them.

“We cannot afford you anything to drink,” they said. “All the water in the world is kept by the monster and his dam.”

“Where is the monster?” Koluscap said, swinging his war club, which was made of the root of a birch tree. “Up the dry stream bed,” they said.

So Koluscap walked up by the dry stream bed. As he walked he saw dried up and dead fish and turtles and other water animals. Soon he came to the dam, which stretched between two hills.

“I have come for water,” he said to the guards on top of the dam.

“GIVE HIM NONE, GIVE HIM NONE!” said a big voice from the other side of the dam. So the guards did not give him water.

Again Koluscap asked and again the big voice answered. Four times he made his request, and on the fourth request Koluscap was thrown a bark cup half-full of filthy water.

Then Koluscap grew angry. He stomped his foot and the dam began to crack. He stomped his foot again and began to grow taller and taller. Now Koluscap was taller than the dam, taller even than the monster who sat in the deep water. Koluscap’s club was now bigger than a great pine tree. He struck the dam with his club and the dam burst open and the water flowed out. Then he reached down and grabbed the water monster. It tried to fight back, but Koluscap was too powerful. With one giant hand Koluscap squeezed the water monster and its eyes bulged out and its back grew bent. He rubbed it with his other hand and it grew smaller and smaller.

“Now,” Koluscap said, “no longer will you keep others from having water. Now you’ll just be a bullfrog. But I will take pity on you and you can live in this water from now on.” Then Koluscap threw the water monster back into the stream. To this day, even though he hides from everyone because Koluscap frightened him so much, you may still hear the bullfrog saying, “Give Him None, Give Him None.”

The water flowed past the village. Some of the people were so happy to see the water that they jumped into the stream. They dove so deep and stayed in so long that they became fish and water creatures themselves. They still live in that river today, sharing the water which no one person can ever own.

These stories come from cultures living in very different and distant environments in North America, yet both stories emphasize the importance of water. They begin with a drought and end with the water’s return.

In “The Hero Twins and the Swallower of Clouds,” the opening poem shows an understanding of the connection between clouds, rain and mountains. When the Cloud Swallower consumes all of the clouds, the rain and snow stop and a drought comes over the Earth. The Cloud Swallower has to be slain before the clouds come again. Because he is so big and wily, the Hero Twins and Grandmother Spider must cooperate to slay him.

In “Koluscap and the Water Monster,” the stream stops flowing when the Water Monster builds a dam. He will give out only filthy water. When Koluscap turns the Water Monster into a bullfrog and breaks the dam, the water flows past the village once more. Some villagers dive in and become aquatic animals that live in the water from that day on.

Discussion

Drought is a serious, life-threatening problem in many regions of the world, including the southwestern United States, the lands lying east of the Rocky Mountains in the United States and Canada and the numerous deserts and arid lands around the world.

The issue of *water rights* arises in both stories. Who owns the water? This is a serious problem when people living down stream must accept the consequences of the water-use practices of upstream communities. For years, Mexico has received the Colorado River from the United States as a greatly reduced flow of *polluted water* high in salts and other contaminants. Some of the activities in this chapter explore the issues of water supply, waste-water treatment and the conservation of fresh water.

Rain is part of the *water cycle*. In this continuous cycle, water falls from the clouds as rain and is then evaporated from the land, plants, animals, river’s and lakes by the sun’s energy. This water then condenses as clouds that rain down on the land once again. Some water enters the *ground water* stores and may remain there anywhere from a short time to many years. Water in the great Ogallala aquifer, underlying the Great Plains in the western United States, is only renewable when considered in terms of geologic time, yet we are using it up in decades.

In mountainous areas, air masses travel up the slopes, the air cools and moisture condenses to form clouds. As a result, there is usually a lot of rain that falls on the windward sides of mountains. A dry region called a *rain shadow* forms on the leeward slopes and beyond because the air has little moisture left to fall as rain.

The surface water that collects in lakes, ponds, rivers and wetlands is full of life: an abundance and variety of plants and animals depend on these habitats to live. These organisms must be adapted to life conditions in fresh water: oxygen levels (dissolved oxygen), temperature, pH (acid, neutral or alkaline conditions), availability of food, water quality and water movement (waves and currents) are all important. Plant and animal adaptations must enable them to perform all or some of these vital functions to live: exchanging, gases, moving, finding optimal temperatures, maintaining correct body fluid concentrations, getting nourishment, excreting waste, reproducing, surviving in the current and adapting to seasonal changes.

Questions

1. How would you describe the characters of the Cloud Swallower and the Water Monster? Why do the Indians believe that horrible monsters are taking the water when it disappears during a drought?
2. Koluscap is strong enough to defeat the Water Monster alone, but the Hero Twins are only able to defeat the Cloud Swallower because they cooperate with Grandmother Spider. What does it mean to cooperate? Why is this a good way to do things?
3. What are some of the terrible things that start to happen when no rain comes in the first story, when the giant is swallowing all the clouds? In what ways is water so important to living things?
4. Is there enough water in your neighborhood? Where does your water come from?
5. Can anyone own the water? Would you take water that someone else needs? How would you feel and what would you do if someone began to take the water you need to live?
6. Where does the water go to once you have used it? Is there an unlimited supply of water in the world? What could you do to conserve your water supply?

Activities

<u>Birth of a Raindrop</u>

You are a tiny speck of dust sitting on top of a dried-up weed in the middle of a big field. It is early October and a cold, strong wind blows. This fall when the children were going back to school, you landed on the weed while it was still alive and green. Now you are wondering, “Will I ever become unstuck from this dried-up old weed?”

The cold wind blows harder and harder, causing your weed stalk to wave back and forth. Suddenly you are thrown off the weed and blown right toward a grove of trees. The bare branches of the trees look closer as the wind carries you toward them. At the last instant, before you crash, you are lifted up over the treetops and into the open sky.

As you rise higher and higher you feel light as a feather. Down below, the field that you came from looks like a dot on the Earth. The wind carries you into a dark gray cloud. You hear a loud cry and almost bump into a large, black bird with a white head. Here in the cloud there are millions and millions of dust particles rushing around and bumping into one another. “Hey watch it!” you yell as careless piece of dust bumps into you. “Ouch! It’s too crowded here!”

It’s also very wet in the cloud, and some water vapor begins to cover you, turning you into a tiny droplet of water. Soon you become too heavy and start to fall back to Earth. All around you other raindrops are falling. Lower and lower you sink. In every direction you look there are raindrops. The whole world seems to be wet.

You can’t tell where you are going. You begin asking yourself, “Where and when will I ever land?”

<u>Materials</u>
Copy of fantasy “Birth of a Raindrop,” paper, pencils.

<u>Life in a Pond or Stream</u>

(A) Turn a person into an aquatic insect to demonstrate some adaptations needed to survive in fresh water.
(B) Visit a pond or stream to study that environment and the plants and animals that live there.

<u>Goals:</u> Appreciate the abundance and variety of life in fresh water. Understand the conditions for life in fresh-water environments. Learn some specific adaptations to aquatic life among freshwater plants and animals.

<u>Age:</u> Younger children and older children

<u>Procedure:</u> *Now a Person: Now an Insect.* (Before-hand: Prepare the parts of the aquatic insect to have them ready when you are making a child into an “insect”.)

Ask for a volunteer to come up front. Do the children think that the volunteer could live underwater for a long period of time? Now say that you are going to turn the volunteer into an aquatic insect. Review, with leading questions, that insects have three body parts (head, thorax, and abdomen) and six legs attached to the thorax. Make a list of all the things that the insect will need to do while underwater (such as get to oxygen, eat, move around, hold still in the current and sense the environment [smells, temperature, light levels, sounds, tastes]). Now, for each of these functions, ask the children what the volunteer will need on his/her body in order to be able to do that thing underwater. Each time you listen to the responses add one or more *adaptations* to the child: gills; breathing tubes and other devices for gas exchange; mouth parts for handling food or attacking prey; legs with hairs or flattened (paddle-like) surfaces for swimming; claws for gripping; antennae or other sensory appendages for sensing temperature changes, scents, vibrations; eyes; etc.

Note: A variation on this activity is to have the children make their friends into aquatic insects. Or, each child could combine the materials to fashion a model of an aquatic insect.

Water Cycle Relay

Activity: Participate in a relay that simulates the water cycle. Understand the water cycle and the important role of the sun's energy in driving the water cycle. Understand that cooperation helps us to accomplish things when we work in groups.

Age: Younger children and Older children.

Procedure: Describe the water cycle. Stress the role of the sun in evaporating the water that eventually forms clouds and in creating the wind that moves the clouds by causing the unequal heating of the Earth's surface and atmosphere. Have someone try to pick up the full bucket of water to see how heavy it would be to carry. Then point out that by cooperating and each taking a little water, the task will be made easier.

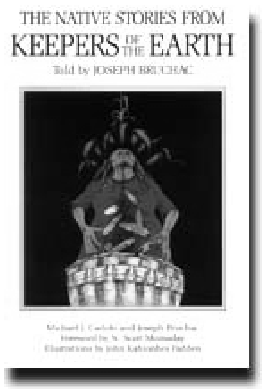
Divide the group into two or three smaller groups and have them line up single file at the lakes (full buckets of water) and facing the clouds (empty buckets about 20 feet [6.1 meters] away). Pass out one cup, or other small container, to each child. Give them their direction:

"In order to evaporate and rise up to form clouds, the water must have the sun's heat. Imagine that each person has the sun's energy. When it is your turn, take a cup (or other small container) of water and run up to the clouds. The object is to *not* spill any water. Pour water into the bucket when you get there. When you have poured your water in, *then* the next person can bring his or her water up to the clouds. When all groups have formed new lines at the clouds, you should all squat."

At this point, in case some water was spilled on the way up to the clouds, you will need to add about one quart (.94 liter) of water to each "cloud" bucket so that there will be enough to go around for the return journey back to the lakes. Here are the directions for round two: "In round two you will 'rain' into the lake by taking water from the clouds into your cup. Once you have reached the lake and poured your 'rain' into it, put the cup down so the next 'rainstorm' can come down. When the whole cloud is rained out (when you have emptied all of your cups into the 'lake'), you should all squat down and the game is over. The water cycle is complete."

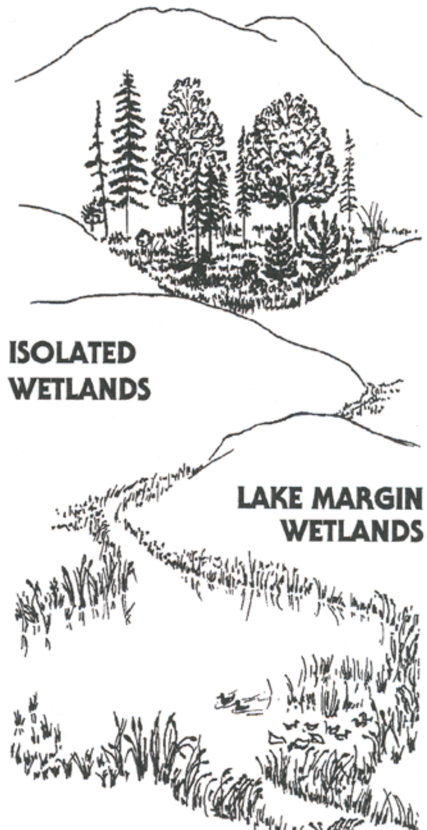
Materials
One full bucket of water and one empty bucket for each group in the relay
A can, cup, or empty milk or juice carton for each child
Signs to mark off lake and cloud areas; open space for running
Extra supply of water

New Mexico Science Standards
Grade 5, II, III, II, 3 and III, I, I, 1
Grade 6, II, II, I, 1
Grade 7, II, I, I, 1; II, I, II, 1; II, II, I, 1, 5; and II, III, II, 3
Grade 8, II, III, II, 2
Grades 9-12, II, II, I, 3; II, III, II, 9, 12; and III, I, I, 12, 13



Source: Excerpt from ***Keepers of the Earth: Native American Stories and Environmental Activities for Children*** © Michael J. Caduto and Joseph Bruchac (1988, 1989). Permission to reprint from Fulcrom Publishing, Golden, Colorado

TYPES OF WETLANDS: THEIR VALUES AND HAZARDS



VALUES

Isolated Wetlands

(Permanently high ground water levels due to discharge and drainage)

1. Waterfowl feeding and nesting habitat
2. Habitat for both upland and wetland species of wildlife
3. Flood water retention area
4. Sediment and nutrient retention area
5. Area of special scenic beauty

Lake Margin Wetlands

1. See values for permanent wetland above
2. Removal of sediment and nutrients from [redacted]
3. Fish spawning area

Riverine Wetlands

1. See values for isolated wetlands above
2. Sediment control, stabilization of river banks
3. Flood conveyance area

Estuarine and Coastal Wetlands

1. See values for isolated wetlands above
2. Fish and shellfish habitat and spawning areas
3. Nutrient source for marine fisheries
4. Protection from erosion and storm surges

HAZARDS

Isolated Wetlands

1. Flooding and drainage problems for roads and buildings due in some instances to widely fluctuating surface and ground water elevations
2. Serious limitations for onsite waste disposal
3. Limited structural bearing capacity of soils for roads and buildings due to high content of organic materials

Lake Margin Wetlands

1. See hazards for isolated wetland above

Riverine Wetlands

1. See hazards for isolated wetlands above
2. Flood conveyance [redacted] inundation and high velocity flows
3. Sometimes, erosion areas

Estuarine and Coastal Wetlands

1. See hazards for wetlands associated with rivers above
2. Often severe flood hazard due to tidal action, riverine flooding, storm surges, and wave action
3. Sometimes severe erosion area in major flood due to wave action

Source: From "Nature Cafe", *Arid Lands, Sacred Waters* Student Activity Packet, New Mexico Museum of Natural History, US Geological Survey and USDA Forest Service. (1992).

Global Warming

“We are upsetting the atmosphere upon which all life depends. In the late 80s when I began to take climate change seriously, we referred to global warming as a "slowmotion catastrophe" one we expected to kick in perhaps generations later. Instead, the signs of change have accelerated alarmingly.” – David Suzuki

Global warming refers to increases in land and sea temperatures across the world. Scientists are beginning to understand and highlight the causes and effects of global warming, both in the United States and across the world. For example, annual temperate increases are already responsible for melting sea ice levels in the arctic regions, creating slight increases in overall sea levels. The effects of global warming on wildlife species include changes in species ranges and shifts in ecological communities. Monitoring work in Yosemite National Park shows that many mammal species that used to be found at low elevations are now being found in alpine regions, largely due to temperature changes throughout the United States. Some wildlife species may adapt to increasing global temperatures, but many species, especially those that depend on cold water conditions and/or alpine ecosystems, and those that inhabit the arctic and antarctic regions, will most likely suffer reduced population sizes and possible extinction due to global warming.

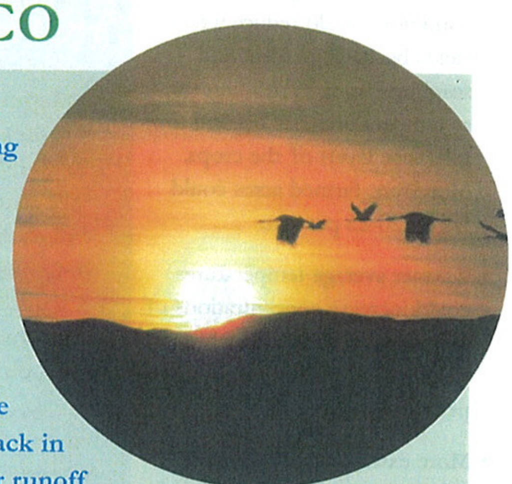
This unit introduces students to global warming and its effects on wildlife. Students can learn about adaptations in the context of species’ responses to climate change and look at global warming and its effects on ecosystems. Other activities include experiments about the greenhouse effect and the role of ozone in the atmosphere.

NATIONAL WILDLIFE FEDERATION



CHANGE THE FORECAST FOR WILDLIFE
SOLUTIONS TO GLOBAL WARMING

Global Warming and NEW MEXICO



New Mexico's growing population is putting pressure on the state's water resources like never before, and global warming may well make the state's water woes even more troubling in the decades to come. The Environmental Protection Agency estimates average temperatures in New Mexico could rise about 4 degrees Fahrenheit by 2100 if global warming continues unabated. This will likely bring hotter, drier summers. Wildfires may increase, droughts will get worse and rains—when they do come—will likely come in more severe downpours that may cause more flash flooding. Warmer temperatures also mean less snowpack in the mountains as well as earlier snowmelt, leading to more winter runoff and reduced summer flows in many New Mexico streams.

Global warming effects on New Mexico wildlife

New Mexico is home to an incredible diversity of native wildlife species, including 447 birds, 154 mammals, 54 fish, 98 reptiles and 26 amphibians. Rising temperatures in the state will likely change the makeup of entire ecosystems, forcing wildlife to shift their ranges or adapt.

- Overwhelming pressures for water resources are already causing the destruction of narrow riparian areas along the streams and rivers of New Mexico. Global warming could exacerbate this habitat loss by restricting water flow even further, hurting fish, wildlife and songbirds such as the southwestern willow flycatcher, which breeds in the area.
- The Mexican big-eared bat, found in parts of Southwest New Mexico, is acutely sensitive to climatic changes. A slight rise in temperature could alter the make-up of plant and tree communities the bat has evolved to depend on.
- Global warming could force birds such as the savanna sparrow and sage thrasher to shift their breeding ranges out of New Mexico. The two species are helpful in keeping outbreaks of rangeland grasshoppers in check.

What is Global Warming?

When coal, gas and oil are burned, they produce carbon dioxide that builds up in the atmosphere and traps the sun's heat. Much of this greenhouse gas released today remains in the atmosphere after even 100 years, trapping more and more heat.

Since the mid-1800s, emissions of carbon dioxide have skyrocketed, and subsequently global temperatures have risen by about 1 degree Fahrenheit in the last century. Earth has not experienced such a rapid change in temperature in thousands of years.

Unless we reduce the pollution that causes global warming, temperatures could climb between 2-10 degrees Fahrenheit this century. Such a rapid rise in temperature would fundamentally reshape the planet's climate, forever changing the landscape and water resources people and wildlife depend upon.

What's at stake for New Mexicans?

Global warming poses a real threat to the future of New Mexico's economy, impacting the state's tourism, agriculture and forestry industries that depend on healthy ecosystems to thrive.

> "Global warming poses an overriding challenge to our responsibility to protect wildlife for our children's future. We must advance balanced solutions that work for people, wildlife and the economy to overcome this challenge."—
>
> **Larry Schweiger**
> *President, CEO*
> *National Wildlife Federation*

- In New Mexico, global warming conditions could reduce wheat yields by 10-30 percent and sorghum yields by 7-9 percent as temperatures rise beyond the tolerance levels of the crops. Moreover, farmed acres could fall by 20-25 percent.
- Warmer average temperatures could increase concentrations of ground-level ozone, which is known to aggravate respiratory problems such as asthma.
- More extreme fluctuations in rain and snowfall due to global warming are projected to negatively impact water resources in the state, causing an increased need for irrigation in an already water-stressed state.
- Loss of wildlife and habitat could mean a loss of tourism dollars. In 2001, more than 884,000 people spent nearly $1.1 billion on hunting, fishing and wildlife viewing in New Mexico, which in turn supported 23,052 jobs in the state.

Global Warming National Policy Solution:
2% Pollution Reduction Per-year

A federal legislative solution can drive American ingenuity, create a new generation of American jobs, and meet our moral responsibility to confront global warming.

A Global Warming Bill Should:

* Reduce U.S. global warming pollution 2% per year, or 20% per decade, and on the order of 80% by the middle of this century. Scientists say the United States must cut our pollution at least this much to avoid the most catastrophic impacts of global warming.

* Encourage innovation and prevent facilities from being built that lock us into many years using old, inefficient technology.

* Provide funding to protect wildlife and their habitat. Global warming is already adding new wildlife management burdens. Funding is needed to help continue the long tradition of fish and wildlife associated recreation.

For more information, visit: www.nwf.org/globalwarming.

Updated 3-22-07. Unless otherwise noted, all images courtesy of USFWS.

Oak Ridge National Laboratory

New Mexico's solutions to global warming

Considering New Mexico's tremendous wind resources, the state has the opportunity to be a leader in developing innovative solutions to global warming.

- New Mexico has the resources to generate more than eight times its electricity needs from wind power, giving it the potential to be a leader in the emerging wind power market.
- State law requires utilities in New Mexico to provide 10 percent of the state's power from renewable sources by 2011, one of the strongest "renewable portfolio standards" in the nation.
- New Mexico's Forest Re-Leaf Program provides municipalities, schools and organizations with funding for planting trees, which helps capture carbon dioxide from the atmosphere.

Following some simple guidelines, you can cut your global warming pollution, become more energy efficient and give something back to nature.

- **Convert to compact fluorescent bulbs:** If every household in America replaced its next burned out light bulb with a compact fluorescent, we would prevent more than 13 billion pounds of carbon dioxide from being emitted. That's the same as taking 1.2 million cars off the road for an entire year.
- **Become a Green Tag subscriber:** Many states now offer options for homeowners to buy electricity from clean, renewable sources such as wind, solar and biomass that produce little or no global warming pollution. Green energy can also be purchased through the National Wildlife Federation by visiting www.nwf.org/energy.
- **Act locally:** Contact your mayor and ask that (s)he sign the U.S. Mayors Climate Protection Agreement, committing your city or town to meet or beat the global warming pollution reductions outlined in the Kyoto Protocol.

For more information, contact:
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NATIONAL WILDLIFE FEDERATION

Global Warming

The Greenhouse Effect in a Jar

Objectives

Students will:

1. Understand the greenhouse effect as a physical phenomenon
2. Use simple experimentation techniques including: observing and recording data, use of

a control, drawing conclusions from results, use of a model

Key Words

1. *Absorb* – to take in and keep from going back or through
2. *Greenhouse gases* - gases in the Earth's atmosphere, such as carbon dioxide, methane and nitrous oxide, that keep the planet warm
3. *Radiate* – to spread out

Background

Sunlight passes through the atmosphere and warms the Earth's surface. The heat radiating from the surface is trapped by greenhouse gases. Without an atmosphere, the Earth's temperature would average about 0 degrees F. This warming due to heat-trapping gases is called the "Greenhouse Effect." The atmosphere allows light to enter, but then traps that energy when it is converted to heat. The greenhouse gases absorb the radiative heat. In this experiment the jar will allow light to enter, but the jar will keep in the heated air.

Materials

2 Small thermometers

1 Jar or other see-through container

1 Clock or watch

1 Copy of the Data Worksheet

Sunlamp or a sunny area

Instructions

Part 1.

Divide students in groups of 3 or 4. Direct the groups to:

1. Place the thermometers a few inches apart under the sunlamp or in direct sunlight.

2. Leave the thermometers there for about three minutes so they will give accurate readings.

3. Record the temperature readings on both thermometers and the time.

4. Place a jar over one of their thermometers, taking care that the jar does not cast a Shadow over the remaining uncovered thermometer. If the thermometers are too large to remain horizontal in the jars, students can stand them against an inner side.

5. Every minute, for ten minutes, record the readings of both thermometers.

6. Compare and contrast the results. Graph the data.

Part 2. - "The Greenhouse Effect "
To simulate global warming, the experiment can be done using two jars, one filled with air and the other with carbon dioxide.

1. Place the two thermometers in the sunlight for a few minutes to let them get warm.

2. Record the readings of both thermometers at the top of the columns.

3. Record the time next to the starting temperatures and place the jar over thermometer #1.

4. Every minute, record the readings of both thermometers without disturbing them.

New Mexico Science Standards
Grade 4, III, I, I, 1
Grade 6, II, III, II, 5
Grade 7, II, I, II, 1 and II, III, II, 3
Grade 8, II, II, I, 3 and III, I, I, 2
Grades 9-12, II, III, II, 8 and III, I, I, 9 and 12

Source: With permission from The Franklin Institute Resources for Science Learning, www.fi.edu/learn

Greenhouse in a Jar Data Sheet

Name ______________________________ Date ____________________

Time	Observation Number	Thermometer #1	Thermometer #2
Start			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			

Global Warming

Testing for Ozone

Objectives

Students will

1. Understand that ozone is a gas found in the troposphere and other parts of the atmosphere
2. Demonstrate that by using Schoenbein paper, variations in the amount of ozone present in the troposphere can be determined from day to day and from place to place
3. Learn that the Schoenbein paper detects ozone by an oxidation reaction caused by the ozone in the surrounding air
4. Draw conclusions about ozone levels of the air based on test results
5. Understand that the formation of ozone holes is related to global warming

Key Words

1. Ozone – a gaseous form of oxygen with three oxygen atoms per molecule, formed by electrical discharge in oxygen
2. Ozone hole – an area of the upper atmosphere where the ozone layer is absent or has become unusually thin
3. *Schoenbein paper* – a special type of paper that will change color when ozone is present
4. Stratosphere – the region of the Earth's atmosphere between the troposphere and mesosphere
5. Troposphere – the lowest and most dense layer of the atmosphere

Materials

Potassium iodide (a teaspoon will be plenty)
Distilled water (must use distilled water)
Spray bottle filled with distilled water (must use distilled water)
Filter paper
Heat source (preferably a hot plate)
Corn starch
Glass stirring rod (do not use metal)
Small paint brush
250 ml beaker
Glass Pyrex plate
Hot pad or mitt for removing the beaker from the heat source

Background

Ozone plays a very important role in the upper atmosphere, where 90% of it exists. Stratospheric ozone acts as a shield against harmful ultraviolet (UV) radiation from the sun. Ultraviolet radiation causes skin cancer in humans and also harms wildlife and plants. Ozone molecules in the troposphere damage lung tissues of animals and prevent plant respiration by blocking the openings in leaves, called stomata, where respiration occurs. Without sufficient respiration, a plant is not able to photosynthesize at a high rate and will not be able to grow. Ozone is also able to enter the stomata and decay plant cells directly.

Ozone can be destroyed by human-produced chemical compounds called chlorofluorocarbons, or CFCs. When these CFCs are combined with extremely cold stratospheric temperatures over the poles, solar radiation, and particular patterns of atmospheric circulation, chemical reactions occur that cause "Ozone Holes" over Antarctica and the Arctic.

The formation of ozone holes is related to global warming and the greenhouse effect in two ways. First, CFCs are greenhouse gases. Thus, the release of these compounds into the atmosphere will have two separate effects: to destroy ozone and to add to the greenhouse effect. Second, if stratospheric temperatures or patterns of atmospheric circulation change as part of global warming, this will affect the chemical reactions that destroy ozone and cause the ozone holes to either grow or shrink.

Christian Friedrich Schoenbein, a Swiss professor, discovered ozone in 1839. He used the reactivity of ozone to measure its presence and demonstrate that it is a naturally occurring component of the atmosphere. He developed a way to measure ozone in the troposphere using a mixture of starch, potassium iodide, and water spread on filter paper. The paper, called Schoenbein paper, changes color when ozone is present. Ozone causes iodide to oxidize into iodine (I_2).

This test is based on the oxidation capability of ozone. Ozone in the air will oxidize the potassium iodide on the test paper to produce iodine. The iodine reacts with starch, staining the paper a shade of purple. The intensity of the purple color depends on the amount of ozone present in the air. The darker the color, the more ozone is present.
The reactions involved are $2KI + O_3 + H_2O \text{-->} 2KOH + O_2 + I_2$
I_2 + starch --> blue color

Instructions
Part 1. - Schoenbein Paper Preparation
Note: For safety, the teacher may want to prepare the paper as a demonstration.

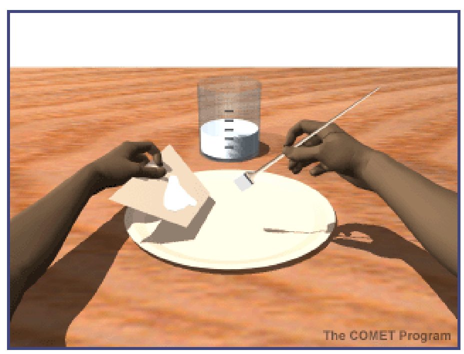
1. Place 100 ml of distilled water in a 250 ml beaker.

2. Add 1 1/4 teaspoon of corn starch.

3. Heat and stir mixture until it gels. The mixture is gelled when it thickens and becomes somewhat translucent.

4. Remove the beaker from the heat source and add 1/4 teaspoon of potassium iodide and stir well.

5. Cool the solution before applying to the filter paper.



6. Lay a piece of filter paper on a glass plate, or hold it In the air, and carefully brush the paste onto the Filter paper. Turn the filter paper over and do the same on the other side. Apply the paste as uniformly as possible.

7. Wash hands after applying the potassium iodide mixture. (Although potassium iodide is not toxic, it can cause mild skin irritation.)

8. Set the paper out of direct sunlight and allow it to dry. A low temperature drying oven Works well if available.

9. Cut the filter paper into 1-inch wide strips.

10. To store the paper, place the strips in a sealable plastic bag or glass jar out of direct sunlight.

Part 2. - Testing Procedure

Notes:

- The xerographic process in most copy machines uses electrostatic charging of a cylinder. The accompanying ionization creates ozone in adjacent air, so a room containing a copy machine makes a good location for this experiment.
- Because relative humidity affects results, Schoenbein paper should not be left outside during periods of high humidity.

1. Give each student at least two strips to test.

2. Have students spray a strip of test paper with distilled water and hang it at a data collection site out of direct sunlight. Make sure the strip can hang freely.

3. Students should expose their paper strips for approximately eight hours. They should note where each strip is hung.

4. After exposure, students should seal the strip in an airtight container if the results will not be recorded immediately.

5. To observe and record test results, students should spray the paper with distilled water and observe the color.

Part 3. - Qualitatively Determine the Ozone Level

1. Have students compare their test strips. This is a qualitative comparison. While numbers cannot be attributed to this test, students can make relative comparisons. Those strips that show little or no change were in places with the lowest ozone concentrations. Those that have a lavender appearance were exposed to more ozone and, finally, those that look dark purple had high ozone exposures.

Part 4. - Questions and Observations

Ask students:

1. What change in the test paper, if any, did you observe? (The paper will vary in color depending on the amount of the oxidation. The color of the paper may not be uniform.)

2. Do all the test papers appear the same? Compare your test paper to those of your fellow students. (The individual test papers will vary depending on the amount of oxidants at various sites. For example, sites near highways will show greater color change due to oxidants from car exhaust and nitrous oxides in heavy traffic areas.)

3. Was the relative humidity for your test day high or low? (The results of individual test papers will vary depending on the specific relative humidity of the site. See the reaction in the Background Information section. Notice that water is a reactant, so humidity will affect the reaction. Sites near lakes or streams may show greater change.)

4. Why do you think the various test papers did not all appear the same? (Student answers will vary. Tropospheric ozone levels vary widely due to the type and number of sources of ozone. Students measuring ozone in their home may report little color change of the paper, but if they live on a busy street, a measurement near the curb will register greater color change. Humidity and oxidants are present in varying levels depending on the time of day, the weather, the season, etc.)

5. Based on the data you collected, do you think this method is a good way to measure ozone in the troposphere? Why or why not? (Some students will point out the difficulty in interpreting the color accurately, while others will note the differences in how the paper was produced from group to group. It is important to stress that this is a good method for measuring relative amounts of ozone.)

Options

1. Using a city or county map of your area, have students place sticky dots corresponding with the color of the Schoenbein paper from the location for which they collected data. Have students initial their dot.

2. Compare data your students collect with those from a local monitoring station. Also, if possible get information about the wind direction during your study.

3. Have groups of students collect daily ozone data for a week. These data can be plotted On a graph using parts per billion (ppb) on the vertical axis and the days on the horizontal axis. The students can see if there is any variability from day to day. By comparing the graphs, the students can see if there is any consistency in their data and if so, try to come up with a theory why. Students could also compare data to weather (temperature, relative humidity, clouds, wind, rain, etc.)

4. Contact your local Air Quality Control Board and request data for your test week. Do your readings agree with those from the control board?

5. It is always a good idea to get as many readings as possible. Incorporate other grade levels and other schools. Contact the state Air Quality Control Board for data during the test period. Compare data from students in different cities and states. Are there correlations or patterns?

Research Project: Construct an Ozone Map of Your Area

1. Give each student two strips of Schoenbein paper in a sealed bag.

2. Have students moisten the paper with distilled water and hang the test strips at two sites In or near their home.

3. Have students record their data noting the color change they observe. Students can then plot relative ozone concentrations on a local map.

4. Have students contour the map indicating areas of high and low ozone concentration.

5. Ask students the following questions:
   - Was there any variation in ozone levels on the map?
   - Where on the map were the concentrations the highest? The lowest?
   - Looking at the area of highest concentration, does there appear to be any obvious explanation for the variation?
   - Why do you think there were ozone level variations?

New Mexico Science Standards
Grades 9-12, Grades 9-12, II, III, II, 8 and III, I, I, 9 and 12

Source: Adapted from Activity 29, University Corporation for Atmospheric Research (UCAR), National Center for Atmospheric Research, www.ucar.edu/learn

Global Warming

Adapt to Survive

Objectives
Students will recognize the importance of animal adaptations to their survival under conditions of global warming.

Key Words
1. *Adaptations* - a behavior, physical feature, or other characteristic that helps an animal survive and make the most of its habitat; the way any living thing is fitted to the life it leads.
2. *Camouflage* – to conceal by disguise or protective coloring
3. *Climate* - a region of the earth having specified climatic conditions
4. *Ecosystem* - all the living organisms in a given area as well as their physical environment
5. *Global warming – an* increase in the earth's atmospheric and oceanic temperatures
6. *Habitat* - the place or environment where a plant or animal normally lives and grows
7. *Mimicry*- a plant's or animal's resemblance to another species or objects in its natural surroundings

Background
The average temperature of Earth has increased almost 10˚ F over the past century; scientists expect the average global temperature to increase an additional 2˚ to 60˚ F over the next hundred years. This may not sound like much, but it could change the Earth's climate as never before. At the peak of the ice age (18,000 years ago), the temperature was only 70 ˚ F colder than it is today, and glaciers covered most of North America.

Even a small increase in temperature over a long time can change the climate. When the climate changes, there may be big changes in the things that people and animals depend on. These things include the levels of the oceans and the places we plant crops. They also include the air we breathe and the water we drink.

Global warming is altering some of the world's habitats and ecosystems. Many of these places rely on a delicate balance of rainfall, temperature, and soil type. A rapid change in climate upsets the balance and endangers many living things. For example, rapidly melting polar ice is changing the natural habitat of polar bears and other marine mammals, making it more difficult for them to survive.

Most past climate changes occurred slowly, allowing plants and animals to adapt to the new environment or move somewhere else. However, if future climate changes occur as rapidly as many scientists predict, plants and animals may not be able to react quickly enough to survive.

Materials
Drawing materials
Animal Habitat Cards

Advance Preparation
Brainstorm and list types of animal adaptations. Adaptations include camouflage, physical features, and behavioral features that help animals survive in their natural habitats.

Instructions

1. Have students imagine that it is now the year 3,000. Humans have the ability to design and create animals. Each should develop an animal that would survive in a specific environment.

2. Hand out the *Animal Habitat Cards* to the students. The cards describe the details of the environment in which the imaginary animal will live.

3. Ask students to draw their individual animal and write a list of the adaptations that would help the animal survive in their specific environment in the year 3,000.

   Animal Criteria:
   Size?
   What does it eat?
   How will it catch/get food and water?
   How will it keep warm/cool?
   Where will it take shelter?
   What is the animal's reproduction rate and gestation period?
   How do the parents and infants interact?
   How will it defend or protect itself from attackers?
   Your animal cannot be a top predator (one that can eat everything else and survive).

New Mexico Science Standards:
Grade 4, II, II, I, 1; II, II, II, 1-3 and III, I, I, 1
Grade 6, II, II, I, 3; II, II, II, 2 and II, III, II, 5
Grade 7, II, I, II, 1; II, II, II, 7, 10 and 12 and II, III, II, 3
Grade 8, II, II, I, 3 and III, I, I, 2
Grades 9-12, II, III, II, 8 and III, I, I, 9 and 12

Source: Adapted from "Designer Animals", Carlsbad Caverns National Park Middle School Biology Curriculum

Animal Habitat Cards

This habitat is dark and cold most of the time. It is very mountainous. It rains almost all day. Because of the wet, dark conditions, the only plants that grow well are small mosses and fungi. The animals in this habitat include a type of mouse, a nocturnal large hunting cat, fish, and a variety of insects.

This habitat is dry and hot. Most of the surface is flat. Water is mostly found in underground streams; however there is a little water at the surface. Most of the terrain is covered in sand, although there are patches of dry grass. When plants are able to get their roots down into the water table, they grow into tall trees with leaves at the top but not along the trunk. Plants not connected to the water table are small and dry, but they are edible. The animals in this habitat include insects,
a species of bird, which roosts in the high trees, a sand-colored lizard, and a type of rat.

This habitat is tropical: wet and hot. Most of the terrain is rainforest. The land is very flat. Water collects in large pools and lakes, which have water in them all year round. A species of poisonous plant grows thickly on the ground. The spines of this plant are poisonous; any animal that steps on one is sure to die. The vegetation is plentiful, and includes leaves, fruits, and nuts. Animals include carnivorous snakes, varieties of insects, monkeys, fish, and birds.

This habitat has a moderate climate. It never gets very hot or very cold, but stays mild all year long. It rains for part of the year and the water forms pools and lakes that dry up towards the end of the year, and then the habitat is very dry. The landscape is partly mountainous and partly flat. Vegetation includes tall trees with high leaves and fruit, and a smaller plant that bears nuts. However, these nuts are inside hard shells that need to be removed before the nut can be eaten. Animals include rats and mice which live underground, insects, and birds that nest in the tall trees, slow moving mammals which also live in the trees, and a species of carnivorous nocturnal wolf.

Global Warming

Ecosystems and Global Warming

Objectives

Students will:

1. Explore the complexity of ecosystem interdependencies
2. Understand how climate change could affect the parts of an ecosystem

Key Words

1. *Climate change* –refers to the variation in the Earth's global climate over time scales ranging from decades to millions of years.
2. *Global warming* –refers to the increase in the Earth's atmospheric and oceanic temperatures.
3. *Greenhouse effect* – a term used to describe the heating effect in the atmosphere of gases such as carbon dioxide, water vapor, and methane, etc.) that allow incoming sunlight to pass through the Earth's atmosphere.

Background

The geographic ranges of plant and animal species are affected by climatic factors such as temperature, precipitation, soil moisture, humidity, and wind. A large shift in these factors in a specific location due to global warming will likely impact the organisms living there.

Species sensitive to temperature may respond to a warmer climate by moving to cooler locations at higher latitudes or elevations. Factors other than climate may limit the ability of organisms to shift their ranges. Physical barriers such as mountain ranges or extensive human settlement may prevent some species from shifting to more suitable habitat. In the case of isolated mountain top species, there may be no new habitat at higher elevation to colonize. Even in cases where no barriers are present, other limiting factors such as nutrient or food availability, soil type, and the presence of adequate breeding sites may prevent a range shift.

In addition to the direct effects of temperature on organism physiology, projected climate changes under an enhanced greenhouse effect might change the availability of food, space, shelter, or water; upset the predator-prey balance of an ecosystem; increase susceptibility to pests-disease; change the frequency of natural hazards such as fires, droughts, and flooding. These effects might lead to local population declines or extinctions for some species.

Materials

Regional nature guides; biology or environmental science books

Instructions

1. Have students use their knowledge of the Southwest to name the ecosystems found in nearby natural areas (such as deserts, wetlands, fields, forests, a river).

2. Have the class vote on one ecosystem to study in more detail. If a field trip is viable, choose an ecosystem that students can visit in one or two field trips to collect data.

3. Divide students into teams. Ask the teams to research the basic parts of the ecosystem chosen by the class. Students should look for organisms in each category of producers, herbivores, omnivores, carnivores, and decomposers. Nature guides, library books, and the Internet can be sources of information for this activity.

The following three websites are examples of internet resources:

New Mexico Department of Game and Fish at www.wildlife.state.nm.us
New Mexico State Parks at www.emnrd.state.nm.us
Randall Davey Audubon Center at http://nm.audubon.org/audubon_center/center.html

4. After the teams have finished their research, have them create a food web (using drawings or pictures, for example) of the basic components of the ecosystem showing interrelationships. The web should include physical factors such as the sun, atmosphere, water, soil, and nutrients. At this point, students can begin to develop hypotheses concerning how global warming might affect the ecosystem.

5. Have each team present an oral report to the class about how global warming could affect one of the plants or animals in the regional ecosystem.

6. Have every student prepare a summary description of the ecosystem as it is today, and a description of what they think the ecosystem might look like in 2,100 if the projected climate changes occur.

Option

If at all possible, take students on a field trip to collect data on the types of plants and animals found in the ecosystem. Students or the teacher can design a species observation sheet, and guidebooks can be used to assist with identifications in the field. Supplement the field observations with Internet or library research, especially for the larger mammals or nocturnal animals (A good online field guide can be found at eNature.com).

NM Science Standards
Grade 4, III, I, I, 1
Grade 6, II, III, II, 5
Grade 7, II, I, II, 1 and II, III, II, 3
Grade 8, II, II, I, 3 and III, I, I, 2
Grades 9-12, II, III, II, 8 and III, I, I, 9 and 12

Source: Adapted from “Climate Change and Ecosystems”, http://www.ucsusa.org/global_warming/science/global-warming-materials-for-educators.html

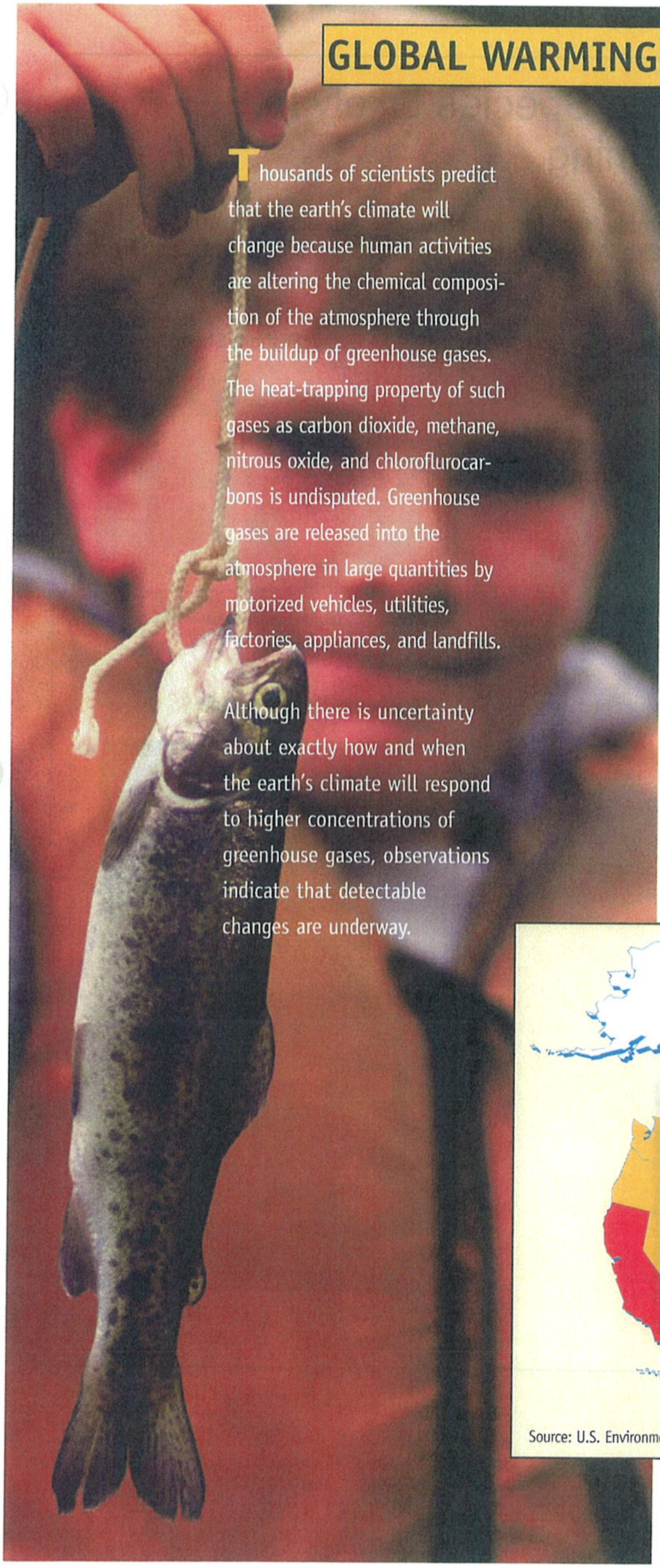
Some New Mexico animal species that may be affected by drought or wildfire

Source: 14-page list of Southwestern animals from the report of the Wildlife and Wildfire Work Group of the Governor's Drought Task Force

Bald Eagle
Boreal Toad
Broad-Billed Hummingbird
Crayfish
Desert Bighorn Sheep
Garter Snake
Gunnison's Prairie Dog
Jemez Mountains Salamander
Jumping Mouse
Leopard Frog
Lesser Long-nosed Bat
Painted Turtle
Pecos Pupfish
Pine Marten
Pinyon Jay (Pinon Jay)
Red Fox
Ridgenose Rattlesnake
Rio Grande Cutthroat Trout
Sandhill Crane
Shrew
Socorro Isopod
Swift Fox
White-nosed Coati

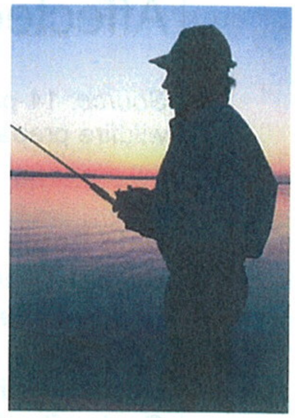
Photo by Joe McMaster

GLOBAL WARMING AND ECOSYSTEMS



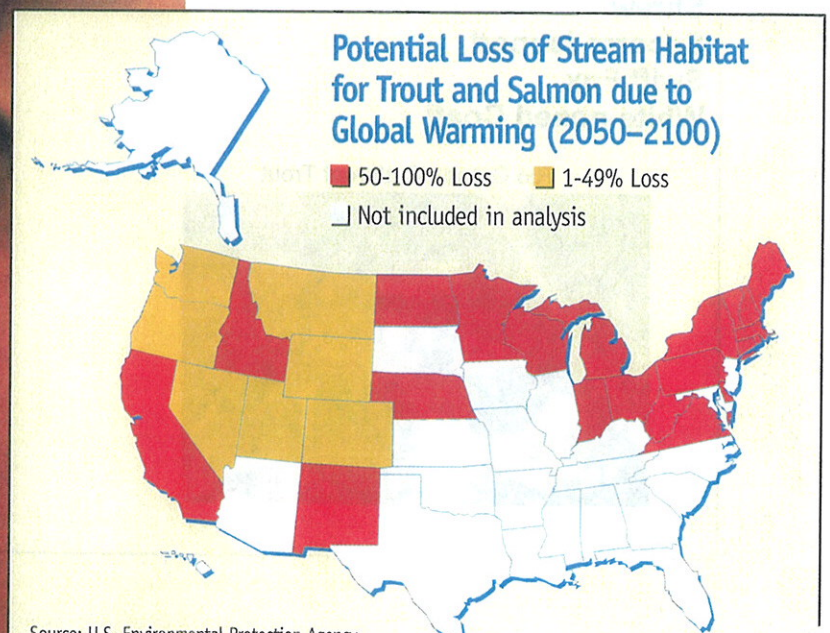
Thousands of scientists predict that the earth's climate will change because human activities are altering the chemical composition of the atmosphere through the buildup of greenhouse gases. The heat-trapping property of such gases as carbon dioxide, methane, nitrous oxide, and chloroflurocarbons is undisputed. Greenhouse gases are released into the atmosphere in large quantities by motorized vehicles, utilities, factories, appliances, and landfills.

Although there is uncertainty about exactly how and when the earth's climate will respond to higher concentrations of greenhouse gases, observations indicate that detectable changes are underway.



Temperatures will most likely rise by an average of 2.5 to 10.4˚F over the next century, along with measurable changes in precipitation, soil moisture, and sea level. All of these changes could have adverse effects on many ecological systems, as well as on human health and the economy.

Map: U.S. Environmental Protection Agency. 1995. *Ecological Impacts from Climate Change: An Economic Analysis of Freshwater Recreational Fishing.* EPA 220-R-95-004. Exhibit 2-27.



Source: U.S. Environmental Protection Agency

Global Warming and New Mexico Wildlife
Word Hunt

Name ______________________________ Date ____________________

Some Southwestern species that may be affected by drought or wildfire

S	C	O	R	E	D	F	O	X	P	I	N	Y	O	N	J	A	Y
O	H	M	H	A	F	I	R	E	A	R	E	E	E	N	E	L	P
C	U	R	N	L	I	N	E	N	P	L	L	S	U	T	W	E	D
O	M	U	E	O	U	M	O	E	G	G	U	C	S	A	E	O	F
R	M	S	X	W	A	D	E	A	A	O	G	I	I	H	D	P	I
R	I	E	W	Y	O	R	E	E	M	O	S	M	S	M	I	A	S
O	N	C	R	E	S	D	D	G	E	T	M	N	E	A	W	R	H
I	G	L	E	H	L	L	N	O	A	T	R	I	S	E	D	D	I
S	B	I	M	A	A	I	Y	R	W	O	E	O	S	I	L	F	Y
O	I	C	B	B	P	F	E	O	H	A	T	X	U	O	R	R	B
P	R	K	T	M	O	T	O	G	A	I	R	E	A	T	O	O	O
O	D	G	U	M	U	W	I	C	R	A	Y	F	I	S	H	G	R
D	E	J	R	P	M	B	I	N	E	T	W	O	R	M	B	V	E
L	Y	W	H	I	T	E	N	O	S	E	D	C	O	A	T	I	A
I	V	O	A	R	A	T	T	L	E	S	N	A	K	E	W	T	L
W	C	I	E	L	E	G	A	L	N	A	G	I	H	C	I	M	T
C	A	S	P	A	I	N	T	E	D	T	U	R	T	L	E	E	O
G	E	S	X	S	A	N	D	H	I	L	L	C	R	A	N	E	A
D	N	P	R	A	I	R	I	E	D	O	G	M	N	M	I	A	D

FIND THESE WORDS

BALD EAGLE
CRAYFISH
SANDHILL CRANE
PINYON JAY
JUMPING MOUSE
DESERT BIGHORN SHEEP
PAINTED TURTLE
LEOPARD FROG
WHITE-NOSED COATI
HUMMINGBIRD
RATTLESNAKE
GILA TROUT
BOREAL TOAD
RED FOX
SOCORRO ISOPOD
SHREW
PRAIRIE DOG

Climate Change and New Mexico Wildlife
Word Hunt

Some Southwestern species that may be affected by drought or wildfire

S	C	O	R	E	D	F	O	X	P	I	N	Y	O	N	J	A	Y
O	H	M	H	A	F	I	R	E	A	R	E	E	E	N	E	L	P
C	U	R	N	L	I	N	E	N	P	L	L	S	U	T	W	E	D
O	M	U	E	O	U	M	O	E	G	G	U	C	S	A	E	O	F
R	M	S	X	W	A	D	E	A	A	O	G	I	I	H	D	P	I
R	I	E	W	Y	O	R	E	E	M	O	S	M	S	M	I	A	S
O	N	C	R	E	S	D	D	G	E	T	M	N	E	A	W	R	H
I	G	L	E	H	L	L	N	O	A	T	R	I	S	E	D	D	I
S	B	I	M	A	A	I	Y	R	W	O	E	O	S	I	L	F	Y
O	I	C	B	B	P	F	E	O	H	A	T	X	U	O	R	R	B
P	R	K	T	M	O	T	O	G	A	I	R	E	A	T	O	O	O
O	D	G	U	M	U	W	I	C	R	A	Y	F	I	S	H	G	R
D	E	J	R	P	M	B	I	N	E	T	W	O	R	M	B	V	E
L	Y	W	H	I	T	E	N	O	S	E	D	C	O	A	T	I	A
I	V	O	A	R	A	T	T	L	E	S	N	A	K	E	W	T	L
W	C	I	E	L	E	G	A	L	N	A	G	I	H	C	I	M	T
C	A	S	P	A	I	N	T	E	D	T	U	R	T	L	E	E	O
G	E	S	X	S	A	N	D	H	I	L	L	C	R	A	N	E	A
D	N	P	R	A	I	R	I	E	D	O	G	M	N	M	I	A	D

FIND THESE WORDS

BALD EAGLE
CRAYFISH
SANDHILL CRANE
PINYON JAY
JUMPING MOUSE
DESERT BIGHORN SHEEP

PAINTED TURTLE
LEOPARD FROG
WHITE-NOSED COATI
HUMMINGBIRD
RATTLESNAKE
GILA TROUT

BOREAL TOAD
RED FOX
SOCORRO ISOPOD
SHREW
PRAIRIE DOG

Global Warming and New Mexico Wildlife
Word Scramble

1. HUGORDT D__ __ __ __ __ __
   EWIFDSILER W__ __ __ __ __ __ __ __ __
   Global warming can cause extreme cycles of __________ and __________.

2. TCUORATHT C__ __ __ __ __ __ __ __ __
   The Rio Grande __________ trout is New Mexico's state fish.

3. TCAYCLFERH F__ __ __ __ __ __ __ __ __
   The SW Willow __________ lives in the Gila-Cliff Valley and is an endangered species.

4. IWSTF OFX S__ __ __ __ F__ __
   A very small canine species, the __________ ______, can run 60 miles per hour.

5. GOLN-EONDS L__ __ __ - N__ __ __ __
   The lesser __________ bat migrates from Mexico following the flowering cycles of desert plants like the saguaro cactus.

6. ERAGTR G__ __ __ __ __
   The __________ snake is one of the few animals that can eat toads, newts, and amphibians with strong chemical defenses

7. FSPPIUH P__ __ __ __ __ __
   The Pecos __________ can only be found in NM and Texas and is endangered.

8. SAEDANRMAL S__ __ __ __ __ __ __ __ __
   An endangered NM amphibian species is the Jemez Mountain __________.

9. EQSOUB B__ __ __ __ __
   A famous wetlands in New Mexico that provides a home for migratory birds and wildlife is the __________ del Apache.

10. LA REGO A__ G__ __ __
    The former vice-president of the United States who made a movie to make people aware of global warming is ___ ________.

Climate Change and New Mexico Wildlife
Word Scramble

1. HUGORDT D _ _ _ _ _ _
   EWIFDSILER W _ _ _ _ _ _ _ _
   Global warming can cause extreme cycles of DROUGHT and WILDFIRES.

2. TCUORATHT C _ _ _ _ _ _ _ _
   The Rio Grande TROUT trout is New Mexico's state fish.

3. TCAYCLFERH F _ _ _ _ _ _ _ _ _
   The SW Willow FLYCATCHER lives in the Gila-Cliff Valley and is an endangered species.

4. IWSTF OFX S _ _ _ _ F _ _
   A very small canine species, the SWIFT FOX, can run 60 miles per hour.

5. GOLN-EONDS L _ _ _ - N _ _ _ _
   The lesser LONG-NOSED bat migrates from Mexico following the flowering cycles of desert plants like the saguaro cactus.

6. ERAGTR G _ _ _ _ _
   The GARTER snake is one of the few animals that can eat toads, newts, and amphibians with strong chemical defenses

7. FSPPIUH P _ _ _ _ _ _
   The Pecos PUPFISH can only be found in NM and Texas and is endangered.

8. SAEDANRMAL S _ _ _ _ _ _ _ _ _
   An endangered NM amphibian species is the Jemez Mountain SALAMANDER.

9. EQSOUB B _ _ _ _ _
   A famous wetlands in New Mexico that provides a home for migratory birds and wildlife is the BOSQUE del Apache.

10. LA REGO A _ G _ _ _
    The former vice-president of the United States who made a movie to make people aware of global warming is AL GORE.

Careers

"Your work is to discover your work and then with all
Your heart to give yourself to it." – Buddha

Many students think that having an animal-related career is an appealing idea. Some also believe that the idea is out of their reach. The more that young people can learn about the possibilities that exist, the easier it will be for them to decide what they want form themselves and to plan a course of action.

There are many professions involving wild animals, or related to wildlife and conservation. An advanced degree in natural sciences, such as biology, zoology, or ecology, is one of the key qualifications for careers that involve working in close contact with animals on a daily basis. Going from college to veterinary school is required for students who want to become veterinarians. There are also positions that require less schooling but still include frequent, direct contact with animals, such as veterinary technician, zoo keeper, or wildlife technician.

Finally, there are jobs in zoos, museums, government and conservation organizations that don't involve working directly with animals on a daily basis, but let you be around them, or support their conservation. Examples of some of these jobs are educators, writers, lawyers, fundraisers, managers, artists, designers, accountants, retailers, office staff, food service staff, gardeners and carpenters.

Careers

Are You Going to be a "Scient-*ist*"?

Objective
Students will learn about some professions in life and physical sciences.

Key Words
Students will use a dictionary in the activity to look up the key words.

Materials
Dictionary
Copies of *Are You Going to be a "Scient-ist"?* Worksheets

Background
The suffix –*ist* is attached to the end of a word to describe a person in one of four ways. The resulting word can describe a specialist in a given profession, such as the herpetologist. An –*ist* word can also describe someone who performs a certain task or produces, operates, makes or plays something. For example, people who play the flute are flutists; people who write novels are novelists. Sometimes –*ist* is connected to a word to describe a personality trait or quality. An optimist is someone who always expects the most favorable, that is, the most optimal, result in any situation. Pessimists, on the other hand, always expect the worst! Lastly, the suffix is sometimes used to describe a person who advocates certain beliefs, doctrines or theories. For instance, people who wanted to abolish slavery before the Civil War were called abolitionists.

Instructions
1. Hand out copies of the worksheets to students.
2. Have students use a dictionary to do the worksheet activities.

(Note: The answer to the trick question on the worksheet is: "All of them.")

New Mexico Science Standards
Grade 4, III, I, I, 4
Grades 9-12, III, I, I, 18 and 19

Source: Adapted from www.wildlife.state.co.us/colo_wild_co/homepg/cwcindex.htm

Are You Going to Be a Scient-*ist*? Worksheet

Name ________________________________ Date _______________________

The dictionary is filled with words that end in the suffix –*ist*. Here is just a sampling of a list of specialists in science professions. Match the scientist in the list below with the subject the scientist studies by writing in the number on the blank line.

1. Agronomist	________ Animals
2. Archaeologist	________ Bird eggs
3. Biochemist	________ Birds
4. Biologist	________ Causes of disease
5. Botanist	________ Cell genetics
6. Chemist	________ Cells
7. Climatologist	________ Chemistry
8. Cytogeneticist	________ Chemistry of living organisms
9. Cytologist	________ Classification of organisms
10. Dendrologist	________ Climate
11. Ecologist	________ Cultivation of fruits and vegetables
12. Embryologist	________ Disease
13. Epidemiologist	________ Composition, uses and effects of drugs
14. Etiologist	________ Epidemics and epidemic diseases
15. Geneticist	________ Fish
16. Geologist	________ Fungi
17. Histologist	________ Genetics
18. Horticulturalist	________ Growth and development of organisms
19. Ichthyologist	________ Life processes
20. Lepidopterist	________ Living organisms
21. Mammologist	________ Mammals
22. Meteorologist	________ Microorganisms
23. Microbiologist	________ Moths and butterflies
24. Mycologist	________ Nutrition
25. Nutritionist	________ Origin, history, and structure of Earth
26. Oologist	________ Past life and culture
27. Ornithologist	________ Plant and animal tissues
28. Pathologist	________ Plants
29. Pharmocologist	________ Organisms and the environment
30. Physiologist	________ Soil management and crop production
31. Taxonomist	________ Trees
32. Zoologist	________ Weather

Trick Question:
How many of the scientists listed above might be involved with a wildlife management issue?

____

Can you find three more examples of “-ist” words that can:

1. Describe a specialist in a given profession:

    ____

    ____

    ____

2. Describe someone who performs a certain task, produces, operates, makes or plays something:

    ____

    ____

    ____

3. Describe a personality trait or quality:

    ____

    ____

    ____

4. Describe a person who advocates certain beliefs, doctrines or theories:

    ____

    ____

    ____

About Us Contact Us Purdue University and USDA

USDA Living Science

Food, Agriculture and Natural Resources Careers

Search

- Agricultural Economist
- Agricultural Engineer
- Agronomist
- Animal Nutritionist
- Animal Physiologist
- Aquaculturist
- Biochemist
- Biometrician
- Biological Engineer
- Botanist
- Climatologist
- Ecologist
- Entomologist
- Environmental Scientist
- Fisheries Scientist
- Florist
- Food Process Engineer
- Food Scientist
- Forester
- Geneticist
- Horticulturist
- Hydrologist
- Logging Engineer
- Marine Scientist
- Molecular Biologist
- Naturalist
- Nutritionist/Dietitian
- Plant Pathologist
- Plant Physiologist
- Range Manager
- Remote Sensing Specialist
- Science Writer
- Soil Scientist
- Toxicologist
- Turf Scientist
- Veterinarian
- Viticulturist
- Weed Scientist
- Wildlife Biologist
- Wood Scientist

Find your future with us!

Each year we need new college graduates to fill 50,000 jobs in the food, agricultural and natural resource system.

Those scientists and professionals

- develop and use new production and processing techniques,
- discover new uses for agricultural and forest products,
- operate in ways that are environmentally sensitive, and
- advance economic competitiveness of the United States through foreign trade.

Look through the careers described on this Web site and see if you can find your future.

USDA and Purdue thank the many contributors to this site.

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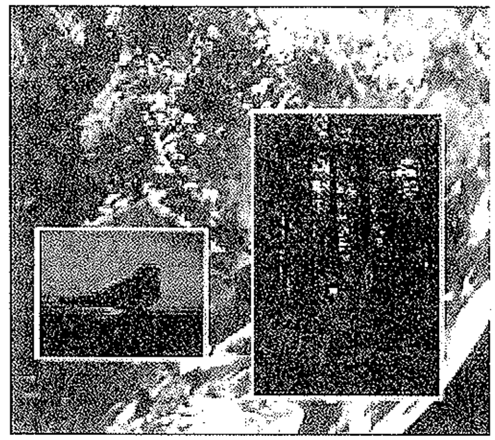
ECOLOGIST

Knowing and sharing spaceship earth.



Ecologists ask scientific questions about the relationships between organisms and their environment. This includes life in remote, unpopulated locations as well as areas where people live. Ecologists teach in college classrooms and laboratories, in nature education centers, in museums, and in public lecture halls. Their work becomes more and more important as our environmental problems increase. Some advise workers in government and private agencies, communicate with a wide variety of groups, and interact with many people.

Ecologists work in universities, governmental agencies, consulting firms, research laboratories, museums, nature centers, and private industries, including those that produce energy, timber, and fish. University ecologists teach and conduct research. They can usually choose their own research topics, including everything from fieldwork and population modeling to molecular genetics. Government and industry ecologists study ways to protect and manage our natural resources. Consultants often monitor the environment and prepare environmental impact statements. Museum and nature center ecologists interpret ecological knowledge for visitors.

To be an ecologist, you should be an intensely curious person who appreciates plants, animals, and the environment. You should feel concern for the deterioration of our world. Ecologists with bachelors degrees often find positions as technicians. For most other jobs, you need an advanced college degree. Government, industries, and museums usually hire ecologists with doctoral degrees.

In high school, take as much science as you can. Be sure to take biology, chemistry, and physics. Take mathematics every year, and learn to work with computers. Gain practical experience as a volunteer in a nature center, a university research laboratory, or a conservation agency.

Photos: National Aeronautics and Space Administration, Thomas Luba

ENTOMOLOGIST

Study what bugs us!

An entomologist is a broadly trained and educated professional in a discipline that touches almost every aspect of our daily lives. Career opportunities are numerous and varied, so if you are interested in science and ready for a challenge, entomology is the career for you. As an entomologist, you can use your natural curiosity and enthusiasm to help solve some of the world's toughest problems. Entomologists are needed worldwide to help farmers and ranchers produce crops and livestock more efficiently by using sound pest management strategies; to produce information about endangered species, fragile ecosystems and our environment; and to help prevent the spread of serious diseases in plants and animals.

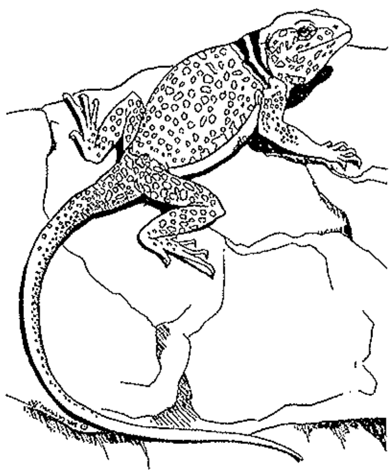
You can find entomologists in professions such as medicine, law, pharmacology, veterinary medicine, teaching, and research; in many aspects of agribusiness; in private pursuits such as consulting; and working for local, state, federal, or international agencies.

In college, a major in entomology is the best preparation for you; however, a well-rounded biological sciences program would be excellent preparation for graduate work. As an undergraduate you will take courses in biology, agriculture, chemistry/biochemistry, mathematics, and statistics, as well as computer science, English, history, and the humanities. As a graduate student you will get experience in taxonomy, physiology, morphology, behavior, and pest management.

In high school take a college preparatory curriculum and include as many science-based courses as possible.

Photos: U.S. Department of Agriculture-Agricultural Research Service, Michael Kerper

Art by Pat Oldham



CAREERS IN HERPETOLOGY

Herpetology is the study of amphibians and reptiles. All herpetologists are first biologists who have a specialized knowledge of amphibians and reptiles.

Herpetologists include people with advanced academic degrees, non-scientists who work with amphibians and reptiles for a living, and people who pursue herpetology as an avocation. All herpetologist share: (a) a strong interest in one or more kinds of amphibians and reptiles, and (b) the persistence and determination necessary to be successful at doing what they want to do.

WHAT DO HERPETOLOGISTS DO?
Most herpetologists do research on amphibians and reptiles. The research may be ecological (how animals live), systematic (how animals are related), morphological (animal structure), behavioral (what animals do), physiological (how the body functions), or biochemical. The results of their research are published in scientific journals and books.

Herpetologists may work in zoos or for wildlife agencies, do environmental assessments, teach, or care for museum collections. Some herpetologists work as writers, photographers, or animal breeders. The major categories of jobs for herpetologists are described below.

POTENTIAL CAREERS
Colleges and Universities: The majority of herpetologists work as professors or researchers in colleges and universities. With few exceptions, a person must have a Ph.D. in biology to teach in these places. Smaller colleges may hire teachers with a master's degree. A few positions such as research assistant or laboratory assistant are available in universities to individuals without a Ph.D. degree.

Museums: Museums offer other jobs for herpetologists. Curators or scientists are usually able to devote most of their time to doing research on amphibians and reptiles. These positions require a Ph.D. degree in biology. Collection managers take care of preserved amphibians and reptiles. They catalog specimens, keep records, and make specimens available for research. Collection manager positions require a master's degree in biology or museum studies. Other museum jobs are available as museum assistants. Often, these are part-time positions for students. As full-time positions, museum assistants are usually required to have a bachelor's degree.

Zoological Parks: There are several herpetological jobs available in zoological parks. Zoo curators and supervisors are manager positions that usually require a master's degree in biology. Most zoo keeper jobs require a bachelor's degree (and sometimes a graduate degree) in biology. Zoo keepers are primary care givers for the animals in their charge. They feed, clean, and maintain the animals in captivity. Some zoos have positions available as educators (usually requiring a master's degree) or researcher at the Ph.D. level.

Wildlife Management : There are a few positions in the state and federal government for herpetologists in wildlife management, usually in non-game programs. Some of these are field positions, others involve work researching and writing regulations. There are also a few jobs for herpetologists with private conservation organizations. All of these jobs require at least a bachelor's degree, usually in wildlife management, and often a master's degree or Ph.D. in biology.

Commercial Enterprises: Some individuals who are interested in herpetology go into business for themselves breeding and selling amphibians and reptiles, or herpetological related merchandise and publications. There is a very limited number of people who make money selling frog legs (for food) or extracting snake venom for medical and research use. It is possible to make a living writing books and magazine articles about herpetology, photographing of amphibians and reptiles, or making nature films.

Other Careers: Many people do not have jobs directly related to herpetology but are still able to keep herpetology as part of their career focus. Careers which can have a herpetological emphasis include high school science teachers, veterinarians, environmental technicians, and biomedical researchers. These career choices all require specialized post-graduate training.

EDUCATIONAL PREPARATION

Informal Education: Informal education in herpetology begins as soon as you develop an interest in reptiles and amphibians. Read all of the books and magazine articles you can about these animals. Becoming an active member of a regional herpetological society is a good way to meet others with common interests. Going out to search for amphibians and reptiles is an excellent way to sharpen observation and note taking skills. Record your field observations of amphibians and reptiles carefully in permanent field books. Learn how to take good photographs of animals and their habitats.

Formal Education: A college education with an emphasis in the sciences is recommended. There is no college or university that offers a major in herpetology at the undergraduate or even the graduate level. Instead, persons interested in herpetology select a major in the biological sciences. The knowledge learned about all aspects of the biology of animals is then applied to an individual study of herpetology. It is important not to neglect other studies as well-herpetologists need courses in statistics, chemistry, computer science, writing, and foreign languages. Acceptance into graduate school is especially competitive. Good grades and a well-balanced undergraduate education are necessary for acceptance.

Graduate programs at many universities allow you to do advanced studies on some aspects of herpetology, and sometimes a comparatively obscure university may have an outstanding herpetologist on its faculty. One good way to select a university for graduate study is to read the current issues of the major herpetological journals (*Copeia, Herpetologica,* and *Journal of Herpetology*). When you find articles on the kind of research that interests you, check and see where the researchers are based, and apply to those institutions. A few universities have had a long tradition of producing herpetologists. These include Harvard University, University of Florida, Cornell University, University of Michigan, University of Kansas, and University of California at Berkeley. Other centers for herpetological study include Duke University, University of Chicago, University of Texas at Austin, and University of Texas at Arlington.

Source: American Society of Ichthyology and Herpetology (http://www.asih.org)

NATURALIST

Interpreting the scheme of things.

Naturalists are scientists and skilled communicators. They study the natural environment and enjoy sharing what they learn with other people. Naturalists are equally at ease narrating multi-projector slide programs for audiences of 500 and working one-on-one with school children to identify flowers. Naturalists help people learn to live more productively on earth without destroying the environment.

Naturalists teach, but rarely in formal classrooms. They work as interpretive naturalists for the National Park Service and as tour guides at zoos. Some teach school groups in outdoor classrooms, while others develop television and video programs, write magazine and news articles, and produce mass media programs on topics such as biological diversity and endangered species.

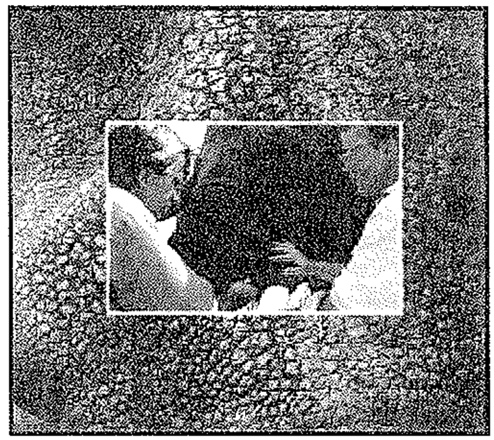
To be a naturalist you should earn a college degree in natural resources, environmental science, or a similar program that emphasizes the scientific aspects of relationships between humans and their environment. You must understand ecological sciences, communication theory, education principles, and resource management. Your education must include a balance between ecological and social sciences.

Take high school, math, computer science, English, literature, social science, and foreign language. Volunteer experience at parks, zoos, museums, or school camps also will help prepare you.

Photos: Thomas Luba, Kathryn Elsesser-Luba, U.S. Department of Agriculture

VETERINARIAN

Healthy creatures great and small.



Most veterinarians work in private practices where they diagnose, treat, and help prevent disease and disabilities in animals. The D.V.M. (Doctor of Veterinary Medicine) degree, however, opens up many career choices. Veterinarians can be practitioners, researchers, public servants, administrators, and teachers. They may work with one or more species of animal, or with additional training, in a clinical specialty such as cardiology, surgery, or neurology. Veterinarians safeguard human health by controlling diseases that can spread from animals to humans.

Veterinarians can start their own businesses or work with others in group practices. Some work for nutrition and pharmaceutical companies. Others do research or enforce regulations for state and federal government agencies. Some join the military, while others work as researchers, teachers, and clinicians in academic institutions. Some veterinarians get involved in international work. Others work at racetracks, zoos, and breeding farms.

To become a veterinarian, you need at least seven years of education beyond high school. You must complete at least three years in an accredited college or university undergraduate program before starting your four-year professional curriculum.

In high school, take college preparatory courses. These include four years of mathematics, science (with special emphasis on chemistry and physics), English, and social sciences. Work with as many different types of animals as you can on farms, in veterinary practices, in zoos, with the Society for the Prevention of Cruelty to Animals, and elsewhere to help you decide if veterinary medicine is for you.

Photos: Kathryn Elsesser-Luba

WILDLIFE BIOLOGIST

Walk on the wildlife side.

Wildlife biologists do research that helps us better manage our natural resources. They may specialize in fields such as physiology, genetics, ecology, behavior, disease, nutrition, population dynamics, land-use, and pollution. They are curious, patient, and persistent. While they enjoy working out-of-doors with wildlife, much of their job involves interactions with people. They collect, analyze, and interpret facts objectively and skillfully, and they can report them clearly to other people.

Traditionally, most wildlife positions were civil service jobs with state, provincial, or federal agencies. Many other opportunities are now available. Some city, town, and county agencies hire wildlife management specialists, and many parks hire them for wildlife interpretation (for example, leading nature walks). Universities and colleges offering wildlife curriculums hire wildlife professionals with advanced degrees to teach and do research. After the enactment of the National Environmental Policy Act of 1969, environmental and other consulting firms began employing more wildlife specialists to produce environmental impact statements and other planning documents. Private employment with large firms dealing in timber, ranching, mining, energy production, paper production, and chemical production is also increasing. Each year opportunities increase in community nature or conservation centers, zoos, and a growing number of private and public conservation-related organizations around the world.

To be a wildlife biologist, you need a college education. Since most wildlife resources and conservation problems relate to people, you need courses in English, history, geography, statistics and economics, as well as in physical and biological sciences. Communication skills, especially speaking skills, must be part of your training.

In high school take as much math, physics, English, chemistry, and biology as possible. If you can, get experience working with committees, conducting meetings, and writing for high school publications.

Photos: Charles K. Elsesser, Kathryn Elsesser-Luba

Careers

Wildlife-Related Careers

Objective
Students will
1. learn about careers related to wildlife
2. recognize factors to consider in selecting an occupation

Key Words
1. *Aptitude* – a natural talent or ability for something, especially one that is not yet fully developed
2. *Bachelor's degree* – a degree awarded on the successful completion of an undergraduate course at a college or university
3. *Biology* – the science that deals with all forms of life, including their classification, physiology, chemistry, and interactions
4. *Career* – a job or occupation regarded as a long-term or lifelong activity
5. *Ecology* – the study of the relationships and interactions between living organisms and their natural or developed environment
6. *Intern* – somebody who works as a low-level assistant or trainee in an occupation in order to gain practical experience
7. *Networking* – the building up or maintaining of informal relationships, especially with people whose friendship could bring advantages such as job or business opportunities
8. *Resume* – a document listing a person's education, job experience and other information
9. *Zoology* – the branch of biology that involves the scientific study of animals and all aspects of animal life

Materials
Writing materials
Copies of *Wild Government Jobs*
Copies of *Interest Inventory* worksheet

Optional materials:
Copies of *How Would You Like Your Resume to Read?*
Copies of *Wild Jobs Survey*

Internet Resources:
My First Resume at http://careerkids.com/resume2.html
Fact sheets with downloadable color posters at www.agriculture.purdue.edu/USDA/careers/

Background
Choosing a career is an important decision. Really knowing oneself is the key. What are your likes and dislikes? What are your strengths and weaknesses? How would you rank in importance things like salary, work schedule, location, interaction with other people, and work duties? For example, some people may not be as picky about what they do, as long as they make a lot of money. Aptitude tests and career surveys are ways to help discover the right occupation.

Collecting information is essential to making a career choice and to obtaining employment. Research may involve reading the newspaper's classified ads, requesting brochures from business' personnel departments, or visiting an employment agency. Interviewing people with wildlife-related jobs in your community is a good method of gathering information too.

Wildlife professionals may work for government agencies or private businesses. Many wildlife-related careers have interesting titles, such as zoo keeper, game warden, marine mammal trainer, park ranger, pet shop owner, snake handler, conservation lobbyist and bass pro angler.

To be successful, these people deal with constant challenges, work as a team and problem-solve every day. Many of these positions require a college degree in biology, ecology or zoology or vocational training along with good communication skills. Strategies for entering wildlife fields involve understanding your own values and skills, keeping up on current issues and networking. Volunteer work and internships are also successful methods of becoming a wildlife professional.

<u>Instructions</u>

Part 1.

1. Discuss background information with students.
2. Have students complete the *Interest Inventory* worksheet.
3. Have students write a report on why wildlife-related careers will or will not be needed in the future.

Part 2.

1. Have students create "career cards" of wildlife professionals in the community to trade with other students. For the front side of the card consider a picture from magazine photograph or a drawing of the careerist in action. The back side of the card should contain facts about the career, such as educational requirements, salary range, pros and cons of the job, and related occupations. Students can use the *Wild Jobs Inventory Form* to help with this project.

2. Have students complete the *How Would You Like Your Resume to Read?* worksheet

<u>Options</u>

1. Start an environmental club, such as Wild Friends, at your school. Present awards to students with outstanding accomplishments or volunteer service. Students can include these awards on their resumes.

2. Make a list of wildlife-related professionals that work in your area. Be sure to include 4-H leaders, farmers, veterinarians, foresters, conservation officers, university professors, wildlife organization leaders, wildlife artists and wildlife rehabilitators.

3. Ask individuals to talk to your students and/or allow them to "shadow" them for part of a day. Students should interview the wildlife professionals and write papers describing the advantages and disadvantages of the occupations.

New Mexico Science Standards
Grade 4, III, I, I, 4
Grades 9-12, III, I, I, 18 and 19

Source: Adapted from "Wildlife-Related Careers", Kentucky Dept. of Fish and Wildlife Resources

(The girl who loves fishing.pdf)

Interest Inventory

Name ________________________________ Date ____________________

Answer the following questions based on your personal goals and desires.

1. Where would you like to work? _______ indoors _______ outdoors
2. Would you like to work with:

   ________ living organisms ________ inanimate objects

3. Which work schedule best fits you?

   ________ routine, Monday – Friday, 8:00 am to 5:00 pm

   ________ flexible, days and nights, holidays and weekends

4. Is important to you that your work will make a
   a real difference for generations to come? _______ yes _______ no

Rank these work considerations from 1 = most important to 6 = least important to you.

_________ salary

_________ work schedule

_________ location

_________ work with a team

_________ work alone

_________ work duties

_________ opportunities for advancement

How Would You Like Your Resume to Read?

Wild Jobs Survey

Name ___________________________________ Date ________________________

1. Can you name any jobs where people work with wildlife?

2. Can you name any jobs where people work with other kinds of animals?

3. What kind of environment do these people work in? (For example, a forest or a zoo.)

4. Do any of these jobs seem interesting to you? If yes, which ones?

5. Do you think you would like to work around or with animals/and or wildlife as

   ______ a summer job? ______ a volunteer?

   ______ as a part-time employee? ______ as a career?

6. What personal qualities do you think you might need to be successful in working around or with animals? (For example, do you need to be kind to animals?)

7. What personal qualities do you think you might need to be successful in working around or with wildlife?

8. What skills or special training do you think you might need?

9. What kind of classes and subjects would you need to study in school for this kind of work?

10. Can you take these classes in high school? _______ In college? _________

11. What kind of education degree do you think you would need to get the job that interests you?

12. Which of the jobs you listed in question number 1 do you think you could get if you had

    a high school degree:

    a Bachelor’s degree from college:

    a Master’s or other graduate degree from college:

13. Do you know where else you might get any special training you may need for the job that interests you? (For example, Vocational School, or working with someone who could teach you)

Wildlife-Related Government Jobs

Many wildlife-related professionals work for government agencies. Some examples are the U.S. Fish and Wildlife Service, the New Mexico Department of Game and Fish and New Mexico State Parks. The positions require the minimum of a bachelor's degree in biology, zoology, resource conservation, forestry, ecology, recreation, law enforcement or a related field.

Wildlife Biologists

Wildlife biologists survey animal populations, collect age and growth information on species and write detailed reports about their findings. They also assist landowners with improving habitat for wildlife and manage wildlife on public lands. On a given day a wildlife biologist might band some birds, relocate a bear, and/or meet with citizens A day in the life of a wildlife biologist might include banding birds, relocating a bear, and/or meet with landowners, hikers and hunters about a specific wildlife problem. Other duties could include working on restoration projects to return animals of special concern, such as Mexican wolves and Aplomado falcons back to the wild.

Conservation Educators and Park Interpreters

Giving visitors a sense of place. Helping people connect with the outdoors on a personal level. Having an impact on young people and their interaction with the natural world. Helping learners of all ages to be aware and knowledgeable about New Mexico's natural resources. These are some of the responsibilities of a conservation educator and a park interpreter. These professionals present programs to students, teachers, sports enthusiasts, resource agency staff, landowners and the general public. Each year, conservation educators and park interpreters explain concepts like biodiversity and ecosystems to thousands of New Mexicans

Fish Hatchery Managers

Like farmers, fish hatchery managers spend much time outside growing and harvesting their crops. Hatchery managers build ponds, fertilize waters to encourage growth of food for young fish, and feed older fish with pellets. Fish hatchery managers select fish stock, collect fish eggs and monitor fish growth and stock public and private waters with fish around the state.

Foresters

Typical duties of foresters are surveying land, measuring and grading trees, planting trees, supervising logging operations, laying out road and trail systems, identifying pest problems and fighting wildfires. Foresters attempt to balance the need for wood products with other forest uses. Foresters also manage wooded lands for recreational use and wildlife habitat, and monitor water quality.

Law Enforcement Officers

Conservation officers, also called game wardens are trained to enforce state and federal laws. These law enforcement officers specialize in outdoor recreation and environmental-related activities. Fish and wildlife officers may investigate poaching and trespassing complaints, fish kills, illegal substances grown on public lands and unsafe boating operation. Officers' duties also involve maintaining good public relations, speaking to special interest groups, working closely with wildlife biologists and helping landowners remove nuisance wildlife.

The Girl Who Loves Fishing

RESUME

Amanda Chavez
123 Rio Grande Blvd.
Albuquerque, New Mexico

Career Objective:
To obtain a fisheries biologist position

Education:
Rio Grande HS, Diploma 2003
Univ. of New Mexico, B.S. in Biology 2007
Univ. of Arizona, M.S. in Forestry, 2009.

Experience:
2005 – present Volunteer Instructor
Albuquerque Biological Park
2008 Fisheries Biologist Intern
US Fish and Wildlife Service, NM
Summers 2005-06 Forestry Technician
Santa Fe National Forest, NM
Summers 2003-04 Jemez Fish Hatchery
NM Dept. of Game and Fish

Professional Organizations/Membership:
American Fisheries Society
Student Conservation Association
Trout Unlimited Junior Member
Bernalillo County 4-H

Awards:
2000 High School Conservationist of the Year
The Wildlife Society – NM Chapter

References:
Professor K. Salmon

The Next Step

Amanda loves to be outdoors. Catching a big trout when she was ten years old has inspired Amanda to become a fisheries biologist. Her favorite school subjects are math and science. She is very concerned about the environment and wants to do her part to make sure there are fishing opportunities for future New Mexicans.

After talking with the director of Trout Unlimited (a nonprofit organization dedicated to the conservation of trout, coldwater stream habitat and flyfishing), Amanda learned that there are a limited number of fisheries biologists' jobs throughout the West. She wants to start planning her career now. Perhaps, then, she will have an edge over her competition.

Amanda has set high goals for herself. Someday, she wants her resume to look like the one that she made up for herself (see Resume Box). For now, she is working hard to get good grades in school.

The Girl Who Loves Fishing

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Resources for Educators

BOOKS

Albuquerque's Environmental Story: Toward a Sustainable Community, by Joan and Hy Rosner
Available from Page One Bookstore, 11018 Montgomery Blvd. NE, Albuquerque, NM 87111, 505-294-2026; or download copy from: www.cabq.gov/aes/

Common Species of the Southwest Series:
50 Common Birds of the Southwest, by Richard L. Cunningham
70 Common Butterflies of the Southwest, by Richard Bailowitz and Douglas Danforth
50 Common Insects of the Southwest, by Carl Olson
50 Common Mammals of the Southwest, by George Olin
50 Common Reptiles and Amphibians of the Southwest, by Jonathan and Roseann Hanson
Available from: Western National Parks Association, 12880 North Vistoso Village Drive, Tucson, AZ; 85755; 560-622-1999; 560-623-9519 fax; info@wnpa.org

Flowering Plants of New Mexico, by Robert DeWitt Ivey, RD & V Ivey, Publishers
Available from: University of New Mexico Bookstore, 2301 Central NE, Albuquerque, NM 87131, (800) 981-BOOK or (505-) 277-5451

Keepers of the Earth: Native American Stories and Environmental Activities for Children, by Michael J. Caduto and Joseph Bruchac (1988, 1989) and *Keepers of the Animals: Native American Stories and Wildlife Activities for Children*, by Michael J. Caduto and Joseph Bruchac (1991). .Fulcrom Publishing, Golden, CO

Nature Ranger, by Richard Walker, DK Publisher
Available from: *Explora!* Museum Bookstore, 701 Mountain Road NW, Albuquerque, NM 87104 ; 505-224-8300; www.explora.us

CURRICULA

Butterflies and Bugs – 5th grade (*English and Spanish*)
www.earthsbirthday.org/fromteachers/nativeplants/index.asp

Carlsbad Caverns National Park Middle School Biology Curriculum
www.nps.gov/archive/cave/education_ms_biology.htm

Carlsbad Caverns National Park Middle School Ecology Curriculum
www.nps.gov/archive/cave/education_ms_ecology.htm

Colorado's Wildlife Company
www.wildlife.state.co.us/Education/TeacherResources/ColoradoWildlifeCompany/

Ecosystem Matters: Activity and Resource Guide for Environmental Educators
www.na.fs.fed.us/spfo/pubs/misc/eco/

New Mexico Department of Game and Fish - Various
www.wildlife.state.nm.us/education/index.htm

New Museum of Natural History & Science – Various (*English and Spanish*)
www.nmnaturalhistory.org

ORGANIZATIONS

Albuquerque Biological Park
903 Tenth Street SW
Albuquerque, NM 87102
Phone: 311 locally or
505-768-2000; 505-764-6281 fax
e-mail: biopark@cabq.gov

Audubon New Mexico
P.O. Box 30002
Albuquerque, NM 87190
505-255-7622
www.audubon.org/states/index.php?state=nm

Bandelier National Monument
National Park Service
HCR 1, Box 1, Suite 15
Los Alamos, NM 87544
505-672-3861 ext. 517 or fax 505-672-9607
www.nps.gov/band/

Bureau of Land Management
P.O. Box 27115
Santa Fe, NM 87502
505-438-7400 or 505-438-7435
www.blm.gov/nm/st/en.html

Carlsbad Caverns National Park
3225 National Parks Highway
Carlsbad, NM 88220
505-785-3127
cave_park_information@nps.gov

City of Albuquerque, Open Space Division
P.O. Box 1293
Albuquerque, NM 87103
505-452-5200 or 311
www.cabq.gov/openspace/

Energy, Minerals & Natural Resources Dept.
New Mexico State Parks
Dave Simon, Director
P.O. Box 1147
Santa Fe, NM 87504
1-888-NM PARKS
www.nmparks.com

Environmental Education Assoc. of NM
P.O. Box 36958
Albuquerque, NM 87176
www.eeanm.org

***Explora!* Museum**
Education Office
1701 Mountain Road NW,
Albuquerque, NM 87104
505-224-8383; 505-224-8300;
www.explora.us

Hawks Aloft, Inc.
P.O. Box 10028
Albuquerque, NM 87184
505-828-9455 or fax 505-828-9769
www.hawksaloft.org
Hawkwatch International New Mexico
1420 Carlisle Blvd. NE #206
Albuquerque, NM 87110
505-255-7622 or fax 505-255-1775
www.hawkwatch.org

Las Cruces Museum of Natural History
700 Telshor Boulevard #1608
Las Cruces, NM 88011
505-522-3120 or fax 505-532-3370
www.las-cruces.org/public-services/museums/nhm.shtm

Living Desert Zoo and Gardens State Park
P.O. Box 100
Carlsbad, NM 88221-0100
505-887-5516 or fax 505-885-4478
www.enmrd.state.nm.us/PRD/Livingdesert.htm

Native American Fish & Wildlife Society, SW Region
8333 Greenwood Blvd. Suite #260
Denver, CO 80221
303-466-1725 ext. 2; 303 466-5414 fax
www.nafws.org

New Mexico Department of Game and Fish
Kevin W. Holladay, Project WILD Coordinator
and Aquatic Resource Education Coordinator
Public Information and Outreach Division
1 Wildlife Way
Santa Fe, NM 87507
505-476-8095; 505-476-8116 fax
e-mail: kevin.holladay@state.nm.us
www.wildlife.state.nm

NM Museum of Natural History & Science
Selena Connealy, Chief of Education
NM Museum of Natural History & Science
1801 Mountain Road NW
Albuquerque, New Mexico 87104
505-841-2836 or
e-mail: selena.connealy@state.nm.us.
www.nmnaturalhistory.org

and
Sandia Mountain Natural History Center
Paul Mauer Mann, Manager
Cedar Crest, NM
505-281-5259

M Project Learning Tree, SW Region
333 Broadway SE
Albuquerque, NM 87102
505-842-3325 or fax 505-842-3106
www.plt.org

New Mexico Recycling Coalition
P.O. Box 24364
Santa Fe, NM 87502
www.nmrecycle.org

New Mexico State Land Office
Dana Vackar Strang, Asst. Div. Director
P.O. Box 1148, 310 Old Santa Fe Trail
Santa Fe, NM 87504
505-827-5096; 505-827-5766 Fax
www.nmstatelands.org

New Mexico Wilderness Alliance
Albuquerque Office
P.O. Box 25464
Albuquerque, NM 87125
505-843-8696; 505-843-8697 fax
nathan@nmwild.org
and
Las Cruces Office
275 North Downtown Mall
Las Cruces, NM 88001
505-527-9962
nmwild.org/

New Mexico Wildlife Federation
2921 Carlisle Blvd NE, Suite 200-J
Albuquerque, NM 87110
Phone: 505.299.5404
e-mail: nmwildlife@nmwildlife.org
www.nmwildlife.org/

Project Del Rio
1770 A.S. Solano
Las Cruces, NM 88001
505-522-7511 or fax 505-522-0775
www.riogrande.org/programs/WSguide.htm

Randall Davey Audubon Center
P.O. Box 9314, 1800 Upper Canyon Road
Santa Fe, NM 87504
505-983-4609 or fax 505-983-2355
http://nm.audubon.org/audubon_center/center.html

Sevilleta National Wildlife Refuge
Kim King-Wrenn, Education Specialist
Sevilleta National Wildlife Refuge
505-864-4021
e-mail: Kimberly_King-Wrenn@fws.gov

Sierra Club of New Mexico
142 Truman St. NE
Albuquerque, NM 87108
505-243-7767 or fax 505-243-7771
www.sierraclub.org/nm/

Talking Talons Youth Leadership
P.O. Box 2020
Tijeras, NM 87509
505-281-1133
www.talkingtalons.com

Tree New Mexico
P.O. Box 81827
Albuquerque, NM 87198
505-265-4554 or toll free 800-510-0554
505-255-9197 fax
www.treenm.com

USDA Forest Service – SW Region
333 Broadway SE
Albuquerque, NM 87102
(505-) 842-3292
www.fs.fed.us/r5/

USDA Forest Service, Gila National Forest
Reserve Ranger District
P.O. Box 170
Reserve, NM 87830
505-533-6232; 505-533-6605 fax
www2.srs.fs.fed.us/r3/gila/

USDA Forest Service, Lincoln National Forest
Federal Building, 1101 New York Avenue
Alamogordo, NM 88310
505-434-7200; 505-434-7218 fax
www.fs.fed.us/r3/lincoln/index.shtml

USDA Forest Service, Sandia Ranger District
11776 Highway 337
Tijeras, NM 87509
505-281-3304; 505-281-1176 fax
www.fs.fed.us/r3/cibola/districts/sandia.shtml
Mailing address:
Cibola National Forest
2113 Osuna Rd. NE Suite A
Albuquerque, NM 87113
505-346-3900; 505-346-3901 fax
www.fs.fed.us/r3/cibola/districts/sandia.shtml

USDA Forest service, Santa Fe National Forest
1220 Saint Francis Drive
Santa Fe, NM 87505
505-281-3304
Mailing address:
1474 Rodeo Rd.
Santa Fe, NM 87505-
www.fs.fed.us/r3/sfe/index.html

U.S. Fish and Wildlife Service, Region 2
Charna Lefton, External Affairs
P.O. Box 1306
Albuquerque, NM 87103
505-248-6285 or 505-248-6282
www.fws.gov/southwest

USFWS Bosque Del Apache Nat'l Wildlife Refuge
101 Highway # 1
San Antonio, NM 87801
505-835-1828
www.fws.gov/southwest/refuges/newmex/bosque/
Mailing address:
P.O. Box 1246
Socorro, NM 87801
505-835-1828

USFWS San Andres National Wildlife Refuge
5686 Santa Gertrudes Drive
Las Cruces, NM 88012
505-382-5047; 505-382-5454 fax
www.fws.gov/offices/directory/default.cfm
Mailing address:
P.O. Box 756
Las Cruces, NM 88004

Water Conservation Program
Office of the State Engineer
P.O. Box 25102
Santa Fe, NM 87504
1-800-WATER-NM; 505-827-3813 fax
www.ose.state.nm.us/water-info/conservation/h2o-outreach.html

Wildlife West Nature Park
87 North Frontage Road
P.O. Box Number 1359
Edgewood, NM 87015
505-281-7655 or toll free 877-981-9453
505-281-7170 fax
Info@WildlifeWest.org
www.wildlifewest.org

White Sands National Monument
National Park Service
Box 1086
Holloman, AFB, NM 88330
505-479-6124; 479-4333 fax
www.nps.gov/whsa/

Wildlife Friends Program
Center for Wildlife Law, Institute of Public Law
MSC 116060 - 1 University of New Mexico
Albuquerque, NM 87131-0001
505-277-5089; 277-5483 fax
http://wildfriends.unm.edu

Wildlife Center, Inc.
P.O. Box 246
Espanola, NM 87532
505-753-9505-; 505-747-8862 fax
www.thewildlifecenter.org

Wildlife Rescue, Inc of New Mexico
P.O. Box 13222
Albuquerque, NM 87192
505-344-2500
www.wrinm.org/

NEW MEXICO MUSEUM OF NATURAL HISTORY & SCIENCE

2006-2007

Teacher Resource Catalog

The Age of Super Giants Teacher's Guide. 2004. 24 pages. To be used in conjunction with a visit to the Age of Super Giants exhibit hall at the Museum, presenting major themes in Earth Science and Life Science Standards specifically related to grades 3 and 6 (and adaptable to other grade levels). The pre- and post-visit activities can also be part of a free-standing unit about the Jurassic Period and dinosaurs in New Mexico. Cost: FREE!

Albuquerque's Geoscape. 2004. Large-format full-color poster. This unique poster focuses on the regional landscape around Albuquerque and presents basic and easy-to-understand information about geology. The poster consists of a central satellite image of the Albuquerque region surrounded by geological topic panels. Poster content is aligned with state and national science standards at the middle-school level and can be modified by teachers of grades K-12. All information that a teacher might need in order to teach a thematic unit on major geological topics is included in the poster and linked to the local landscape. An accompanying web site includes additional information, suggested activities, and field trips. Cost: $10.

Arid Lands, Sacred Waters/*Tierras áridas, aguas sagradas.* (NMMNHS Bilingual Education Series Volume 1). 1992. 51 pages. This bilingual English/Spanish curriculum explores the importance of water as a precious and non-renewable resource in the southwest. Includes background information, 13 hands-on activities/experiments for grades 3-12, glossary, bibliography, student pages, and teacher pages. Cost: FREE!

The Bosque Education Guide. 2003. 634 pages. A resource book of background information, activities, curriculum suggestions, and references to help K-12 teachers teach about their local cottonwood forests. The Guide has field trip activities as well as those for the classroom or school yard. Topics include the natural history of the bosque, geology of the Rio Grande valley, surface and groundwater, the demands on the river's water budget and human influence, mapping activities, webquests, and service learning ideas. Correlated to New Mexico standards. A joint project of U.S. Fish and Wildlife Service's Bosque Initiative Group, New Mexico Museum of Natural History and Science and the Rio Grande Nature Center. Cost: $35. Selected activities available on-line at http://museums.state.nm.us/nmmnh/BEG/beghome.htm.

Earthshaker. 2005. DVD. 56 minutes. In 1979, two hikers in the Ojito Wilderness Area northwest of Albuquerque made an earthshaking discovery—four huge, largely intact fossilized tailbones from some very giant animal. From the thrill of discovery to the grand unveiling in the Age of Super Giants exhibit hall at the Museum, this documentary tells the fantastic story of *Seismosaurus*, the world's longest dinosaur. Cost: $24.99

The **Ecology Education Program** has a collection of equipment and kits that could be used by classroom teachers who are experienced in ecology data collection and would like to incorporate an element of field work into their classes. We have both aquatic and terrestrial sampling equipment including water chemistry kits, nets, spreader boards, GPS units, compasses, clinometers, and insect sampling equipment. Contact Linda Fey at 505-841-2849 or linda.fey@state.nm.us for more information. Cost: $20 for kits containing non-consumable materials and $40 for kits that contain consumables.

Ecosystems Everywhere: New Mexico Ecosystems Curriculum. 2005. CD. This CD will make ecology come alive for your students with hands-on activities based on local ecosystems. All our curricula and programs are standards-linked, multi-disciplinary, and New Mexico-focused. The CD contains two ecology curricula (with a total of 14 activities). Teacher-tested lessons help your fifth grade students learn ecology in fun ways. Also included are Spanish translations of student pages, an English/Spanish ecology glossary and helpful information about planning field trips. Cost: FREE!

Available on CD or at http://museums.state.nm.us/nmmnh/edu_smnhcurriculum.html.

Borrow materials from the **Education Division Collections**! We have lots of cool stuff like fossils, rocks, minerals, and biological specimens. In addition, loaner kits of fossils, minerals, skeletal materials, and marine organisms are available. Materials are only available by pick-up at the Museum. Contact Mike Sanchez, 505-841-2853 or michael.sanchez1@state.nm.us . Cost: FREE!

Large-Format Film Teacher Guides.
Each film shown in the Lockheed Martin Extreme Screen DynaTheater is accompanied by an illustrated teacher's guide with hands-on activities and background information. Most are written for grades 5-8, but the activities can be adapted to higher or lower grade levels. Guides available are: **Everest, Lost Worlds, The Living Sea**, and **Journey into Amazing Caves**. Limited quantities available. Cost: FREE!

Making Tracks on Mars: Teacher Resource and Activity Guide. 2006. CD. This curriculum is designed to use students' interest in Mars as a "hook" to teach a wide variety of science and non-science topics. It includes content information, information about previous and current missions (especially the ongoing Mars Exploration Rover mission), and 20 tested, hands-on activities for grades 3-10. Each activity includes relevant national and New Mexico standards. An appendix lists web sites, other educational products, and New Mexico field trip locales. The CD also includes an annotated Mars Exploration Rover Mission image file and an annotated PowerPoint presentation about Mars and the Mars Exploration Rover mission. Developed by the Museum and the LodeStar Astronomy Center. Cost: FREE!

New Mexico: The Volcano State. 2003. VHS or DVD. 14 minutes. Explore the volcanoes of the National Parks and Monuments in the Land of Enchantment. This video, produced in association with the U.S. Park Service, serves as an introduction to a range of volcano types and volcanic landscapes that occur in New Mexico. Examples profiled include Capulin Volcano National Monument, El Malpais, Bandelier National Monument, Petroglyph National Monument, and the Gila Cliff Dwellings. Cost: VHS $17.99, DVD $29.99.

Proyecto Futuro **Earth and Space Science Bilingual Curriculum.**1997. 301 pages. This curriculum manual contains more than forty hands-on activities with student handouts and activity guides in both English and Spanish. Designed with a focus on New Mexico earth science for students and teachers in grades K-8 and linked to national and New Mexico standards. Topics covered include water, meteorology, rocks and minerals, time and fossils, plate tectonics, astronomy, maps, and models.
Cost: $35.

Proyecto Futuro

Proyecto Futuro **Life Science Bilingual Curriculum.** 2002. 480 pages. This curriculum manual contains more than fifty hands-on activities with student handouts and activity guides in both English and Spanish. Developed specifically for New Mexico students and teachers in grades K-8, the curriculum manual is linked to both national and New Mexico standards (2003). Topics include fungi, plants, invertebrates, vertebrates, human body, and ecology. Cost: $35.

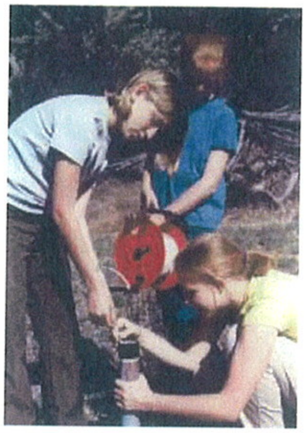
The Rió Grande Bosque Workbook/*Manual del bosque del Río Grande.* 1995. 135 pages. Developed in collaboration with the students and teachers of Reginald F. Chavez Elementary School, this bilingual workbook provides hands-on activities to explore the bosque. This workbook is for reading, writing in, drawing in, taking on field trips, talking about, and coloring! Cost: FREE!

TimeTracks: A Journey through the Natural World. 2001. 64 pages An exploration of New Mexico through geologic time. Each section describes the environment, fauna, and flora of our region from Earth's very beginnings to New Mexico today. Written in an easy-to-read format with beautiful photographs and illustrations, this book will take you on a journey through time and introduce you to the interwoven fabric of geological and biological processes and patterns. Linked to the permanent exhibits of the New Mexico Museum of Natural History and Science, and written by Museum curators and educators. Cost: $4.95.

NEW MEXICO DEPARTMENT OF
CULTURAL AFFAIRS

The New Mexico Museum of Natural History and Science
is a Division of the Department of Cultural Affairs, State of New Mexico.

EDUCATIONAL OPPORTUNITIES AT THE SEVILLETA NATIONAL WILDLIFE REFUGE



Biome Study: Students can use the Refuge to sharpen their knowledge of basic field study techniques and use of simple scientific instruments by conducting an inventory of a study quadrat in one or more of the biomes on the Refuge. Teachers and parents who participate in a one day orientation can receive a permit to conduct biome studies on the Refuge. All necessary field equipment is available for use by permitted educators. A limited amount of staff time is available for classroom visits prior to conducting the biome study. The program currently meets a minimum of 12 NM benchmarks for science education at the elementary school level. This program has been used successfully with students from 2^{nd} - 10^{th} grades, but is most popular with 4^{th} - 6^{th} graders.

Designated Study Areas: The Sevilleta National Wildlife Refuge protects examples of four biomes: Chihuahuan Desert, short grass prairie, Colorado plateau shrub steppe and pinyon juniper woodlands within its boundaries. Study areas have been designated for use by students within each of the biomes. Teachers and parents can obtain a permit to use one or more of the study areas by attending a one day orientation.

Student Research: Individual students, as well as classes, may obtain permits to conduct research on the Sevilleta National Wildlife Refuge by submitting a proposal to the Environmental Education Specialist.

Chihuahuan Desert Teacher's Guide: A guide has been developed for use by teachers who would like to visit the Refuge with their students to study this biome. Multi-disciplinary lesson plans for pre-visit, on-site and post-visit activities are included. All lessons are coordinated to the New Mexico educational standards and benchmarks. The Guide is targeted toward upper elementary school teachers.

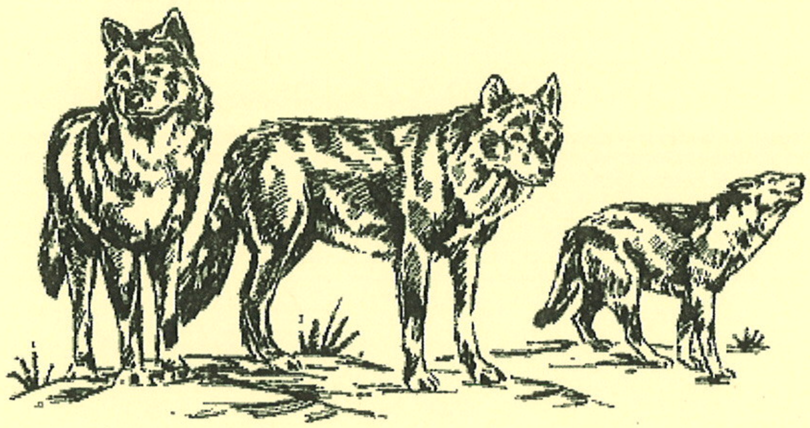
A teacher workshop focusing on the Chihuahuan desert and introducing the guide is planned for the spring of 2007

Mexican Gray Wolf Presentation: This 45 minute interactive presentation will introduce your students to the concept of endangered species while focusing on the Mexican Gray Wolf as an example of one endangered species that is struggling to survive right here in New Mexico.

Traveling Exhibit Trailer: The 35 foor mobile exhibit trailer can visit your school as a way to get students excited about New mexico's wildlife na d wildlife refuges. Teachers and Refuge staff work togethr to lead students through hands-on, standards based, directed activites and help them make the most of the visit.

For more information contact:
Kim King-Wrenn
Education Specialist
Sevilleta National Wildlife Refuge
505-864-4021
Kimberly_King-Wrenn@fws.gov

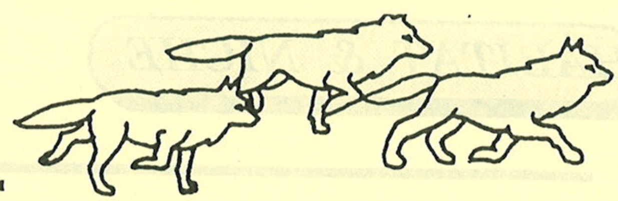
The Mexican Wolf



AN EDUCATIONAL ACTIVITY PACKET

Carol Cochran, Education Curator
Arizona-Sonora Desert Museum
2021 N. Kinney Road
Tucson, AZ 85743

NATURAL HISTORY



CLASSIFICATION

Concepts: classification, mammal, vertebrate, domesticated, wild

Kingdom:	Animal
Phylum:	Chordata
Subphylum:	Vertebrata
Class:	Mammalia
Order:	Carnivora
Family:	Canidae
Genus/Species/Subspecies:	*Canis lupus baileyi*

Activities:

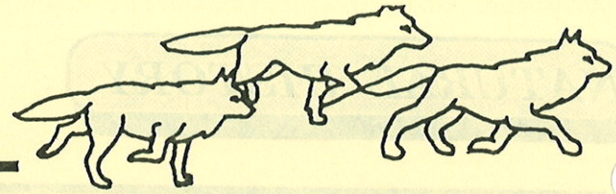
- Use the wolf as an example of a vertebrate and a mammal; distinguish vertebrates from invertebrates, mammals from other vertebrate classes. Good activities are "The Layered Wolf" and "The Vertebrate Grab Game" from *NatureScope,* "Amazing Mammals, Part 1."
- Using pictures on a bulletin board, examine the distinguishing characteristics of the canine family. Compare and contrast this family with the feline family. Compare wolves to other canines, e.g. foxes, coyotes.
- Compare and contrast the wolf and the domestic dog, all breeds of which derived from the wolf. Note differences in behavior, reproduction, social organization, relation to man. Discuss domestication: how and why it occurs. Why did man domesticate dogs? What qualities and characteristics of the wolf have been retained? What eliminated or lost? Discuss ears, tails, snouts, markings (and the importance of these in communication), as well as social behavior. Which should we fear more, a feral dog or a wild wolf? Why? Although there are no confirmed reports of attacks on humans by wild, healthy wolves in North America, most people believe wolves to be dangerous to humans. Discuss the possible causes for this mistake. Would wolves make good pets?

PHYSICAL CHARACTERISTICS

Concepts: dentition, locomotion, senses, adaptation, body language

Activities:

- Before discussing the wolf or viewing the slide program have students draw a wolf. After the slide program and discussion, have them draw a wolf again. Examine the sets of drawings for differences. In an example cited by Barry Lopez in *Of Wolves and Men*, the initial drawings of a group of grade-school children depicted the wolf with enormous fangs. The children then saw a live wolf and discussed it. The children did another drawing. The new drawings had no large fangs. They all had enormous feet.
- Draw a wolf and discuss a wolf's physical characteristics as adaptations to habitat, niche as top predator, and social living.
- *NatureScope's* "Amazing Mammals, Part 1" contains two good activities appropriate here: "Sniffing Out a Trail," which illustrates the importance of a sense of smell and "Layered Wolf" which illustrates a wolf's physical characteristics.



HABITAT

<u>Concepts:</u> components of habitat (food, water, shelter/cover, space), limiting factor, carrying capacity, human impacts on habitat

<u>Activities:</u>

- Discuss habitat and the components of habitat (food, water, shelter/cover, space). As a discussion technique, have children brainstorm what is necessary for wolf (or human) survival, and list these on the board.
- Draw a picture or mural, or create a diorama,depicting good habitat for the Mexican wolf. Tips:

  1. Mexican wolf country includes chaparral-desert scrub, up through grasslands, into spruce-fir woodlands, usually above 4000'. Wolves seemed especially numerous in open ponderosa pine forests and pine/oak foothills. They live where their prey (mainly deer) live.

  2. Captive wolves need two quarts water per wolf per day. Water must be within a reasonable distance of den site.

  3. Wolves prefer large ungulates as prey: white-tailed or mule deer, pronghorn, javelina, bighorn sheep; they also eat smaller vertebrates, such as rabbits or squirrels, when available and when other food is scarce.
  4. Wolves need a large territory in which to find food. The Recovery Plan calls for at least 200 square miles per pack.

  5. Wolf habitat must contain vegetative cover because prey species need it. Good den sites are important for the wolf: under rock ledges, in slopes, under dense brush. Discuss the interconnections between wolf, prey, habitat. What practices might degrade or modify wolf habitat (predator control, road building, development, agriculture, livestock grazing, e.g.)? What happens to wolves when habitat is destroyed or changed? How do habitat loss and decline of wolves affect other animals?
- Use *Project Wild* activities relating to habitat, e.g. "How Many Bears Can Live in this Forest," or "Oh, Deer!"
- Look at a topographical or vegetation map of your state and determine where wolves could live.

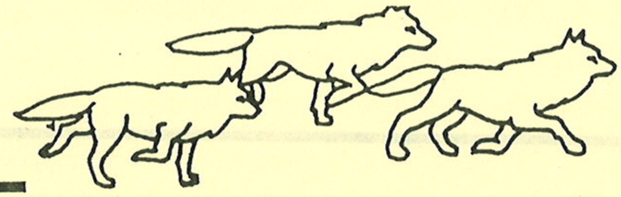
NICHE

<u>Concepts:</u> niche, predation, food web, carnivore, herbivore, omnivore

<u>Activities:</u>

- Discuss the general concept **NICHE** and the specific niche of a wolf: its role as a predator of large ungulates, occupying a certain habitat, active diurnally or nocturnally depending on when prey is most easily caught, etc. Distinguish niche of wolf from that of coyote, mountain lion, grizzly, and other Southwestern predators.
- Discuss predation. Allow children to express feelings about killing and about predators; distinguish predation from violence, cruelty, hatred, etc.; discourage use of the term "enemy." Compare predation to human killing and eating of meat, wolves' teeth to knives, forks, etc. Who really is the underdog considering that prey usually escapes? Why has man eliminated many top predators?
- Discuss the role of predation in the energy cycle and the food web. Make a flannel board display of the components and have children tell the story.
- Play the food web game: The children form a circle, th leader standing inside the circle with a ball of string. Ask one child to name a plant growing in wolf habitat (e.g., grass) and give that child the end of the string. Ask another for the name of an animal that might eat the grass (prairie dog, e.g.) and have that child hold the string. Who might eat the prairie dog? Continue connecting the children with string, bringing in other relationships such as water, soil, etc., as well as food relationships until all children are connected in a symbol of the web of life. To demonstrate the importance of the interrelationships, take away one member of the web (e.g., prairie dogs are poisoned). Have the prairie dog tug on the strings it holds; anyone who feels a tug is in some way affected by the death of the prairie dog. Now everyone who felt a tug from the prairie dog gives a tug. Continue until it is shown that every individual is affected by the death of the prairie dog. Discuss the degrees and kinds of effect.
- Discuss different adaptations of carnivores, herbivores, omnivores (e.g., senses, abilities for either capturing or escaping capture, dentition, digestive systems, reproductive strategies, social organization, etc.). Use wolf and deer as examples.
- Some good predator/prey games are "Quick Frozen Critters" and "Musk Ox Maneuvers" from *Project Wild.*
- Play OBIS' "Food Chain Game," described on th following pages. Apply the lessons learned to the wolf.

FOOD CHAIN GAME



Feeding relationships are often difficult to observe. In this activity, youngsters gain some understanding of these relationships by assuming the roles of animals, playing tag, and simulating feeding relationships. Popcorn is spread over a lawn area. The kernels of popcorn represent plants, which are food sources for the plant eaters. Some youngsters play grasshoppers (plant eaters), some play frogs (which eat grasshoppers), and some play hawks (which eat frogs). The object of the game is for each animal to get something to eat without being eaten before the "day" (five minutes) is over. In nature, the populations of plants and animals are usually large enough to insure continuation of the species if some are lost. In this game, populations (popcorn plants, hoppers, frogs, hawks) are so small, that the survival of **even one** of each kind will be considered an indication of a "balanced," ongoing community. You can repeat this game many times during one activity session. With each repeat, encourage the youngsters to change rules of behavior and numbers of each kind of animal until a "balance" is achieved in your corn-hopper-frog-hawk FOOD CHAIN.

PREPARATION

At least ten youngsters are needed for best results.

Sashes:

Make the sashes from strips of cloth in three different colors. Have enough sashes for 3/4 of the group to be grasshoppers, 1/3 to be frogs, and 1/3 to be hawks. The unbalanced ratio provides the opportunity to change the population numbers in the game. Make the sashes about a meter long and 20 to 30 cm wide. Prepare "stomach" bags. Place a strip of masking tape across the sandwich bag so the bottom edge of the tape is 4 cm from the bottom of the bag. (See ANALYSIS section of ACTION.)

Site Selection:

A section of lawn 15 meters on a side is sufficient. The group may decide to designate potential "home bases" such as trees, a walk, etc., where hoppers and frogs can hide, or be "safe."

SURVIVE AS AN ANIMAL IN A MAKE-BELIEVE FOOD CHAIN BY GETTING ENOUGH TO EAT WHILE AVOIDING BEING EATEN YOURSELF

MATERIALS

For Each Animal:

- sashes about 20 cm x 100 cm (see PREPARATION section for number)
- 1 plastic bag "stomach" (sandwich bag)

For the Group:

- 4-5 liters of popped corn
- 1 data board
- 1 marking pen
- 1 kitchen timer with bell
- 1 roll of 1" masking tape

ACTION

Introducing Food Chains:

Ask the participants if they know what mice eat and what eats mice. "Mice eat seeds and snakes eat mice," they may respond. Diagram the relationship they describe and introduce it as a **food chain**. (Arrows point in the direction that the food goes.)

seed ⟶ mice ⟶ snakes

Ask the kids if they can think of other food chains, including a food chain that contains them.

(over)

Food Chain Game:

1. Describe the limits of the gaming area. Spread popcorn over the area (save a little for later). Tell the group that you are distributing plants that grasshoppers eat.
2. Hand out a plastic bag and a grasshopper sash (all one color) to 1/3 of your group. Tell the kids to put their "food" (popcorn) in their "stomachs" (bags) when the game starts.
3. Hand out a bag and a frog sash to a second 1/3 of the group, and hawk sashes to the last 1/3. When the game starts, frogs will try to capture (tag) hoppers, and the hawks will pursue frogs. When a frog captures a hopper, the hopper's stomach contents are transferred to the stomach of the frog. When the hawk captures a frog, he takes the frog's whole stomach. Hawks do not eat hoppers in this game.
4. State the challenge. Set the timer for five minutes and holler "GO!" The first game usually lasts only a few seconds with one of two things happening. Hoppers are gobbled up and hoppers continue to eat popcorn and get fat.
5. ANALYSIS. How many animals survive? For a hopper to survive, popcorn must fill the stomach bag to the bottom of the tape (4 cm). For a frog to survive, popcorn must fill the stomach bag to the top of the tape (6 1/2 cm). Hawks must have the equivalent of one frog with sufficient food to survive. If at least one of each kind of animal survives, you have an ongoing food chain. Return the corn to the activity area after each game.
6. INSTANT REPLAY. Learn by making rule variations. Ask for suggestions on rules changes that might result in more of a balance after the five-minute day. Usually one rule is changed for each replay. When you have settled on your new rules, play again. Suggest these changes if the kids can't offer any:
   a. Change the number of hoppers and/or frogs and/ or hawks.
   b. Let each hopper come back as another hopper once after being captured and transferring "stomach" contents.
   c. Provide a "safety zone" for frogs and/or hoppers where they can be safe.
   d. Timed releases. Let hoppers go first to forage unmolested. One minute later release the frogs, and later the hawk(s).
   e. Spread out more popcorn.

NOTE: You may want to eliminate bickering over who will be which organism by drawing markers from a hat to assign roles for replays.

FOOD FOR THOUGHT

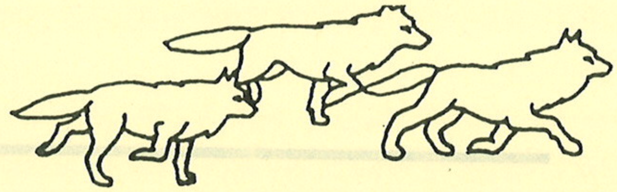
After each game, analyze the results. How many hoppers got a full stomach? How many frogs? The hawks?

Encourage youngsters to compare game results after each rule change, and to comment on how the game "balance" compares with balance in the real world. In nature's balance, there are more plants than plant eaters and more plant eaters than animal eaters. You might wish to graphically represent the results on your data board.

- What would happen if there were only half as many popcorn plants? What would happen to the animal that depends on those plants?
- If there were no frogs, what would happen to the plant population? The hopper population? The hawk population?
- Can you describe some food chains that you are part of?
- Are there any plants or animals that are not part of any food chains?

**This activity from* *Outdoor Biology Instructional Strategies* *developed at the Lawrence Hall of Science, University of California, Berkeley.*

WOLF SOCIETY



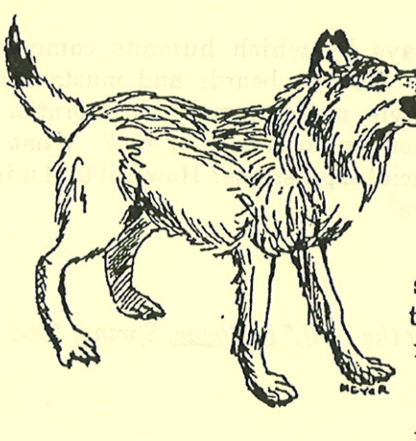
SOLO WOLVES

Consisting mostly of younger animals that have left the pack, "loners" have no social territory and rarely scent-mark or howl. Seeking partnership and vacant territory, these individuals are more prone to death by bullet, trap, malnutrition, or territorial aggression. Sometimes, when natural prey have been exterminated, packs are compelled to disband, loners may become prevalent, and wolves may be forced to subsist on garbage, domestic sheep, goats, and even dogs.

SOCIAL STRUCTURE

The wolf pack is a family unit consisting primarily of a breeding pair and their offspring (pups and juveniles). Couples usually mate for life. Pack size can be as small as two or three or as large as twenty, depending on prey density and size, but is more often between five and eight. Higher numbers are more likely to exist where moose, rather than deer, are the major prey.

Fighting seldom takes place within the wolf pack. Allegiances are motivated more by harmony and integration with pack members than by aggression and conflict. A functional hierarchy, consisting of dominants and subordinates, maintains order within the pack. Roles are expressed and reinforced through occasional threats (fixed stares, raised ears, wrinkled brows, growls, bared teeth), signs of submission (lowered head and tail, flattened ears, rollover), and subordinate affection (pup-like mouth nuzzle, face licks).



The dominance hierarchy exists for each of the sexes (excluding pups), the female hierarchy being more linear and aggressive. There is a sizeable gap between the **alpha** (highest ranking) and lower ranks of each sex, particularly during breeding season. This discourages and blocks subordinate mating and provides a valuable strategy to avoid too many pups in the pack.

The social bonds between wolves are very strong, closely resembling bonds between dogs and their human companions in both degree and expression. The existence of this strong bonding system suggests why the dog is so easily domesticated.

Wolves commonly share food with pups and other adults by carrying parts of a kill home, leading others to a kill site, or regurgitation (especially with pup feeding). Such sharing among adult members of a group is rare among animals and, within the primate order, occurs only among our own species. Significantly, wolf pups raised without a pack structure adapt very poorly to life in the wild.

RANGE AND TERRITORY

A typical wolf pack has a range averaging 10 square miles per adult wolf, but range size for a given pack might be anywhere between 50 and 5,000 miles, depending upon many environmental factors, particularly prey density. It is common for wolves to be moving 8-10 hours in a day and covering distances from 30 to 125 miles. Wolf territory (the area defended and occupied more or less exclusively by the group) is part of a dynamic process, rather elastic and in many cases overlapping neighboring ranges. It tends to be more stable and year-round for the forest dwellers, while tundra wolves are more nomadic, attending to the migratory habits of their prey.

(over)

COMMUNICATIONS

Active and diverse communications take place both between and within wolf societies. Inter-pack communication occurs chiefly by way of scent-marking (urine, feces, scratching) and howling, and is largely employed as a means to assert pack presence and maintain territory. While intruders may be attacked most aggressively, direct encounters are rare, thanks to the distance afforded by the nature of these visual and olfactory messages.

Intra-pack communications are both elaborate and varied. Being such complex social animals, wolves express highly-developed behavior patterns and means of conveying complicated messages through audible, tactile, and visual means. Audible signals occur through vocalizations such as howls, barks, whimpers and growls. Visual messages may be conveyed through body posture, movement and facial expression. Body rubbing and rolling and ritualized displays involving urine and excrement combine with various forms of glandular emissions (e.g. tail, paw, anus, mouth) to provide an olfactory medium as well.

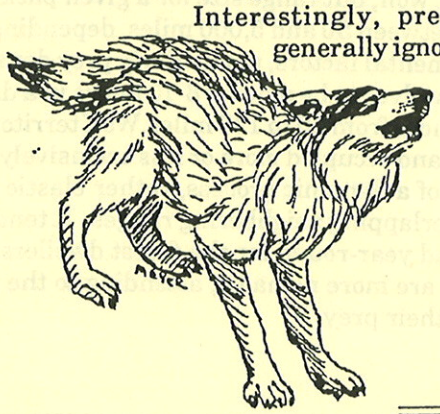
Pack members communicate such emotions as friendliness, excitement, threat, fear, submission, affection, and mood. While the growing wolf can innately produce these forms of communication, he/she must learn what they mean and when to use them.

HOWLING

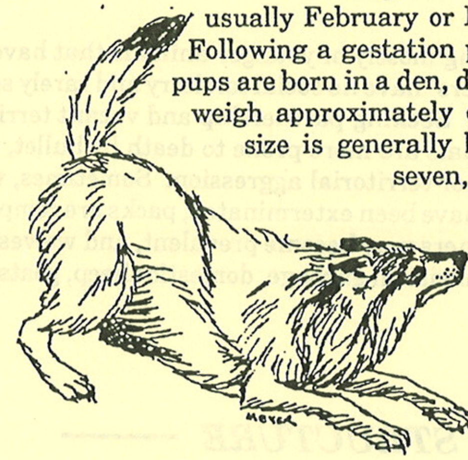
Howling seems to provide a number of functions for the wolf:

— keeping track of wolves within the pack
— keeping track of wolves between packs
— assembling pack members
— demarcation of territory
— announcing or defending a fresh kill
— unification (a group howl)

Interestingly, prey species seem to generally ignore wolf vocalizations.



BREEDING



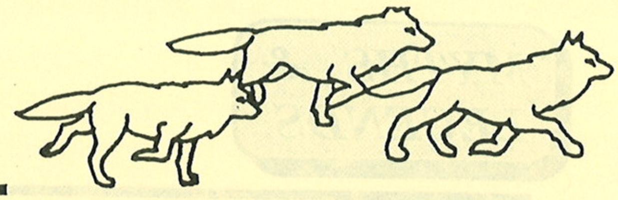
Breeding occurs in late winter, usually February or March, each year. Following a gestation period of 63 days, pups are born in a den, deaf and blind, and weigh approximately one pound. Litter size is generally between four and seven, but can range from one to fourteen, depending on the fitness of the parents and nutritional circumstances.

Pups are able to hear in a few days following birth and open their eyes in 11-15 days. Within two weeks the pups are walking and, a week later, playing at the den entrance. In a month's time they emerge from the den, are able to howl, and even begin to establish levels of dominance among themselves. In three to five months the juveniles are traveling with the pack and are hunting soon thereafter. Pup mortality the first year is greater than 50%, resulting from injury, predation or disease.

Pups receive cooperative care from pack members, the parents being particularly attentive. Following a few weeks of milk, the pups are eating meat, provided at first by the father and other pack members. By the next breeding season some of the young will leave the pack ("disperse"), while others will remain ("biders"). Sexual maturity comes by 22 months of age, although mates are sometimes selected in the first year.

- Consider ways by which humans communicate nonverbally. How do beards and mustaches, hair length and style, make-up and hair coloration affect communication, intentionally or not? What do we sense from facial expressions? How is it that mime can be so effective?

From "Looking at the Wolf," Biologue, Spring, 1986. Teton Science School.



THE PACK

Concepts: social organization, social dominance, hierarchy, dominant, subordinate, pack, alpha wolf

Activities:
A good way to put the wolf in a positive light is to discuss the wolf's sociability and the qualities that make it a social animal (for example, intelligence, loyalty, friendliness). Discussion of ways in which wolves are like humans is also a positive approach.

- Research the social structure of a wolf pack; use "The Wolf Society" as a start. Discuss the composition of a wolf pack: generally a breeding pair and their young of various ages. Compare to a human family: Who is dominant? Who is subordinate? How are positions of authority maintained? What are the roles of members? Who cares for the young and how? What do family members do together?
- Discuss any negative connotations associated with the term **pack**. Compare wolf packs to packs of feral dogs which have no social structure or bonds of attachment, are without monogamous relationships between a breeding pair, have no fear of humans.
- Write a first-person narration of a day in the life of a Mexican wolf, trying to think and experience as a wolf, rather than as a human.

COMMUNICATION

Concepts: communication, body language

To maintain their highly developed social organization, wolves rely on communication through smell, sound, facial expression, and body posture. Although humans may not be able to perceive many facets of wolf communication, careful observation teaches us much about wolves, related animals, and ourselves. It's estimated that 80% of human communication is transmitted via body language, though we seldom acknowledge this mode of expression.

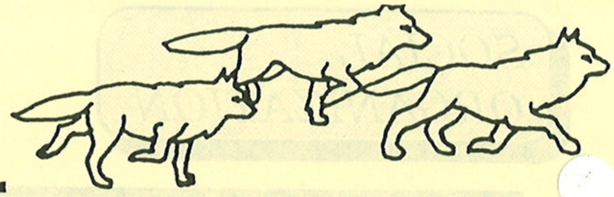
Activities:

- Examine the drawings of wolf facial expressions and tail postures and their interpretations which are included in this packet. Note how the wolf's color patterns heighten the expressive areas of face and body: mask-like appearance, dark circles around the eyes, light areas, eye brows, black lips, dark rims around ears, light underbody, dark tip of tail, dark hackles and back markings.
- Discuss how humans communicate using facial expression and body language. What do the following expressions communicate to us: smile, wink, stare, frown, wrinkled brow? Act out in mime: sadness, happiness, fear, excitement, threat, relaxation.
- Students can form a pack and choose a role and rank for each to portray, using wolf communication.
- Students can observe the behavior of pet dogs and watch for facial and body language. They can take pictures of dominant, submissive, friendly, aggressive, fearful behavior and bring these to class to discuss. Note how human breeding or doctoring of dogs has reduced possibilities for communication by reducing color patterns and fur length, or by altering size and shape of ears and tails.
- The "Wolves and Humans, Teachers Materials" packet from the Minnesota Science Museum contains a good discussion of wolf communication.
- Members of the dog family have a remarkable ability to smell, to discriminate among smells, and to remember odors. Discuss the physical basis for this, using this demonstration taken from *ZooBooks*, "Wild Dogs."

  A dog's nose can smell things that your nose can't. Like your nose, the inside of a dog's nose contains moist surfaces that "catch" smells in the air. The wild dog's nose has about 5 times more surface area than yours does. So it can catch more smells from the air than you can. The nose itself is not 5 times larger than a human nose. For all the extra smelling surface to fit inside, it must be wrapped and folded many times.

  SEE FOR YOURSELF how so much smelling surface can fit into a dog's nose. Cut out two pieces of paper, one about 5 times bigger than the other.
  1. Fold the smaller piece 3 times. This is like the surface area inside a human's nose.
  2. Now fold the larger piece about 10 times. This is like the surface area inside a dog's nose.
- Play "Sniffing Out a Trail" from *NatureScope's* "Amazing Mammals, Part 1."

MYTHS & LEGENDS



Folklore is an expression of a culture's deepest feelings, including the way in which people relate to the natural world. It appears throughout history that the closer human culture has been to the life patterns of the wolf, the more respected the animal has been. Thus, when humans were hunters, they admired the wolf. This attitude still exists today among many Native American cultures which value harmony with the earth. However, among humans who have become city dwellers, ranchers or farmers, the wolf has been perceived as a threat to human life and property.

Mention of the word **wolf** elicits from people a variety of feelings from love and admiration to hate and fear. These emotions have been instilled in humans through myths and folklore. It is, therefore, important to examine these myths and feelings and compare them to the biological facts of the wolf.

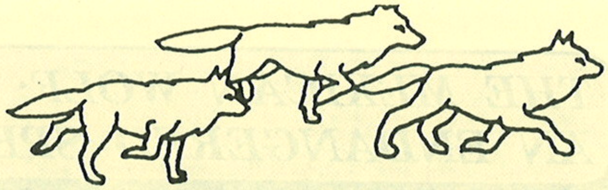
<u>Concepts</u>: fact, fiction

<u>Activities</u>:

- Read and compare two tales which illustrate different cultural feelings about the wolf. Two examples are included, "The Man Whom the Wolves Helped," and "A German Folktale."
- Read children's stories about wolves and discuss whether the wolf depicted is "real" or "make believe" and how one can tell. *Project Wild's* "And the Wolf Wore Shoes" is a related activity.
- Individually or in groups, rewrite one of the "big, bad wolf" stories, such as "Little Red Riding Hood," so that it reflects a wolf's point-of-view and a more accurate picture of the wolf. Or create a play or puppet show.
- Show pictures of wolves engaged in some sort of activity. Imagine what happened before, during, and after the picture was taken.
- Do "First Impressions" from *Project Wild.*
- Discuss the wolf's negative image - in stories, in common speech, in our imagination. How did the wolf acq[illegible] this image? Is it deserved? Barry Lopez, *Of Wolves* [illegible] *Men*, is helpful here.
- To counteract the wolf's negative image, and to illustrate that much of what we say about the wolf is really true of us, draw up a list of characteristics which may or may not be shared by wolves and humans. As a start:

<u>Traits</u>	<u>Wolves</u>	<u>Humans</u>
They communicate with signs	____	____
They live in families	____	____
Individuals share with others	____	____
They kill wolves and humans	____	____

WOLF TALES



These stories show two different images of the wolf, from two different cultures. In "The Man Whom the Wolves Helped," from the Tahltan of the Canadian Rockies, the wolf is a helper and teacher. The German tale, on the other hand, portrays the wolf as foolish.

THE MAN WHOM THE WOLVES HELPED

An old man called XE'nda, and many people, were hunting caribou but they could not kill any. They were starving, and became weak. XE'nda went hunting one day, although he could hardly walk. He came on a long trail of fresh caribou-tracks, and followed it. After awhile he came to where a number of snowshoe-tracks followed behind the caribou, then on another and another. He thought some of the people had killed them. He pressed on, and soon heard talking, and then saw a number of strange people beside some dead caribou. They called out in the Kaska language, "A man is coming!" and then invited him to come nearer. He asked them who had killed the game. They answered that they had. They lighted a fire, and cooked and ate the two caribou there. They said to XE'nda, "Your snowshoes are too narrow. You cannot run fast with them, and the caribou-skins. If you use snowshoes like those we have, you will be able to travel better and get game." They showed their snowshoes to XE'nda, and further told him he could have all the caribou they had killed. XE'nda thought he must have slept; and when he woke up, the fire was out, and two caribou-skins were lying there. He looked for tracks, and saw only wolf-tracks. He returned to camp, and on the way came to the caribou-carcasses he had first seen. He cut out some meat and took it along. He told the people that he had killed caribou, and the people went out at once to carry in the meat. When they got to the carcasses, they saw that the caribou had been killed by wolves, and they knew that the wolves had helped XE'nda. *After this, the people made snowshoes like those the wolves had shown to XE'nda, and they obtained more game.* In this way did the Tahltan learn how to make the shovel-nosed snowshoes they now use; and *this is why snowshoes of this kind are called "wolf snowshoes."*

—Teit, James A. "Tahltan Tales." Journal of American Folklore, Vol. 32, p. 250.

A GERMAN FOLKTALE

The wolf was ravenously hungry. In the forest there was nothing left for him to catch, and so he had to attack the villages in order to appease his hunger.

Getting near the village, he met the fox and said to him, "Tell me, fox, how can I get something to eat? I am starving. You know this place. If you don't tell me, I will tear you to pieces."

The fox replied, "Be quiet. I shall get enough food for you. There is a beekeeper who has four big pots full of honey in the cellar. As soon as he goes to bed we can go there." After a while, the fox said, "Now we can start. Follow me. He has gone to sleep." They went along the hedge to the house of the beekeeper, and the fox said, "Here is the vent of the cellar. There is nobody around. You need not be afraid." The fox crept inside, and the wolf followed.

In the cellar, the fox said, "Here are four pots. The first one is for me—I have already had half of it. The second one is for you." The wolf fell to his pot, and the fox went to his. When the fox had enough, he went to the vent to see if he could still squeeze through. He could, and so he went back to eat. Then he tried a second time.

The wolf said, "Where are you going all the time?"

The fox replied, "I'11 just go to see whether the road is clear. You just go on eating."

That seemed all right to the wolf. The fox went for the third time. But the beekeeper was not sleeping any longer. The fox went to tell him that the wolf was in the cellar eating the honey. He advised him to take a club in order to kill the wolf. The beekeeper got a stick, went to the cellar, and fell upon the wolf. The wolf tried to get out through the vent, but he was too fat and could not get through. He managed to get his head and front leg out, but not his body. The beekeeper gave him a sound beating. In his great distress, the wolf finally freed himself.

The fox waited behind the hedge in order to find out if the wolf would come back.

"Now I am going to tear you to pieces!" the wolf shouted. "You have betrayed me. It is your fault that I was beaten."

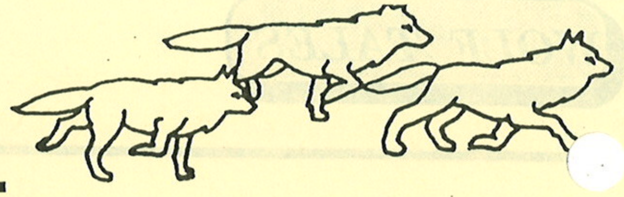
The fox justified himself as well as he could by saying, "I had to run myself. I had no time to warn you."

But the wolf was very cross. "You are a liar, and I am going to kill you."

Now the fox was in a corner and said, "You can, of course, kill me, for you are stronger than I; but I am innocent. If you kill me, you will have to be ashamed in the presence of the other animals."

—Baumann, Lotte, translator, Folktales of Germany. University of Chicago Press, 1966.

THE MEXICAN WOLF: AN ENDANGERED SPECIES



To the Native Americans and the early Spanish and Anglo settlers in the Southwest, the howl of "el lobo" was a familiar sound. The Native Americans loved the wild sound for they respected the wolves for their ability as great hunters. Native Americans used wolf pelts as a disguise to enable them to creep close to the buffalo for a good shot. They knew that the buffalo did not fear wolves unless they were guarding young or were vulnerable because of injury or illness.

Gray wolves (*Canis lupus*) originally roamed most of North America, with over 24 subspecies in all. The Mexican wolf, one of the subspecies (*Canis lupus baileyi*), originally ranged over forested areas above 4000' in New Mexico, Arizona, West Texas and northern Mexico. The size of the historic Mexican wolf population is not known, but Mexican wolves probably never were as numerous as their northern and eastern relatives because the arid Southwestern environment supported fewer prey.

The decline of the Mexican wolf and its eventual extermination were not accidental. The arrival of cattle ranchers in the Southwest in the late 1870's and 1880's began a war against large predators. Large numbers of livestock on the open range provided a readily available food supply for wolves. Increased human hunting of the wolves' natural prey encouraged a switch to livestock as a food source. Wolf population numbers increased temporarily, and predation became a problem.

By the 1890's, the wolf was considered a pest by the ranching community. In 1893, the Arizona-New Mexico territorial Legislature passed the first of many predator control bills. This Territorial Bounty Act provided a bounty for predators like the wolf. In the early 1900's, the U.S. Government, through its Department of Biological Survey (later the U.S. Fish and Wildlife Service), actively pursued the wolf, using traps, guns, and poison. By the late 1920's, the Mexican wolf was effectively gone from the wilds of the Southwest and breeding populations survived only in Mexico. Meanwhile, Mexico also persecuted the wolf; beginning in the 1950's, Compound 1080 was especially effective in reducing wolf numbers. This extermination process was officially stopped in 1976, when the Mexican wolf was classified as endangered in the United States. The U.S. and Mexico signed a Mexican Wolf Recovery Plan in 1982.

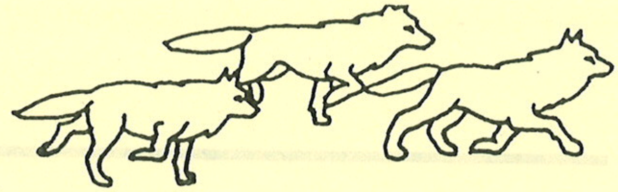
Today there are only a few Mexican wolves living free in the Sierra Madres of Mexico; there is a population of zoo animals in the United States. The Recovery Plan calls for maintaining Mexican wolves—in captivity, if necessary, but preferably in the wild through a reintroduction program.

If Mexican wolves are released, the release would be carefully controlled. Only a few pairs would be released, in very remote areas where there are few, or no, livestock or people. Released wolves would be carefully monitored. Livestock operators would be consulted in planning the reintroduction, and measures would be taken to protect their interests.

<u>Activities</u>:

- The Mexican wolf can be used to focus a discussion on endangered species: what are they, why are they endangered, what are our responsibilities toward them, what actions can be taken, what problems or controversies surround these actions? *NatureScope's* "Endangered Species" book is especially valuable. Highly recommended are the activities "Get the Connection," in which children examine their feelings about different species and discuss which ones they think it's important to protect, and "The Rare Scene," in which students discover what characteristics make an animal prone to extinction.
- The Mexican wolf was deliberately exterminat Obstacles to its recovery are political and emotional, not biological. To understand the controversy surrounding the wolf, students can take the parts of those involved: the livestock operator, the federal or state wildlife biologist, the wolf supporter, the governor of a Southwestern state, the U.S. Fish and Wildlife Service director, the Secretary of the Interior and effected U.S. Senators and Representatives. Have students role play a decision on reintroduction of wolves in a site in your state.
- Discuss our responsibility to an endangered species. Are there any circumstances under which we should let a species go extinct or maintain it only in captivity? What are we willing to pay in terms of money, sacrifices, changes in behavior, in order to protect or restore endangered species, specifically the wolf?
- Discuss the pros and cons of restoring the wolf to the wild vs. maintaining it in captivity.
- Study the lives of people who have made a difference in protecting endangered species.
- Visit a zoo which has the Mexican wolf or another endangered species and find out what is being done to protect it.
- Invite a wildlife biologist, conservationist, or government official to talk to the class about the Mex wolf.

VOCABULARY



ADAPTATION. Modification of an organism in structure or function in adjusting to a new condition or environment.

AGGRESSION. An offensive action or procedure.

ALPHA WOLF. The highest ranking individual within the dominance hierarchy. There is usually an alpha male and an alpha female, each the highest ranking male and female and usually the parents of the rest of the pack.

BODY LANGUAGE. The use of posture, gesture, facial expression to communicate meaning.

CANINE TOOTH. A sharp, pointed tooth lying lateral to the incisors, especially prominent in canines; "fang."

CAPTIVITY. The state of being confined and held under control.

CARNIVORE. An animal that eats fresh meat.

CARRYING CAPACITY. The total number of any species that a given area of habitat will support at any given time without causing deterioration.

CLASSIFICATION. Taxonomy; the systematic arrangement of animals and plants into groups or categories based on characteristics common to a group, especially those due to relationship and common descent. The categories or taxa in common use, from the largest and most inclusive to the smallest and most limited, are: kingdom, phylum, class, order, family, genus, species.

COMMUNICATION. An exchange of information through a common system of symbols.

DOMESTICATED. Referring to animals, those which humans have tamed, kept in captivity, and bred for special purposes. All domesticated animals have their origins in wild ancestors.

DOMINANCE (SOCIAL DOMINANCE). A hierarchial pattern of social organization involving domination of some members of a groups by other members in a relatively orderly and long-lasting pattern.

DOMINANT. Commanding, controlling, or prevailing over others.

ENDANGERED SPECIES. A species that is in danger of extinction throughout all or a significant portion of its range.

EXTINCTION. The condition of having been removed from existence. An extinct species has vanished from our world forever.

FOOD CHAIN. The transfer of food energy from the source in plants through a series of animals, with repeated eating and being eaten.

FOOD WEB. An interlocking pattern of food chains.

HABITAT. The place or type of site where a plant or animal naturally or normally lives and grows; the arrangement of food, water, shelter or cover, and space suitable to animals' needs.

HERBIVORE. A plant eater.

HIERARCHY. In general, a system of two or more levels of units, the higher levels control- ling to some degree the extent of the activities of the lower levels in order to in the group as a whole.

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INCISOR. A cutting tooth in the front of an animal's jaw.

LIMITING FACTOR. The critical factor in shortest supply in an environment which limits the growth or some other activity of an organism or population (e.g., in a desert, the limiting factor is often moisture).

LITTER. All of the babies born at the same time to an animal.

MAMMAL. Any vertebrate of the class Mammalia, characterized by possession of hair and mammary glands. They are air-breathing, possessing lungs, have a four-chambered heart and are warm blooded or endothermic. With a few exceptions, all bear live young.

MOLAR. A tooth with a rounded or flattened surface adapted for grinding.

NICHE (ECOLOGICAL NICHE). A description of the roles and associations of a particular species in the community of which it is a part.

OMNIVORE. An animal which eats both plant and animal materials.

PACK. A group of wolves with social attachments to each other; usually a mated pair and their offspring from various years.

PREDATION. The act of capturing and killing other animals for food.

PREDATOR. An animal that kills and eats other animals.

PREMOLAR. Tooth of mammal in front of the true molars and behind the canines when present.

PREY. Animals that are killed and eaten by other animals.

SPECIES. A population of individuals that are more or less alike, and that are able to breed and produce fertile offspring under natural conditions; a category of biological classification immediately below the genus.

SUBMISSION. Yielding or giving in to the authority of another.

SUBORDINATE. One that is inferior to or controlled by another.

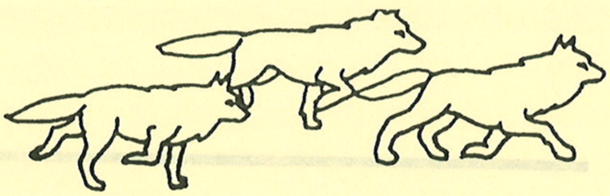
SUBSPECIES. A subdivision of a species consisting of a group of individuals, usually a geographical race, which differs slightly from other groups (subspecies) of the same species but between which interbreeding is possible.

THREATENED SPECIES. A species that is likely to become endangered.

VERTEBRATE. An animal with a spinal column.

WILD. Not tamed or domesticated; living in a basically free condition. A wild animal provides its own food, shelter, and other needs in an environment that serves as a suitable habitat.

RESOURCES



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EDUCATIONAL ACTIVITIES AND MATERIALS

"Amazing Mammals, Part I" and "Endangered Species." *Nature Scope.* National Wildlife Federation (1412 16th Street NW, Washington, DC 20036-2266).

"Audubon Adventures," December 1987. National Audubon Society (613 Riversville Road, Greenwich, CT. 06830).

"Looking at the Wolf." *Biologue,* Spring 1986. Teton Science School (P.O. Box 86, Kelly, WY 83011).

OBIS (Outdoor Biology Instructional Strategies). Lawrence Hall of Science, University of California (Berkeley, CA 94720).

Project Wild. (Don MacCarter, Project Wild Coordinator, New Mexico Department of Game and Fish, State Capitol, Santa Fe, NM 87503; Kerry Baldwin, Education Branch Supervisor, Arizona Department of Game and Fish, 2222 W. Greenway Rd., Phoenix, AZ 85023).

"Puppy Paws." Wild Canid Survival and Research Center (P.O. Box 760, Eureka, MO 63025).

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"Wild Dogs" and "Wolves." *ZooBooks* (P.O. Box 85271, Suite 6, San Diego, CA 92138).

Wolf-Pac. 1989. Yellowstone Association for Natural Science, History and Education (P.O. Box 117, Yellowstone National Park, WY 82190).

Wolves and Humans, Teachers Materials. Minnesota Science Museum (30 East 10th Street, St. Paul, MN 55101).

ORGANIZATIONS

Arizona Department of Game and Fish
2222 W. Greenway Road
Phoenix, AZ 85023
602-942-3000

Arizona-Sonora Desert Museum
2021 N. Kinney Road
Tucson, AZ 85743
602-883-1380

Mexican Wolf Coalition
207 San Pedro NE
Albuquerque, NM 87108
505-265-5506

National Audubon Society
P.O. Box 9314
Santa Fe, NM 87504
505-983-4609

New Mexico Department of Game and Fish
State Capitol
Santa Fe, NM 87503
505-827-7882

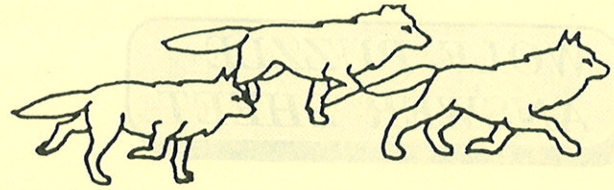
Preserve Arizona's Wolves (P.A.W.S.)
1413 E. Dobbins Road
Phoenix, AZ 85040

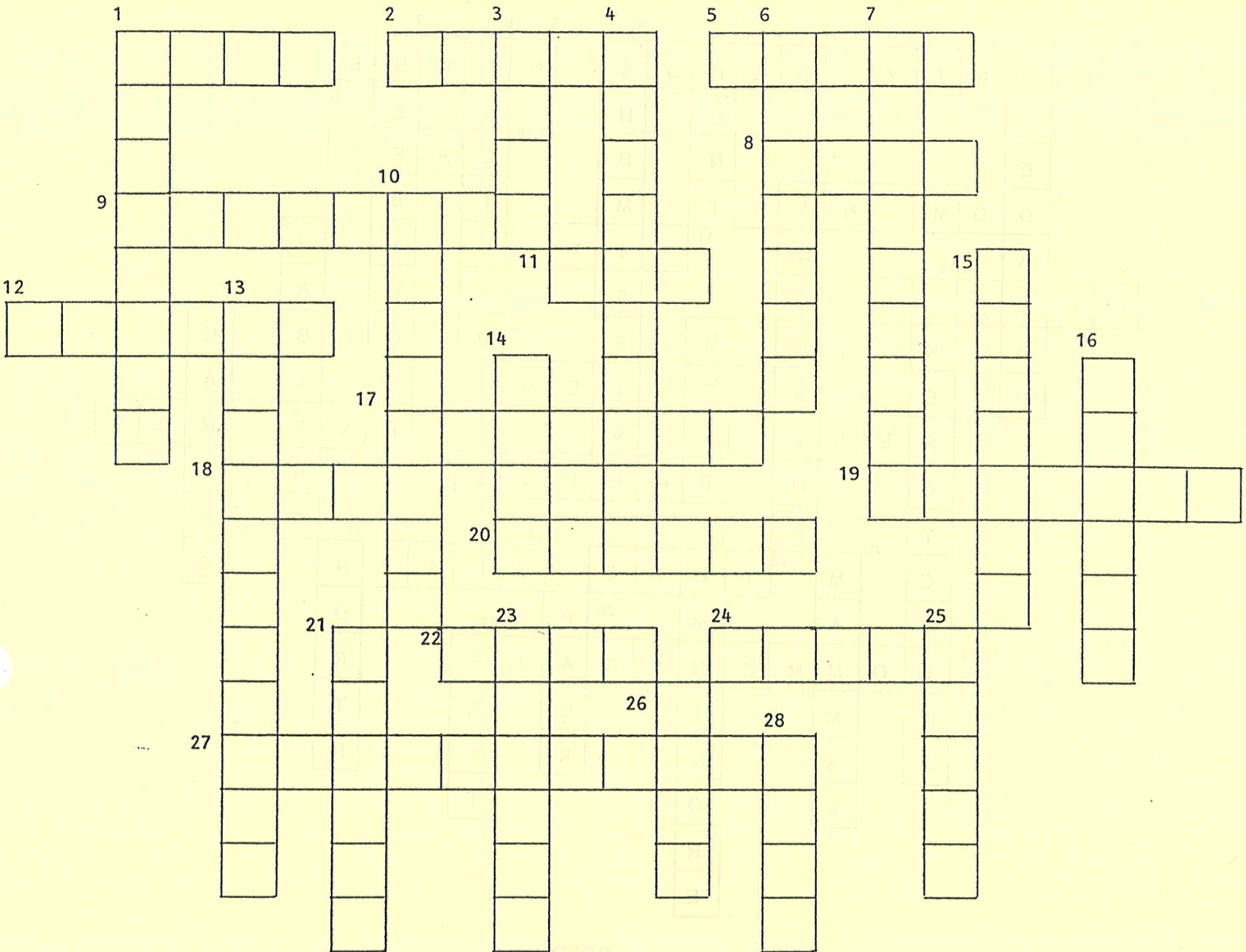
Rio Grande Zoological park
903 10th Street SW
Albuquerque, NM 87102
505-843-7413

U.S. Fish and Wildlife Service, Region 2
Endangered Species Office
500 Gold Avenue SW
Albuquerque, NM 87103
505-766-2324

Wild Canid Survival and Research Center
P.O. Box 760
Eureka, MO 63025
314-938-5900

WOLF PUZZLE





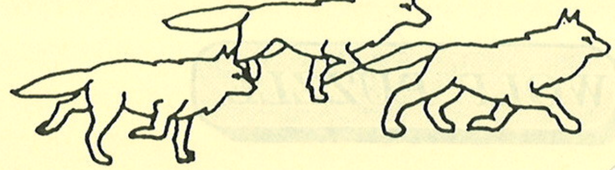
ACROSS:

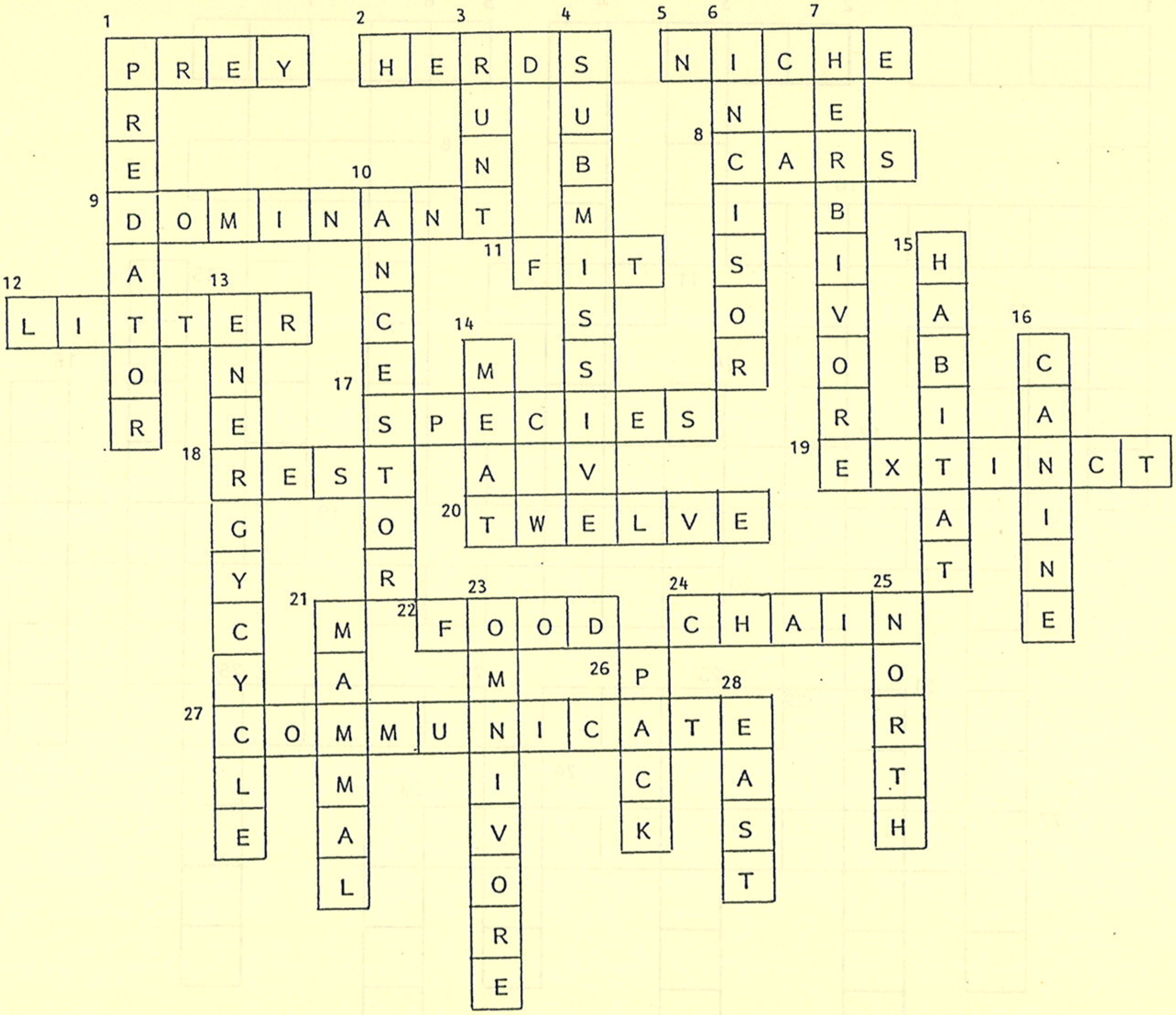
1. Animal hunted and eaten by other animals
2. Groups of grazing (or browzing) animals
5. The role or "job" of an animal
8. Machines which frequently kill wildlife
9. The "top" or "lead" animal in a group
11. To survive, animals must ____ into their environment
12. A group of babies born at the same time
17. A group of animals or plants which are very much like one another and can interbreed
18. After hunting and eating wolves usually _____ .
19. There are so few Mexican wolves, they are almost _____ .
20. A dozen wolves
22. The energy cycle can also be a (22) ____
24. (24) ____
27. Wolves use their bodies and voices to _____ with each other

DOWN:

1. Animal which hunts and kills for its food
3. Smallest animal in a litter
4. Animal which is not dominant
6. Small front tooth
7. A plant eating animal
10. Relative who lived in the past
13. Plants, soil, sun and animals are all parts of the (2 words)
14. Carnivores eat _______ .
15. The place where an animal lives
16. Large pointed tooth, "fang"
21. An animal which has fur; bears warm-blooded, live young and nurses them on milk
23. An animal which eats both plant & animal food
25. Several species of wolves were common in ____ America
26. A closely related group of wolves
28. The red wolf is found _____ of the Mississippi

WOLF PUZZLE ANSWER SHEET





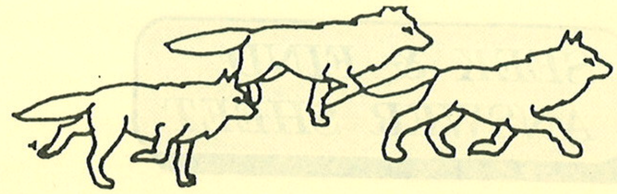
ACROSS:

1. Animal hunted and eaten by other animals **prey**
2. Groups of grazing (or browsing) animals **herds**
5. The role or "job" of an animal **niche**
8. Machines which frequently kill wildlife **cars**
9. The "top" or "lead" animal in a group **dominant**
11. To survive, animals must **fit** into their environment
12. A group of babies **litter**
17. A group of animals or plants which are very much like one another **species**
18. After hunting and eating wolves usually **rest**
19. The Mexican gray wolf is almost **extinct**
20. A dozen wolves **twelve**
22. The energy cycle can also be a (22) **food** (24) **chain**
27. Wolves use their bodies and voices to **communicate** with each other

DOWN:

1. Animal which hunts and kills for its food **predator**
3. Smallest animal in a litter **runt**
4. Animal which is not dominant **submissive**
6. Small front tooth **incisor**
7. A plant eating animal **herbivore**
10. Relative who lived in the past **ancestor**
13. Plants, soil, sun & animals are all parts of the **energy cycle**
14. Carnivores eat **meat**
15. The place where an animal lives **habitat**
16. Large pointed tooth, "fang" **canine**
21. An animal which has fur, bears warm-blooded live young and nurses them on milk **mammal**
23. An animal which eats both plant and animal food **omnivore**
25. Several species of wolves were common in **North** America
26. A closely related group of wolves **pack**
28. The red wolf is found **east** of the Mississippi

SEEK & FIND

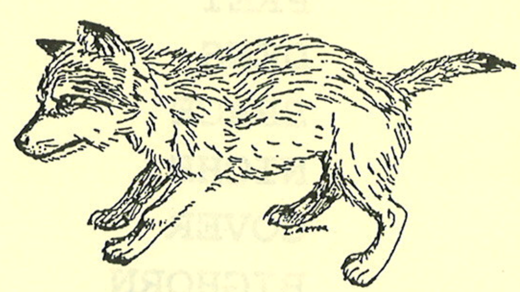


WHAT DO WOLVES NEED IN THEIR HABITAT?

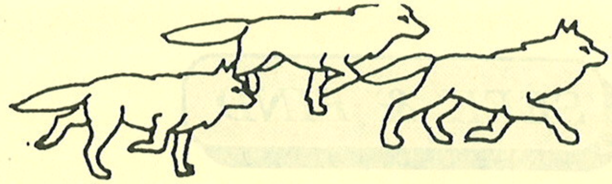
Fill in the blanks. Then find the words in the puzzle on the bottom of the page.

1.	Herbivores which have antlers.	_ _ _ R
2.	These are not really antelope.	P _ ON _ H _ _ N
3.	This animal looks like a pig.	_ A _ _ L _ NA
4.	Large curving horns help identify this herbivore.	_ _ G _ OR _
5.	The opposite of predator.	_ _ E _
6.	Animals need both of these to survive.	F _ _ D, _ AT _ R
7.	Pups are raised in these.	_ E _ S
8.	This gives protection from the weather.	_ HE _ T _ R
9.	All habitats should have enough	_ P _ C _
10.	Higher places where wolves might be found.	_ O _ _ T _ _ NS
11.	The "job" or role of an animal.	_ I _ H _
12.	A hunter.	_ R _ D _ T _ R
13.	This could help animals hide.	_ OV _ _
14.	This animal is usually prey.	_ E _ _ IV _ _ E
15.	A meat eater.	_ AR _ _ _ OR _
16.	A plant and meat eater.	O _ NI _ O _ E

V	D	H	I	H	Q	Y	M	X	G	B	P	R	V	A	D	X	H
K	X	J	A	V	E	L	I	N	A	S	R	R	J	E	Y	Y	S
S	W	X	Y	P	A	M	W	J	P	H	E	W	G	X	O	B	W
P	R	E	J	H	R	O	M	R	J	E	V	E	Y	D	P	B	K
W	R	C	V	O	A	V	E	V	C	L	O	K	S	R	T	B	E
P	H	T	P	K	S	D	U	A	T	T	C	H	J	K	P	I	D
N	T	A	V	M	A	N	R	W	Z	E	E	E	H	C	P	G	W
Y	N	O	N	T	X	N	I	D	L	R	H	N	H	B	S	H	E
S	K	F	O	R	I	C	J	A	B	N	R	B	N	C	A	0	N
E	I	R	O	V	Y	B	E	I	T	O	C	O	F	T	I	R	X
E	C	P	O	O	X	S	V	S	H	N	W	H	F	D	E	N	S
R	T	R	F	X	D	O	P	G	I	F	U	F	R	H	D	N	Q
O	E	H	S	U	R	W	N	A	V	D	S	O	G	H	S	R	J
V	I	D	P	E	K	O	A	D	C	E	B	V	M	Y	J	J	G
I	X	P	F	U	R	T	D	T	T	E	L	K	H	F	H	I	P
N	Z	L	J	P	J	L	N	D	E	R	R	S	P	R	W	G	K
M	D	I	N	I	X	S	N	H	O	R	L	O	X	H	Y	K	Q
O	B	J	V	N	U	P	T	Q	D	G	F	H	U	S	V	S	E



SEEK & FIND ANSWER SHEET



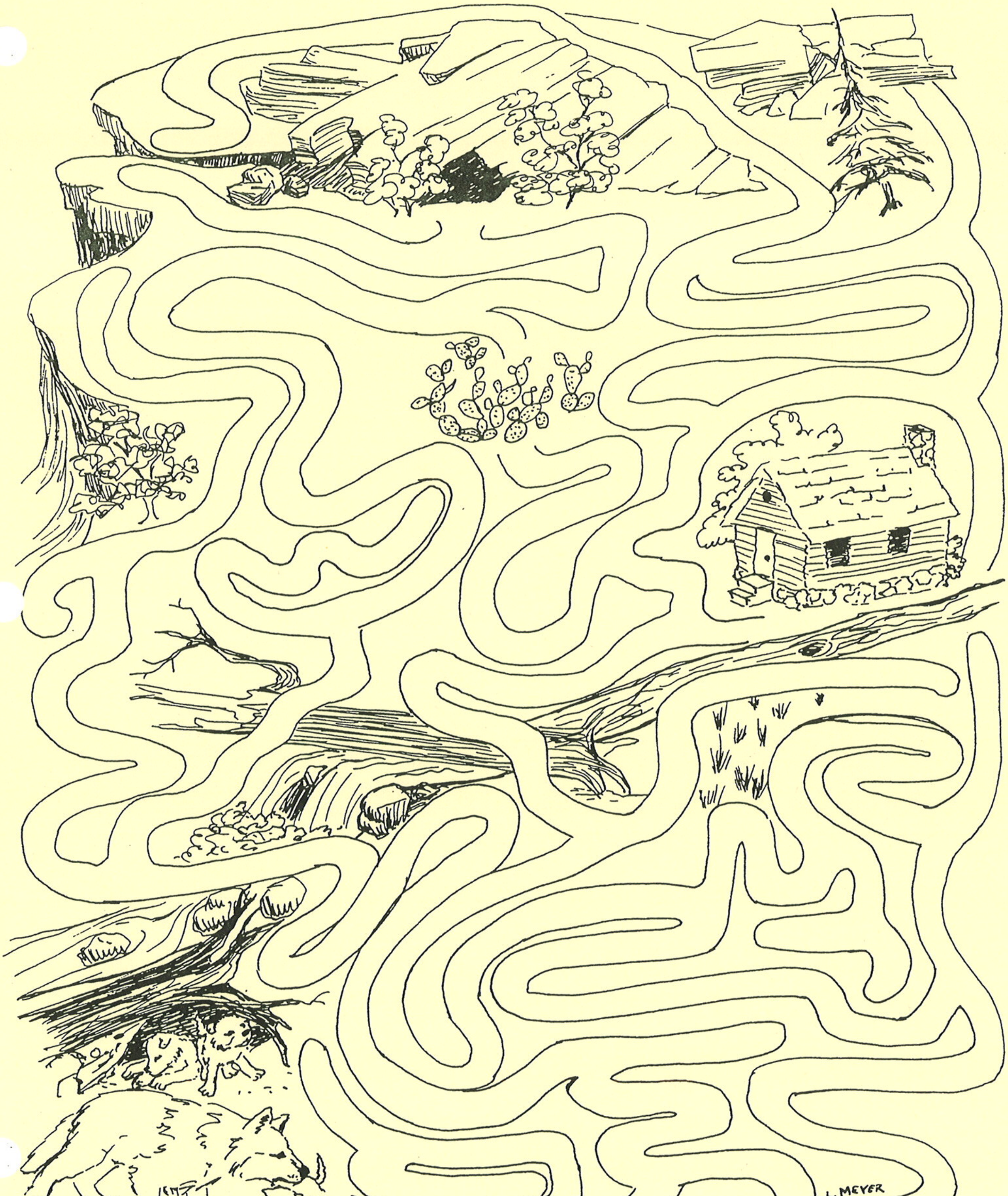
. . J A V E L I N A S R . . . . . .
. . . Y . . . . . P H E . . . . . .
. . E . . . . . R . E V . . . . . .
. R . . . . . E . C L O . . . . B .
P . . . . S D . A . T C H . . . I .
. . . . . A N R . . E E E . . . G .
. . . . T . N I . . R . N H . . H .
. . F O . I . . A B . R . . C . O .
. . R O V . . . I T O . . . . I R .
E . . O O . S V . H N . . . D E N S
R . R . . D O P G . . U . . . . . .
O E . . . R W N A . D . O . . . . .
V . . . E . O A . C E . . M . . . .
I . . . . R . . T . E . . . .
N . . . P . . . . E R . . . .
M . . . . R . . . .
O . . . .

DEER
PREY
DENS
SPACE
NICHE
COVER
BIGHORN
SHELTER

JAVELINA
OMNIVORE
PREDATOR
PRONGHORN
FOOD/WATER
MOUNTAINS
CARNIVORE
HERBIVORE

What has caught the wolves interest?
Follow the dots from 1 to 48 to see.

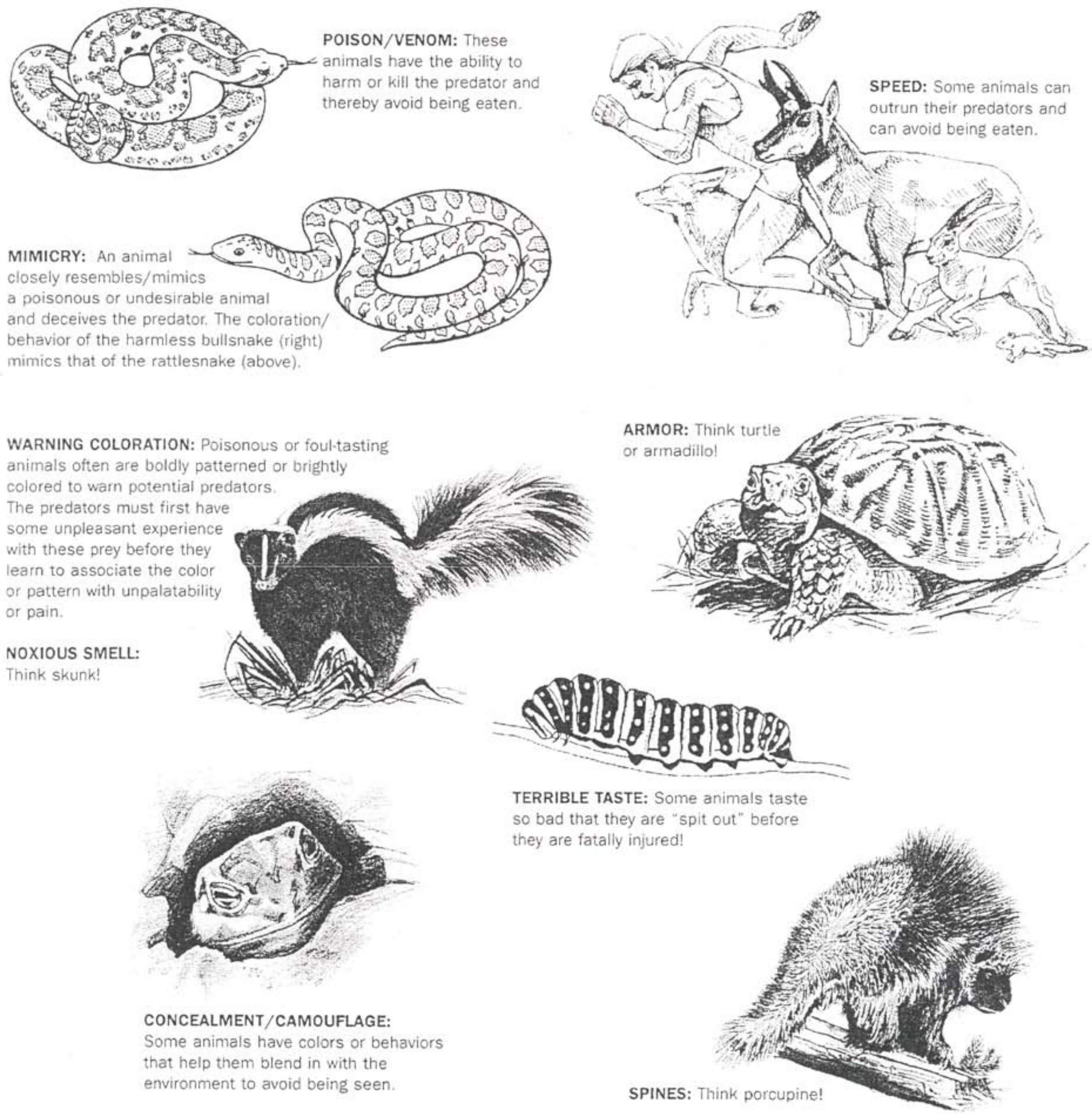

MEYER



Help the mother wolf find her way to the new den.

Animal Adaptations

Adaptations are characteristics of species that help them move, hide from predators, stay warm or cool, and find food, water and shelter. For example, the webbed feet of a duck are an adaptation that helps it swim or move through the water more easily. The colors and behavior of a bullsnake are adaptations that make it resemble a rattlesnake so that it may fool a predator. Hibernation is an adaptation that helps a black bear survive the winter. A kangaroo rat living in the desert never needs to drink water because has adapted to get all the water it needs from the seeds it eats.



GraphicSource: From "Masters of Defense", Educators Guide, Colorado Division of Wildlife, www.wildlife.state.co.us/colo_wildlife_co

“I continue to handpick the beetles, mosquitoes feast on me,
birds eat the mosquitoes, something else eats the birds,
and so on up and down the biotic pyramid.” –
William Longgood

Common Species

Common Birds of the Southwest

Acorn Woodpecker	*Melanerpes formicivorus*
American Coot	*Fulica americana*
American Kestrel	*Falco sparverius*
Barn Swallow	*Hirundo rustica*
Belted Kingfisher	*Ceryle alcyon*
Black Phoebe	*Sayornis nigricans*
Black-chinned Hummingbird	*Archilochus alexandri*
Black-throated Sparrow	*Amphispiza bilineata*
Brewer's Blackbird	*Euphagus cyanocephalus*
Broad-tailed Hummingbird	*Selasphorus platycercus*
Brown-headed Cowbird	*Molothrus ater*
Cactus Wren	*Campylorhynchus brunneicapillus*
Canyon Towhee	*Pipilo fuscus*
Chihuahuan Raven	*Corvus cryptoleucus*
Cliff Swallow	*Hirundo pyrrhonota*
Common Raven	*Corvus corax*
Curve-billed Thrasher	*Toxostoma curvirostre*
Gambel's Quail	*Callipepla gambelii*
Gila Woodpecker	*Melanerpes uropygialis*
Gray-breasted Jay	*Aphelocoma ultramarine*
Great Blue Heron	*Ardea herodias*
Great Horned Owl	*Bubo virginiaus*
***Greater Roadrunner** (also known as Chapparal Bird**)**	*Geococcyx californianus*
House Finch	*Carpodacus mexicanus*
Inca Dove	*Columbina inca*
Killdeer	*Charadrius vociferus*
Ladder-backed Woodpecker	*Picoides scalaris*
Loggerhead Shrike	*Lanius ludovicianus*
Mallard	*Anas platyrhynchos*
Mourning Dove	*Zenaida macroura*
Northern Cardinal	*Cardinalis cardinalis*
Northern Flicker	*Colaptes auratus*
Northern Mockingbird	*Mimus polyglottos*
Northern Oriole	*Icterus galhula*
Phainopepla	*Phainopepla nitens*
Pied-billed Grebe	*Podilymbus podiceps*
Pyrrhuloxia	*Cardinalis sinuatus*
Red-tailed Hawk	*Butco jamaicensis*
Red-winged Blackbird	*Agelaius phoeniceus*
Scaled Quail	*Callipepla squamata*
Scott's Oriole	*Icterus parisorum*
Scrub Jay	*Aphelocoma coerulescens*
Stellar's Jay	*Cyanocitta stelleri*
Turkey Vulture	*Cathartes aura*
Vermillion Flycatcher	*Pyrocephalus rubinus*
Western Bluebird	*Sialia mexicana*
Western Kingbird	*Tyrannus verticalis*
Western Meadowlark	*Sturnella neglecta*
White-breasted Nuthatch	*Sitta carolinensis*
White-winged Dove	*Zenaida asiatica*

* New Mexico State Bird

Common Species

Common Butterflies of the Southwest

American Lady	*Vanessa virginiensis*
American Snout	*Libytheana carinenta*
Aphrodite	*Speyeria aphrodite*
Arizona Hairstreak	*Erora quaderna*
Arizona Powdered Skipper	*Systasea zampa*
Black Swallowtail	*Papilio polyxenes coloro*
Bordered Patch	*Chlosyne lacinia*
Branded Skipper	*Hesperia comma*
Cabbage White	*Pieris (Artogeia) rapae*
Common Buckeye	*Junonia coenia*
Common Checkered Skipper	*Pyrgus communis*
Dogface Sulphur	*Zerene cesonia*
Dorantes Longtail	*Urbanus dorantes*
Fatal Metalmark	*Calephelis nemesis*
Field Crescent	*Phyciodes campestris*
Giant Swallowtail	*Papilio (Heraclides) cresphontes*
Gray Hairstreak	*Strymon melinus*
Great Basin White	*Pieris beckerii*
Great Blue Hairstreak	*Atlides halesus*
Hackberry Emperor	*Asterocampa celtis*
Juniper Hairstreak	*Mitoura grynea siva*
Mexican Yellow	*Eurema mexicanum*
Monarch	*Danaus plexippus*
Mormon Metalmark	*Apodemia mormo*
Mourning Cloak	*Nymphalis antiopa*
Mylitta Crescent	*Physciodes mylitta*
Northern Cloudywing	*Thorybes pylades*
Orange Skipperling	*Copaedes aurantiacus*
Pahaska Skipper	*Hesperia pahaska*
Painted Lady	*Vanessa cardui*
Pipevine Swallowtail	*Battus philenor*
Purplish Copper	*Lycaena helloides*
Queen	*Danaus gilippus*
Red Admiral	*Vanessa atalanta*
Red Satyr	*Megisto rubricata*
Red-bordered Satyr	*Gyrocheilus patrobas*
Red-Spotted Purple	*Basilarchia arthemis*
***Sandia Hairstreak**	*Callophrys mcfarlandi*
Sara Orangetip	*Anthocharis sara*
Satyr Comma	*Polygonia satyrus*
Silver-spotted Skipper	*Epargyeus clarus*
Silvery Blue	*Glaucopsyche lygdamus*
Tailed Copper	*Lycaena arota*
Taxiles Skipper	*Poanes taxiles*
Texsn Crescent	*Anthanassa texana*
Tiny Checkerspot	*Dymasia dymas*
Two-tailed Swallowtail	*Papilio (Pterourus) multicaudatus*
Variegated Fritillary	*Euptoieta Claudia*
Viceroy	*Basilarchia archippus*
Weidemeyer’s Admiral	*Basilarchia weidemeyerii*
Western Pygmy-Blue	*Brephidium exile*

* New Mexico State Butterfly

Common Species

Common Insects of the Southwest

Antlion	*Scotoleon niger*
Bagworm	*Oiketicus toumeyi*
Bee Killer	*Apiomerus flaviventris*
Black Witch	*Ascalaphus odoratus*
Carpenter Bee	*Xylocopa californica arizonensis*
Cholla Long-horned Beetle	*Moneilema gigas*
Cicada	*Diceroprocta apache*
Cochineal Scales	*Dactylopius confusus*
Convergent Ladybird Beetle	*Hippodamia convergens*
Crane Fly	*Tipula* spp.
Creosote Walking Stick	*Diaoheromera covilleae*
Desert Cockroach	*Arenivaga erratica*
Desert Encruster Termite	*Gnathamitermes perplexus*
Dung Beetle	*Canthon imitator*
Fig Beetle	*Cotinus mutabilis*
Firefly, Lightning Bug	*Pleotomus nigripennis*
Giant Mesquite Bug	*Thasus neocalifornicus*
Gray Bird Locust	*Schistocerca nitens*
Greater Angle-winged Katydid	*Microcentrum rhombifolium*
Green Darner	*Anax junius*
Green Lacewing	*Chrysoperla carnea*
Harvester Ant	*Pogomyrmex barbatus*
Honeybee	*Apis mellifera*
Horse Lubber	*Taeniopoda eques*
Hover Fly	*Volucella isabellina*
Iron-cross Blister Beetle	*Tegrodera aloga*
Jerusalem Cricket	*Stenopelmatus* spp.
Kissing Bug	*Triatoma rubida*
Leaf-cutter Bee	*Megachile chilopsidis*
Leaf-footed Bug	*Acanthocephala thomasi*
Mud Dauber	*Sceliphron caementarium*
Oak Gall	*Atrusca bella*
Opuntia Bug	*Chelinidea vittiger*
Orange Skimmer	*Libellula saturata*
Palo Verde Root Borer	*Derobrachus geminatus*
Paper Wasp	*Polistes flavus*
Pinacate Beetle	*Eleodes obscurus sulcipennis*
Praying Mantis	*Stagmomantis limbata*
Predatory Ground Beetle	*Calosoma peregrinator*
Rainbow Grasshopper	*Dactylotum bicolor*
Robber Fly	*Efferia* spp.
Seed Bug	*Lygaeus kalmii*
Shore Earwig	*Labidura riparia*
Spittle Bug	*Clastoptera arizonana*
***Tarantula Hawk Wasp**	*Pepsis formosa*
Ten-striped June Beetle	*Polyphylla decimlineata*
Tiger Beetle	*Cicindela lemniscata*
Velvet Ant	*Dasymutilla magnifica*
Webspinner	*Oligotoma nigra*
White-lined Sphinx Moth	*Hyles lineata*

* New Mexico State Insect

Common Spiders & Scorpions of the Southwest

Arizona Brown Spider	*Loxosceles arizonica*
Bark Scorpion	*Centruroides exilicauda*
Black Widow Spider	*Latrodectus Hesperus*
Daddy Longlegs	*Pholcus phalangioides*
Devil Scorpion	*Vaejovis spinigeris*
Giant Crab Spider	*Olios giganteus*
Giant Hairy Scorpion	*Hadrurus arizonensis*
Tailless Whip Scorpion	*Paraphrynus spp.*
Tarantula	*Aphonopelma chalcodes*
Violin Spider	*Loxosceles apachea*
Webspinner	*Oligotoma nigra*
Whipscorpion	*Mastigoproctus giganteus*
Wolf Spider	*Schizocosa mccooki*

Common Species

Common Mammals of the Southwest

American Badger	*Taxidea taxus*
American Beaver	*Castor canadensis*
Antelope Jackrabbit	*Lepus alleni*
Banner-tailed Kangaroo Rat	*Dipodomys spectabilis*
Bighorn Sheep	*Ovis canadensis*
***Black Bear**	*Ursus americanus*
Black-footed Ferret	*Mustela nigripes*
Black-tailed Jackrabbit	*Lepus californicus*
Black-tailed Prairie Dog	*Cynomys ludovicianus*
Bobcat	*Lynx rufus*
Botta's Pocket Gopher	*Thomomys bottae*
Brazilian Free-tailed Bat	*Tadarida brasiliensis*
Cactus Mouse	*Peromyscus eremicus*
Cliff Chipmunk	*Tamias dorsalis*
Collared Peccary	*Pecari tajacu*
Common Gray Fox	*Urocyon cinereoargenteus*
Common Hog-nosed Skunk	*Conepatus mesoleucus*
Common Porcupine	*Erethizon dorsatum*
Coyote	*Canis latrans*
Deer Mouse	*Peromyscus maniculatus*
Desert Cottontail	*Sylvilagus audubonii*
Desert Shrew	*Notiosorex crawfordi*
Elk	*Cervus elaphus*
Grasshopper Mouse	*Onychomys* spp.
Harris' Antelope Squirrel	*Ammospermophilus harrisii*
Hooded Skunk	*Mephitis macroura*
Kit Fox	*Vulpes macrotis*
Mexican Raccoon	*Procyon lotor*
Mountain Lion	*Puma concolor*
Mule Deer	*Odocoileus hemionus*
Nine-banded Armadillo	*Dasypus novemcinctus*
Northern River Otter	*Lontra canadensis*
Pallid Bat	*Antrozous pallidus*
Pocket Mouse	*Perognathus* spp.
Pronghorn	*Antilocapra americana*
Red Squirrel	*Tamiasciurus hudsonicus*
Ringtail	*Bassariscus astutus*
Rock Squirrel	*Spermophilus variegates*
Round-tailed Ground Squirrel	*Spermophilus tereticaudus*
Southern Long-nosed Bat	*Leptonycteris curasoae*
Spotted Ground Squirrel	*Spermophilus spilosoma*
Striped Skunk	*Mephitis mephitis*
Viriginia Opossum	*Didelphis virginiana*
Western Pipistrelle	*Pipistrellus hesperus*
Western Spotted Skunk	*Spilogale gracilis*
White-nosed Coati	*Nasua narica*
White-tailed Deer	*Odocoileus virginiannus*
White-throated Woodrat	*Neotoma albigula*

* New Mexico State Animal

Common Species

Common Reptiles & Amphibians of the Southwest

Black-necked Garter Snake	*Thamnophis cyrtopsis*
Black-tailed Rattlesnake	*Crotalus molossus*
Bullfrog	*Rana catesbeinana*
Canyon Treefrog	*Hyla arenicolor*
Coachwhip	*Masticophus flagellum*
Common Chuckwalla	*Sauromalus obesus*
Common Collared Lizard	*Crotaphytus collaris*
Common Kingsnake	*Lampropeltis getula*
Couch's Spadefoot Toad	*Scaphiopus couchii*
*Desert Grassland Whiptail Lizard	*Aspidoscelis uniparens*
Desert Iguana	*Dipsosaurus dorsalis*
Desert Spiny Lizard	*Sceloporus magister*
Desert Tortoise	*Gopherus agassizii*
Gila Monster	*Heloderma suspectum*
Gopher Snake	*Pituphis melanoleucus*
Great Plains Skink	*Eumeces obsoletus*
Greater Earless Lizard	*Cophosaurus texanus*
Green Rat Snake	*Senticolis triaspis*
Long-nosed Snake	*Rhinocheilus lecontei*
Lowland Leopard Frog	*Rana yavapaiensis*
Lyre Snake	*Trimorphodon biscutatus*
Madrean Alligator Lizard	*Elgaria kingi*
****New Mexico Spadefoot Toad**	Spea multiplicata
*****New Mexico Whiptail Lizard**	*Cnemidophorus neomexicanus*
Night Snake	*Hypsiglena torquata*
Red-spotted Toad	*Bufo punctatus*
Regal Horned Lizard	*Phrynosoma solare*
Regal Ringneck Snake	*Diadophis punctatus*
Rock Rattlesnake	*Crotalus lepidus*
Rosy Boa	*Lichanura trivirgata*
Side-blotched lizard	*Uta stansburiana*
Sidewinder Rattlesnake	*Crotalus cerastes*
Sonoran Desert Toad	*Bufo alvarius*
Sonoran Mud Turtle	*Kinosternon sonoriense*
Sonoran Whipsnake	*Masticophis bilineatus*
Tiger Rattlesnake	*Crotalus tigris*
Tiger Salamander	*Ambystoma tigrinum*
Tree Lizard	*Urosaurus ornatus*
Vine Snake	*Oxybelis aeneus*
Western Banded Gecko	*Coleonyx variegates*
Western Blind Snake	*Leptotyphlops humilis*
Western Box Turtle	*Terrapene ornata*
Western Coral Snake	*Micruroides euryxanthus*
Western Diamondback Rattlesnake	*Crotalus atrox*
Western Hognose Snake	*Heterodon nasicus*
Western Patch-nosed Snake	*Salvadora hexalepis*
Western Shovel-nosed Snake	*Chionactis occipitalis*
Woodhouse Toad	*Bufo woodhouseii*
Zebra-tailed Lizard	*Callisaurus draconoides*

* The Genus of this lizard has been reclassified. The former Genus is *Cnemidophorus*.
** New Mexico State Amphibian
*** New Mexico State Reptile

Common Species

Common Fish in the Southwest

American Eel	*Anguilla rostrata*
Black Bullhead	*Ictalurus melas*
Bluegill	*Lepomis macrochirus*
Brook Trout	*Salvelinus fontinalis*
Brown Trout	*Salmo trutta*
Channel Catfish	*Ictalurus punctatus*
Common Carp	*Cyprinus carpio*
Cutthroat Trout	*Oncorhynchus clarki*
Flathead Chub	*Platygobio gracilis*
Flathead Minnow	*Pimephales promelas*
Gizzard Shad	*Dorosoma cepedianum*
Grass Carp	*Ctenopharyngodon idella*
Green Sunfish	*Lepomis cyanellus*
Longnose Dace	*Rhinichthys cataractae*
Mosquitofish	*Gambusia affinis*
Rainbow Trout	*Oncorhynchus mykiss*
Red Shiner	*Cyprinella lutrensis*
***Rio Grande Cutthroat Trout**	*Oncorhynchus clarki virginalis*
Rio Grande Chub	*Gila Pandora*
Rio Grande Silvery Minnow	*Hybognathus amarus*
Rio Grande Sucker	*Catostomus plebeius*
River Carpsucker	*Carpiodes carpio*
White Sucker	*Catostomus commersoni*
Yellow Perch	*Perca flavescens*

* New Mexico State Fish

Common Species

Common Plants of the Southwest - Desert

Beardtongue	*Penstemon barbatus*
Blanketflower	*Gaillardia pulchella*
Buffalo Gourd	*Cucurbita foetidissima*
Checkermallow	*Sidalcea neomexicana*
Datura	*Datura meteloides*
Desert Four O'clock	*Mirabilis multiflora*
Desert Globemallow	*Sphaeralcea ambigua*
Fishook barrel cactus	*Ferocactus wislizenii*
Indian Paintbrush	*Castilleja* spp.
Mexican poppy	*Eschscholzia mexicana*
Prickly Pear cactus	*Opuntia* spp.
Rabbitbrush	*Chrysothamnus nauseosus*
Sagebrush	*Artemisia tridentata*
Teddy Beat Cholla	*Opuntia bigelovii*
Yucca	*Yucca baccata*

Common Species

Common Plants of the Southwest - Mountain

Aspen	*Populus tremuloides*
Columbine	*Aquilegia chrysantha*
Coyote Willow	*Salix exigua*
Juniper	*Juniperus monosperma*
Lupine	*Lupinus palmeri*
Mountain Mahogany	*Cerocarpus montanus*
Mullein	*Verbascum thapsus*
Oak	*Quercus spp.*
Pinon pine	*Pinus edulis*
Rabbitbrush	*Chrysothamnus nauseosus*
Sagebrush	*Artemisia tridentate*
Wild Rose	*Rosa woodsii*
Yarrow	*Achillea lanulosa*

Common Species

Common Plants of the Southwest - Riparian

Cattail	*Typha latifolia*
Cocklebur	*Xanthium strumarium*
Coyote Willow	*Salix exigua*
Duckweed	*Lemna minor*
Four-wing saltbush	*Atriplex canescens*
Goodding Tree Willow	*Salix gooddingii*
Indigo Bush Amorpha	*Amorpha fruticosa*
New Mexico Olive	*Forestiera neomexicana*
Peachleaf Tree Willow	*Salix amygdaloides*
Pondweed	*Potamogeton* sp.
Rabbit brush	*Chrysothamnus nauseosus*
Rio Grande Cottonwood	*Populus fremonti*
Rushes	*Juncus* sp.
*Russian Mulberry	*Morus alba*
*Russian Olive	*Elaeagnus angustifolia*
Sagewort	*Artemisia dracunulus*
*Salt Cedar	*Tamarix chinensis*
Sand Sagebrush	*Atremsia filifolia*
Sedges	*Carex* sp.
Showy Milkweed	*Asclepias speciosa*
*Siberian Elm	*Ulmus oumila*
Sweet Clover	*Melilotus* sp.
Virginia Creeper	*Parthnocissus inserta*

* Non-native species that has been introduced to the Southwest

Common Animal and Plant Species of the Southwest

Fire and Water Word Scramble

Name ______________________________ Date ________________

Unscramble each of the clue words.

CESNEVRO ☐☐☐☐☐☐☐☐

NERRODTAWGU ☐☐☐☐☐☐☐☐☐☐☐

PNDIATAATO ☐☐☐☐☐☐☐☐☐☐

BAMROTICITHA ☐☐☐☐☐☐☐☐☐☐☐☐

CANTOUNRL ☐☐☐☐☐☐☐☐☐

FOFNUR ☐☐☐☐☐☐

NADWETL ☐☐☐☐☐☐☐

RETWA ☐☐☐☐☐

COOSUNIBMT ☐☐☐☐☐☐☐☐☐☐

HEETYDRAD ☐☐☐☐☐☐☐☐☐

LUFE ☐☐☐☐

NOITOADIX ☐☐☐☐☐☐☐☐☐

SANPOGHET ☐☐☐☐☐☐☐☐☐

RIDPEERCB NUBR ☐☐☐☐☐☐☐☐☐ ☐☐☐☐

COHNORNOYLOREDGD ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

IWFLERDI ☐☐☐☐☐☐☐☐

PYLAA KELA ☐☐☐☐☐ ☐☐☐☐

Fire and Water Word Scramble

<u>Solutions:</u>

Conserve

Groundwater

Adaptation

Microhabitat

Nocturnal

Runoff

Wetland

Water

Combustion

Dehydrate

Fuel

Oxidation

Pathogens

Precribed Burn

Dendrochronology

Wildfire

Playa Lake

Keep Your Distance Word Search

Name ________________________________ Date ____________________

T	D	O	O	D	X	I	N	J	W	L	S	U	R	R
B	L	R	R	G	W	A	F	T	A	X	J	P	V	E
E	K	Y	O	S	N	O	U	I	T	U	M	V	T	L
S	Y	R	T	N	H	I	R	D	A	F	N	T	O	O
E	W	E	A	I	X	T	T	C	X	N	D	R	D	Y
C	O	K	D	Z	S	T	A	C	A	R	W	H	N	Y
O	K	O	E	E	K	R	D	T	I	Q	E	T	A	E
S	M	O	R	V	M	G	E	M	I	L	O	R	L	Y
Y	E	R	P	C	T	X	V	V	Z	B	F	U	D	A
S	E	I	C	E	P	S	E	V	I	T	A	N	O	Y
T	I	Z	X	K	Z	Z	F	O	K	D	Y	H	O	L
E	A	Y	E	L	B	I	T	A	P	M	O	C	W	C
M	E	S	A	X	N	Y	M	H	P	L	M	I	E	G
O	L	S	Q	Q	M	Y	K	H	I	V	V	E	B	X
T	L	J	K	B	E	J	E	Y	I	V	I	A	U	P

BIODIVERSITY
COMPATIBLE
CONFLICTING
CROWD
ECOSYSTEM
HABITAT
NATIVE SPECIES
NYMPH
PREDATOR
PREY
ROOKERY
TERRESTRIAL
WOODLAND

The Mexican Wolf

AN EDUCATIONAL ACTIVITY PACKET

Carol Cochran, Education Curator
Arizona-Sonora Desert Museum
2021 N. Kinney Road
Tucson, AZ 85743

New Mexico Endangered Species Word Scramble

Name ____ Date ____________________________

Unscramble the words below that go with endangered species.

NMAEIXC F0WL	
GAJAUR	
YSVIRLE WNONMI	
DGEIR-SONEDE ETTARLKNEEAS	
GLON SONED TBA	
YTCHEFLACR	
LIAG UTROT	
OBOL	

Write four sentences using some of the words above.

1.____

____

2.____

____

3.____

____

4.____

____

Endangered Species Word Scramble Answers

Answers:

MEXICAN WOLF

JAGUAR

SILVERY MINNOW

RIDGE-NOSED RATTLESNAKE

LONG-NOSED BAT

FLYCATCHER

GILA TROUT

OBOL

Pyramids

Pyramids of Life

Objectives

Students will:

1. Recognize the food web and the living things that are a part of it
2. Understand how energy flows within an undisturbed habitat
3. Understand the interdependency of living things in an ecological system

Key Words

1. *Carnivores* - meat-eating animals
2. *Detritivores* - organisms that feed on small bits of dead material and waste from each level of the energy pyramid
3. *Energy pyramid* – a pyramid used by ecologists to show how much energy is in an ecological system
4. *Herbivores* - plant-eating animals
5. *Photosynthesis* – the process used by plants to change sunlight into chemical energy
6. *Prey* – animals that are eaten by other animals
7. *Respiration* – the process used by animals to break down glucose and other food molecules produced by plants into water and carbon dioxide
8. *Scavengers* – animals that eat dead animals
9. *Thermodynamics* - the branch of science that deals with the conversion of one form of energy to another

Background

There are two important laws of thermodynamics that are fundamental to understanding how energy behaves in living systems. The First Law states: Energy can be changed from one form to another, but it can never be created or destroyed.

Energy transformation occurs all the time in living systems: photosynthesis converts light energy into chemical energy, mammals convert the chemical energy in their food into the heat needed to keep their bodies warm.

The Second Law states: In all energy exchanges and conversions, the potential energy of the final state is always less than the potential energy of the first state. In other words, every time energy changes form, there is less useful energy after the change than before. Almost every time energy changes form, some of the energy turns into "low quality" heat that is "lost" to the surrounding environment. The energy still exists, but is no longer easily used.

Ecologists use an energy pyramid to show how energy flows in an ecological system. The pyramid basically shows how more plants are needed to feed mice that are needed to feed snakes that are needed to feed one coyote.

♦

coyote

snakes-snakes

mice-mice-mice-mice

plants-plants-plants-plants-plants

sunlightsunlightsunlightsunlightsunlightsunlight

Each time an animal eats another animal or plant, about 90 percent of the energy contained in the food source is lost due to the digestion process. Therefore, only about 10 percent of the energy is actually transferred to the next level of the food chain.

Understanding the Laws of Thermodynamics and applying them to the food pyramid helps us to see why there needs to be more mice than coyotes in a desert ecosystem.

The energy of the sun is passed along from one organism to another; from plants to plant eaters, to the animals that eat them. Humans and every other animal use the energy of the sun that is stored in plants. Animals break down the glucose and other food molecules produced by plants into water and carbon dioxide in a process called respiration.

In this system, everybody is an energy consumer. The plant-eating mice (the herbivores), are the primary consumers. During respiration, the stored chemical energy captured by the plant is released for use in the body of the mouse. Then, snakes (carnivores), called secondary consumers, prey on the mice. Then, the coyote (larger carnivore), called a tertiary consumer, preys on the secondary carnivores that prey on herbivores.

Detritivores are organisms that feed on small bits of dead material and waste from each level. As each of these organisms dies, its components are broken down by digestion or by various decomposers, such as bacteria and fungi. Scavengers are consumers too. From earthworms to vultures, scavengers are animals that eat dead animals. They help recycle nutrients for further use in the ecosystem.

Most prey animals also are eaten by more than one kind of predator. Thus, a simple food chain is part of a more complex food web. Each individual in the food web pursues energy to keep going and growing, and to reproduce. All of that energy comes from the sun through plants. and in the end, the energy returns to the universe as waste heat.

<u>Materials</u>
Owl pellets (some sources are listed at end of the activity)
Paper towels
Bone diagram
Tweezers or toothpicks

<u>Advance Preparation</u>
Write the words shrews, grazing insects, sun, owl, grass on the board.

<u>Instructions</u>
Part 1.
1. Divide students into teams of two and give each pair an owl pellet.
2. Have students begin taking apart their pellet. Students should examine the various bones they find in the pellet.
3. Have students compare these bones to a bone chart. After identifying the various types of bones found in the pellet, have them explain what they conclude from these findings.
4. Using the original words on the board, ask students to draw the food chain in this activity.

Part 2.
1. The class will make a food web mural. Students can choose any Southwestern ecosystem.
2. Once they've selected an ecosystem, have each student pick a plant or animal that lives there and research its place in the food web. Once students have determined its place, they should also identify its predators and prey.
3. When students have completed their findings they can place their information on the class food web mural.

Some Pellet Sources

Note: Listing does not connote endorsement of the company or product by the University of New Mexico Wild Friends Program.

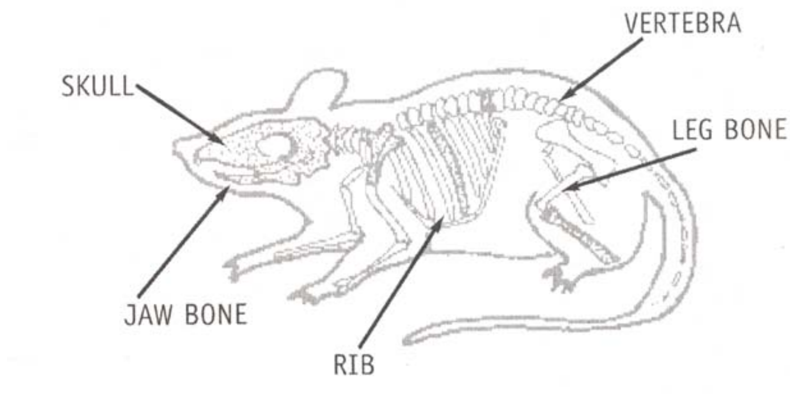
1. Carolina Biological Supply Co., 2700 York Road, Burlington, NC 27215; 1-800-334-5551
2. Educational Innovations, Inc., 362 Main Avenue , Norwalk, CT 06851; 203-229-0730; 203-229-0740 (fax); e-mail: info@teachersource.com
3. Genesis, Inc., P.O. Box 2242, Mount Vernon, WA 98273 Information 360-422-6764; Orders Only 1-800-4PELLET; e-mail: info@pellet.com
4. Nature's Classroom, P.O. Box 400 Oakhurst, CA 93644-0400 FAX/Messages 1-800-291-7691; http://www.owlpellets.com/orderform.htm
5. Pellets, Inc., P.O. Box 5484, Bellingham, WA 98227-5484; 1-888-466-OWLS; 360-738-3402 (fax)

New Mexico Science Standards
Grade 5, II, II, I, 3
Grade 7, II, I, I, 1-2; and II, I, II, I
Grades 7 and 8, II, II, I, 3
Grades 9-12, II, II, I, 2-6

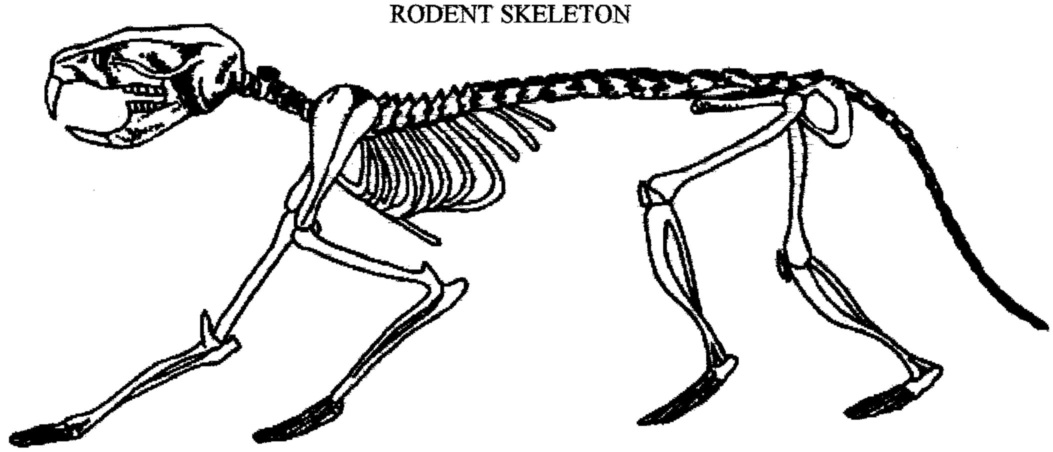
Source: Adapted from "What's Cookin'", Carlsbad Caverns National Park Ecology Curriculum for Middle School

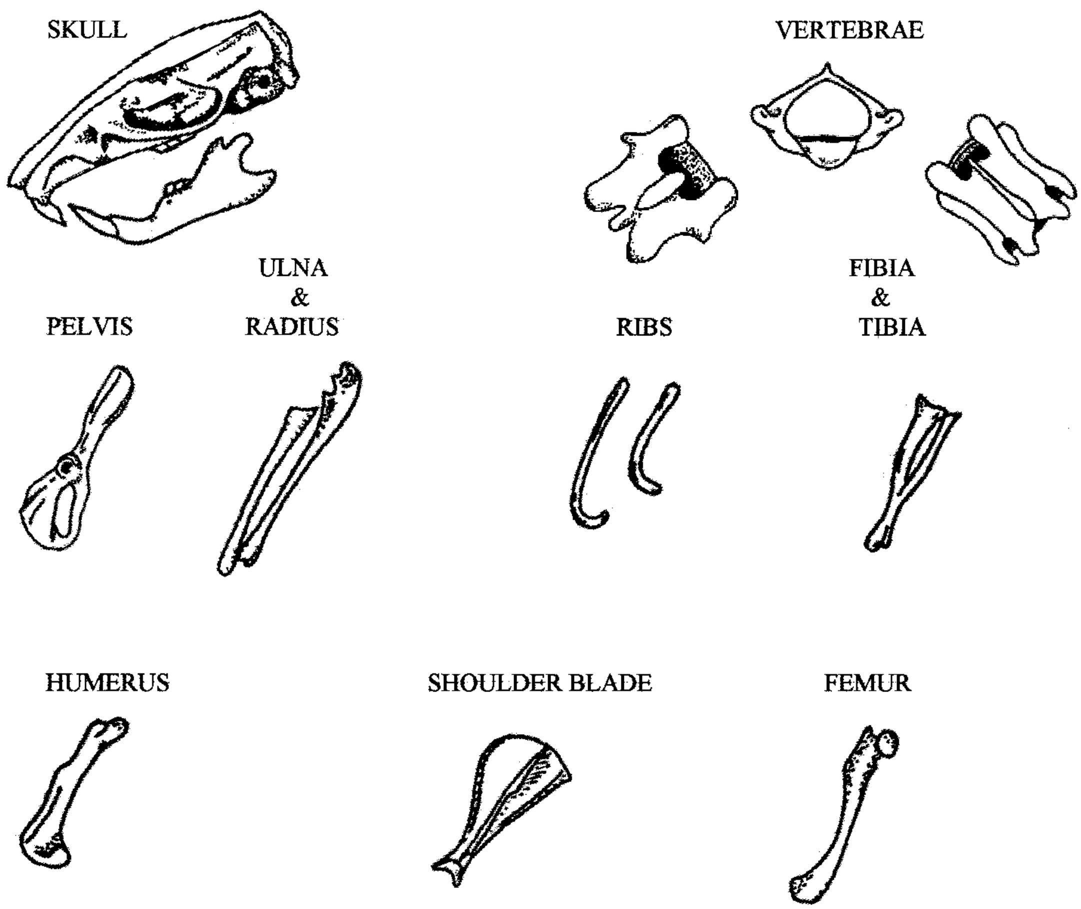
> *"I continue to handpick the beetles, mosquitoes feast on me, birds eat the mosquitoes, something else eats the birds, and so on up and down the biotic pyramid." – William Longgood*

Bones of a Small Mammal



BONES FOUND IN OWL PELLETS
RODENT SKELETON



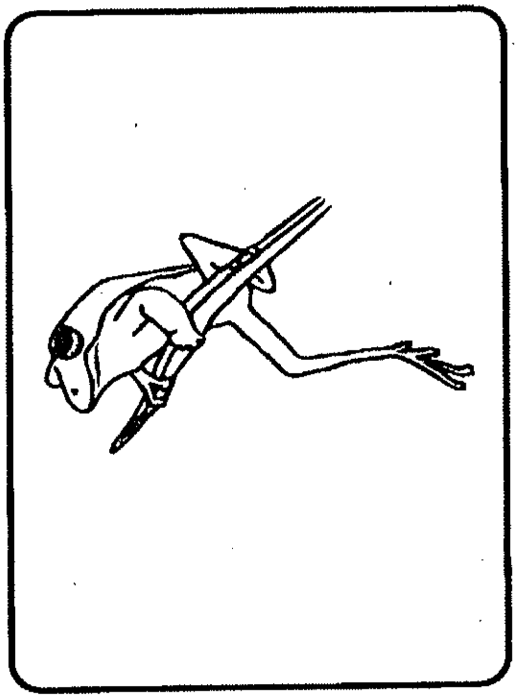


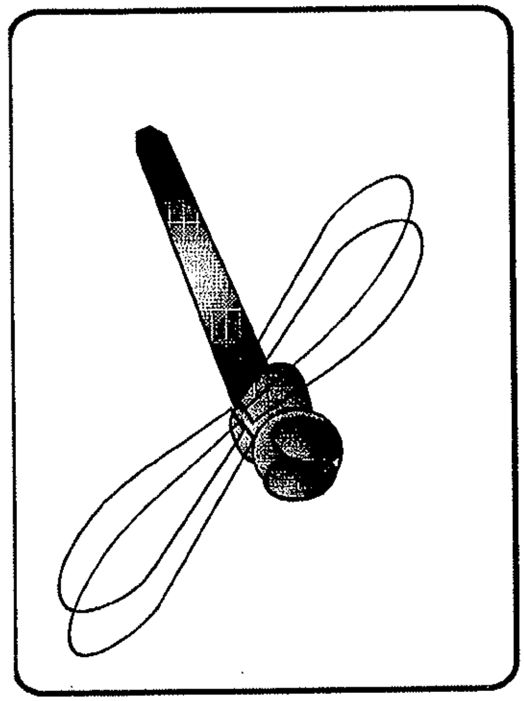
DRAGON FLY (insect): Dragonflies are most often seen flying along the edges of lakes and streams. The larvae, commonly called nymphs, live almost entirely in freshwater. Some species burrow in sand or mud while others cling to vegetation. Nymphs eat microscopic (very tiny) animals, but as they grow they eat mosquitoes, other insect larvae, and small worms. Dragonflies are beneficial insects eating many other pest insects. Birds, frogs, spiders, and fish eat nymphs and adult dragonflies.

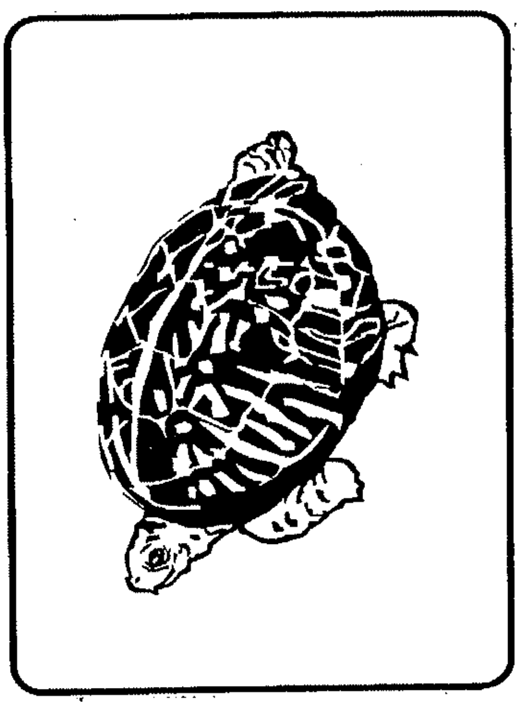
FROG (amphibian): In the early stages of growth, frogs are called tadpoles. Tadpoles have tails, live mostly in the water and have gills so they can breathe. Frogs do not have tails. Some frogs live in the water, some live on land, and some live in trees. Frogs eat lots of insects, including grasshoppers. Frogs in turn are eaten by birds, mammals, reptiles (especially snakes), and humans (frog legs).

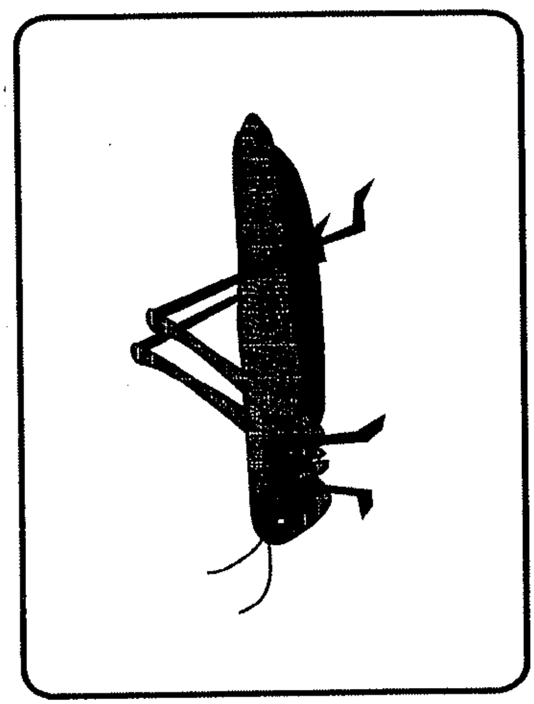
GRASSHOPPER (insect): Grasshoppers are generally green or brown. They have long slender bodies with large powerful back legs for jumping. They eat the leaves, stems, or young shoots of plants, often feeding on grass, clover, and other plants. Females lay their eggs in the soil and sometimes in rotting wood. Grasshoppers are found in grasslands, fields, deserts, gardens, lawns, woods, and brushy areas. Frogs and skunks eat grasshoppers.

TURTLE (reptile): Some turtles live in the water and some live on land, but all lay their eggs on land. The eggs are usually buried in sand, mud, or decaying vegetation. Some turtles eat mostly plants while others eat only living or dead animals. Turtles have no teeth. The eggs and young turtles may be eaten by other animals.







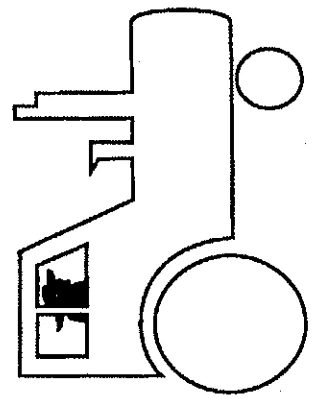


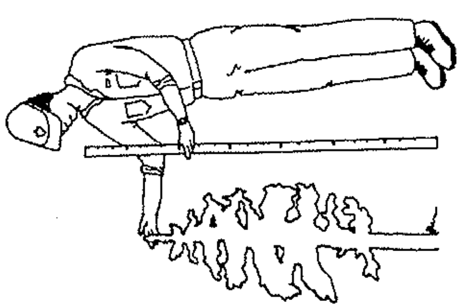
COMMODITY USER (FARMER): In our community, this agricultural producer is growing winter wheat on about 1,000 acres of land. No fertilizers or pesticides are being used. Every two-three years, the wheat crop is rotated with a soybean crop. This crop rotation practice helps maintain good soil quality. A machine called a combine is used to harvest the wheat. Soybean plants return nitrogen to the soil, which helps other plants grow.

ENVIRONMENTALIST: This person cares about the environment, everything from the air we breathe to the water we drink. Most believe we all can do something to help protect our environment, whether it is recycling or walking to school or work whenever possible. Most believe it is important to balance human needs with the needs of animals and vegetation. This person may be concerned with issues ranging from local government to the global (world) environment. Actions taken by this person vary from writing letters to Congress to cleaning up rivers.

STUDENT: You can create your own role. Think about what you do at home, in school, and outdoors. Prepare your self-description based on: what you eat, where you live, your habitats or what you like to do, materials needed to build a home or shelter, where you will get the materials, and from what you need protection.

ECOSYSTEM MANAGER: This person is interested in balancing human needs with the needs of animals and vegetation. The Ecosystem Manager's career requires that most of his/her time is spent working with a specific ecosystem. For example, this person might be responsible for taking care of the natural resources (air, water, land, soil, plants, animals) at a wildlife refuge, national park or forest, etc.



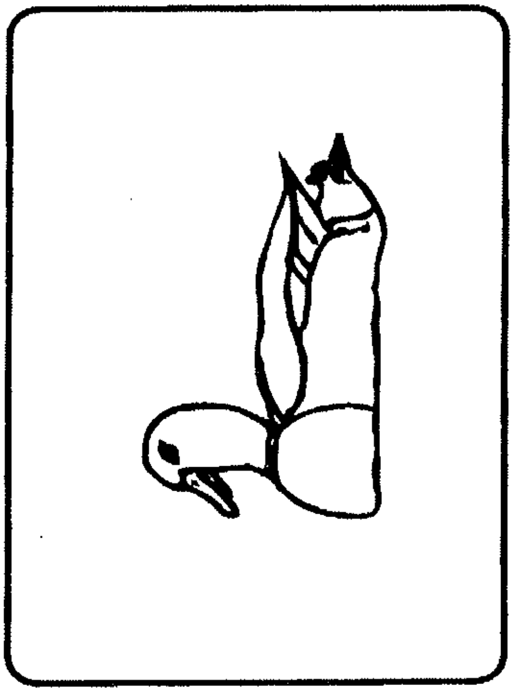
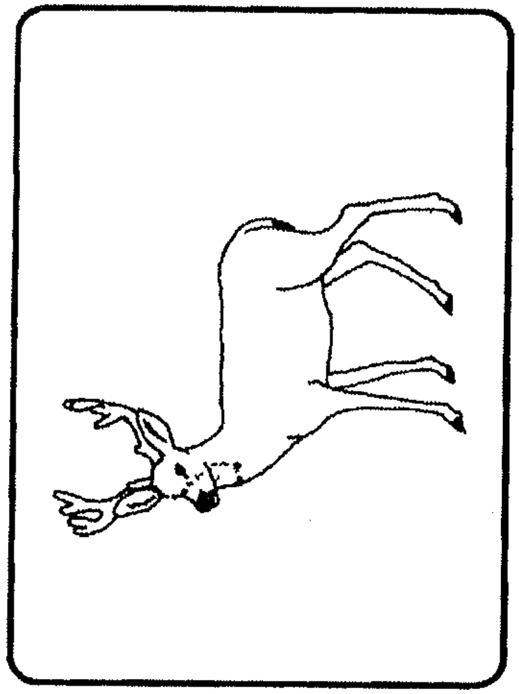


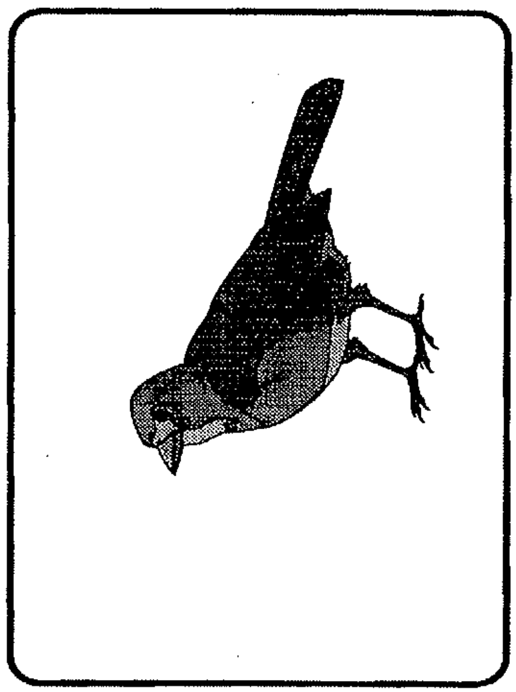
DEER (mammal): Deer can be found in a variety of habitats throughout the world. They feed on grass, leaves, buds, and twigs of woody bushes. Deer have long been used by humans as a source of meat and hides. Coyotes, mountain lions, and domestic dogs eat deer.

MALLARD (bird): Mallards live in marshes, shallow freshwater ponds and coastal waters. They get their food by dipping their bills and heads into the water looking for seeds, aquatic vegetation, and small fish. They also eat grains and vegetation. Their nest is hidden in vegetation near the water's edge. Coyotes, foxes, bobcats, domestic cats and dogs, hawks, snakes, crows, and ravens eat mallards and their eggs.

ROBIN (bird): The American robin lives in open forests, farmlands, parks, and suburbs. They generally build their nests on branches, in forks of trees, or on houses or barns where there are ledges. Mud, twigs, roots, grass, and paper are used to make the nest. They eat berries, worms, and insects. Coyotes, foxes, bobcats, domestic cats and dogs, hawks, snakes, crows, and ravens eat robins and their eggs.

RED-TAILED HAWK (bird): This hawk is usually found in open woodland areas. Nests are built in trees and sometimes in cliffs and human-made structures like tall buildings. The nest is usually large and made of sticks, lined with grass and green leaves. These hawks generally hunt for live animals during the day. They eat mice, rabbits, squirrels, beavers, prairie dogs, and snakes. Coyotes, foxes, bobcats, domestic cats and dogs, other hawks, snakes, crows, and ravens eat the red-tailed hawk.

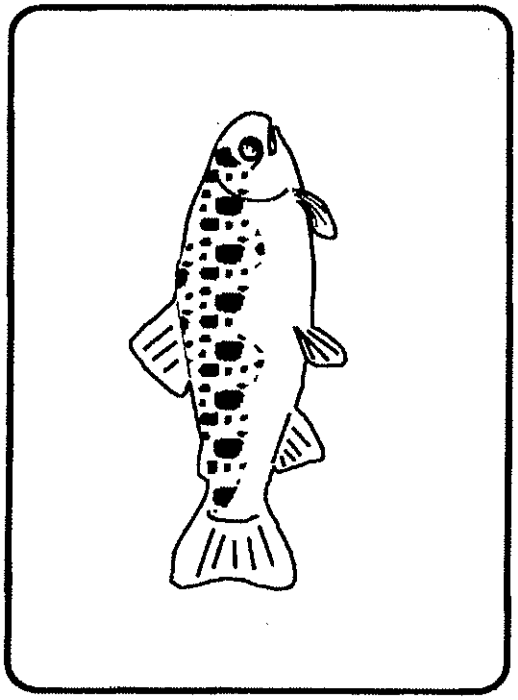


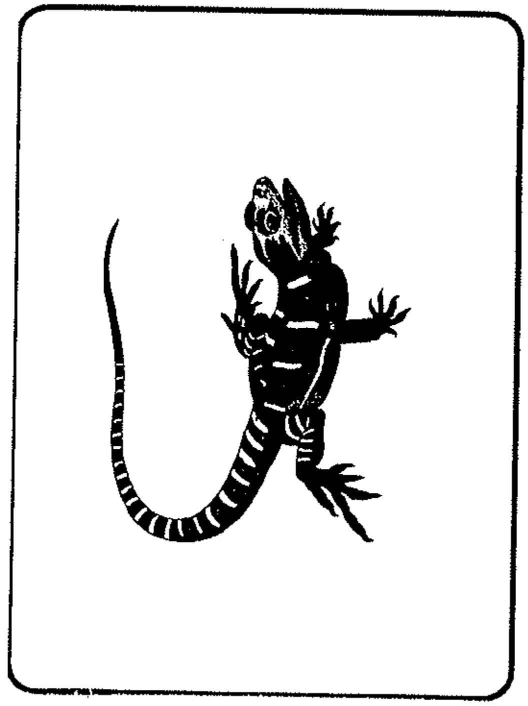
LIZARD (reptile): Lizards are the most abundant of all reptiles. They are found in many habitats in the warmer parts of the world. Most, if not all, lizards can swim. Most lizards eat insects; some of the larger lizards eat vegetation. Lizards can be found in many places: in or under fallen logs, hiding under brush and piles of leaves, on rocky slopes, canyon walls, patches of sandy soil, and deserted buildings. Coyotes, foxes, bobcats, domestic cats and dogs, hawks, snakes, crows, and ravens eat lizards.

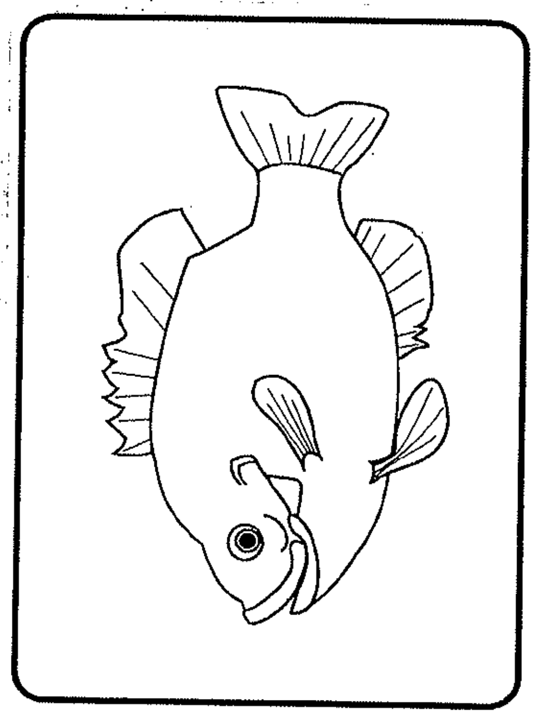
RAINBOW TROUT (fish): Trout are found in cold, clear lakes and streams, especially where the water is moving rapidly. They are often found in the shadow created by overhanging banks and tree limbs. Eggs are laid in the fall or spring and in a stream or on the stream materials (sand, gravel). They eat aquatic insects and terrestrial insects that land on the water. Otters, mink, herons, other trout, and humans eat rainbow trout.

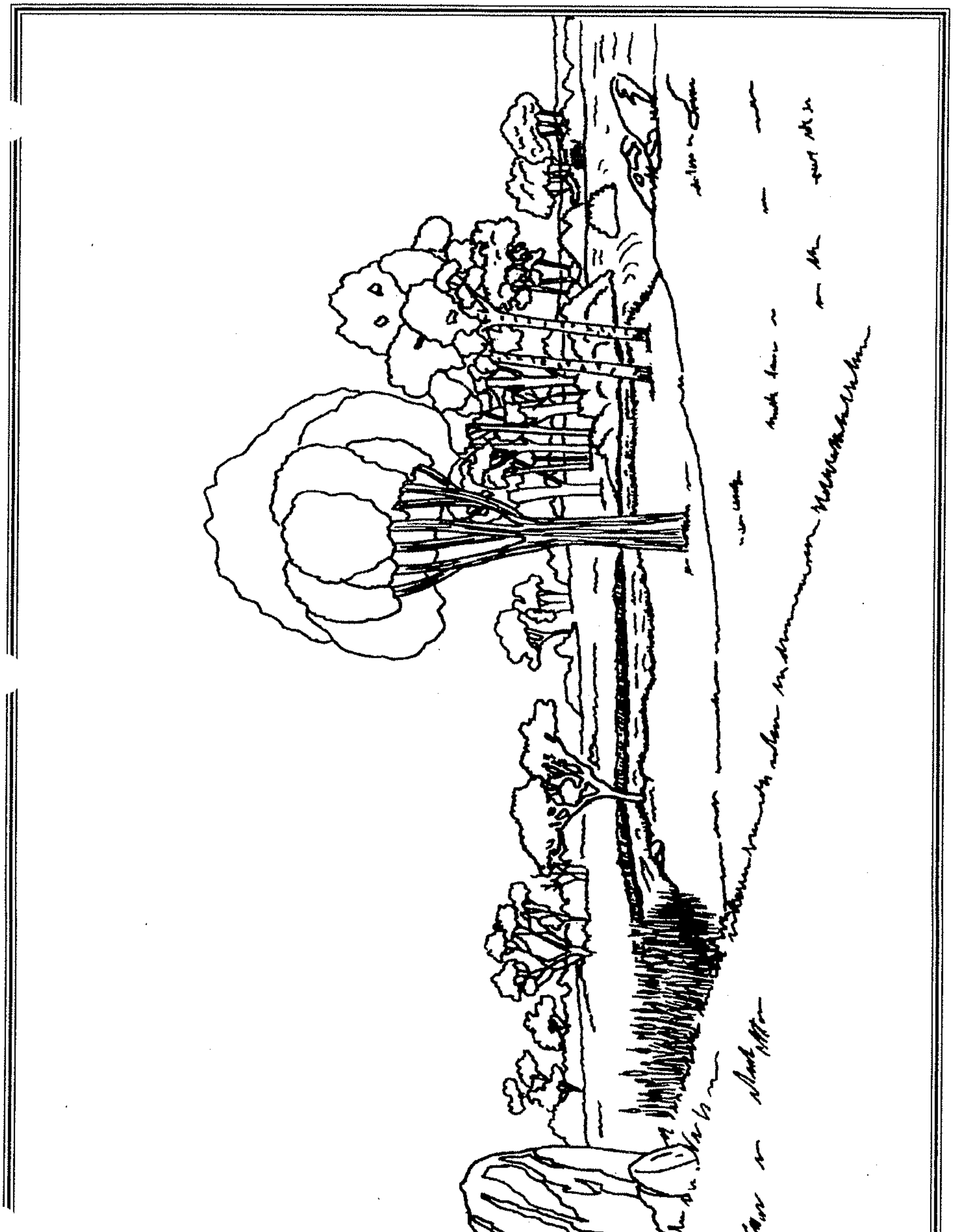
SUNFISH (fish): This fish lives in warm, shallow, weedy ponds and warm, mud-bottomed or rocky streams. They may be in areas of heavy vegetation or under overhanging tree limbs. They eat aquatic insects and terrestrial insects that land on the water. Otters, mink, herons, turtles, water snakes, and other fish eat the sunfish.

FOX SQUIRREL (mammal): The fox squirrel uses trees to build a nest, to hide from enemies, and for food. It eats the fruit, buds, and the bark of twigs and often buries gathered food. They sometimes eat birds. Coyotes, foxes, bobcats, domestic cats and dogs, hawks, snakes, crows, and ravens eat squirrel.









WILDLIFE NOTES

Oryx

Also known as gemsbok, oryx are one of Africa's largest antelope. You do not have to travel that far, however, to find them. Transplanted to New Mexico from 1969 to 1973, they have found White Sands Missile Range to their liking. New Mexico's herd is the only free-ranging herd outside Africa.

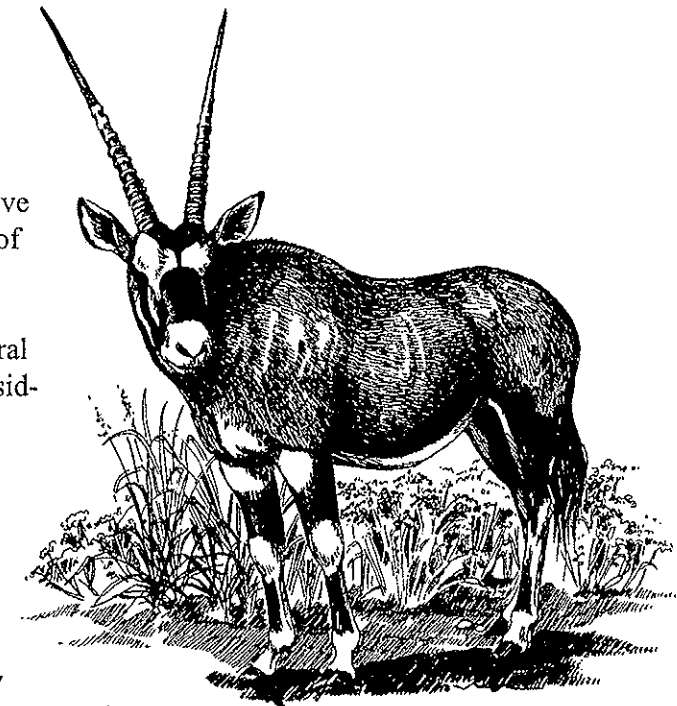
Oryx (*Oryx gazella*) were brought to New Mexico to enhance hunting opportunities for exotic game species. Curious observers also may see oryx near U.S. 70 between Alamogordo and Las Cruces. The long, dark horns and the black-and-white face mke an oryx difficult to mistake for another big game animal.

Description

Adult oryx may weigh more than 400 pounds. They go through subtle color changes, beginning with a light brown or tan coat up to the age of six or eight months. At adulthood, the coat is grayish. Bull's horns have very fine, compacted ridges at the lower ends; cows also carry the long and slightly curving horns.

Bulls and cows often spar, locking their horns and pushing their opponent. The purpose seems to be a show of dominance. It is common to see oryx with broken horns.

Life History



Oryx may calve all year round. There have been no reports of disease at White Sands Missile Range, and natural predation is considered low. The animals seem to prefer a shrubby habitat, with creosote, mesquite, and grass. Much of the water they need comes from vegetation, but they will drink standing water if it is available. The missile range receives only about eight inches of moisture a year.

Subhead?

Population growth is limited primarily by hunting. In 1989 the oryx population was about 600, but special depredation hunts were held south of U.S. 70 and on the Small Missile Range because oryx were wandering too far from their main habitat and were interfering with certain U.S. Army activities. The population now is less than 400 oryx. Last year up to 180 hunting licenses were available.

A wildlife biologist for White Sands Missile Range has noted oryx size and ages at field stations during hunts, and has obtained blood samples from oryx. These will be used for laboratory analyses that may show history of disease in oryx, or a relation between disease potential and the scabies mite that plagues desert bighorn sheep in higher elevations at White Sands Missile Range.

Hunting dates and numbers of licenses are proposed by the Department of Game and Fish, with recommendations from White Sands Missile Range. In the past there have been hunts where sportsmen are essentially on their own, and hunts where every hunter is escorted by a game department officer or an army MP game warden, when there are sensitive facilities in the hunt area.

One of the best trophies recently bagged was killed by Roxanne Rhea of Roswell in October 1988. Her oryx had 42-inch horns and weighed at least 450 pounds.

In recent years a debate has arisen: Should New Mexico continue to manage non-native wildlife, such as oryx, for public hunting and viewing? So far oryx appear likely to remian on White Sands Missile Range, where they have adapted well, but may surprise the visitor who was not expecting an African safari.

Published 1992

Wildlife Notes is published by the Department of Game and Fish. If you are interested in obtaining additional copies, please send your request to:

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