# Topic Lesson 1 – A Forest is More than Just Trees

*Grade Level: Elementary and Middle School*

**Overview:** Students will learn about the interdependence of species in a forest, including humans.

**Time:** 1 hour total for both required activities and additional 1 hour for each optional lesson

**Timeline:** Sept. 12th – Oct. 7th

**Key Concepts**:

1. Interdependence: All species in a forest ecosystem are connected, including those underneath the soil.
2. Cultural connections to forests: Human communities use forests for social, economic, and spiritual needs.

**Vocabulary:**

- Abiotic: The physical rather than the biological environment, such as air, wind, water, sunlight.
- Biotic: The living aspect of an ecological community or ecosystem.
- Class: One of the rankings in the Kingdoms of life in the following hierarchy: Kingdom, phylum, class, order, family, genus, species
- Community: A group or association of populations of two or more different species occupying the same occupying the same geographical area at the same time.
- Ecosystem: A biological community or interacting organisms and the physical environment.
- Forest: A complex system with many interdependent elements, including plant and animal species, soil and water and cycles and processes.
- Kingdoms of life: All living organisms are divided into kingdoms, which are defined as groups of living organisms with similar characteristics and shared evolutionary lineages.
- Interdependence: All organisms in an ecosystem depend upon each other. If the population of one organism rises or falls, then this can affect the rest of the ecosystem.
- Web of life: The web of life is shown by the interdependence in a system in which all the living things depend on each other as well as on abiotic things like the sun, water, and air.

## Introduction to Forests (Required)

### Whole Class Discussion – Why are forests important? (10 minutes)

1. Ask students why forests are important. Have students recall that they answered this question in the previous Legislative Topics and Voting lesson.
2. Record their answers on a large piece of paper or your white board. When recording, have students categorize their answers using these three categories: **Ecological, Economic, Human**.

   ***Helpful Tip:*** For younger students, you might prompt with questions such as: How do forests help the environment (Ecological)? What products come from forests (Economic)? How do humans interact with forests?

3. Use this list to compare with your student's answers. Review anything that your students might have missed:

    - **Ecological**
        i. Groundwater recharge: Trees reduce topsoil erosion by catching precipitation with their canopies, which decreases the forces of storms and slows down water runoff that in turn ensures that groundwater supplies are replenished.
        ii. Improve water quality: During photosynthesis, trees give off the oxygen we need to breathe and take in greenhouse gases out of the air, like carbon dioxide and other pollutants. Trees store these gases in their wood. This is called carbon sequestration.
        iii. Provide habitat for wildlife: Forests supply not only food but also shelter.
        iv. Clean the environment: During photosynthesis, trees or absorb, or sequester, carbon dioxide and convert it into oxygen for us to breathe. Trees also remove sulfur dioxide and nitrogen dioxide, two major forms of pollutants, from the air.
        v. Cool the environment**:** Forested lands are between 2 to 4 degrees cooler during the summer than non-forested lands.
    - **Economic**
        i. Harvesting forest products: Forests provide consumable goods such as wood and piñon nuts.
        ii. Recreation, Outdoor Industry, and Tourism: Fees, lodging, food etc.
    - **Human**
        i. Cultural: Hunting, fishing, camping, harvesting.
        ii. Spiritual: Renewal, peace, and reflection.
        iii. Recreational: Camping, hiking, biking, and other outdoor activities.

    ***Optional Extension***: Since there is overlap in some of the examples listed and in the ideas students might come up with, consider making a Venn diagram with three circles to show the interconnections.

## Activity One: The Web of Life – Interdependence in a Forest (Required)

**Activity Overview:** Students will each represent a species in a piñon-juniper forest. They will stand in a circle and connect to each other by a string to demonstrate the interconnections of all species, or the web of life, in this ecosystem.

**Materials:**

- "Who Am I" Cards (PDF attachment in email)
- Hole punch or tape
- String
- The Web of Life Species List (See pg. 8)
    - One per student or copied on white board for everyone to see

**Preparation:**

- Print "Who Am I" cards (PDF attachment in email) and the Web of Life Species List (See pg. 8)
- Cut out cards and attach tape to the back of each one to tape on the student's back or hole punch and attach a string to hang around student's neck

**Introduction (10 minutes)**

1. Explain to students that all life in a forest is interconnected from the trees to the animals to the other plants to the fungus and bacteria.
2. Provide students the master list of sample organisms found a piñon-juniper forest ecosystem. You can either hand out sheets to each student or, alternately, you can make a master list to post in the front of the class. (See page 8 for the Web of Life Species List)
3. Go over the list. If students are not familiar with the biological kingdoms of life, review the definition. Then, for each organism on the list, note what kingdom it belongs to. (For this lesson, we are only using the kingdoms of Plant, Animal, Fungus). Once the kingdoms are noted, further break down the animal kingdom into classes. (For this lesson, we are only using the classes of mammals, birds, reptiles, amphibians from the phylum Chordata, and insects and arachnids from the phylum Arthropoda.)

   ***For Elementary Students:*** It is enough just that students can understand basic categorization such as the difference between plant and animal and the difference between the types of invertebrates, such as the difference between a bird and a mammal. You do not have to introduce the biological grouping of class (kingdom and phylum) for younger students.

**Group Activity – The Web of Life (30 minutes)**

1. Bring students outside or to a large area inside the building. Bring the master list for students to refer to or copies of the list. Have students stand in a circle. At this point, they can stand in any order.
2. Distribute "Who Am I" cards with tape or string attached, one per student, by hanging it with string draped towards their back or taped to their back. Instruct students **not** to look at their cards. Explain that these cards are the same ones that were on the master list they just looked at. Make sure to have the list with you on display or that students have copies of the list.

   ***Note***: If you have fewer than 25 students, you don't have to use all the cards. Alternately, if you have more than 25 students, students can share a card.
3. Once students have their cards, have students each try, one at time, to guess their organism by asking scientific "Yes/No" questions. For the sake of time, give **each student three questions to ask and three guesses**. If they don't guess by the third try, tell them who they are. Once they have their answer, put their card/badge in the front of their body and have them read the information out loud to the group. Here are some example questions:
   a. Am I in the plant kingdom? (For younger students: Am I a plant?)
   b. Do I have a backbone?
   c. Do I have wings?
   d. Can I move?
   e. Do I walk on four legs?
4. Once everyone has guessed who they are, ask them questions about connections between some of these organisms they represent in this piñon-juniper ecosystem. Here are some example questions:
   a. How is a piñon jay connected to a piñon tree?
      i. Piñon jays eat the piñon nuts and disperse the seeds so new trees can grow.
   b. How is a lizard connected to blue grama grass?
      i. Grass provides shade, shelter, and a place to hunt.
   c. How is a black-chinned hummingbird connected to a juniper tree?

        i. The tree provides shelter and a place to build a nest.
    d. How is a black bear connected to a Gambel Oak?
        i. The bear eats the acorns and helps disperse the seeds.

5. Follow the Web Chart on pg. 9 and rearrange students around the circle by their species as shown on the chart. While you do not need to follow this exact order, and you might not have the exact number of students, the chart is the most efficient way for them to be organized to do the next step.

   ***Important Note:*** You are NOT arranging them by the numbers. The numbers are used to indicate the order the string gets passed.

6. Once the students are arranged around the circle, refer, again, to the Web Chart for this next part. *Now you will follow the numbers on the web chart to pass the string around the circle.* Start with #1, which is the piñon tree, and hand this student the string. From #1, have that student pass the string to the card/species that is #2 on the web chart. Tell students what you are doing; For example: The piñon tree is now connecting to the piñon jay. Even though the Web Chart only shows arrows for the first five species, continue to follow the Web Chart and connect students by numerical order until they are all connected.

   ***Important Note***: The organisms are connected in a big *web,* and as such not all the organisms are connected directly or in a linear fashion as in a food chain. Some of the connections are less direct or obvious. (For more explanation and examples of the less direct connections, refer to the teaching notes on page 17.)

7. Once everyone is connected by the string, have them all tug gently and feel the pull from other organisms in the circle. The pull represents the fact that they are all connected. Then ask specific students to pull on the string one at a time. For example, ask the student who is the juniper tree to tug on the string. Then ask who feels the tug and what species they are. Next, have those who felt the tug from the juniper tree tug on the string. Ask who feels this tug and which species they are, and have them tug. Do this again until everyone has felt the tug.
8. Ask the question: Is every species in this piñon-juniper web connected? Here you can again ask specific questions about the connections. Here are a few example questions:
    a. How is the hummingbird connected to the penstemon?
    b. How is a black bear connected to a Gambel Oak?

   ***Helpful Tip***: See teaching notes on pg. 17 for further examples of connections, both direct and indirect.

9. Ask what would happen if you took one of the organisms out of the web. Cut the string at this point. For example, what happens if you take a piñon jay out of a piñon-juniper forest? Cut the piñon jay connection in both directions. What happens?

**Discussion and Wrap-up (10 minutes)**

1. Have students turn in their cards, collect string, and discuss the activity using your own questions or some of the sample questions below:
    a. List some of the connections in the piñon-juniper forest.
    b. List three feeding connections. (Deer eating grass, predator eating prey, hummingbird drinking nectar)
    c. List two non-feeding connections. (Hummingbird pollinating a flower, tree providing shelter)

d. What happens when those connections are broken?

***Optional Extension***: Have students write a half page to one page describing why a forest is more than just trees.

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## *Optional Activity One: Meet A Tree*

**Activity Overview:** Students will choose a tree on the school campus and become familiar with the tree. They will then assess the tree for its shade value, size, canopy cover and overall condition.

**Materials:**

- Blindfolds
- Measuring tape to be shared among partners. If possible, providing one tape per group will expedite the lesson.
- String, one ball of string per partner group.
- Thumbtack, one per partner
- Calculators, one per partner
- Student Data sheets (see pg. 10-12)

**Preparation:**

- Find trees on the campus
- Copy student data sheets
- *Optional*: Watch video on how to measure tree diameter

**Group Activity and Data Gathering (50 minutes)**

1. Assign partners and hand out data sheets (see pg. 10-12), one per pair. Hand out blindfolds.
2. Go outside and take students to the trees you have previously identified. It is best if there are several trees near each other and several groups of partners can be at each tree.
3. Explain that one person will be blindfolded. Person one describes their sensory experience of the tree, including touch, smell, and hearing. The partner records on the data sheet. Then switch roles.
4. Once each student has had a chance for a sensory exploration, explain that students will work with the same partner to examine the tree visually, recording their observations on the data sheet. Observations should include all signs of wildlife in and around the tree. This could include things like bite marks to a leaf, indicating insects, eggs on leaves, nests, discolored leaves. Record these observations on their data sheets.
5. As they record their observations, they should think about what questions they have based on observations. Record these questions on their data sheet.
6. Measure Diameter at breast height of the tree (DBH) DBH can tell us things like how much water the tree needs to be healthy, how much water it helps keep in the ground and how much $CO^2$ it can store over its lifetime. To do this, follow the steps below:
    a. With your measuring tape, measure 4.5 feet up the trunk of the tree from the ground. You might use a thumbtack to mark the measurement.

b. Wrap your string around the tree at the 4.5 foot measurement. Make sure the string is tight around the tree.
c. Cut the string
d. Convert the circumference measurement to diameter by dividing the circumference by pi (3.14).

7. Measure temperature: While this is not a scientific measurement, a sensory experience can remind students the importance of the cooling effect of trees. Stand in the sun then stand in the shade. Describe the difference on the data sheet.
8. Measure shade value of the tree: Have students use their data sheet to record answers for the following aspects of a tree's value for shade: trunk condition, insects and diseases, crown (or canopy). Collectively, these conditions are a way of assessing a tree's health and its shade giving ability.

**Discussion and Wrap-up (10 minutes)**

1. Return to classroom. Have each student pair give an overall assessment of their tree. An assessment can include their sensory impressions, the tree's value to wildlife, and the tree's shade value. If more than one group of students shared the same tree, they can each report their findings.

***Optional Extensions***:

- Using what they have learned about the tree, have students write a one-page (more or less depending on the age group) first person autobiography of their tree.
- Have students try to identify the tree by going to: www.peecmature.org/learn/nature-guides/tree-guide. This is a guide to native trees, so if the trees in your schoolyard are ornamental, this guide might not list the tree species.
- Come up with a plan for caring for your school trees to monitor their health.

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## *Optional Activity Two: Meet A Forest*

*This activity will work for classes that **have access to a forested area** or a school with multiple trees near each other on school grounds.*

**Activity Overview:** Students will choose a tree on the school campus and become familiar with the tree. They will then assess the tree for its shade value, size, canopy cover and overall condition.

**Materials:**

- Scavenger hunt sheet, one per group (See pg. 13-14)
- Pens/pencils, one per group
- Clipboard or something to write on, one per group

**Preparation:**

- Copy scavenger hunt sheets (See pg. 13-14)
- Review all the categories on the scavenger hunt sheet

**Introduction (5 minutes)**

1. Tell students that they will be going outside to a forest to get to know the ecosystem better. Before they go discuss who the original indigenous inhabitants of this land were and are. If you are not sure, you can go visit the following website for help: https://native-land.ca/

**Group Activity and Data Gathering (50 minutes)**

1. Place students in groups of four (a smaller or larger group is fine, depending on class size) and give each student a scavenger hunt sheet. Go over the scavenger hunt sheet to make sure students understand everything on it.
2. Take the students to the forested area. Have them look for the various things on the scavenger hunt, checking off each when they find them. Have them write their observations and questions.

**Discussion and Wrap-up (5 minutes)**

1. Return to the classroom and discuss their findings, observations, and questions.
   ***Optional Extension***: Record a master list of what species they found. Have students research what they found and name as many species as they can. Field guides are a great resource for identifying species.

# Web of Life Species List

*Activity One: The Web of Life – Interdependence in a Forest*

**Plants**

- Pinon
- Juniper
- Gambel oak
- Mountain Mahogany
- Penstemon species
- Blue grama grass

**Animals - Birds**

- Pinon jay
- Cedar waxwing
- Cooper's Hawk
- Red-Tailed Hawk
- Black-chinned hummingbird
- Ladder-backed woodpecker

**Animals - Mammals**

- Black bear
- Mule deer
- Desert cottontail
- Coyote
- Mountain Lion
- Human
- Rock squirrel

**Animals - Reptiles and Amphibians**

- New Mexico whiptail lizard
- Fence lizard

**Animals - Insects**

- Sphinx moth
- Bark beetle species

**Other**

- Cryptobiotic crust
- Mycorrhizal fungus

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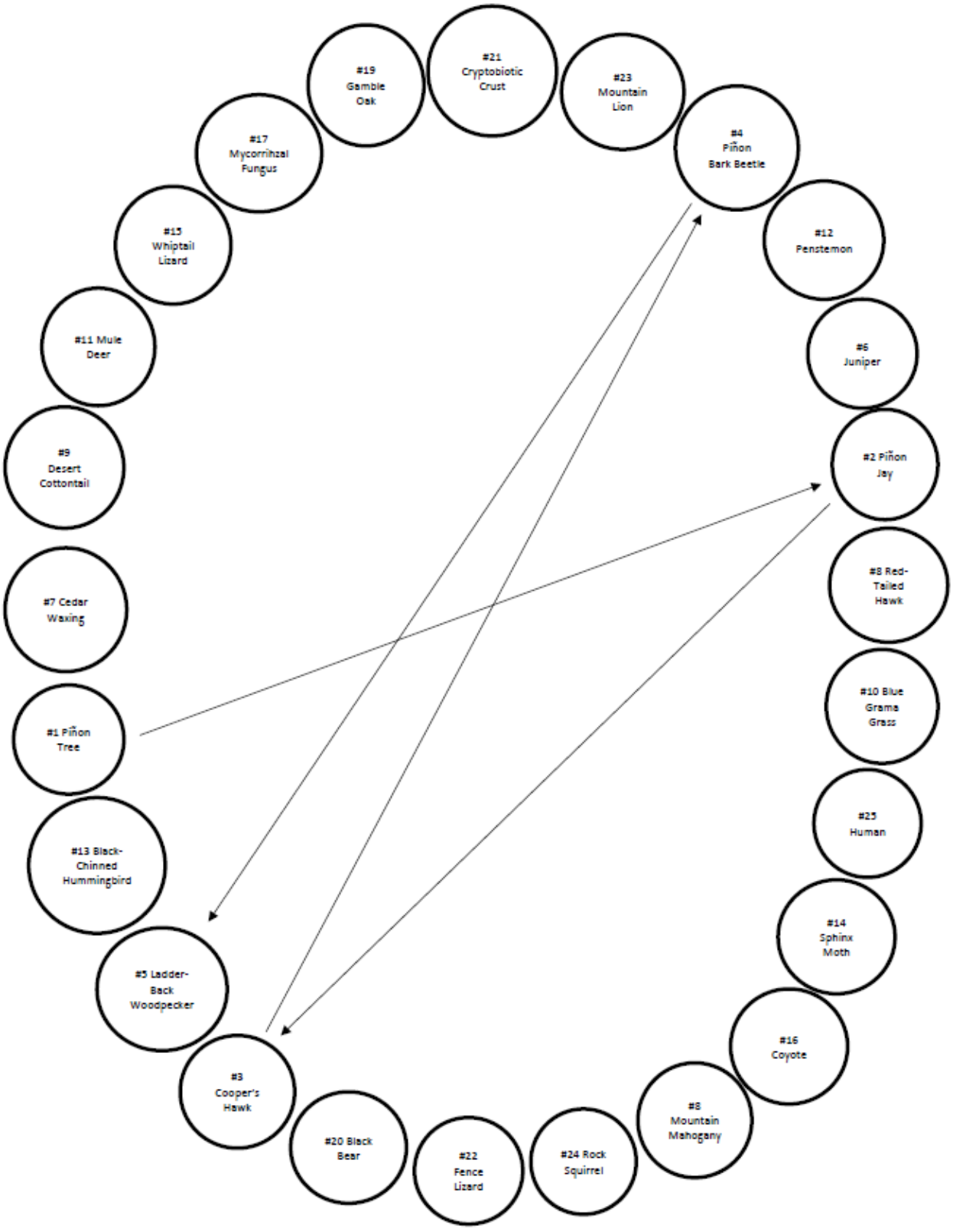
# Web Chart

*Activity One: The Web of Life – Interdependence in a Forest*



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# Meet a Tree: Student Data Sheet

*Optional Activity One: Meet A Tree*

1) Person one: Tree observations with blindfold

2) Person two: Tree observations with blindfold

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## Observations & Questions Table

| Observations | Questions |
|---|---|
| | |
| | |
| | |
| | |
| | |

## Diameter at Breast Height

Circumference: _____

Diameter: _____

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# Guide for Judging Value of a Shade Tree

**Trunk Condition** Solid and no cracks or missing bark (5 points)

Sections of bark missing (3 points)

Extensive decay and hollow (1 point) Score: _____

**Structure** Sound and no major missing limbs (5 points)

One major or several minor dead limbs (3 points)

Two or more major dead limbs (1 point) Score: _____

**Insects and Disease** No pests present (5 points)

One pest present (3 points)

Two or more pests present (1 point) Score: _____

**Crown Development** Full and balanced (5 points)

Full but unbalanced (3 points)

Lacking full crown (1 point) Score: _____

## Determining Condition

| Total Points | Condition Class |
|---|---|
| 20-15 | Excellent |
| 14-10 | Good |
| 9-5 | Fair |
| 4-0 | Poor |

# Meet a Forest: Scavenger Hunt Data Sheet

*Optional Activity Two: Meet A Forest*

## Forest Scavenger Hunt

Look for the following biotic components of the forest. Check off each thing you found in the box. Record at least one observation and one question about each item you find.

| I have found | Observation | Question |
|---|---|---|
| A tree with needles | | |
| A tree with leaves | | |
| A sign of an insect | | |
| A nest | | |
| A fungus | | |
| Something decaying | | |

| | | |
|---|---|---|
| A bird (you can listen or look or both) | | |
| A decomposer | | |
| A lichen | | |
| A sign of something that has been eaten (for example, a hole in a leaf) | | |
| A sign of insect damage | | |
| Something interesting | | |
| A sign of humans | | |

# Teacher Background Information

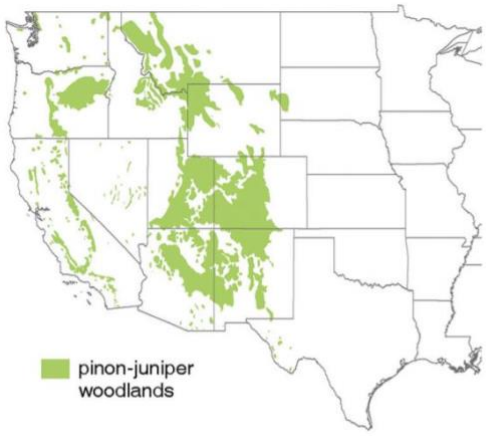
## General Information – New Mexico Forests Overview

New Mexico's forest land covers 24.7 million acres. Forty-three percent (10.7 million acres) of this forest land is privately owned, and another 32 percent (7.9 million acres) is administered by the USDA Forest Service. The State's most abundant forest type is piñon/juniper woodland, which covers more than 10 million acres. Piñon/ juniper woodlands combined with juniper woodlands cover a total of 13.5 million acres, or more than half of New Mexico's forest land area. Gambel oak is the most abundant tree species by number of trees, followed by common piñon. Ponderosa pine makes up about one-quarter of the State's total tree volume and biomass, and thus is the most abundant tree species in terms of volume and biomass.

A forest: is a complex system with many interdependent elements, including plant and animal species, soil and water and cycles and processes. When it is functioning well, this system supports a diversity of species, helps to store and filter water, improves air quality, stores carbon, and performs other vital ecosystem services. People depend on healthy forests for these ecosystem services, as well as for food and other products.

Interdependence: The organisms in a forest are interdependent on each other. For example, plants synthesize their own food through photosynthesis upon which all other species directly or indirectly depend. In turn, plants depend on animals for processes like pollination and seed dispersal. Dead bodies of animals as well as rotting vegetation decay and release nutrients into the soil. Additionally, trees are connected underground through a vast network of fungus called mycorrhizal that enables them to communicate with each other. While there are a variety of forest types in New Mexico, the dominant types are piñon-juniper and ponderosa with the bosque occurring along rivers, primarily the Rio Grande.

Piñon-juniper forests: Piñon-juniper communities occupy areas in 10 states of the Great Basin, the Colorado Plateau, the Rocky Mountains, and the Sonoran and Chihuahuan Deserts. Piñon and juniper trees grow together and tolerate a broad range of environmental conditions that allows them to compete in a variety of plant communities. Piñon and juniper woodlands are widespread on the Colorado Plateau between about 1200 to 1500 m (5000 to 7000 ft) in elevation (see map below). Piñon or juniper may dominate the canopy, or the two may co-dominate. Both trees are slow-growing, long-lived (up to 1000 years of age), and slow to reach maturity. Piñons may bear cones at 25 years, but good seed production does not occur until trees are 75-100 years old, and maximum production occurs at 160-200 years of age. Cones require 3 years to mature. Large seed crops are produced every 3 -7 years, depending on water availability, followed by multiple years of low cone production. One-seed junipers begin producing seeds at 10-30 years of age, with maximum production at 50-200



years of age. Fleshy cones, often called juniper berries, mature in 1 season, in late summer and autumn, and often persist on the tree for 1-2 years. Large seed crops are usually produced at 2-5-year intervals. Seeds of both species are dispersed by small mammals and birds, especially by jays that cache large numbers of seeds. Seeds that have passed through the digestive tracts of birds and mammals germinate faster than uneaten seeds. New Mexico's most abundant forest type is piñon/juniper woodland, which covers more than 10 million acres. Piñon/ juniper woodlands combined with juniper woodlands cover a total of 13.5 million acres, or more than half of New Mexico's forest land area.

For more reading: https://santafebotanicalgarden.org/plant-of-the-month-july-2021/

Ponderosa Pine Forests:

Found throughout Rocky Mountain foothills, these ecosystems occur in dry, rocky habitats from the mountains of central Wyoming down through the Colorado Rocky Mountains into the mountains of New Mexico, and west into the mountainous plateaus and isolated mountains of Arizona and Utah. While they typically appear below the region's other montane forests, in some mountain ranges the Ponderosa Pine ecosystem 'zone' spans some 4500 ft in elevation from the lowest stands to the highest.

Healthy ponderosa ecosystems include a mosaic of dense patches of pine trees interspersed with grassy meadows at higher elevations, with large areas of more open savanna-like pine woodlands at lower elevations. This natural patchiness is a very important ecosystem character that no longer exists in most areas of this ecosystem. Before European settlement, ponderosa pine forests were more open than we see them today. Widely spaced trees towered above rich grasses and occasional clumps of Gambel's oak. Frequent, naturally-occurring surface fires kept the forest healthy and open. Individual ponderosa pine trees (*Pinus ponderosa*) can live well over 500 years. Their extreme drought resistance stems from long "tap roots" that provide secure anchors that access soil moisture deep underground. Intolerant of shade from other trees, ponderosa pines are most successful in open sunlight. In fires have burned many of the park's large stands of ponderosa pine creating open grasslands in many areas. Ponderosa pine makes up about one-quarter of the State's total tree volume and biomass, and thus is the most abundant tree species in terms of volume and biomass.

Bosque Forest:

A bosque ecosystem encompasses a riparian (the interface between land a river or stream) forest and floodplains that surround a river. In the U.S., this type of ecosystem is found almost exclusively in the arid Southwest, mostly along the Rio Grande. The river, flowing through the center of the bosque, sustains this forested oasis, as the river and woodland combine to become one riparian ecosystem. The combination makes the bosque a haven for an unusual variety of flora and fauna that rely on both the river and the forest.

A recently published field guide lists more than 500 different species of animals living in New Mexico's bosque. While many of the animals are difficult to see — such as bats due to their nocturnal nature — others are frequently encountered on walks through the woods, including desert cottontails, rock squirrels, muskrats, porcupines and coyotes. The American beaver is another bosque resident. This aquatic rodent's diet consists primarily of the cambial tissue under the bark of cottonwood and willow growing in the woodland. The bosque also is an excellent migration route, providing food, shelter and water for large numbers of ducks, geese, sandhill cranes and a host of other migratory birds. Many of these birds, like herons and egrets, are wading birds and not typically found in forests.

The cottonwood trees, with heart- or triangular-shaped leaves, are sometimes referred to as the heart of the bosque, as they provide critical habitat for many of the birds, mammals, insects, spiders and crustaceans of the riparian ecosystem. Rio Grande cottonwoods have been growing in the bosque for more than a million years and are heavily dependent on a reliable water supply for germination and survival.

**Web of Life – Interdependence Further Explained**

An important thing to note is that this is a web and not a food chain. As such, not all of the connections are one-to-one direct connections in which one organism eats another. There are connections through competition, in which two organisms compete for a food source. There are connections through a symbiotic mutualism, in which two organisms benefit from each other, such as a hummingbird getting nectar from a penstemon flower, and thus pollinating the flower. *The point here is that all the organisms in this forest web are connected either directly or indirectly*. Here are some examples of direct, indirect and overall connections:

**Direct**:

- Piñon tree to piñon jay to Cooper's hawk: These first three connections are a classic example of a food chain. The piñon tree provides nuts that the piñon jay eats. The Cooper's hawk eats the piñon jay.
- The bark beetle to the ladder-back woodpecker to the juniper: The bark beetle is a food source for the ladder-back woodpecker. The ladder-back woodpecker is also connected to the juniper tree as a feeding source, if they drill into the juniper for insects.
- Red-tailed hawk to desert cottontail to blue grama grass to mule deer: The red-tailed hawk eats the cottontail, which in turn eats the blue grama grass. The mule deer also eats the blue grama grass.

**Indirect**:

- Coyote to mycorrhizal fungus: The string connects these two organisms. Although they are not directly connected, the idea is that in a web everything is connected. So, the mycorrhizal fungus, for example, connects the trees and keeps them healthy. The trees provide oxygen as well as food for herbivores. The carnivores feed on the herbivores.
- Cryptobiotic crust to fence lizard to mountain lion: Like the previous example, the fence lizard might not be exactly connected to the cryptobiotic crust, but the crust is an essential part of the entire ecosystem, keeping it healthy. Likewise, while it is possible for a mountain lion to

eat a lizard, mountain lions tend to feed on larger prey. However, in a web, again, everything is connected.

- The penstemon to the black chinned hummingbird to the sphinx moth: In this connection, both the hummingbird and the sphinx moth are pollinators. This type of connection is one in which the two pollinators are linked by a shared resource.

**Overall Connections:**

- Tree are connected to all other organisms by providing shade, shelter, oxygen, and for the animals that eat plants (herbivores) by providing food.
- A beetle might be a decomposer and therefore is connected to the entire system by eliminating other decaying organisms.

**Meet a Tree – Context Further Explained**

Although in lesson one, the importance of forests was discussed, individual trees are important as well. Urban forestry, in which trees are intentionally planted in places like schools and other populated settings, has a positive impact in many ways. For example, a tree can serve as a sound barrier and lower sound pollution. Trees have a cooling effect on hot days. A single, large deciduous tree (a tree that loses its leaves) in leaf provides protection from ultraviolet radiation. Urban trees contribute to a healthy environment, reducing storm water runoff, reducing erosion, and providing food and shelter for animals. Although difficult to measure, trees have a positive effect on psychological health.

## Piñon Jay
2

*Gymnorhinus cyanocephalus*

Piñon Jays are year-round residents in piñon-juniper habitats across the southwestern US. They nest colonially (in groups) and breed cooperatively (last year's offspring helping this year's parents and nestlings) on traditional nesting grounds. Piñon jays are omnivorous, taking pine seeds, acorns, juniper berries, arthropods, and small vertebrates, but they especially depend on the seeds of piñon pines. With their ability to carry up to 50 piñon seeds at a time, Piñon Jays are the main long-distance seed disperser for piñon trees.

## Juniper Tree
6

*Juniperus scopulorum*

There are five common species of juniper trees. Many birds eat the seeds of juniper trees and spread them, thus helping the tree to regenerate. The rocky mountain juniper is native to western North America. It is an evergreen tree, meaning it does not lose its leaves. The seed cones are berry-like and strongly fragrant.

## Cedar Waxwing
7

*Bombycilla cedronum*

The Cedar Waxwing is a medium-sized, sleek bird with a large head, short neck, and short, wide bill. Waxwings have a crest that often lies flat and droops over the back of the head. The wings are broad and pointed. The tail is fairly short and square-tipped. Cedar Waxwings are social birds that you're likely to see in flocks year-round. They sit in fruiting trees swallowing berries whole, or pluck them in mid-air with a brief fluttering hover. Juniper berries are one of their favorite foods and you can see flocks of waxwings on these trees in winter.

## Piñon Pine
1

*Pinus Edulis*

The piñon pine grows in southwestern North America, especially in New Mexico, Arizona and Utah. The trees have edible nuts and are a staple food for many Native American groups. These nuts are an important food source for the piñon jay and many other birds that disperse the seeds.

## Penstemon Eatonii 12

*Penstemon* Species

Penstemon flowers, such as the one in this photo, live in desert or alpine climates. Plants begin blooming in late May and early June. They come in shades of red, pink, purple and blue. They all have long, tubular flowers that are a great source of nectar for hummingbirds, who can fit their long beaks into the corolla (the petals). Penstemon are often referred to as beardtongue.

## Black-Chinned Hummingbird 13

*Archilochus alexandri*

This small green-backed hummingbird is found from deserts to mountain forests during summer. Many of them migrate to Mexico for winter, while some stay along the Gulf Coast. This adaptable hummingbird is found in many urban areas and will come to backyard feeders—but they do not need any red dye, which can hurt them. Their preferred food is nectar from flowers, but like all hummingbirds, they also eat small insects and spiders for protein.

## Mountain Mahogany 18

*Cercocarpus montanus*

This plant is a shrub or small tree that grows up to 12 feet. It is beneficial because it fixes nitrogen, meaning it helps convert atmospheric nitrogen into a form that plants can use. It is an evergreen tree, meaning it does not lose its leaves. It is also an important food source for elk and deer. In Spanish, it is called “Palo duro” meaning hard wood, due to its tough branches and trunks. Native peoples use them medicinally, especially the bark.

## Fence Lizard 22

*Sceloporus occidentalis*

This lizard is found in the Southwest down to Mexico and as far north as Washington state. The belly of the adult is blue, and it is also sometimes called a blue-belly lizard. They are diurnal, come out in the day, and are often found basking in the sun.

## Gamble Oak
19

*Quercus gambeii*

This native tree often forms large stands or groupings of trees. It is native to most of the southwestern United States. It prefers to live in canyons and mesas and on low-elevation mountain slopes with piñon pine and juniper and higher with ponderosa pines. Thickets of these trees provide habitat for birds and small animals and food for wildlife such as bears. The larger trees are also more likely to have holes or cavities in the trunk, creating homes for birds and other small animals. It is also a host tree for the Colorado hairstreak butterfly, meaning this butterfly needs this tree for food and for laying its eggs.

## Black Bear
20

*Ursus americanus*

Black bears are medium-sized bears endemic (found only in) to North America. Black bears are omnivores, meaning they eat vegetation, fruits and nuts as well as animal protein. Most of their diet is vegetation. Their diet varies from season to season. They prefer to live in an area that is relatively inaccessible with thick understory vegetation and large amounts of edible food, such as acorns from the Gambel Oak. Black bears hibernate in the winter.

## Blue Grama Grass
10

*Bouteloua gracilis*

The blue grama is the New Mexico state grass and one of the more widespread grasses in New Mexico. It can grow up to 1 foot tall, and the seed stalks have curling comb-like spikes. This grass is an important food source for mule deer as well as for scaled quail and some songbirds and small mammals, such as prairie dogs, pocket gophers and jackrabbits.

## Mule Deer
11

*Odocoileus hemionus*

This deer is native to western North America and is named for its large, mule-like ears. Although they are capable of running, they are often seen stotting, in which they spring into the air, lifting all four feet off the ground. They eat many different plants, including Gambel oak, blue grama, and mountain mahogany. Mule deer are eaten by larger predators, especially mountain lions.

## Desert Cottontail
9

*Sylvilagus auduboni*

The desert cottontail is named for its white puff of a tail. They are found in arid lands of the Southwest and into the Plains states. Their habitat is piñon-juniper forests as well as grasslands. Cottontails are herbivores, eating only plants. Ninety percent of their diet is grass! Coyotes feed on cottontails, as do owls, hawks, and other carnivorous (meat-eating) mammals.

## Red Tailed Hawk
8

***Buteo jamaicensis***

The red-tailed hawk is the most common hawk in North America. They soar above open fields, slowly turning circles on their broad, rounded wings. Red-tailed hawks often perch on top of telephone poles, eyes fixed on the ground to catch the movements of a vole or a rabbit. Mammals make up the bulk of most Red-tailed Hawk meals. Frequent victims include voles, mice, wood rats, rabbits, snowshoe hares, jackrabbits, and ground squirrels. These hawks also eat birds.

## Cooper's Hawk
3

*Accipiter cooperii*

This hawk prefers to live in rural woodlands where there are large trees as well as in suburban backyards. They eat small to medium-sized birds as well as small mammals. These birds are skillful fliers, flying through trees in pursuit of birds to eat.

## Human
25

*Homo Sapiens*

With about 8 billion humans on the planet, we interact with every ecosystem, including forests of all types.

## Piñon Bark Beetle
4

*Piñon ips*

There are many species of beetles, but one species, the piñon bark beetle, specializes on piñon trees. They use the inner bark and outer sapwood for food and to rear their offspring. Healthy trees are not attacked or hurt. But with increased drought and heat, the trees are more stressed and more vulnerable to the beetles.

## Sphinx Moth
14

*Sphingidae* family

These moths hover like hummingbirds when feeding on nectar. They are pollinators and agile fliers.

## Coyote
16

*Canis latrans*

Coyotes are a species of canines (dogs) native to North America. Coyotes are smaller than wolves. They are widely distributed across North America. The basic social unit of the coyote is the family. They eat mouse-sized rodents by pouncing. Sometimes they form a hunting relationship with badgers, in which they help each other to dig up rodent prey.

## Whiptail Lizard
15

*Aspidoscelis neomexicanus*

This female-only species of lizard is found in New Mexico and Arizona and is the official state reptile of New Mexico. Whiptail lizards hunt during the day and eat insects. They are fast moving and dart for cover if approached.

## Rock Squirrel 24

*Otsospermophilus variegatus*

The rock squirrel is native to Mexico and the Southwestern United Sates. They are the largest member of the squirrel family. They are herbivores and eat plants, juniper berries, piñon nuts, Gambel's oak acorns, as well as small vertebrates. They are fed upon by coyotes, foxes and other carnivores, including humans.

## Ladder-backed Woodpecker 5

*Dryobates scalaris*

These woodpeckers are only found in the USA in the southwestern part of the country in arid landscapes. These woodpeckers are small and good foragers on not just trees, but on prickly pear cactus and cholla. They peck into trees for wood-boring beetles, and other insects. They are quite acrobatic and can be seen hanging upside down.

## Cryptobiotic Soil Crust 21

Genus *Cyanobacterium*

Cryptobiotic crusts are important parts of arid, dry lands. Crypto means hidden while biota means life. The small mounds of dark crust are created by very small organisms such as algae, fungi, and cyanobacteria. This crust is an important way in which arid soils resist erosion by wind and water. Also, they can convert nitrogen from the atmosphere into a form plants can use. These crusts are easily damaged if you walk on them.

## Mycorrhizal Fungus 19

*Fungal* Phylum

This fungus grows underground in a mutualistic symbiotic relationship with tree roots. This means both the tree and the fungus benefit. The fungus helps the tree get water and nutrients, while the tree provides the fungus with sugars. The trees also communicate with each other through the network of fungus.

# Mountain Lion



*Puma Concolor*

This large cat is native to the Americas. Its range spans from the Yukon to the Andes in South America. Its other names include puma, catamount and panther. They feed on a variety of small prey, but its primary food source in New Mexico is mule deer.

# Connections to State Standards

*Disclaimer: This lesson contributes to the development of mastering these standards in combination with your established classroom curriculum, but was not created for your students to master the standards listed below.*

## Grade 4

NM ELA Standards:

- **RI.4.7**: Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
- **SL.4.1**: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

NGSS and NM STEM Ready Standards:

- **4-LS1-1**: Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- **4-LS1-2**: Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.

NM Social Studies Standards:

- **K-4 Benchmark II-B**: Distinguish between natural and human characteristics of places and use this knowledge to define regions, their relationships with other regions, and patterns of change.
- **K-4 Benchmark II-C:** Be familiar with aspects of human behavior and man-made and natural environments in order to recognize their impact on the past and present.
- **K-4 Benchmark II-F**: Describe how natural and man-made changes affect the meaning, use, distribution, and value of resources.
- **K-4 Benchmark II-D**: Understand how physical processes shape the Earth's surface patterns and biosystems.

## Grade 5

NM ELA Standards:

- **RI.5.7**: Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
- **SL.5.1**: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

NGSS and NM STEM Ready Standards:

- **5-LS2-1**: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.

NM Social Studies Standards:

- **5-8 Benchmark 2-B**: explain the physical and human characteristics of places and use this knowledge to define regions, their relationships with other regions, and their patterns of change.
- **5-8 Benchmark 2-C**: understand how human behavior impacts man-made and natural environments, recognize past and present results and predict potential changes.
- **5-8 Benchmark 2-F**: understand the effects of interactions between human and natural systems in terms of changes in meaning, use, distribution and relative importance of resources.

## Middle School

NM ELA Standards:

- **RI.6-8.7**: Integrate and evaluate content presented in diverse media and formats, including visually and quantitatively, as well as in words.
- **SL.6-8.1**: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

NGSS and NM STEM Ready Standards:

- **MS-LS2-1:** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- **MS-LS2-2:** Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- **MS-LS2-4:** Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- **MS-ESS3-3:** Apply scientific principles to design a method for monitoring and minimizing human impact on the environment.

NM Social Studies Standards:

- **5-8 Benchmark 2-B**: explain the physical and human characteristics of places and use this knowledge to define regions, their relationships with other regions, and their patterns of change.
- **5-8 Benchmark 2-C**: understand how human behavior impacts man-made and natural environments, recognize past and present results and predict potential changes.
- **5-8 Benchmark 2-F**: understand the effects of interactions between human and natural systems in terms of changes in meaning, use, distribution and relative importance of resources.