



Description: Students interpret the bosque on a field trip using individual informational clue cards.

Objective: To help students learn to observe and make inferences from their observations about the ecological processes in the bosque.

Materials:

- Photocopies of clue cards
- Field journals, pencils
- Appropriate field trip equipment (See *Planning a Bosque Field Trip*, in Chapter 3 Going Out: Field Activities)

Phenomena: I can discover many things about the bosque (or other natural area) if I make careful observations. I can discover clues that will tell me about the plants and animals that live here now, lived here in the past, and will live here in the future.

Lesson Questions:

- *Why are there piles of dirt on the ground?*
- *Why are pieces of the bark missing on that cottonwood tree?*
- *Why is saltbush growing in the bosque?*
- *How did that tree get mud rings around its base?*

8. Reading the Bosque



Grades: 4–12

Time: one field trip to the bosque, about two hours

Subjects: science



Terms: *arson, cambium, cohort, debris, germinate/germination, larvae, meander, overbank flooding, photosynthesize, riparian, scat, sediment, semi-parasitic, snags, sucker, water table*



New Mexico STEM Ready! / Next Generation Science Standards

NOTE: see **NGSS Connections to *Going Out: Field Activities*** at the end of this chapter for more possible field trip NGSS connections and for suggestions using each standard.

NGSS DCIs and New Mexico State Performance Expectations

- 1.LS1.B Growth & Development of Organisms
- 1.LS1.D Information Processing
- 3.LS1.B Growth & Development of Organisms
- 3.LS2.D Social Interactions & Group Behavior
- 4.LS1.A Structure & Function
- 4.LS1.D Information Processing
- 5.LS1.C Organization for Matter & Energy Flow in Organisms
- 5.LS2.A Interdependent Relationships in Ecosystems
- 5.ESS3.C Human Impacts on Earth Systems
- MS.LS2.A Interdependent Relationships in Ecosystems
- MS.LS2.C Ecosystem Dynamics, Functioning and Resilience
- MS.LS4.D Biodiversity and Humans
- MS-ESS3-3 NM PE Human Impacts 
- MS.ESS3.C Human Impacts on Earth Systems 
- MS.ESS3.D Global Climate Change

NGSS CCCs

Patterns; Cause & Effect; Energy & Matter: Flows, Cycles, & Conservation; Stability & Change

NGSS SEPs

Asking Questions & Defining Problems; Constructing Explanations & Designing Solutions;
Engaging in Argument from Evidence*

*indicates extension activity

Background: When we read, we interpret many symbols (letters) that make up the words. The words make up sentences that express ideas. Reading is a process of understanding others' written thoughts by making sense of many smaller symbols. We use reading or decoding skills in other areas as well. For example, musical notes on a scale are symbols we translate into melodies and songs.

Naturalists are adept at “reading” the landscape. That means that they can infer what is happening, or has happened, or might happen in the future, by looking at the clues on the landscape and translating them into a larger understanding of the ecosystem. Reading the landscape requires building an understanding about what your observations mean. For example, a person looking at tracks in a trail might say, “Look, an animal walked here.” A more experienced observer might be able to identify the animal based on the shape of the track. An expert might add when the animal came by, what other animals it was with, and maybe even what it was doing. Like any other kind of reading, the more you read the landscape, the better you will become at interpreting what you see. Unlike reading words, landscape reading is not an exact science. People often interpret ecosystem “stories” in different ways. Some students may read the bosque well, even though they struggle with reading words.



As you go through this activity with students, they will develop knowledge and a better understanding of how to “read the bosque,” or how to interpret the **riparian** area (rye-PEAR-ee-an; relating to or living or located on the bank of a natural fresh watercourse such as a river, stream, creek, pond or lake) to tell a story about the past and the present.

Procedure:

- ◆ Introduce the idea that we know things from making observations. For example, if the cereal box is empty, we know that all the cereal is gone. If the sun is streaming through our window and our parents are yelling at us to get up, we know it is morning. Much of what we know about the world around us is gathered by observing phenomena through our senses (sight, smell, hear, taste, touch). Explain that much of what we know about the bosque comes from our observations. By learning what our observations mean, we can know the bosque better.

In reading we use words, linked together in sentences, to share ideas. In reading the bosque landscape, we learn to identify the elements of the bosque, such as a type of plant. Then, we combine those observations to understand a bigger story and learn about the larger ecosystem.



*North American Porcupine eating in
a Russian Olive tree in the Bosque*
Photograph by Laurel Ladwig



- Have students make a KWL chart.

Ask *What do you **Know** about the bosque?* For students who have been to the bosque before, ask what they know based on their own observations.

Ask *What do you **Want** to know, that could be discovered through observation?*

If students are using a Bosque Field Journal, KWL charts may be added to their journals. At the end of the field trip, ask *What have you **Learned** about the bosque, based on your observations?* (**Asking Questions & Defining Problems**)

- Trip to the bosque:

There are 28 Clue Cards. Use one per student or pair of students. A few cards are seasonal, such as when the cottonwoods are sending out seeds covered in “cotton” and it seems like it is snowing, but cottonwood cotton can usually be found year-round if you look. You will be able to use most of the cards at any time of year, but it is best to do a reconnaissance trip to identify cards that will apply on your particular walk.

**Teaching Multiple Subjects
Using a Lacy Leaf**

**Find a Lacy
Leaf and draw
it.**

**Is this leaf from
this growing
season?**

Estimation- MATH
Prediction- SCIENCE
Observation-ART
Story Telling-LANGUAGE ARTS

**Write a story
about where
this leaf has
been.**

**Estimate
how many
holes you
see.**

Use this activity as a jumping off point for many different subjects and standards that you want your students to reach. Above is an example of how you could use the lacy leaf Reading the Bosque card (#9) to teach multiple subjects at once.



Hand out the cards to students and explain that they will be the experts as they walk in the bosque. Each card has an introductory question or “something” to look for. They should read through the text on the card and figure out how to answer that question or what that “something” is. You should go over terms they will be using. As you walk, when they see the item referred to, the whole group should stop and learn from the “expert” about it. They can read the paragraph or, even better, having read it before, they tell the information to the whole group in their own words. Or ask the group their thoughts on the answer to the question and then fill in with extra information from the card.

As facilitator, you may have to stop the group and say, “Does someone have some information about ____?” in order to remind the students that this is a good place to share a particular card.

- If using their Bosque Field Journals, have students record their observations in them.
- Older students may take photos of clues to be shared later as part of research, reflection and /or share-out in the classroom.
- For any age, use clue cards to guide research in the classroom. Provide field guides and other naturalist books for reference.
- Each card includes an **Additional Learning Challenge** for more advanced students. After discussing the main clue at the top of the card, have students read their challenge to the class and offer a possible answer or explanation based on their observations. You may use these challenges to guide research back in the classroom.

🍄 Depending on what you see on any given walk, there are many science standards that can be addressed. Here are some examples. The numbers shown in parentheses indicate the activity cards where each of these may be addressed.

What behaviors do adult birds do to help provide a good start for their young? (12, 13) **(1.LS1.B Growth & Development of Organisms)**

Cottonwood trees send off fluffy tufts carrying seeds to new locations. Look at the challenges of cottonwoods reproducing. (16) **(3.LS1.B Growth & Development of Organisms)**

Look at ants. (4) *How does living in a group help the colony?* **(3.LS2.D Social Interactions and Group Behavior)**. *How do ants communicate with each other?* **(1.LS1.D Information Processing; 4.LS1.D Information Processing)**


What adaptations do pocket gophers have to living underground? (2) **(4.LS1.A Structure & Function)**

Look at the various animals that eat cambium, the inner bark of trees: beaver, porcupine and bark beetles. *How do they each obtain the food that they need?* (1, 6, 11) **(5.LS1.C Organization for Matter & Energy Flow in Organisms; Patterns)**



How did a cottonwood leaf get to be lacy? What organisms depend on them? (9) **(5.LS2.A Interdependent Relationships in Ecosystems)**

Mistletoe is a partial parasite on cottonwood trees. *How does it survive and reproduce?* (20) **(MS.LS2.A Interdependent Relationships in Ecosystems; Energy & Matter: Flows, Cycles, & Conservation)**

Look at ways humans have altered the river and bosque habitat, and consider effects on native plants and animals. (15, 18, 19, 24) Look for marsh plants and consider the impact humans have had on wetlands throughout the bosque ecosystem. (22, 23) Look at a site that has been burned. (10) *How might the actions of humans increase the risk of fire in the bosque, both directly and indirectly? How can we decrease that risk?* **(5.ESS3.C Human Impacts on Earth Systems; MS-L2.C Ecosystem Dynamics, Functioning & Resilience; MS.LS4.D Biodiversity & Humans; MS-ESS3-3 NM PE Human Impacts; MS.ESS3.C Human Impacts on Earth Systems; Cause & Effect** 

Younger Students

If there will only be one trip to the bosque for a group of younger students, then select 3-4 cards and assign a card to each small group to do the research and report back to class. If multiple trips are possible, select one theme for each trip for the class to focus on. For example, use “Looking for stumps,” as a focus for a trip. At each stump students think about what had happened in order for that tree to fall, and the teacher helps the class think through answers.

Suggested cards for younger students: looking for antlion pits, stumps, harvester ant hills, pocket gopher mounds, seasonal signs, bark beetles, jetty jacks, lacy leaves and isopods, tracks and scat. You will need to summarize the information for their level.

Assessment:

Revisit the KWL charts and ask students: *What have you **Learned**, based on your observations?* Record in journals, and/or present to the class. Use unanswered questions based on students’ observations to guide research back in the classroom.

Extension:

Use “**Additional Learning Challenges**” from the cards as research extensions.

Resources:

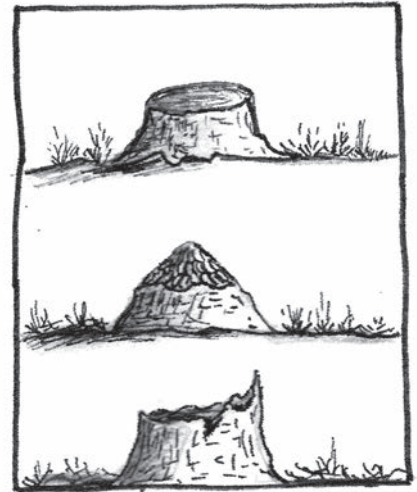
The “Changing River” activity in Chapter 4 will give an overview of the concepts in this activity.

Clue Cards

(1) Stump. Why did that tree fall down?

Look at the surface of the stump.

- If the tree stump is cut straight across and even, it was cut by a person using a saw. Sometimes trees are taken from the bosque for the wood. In some areas a tree might be cut down so that it does not fall on people using a trail or to move it off the trail.
- If the tree has teeth marks along the cut, it was cut down by a beaver. Along the Rio Grande, beavers cut trees to use for food. After the tree falls, if it is a large tree the beavers take off the branches to use, but they will not eat the trunk. For small trees, beavers will take the whole tree. They eat the layer of tissue underneath the bark, called the **cambium** (CAM-bee-um).
- If the stump has jagged edges, the tree blew over, perhaps in a strong wind. This often happens to trees that are already damaged by fires or by drought stress. Often these tree stumps are at different heights because the trees break off at different places.



Additional Learning Challenge:

What happens to trees that fall down in the bosque?

(2) Look for piles of soil about 1 foot (30 centimeters) across. What made these mounds?

These are pocket gopher mounds. They are very common in the bosque, because gophers are able to dig easily in the soil near the river. The gopher digs a tunnel underground, then pushes all of the soil that it moved aside to make the tunnel up through the tunnel's hole to the surface. Gophers usually fill in the entrance hole so that predators can't get in as easily, so typically you will not find a hole in the pile of soil. Gophers spend most of their lives underground. Many desert plants have enlarged roots or other underground storage parts that store nutrients and water for the plants. Gophers dig new tunnels to get to these underground parts of plants, which are their favorite foods. Being underground also helps the gopher avoid predators and extreme hot and cold temperatures.



Pocket Gopher Mound

Additional Learning Challenge:

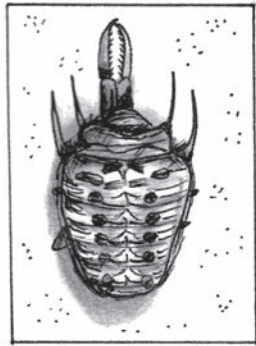
What adaptations do pocket gophers have to life underground?

(3) Look for small pits in the sand—2-inch (5-centimeter) funnel-shaped depressions. What made these pits and what are they for?

A young antlion (also called a “doodlebug”) lives here. Antlion **larvae** (LAR-vey; young insects, which eventually become adults that fly) hide at the bottom of small, conical pits that they make in sand or fine dirt. They wait to catch ants and other small insects that fall into the pit. Antlions have large jaws to catch their prey.



Antlion Pit



Antlion Larvae



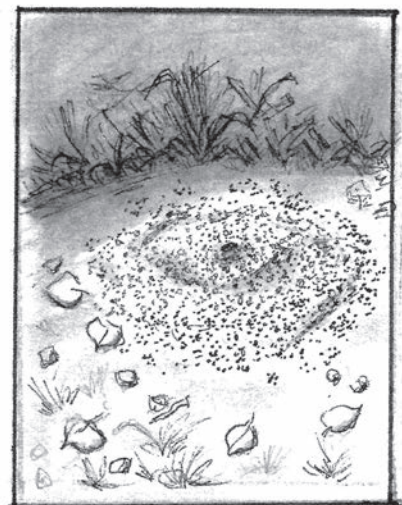
Adult Antlion

Additional Learning Challenge:

What other holes can you find in the bosque? Can you tell what made them?

(4) Look for a mound of sand with a wide circle of bare ground around it. What made that hole? Do you see any ants going in and out of the hole? What are they doing?

This mound with a hole in it was made by harvester ants. Harvester ants build large, underground nests over 9 feet (3 meters) deep with many storage chambers. They eat seeds, which they collect from the area around the nest and then carry underground. Sometimes they also eat other small animals such as isopods, which they sting and carry underground. The ants carefully tend the mound outside the nest. They place bits of dead plant material, small stones, and, sometimes, tiny bits of leaves on the surface of the mound, probably to trap warmth from the sun. Sometimes there are also skeletons from isopods. Often small trails can be seen going out from the nest; worker ants forage along these, looking for seeds. The ants stay underground in winter and eat stored food.



Harvester Ant Hill

Additional Learning Challenge:

What happens when we kill ants or other animals that humans consider to be “undesirable?”

(5) Look high in the trees for a spiky brown ball (bigger than a soccer ball) that looks like a giant nest, but it is not made of sticks. It might even move. What is this?

It is a porcupine! Porcupines are often seen high in cottonwood trees, but they use other trees as well. They are shy and often appear to be sleeping, but sometimes you can see them feeding on tree bark or buds. They are covered by prickly quills, which are really modified hairs. Porcupines cannot shoot their quills. They are easiest to see in winter when the trees have no leaves.



Additional Learning Challenge:
Why do porcupines have spiny quills?

Porcupine Curled up in Tree

(6) Look for trees with large patches of bark missing from trunk or branches with little paired tooth marks, sometimes high in the tree. What caused this?

Porcupines live in trees. In winter, they chew off patches of bark and eat the inner layer of bark, the growing part called the **cambium** (CAM-bee-um). They sometimes chew the bark off all the way around a branch or trunk, but they do not cut the whole tree down the way beavers do. In spring and summer, they may eat new leaves, buds, and twigs. Porcupines often prefer to eat up high where they are safe from predators.



Porcupine



Porcupine Chew

Additional Learning Challenge:
Why do porcupines (and beavers) eat the cambium part of the tree?

(7) Look for tracks that appear to be tiny hands. Who made these tracks?

These tracks were made by a raccoon—they tell you that a raccoon was here. The tracks left by the front feet of raccoons look like small human hands, so they are easy to identify. Raccoons often walk along the mud or wet sand in the riverbed, or along the shore, as they look for food. They like to eat aquatic animals such as frogs and crayfish.



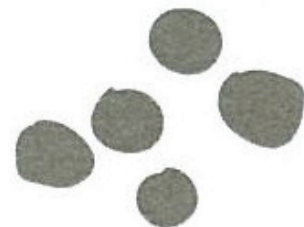
Raccoon Tracks

Additional Learning Challenge:

What other tracks can you find in the bosque and along the river? Can you identify them?

(8) Can you find any animal scat (droppings) and what can you tell from it?

“Scat” is a name used by biologists for “poop.” You can tell what animal has been here by the scat it leaves behind. You can also tell a lot about what an animal eats by looking at its scat. For example, coyote scat will have small bones and fur in it if the coyote has been eating mice, or it may contain the hard shells from beetles if that is what the coyote has been eating. Or, it may have berry seeds or other bits of hard plant material. The shape of an animal’s scat can often identify the type of animal. Rabbit scat are round pellets that are filled with plant material. Look in a book of animal signs to learn how to identify scat.



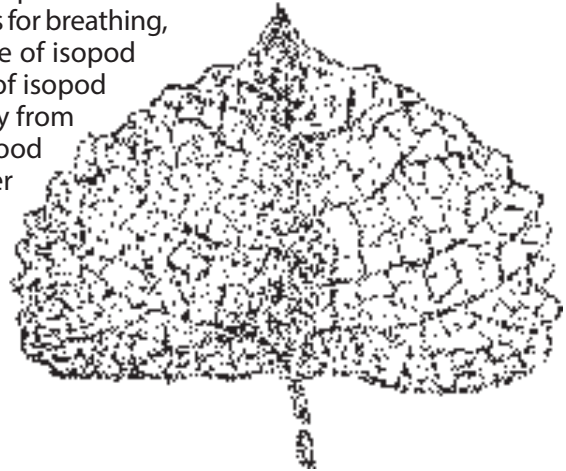
Rabbit Scat

Additional Learning Challenge:

What happens to the scat left behind by animals in the bosque?

**(9) Look at the fallen leaves on the ground. Can you find a “lacy” leaf?
How did the leaf get this way?**

This leaf was eaten by isopods (pillbugs, woodlice). The isopods eat away the soft tissue of the leaf and leave behind the tougher veins, giving the leaf a lacy appearance. Isopods are crustaceans and related to shrimp and crabs. They have gill-like structures for breathing, so they need to be in moist areas. The most common type of isopod in the bosque rolls up when it is disturbed. Another kind of isopod cannot roll up so instead, it moves faster to try to get away from predators. Females can hold as many as 200 eggs in a brood pouch on their undersides. Isopods are the main chewer of fallen cottonwood leaves in the bosque. They start the process of decomposition that is an important part of the nutrient cycle—providing necessary nutrients to plants and animals in the bosque ecosystem.



Lacy Cottonwood Leaf

Additional Learning Challenge:

What would happen to the forest if there were no decomposers?

**(10) Do you see any charred stumps or snags (standing dead trees)?
What happened here?**

The site was burned by a fire. Fires may not have been an important part of the bosque before the river ecosystem was changed and flooding was reduced. When the bosque flooded regularly, the wetter ground did not carry fire. The branches that fell off of trees decomposed faster with the added moisture. For instance, a log that might take 70 years to decompose today in our current dry conditions might have taken only 10 years to decompose when there was regular **overbank flooding** that kept the soil moist. This wood from fallen tree branches or standing dead trees (**snags**) now contributes to very hot fires that do a lot of damage in the bosque today. While some burned trees may re-sprout from the stump or roots, very hot fires may kill the tree completely. Most bosque fires are started by humans. Ignition sources include dropped lit cigarettes or matches, fireworks, burning to clear adjacent fields or ditches and intentional acts of arson. Only a small number of fires in the bosque today are started by lightning.



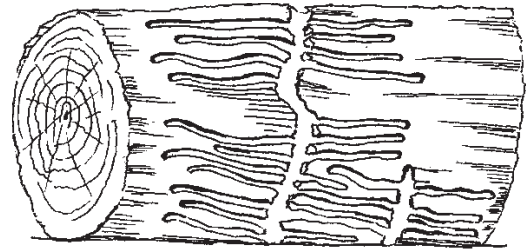
Snag

Additional Learning Challenge:

What can you do to help reduce the risk of fires damaging the bosque?

(11) Inspect fallen logs carefully. Can you find any small trails cut into them where bark is falling off? How did they get there?

The trails were made by bark beetles. Adult bark beetles bore through the bark of a tree and make tunnels between the bark and wood and eat **cambium** (CAM-bee-um), in which they lay their eggs. The young, called **larvae** (LAR-vey), also make tunnels under the bark. Sometimes, if there are enough of them, the beetles can kill a tree by making these tunnels. If the numbers of beetles are low, this will not kill the tree. Trees that are sick or facing drought are more likely to die from bark beetles.



Bark Beetle Trails

Additional Learning Challenge:

How might climate change and increasing drought affect trees exposed to bark beetles?

(12) Look for a nest in a tree. What materials is it made from?

Many types of birds build nests in trees, often using sticks, twigs, grasses and other plant material. Sometimes they include man-made objects, such as plastic bags. They build nests as places to lay their eggs and raise their babies. Nests are often hard to see when the trees have leaves on their branches, but are easy to spot in the winter after trees have lost their leaves. Nests tell us that birds live in the bosque during their breeding seasons. Owls build their nests in winter, but most smaller birds build nests in spring or summer. Sometimes we can tell what type of bird made the nest. Use a field guide to nests to help you discover the builder.



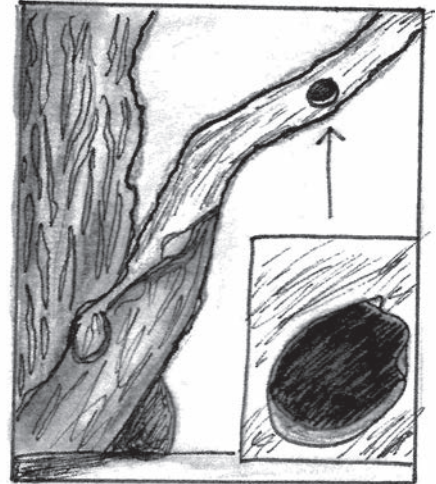
Bird Nest

Additional Learning Challenge:

What will happen to birds that nest in trees if the bosque trees die off due to factors such as drought, decreased seedling survival or fire?

(13) Look for a round hole in a standing dead tree or in a dead branch of a living tree. What is this hole and what made it?

Woodpeckers drill holes in **snags** (standing dead trees) or branches to use as nesting cavities. They use their strong bills to chip out the dead wood and then build a nest inside the cavity. Sometimes woodpeckers reuse these nesting cavities for more than one breeding season, and sometimes other types of birds use them. Birds in the bosque that use woodpecker cavities include nuthatches, chickadees, wrens and western screech owls. Sometimes native mice even build their nests in abandoned woodpecker holes! These trees are sometimes called "wildlife trees" due to their importance in providing animal habitats.



Cavity Nest

Additional Learning Challenge:

What will happen if large trees such as cottonwood are replaced by smaller trees such as saltcedar?

(14) Look along the river's edge for a trail that appears to have been swept with a broom going into the woods. What made this?

Beavers make trails into stands of young willows, cottonwoods or other trees. They cut small trees and drag them back to their dens in the riverbank, so the trail they leave behind looks like it was swept with a broom. Follow the trail away from the water and you may find the area where the beaver has cut small saplings. They prefer to cut young, tender trees rather than large, old ones. If they cut down large trees, they only take the smaller branches and leave the trunk. They eat the inner layer of bark, called the **cambium** (CAM-bee-um).



Beaver Trail

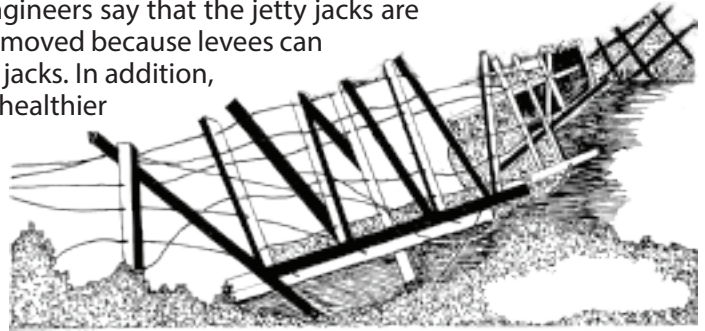
Additional Learning Challenge:

Can you identify the type of trees the beavers are cutting?

What happens if there are no young trees for the beavers to cut?

**(15) Look for big metal structures near the river.
What are these and why are they here?**

These are called Kellner jettys, jacks, or “jetty jacks.” Jetty jacks were put in along the river by the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation, starting in the early 1950s. They helped to straighten the river and protect the levees. They work by slowing the speed of the river’s flow, which causes **sediment** (dirt) carried by the water to drop out. As the dirt builds up, **riparian** (rye-PEAR-ee-an; streamside) plants can start to grow. This helps keep the river bank in one place, and prevent the river from moving across the floodplain. This also protects the levees during a flood, preventing the floodwaters from eroding the levees. Today, engineers say that the jetty jacks are no longer needed and some jetty jacks are being removed because levees can now be built to withstand floodwaters without the jacks. In addition, we also now know that floodplain ecosystems are healthier if the river can move freely across the land.



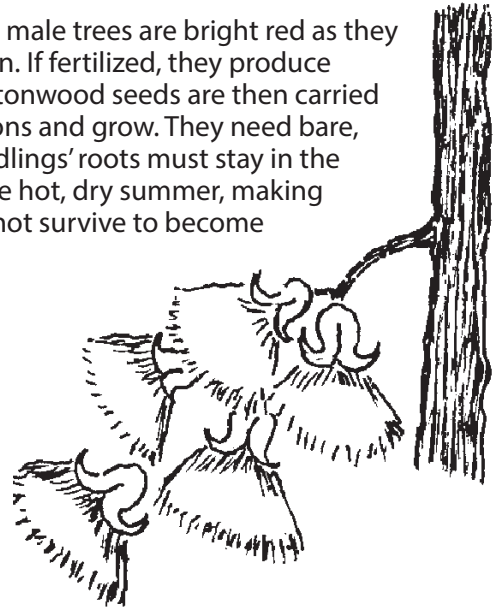
Jetty Jacks

Additional Learning Challenge:

How does straightening the river affect the plants and animals that live here?

(16) Does it look like snow in the summer? Find some cottonwood cotton and inspect it carefully. Why do cottonwoods make cotton?

Cottonwoods have separate male and female trees. The flowers on male trees are bright red as they emerge; they produce pollen. The flowers on female trees are green. If fertilized, they produce pea-like fruits that open to release hundreds of cottony seeds. Cottonwood seeds are then carried by the wind on the chance that some will land in the right conditions and grow. They need bare, wet soil to **germinate** (GERM-in-ate), with lots of sunlight. The seedlings’ roots must stay in the wet soil as the **water table** (underground water) drops through the hot, dry summer, making that underground water harder for roots to reach. Most seeds do not survive to become large cottonwood trees.



Additional Learning Challenge:

Why do cottonwoods produce so many seeds?

Cottony Seeds on Female Cottonwood

(17) Look for a low plant with thick, leathery leaves and large white flowers during summer and fall. What is this plant and what does it tell you?

This plant is yerba mansa. It grows in moist areas or in places with a high water table. The presence of this plant in the bosque tells you that the **water table** (underground water) is probably fairly high (or near the surface). Yerba mansa has been used medicinally for generations to treat many ailments. Maybe you can ask an elder about this plant.



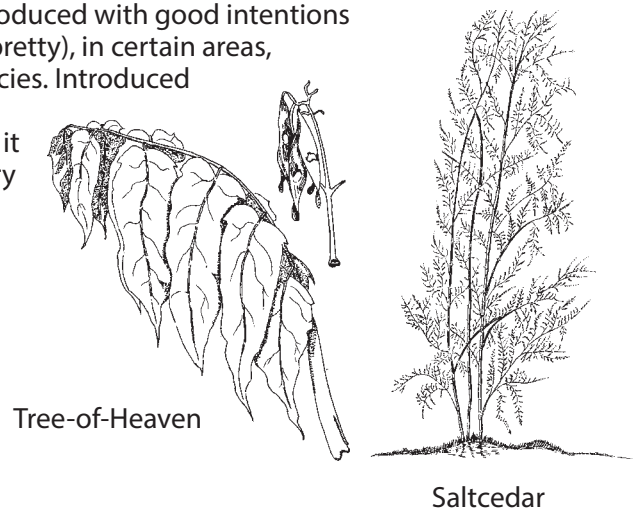
Yerba Mansa *Anemopsis californica*

Additional Learning Challenge:

What would happen to this plant if the water table drops due to extended drought?

(18) Look for non-native trees and shrubs, such as elm, saltcedar, Russian olive, tree-of-heaven and mulberry. What do these tell you?

The presence of introduced plant species tells you that humans have altered the ecosystem. Trees and shrubs that did not occur naturally in the bosque were introduced by people for a variety of reasons, beginning in the 1800s. Although these plants were introduced with good intentions (such as to stabilize the riverbank or because they look pretty), in certain areas, introduced plants have taken over in place of native species. Introduced plants are not all bad or all good, but some are more (or less) harmful than others. Some, such as saltcedar, make it harder for native plants to grow. Others, such as mulberry with its edible fruits, provide food for native animals. Either way, these introduced plants are now part of the bosque ecosystem.



Tree-of-Heaven

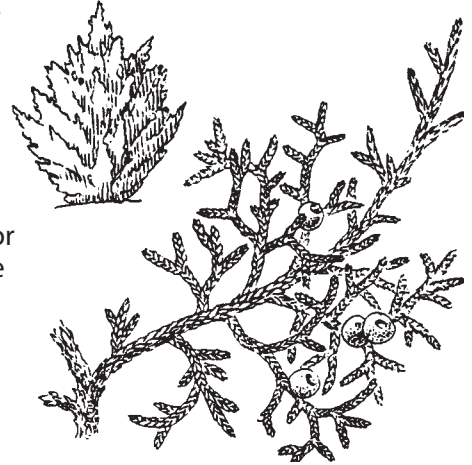
Saltcedar

Additional Learning Challenge:

How might non-native plants affect the animals that live in this area?

(19) Look for upland shrubs such as juniper, snakeweed or four-winged saltbush in the bosque. What does their presence indicate?

The presence of these upland shrubs in the bosque suggests that the **water table** (underground water) is fairly deep or that the area no longer floods, because these plants typically grow in dry soil up on the mesas. Sometimes these plants grow on the levees. Upland shrubs do well in the bosque when the ground water level drops. This is typical along regulated rivers in which dams control the flow of the river. These shrubs do not require as much water as the typical **riparian** (rye-PEAR-ee-an; streamside) shrubs like New Mexico olive or coyote willow. Juniper is a good indicator of a deep water table in the bosque, because this plant does not do well in moist soil.



Juniper

Additional Learning Challenge:

Based on the presence or absence of upland shrubs, what can you conclude about this area?

(20) Look for a cluster of bright green leaves growing on the branch of a tree that looks different from the regular leaves of that tree. What is this?

Mistletoe is a **semi-parasitic** plant that grows in cottonwoods, elms and other broadleaf trees. It can **photosynthesize** (fo-tow-SIN-thuh-size) to make its own food, but it also sends root-like structures through the tree's bark and into its branches to steal water and nutrients from its host. It is easy to see the green mistletoe plant in its host tree during the winter when the tree's own leaves have turned brown or fallen. Mistletoe is more common in southern New Mexico but has been moving north, probably because drought-stressed trees are more vulnerable. Although it can further stress the host tree, mistletoe also provides food and shelter for a large variety of animals, including birds, mammals and insects. It is very toxic to humans, though, so don't be tempted to eat its leaves or berries! The seeds of bosque mistletoes stick to the legs and bills of birds, who carry them to new trees where the seeds can grow.



Mistletoe

Additional Learning Challenge:

*Is mistletoe harmful or beneficial to the whole ecosystem? Why?
How might global warming affect the mistletoe and its host trees?*

(21) Look at a group of cottonwood trees. Are they all the same age?

Cottonwood seeds **germinate** (GERM-in-ate; sprout) on sand bars or open areas where conditions are favorable, with plenty of available light and moisture. Typically, many seeds will germinate along the same stretch of ground when conditions are good. This results in a whole group of cottonwood trees that are the same age growing up together in a patch. We call this group of same-aged trees a cohort. Although trees that are the same age are generally in the same size class with roughly the same height and diameter, sometimes their sizes can vary.



Cottonwood Cohort

Additional Learning Challenge:

What could cause trees that are the same age to be different sizes?

(22) Look along the edge of the river, along channels or on sandbars. Can you find baby cottonwoods?

Baby cottonwoods (seedlings) need bare soil where they have lots of sunlight and lots of water. The conditions needed by baby cottonwoods are less common now because flood control and other conditions have altered the river. As a result, there are very few young cottonwoods along the Rio Grande, and many young trees are washed away with each year's high water. Land managers are now changing their approach and trying to improve growing conditions to allow cottonwoods to again thrive in our bosque by allowing **overbank flooding** in high water years, creating secondary channels and planting cottonwoods.



Baby Cottonwood

Additional Learning Challenge:

What will happen to the bosque if there are no baby cottonwoods?

(23) Look for cattails, sedges or other marsh plants. What does this tell you?

It is likely that this is a wetland created by humans. Although marshes, ponds and wet meadows were once common in the floodplain, wetland habitats decreased after humans regulated the river and drained the floodplain to create farms and build cities. Now land managers know how important wetlands are. They help with flood control, improve water quality, decrease soil erosion, provide habitat for many plants and animals, and more. Land managers now create wetland habitats such as ponds and marshes. These are great places to go to look for wildlife!



Cattails

Additional Learning Challenge:

What are things that you could do to help protect and restore wetlands in New Mexico?

(24) Look at the state of individual cottonwoods. How can you tell a healthy cottonwood from an unhealthy cottonwood?

Cottonwoods usually live where water is abundant. This would be true in the **riparian** (rye-PEAR-ee-an; streamside) zone of a river in its natural condition. When cottonwoods do not get enough water, they become unhealthy. They often have dead branches with dry, brown leaves, even in summer. Some of their branches may fall off due to drought stress. In some trees you can see a dark liquid coming from where a branch fell off. These trees may be more susceptible to attacks by insects. In contrast, healthy trees have full green leaves and branches.



Healthy Cottonwood



Unhealthy Cottonwood

Additional Learning Challenge:

Do most of the cottonwoods in this area appear to be healthy or unhealthy? What might this tell us about the availability of water here?

(25) Look for cottonwood trees with a single trunk and trees with several trunks growing from the base. What causes the difference?

A cottonwood can grow from a seed, or by sprouting from an existing trunk or a shallow root. The cottonwood with a single trunk grew from a seed. The group or cluster of trunks grew from sprouts called **suckers**. Cottonwoods grow suckers in response to many types of disturbances that cut down the original tree. Examples of disturbances include being cut by a beaver, being burned by a fire, or being knocked over by a flood. Usually the underground roots are not bothered by these things, and the tree is able to sprout again. When it does, it typically sends up several stems instead of just one. This results in clusters of trees that come out of one base. Sometimes they look like separate trees because dirt has covered up the area where the trunks are joined, but you can still see that the trees are growing very close together.



Multi-trunk Tree



Single-trunk Tree

Additional Learning Challenge:

How would the ability to re-sprout be an advantage to a tree exposed to many disturbances?

(26) The bosque changes based on the seasons. What things do you notice in or near the bosque that tell you what time of year it is?

Some examples:

a) Spring—cottonwood flowers. Cottonwoods flower only in the spring, usually around April in the Middle Rio Grande Valley. The exact date varies among years, and flowers come out earlier in more southern areas. The red catkins of male flowers are easier to see than the green female flowers.

b) Late spring/early summer: cotton in the air. The cotton carries the cottonwood seeds. It is released during the period when the river is most likely to overflow its banks and create habitat for seed germination and seedling growth.

c) Fall—cottonwood leaves have turned yellow.

d) Fall or spring—V of cranes flying overhead. Large numbers of waterfowl (ducks, geese, cranes) migrate along the Rio Grande. They fly south in the fall. In the spring, they can be seen flying north.

e) Winter—flock of crows roosting in cottonwoods. Large numbers of crows roost in the bosque during the winter. In the summer, most of them head north to breed, but some stay in the valley.

f) Winter—most cottonwood leaves have fallen off the trees, or if still on the tree branches, the leaves are dry and brown.



Flowering Cottonwood



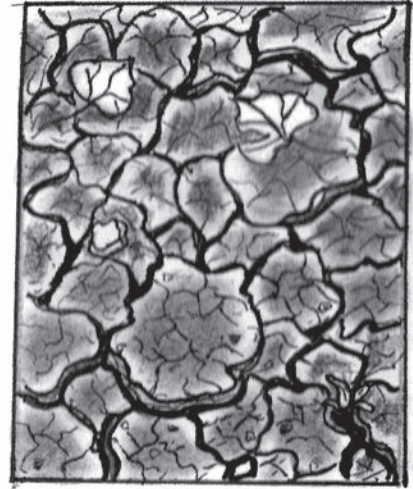
Yellow Leaf in Fall

Additional Learning Challenge:

What other examples can you see? How might climate change alter these seasonal clues?

(27) Look for cracks in the soil and rings of mud or debris (de-BREE) at the base of the trees. Why are these here?

When the snow melts high in the mountains and the streams swell with water, the river naturally swells as well. When so much water comes down the river that it can no longer stay in the channel but has to flow over the riverbanks, this is called **overbank flooding**. Today we have several reservoirs that capture and hold this spring runoff to make water available later in the summer for farming, so fewer places in the bosque experience overbank flooding naturally. Because flooding helps the forest, land managers now do allow the bosque to flood in the years in which enough water is available. One way to identify areas that flood is to look for mud rings or **debris** (de-BREE; grass, leaves, trash, etc) on the trees. The spring river water carries **sediment** (dirt) that is deposited in the forest. The height of the mud rings indicates the depth of the flood water. Soils that are wetted regularly also develop cracks when they dry out. They are called mud cracks.



Mud Cracks

Additional Learning Challenge:

What other signs of regular flooding do you see?

Do you think the area you are in has flooded in recent years?

**(28) Look for a bend of a river.
Can you tell which side of the river is moving faster?**

The river flows faster on the outside edge of a bend, or **meander** (mee-AN-dr). The swift water cuts into the outer bank, eroding away some of the soil and cutting a sharp bank on that side. On the inside of the bend, the water moves more slowly. This slower-moving water drops some of the **sediment** (dirt) it carries, along the edge of the meander. The sediment gradually builds up, pushing the inner bank out into the river to form a sandbar. This is how the course of a river moves across the landscape: by eroding and depositing sediment.



Meander

Additional Learning Challenge:

How would floodplain vegetation be affected by a moving river?