



New Mexico STEM Ready! /Next Generation Science Standards

NGSS Connections to Going Out: Field Activities

Disciplinary Core Ideas (DCIs) and New Mexico State Performance Expectations

The following NGSS connections may be used while out on field trips, or back in the classroom following an outing, depending on specific observations and which opportunities arise. DCI's included with all of the Going Out activities are included here.

K-2.ETS1.B Developing Possible Solutions *Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.*

How can we help the bosque, including the cottonwoods and the animals that live there?

As a culminating activity, challenge students to think about what they would do in 20 years to help the bosque of the future. Allow for creative ways to show their ideas—build models, draw, video, etc.

K.LS1.C Organization for Matter and Energy Flow in Organisms *All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow.*

Select some plants and animals from your discovery walk. *How does each plant or animal get the energy it needs to survive?* Plants need sunlight, air and water to survive—they make their own food with just these things.

Animals need to eat to survive. *What kinds of foods do specific animals eat?* They might eat plants, or they might eat other animals.

K.ESS2.D Weather and Climate *Weather is the combination of sunlight, wind, snow or rain, and temperature in a particular region at a particular time. People measure these conditions to describe and record the weather and to notice patterns over time.*

Have students record the weather in their field journals each day they go out. As the year goes on, challenge them to show how things have changed through writing or drawings. Chart the temperature changes.

K.ESS2.E Biogeology *Plants and animals can change their environment.*

Look for examples of plants changing their environment. *For example, do plants that live next to the river have any effect on where the river flows? What happens to the bank of the river? On a sandbar?*

Trees and other vegetation growing along the river can stabilize the bank, affecting whether the river stays in one place or moves across the floodplain. Plants that grow on sandbars trap sediment and further stabilize the bar.

Look for examples of animals changing the environment. For example, ants create mounds and move tiny rocks and other material out of their underground nests. Pocket gophers and squirrels dig burrows, excavating soil from underground. Beavers cut trees, and in some areas (but not the Rio Grande), may build dams that create ponds. Birds build nests that may be used by other animals, including woodpeckers who excavate cavities in dead trees.

What are ways that humans change the environment?

K.ESS3.A Natural Resources *Living things need water, air and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.*

Think of the plants and animals you saw on your walk. *What resources does each need to survive, and where do they get those resources?* For example, trees need sunlight, air and water to live. They must live where those resources are available. Trees use sunlight to make their own food. If there is more water, many kinds of trees will be able to get bigger. Some types of plants require more water, so they must live in wetter areas.

Ducks need water to find their food and for protection from danger. They eat aquatic plants and invertebrates, so they need to live near ponds, ditches or the river.

Compare these to resources that humans use. *Where do we get our resources? How does that affect where we can live?*

K.ESS3.C Human Impacts on Earth Systems *Things that people do to live comfortably can affect the world around them. But they can make choices that reduce their impacts on the land, water, air, and other living things.*

Challenge students to think about what they might do to help the bosque of the future.

1.LS1.A Structure and Function *All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow.*

All living organisms have external structures that help them to survive. Think about plants and animals you saw on your walk. *What features do they have that help them survive?* Birds have wings to fly, fish have fins to swim, trees have leaves to absorb sunlight energy and roots to gather water and nutrients. Winter Buds: Plant structures can be observed in winter, even when the shrubs and trees have no leaves. Observe winter twigs carefully to identify plant structures; *how do these benefit the plant?*

1.LS1.B Growth and Development of Organisms *Adult plants and animals can have young. In many kinds of animals, parents and the offspring themselves engage in behaviors that help the offspring survive.*

Follow up on the Parents & Young prompt and Reading the Bosque cards for nests and nesting cavities. Consider examples of parents and young seen during your walk. *In what ways (traits of plants, behaviors of animals) did you see parent organisms helping their young survive? Are eggs carefully placed somewhere? Are millions of seeds produced so that a few may survive? Is a burrow dug or a nest built to protect the growing young?* Examples include a songbird feeding its young, baby ducks guided by their mother, a spider creating an egg sack to protect its eggs, or young Sandhill Cranes staying with their parents through their first winter. Learn more about the ways parents help their offspring survive.



1.LS1.D Information Processing *Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs.*

Note animals observed during your walk and consider ways they process information. An easily seen example is ants and the use of their antennae to follow a scent trail left by other ants from their colony to mark the location of a food source. Some types of plants, such as sunflowers, actually turn their flowers to track the movement of the sun. Think of bosque animals and what body parts and senses help them to find food and escape danger. Three examples: cottontail ears/hearing, coyote nose/smell, dragonfly eyes/sight.

1.LS3.A Inheritance of Traits *Young animals are very much, but not exactly, like their parents. Plants are also very much, but not exactly, like their parents.*

How are adult organisms like their offspring? Compare baby cottonwoods (seedlings) with adult cottonwoods – how are they alike or different? Young cottonwoods have smooth bark on their stems, while adults have rough bark, but the leaves of the two ages are similar. Young insects might be quite similar to their parents (such as grasshoppers, though baby grasshoppers do not have wings) or quite different (such as caterpillars of butterflies or moths).

1.LS3.B Variation of Traits *Individuals of the same kind of plant or animal are recognizable as similar but can also vary in many ways.*

Students can gather cottonwood leaves from the ground. Look at them closely. *Are they all the same? Play the game where everyone gets one leaf; spend time paying close attention to your leaf—are there any individual markings or pattern in the leaf? Put all leaves in a pile. Students sit in a circle while the teacher pulls out one leaf at a time and sends it around the circle. Can each student find “their” leaf?*

Discuss how seemingly identical leaves are actually different. *How are the students able to tell them apart? In some cases it is the variation in the inherited information as the leaf grew; in others it might be an insect that chewed it, or more or less water affecting its growth.*

2.LS2.A Interdependent Relationships in Ecosystems *Plants depend on water and light to grow. Plants depend on animals for pollination or to move their seeds around.*

Look closely at plants on your walks. *What conditions are needed for plants to grow? How do we get big trees in the bosque, but not up on a mesa? Do you see flowers? Can you find pollinators visiting those flowers? Look at seeds. Plants have different strategies for dispersing their seeds—see how many different types of seeds you can find, and how they might be dispersed.*

2.LS4.D Biodiversity and Humans *There are many different kinds of living things in any area, and they exist in different places on land and water.*

Record animals or plants seen in different habitats. Each habitat has animals and plants that live well under those conditions and with those resources. *How do habitats differ, and how does that affect the plants and animals living there?*

3-5.ETS1.B Developing Possible Solutions *Research on a problem should be carried out before beginning a design solution. Testing a solution involves investigating how well it performs under a range of likely conditions. At whatever stage, communicating with peers about proposed solutions is an important part of the design process, and shared ideas can lead to improved designs.*

How can we help the bosque, including the cottonwoods and the animals that live there?

As a culminating activity, challenge students to think about what they would do in 20 years to help the bosque of the future. Allow for creative ways to show their ideas—build models, draw, video, etc.

3.LS1.B Growth and Development of Organisms *Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles.*

Record observations of plants on your walks in your journals. Look for seasonal changes of plants through the year: when do first leaves appear, flowers, seeds, and fall color changes. Model the life cycle of one of the plants you have been observing. Note the production of seeds and cotton by cottonwoods and the challenges the plants face in reproducing.

3.LS2.C Ecosystem Dynamics, Functioning, and Resilience *When the environment changes in ways that affect a place’s physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.*

When looking at specific animals, whether vertebrates or invertebrates (such as arthropods), consider specific habitat requirements for that species. *What would happen to that species if that habitat, or microhabitat, were to change? What if it got hotter, drier, certain food plants died out, a fire burned through the area, etc.?* Consider a variety of possible changes and how the species is likely to cope with each.

3.LS2.D Social Interactions and Group Behavior *Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.*

Ants are easily seen examples of group-living animals in the bosque. Geese and cranes provide additional examples. *How do these organisms benefit from living in a group?*

3.LS3.B Variation of Traits

-Different organisms vary in how they look and function because they have different inherited information.

-The environment also affects the traits that an organism develops.

See 1.LS3.B for the cottonwood leaf game, to consider individual variation.

The same type of plant may differ in appearance depending on local conditions. *Is there more rainfall for one, more shade, different soil, etc.?* Animals also show variation in appearance based on variation in their local environment,



such as diet, humidity and light cycles. For example, the sex of some reptiles, including most turtles, actually depends on the temperature at which the eggs are incubated.

3.LS4.C Adaptation *For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all.*

Think of plants or animals that live in the bosque or river and that you saw on your walk. *What is one species that survives well in the bosque? Why does it survive well there? What part of the bosque habitat provides what the species needs? What characteristics does the animal or plant have that allows it to live in the bosque?* An example is a woodpecker. Woodpeckers require large trees in which they can drill nesting holes. The cottonwoods provide this habitat. The woodpecker has a stout bill, a stiff tail used for balance and a special toe arrangement that allow it to climb up tree trunks and drill holes. Contrast the bosque habitat with other habitats in North America that have different conditions, perhaps less water or harsher winters. *What is an example of an organism that lives well in a different habitat, but would not do well in the bosque? What signs did you find that tell us something about the animals that live in that particular habitat? Consider also microhabitats within the bosque. What kinds of organisms survive well, less well or not at all in that particular microhabitat?*

3.LS4.D Biodiversity and Humans *Populations live in a variety of habitats, and change in those habitats affects the organisms living there.*

Record animals or plants seen in different habitats or microhabitats. Consider also signs that tell us something about what habitat an animal uses. Each habitat has animals and plants that live well under those conditions and with those resources. *How do habitats/microhabitats differ, and how does that affect the plants and animals living there? What will happen to the plants and animals if the habitat/microhabitat changes?*

4.LS1.A Structure and Function *Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.*

All living organisms have internal and external structures that help them to survive. Use plants and animals you saw on your walk. *What characteristics do they have that help them survive, and what is the specific function of each structure?* Birds have wings that allow them to fly, fish have fins that help them swim, porcupines have long claws to help them climb trees, trees have leaves to absorb sunlight energy and roots to gather water and nutrients. Internal structures include hollow bones in birds to reduce weight and help them fly, a jaw that can dislocate to allow a snake to eat large prey or special vascular tissues in trees (xylem and phloem) that transport water, sugars and other materials around in the plant. Each particular structure provides a function that helps that animal or plant to live successfully.

Pick any plant or animal. What structures enable it to survive? Write about it or make a model with labeled features. Use evidence, data and/or a model to explain your reasoning.

Winter Buds: Plant structures can be observed in winter, even when the shrubs and trees have no leaves.

Consider structures that help plants survive in winter, as well as the function of structures easily observed at that time.

4.LS1.D Information Processing *Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal's brain. Animals are able to use their perceptions and memories to guide their actions.*

Note animals observed during your walk and consider ways they process information. An easily seen example is ants and the use of their antennae to follow a scent trail left by other ants from their colony to mark the location of a food source. Another example is bird communication. Birds use auditory communications; one bird sings or chirps while another hears the song. Songs provide information about territory boundaries as well as mate choice. Chips and chirps are used to keep contact with other flock members. Other types of sounds, like drilling on tree trunks, are used as well. Birds are able to process and understand these auditory signals.

5.LS1.C Organization for Matter & Energy Flow in Organisms *Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. Plants acquire their material for growth chiefly from air and water.*

Plants need sunlight, air and water to survive—they make their own food with just these things. Animals need to eat to survive. They might eat plants, or they might eat other animals. Use **Species of Greatest Conservation Need** as examples. These are animals that are threatened or endangered, or considered at risk of becoming so, and so need extra management attention. How does each species get the materials and energy it needs to survive? **Rio Grande Silvery Minnows** eat algae and tiny plant pieces found in the river. **New Mexico Meadow Jumping Mice** live in marshes where they eat flowers and seeds of grasses and other plants, in addition to insects. **Northern Leopard Frogs** eat insects that fly near water; they must feed in wet habitats. **Southwestern Willow Flycatchers** also eat insects that fly near water and so live in riparian vegetation. **Bald Eagles** eat fish, or carrion (dead animals), so they typically live and hunt near water courses. All of these animals need wetland habitats to acquire the materials and energy needed for body repair, growth and motion.

Consider various animals that eat cambium, the inner bark of trees (beaver, porcupine, bark beetles). *How do each of these obtain the food they need to survive?*

5.LS2.A Interdependent Relationships in Ecosystems *The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plant parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.*



Consider organisms that you see on your walk, and categorize them as producers, consumers, decomposers (or nonliving). *How might the different organisms be related?*

Look for lacy cottonwood leaves, signs that decomposers have been at work. How did the leaf get to be lacy? What organisms depend on cottonwood leaves?

Have any introduced species damaged this ecosystem? (See the Guide for more information on introduced species!)

5.ESS3.C Human Impacts on Earth Systems *Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air and even outer space. But individuals and communities are doing things to help protect Earth's resources and environments.*

From your walk in the bosque, think about the signs of humans changing things in the bosque. There are great things and maybe not so great things. *Can you make some lists? What are ways that humans are helping the river and the bosque? What restoration projects did we see on our walk? Are any animals or plants helped by these restoration projects? If so, which animals or plants are helped, and in what ways are they helped through those projects? When sampling aquatic invertebrates, what does the composition of the species present tell us about the quality of the habitat? How do humans affect the species present in an aquatic ecosystem? How might the actions of humans increase the risk of fire in the bosque, both directly and indirectly, and how can we decrease that risk?*

MS.LS2.A Interdependent Relationships in Ecosystems

- *Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and with nonliving factors.*

- *In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.*

- *Growth of organisms and population increases are limited by access to resources.*

- *Similarly, predatory interactions may reduce the number of organisms or eliminate whole populations of organisms. Mutually beneficial interactions, in contrast, may become so interdependent that each organism requires the other for survival. Although the species involved in these competitive, predatory, and mutually beneficial interactions can vary across ecosystems, the patterns of interactions of organisms with their environments, both living and nonliving, are shared.*

Mistletoe is a partial parasite that depends on its host cottonwood trees. How does it survive and reproduce?

MS.LS2.C Ecosystem Dynamics, Functioning and Resilience

- *Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.*

- *Biodiversity describes the variety of species found in Earth's terrestrial and oceanic ecosystems. The completeness or integrity of an ecosystem's biodiversity is often used as a measure of its health.*

On your walk, look for the diversity of living organisms. Try to get a sense of the biodiversity of the bosque. Make lists of plants and animals or animal sign observed.

How might the species present change with changes to the physical or biological components of the ecosystem? For example, if the climate continues to warm and drought continues in New Mexico, how might microhabitats within the bosque change, and how might that affect species living there? How has the local biodiversity already been affected, such as with the introduction of non-native plants or the presence of upland plants in riparian areas? How have human actions, such as the introduction of jetty jacks and changes in river flow, affected the species present?

MS.LS4.D Biodiversity and Humans *Changes in biodiversity can influence human's resources, such as food, energy, and medicines, as well as ecosystem services that humans rely on—for example, water purification and recycling.*

How do the human-caused changes to bosque habitats affect the organisms living there? What value can people put on the bosque? What benefit does the bosque give to humans? (Monetary, spiritual, ecological, mental, etc.?)

MS.ESS3.D Global Climate Change *Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding human behavior and applying that knowledge wisely in decisions and activities.*

Winter Buds: Many plants depend on cold winter temperatures to facilitate certain aspects of their annual cycles, such as the development and timing of bud and leaf emergence, flowering and setting fruit. *How might global warming affect these aspects of plant life cycles, how would such changes affect humans, and what might we do to lessen these impacts?*

HS.LS2.C Ecosystem Dynamics, Functioning, & Resilience

- *A complex set of interactions within an ecosystem can keep its numbers and types of organisms relatively constant over long periods of time under stable conditions. If a modest biological or physical disturbance to an ecosystem occurs, it may return to its more or less original status (i.e., the ecosystem is resilient), as opposed to becoming a very different ecosystem. Extreme fluctuations in conditions or the size of any population, however, can challenge the functioning of ecosystems in terms of resources and habitat availability.*

- *Moreover, anthropogenic changes (induced by human activity) in the environment—including habitat destruction, pollution, introduction of invasive species, overexploitation, and climate change—can disrupt an ecosystem and threaten the survival of some species.*

When sampling aquatic invertebrates, what does the composition of the species present tell us about the quality of the habitat? How do humans affect the species present in an aquatic ecosystem? How might changes in the composition of species present affect the ecosystem overall? How might species composition affect the resilience of the ecosystem?



New Mexico Specific Science Standards



Because these performance expectations are unique to New Mexico, we present the PEs as well as the supporting DCIs, CCCs, and SEPs that can be addressed by the Signs of Humans activity.

New Mexico Performance Expectation

MS.Human Impacts

MS-ESS3-3 NM Describe the advantages and disadvantages associated with technologies related to local industries and energy production. [Clarification: Examples may include examining short- and long-term impacts of related technologies on water usage (such as the withdrawal of water from streams and aquifers, the construction of dams and levees, or sewage treatment plants), land usage (such as urban development, agriculture, the removal of wetlands, or solar panel installation), pollution (such as of the air, water, or land), local employment, and economic stimulus.]

MS.ESS3.C Human Impacts on Earth Systems

-Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things.

-Typically, as human populations and per-capita consumption of natural resources increase, so do the negative impacts on Earth unless the activities and technologies involved are engineered otherwise.

-The sustainability of human societies and the biodiversity that supports them requires responsible management of natural resources.

From your walk in the bosque, think about the signs of humans changing things in the bosque. There are great things and maybe not so great things. *Can you make some lists? In what ways have humans altered the bosque? What organisms may be affected by these changes? How might impacts on resources be increased as human consumption increases?*

What are ways that humans are helping to manage the river and the bosque? What restoration projects did we see on our walk? Are any animals or plants helped by these restoration projects? If so, which animals or plants are helped, and in what ways are they helped through those projects? How do humans benefit from these management practices? How might the actions of humans increase the risk of fire in the bosque, both directly and indirectly, and how can we decrease that risk?

MS.ETS2.B Influence of Engineering, Technology, and Science on Society and the Natural World

The uses of technologies and any limitations on their use are driven by individual or societal needs, desires and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions.

After years of building structures in the Rio Grande and its floodplain with the goals of reducing flooding, drying out waterlogged soils and delivering water for irrigation, biologists began to see impacts on the bosque ecosystem that were not intended or expected. The cottonwood forest corridor of the river was getting old, with few seedlings growing to replace them. Fish species like the Rio Grande silvery minnow were not finding the shallow, muddy, backwater areas needed to lay their eggs and produce successful fry. Have students research one of the species listed below to understand why their numbers have been reduced, and then how managers can improve conditions for their eventual success. Some of these may include engineering projects.

Species of Greatest Conservation Need (SGCN):

Rio Grande Silvery Minnow (*Hybognathus amarus*)

Northern Leopard Frog (*Lithobates pipiens*)

Bald Eagle (*Haliaeetus leucocephalus*)

Yellow-billed Cuckoo (*Coccyzus americanus*)

Southwestern Willow Flycatcher (*Empidonax traillii extimus*)

New Mexico Meadow Jumping Mouse (*Zapus luteus*)

San Juan River SGCN Species:

Colorado Pikeminnow (*Ptychocheilus lucius*)

Razorback Sucker (*Xyrauchen texanus*)

CCCs: Cause and Effect; Systems and System Models

SEPs: Engaging in argument from evidence; Obtaining, Evaluating and Communicating Information

Activity: *Signs of Humans*

Additional Standards:

Science, Technology, Society, and the Environment *Interdependence of Science, Engineering & Technology*

K-2 Science and engineering involve the use of tools to observe and measure things.

3-5 Science and technology support each other. Tools and instruments are used to answer scientific questions, while scientific discoveries lead to the development of new technologies.

Use simple tools as you explore the bosque, such as thermometer, ruler, compass and magnifiers, to help observe and measure things.

Crosscutting Concepts (CCCs) (See Appendix K for descriptions)



Patterns

Cause & Effect

Systems & System Models

Structure & Function

Stability & Change

Science and Engineering Practices (SEPs) (See Appendix K for descriptions)

Asking Questions & Defining Problems

Developing & Using Models

Planning & Carrying Out Investigations

Analyzing & Interpreting Data

Constructing Explanations & Designing Solutions

Engaging in Argument from Evidence

Common Core Connections

English Language Arts:

Text Types & Purposes

Production & Distribution of Writing

Research to Build and Present Knowledge

Reading Informational Texts*

Vocabulary Acquisition and Use*

Mathematics:

5.MD Measurement & Data

Represent & Interpret Data

Statistics & Probability

Activity: Naturalist Notebooks

Geography:

Geographic Representations & Reasoning



*Young Rock Squirrels (Otospermophilus variegatus)
at Rio Grande Nature Center State Park*

Photograph by Laurel Ladwig