Observation and Nature Journaling Exploration Packet

Thank you to the following organizations for their contributions:
Nature Journaling

What is a Nature Journal?

Nature journals can be anything you would like them to be. They can be a collection of drawings of your nature walk observations or a scientific study of things you record in your own back yard.

Scientists, botanists and wildlife biologists all use variations of nature journals to document the cool wonders of Missouri, often referring to them for future study.

Nature Art

Many people create nature journals by drawing and sketching natural wonders found during their nature hikes and in their own backyards. Your journal can be a collection of your drawings from observation, your thoughts or anything in nature that gives you inspiration.

- Sketches of animals and insects
- Pressed flowers and other nature findings
- Nature poetry
- Personal thoughts and reflections
Nature study, if properly presented, will enlarge a pupil’s educational horizon.”

-George Washington Carver

Nature Science Study

Many people create nature journals to document their scientific findings. Perhaps you will find things of interest that you wish to learn more about. Nature journals provide a great way to document interesting findings, unusual phenomena, and record history of the habitat you are exploring.

Give it a Try! You are in Good Company

Notable scientists and historians use and refer to nature journals for scientific and historical records.

- **Leonardo da Vinci** and many other artists as well as famous scientists, investigators and biologists have made historic scientific journal entries to explore science phenomena that later inspired art, scientific study and famous research!

- **George Washington Carver** was a famous botanist, inventor, and educator who saw value of nature studies in the elementary classroom. He was an avid and passionate supporter of scientific nature study in childhood, often promoting scientific nature observations through journals.

Getting Started

Creating a nature journal is as simple as getting outside! Take a walk in your community, yard or other natural area and make observations. There are no rules in nature journaling!

- Sketch a new finding that is of interest to you
- Record your thoughts while in a natural space or trail
- Press leaves, flowers, feathers or other found natural objects into your journal
- Note questions you think of on your walk for future discovery and continued learning
Monarch Butterfly
Danaus plexippus

Animalia > Arthropoda > Insecta > Lepidoptera > Nymphalidae > Danaus

Monarch Migration
1. Monarchs from the previous summer overwinter in mountain forests in Mexico
2. In March they fly back, stopping in Texas to lay eggs before they die. These eggs hatch, the larvae eat and pupate, and new adults emerge.
3. These adults fly to Missouri and points north, reproducing until August. They migrate back to Mexico in September and October.

The butterflies are so thick on the trees in Mexico that they look like leaves. Sometimes there are so many butterflies on a branch that the branch breaks!

Size
- Adults: orange wings with black veins and white spots on the margin. Caterpillars: yellow, black and white bands around the body, chrysalis: blue green with gold spots.

Other Characteristics
- In Oahu, Hawai'i, a white form of the Monarch has appeared and is becoming more common because birds able to eat the orange form, either don't think it is edible, or ass well, or don't think it is edible.

What eats Monarchs:
- Most are protected from predators by the milky latex of their bodies. Some birds can eat them, chrysalis, caterpillars, Milkweed, Spiders, Joes, Jays, Cardinals, Sparrows, Grackles, Jays.

What Monarchs eat:
- Nectar is the only food for adults, they get nectar from many flowers - milkweed,级别, prairie rennments, parks, yards, gardens and road edges.

Habitat (home/food/water)
- fields, meadows, prairie remnants, parks, yards, gardens and road edges.

Home
- larvae live on milkweeds.

North American Distribution

Missouri Distribution

MO Species Coloring Sheets at www.meea.org / Copyright October 2012 Jan Weaver/May be used for free for educational purposes
Micro-hike

Take a micro-hike into a tiny world and discover what lives there.

What You'll Need:

- String
- Safe scissors
- Short stakes (could use pencils or popsicle sticks)
- Magnifying glasses/hand lens
- Paper and toothpicks (optional)

Step 1: Measure out about 20 to 30 feet of string. Tie each end to a short stake, such as a tent stake.

Step 2: Take your string and stakes outdoors and stretch the string across an area with some variation. You might run it across part of a lawn, under an arching shrub, and alongside a flower bed.

Step 3: Secure the line with more stakes if necessary. Keep in mind that the string doesn't have to be straight; it can run along the base of a fence or beside a pond or stream.

Step 4: Start at one end of the string on your hands and knees. Make sure that you and every person who will be "hiking" with you has a magnifying glass. Use your magnifying glasses to examine everything under the string.

Step 5: Look for different kinds of plants, including moss between the grass blades or under a shrub. Look for fungi of different forms. Find animals such as insects, spiders, and worms.

Step 6: Move slowly down the string, searching for every living thing you can find. You might end up taking a whole hour to hike! You never know what interesting things you'll find.

Step 7: When you're done, write down what you've seen or compare your observations with those of others who hiked with you. What interesting things did they see that you missed?

Step 8: After discussing your discoveries, use paper and toothpicks to make tiny signs to mark the most interesting ones. Then invite others to take your hike!

Source: THE EDITORS OF PUBLICATIONS INTERNATIONAL, LTD.
I Wonder....Insects

- If you were an insect what kind would you like to be and where would you like to live?
- If you were a bee show us your “happy dance” that you would do to show the other bees where you found your favorite flower.
- If you were a dragonfly would you like to live near a small pond or a large pond?
- If you were a lightning bug would you like to live in someone’s backyard or at the park? Why?
- If you were a butterfly how would you hide from birds?
- If you were a scientist what insect would you study and what would you want to know about that insect?
- What would happen if all the insects disappeared?
- Think of an insect, and then use up to 5 descriptive words to best describe it. Then see if anyone in the group can guess the insect.
- If you were an insect smaller than your baby fingernail how would you protect yourself?
- If you were an insect, would you like to be active during the day or at night? Why?

Missouri Botanical Garden

I Wonder....Food

- If you were a bee, which fruit or vegetable would you like to help pollinate?
- If you could grow only one fruit or vegetable, what would it be and why?
- What fruit or vegetable have you not tried or will never try and why?
- If you had the last apple on earth what would you do with it?
- If you were an astronaut traveling in space what fruit or vegetable would you miss eating the most?
- Think of a fruit or vegetable, and then use up to 5 descriptive words to describe it. Then see if anyone in the group can guess the fruit or vegetable.
- If you were a scientist, what fruit or vegetable would you study and what would you want to know about that plant?
- What would it be like to be a rabbit living in the Missouri Botanical Garden? What part of the garden would you like to live in?
- What fruit or vegetable do you wish you could eat every day?
- What would you do if you were a bee keeper with the last hive of honeybees in the world?

Missouri Botanical Garden
I Wonder....Plants and Animals

- If there is an empty lot near your house and you were asked by the mayor to plant something there, what would you plant and why?
- If you were a wild animal living in the city, what type of animal would you like to be and where would you like to live?
- What would happen if all the trees in the city were cut down? How would this affect the people and animals living there?
- If you moved to Alaska, what plant or animal would you miss seeing that lives in your neighborhood?
- If you were a scientist, what plant in the city would you study and what would you want to know about this plant?
- What would it be like to be a squirrel living in the Missouri Botanical Garden? What part of the garden would you like to live in?
- If you were a bird, would you like to live in a tree in someone’s backyard or in the park? Why?
- Think of animals that live in the city, pretend that you are having a conversation with one of those animals. What animal is it and what are you talking about?
- If you were a seed, would you like to travel by water or attached to animal fur? Why?
- If you were a fish, would you like to live in a pond or a river? Why?

Missouri Botanical Garden

I Wonder....Trees

- If you were a large oak tree what animal would you like to provide a home for?
- If you were a large oak tree what animal would you not like to provide a home for?
- What would you do if you were a worm that lived in the forest?
- If you were a bird living in the forest, would you be a large bird or a small bird? Why?
- Think of a plant in the forest, then use up to 5 descriptive words to describe it and see if anyone in the group can guess the plant.
- If you were a scientist, what plant in the forest would you study and what would you want to know about that plant?
- If you were a small tree in the forest, what types of other plants would you want to live near you and why?
- What would it be like to be an owl living in the Missouri Botanical Garden? What garden would you like to live in?
- If you were a forest plant, what kind of defense would you have to keep insects from eating you?
- If you were a fox, would you like to live in the forest or in someone’s backyard? Why?

Missouri Botanical Garden
Make Your Own Microscope

Materials:
Plastic or paper cup
Saran wrap or clear sandwich bag
Rubber band or hair tie
Scissors
Water
Journal
Pencil

1. Cut the bottom of the cup off using the scissors so you are left with the cylinder sides of the cup. Then, starting at the bottom of the cup, cut a rectangular arch out of the side out the cup, leaving about an inch of room at the top.

2. Cut a square section of plastic wrap or sandwich bag so that it fits over the wider, open end of the cup with one inch of extra material on the sides.

3. Using the rubber band, hair tie, or tape, secure the plastic sheet over the wide end of the cup so that there is a slight dip in the center like a shallow bowl.

4. Pour a small amount of water in this bowl to complete the lens of your microscope (be careful not to spill!), you can adjust the amount of water to find what works best.

5. To use, place an object or specimen under the open end of the cup, moving the item up or down using the window to focus what you see through the water lens. Note: this works best when there is adequate light on the specimen. Look at all that magnified detail!

6. Note what you observe. Notice differences in what you see and draw conclusions about how the different characteristics of the insect might be providing for its lifestyle and needs.
Cup Trap Exercise and Journaling

What insects travel across the soil near you? What might emerge at different times of the day and night? Let's find out using a cup trap!

To make one:
1. Dig a small hole in your testing habitat large enough to fit a cup or small can.
2. Adjust the hole depth and cup position so the lip of the cup is even with the top of the soil. Your trap is now set.
3. Return in 4-12 hrs. to see what crossed its path!
4. Journal entry information:
   a. Location: Date & time trap set:
   Weather: Temperature:
5. Note insects found & descriptions:
   Helpful Prompt: I notice that...I wonder about...

Please remember to release trapped critters after you journal!

Additional Journal writing ideas:

- Do you notice any differences in the type and number of insects traveling in the habitat at night vs the day?
- Rainy vs. Sunny days? Cold vs. Warm days? Spring vs. Summer?
- What are some similarities between the insects you found? Some differences?
<table>
<thead>
<tr>
<th>Animals</th>
<th>Plants</th>
</tr>
</thead>
</table>
| *Observe activities of nesting birds.  
*Look for the return of butterflies and hummingbirds.  
*Look for frog and toad eggs in ponds.  
*After a rain examine a water puddle. Is there anything living in there? Write a story about something you found (or an imaginary animal) living in the water puddle. | *Record the first leaves and tree flowers you see.  
*What is the first blooming flower you see in your yard or the park  
*Find a plant that is hiding. Make up a story about this plant and write about it in your journal.  
*Find a tree that interests you; draw it and describe what makes this tree so special. |
| *Look carefully for camouflage insects on plants.  
*Look for damage done to plants by insects feeding.  
*Listen at night for animal sounds.  
*Observe a bird eating. Describe how the bird uses its beak and feet in your journal.  
*Find an insect that flies; write a story about that insect in your journal | *Plant your own garden, draw and record its growth.  
*Sit in the shade of a tree. Write a story about the life of this tree starting with the seed being planted.  
*Find a plant that is sharp and write down why you think it is sharp.  
*Find a spot to sit, list any non-living items you can see. Why are they here? Are they helping or hurting plant or animals? |

---

Chart adapted from Keeping a Nature Journal by Clare Walker Leslie & Charles E Roth

Missouri Botanical Garden
<table>
<thead>
<tr>
<th>Season</th>
<th>Animals</th>
<th>Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autumn</td>
<td>* Look for signs of insect and bird migration.</td>
<td>* Observe and draw the different types of nuts.</td>
</tr>
<tr>
<td></td>
<td>* Watch squirrels and other rodents storing food for the winter.</td>
<td>* Find three different types of nuts and draw them largest to smallest in your journal.</td>
</tr>
<tr>
<td></td>
<td>* Pick an animal that lives at the Missouri Botanical Garden. Write a story about how this animal uses the plants found in the Garden.</td>
<td>* Which trees and shrubs change color? What colors did the leaves turn?</td>
</tr>
<tr>
<td></td>
<td>* Find an insect caught in a spider web and draw it in your journal.</td>
<td>* Find a tree with two different colored leaves on it; draw the leaves in your journal.</td>
</tr>
<tr>
<td></td>
<td>* What animals are staying active?</td>
<td>* What animals are staying active?</td>
</tr>
<tr>
<td></td>
<td>* What birds do you see?</td>
<td>* What birds do you see?</td>
</tr>
<tr>
<td>Winter</td>
<td>* Look for tracks in the mud or snow.</td>
<td>* Look for tracks in the mud or snow.</td>
</tr>
<tr>
<td></td>
<td>* Find a small shrub that looks like it might make a good shelter for an animal. Write a story about an animal that lives there during the winter.</td>
<td>* Find a small shrub that looks like it might make a good shelter for an animal. Write a story about an animal that lives there during the winter.</td>
</tr>
<tr>
<td></td>
<td>* List three things in nature you can only find during the winter.</td>
<td>* List three things in nature you can only find during the winter.</td>
</tr>
<tr>
<td></td>
<td>* Observe the seeds and cones of evergreens.</td>
<td>* Observe the seeds and cones of evergreens.</td>
</tr>
<tr>
<td></td>
<td>* Find three different green plants. List the plants in your journal from darkest to lightest green. If you don’t know the plant names, draw them instead.</td>
<td>* Find three different green plants. List the plants in your journal from darkest to lightest green. If you don’t know the plant names, draw them instead.</td>
</tr>
</tbody>
</table>

Chart adapted from *Keeping a Nature Journal* by Clare Walker Leslie & Charles E. Roth
### BingoNature

<table>
<thead>
<tr>
<th>many A plant with one stalk flowers</th>
<th>red Something</th>
<th>that smells something good</th>
</tr>
</thead>
<tbody>
<tr>
<td>An home animal</td>
<td>Something seed with</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>A leaf</td>
<td>A small animal</td>
</tr>
<tr>
<td>3 more with petals</td>
<td>yours hand</td>
<td>an eats animal</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>many A plant with one stalk flowers</th>
<th>red Something</th>
<th>that smells something good</th>
</tr>
</thead>
<tbody>
<tr>
<td>An home animal</td>
<td>Something seed with</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>A leaf</td>
<td>A small animal</td>
</tr>
<tr>
<td>3 more with petals</td>
<td>yours hand</td>
<td>an eats animal</td>
</tr>
<tr>
<td>Ingredient</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>5-7 Apples</td>
<td>Granny Smith Apples; Core Apples and Slice Horizontally</td>
<td></td>
</tr>
<tr>
<td>3 Lemons/lemon juice</td>
<td>Fresh Lemon or Lemon Juice; Coat Apple Slices with Lemon Juice</td>
<td></td>
</tr>
<tr>
<td>1 Jar</td>
<td>Peanut Butter (mixed with Lemon juice or melted); Spread mix onto Apple Slices</td>
<td></td>
</tr>
<tr>
<td>3-5 Dried Oz</td>
<td>Granola (Flavored or Natural); Sprinkle onto Slices</td>
<td></td>
</tr>
<tr>
<td>1 Jar</td>
<td>Honey or Agave; Drizzle over Apple Slices</td>
<td></td>
</tr>
<tr>
<td>1 Bottle</td>
<td>Cinnamon; Lightly Sprinkle over Top</td>
<td></td>
</tr>
</tbody>
</table>

The resulting document is a page that describes a recipe for "No Fry Apple Fritters". It includes a list of ingredients and preparation steps. The ingredients include 5-7 Granny Smith Apples, 3 Lemons or lemon juice, 1 jar of Peanut Butter mixed with lemon juice or melted, 3-5 oz of granola (flavored or natural), 1 jar of honey or agave, and 1 bottle of cinnamon. The preparation steps involve core and slice the apples horizontally, coat the apple slices with lemon juice, spread the peanut butter mix onto the apple slices, sprinkle granola onto the slices, drizzle honey or agave over the apple slices, and lightly sprinkle cinnamon over the top.
Earthworms

- Earthworms eat dirt, dead plants and roots in the ground.
- They are invertebrates, which means they don’t have bones.
- They don’t have a nose or lungs like we do. Instead they breathe through their skin!
- Earthworms don’t have eyes, but they can sense light and dark.
- They also don't have ears. Instead they feel vibrations with their bodies!
- They are important to our environment!
- When they burrow in the soil, it brings air to the roots of plants, and their poop makes dirt healthy for plants to grow.

Draw your earthworm observations here:
Pillbugs (Roly-Polys)

- Pillbugs eat dead plants, rotting wood and fungus.
- They live under rocks, logs and in other damp places.
- They have to stay damp so they can breathe through their gills.
- Some animals with gills live in the water but pillbugs can't survive there.
- Pillbugs aren't insects! They are related to lobsters, crabs and crayfish.
- They have 14 walking legs and 4 antennae – 2 large and 2 small.
- They roll into a ball to keep from drying out and to protect themselves from predators.

Draw your pillbug observations here:
Safe vs. Not Safe to Touch

This sheet will teach you about some of the insects that live near your home and how you can safely observe and interact with them. Knowing which types of insects live near you can tell you a lot about other plants and animals and the health of our environment.

Butterflies:
Butterflies will not bite or sting you, but we might hurt them by accident. When you see a butterfly, look but don’t touch.

Bees:
Bees can sting. It is best to look but don’t touch them.

Spiders:
Some spiders can bite. It is best to look but not touch.

Pill bug:
Pill bugs are safe to touch. They do not bite or sting.

Ladybug:
Ladybugs are safe to touch. Did you know they can fly?

Earthworm:
Worms are safe to touch, but they are slimy!

You can find many insects and other invertebrates near your own home! That is why it is important to know how to identify them, and if they are safe to touch.

How to use your bug viewer:
1. With an adult cut out the bug viewer using the solid line, NOT the dotted line.
2. Next, cut these instructions out along the dotted line to make a viewing window.
3. Attach a popsicle stick or even a stick from outside to the back of the bug viewer.
4. Enjoy searching for bugs near your home! The bug viewer can help you identify and see the bug that you are looking at up close.
Safe vs. Not Safe to Touch

Interacting with Insects

Insects eat a variety of foods they find in their environments. They may eat only one plant to survive or even eat dead animals and other dead insects. To make sure you stay safe when viewing insects, make sure to use the information on this sheet along with these tips:

- Always wash your hands before and after handling insects.

- If you are looking for insects under a log, lift the log to your body so that any unsafe animals that may crawl out are going to be moving away from you.

- Unless you are positive it is a safe insect to touch or hold, it is best to just observe them in their own environment. You can take pictures and even draw or journal about what you saw!

- To view an insect more closely for a short time, you can use a clear container with some small holes poked in the lid.

- If you would like to pick up a safe insect, make sure to do it softly. Invertebrates do not have bones like humans do!

- After observing, bring the insect back to where you found it.

INSECT SONG
To the tune of "Mary Had a Little Lamb"

Insects have three body parts, body parts, body parts.
Insects have three body parts. Spiders, they have two.

Insects have six bendy legs, bendy legs, bendy legs.
Insects have six bendy legs. Spiders, they have eight.

Insects have two antennae, antennae, antennae.
Insects have two antennae. Spiders, they have none.
Aligned & suggested Missouri Learning Standards for the
Nature Journaling Exploration Packet

Kindergarten
- K.PS1.A.1 Make qualitative observations of the physical properties of objects (i.e., size, shape, color, mass).
  - Micro Hike
- K.LS1.C.1 Use observations to describe patterns of what plants and animals (including humans) need to survive. [Clarification Statement: Examples of patterns could include that animals need to take in food but plants do not; the different kinds of food needed by different types of animals; the requirement of plants to have light; and, that all living things need water.]
  - Micro Hike, I Wonder...
- K.ESS1.B.1 Make observations during different seasons to relate the amount of daylight to the time of year. [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.]
  - Subjects to Observe throughout the Seasons,
- K.ESS2.E.1 With prompting and support, construct an argument using evidence for how plants and animals (including but not limited to humans) can change the environment to meet their needs.
  - Earthworms, Micro Hike, I Wonder...

First Grade
- 1.LS3.A.1 Make observations to construct an evidence based account that young plants and animals are like, but not exactly like, their parents. [Clarification Statement: Examples of patterns could include features plants or animals share. Examples of observations could include leaves from the same kind of plant are the same shape but can differ in size; and, a particular breed of dog looks like its parents but is not exactly the same.
  - Nature Journaling, Make Your Own Microscope, Cup Trap Exercise, Earthworms, Pillbugs
- 1.ESS1.A.2 Use observations of the sun, moon, and stars to describe patterns that can be predicted. [Clarification Statement: Examples of patterns could include that the sun and moon appear to rise in one part of the sky, move across the sky, and set; and stars other than our sun are visible at night but not during the day.]
  - Nature Journaling

Second Grade
- 2. PS1.A.1 Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties. [Clarification Statement: Observations could include color, texture, hardness, and flexibility. Patterns could include the similar properties that different materials share.]
  - Nature Journaling, Nature Bingo, Micro Hike, Make Your Own Microscope
Third Grade

- 3.PS1.A.1 Predict and investigate that water can change from a liquid to a solid (freeze), and back again (melt), or from a liquid to a gas (evaporation), and back again (condensation) as the result of temperature changes.
  - Subjects to Observe throughout the Seasons
- 3.LS1.B.1 Develop a model to compare and contrast observations on the life cycle of different plants and animals. [Clarification Statement: Changes organisms go through during their life form a pattern.]
  - Nature Bingo, Nature Journaling
- 3.LS3.C.1 Construct an argument with evidence that in a particular ecosystem some organisms -- based on structural adaptations or behaviors -- can survive well, some survive less well, and some cannot. [Clarification Statement: Examples of evidence could include needs and characteristics of the organisms and habitats involved. The organisms and their habitat make up a system in which the parts depend on each other.]
  - Nature Journaling, Subjects to Observe throughout the Seasons
- 3.LS3.D.1 Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change. [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.]
  - Nature Journaling, Subjects to Observe throughout the Seasons

Fourth Grade

- 4.ESS1.C.1 Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time. [Clarification Statement: Examples of evidence from patterns could include rock layers with marine shell fossils above rock layers with plant fossils and no shells, indicating a change from land to water over time; and, a canyon with different rock layers in the walls and a river in the bottom, indicating that over time a river cut through the rock.]
  - Nature Journaling, Micro Hike

Fifth Grade

- 5. ESS1.B.1 Make observations during different seasons to relate the amount of daylight to the time of year. [Clarification Statement: Emphasis is on relative comparisons of the amount of daylight in the winter to the amount in the spring or fall.]
  - Subjects to Observe throughout the Seasons, Nature Journaling

Sixth Grade - Eighth Grade

- 6-8.PS1.A.3 Gather, analyze, and present information to describe that synthetic materials come from natural resources and how they impact society. [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.]
  - Nature Journaling, Nature Bingo
- 6-8.LS1.B.1 Construct an explanation for how characteristic animal behaviors as well as specialized plant structures affect the probability of successful reproduction of animals and plants respectively. [Clarification Statement: Examples of animal behaviors that affect the probability of animal reproduction could include nest building to protect young from cold, herding of animals to protect young from predators, and vocalization of animals and colorful plumage to attract mates for breeding. Examples of animal behaviors that affect the probability of plant reproduction could include transferring pollen or seeds; and, creating conditions for seed germination and growth. Examples of
plant structures that affect the probability of plant reproduction could include bright flowers attracting butterflies that transfer pollen, flower nectar and odors that attract insects that transfer pollen, and hard shells on nuts that squirrels bury.

- Nature Journaling, Subjects to Observe throughout the Seasons, Nature Bingo
- 6-8.LS1.B.2 Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.]

- Nature Journaling, Subjects to Observe throughout the Seasons, Nature Bingo, Cup Trap Exercise
- 6-8.LS1.C.1 Construct a scientific explanation based on evidence for the role of photosynthesis and cellular respiration in the cycling of matter and flow of energy into and out of organisms.

- Nature Journaling, Subjects to Observe throughout the Seasons, Nature Bingo
- 6-8.LS2.A.2 Construct an explanation that predicts the patterns of interactions among and between the biotic and abiotic factors in a given ecosystem. [Clarification Statement: Relationships may include competition, predation, and symbiosis.]

- Nature Journaling, Subjects to Observe throughout the Seasons, Nature Bingo, Micro Hike
- 6-8.LS2.A.1 Analyze and interpret data to provide evidence for the effects of resource availability on individual organisms and populations of organisms in an ecosystem. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

- Nature Journaling, Subjects to Observe throughout the Seasons, Nature Bingo
- 6-8.LS2.C.1 Construct an argument supported by empirical evidence that explains how changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making inferences about changes in populations, defining the boundaries of the system, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

- Nature Journaling, Subjects to Observe throughout the Seasons, Nature Bingo

9th Grade - 12th Grade
- 9-12.LS2.A.1 Explain how various biotic and abiotic factors affect the carrying capacity and biodiversity of an ecosystem using mathematical and/or computational representations. [Clarification Statement: Examples of biotic factors could include relationships among individuals (e.g., feeding relationships, symbioses, competition) and disease. Examples of abiotic factors could include climate and weather conditions, natural disasters, and availability of resources. Genetic diversity includes within a population and species within an ecosystem. Examples of mathematical comparisons could include graphs, charts, histograms, and population changes gathered interdependent from simulations or historical data sets.
- **Nature Journaling, Subjects to Observe throughout the Seasons, Nature Bingo**

  - 9-12.LS2.B.1 Construct and revise an explanation based on evidence that the processes of photosynthesis, chemosynthesis, and aerobic and anaerobic respiration are responsible for the cycling of matter and flow of energy through ecosystems and that environmental conditions restrict which reactions can occur. [Clarification Statement: Examples of environmental conditions can include the availability of sunlight or oxygen.]

    - **Nature Journaling, Subjects to Observe throughout the Seasons, Nature Bingo**

  - 9-12.LS2.C.1 Evaluate the claims, evidence, and reasoning that the interactions in ecosystems maintain relatively consistent populations of species while conditions remain stable, but changing conditions may result in new ecosystem dynamics. [Clarification Statement: Examples of changes in ecosystem conditions could include modest biological or physical changes, such as moderate hunting or a seasonal flood; and extreme changes, such as volcanic eruption or sea level rise.]

    - **Nature Journaling, Subjects to Observe throughout the Seasons, Nature Bingo**