unit 13

Adapting to Change
**Unit 13**

*Adapting to Change*

Visit the [Unit 13 Curriculum Page](http://schoolpartnership.wustl.edu/instructional-materials/mysci-unit-13-adapting-change/) for more resources.

**DESIGN CHALLENGE:**
How can we create a complex model of an ecosystem?

- **section 1**
  - lesson 1: What is an ecosystem?
  - lesson 2: What are the components of an ecosystem?
  - lesson 3: What are the different roles in an ecosystem?
  - lesson 4: How do animals of the same species work together?
  - lesson 5: How can we model an ecosystem?
  - lesson 6: How can we represent a complex ecosystem on paper?
  - lesson 7: How do organisms survive change?
  - lesson 8: How can we create a complex model of an ecosystem?
  - lesson 9: How are ecosystems affected by change?
  - What kinds of adaptations do plants and animals have that allows them to survive in their particular ecosystem?
  - How are ecosystems affected by change?
  - What do fossils tell us about ecosystems from long ago?
**Unit 13 Teacher Preparation List**

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Inside MySci kit, you’ll find:</th>
<th>Items you must supply:</th>
<th>Extra prep time needed:</th>
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<tbody>
<tr>
<td>Lesson 1</td>
<td>6 Missouri Department of Conservation ecosystem posters: Forest, Prairie, Wetlands, Rivers, Fence Post and Small Stream 1 plastic basket/plant pot large gravel variety of seeds 1 spray bottle</td>
<td>Science notebooks &amp; internet access Chart Paper</td>
<td>Review MySci Safety Guidelines  Copy and administer the pre-assessment  Start the seeds sprouting in the gravel plant pot, spray with water bottle several times a day  Copies of Ecosystem Introduction Activity Sheet (Appendix i)  Copies of the Pizza Pie chart (Appendix ii)  Copies of Ecosystem Interactions Activity Sheet (Appendix iii), extra prep time needed</td>
</tr>
<tr>
<td>Lesson 2</td>
<td><em>What Does an Animal Eat</em>, by Lawerence Lowery  <em>Around One Log</em>, by Fredericks  6 MDC posters from Lesson 1</td>
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<td>Lesson 4</td>
<td><em>At Home with Gopher Tortoise</em>, by Madeline Dunphy  6 MDC posters from Lesson 1</td>
<td>Science notebooks &amp; internet access Scissors Tape Colored pencils</td>
<td>Copies of the Ecological Pyramid (Appendix iv)</td>
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<tr>
<td>Lesson 5</td>
<td>1 small aquarium (Plastic critter box) Variety of seeds 1 grow light and clamp Materials from Lesson 1</td>
<td>Science notebooks &amp; internet access</td>
<td>Copies of the Ecosystem Flow Chart handout (Appendix v)  Ecosystem Flow Chart Teacher Directions (Appendix vi)  Set out the aquarium full of water overnight to de-chlorinate unless you are using chemical de-chlorinater. Discuss with Science coordinator about setting up ecosystem live materials</td>
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<tr>
<td>Lesson 6</td>
<td>6 MDC posters from Lesson 1</td>
<td>Science notebooks &amp; internet access Chart Paper Computers for students use (optional)</td>
<td>Copies of the Guidelines (Appendix vii)  Copies of the Peer Review Sheet (Appendix viii)</td>
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## Unit 13 Teacher Preparation List (continued)

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<td>6 MDC posters from Lesson 1</td>
<td>Science notebooks &amp; internet access</td>
<td>Copies of the Animal Report Template (Appendix ix) Teacher prep time for how to do research: NAT GEO website link, <a href="http://kids.nationalgeographic.com/animals/">http://kids.nationalgeographic.com/animals/</a></td>
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<tr>
<td><strong>Lesson 8</strong></td>
<td>Science notebooks &amp; internet access</td>
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<td>Copies of Ecosystem Change Grid Activity Sheet (Appendix x) Copies of Lesson 8 Evaluating Questions Activity Sheet (Appendix xi)</td>
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| **Lesson 9** | 6 Sets of fossils  
*No Monkeys, No Chocolate*, by Melissa Stewart | Science notebooks & internet access | Copy and administer the post-assessment |
Lesson 1: What are the components of an ecosystem?

Learning Target:
Identify components of an ecosystem.

Summary:
Students will examine posters of ecosystems and discuss components of each system.

Engage:
Ask the class: What is an ecosystem? If we break that word into 2 parts — eco and system — what does that mean to you?

Take several students’ ideas and record them on chart paper. Define a system as:

- A set of connected things or parts forming a complex whole, in particular.
- A set of things working together as parts of a mechanism or an interconnecting network.

Ask the class to give examples of systems. Possible answers would include:

- Human body systems such as the respiratory system or circulatory system.
- Heating or cooling systems, Internet, or anything where there are parts that work together to support things coming in and going out of the system.

Explore:
Ask the class: What are some of the components of an ecosystem?

Place students into six groups and give them each a unique ecosystem poster. Pass out copies of the first page of the Ecosystems Introduction sheet (Appendix i). Review the questions on the sheet and then have the students examine their poster while answering the questions in the handout.

Explain:
Ask the class: What did you notice about your ecosystem poster?

Have each group review one of the questions from the Ecosystem Introduction sheet (Appendix i) to share with the class about its poster. Review question 3 together, making sure that air, water, soil, and rocks are mentioned by the students. Pass out copies of the Pizza Pie chart (Appendix ii). This chart shows levels of increasing organization from individuals to the biosphere. Go over the definitions each level of organization with the students.

MySci Materials:
6 Missouri Department of Conservation ecosystem posters: Forest, Prairie, Wetlands, Rivers, Fence post and Small Stream
1 plastic basket/plant pot
Large gravel
Variety of seeds
1 spray bottle

Teacher Provides:
Copies of Ecosystem Introduction activity sheet (Appendix i)
Copies of the Ecosystem Pizza Pie chart (Appendix ii)
Copies of Ecosystem Interactions Activity Sheet (Appendix iii)
Science notebooks
Chart paper
Internet access

Start the seeds for the ecosystem by first soaking them in water, then soaking the gravel and putting the seeds on top of the gravel. Spray them several times a day until they begin to sprout. Then they will be ready to add to the ecosystem that will be built in Lesson 6. The roots of the plants should start coming out the bottom of the plant pot.

Teaching Tip:
This icon highlights an opportunity to check for understanding through a formal or informal assessment.

Teaching Tip:
Eco refers to natural environment and system is the way everything works together.

Teaching Tip:
Information about each ecosystem is on the back of its poster, along with additional activities and vocabulary.
Lesson 1 continued: What are the components of an ecosystem?

students as an example. Here is a website that describes the different levels of organization represented in this chart: [http://eschooltoday.com/ecosystems/levels-of-organisation-in-an-ecosystem.html](http://eschooltoday.com/ecosystems/levels-of-organisation-in-an-ecosystem.html).

Ask the students to look at their posters and decide which level of organization their whole poster represents (they should say that it represents the ecosystem level).

Here is a video which furthers explains ecosystems: [https://www.youtube.com/watch?v=aYmdrJWLQ4Y](https://www.youtube.com/watch?v=aYmdrJWLQ4Y)

ELABORATE

Hand out Appendix iii, which is a blank copy of the Pizza chart. Using Appendix ii (the completed sample) as a guide, ask students to work together as a group and draw each level of organization for their poster. The students should brainstorm as a group, but all students should have their own drawing. Have each group share what kind of ecosystem they have with the rest of the class. Ask the students to brainstorm as a class to think of different ecosystems that are in other parts of the world. Ask students to describe what those ecosystems are like, and how they are similar or different than Missouri ecosystems.

EVALUATE

- Ask: What must an ecosystem have to work? Write in your science notebook some biotic and abiotic components of the ecosystem shown on your poster.

Using ideas from their notebooks, students list what they think an ecosystem needs. Look for air, water, soil, rocks, and living organisms in their explanations.

Important Teacher Information:

- Wetland poster: Swamps, sloughs, marshes, rivers, ponds, lakes and potholes all can be wetlands. Wetlands are bodies of shallow standing water. Three features of wetlands are water, soil, and water-loving plants.

- Prairies poster: Prairies are extensive grasslands, with grasses and wildflowers, as well as a few woody bushes and trees. Three features of prairies are deep-rooted plants, direct sun, and water.

- Rivers and streams poster: Gravity pulls water from a higher area to a lower area. Rivers and streams have pools, riffles, channels, and floodplains. Their health depends on what happens in the watersheds through which they flow.

- Forest poster: Missouri forests have three layers of plant growth: canopy, understory, and forest floor. Each of those layers is home to specific plants and animals. Health of the forests depends on plentiful sunshine and water, and interactions among the layers.

- Fence Post poster: The area near fence post offer many kinds of diversity. While one side maybe farmed, usually the other side, often near a road, offers wildflowers, insects, birds, reptiles and small mammals.

- Small Stream poster: The difference between a small stream and a river and stream is that small streams often dry up in the dry season. Therefore they usually attract amphibians and reptiles, maybe crawfish, instead of fish.
Lesson 2: What are the different roles in an ecosystem?

**LEARNING TARGETS**
Classify components of an ecosystem as producer, consumer or decomposer.

**SUMMARY**
Students will explore the different roles that organisms play in an ecosystem through the wildlife posters.

**ENGAGE**
Ask students: *Does every living thing in an ecosystem have an important role? What are some examples of how a living thing might interact with other living things in an ecosystem?* Ask students to think of three different living things in an ecosystem, and what they might do in the ecosystem.

**EXPLORE**
Give students their posters. Ask students to consider all of the living things in the poster. In groups, have students brainstorm ideas of why each living thing in their ecosystem is important. Ask students to consider what the living thing eats (or how it obtains energy). Read the book *What Does an Animal Eat?* by Lowery. After reading, ask the students to identify any similarities between the animals in the book and the animals on their posters. Show the class the slides at Sheppard Software [http://www.sheppardsoftware.com/content/animals/kidscorner/animaldiet/herbivore.htm](http://www.sheppardsoftware.com/content/animals/kidscorner/animaldiet/herbivore.htm)

Ask the students to identify the omnivores, herbivores and carnivores on their posters.

**EXPLAIN**
Give students the definitions of producer, consumer and decomposer. Have students play the following game to identify examples of each: [http://www.sheppardsoftware.com/content/animals/kidscorner/games/producersconsumersgame.htm](http://www.sheppardsoftware.com/content/animals/kidscorner/games/producersconsumersgame.htm).

Have the student groups get together to find examples of producers, consumers, and decomposers on their posters. Ask the students to share their findings with the rest of the class. Then read and discuss *Around One Log*.

**ELABORATE**
Ask: *Using the Missouri environment posters, can you draw food webs?*

*Activity:* Have the groups create food webs based on information they have gained about producers, consumers, and decomposers.

**EVALUATE**
✔ Ask students to think of a producer, consumer, and decomposer that lives in their neighborhood. Have students write their answers in their science notebooks.

*Can you name a producer, consumer, or decomposer that lives in more than one ecosystem?* Have students write their thoughts in their notebooks.

**MYSCI MATERIALS:**
- *What Does an Animal Eat?* by Lowery
- 6 MDC posters from Lesson 1
- *Around One Log*, by Fredericks

**TEACHER PROVIDES:**
- Copies of Ecosystem Interactions Activity Sheet (Appendix iii)
- Science notebooks
- Internet access

*Teaching Tip:*
Make sure that students know to read the back of the posters for more information!
Lesson 3: How do animals of the same species work together?

LEARNING TARGETS
Construct an argument that some animals form groups to help them survive.

SUMMARY
Students will learn more about animal groups and how animals work as a team to survive in their ecosystems.

ENGAGE
Ask students to think about all of the different ways that a living thing’s survival could be threatened. Answers might include predation, disease, drought, famine, etc. Ask students to brainstorm ways that a living thing could avoid these dangers. Have them record their ideas in their science notebooks.

EXPLORE & EXPLAIN
Ask the class: Did you know that animals can work together to benefit each other? What are some ideas that you have for how animals might work together to help each other survive?
Show Living In Groups — Social Behavior  http://www.youtube.com/watch?v=5hI-jsdq3kdQ
Students should write their thoughts about the benefits of animals working together in science notebooks.

ELABORATE
Ask the class: Think about the animals you saw in the video. What are some physical structures that the different animals have that help them work together in social groups to survive? Have students write their thoughts in science notebooks.

EVALUATE
Use their science notebooks for assessing where the students are using these questions:
Choose an animal from your poster. (If it is hard to find information on line about animals from their poster, they might need to choose other animals, like elephants or meerkats as examples. See videos in Teaching tip!)
What are some examples of how your animal works with its family/group?
How do the actions of your animal help it to survive in its ecosystem?
What would happen to your animal if it did not have other members in its group to help it?

MYSCI MATERIALS:
6 MDC posters from Lesson 1

TEACHER PROVIDES:
Science notebooks
Internet access

Teaching Tip:
The term “help” could be confusing. Fish, for example swim in schools which help them avoid predators. They might not be consciously thinking, “I’m helping my neighbor”, but the behavior it exhibits does so.

Teaching Tip:
This video takes 15 minutes, but is worth it!

Teaching Tip:
Some examples would include elephants throats that emit low rumble, ants’ antennas, etc.

Teaching Tip:
Here are some additional videos!
Elephants working together to help a baby elephant
Meerkat Manor works together
http://www.youtube.com/watch?v=vX-mU5qUDR50
Lesson 4: How can we show the flow of energy with a pyramid?

**LEARNING TARGETS**
Sequence the flow of energy through a food chain beginning with the Sun.

**SUMMARY**
Students make and label a pyramid with different trophic levels.

**ENGAGE**
Read *At Home with Gopher Tortoise*. Ask the class to make a list of the animals they see or hear about in the book as you read it. Discuss the different animals that all live in the tunnels made by the tortoise.

**EXPLORE**
Pass out copies of the Ecological Pyramid (Appendix iv). Explain to the class that they are going to fill in the center of the pyramid from the bottom up. The bottom layer is to be labeled, “Producer”. The next layer is “Consumer-Herbivore”, next “Consumer-Carnivore”, and lastly, “Consumer-Top Carnivore”. The students may want to color the bottom layer green, and can decide the other colors as a class.

On the other two sides of the pyramid, students should fill in the levels with animals chosen from either their poster or from At Home with Gopher Tortoise. Each student will then have 2 examples of a food pyramid or chain. When the students are done, they may cut, fold and tape their pyramids.

**EXPLAIN**
Ask one student to explain their pyramid beginning with producers and ending with top carnivores. Have students estimate the numbers of individual organisms that might be in each trophic level. Guide the discussion so that they realize producers make up the greatest numbers, followed by herbivores, then carnivores, and finally the top carnivores of which there are only relatively few.

**ELABORATE**
Ask the students: *Why do you think producers make up the biggest portion of an energy pyramid? Why do top consumers make up the smallest portion of the energy pyramid?* Tell students that the size of the level of the pyramid indicates how many organisms would be in that ecosystem. Allow students to brainstorm. Show the students the following video from PBS Learning Media. Only show from time 7:40 to time 8:32. The teacher may want to watch the entire video to further guide the conversation, but this 52 second clip is appropriate for the students. [http://www.pbslearningmedia.org/resource/5a7a7f90-b216-47ff-96bf-9a4e7feb04a9/ecosystem-ecology-links-in-the-chain-crash-course-ecology-7/](http://www.pbslearningmedia.org/resource/5a7a7f90-b216-47ff-96bf-9a4e7feb04a9/ecosystem-ecology-links-in-the-chain-crash-course-ecology-7/)

**EVALUATE**
Using one side of your pyramid, write how each level gets its energy, including the producers, in your science notebook.

**MYSCI MATERIALS:**
- *At Home with the Gopher Tortoise*, by Madeline Dunphy
- 6 MDC posters from Lesson 1

**TEACHER PROVIDES:**
- Copies of the Ecological Pyramid (Appendix iv)
- Scissors
- Tape
- Colored Pencils
- Science notebooks
- Internet access

**Teaching Tip:**
Producers “eat” or get their energy from the Sun.
Lesson 5: How can we represent a complex ecosystem on paper?

LEARNING TARGETS
Collaboratively develop a model that shows the relationships in an ecosystem.

SUMMARY
Students will combine their knowledge and experiences from the previous lessons to create a flowchart of an ecosystem.

ENGAGE
Ask the class: Has anyone built a model before? What was it of? Why do scientists use models?

Take several different students answers. If no one says scientists use models when the real things are too small or large or not possible to study in a lab or classroom, suggest that answer.

Show the students the sprouted seeds started in Lesson 1. Explain that the class is going to have a mini ecosystem model. Show them the small aquarium, heat lamp (which represents the sun) the water plants and snails and the sprouted seed container. Ask the class if anyone can figure out how it is going to go together. Show them that the seed container is going to sit in the water so the roots can use the water. The water plants are going to provide oxygen and food to the snails. The snails will provide nutrients for the plant roots.

EXPLORE
In Appendix vi, there are teacher directions for this lesson. Give students a copy of Appendix v. Tell students, “Today we are going to make a specific kind of model called a flowchart. This paper flowchart will show the different levels of our container ecosystem. Allow students to create their flowcharts with teacher guidance.

EXPLAIN
Use this video for further clarification of energy flowcharts. https://www.youtube.com/watch?v=eGG7hyx_HlA

ELABORATE
Activity: Students work individually to add more items to their flowchart models. They can work from the list or add anything that might be found in a wetland that the container model is showing. You might want to refer to the Wetlands poster for more plants and animals to put in their flowchart model. Encourage students to add producers, consumers, and decomposers.

MYSCI MATERIALS:
1 small aquarium (plastic critter box)
Ecosystem Flow Chart Teacher Directions (Appendix vi)
1 grow light and clamp
Materials from Lesson 1

TEACHER PROVIDES:
Copies of the Ecosystem Flow Chart handout (Appendix v)
Ecosystem Flow Chart Teacher Directions (Appendix vi)
Science notebooks
Internet access

Teaching Tip:
You may wish to photocopy the Poster Key from the back of the “Exploring Missouri Wetlands” poster.
Lesson 5 continued: How can we represent a complex ecosystem on paper?

EVALUATE

After the students have had time to work on their flowcharts, they should pair up with a partner to compare flowchart models. Ask: What is the same? What is different? If you disagree with any part of your partner’s model, explain why you think it should be changed. Can you add anything to your model based on your partner’s model? Once a pair has finished, team up with another pair to share your flow charts and repeat the process as a team of four.
Lesson 6: How can we create a complex model of an ecosystem?

LEARNING TARGETS
Create a complex model of an ecosystem and present the model to peers.
Compare and contrast ecosystem components.

SUMMARY
Students will create a complex model of an ecosystem based on their previous learning. Several options are presented based on teacher and/or student preference.

ENGAGE
Start with the wetlands poster. Ask the students: What are some ways that we have tried to represent the ecosystem shown on this poster?
Make sure through your class discussion that you mention the poster itself as a model, the ecosystem pyramids you made, and the flow chart model. All of these are ways to give an idea of the real wetland ecosystem.

EXPLORE
Today, we are going to bring these ideas to represent other ecosystems. You can have your students choose from among the remaining posters or allow them to choose another ecosystem that is not represented in Missouri (desert, rain forest, tundra, deep ocean, coral reef, etc). If students choose an ecosystem not represented on the posters, they will be required to do research or you must provide additional research materials.

EXPLAIN
Option 1: Paper Flow Chart Model
Using the same methods we used to create a flow chart for the wetland ecosystem in Lesson 5, create a flow chart model for a different habitat. Use the same symbols for producers and consumers for your new model. Your model must include at least 3 each of producers, consumers, and decomposers that actually live in the same habitat.

Option 2: Construct a 3D model
Construct a 3D model of your chosen ecosystem in a shoebox. Before you start to build, make a plan of the living and non-living things that you will represent in your model and show the plan to the teacher. Along with your model, create a key of living things that are represented in your model, including the location and name of each living thing. Use the back of the posters as a guide for this.

Option 3: Construction Instructions
Make a list of materials and give instructions on how someone could build a model of your ecosystem. Assume that it will be built in a closed fish tank about the size of your school desk. Include all living and non-living things that need to go into your ecosystem and a sketch of what the ecosystem will look like when it is finished.

MYSCI MATERIALS:
6 MDC from Lesson 1

TEACHER PROVIDES:
Computers with Internet access for research (optional)
Chart paper
Copies of the Guidelines (Appendix vii)
Copies of the Peer Review Sheet (Appendix viii)

Teaching Tips:
You can have students work individually, in pairs, or in small groups on this project. You could also assign a single ecosystem to a team of students and have them complete all three options for that ecosystem.
If you decide to use this project as a multi-day or take-home project, be sure to give students a chance to get feedback from you and/or from their peers as they progress. Encourage them to use the guidelines as a check-list to make sure they are on the right track.
Lesson 6 continued: How can we create a complex model of an ecosystem?

ELABORATE
Activity: Gallery Walk

Once all students/groups have completed their model, set up the models grouped by ecosystems (if more than one student/group modeled a similar ecosystem).

Hand out copies of the Peer Review Sheet. Instruct students that they should look at all of the ecosystem models and fill out the peer review sheet for four ecosystems that are different from the ecosystem they modeled.

EVALUATE
When you have finished the gallery walk, have students answer these questions in their science notebooks: What did you see that was the same in all ecosystems? What was different about the ecosystems you saw? Discuss their answers when they have finished.
How do organisms survive change?

Lesson 7: What kinds of adaptations do plants and animals have that allows them to survive in their particular ecosystem?

LEARNING TARGET
Describe how animals and plants have adapted to their environment. Describe the limitations of an organism’s ability to adapt.

SUMMARY
Students will work in groups to create a newspaper article about an animal.

ENGAGE
Ask the class: What are some examples of ways that living things are well-matched to their environment? Have students share their ideas. Answers might include blending in (camouflage), long hair in the cold, etc.

EXPLORE
Students will pick an animal from their MDC ecosystem poster. Then they will break into groups or pairs to create newspaper articles using the template. Hand out copies of Appendix ix. Use books or the internet for research. Once students are finished with their articles, they will share them with classmates.

EXPLAIN
Have groups present their articles to the class. Give students the formal definition of adaptation: the process by which a species becomes better suited to its environment.

ELABORATE
Ask the class: Do you think that plants have adaptations? What might they be? Have students share their ideas. Present the following three plants to students: a cactus, a water lily and an orchid. Ask students to think about what features each plant has to help it survive in its particular environment. (Cacti have modified leaves/needles to prevent water loss. Water lilies have floating leaves to get lots of sunlight. Orchids can be colored and shaped like the insects they want to attract for pollination.) Show students the following video from PBS Learning Media:  http://www.pbslearningmedia.org/resource/a362ee72-74b3-4b10-9e7c-e7ecbb9aaa8d/a362ee72-74b3-4b10-9e7c-e7ecbb9aaa8d/ . Remind students that these plant adaptations, as well as animal adaptations, took a long time (generations) to develop. Living things can make some immediate changes to try to survive in their environment if it changes, but this is different from an adaptation.

EVALUATE
Use the students newspaper articles as the final evaluation for this lesson.

MYSCI MATERIALS:
6 MDC posters from Lesson 1

MYSCI MATERIALS:
Copies of the Animal Report Template (Appendix ix)
Science notebooks
Internet access

Teaching Tip:
Misconception Alert! Some students may confuse the ideas of adaptation, acclimatization, and learning. Individuals can acclimatize and learn to improve chances of survival. However, species as a whole have adaptations that have developed over time. These adaptations make them suited to their environment. If the environment changes, some individuals may have traits that allow them to survive and reproduce better than others. This leads to new adaptations over time. An individual cannot create adaptations out of thin air just because the environment changed. However, they can acclimate and learn. Unit 14 addresses this in greater detail.
Lesson 8: How are ecosystems affected by change?

LEARNING TARGETS
Identify factors (human-made or natural) that disrupt ecosystem balance.
Describe solutions to ecological disruption.

SUMMARY
Students will use ecosystem posters to suggest problems that humans or other changes might cause. They also will discuss possible solutions.

ENGAGE
Tell the class: Let’s go back to our MDC posters. Take a good look at them. Can you think of a situation where change or human impact could hurt that ecosystem? (Examples: a flood, building a highway or subdivision, a drought, etc.)

EXPLORE
Hand out copies of the Ecosystem Change Grid sheet (Appendix x).
Have each group come up with a scenario for an environmental problem for their poster.

For example, Florida once wanted to drain the Everglades to put in an airport. But people discovered that to do so would not only destroy the local ecosystem, but the larger impact could affect the entire state of Florida as the wetlands act as a sponge, soaking up the water that flows down from the southern half of the state. Also, water from the Everglades flows into Florida Bay, helping keep brackish water systems healthy. They decided to put the airport somewhere else.

EXPLAIN
Have each group share with the class the scenario for their poster.

ELABORATE
Have groups exchange scenarios and come up with possible solutions to those scenarios. Ask the students: What are the trade-offs of these solutions? Are some solutions better than others? What factors do you need to keep in mind when trying to solve ecological disruption?

EVALUATE
Have students complete Lesson 8 Evaluating Questions (Appendix xi).

TEACHER PROVIDES:
Copies of Ecosystem Change Grid Activity Sheet (Appendix x)
Copies of Lesson 8 Evaluating Questions Activity Sheet (Appendix xi)
Internet access
Science notebooks

Teaching Tip:
Groups might research environmental agencies and activists, or read about environmentalists.
Famous Environmentalists
http://www.deq.state.or.us/lq/pubs/docs/sw/curriculum/RRPart0303.pdf
EPA Teacher Resources
http://www.epa.gov/students/
EcoKids
http://www.ecokids.ca/pub/index.cfm
Lesson 9: What do fossils tell us about ecosystems from long ago?

LEARNING TARGET
Describe how fossils provide evidence about the types of organisms that lived long ago.

SUMMARY
Students will write in their journals what they know about fossils, explore various fossils, and present new understandings about plants and animals no longer living on earth.

ENGAGE
Ask the class: What do you know about fossils?
Students will write everything they know about fossils in their science notebooks. Students then share with classmates what they know about fossils. Students can add new information to their notebooks.

EXPLORE
Activity: Pass out fossils to the groups. Ask them to come up with questions about the fossils. Possibilities include the following:
- What do you notice about the different fossils?
- Where do you think this fossil was found? Why?
- What type of animal do you think this fossil was made from? Why?
- How long ago do you think this animal lived? Why?
Students will explore fossils and answer questions in their science notebooks. Students then will share their ideas about the fossils.

EXPLAIN
Once students have shared their thoughts about the fossils, show them this video:
What is a Fossil? http://www.youtube.com/watch?v=3rkGu0B1tKM

ELABORATE
Ask the class: How does the removal of one species affect the whole ecosystem?
Read, No Monkeys, No Chocolate and discuss. Ask students to think about the fact that the fossil record shows living things that are no longer in the ecosystem where the fossil was found (i.e. dinosaurs, ancestors to various animals that look different today). Ask students to come up with ideas to explain why there are differences between the fossil record and what we see today. The main takeaway should be that ecosystems change over time, therefore, living things in the ecosystem change as well. Some organisms adapt and stay in the ecosystem, while others do not. One way you can tell what an environment was like a long time ago is by looking at fossils.

MYSCI MATERIALS:
6 Sets of fossils
No Monkeys, No Chocolate, by Melissa Stewart

TEACHER PROVIDES:
Science notebooks
Internet access

Teaching Tip:
Cover up the info about fossils. Check about this video about crinoids, Missouri state fossil: https://www.youtube.com/watch?v=GYhqVYO4F3w
Lesson 9 continued: What do fossils tell us about ecosystems from long ago?

EVALUATE
Ask the class: *What are the possibilities that could happen to plants and animals when their environment changes? Write your answers in your science journal.*
(Becoming extinct should be one of the answers. Adapting or moving is another possibility.)

*Extension Activity:* If you want to do an extension activity, here is one to try! Use bread and gummy candy to show sedimentary layers and make “fossils”. *Making Fossils and Taking Core Sample Activity* [http://www.earthsciweek.org/forteachers/2009/FossilFormation_Sept_cont.html](http://www.earthsciweek.org/forteachers/2009/FossilFormation_Sept_cont.html)
Key to Understanding the NGSS Codes

**NGSS codes begin with the grade level, then the “Disciplinary Core Idea code”, then a standard number. The Disciplinary Core Ideas are:**

**Physical Sciences**
- PS1: Matter and its interactions
- PS2: Motion and stability: Forces and interactions
- PS3: Energy
- PS4: Waves and their applications in technologies for information transfer

**Life Sciences**
- LS1: From molecules to organisms: Structures and processes
- LS2: Ecosystems: Interactions, energy, and dynamics
- LS3: Heredity: Inheritance and variation of traits
- LS4: Biological evolution: Unity and diversity

**Earth and Space Sciences**
- ESS1: Earth’s place in the universe
- ESS2: Earth’s systems
- ESS3: Earth and human activity

**Engineering, Technology, and Applications of Science**
- ETS1: Engineering design
- ETS2: Links among engineering, technology, science, and society

For more information, visit [http://www.nextgenscience.org/next-generation-science-standards](http://www.nextgenscience.org/next-generation-science-standards)
Populations live in a variety of habitats, and change in those habitats helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.

For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive. Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.

Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments.

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. (secondary to 3-LS4-4)

Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (Note: Moved from K–2) (3-LS4-1)

Some systems appear stable, but over long periods of time will eventually change. Interdependent Relationships in Ecosystems

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. (secondary to 3-LS4-4)

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. (Note: Moved from K–2) (3-LS2-1)

LS4.A: Evidence of Common Ancestry and Diversity

Some kinds of plants and animals that once lived on Earth are no longer found anywhere. (Note: Moved from K–2) (3-LS4-1)

Fossils provide evidence about the types of organisms that lived long ago and also about the nature of their environments. (3-LS4-1)

LS4.C: Adaptation

For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. (3-LS4-3)

LS4.D: Biodiversity and Humans

Populations live in a variety of habitats, and change in those habitats affects the organisms living there. (3-LS4-4)
## MISSOURI GLE STANDARDS

### Key to Understanding the GLE Codes

GLE codes are a mixture of numbers and letters, in this order: Strand, Big Idea, Concept, Grade Level and GLE Code.

The most important is the strand. The strands are:

1. **ME**: Properties and Principles of Matter and Energy
2. **FM**: Properties and Principles of Force and Motion
3. **LO**: Characteristics and Interactions of Living Organisms
4. **EC**: Changes in Ecosystems and Interactions of Organisms with their Environments
5. **ES**: Processes and Interactions of the Earth's Systems (Geosphere, Atmosphere and Hydrosphere)
6. **UN**: Composition and Structure of the Universe and the Motion of the Objects Within It
7. **IN**: Scientific Inquiry
8. **ST**: Impact of Science, Technology and Human Activity

For more information, visit [http://dese.mo.gov/college-career-readiness/curriculum/science](http://dese.mo.gov/college-career-readiness/curriculum/science)

### Third Grade Standards

<table>
<thead>
<tr>
<th>Concept</th>
<th>GLE Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ME 2 C 3 a</td>
<td>Identify the Sun is the primary source of light and food energy on Earth</td>
<td></td>
</tr>
<tr>
<td>EC 2 A 3 b</td>
<td>Classify populations of organisms as producers or consumers by the role they serve in the ecosystem</td>
<td></td>
</tr>
<tr>
<td>EC 2 A 3 c</td>
<td>Sequence the flow of energy through a food chain beginning with the Sun</td>
<td></td>
</tr>
<tr>
<td>EC 2 A 3 d</td>
<td>Predict the possible effects of removing an organism from a food chain</td>
<td></td>
</tr>
<tr>
<td>IN 1 B 3 a</td>
<td>Pose questions about objects, materials, organisms and events in the environment</td>
<td></td>
</tr>
<tr>
<td>IN 1 B 3 c</td>
<td>Make qualitative observations using the five senses</td>
<td></td>
</tr>
<tr>
<td>IN 1 B 3 d</td>
<td>Measure length to the nearest centimeter, mass using grams, temperature using degrees Celsius, volume using liters</td>
<td></td>
</tr>
<tr>
<td>IN 1 C 3 a</td>
<td>Compare amounts/measurements</td>
<td></td>
</tr>
<tr>
<td>IN 1 C 3 b</td>
<td>Judge whether measurements and computation of quantities are reasonable</td>
<td></td>
</tr>
<tr>
<td>IN 1 C 3 c</td>
<td>Use qualitative and quantitative data as support for reasonable explanations</td>
<td></td>
</tr>
<tr>
<td>IN 1 C 3 d</td>
<td>Use data as support for observed patterns and relationships, and to make predictions to be tested</td>
<td></td>
</tr>
<tr>
<td>IN 1 C 3 e</td>
<td>Evaluate the reasonableness of an explanation</td>
<td></td>
</tr>
<tr>
<td>IN 1 D 3 a</td>
<td>Analyze whether evidence supports proposed explanations</td>
<td></td>
</tr>
<tr>
<td>ST 3 A 3 a</td>
<td>Identify a question that was asked, or could be asked, or a problem that needed to be solved when given a brief scenario (fiction or nonfiction of people working alone or in groups solving everyday problems or learning through discovery)</td>
<td></td>
</tr>
<tr>
<td>ST 3 A 3 b</td>
<td>Work with a group to solve a problem, giving due credit to the ideas and contributions of each group member</td>
<td></td>
</tr>
</tbody>
</table>

### Fourth Grade Standards

<table>
<thead>
<tr>
<th>Concept</th>
<th>GLE Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC 1 A 4 a</td>
<td>Identify the ways a specific organism may interact with other organisms or with the environment (e.g., pollination, shelter, seed dispersal, camouflage, migration, hibernation, defensive mechanism)</td>
<td></td>
</tr>
<tr>
<td>EC 1 A 4 b</td>
<td>Identify and describe different environments (i.e., pond, forest, prairie) support the life of different types of plants and animals</td>
<td></td>
</tr>
<tr>
<td>EC 1 D 4 a</td>
<td>Identify examples in Missouri where human activity has had a beneficial or harmful effect on other organisms (e.g., feeding birds, littering vs. picking up trash, hunting/conservation of species, paving/restoring green space)</td>
<td></td>
</tr>
<tr>
<td>EC 2 A 4 a</td>
<td>Classify populations of organisms as producers and consumers by the role they serve in the ecosystem</td>
<td></td>
</tr>
<tr>
<td>EC 2 A 4 b</td>
<td>Differentiate between the types of consumers (herbivore, carnivore, omnivore, detritivore/decomposer)</td>
<td></td>
</tr>
<tr>
<td>EC 2 A 4 c</td>
<td>Categorize organisms as predator or prey in a given ecosystem</td>
<td></td>
</tr>
<tr>
<td>EC 3 C 4 d</td>
<td>Predict which plant or animal will be able to survive in a specific environment based on its special structures or behaviors</td>
<td></td>
</tr>
</tbody>
</table>
Ecosystems Introduction
Section 1, Lesson 1

Name: ________________________________ Date: ____________________

ECOSYSTEMS POSTERS
List the ecosystem on your poster:
______________________________________________________________

1. Write 2 questions about your ecosystem poster.
   a. ___________________________________________________________
      ___________________________________________________________
   b. ___________________________________________________________
      ___________________________________________________________

2. Write 2 things you notice about the ecosystem poster.
   I notice _______________________________________________________
   and __________________________________________________________

3. List the parts of the ecosystem you know.
   The parts are _____________________________________________,
   _____________________________________________,
   _____________________________________________,
   _____________________________________________, etc.
Ecosystem Pizza Pie Chart

Section 1, Lesson 1
Using your Ecosystem Pizza Chart as an example, pick an animal or plant from your poster and make a Pizza chart for it. An example could be a drawing of a fish, a school of fish, the school in the water, the stream in a forest, the forest on Earth. All examples should end with the biosphere!

Could the species you chose live in another ecosystem? Why or why not?

________________________________________________________________________

________________________________________________________________________

Using your poster, find 1 producer: ____________________________________________

Find 1 consumer: ____________________________________________________________

Find 1 decomposer: ___________________________________________________________
Ecological Pyramid

Section 1, Lesson 4
Ecosystem Flow Chart

Section 2, Lesson 5

KEY

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sun</strong></td>
<td><img src="image" alt="Sun" /></td>
</tr>
<tr>
<td><strong>Who eats who/energy</strong></td>
<td><img src="image" alt="Arrow" /></td>
</tr>
<tr>
<td><strong>Producers</strong></td>
<td><img src="image" alt="Triangle" /></td>
</tr>
<tr>
<td><strong>Consumers</strong></td>
<td><img src="image" alt="Box" /></td>
</tr>
<tr>
<td><strong>Decomposers</strong></td>
<td><img src="image" alt="Inverted Triangle" /></td>
</tr>
</tbody>
</table>
1. Hand out the Ecosystem Flow Chart handout (Appendix v) to the students.

2. Sketch on the board or display on your whiteboard the blank handout.

3. Explain the Key to the students. Ask for student definitions or examples of producer, consumer, and decomposer.

4. Then, show the students how to start with air, rocks, and water that are in the container ecosystem. Ask them where they should place the plants, and which symbol to use.

5. Place the plant and then discuss how to show the arrow. The sun gives energy to the plant, so draw that arrow.

6. Use this procedure to show the students how to place the snails.

TEACHER ANSWER KEY:

<table>
<thead>
<tr>
<th>KEY</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sun</td>
<td>☀</td>
</tr>
<tr>
<td>Who eats who/energy</td>
<td>→</td>
</tr>
<tr>
<td>Producers</td>
<td>△</td>
</tr>
<tr>
<td>Consumers</td>
<td>□</td>
</tr>
<tr>
<td>Decomposers</td>
<td>▼</td>
</tr>
</tbody>
</table>

![Ecosystem Flow Chart Diagram](image-url)
Guidelines and Rubric

Section 2, Lesson 6

ALL OPTIONS MUST:
- Include your name
- Include the name and location of your ecosystem
- Include at least 3 producers
- Include at least 3 consumers
- Include at least 3 decomposers

OPTION 1: FLOW CHART
- Includes arrows showing how the different living things get food/energy

OPTION 2: 3-D MODEL
- Includes a “key” that names all living things in the ecosystem

OPTION 3: CONSTRUCTION INSTRUCTIONS
- Includes a list of all living and non-living things the model needs
- Includes instructions on how to put the ecosystem together
- Includes a sketch of what the finished ecosystem will look like
# Peer Review Sheet

**Section 2, Lesson 6**

Name: ________________________________

<table>
<thead>
<tr>
<th>STUDENT</th>
<th>ECOSYSTEM AND TYPE OF MODEL</th>
<th>NAME AT LEAST 1 PRODUCER</th>
<th>NAME AT LEAST 1 CONSUMER</th>
<th>NAME AT LEAST 1 DECOMPOSER</th>
<th>WHAT ELSE DID YOU NOTICE ABOUT THEIR ECOSYSTEM?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Animal Report Template
Section 3, Lesson 7

**DRAW YOUR ANIMAL HERE:**

**ANIMAL NAME:** _______________________________

| Weight: ________________________________ |
| Length: ________________________________ |

**MY ANIMAL IS:**
- [ ] Fish
- [ ] Amphibian
- [ ] Reptile
- [ ] Bird
- [ ] Mammal
- [ ] Insect
- [ ] Herbivore
- [ ] Carnivore
- [ ] Omnivore

**MY ANIMAL'S ECOSYSTEM IS:**
- ________________________________
- ________________________________
- ________________________________

**MY ANIMAL HAS THESE ADAPTATIONS FOR SURVIVAL:**
- ________________________________
- ________________________________
- ________________________________

**MY ANIMAL DOES THESE THINGS TO SURVIVE:**
- ________________________________
- ________________________________
- ________________________________

**DELICIOUS EATS FOOD CHAIN:**

- Predator
- Consumer
- Producer

**WHERE ON EARTH DO THEY LIVE?**

- North America
- Europe
- Asia
- Africa
- South America
- Australia
- Antarctica
- Atlantic Ocean
- Indian Ocean
- Pacific Ocean

**AMAZING FACTS ABOUT MY ANIMAL:**
- ________________________________
- ________________________________
# Ecosystem Change Grid

**Section 3, Lesson 8**

Name: _______________________________________________  Date: __________________________

<table>
<thead>
<tr>
<th>POSTER</th>
<th>WHAT HAPPENS? WHAT CHANGES?</th>
<th>SURVIVES WELL AND WHY</th>
<th>SURVIVES LESS WELL AND WHY</th>
<th>DOES NOT SURVIVE AND WHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wetlands</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Animal:</td>
<td>Animal:</td>
<td>Animal:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Plant:</td>
<td>Plant:</td>
<td>Plant:</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Your poster:</th>
<th>Your change:</th>
<th>Animal:</th>
<th>Animal:</th>
<th>Animal:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Plant:</td>
<td>Plant:</td>
<td>Plant:</td>
</tr>
</tbody>
</table>
Evaluating Questions
Section 3, Lesson 8

Name: ________________________________ Date: __________________

1. Draw a food chain (describe the living things using words and linking the living things with arrows).

2. Make the food chain into a food web.

3. What living thing would not survive in this ecosystem? Why not?
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________

4. What things could happen to change the balance of this ecosystem?
   ___________________________________________________________________
   ___________________________________________________________________
   ___________________________________________________________________
Vocabulary Words

All Sections and Lessons

RECOMMENDATION
We recommend that students participate in investigations as they learn vocabulary, that it is introduced as they come across the concept. MySci students work collaboratively and interact with others about science content also increasing vocabulary. The hands-on activities offer students written, oral, graphic, and kinesthetic opportunities to use scientific vocabulary and should not be taught in isolation.

ecosystem  fossil
component  extinct
organism  food web
individual  omnivore
habitat  herbivore
population  carnivore
community  disruption
biosphere  energy pyramid
forest  food web
prairie  food chain
wetlands  biotic
grasslands  abiotic
environment  survival
producer  social behavior
consumer  trophic level
decomposer  adaptation

species