Grade 5: Life Science Module

Lesson Sequence 10: Changing Ecosystems

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Overview

Total Time: 2 hours of instruction (divided into two sections)

In this lesson sequence, students learn how one part of the ecosystem can affect the other parts of the ecosystem and, ultimately, the health of an ecosystem. They learn, through a case study, about the reintroduction of wolves to Yellowstone National Forest. They also study invasive species and make predictions about how their expert ecosystem might change under a particular scenario.

Lesson Sequence Focusing Question and Big Ideas

How does a change in one part of an ecosystem affect the cycling of matter and energy in the ecosystem?

- A change affecting one part of the ecosystem affects the remaining parts and organisms.
- The loss of producers destabilizes and endangers the entire ecosystem the most because producers are needed to take energy from the sun and turn it into usable stored energy.
- The loss of a particular consumer in an ecosystem results in an increase in the number of its prey/food source and a decrease in its predators because they lose a food source.
- If a new organism is introduced into an ecosystem, the population of its food source will decrease.
- If there is no natural predator for the new species, it will increase in number because few will be killed.

Long-Term Learning Addressed (Based on NGSS)

Use a model to predict that when a biotic or abiotic factor in an ecosystem changes, the entire ecosystem is affected. (Based on **NGSS 5-LS2-1**)

This lesson sequence explicitly addresses:

Science and Engineering Practices:

- **Developing and Using Model:** Use models to describe and/or predict phenomena. *Students use their expert ecosystem explanatory models to predict what would happen if one part of their ecosystem was changed.*

Crosscutting Concepts:

- **Systems and System Models:** A system can be described in terms of its components and their interactions. *Students learn that changing one part of an ecosystem can have negative effects other parts of the ecosystem.*

Disciplinary Core Ideas:

- **LS2.A: Interdependent Relationships in Ecosystems:** Newly introduced species can damage the balance of an ecosystem. *Students learn about and discuss how removing and adding species can affect the balance of an ecosystem.*

Lesson Sequence Learning Target

- I can use a model to predict how a change in one part of an ecosystem can affect the other parts of the ecosystem.

Ongoing Assessment

- Student science notebooks: Changing Ecosystems entry
- Participation in Back-to-Back and Face-to-Face protocol
- Expert ecosystem explanatory model

Agenda

Total Time: 2 hours of instruction

Section 1

1. **Opening**
   A. Introducing Learning Target and Focusing Question (10 minutes)
2. **Obtaining Information**
   A. Studying the Removal of Wolves from Yellowstone (50 minutes)
   Optional Extension: Read Aloud

Section 2

1. **Obtaining Information**
   A. Studying Invasive Species (15 minutes)
   Optional Extension: Deeper Dive into Invasive Species
2. **Engaging in Argument**
   A. Evaluating a Model Argument (20 minutes)
3. **Developing and Using Models**
   A. Making Predictions Using Explanatory Models (25 minutes)

Teaching Notes

Purpose of lesson sequence and alignment to NGSS standards:

- In this lesson sequence, students learn that when one part of the ecosystem changes—through the introduction of a new species—the rest of the ecosystem is affected and the balance of the ecosystem changes (a Disciplinary Core Idea).
- In Section 1, students study the reintroduction of wolves to Yellowstone National Park. They learn how an entire ecosystem can be affected by a change to one part of the system (a Crosscutting Concept). This helps to deepen their understanding of balance in an ecosystem.
- In Section 2, students read and dissect a model argument (a Science and Engineering Practice) about the health of the Yellowstone National Park ecosystem and see how to apply the criteria for healthy ecosystems. They then learn about invasive species and how they can affect the health and balance of an ecosystem. Finally, they use their own expert ecosystem explanatory models to make predications about how their ecosystem might change under a particular scenario.

How it builds on previous work in the Life Science Module:

- As students deepen their understanding of how to assess the health of an ecosystem, they must understand that a healthy system will be in balance. Adding new species, especially invasive species or removing species, can have an effect on the balance of an ecosystem.

How it connects to the CCSS Standards and EL Education's Language Arts Grade 5 Module 2:

- The class discussion in Section 1 provides students the opportunity to practice their speaking and listening skills while collaborating in whole group discussions (CCSS ELA SL.5.1).
- Students may be familiar with the Back-to-Back and Face-to-Face protocol from Language Arts Grade 5 Module 2. This protocol provides students the opportunity to practice speaking and listening skills (CCSS ELA SL.5.1).

Possible student misconceptions:

- Students may think that an ecosystem is either healthy or not, rather than being on a continuum. This lesson sequence is a good place to address such misconceptions and to reinforce that an ecosystem's health can improve over time.
- Students may think that wolves were "bad" because they ate elk or that ranchers were "bad" when they hunted the wolves out of the park. Or they may think that adding a species is "good." Remain objective when looking at the balance of an ecosystem and look for evidence that each part is helping the whole function better.

Possible broader connections:

- Connect to students' lives by discussing examples of how local ecosystems may have been changed through deforestation or invasive species.
- Connect to other sciences by discussing other times when students may have made predictions.

Areas where students may need additional support:

- For students who need support with auditory processing or ELLs: Consider providing running notes or an outline of the video.
- Students may need additional support in evaluating model arguments. Consider using a student exemplar from Lesson Sequence 9 for additional practice in deconstructing an argument.

Down the road:

- In the next lesson sequence, students complete the summative assessment. Address any lingering misconceptions before then.

In advance:

- Read each section and complete the Preparing to Teach: Self-Coaching Guide.
- Prepare technology necessary to play:
  - "Wolves of Yellowstone" <http://www.pbslearningmedia.org/resource/a58e3ca2-52ab-45f5-87ac-26ee0d681146/wolves-of-yellowstone-earth-a-new-wild/>.
  - "How Does the Greater Yellowstone Ecosystem Benefit from Having Wolves?" <http://www.nps.gov/yell/learn/photosmultimedia/qa-wolves.htm>.
  - "Indiana Expeditions | Invasive Insects" <http://www.pbslearningmedia.org/resource/26a6e472-4338-4963-92d5-5f44e3282f21/indiana-expeditions-invasive-insects/>.

- Create:
  - The Invasive Species cards, making enough for one card per student (see supporting materials). Consider laminating the cards for future use.
  - The Ecosystem Scenario cards, making enough for one set of cards per ecosystem expert group (see supporting materials). Consider laminating the cards for future use.
- Review the Back-to-Back and Face-to-Face protocol. See the Classroom Protocols pack on Curriculum.ELeducation.org.
- Post: Lesson sequence learning target, lesson sequence focusing question, Criteria for Healthy Ecosystems anchor chart, Concepts Scientist Think About anchor chart, and Scientists Do These Things anchor chart.

Optional extensions:

- *Read Aloud:* Read *The Wolves Are Back* by Jean Craighead George.
- *Deeper Dive into invasive Species*. Students could study the wealth of information about invasive species. Consider the following sources:
  - <http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsm91_054504.pdf>
  - <http://hungrypests.com/resources/youth.php>
  - <http://www.nps.gov/plants/alien/factmain.htm>
  - <http://www.pbslearningmedia.org/resource/4ade6566-c970-41ad-afbf-70ab842ad80a/4ade6566-c970-41ad-afbf-70ab842ad80a/>

Vocabulary

predict: to make an educated guess about what is going to happen
invasive: a plant or animal that is not normally in a particular ecosystem but is recently introduced and typically is destructive

Materials

General Materials

- ☑ Opening image (one to display)
- ☑ Student science notebook (from Lesson Sequence 1; one per student)
  - Changing Ecosystems entry (page 42 of student science notebook)
- ☑ "Wolves of Yellowstone" (video; play in entirety; see Teaching Notes)
- ☑ Criteria for Healthy Ecosystems anchor chart (begun in Lesson Sequence 1; added to during Section 1)
- ☑ "How Does the Greater Yellowstone Ecosystem Benefit from Having Wolves?" (video; play in entirety; see Teaching Notes)
- ☑ Concepts Scientists Think About anchor chart (begun in Lesson Sequence 2; added to during Section 2)
- ☑ "Indiana Expeditions | Invasive Insects" (video; play from 0:40–2:26; see Teaching Notes)
- ☑ Invasive Species cards (one per student)

- ☑ Scientists Do These Things anchor chart (begun in Lesson Sequence 2; added to during Section 2)
- ☑ Yellowstone National Park Ecosystem graphic organizer (one per student)
- ☑ Health of Yellowstone National Forest Ecosystem: Model Argument (one to display)
- ☑ Expert ecosystem explanatory model (begun in Lesson Sequence 5)
- ☑ Ecosystem Scenario cards (one set per ecosystem expert group)

Science-Specific Materials (gathered by the teacher)

- ☑ N/A

Section 1: Opening

A. Introducing Learning Target and Focusing Question (10 minutes)

- Display the **Opening image**.
- Ask students to turn and talk with an elbow partner, but do not ask students to share with the class:

  "Does this picture show a healthy ecosystem?"

  "What would happen if we removed one organism, like the elk, from this picture? What if we added an organism, like a bear?"

  "What if we added trees? What might happen?"

  "What about a river?"
- Invite students to take out their **student science notebooks** and open to the **Changing Ecosystems entry**.
- Select a volunteer to read the focusing question listed under "Opening" aloud while the other students follow along, reading silently in their heads:
  - "How does a change in one part of an ecosystem affect the cycling of matter and energy in the ecosystem?"
- Remind students that they have been learning how ecosystems work and how matter and energy cycle through an ecosystem. Today, they will think about how that cycle can be interrupted or changed when one part of the ecosystem changes.
- Direct students' attention to the posted lesson sequence learning target and read it aloud as students follow along, reading silently in their heads:
  - ***"I can use a model to predict how a change in one part of an ecosystem can affect the other parts of the ecosystem."***
- Underline the word *predict*.
- Using a total participation technique, invite responses from the group:

  "What do you think the word* predict *means?" (to make an educated guess about what is going to happen)
- Define *predict* as necessary. Consider drawing connections between other situations where students may have made predictions (e.g., Language Arts class, other domains of science, their personal lives) [1].

- Invite students to record their ideas about the lesson sequence focusing question or the learning target under the "Opening" section of their student science notebook.

Preparing to Teach: Self-Coaching Guide

1. What experience do my students have with making predictions?

Section 1: Obtaining Information

A. Studying the Removal of Wolves from Yellowstone (50 minutes)

- Tell students they will now watch a video that shows how a change in one part of an ecosystem can affect the other parts of the ecosystem. Briefly introduce Yellowstone National Park.
- Tell students that as they watch the video the first time, they should focus on understanding the gist of the video. They should also record new vocabulary in the "Obtaining Information" section of the Changing Ecosystems entry in their student science notebooks.
- Show "**Wolves of Yellowstone.**"
- Ask students to turn and talk to an elbow partner [(1)]:

  "What is the gist of the video?" (Wolves were reintroduced to Yellowstone National Forest; this affected other parts of the ecosystem.)

  "What are some vocabulary words that you found?" (Responses will vary.)
- Explain that they will watch the video again. This time they should write down some of the ways that the abiotic and biotic features of the ecosystem were affected by the wolves.
- Play the video again, pausing it as new concepts are introduced. At each pause point, discuss the big ideas from that section [(2)].
- Once students have completed their second viewing, invite them to turn and talk to an elbow partner [(3)]:

  "What happened to the elk population when there weren't wolves? How did this affect the abiotic and biotic features of the ecosystem?" (The elk population increased when there weren't wolves as predators. When there were too many elk, it damaged the shrubs in the ecosystem because that's what all the elk ate. Also, the elk made the river water murky, which had negative effects on the fish, etc.)
- Direct students' attention to the **Criteria for Healthy Ecosystems anchor chart**.
- Elicit student responses about the video's big ideas. Consider asking:

  "When the wolves were gone, how well did Yellowstone meet the criteria for a healthy ecosystem? Why?" (The system was not in balance, but responses will vary as to why. For example, not all the animals could get their needs met because the elk were changing the habitat of the animals.)

  "What happened when the wolves were reintroduced?" (The wolves kept the number of elk under control, which reversed a lot of the negative consequences mentioned.)

  "The wolves directly affected the elk population because they ate the elk. But they also indirectly affected many other biotic and abiotic features. What were they?" (the plants and soil around the river beds, the quality of the water, the direction of the water, beavers, songbirds, etc.)

- After 10–15 minutes, tell students they will now watch a video that explains more about the meaning of *balance* and how it relates changes in an ecosystem.
- Play "**How Does the Greater Yellowstone Ecosystem Benefit from Having Wolves?**"
- Debrief students on the video. Ask [4]:

  "What new information have we learned about the importance of a balanced ecosystem?" (When there is a change, it can affect the balance of an ecosystem—for example, taking away a species like wolves; other parts of the ecosystem can be thrown out of balance.)
- Remind students of the lesson sequence focusing question by directing their attention to it and reading it aloud:
  - "How does a change in one part of an ecosystem affect the cycling of matter and energy in the ecosystem?"
- Ask:

  "What does balance have to do with the cycle of energy and matter in an ecosystem?" (If the system is not in balance, then the cycle of matter and energy will be interrupted. For example, when the elk were eating and trampling the berry bushes, the bears couldn't get enough food [matter and energy] to build up fat for hibernating. When the elk eroded the river banks, the fish and the animals that feed on fish couldn't get the food [matter and energy] they needed to live.)

  "How can we capture what we learned from studying Yellowstone to the Criteria for Healthy Ecosystems anchor chart?" (Responses will vary. Record all valid answers on the anchor chart and refer to the supporting materials for possible responses.)
- Ask:

  Does the idea that changing one part of a system (like an ecosystem) can affect the other parts apply to other systems? Can you give an example?" (Yes. Responses will vary, but may include: If you removed the pedals from a bike, the whole system would be affected; or if your heart stopped pumping blood, that would affect the whole circulatory system.)
- Add "Example: Ecosystem" and other students examples under the row that says "When one part of a system changes, the whole system is affected" in the Systems column of the **Concepts Scientists Think About anchor chart**.

Preparing to Teach: Self-Coaching Guide

1. After previewing the video, what vocabulary words do I suspect my students will need help with?
2. After previewing the video, at what points will I pause?
3. As students share out, how can I encourage them to provide evidence for their ideas? (Consider: "What have you seen or heard that makes you think that?")
4. What questions can I use to prompt students to see connections between one another's ideas? Consider:
   - "Does anyone have something similar?"
   - "How are these ideas the same? How are they different?"
   - "Can someone paraphrase what Student A said"?
   - "Who thinks something similar or different?"
   - "Can you add to what Student A said?"

Section 2: Obtaining Information

A. Studying Invasive Species (15 minutes)

- Transition to the discussion about invasive species by saying something like: "In the case of Yellowstone, adding an organism that was once there helped the balance and stability of the ecosystem. But adding an organism can sometimes make an ecosystem unstable and unbalanced. We call these organisms *invasive species*."
- Play "**Indiana Expeditions | Invasive Insects.**"
- Ask (1):

  "What is an invasive species?" (a species that comes from a different ecosystem that disrupts the balance of the ecosystem)

  "How is an invasive species different from the wolves of Yellowstone?" (The wolves belonged there. They had once lived there and interacted with the other organisms in a way that helped all organisms.)
- Clarify that invasive species can be plants or animals.
- Tell students they will now learn about some of the invasive species in the United States.
- Distribute **Invasive Species cards**.
- Tell students that they will use the Back-to-Back and Face-to-Face protocol to share the information on their cards. Remind them that they used this protocol in Lesson Sequences 3 and 4, and review as necessary. Refer to the Classroom Protocols pack on Curriculum.ELeducation.org for the full version of the protocol.
  - Ask students the following questions and give them 30 seconds to consider how they will respond:

  "Where did the invasive species on your card come from, and how did it get to the U.S.?"
  - Invite students to turn face-to-face to share their responses.
  - Have students repeat these steps with a new partner for each question.

  "Why is the invasive species on your card a concern?"

  "How does the invasive species on your card affect the native organisms?"

  "What does the invasive species on your card teach us about balance and stability in an ecosystem?"
- Guide students through the protocol, repeating with new partners as time allows.
- Invite students to return to their seats.

Preparing to Teach: Self-Coaching Guide

1. Remind students of the food web nest they built in Lesson Sequence 8 using balls of string or yarn. Round 2—where all the producers handed the balls of string to the same consumer—simulated the effect of invasive species.

Section 2: Engaging in Argument

A. Evaluating a Model Argument (20 minutes)

- Tell students they will now look more closely at an argument about how balance and stability are important criteria for the health of an ecosystem. Consider saying something like: "You have been thinking a lot about the ecosystem of Yellowstone. You've learned how changing the food web, by removing and then replacing the large carnivores like the wolves, affected the health of the ecosystem. Today you will read an argument that answers the question: 'How healthy is Yellowstone National Park Ecosystem?' In order to answer that question, the author had to look at the criteria for a healthy ecosystem. Then the author had to think about how many of the criteria Yellowstone meets and how well it meets each of the criteria. You probably have an idea about how you would answer that question. Now you're going to see how someone else used evidence and scientific reasoning to create an argument for how well Yellowstone meets the criteria for a healthy ecosystem."
- Direct students' attention to the **Scientists Do These Things anchor chart** and select a volunteer to read the steps for making an argument:
  1. Make a claim (answer the question).
     - I'm arguing that ...
  2. Use the evidence and scientific reasoning to support the claim.
     - *My evidence for this is ...*
     - *This evidence shows ...*
  3. Explain why the evidence is relevant and sufficient.
     - *This is evidence is sufficient because ...*
     - *Further evidence could include ...*
- Distribute the **Yellowstone National Park Ecosystem graphic organizer** and display it and the **Health of Yellowstone National Forest Ecosystem: Model Argument** side-by-side.
- Tell students that when they write their own argument about the health of an ecosystem, they will use a graphic organizer like this one to help them make sure they answer all parts of the prompt [(1)].
- Let them know that, today, they will work together as a class to check that the model argument answers all parts of the prompt by making sure that all parts of the Yellowstone National Park Ecosystem graphic organizer can be filled in.
- Redirect students' attention to the model argument and read it aloud as students follow along, reading silently in their heads [(2)].
- Tell students you are going to read the model argument again, and this time you want them to pay attention to the evidence the author uses. Reread the model argument.
- Invite students to record the evidence used in the first paragraph in their Yellowstone National Park Ecosystem graphic organizer.
- Cold call a few students to share out what they recorded. Record student responses in the appropriate column of the displayed version of the graphic organizer.
- Repeat this process for each paragraph of the model argument.
- Tell students you are going to read the model argument aloud again, and this time you want them to pay attention to the reasoning the author uses.

- Invite students to record the reasoning that links the evidence with each of the criteria for a healthy ecosystem on the graphic organizer.
- Cold call a few students to share out what they recorded. Record student responses in the appropriate column of the displayed version of the graphic organizer.
- Using a total participation technique, invite responses from the group:

  "How did the author of the model argument explain whether he or she had enough evidence?" (The author talked about what is important for a healthy ecosystem and explained whether or not there was evidence for these criteria.)

  "Do you think the author has enough strong evidence to support his or her claim?" (Responses will vary, but may include: Yes, the author explained more than one criteria.)

  "Where does the author evaluate the evidence?" (in the last paragraph)
- Emphasize that this is a strong argument because the author makes a claim, supports the claim with relevant and sufficient evidence, and explains why the evidence is relevant and sufficient. Further, all components of the Yellowstone National Park Ecosystem graphic organizer are able to be filled in so no part of the argument is missing.
- Tell students they will get a chance to write an argument and you are confident they can make a claim, use evidence and reasoning to support their claim, and evaluate their evidence.

Preparing to Teach: Self-Coaching Guide

1. What experience do my students have with graphic organizers? Do I need to take some time to orient them to how this one works?
2. Now that I have previewed the model argument, what evidence do I want the students to notice?

Section 2: Developing and Using Models

A. Making Predictions Using Explanatory Models (25 minutes)

- Remind students of the lesson sequence learning target by directing their attention to it and reading it aloud:

  "I can use a model to predict how a change in one part of an ecosystem can affect the other parts of the ecosystem."
- Direct students' attention to the Scientists Do These Things anchor chart and select a volunteer to read aloud the fourth bullet in the "Develop a Model" column:

  — "Models can be used for making predictions."
- Remind students that, earlier in the lesson sequence, they defined the act of predicting as making an educated guess about what is going to happen.
- Tell students that they are going to use what they have learned about the importance of balance and stability to make a prediction about how the ecosystem depicted in their expert ecosystem explanatory model might change when one part of the ecosystem changes.
- Add "Use expert ecosystem explanatory model to make a prediction about what would happen to the ecosystem if something changed" to the "Develop a Model" column on the Scientists Do These Things anchor chart.

- Invite students to move to sit with their ecosystem expert group.
- Distribute **expert ecosystem explanatory models** and **Ecosystem Scenario cards**.
- Tell students they will now work with their expert group to look at their Ecosystem Scenario card and make a prediction about what would happen in their ecosystem if each scenario occurred.
- Remind students to work collaboratively with their group to make a prediction about the changes that may occur as a reaction to a single change in their ecosystem. Model as necessary.
- Invite groups to begin discussing and consider possible predictions. Circulate to support students as they work (1).
- After 15 minutes, direct students to open their student science notebooks to the Changing Ecosystem entry and find the "Developing and Using Models" section.
- Explain to students that they are going to create an argument using evidence to support their prediction about what they think is going to happen. Now they will write this argument in their notebook. They may work individually or with a partner, but each student should write the argument in his or her own notebook.
- Instruct students to choose one of the scenarios from the set and summarize the one change in their notebook.
- Then give students time to write an argument to support their predication about what would happen to the health of the ecosystem with the change (2).
- Circulate to provide assistance.
- After 10 minutes, refocus whole group. Give students specific positive feedback on their ability to use models and construct arguments. Emphasize that they are doing the work of scientists. (Example: "Using a model to make a prediction is exactly what scientists do. The better you get at making models, the more accurate your predictions and the stronger your arguments will be.")

Preparing to Teach: Self-Coaching Guide

1. My students may need additional time. How can I provide them more time?
2. What students need additional instruction for writing arguments before the summative assessment in the next lesson sequence?