Grade 5: Life Science Module

Lesson Sequence 9: Stability and Balance

Lesson Sequence 9: Stability and Balance

Overview

Total Time: 2.5 hours of instruction (divided into three sections)

In this lesson sequence, students build their own definition and understanding of a balanced and stable ecosystem through a modeling activity with balls of string/yarn. They also construct an argument about the health of the ecosystem depicted in their expert ecosystem explanatory model by using evidence collected throughout the Life Science Module.

Lesson Sequence Focusing Question and Big ideas

How is the flow of matter and energy stable and balanced in a healthy ecosystem?

- A diverse number of organisms is beneficial to the balance and stability of the ecosystem.
- A complete food web is important to the balance and stable flow of matter and energy in an ecosystem.

Long-Term Learning Addressed (Based on NGSS)

Compare and refine arguments based on an evaluation of evidence that in a healthy ecosystem, a diversity of species meets their needs, including the need for food, in a stable web of life. (Based on NGSS 5-LS2-1)

This lesson sequence explicitly addresses:

Science and Engineering Practices:

- **Engaging in Argument:** Compare and refine arguments based on an evaluation of the evidence and reasoning presented. *Students create their own argument about the health of the ecosystem depicted in their expert ecosystem explanatory model. As students present these arguments, their peers provide critiques based on the evidence and reasoning provided.*

Crosscutting Concepts:

- **Systems and System Models:** A system can be described in terms of its components and their interactions. *Students participate in a simulation to learn that an ecosystem is healthy when its components interact in a balanced and stable way.*

Disciplinary Core Ideas:

- **LS2.A: Interdependent Relationships in Ecosystems:** A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. *Students consider the importance of multiple species in an ecosystem through their modeling of balance and stability using balls of string/yarn. They create an argument about the health of their expert ecosystem based on this criteria.*

Lesson Sequence Learning Targets

- I can explain balance and stability in an ecosystem.
- I can evaluate evidence about the health of an ecosystem.

Ongoing Assessment

- Scientists Meeting
- Student science notebooks: Stability and Balance entry
- Ecosystem explanatory model

Agenda

Total Time: 2.5 hours of instruction

Section 1

1 **Opening**

A. Introducing Learning Targets and Focusing Question (5 minutes)

2 **Carrying Out Investigation**

A. Modeling: Stability and Balance (30 minutes)

B. Scientists Meeting: Building Understanding (15 minutes)

Section 2

1. **Engaging in Argument**

A. Constructing an Argument: Health of Ecosystems (35 minutes)

2. **Evaluating Information**

A. Peer Critique: Health of Ecosystems (45 minutes)

Section 3

1. **Engaging in Argument**

A. Revising an Argument: Health of Ecosystems (20 minutes)

Teaching Notes

Purpose of lesson sequence and alignment to NGSS standards:

- In this lesson sequence, students learn that the ability of many organisms to get their needs met (or balance) in a relatively stable web of life (a Disciplinary Core Idea) is a necessary component of a healthy ecosystem.
- In Section 1, students participate in a demonstration that illustrates how the parts of the food web interact (a Crosscutting Concept) to form a stable and balanced system. They then synthesize their learning in a Scientists Meeting.
- In Sections 2 and 3, students apply the criteria for healthy ecosystems that they have been compiling across Lesson Sequences 1–8 and construct an argument (a Science and Engineering Practice) about their expert ecosystem. They then use the Praise, Question, Suggestion protocol in pairs to refine the evidence for their arguments.

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

- Students continue to refine their criteria for assessing the health of an ecosystem. In this lesson sequence, they add the idea of balance and stability to the criteria. They also use this information to construct an argument about healthy ecosystems.

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

- Students discuss the concept of biodiversity in this lesson sequence. The tropical rainforest that students study in Language Arts Grade 5 Module 2 is an ecosystem rich in biodiversity.
- The Scientists Meeting 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).
- The argument that students write in Section 2 provides them an opportunity to practice argument writing (CCSS ELA W.5.1).

Possible student misconceptions:

- Students may think that diversity of organisms is the most important criterion in an ecosystem's health and stability. In reality, no one criterion is more important than another. Although this lesson focuses on the interaction of biotic features (such as organisms in a food web), the interaction of abiotic features is also very important. Discuss other abiotic factors, such as pollution, that could cause an ecosystem to be unhealthy.

Possible broader connections:

- Connect to students' lives by having them consider when they have been sick. They may have had a virus that threw off the stability of the way their body functions. Students have also likely been in traffic before. Perhaps a small accident threw off the stability of the flow of traffic, causing backup.

Areas where students may need additional support:

- Students may need additional support constructing an argument. Consider what structures students may already be familiar with for organizing information.

Down the road:

- Students will continue to return to their expert ecosystem explanatory models and use them to make a prediction in Lesson Sequence 10. Post (or store) them in a safe and easily accessible location.

In advance:

- Read each section and complete the Preparing to Teach: Self-Coaching Guide.
- Familiarize yourself with what will be expected of students during the food web activity in Section 1 by reading the Directions for Food Web Simulation and gather balls of string or yarn (see supporting materials).
- Review the Praise, Question, Suggestion protocol (see the Classroom Protocols pack on Curriculum.ELeducation.org).
- Decide whether students will use sticky notes or notecards to flag evidence to use when constructing their argument about the health of the ecosystem depicted in their expert ecosystem explanatory model.
- Post: Lesson sequence learning targets, lesson sequence focusing question, Criteria for Healthy Ecosystems anchor chart, Concepts Scientists Think About anchor chart, and Scientists Do These Things anchor chart.

Optional extensions:

- *Tracing Energy back to the Sun*: Students could extend the string activity in Section 1 to include learning about how energy originates with the sun <http://dnr.wi.gov/eek/teacher/invasivesguide/Web%20of%20Life.pdf>.

Vocabulary

evaluate: to figure out how good, useful, or successful something is

balance: an even distribution, steady; in a balanced ecosystem all organisms are getting their needs met and all cycles are flowing

stable: not likely to change or become unhealthy; a stable ecosystem is unlikely to be affected by small changes

biodiversity: the variety of organisms in an particular place

Materials

General Materials

- ☑ Student science notebook (from Lesson Sequence 1; one per student)
  - — Stability and Balance entry (page 38 of student science notebook)
- ☑ Food Web Name cards (enough for one card per student; used in Section 1)
- ☑ Directions for Food Web Simulation (for teacher reference)
- ☑ Criteria for Healthy Ecosystems anchor chart (begun in Lesson Sequence 1; added to during Section 1)
- ☑ Concepts Scientists Think About anchor chart (begun in Lesson Sequence 2; added to during Section 1)
- ☑ Scientists Do These Things anchor chart (begun in Lesson Sequence 2; see Lesson Sequence 8 supplementary materials)
- ☑ Expert ecosystem explanatory model (begun in Lesson Sequence 5)
- ☑ Peer Critique: Expert Ecosystem Explanatory Model Argument (one per student)

Science-Specific Materials (gathered by the teacher)

- ☑ Balls of string or yarn (five to eight; enough for each "producer" to have one; used in Section 1)
- ☑ Sticky notes or notecards (four to six per student; used in Section 2; see Teaching Notes)
- ☑ Timer (optional; used in Section 2)

Section 1: Opening

A. Introducing Learning Targets and Focusing Question (5 minutes)

- Invite students to take out their **student science notebooks** and open to the **Stability and Balance entry**.
- Select a volunteer to read the focusing question listed under the "Opening" section aloud, while the other students follow along, reading silently in their heads:
  - — "How is the flow of matter and energy stable and balanced in a healthy ecosystem?"

- Underline the words *stable* and *balanced*. Tell students that they will complete an activity in this lesson sequence to help them build their own definitions of these words.
- Direct students' attention to the posted lesson sequence learning targets and read them aloud as students follow along, reading them silently in their heads:
  - ***"I can explain balance and stability in an ecosystem."***
  - ***"I can evaluate evidence about the health of an ecosystem."***
- Underline the word *evaluate*.
- Using a total participation technique, invite responses from the group:

  "What do you think the word evaluate means?" (to figure out how good, useful, or successful something is)
- Define *evaluate* as necessary. Consider drawing connections between school evaluations or grading and evaluating evidence [1].
- Remind students that to assess the health of an ecosystem, they will gather evidence to show how well the ecosystem meets the criteria. Once they have gathered evidence, they will evaluate if that evidence is sufficient and relevant—an important step in creating a scientific argument.

Preparing to Teach: Self-Coaching Guide

1. My students evaluated evidence in Lesson Sequence 4. What additional practice may they need with this skill?

Section 1: Carrying Out Investigation

A. Modeling: Stability and Balance (30 minutes)

- Invite students to turn and talk to an elbow partner [1]:

  "What do you think it means for an ecosystem to be in balance?" (Responses will vary. Students may say that in a balanced ecosystem, all organisms are getting their needs met and all cycles are flowing.)

  "What do you think it means for an ecosystem to be stable?" (Responses will vary. Students may say that a stable ecosystem is unlikely to be affected by small changes.)
- Tell students that one way to think about balance and stability is to look at the plants and animals in an ecosystem and the food webs they create. These food webs are also part of the cycle of matter and energy in an ecosystem, so they are useful to consider when assessing the health of an ecosystem.
- Tell students they will now participate in an activity where they will model food webs so they can visualize how food webs can be stable and balanced [2].
- Distribute **Food Web Name cards**.
- Invite students to gather in a circle and hold their card so it is visible to the group. Ensure all roles of the food web are mixed up (e.g., not all "producers" should stand next to each other).
- Distribute **balls of string or yarn** to each of the students holding a "Producer" name card.

- Tell the students they will hold onto the end of the string and pass the ball of string to model how the flow of energy and matter moves from organism to organism in an ecosystem. As each student passes the ball of string up the food chain, he or she should hold onto a section of string.
- Guide students through four rounds of the food web activity. Refer to the **Directions for Food Web Simulation (for teacher reference)** for guidance.
- After completing Round 4, gather the string and the cards and invite students to return their seats.
- Invite students to open their student science notebook to the "Carrying Out Investigation" section in the Stability and Balance entry. Ask them to record (with words or drawings) their learning from the activity in the space provided.
- After 5 minutes, refocus whole group.

Preparing to Teach: Self-Coaching Guide

1. What do I anticipate my students will say at this point?
2. After previewing the Directions for Food Web Simulation, how can I help students quickly and efficiently transition into this activity?

B. Scientists Meeting: Building Understanding (15 minutes)

- Ask students to bring their science notebooks and gather for a Scientists Meeting [1].
- Using a total participation technique, invite responses from the group:

  "What are the norms of a Scientists Meeting?" (take turns talking, build on one another's ideas, disagree respectfully, ask questions to clarify information)
- Remind students that a Scientists Meeting is a conversation where they speak to one another as scientists and not just to the teacher.
- Share with students that the goal of today's meeting is to build their understanding about the criteria for a healthy ecosystem.
- Ask for a few volunteers to share what they learned about balance and stability during the food web activity and lead students to a consensus about the definition of *balance* and *stability*. Consider asking:

  "What does it look like when an ecosystem is balanced?" (All organisms have their needs met.)

  "What does it look like when an ecosystem is stable?" (All parts are working together; it is unlikely to change.)

  "How does biodiversity relate to stability and balance?" (When there are many types of organisms fulfilling many parts of the food chains, the ecosystem is likely to be stable and in balance.)

  "How does a food chain relate to stability and balance?" (When all parts of the food chain are present, an ecosystem is more likely to be stable and in balance.)
- Encourage students to use evidence from the food web activity as evidence and make connections to one another's ideas by asking:

  "What net helped you see that?"

  "Did anyone else think something similar?"

  "Did anyone come to a different conclusion?"

- After 10 minutes, ask:

  "How might you add this learning to the criteria for a healthy ecosystem? Which criteria for a healthy ecosystem does this learning relate to?" (Row 1—the organisms in an ecosystem; Row 3—big cycles. Students likely won't mention Row 3. If they don't, say: "Remember that when we talk about the food web, we are talking about the cycle of matter and energy.")

- Direct students' attention back to the learning sequence focusing question:
  - "How is the flow of matter and energy stable and balanced in a healthy ecosystem?"
- Remind students that the flow of matter and energy is an important criterion for a healthy ecosystem. Ask:

  "So what does a balanced and stable flow of matter and energy in a food web look like?" (All levels of the food web are present. There is overlap among the food chains. All animals can get the energy they need for growth and body function. Energy is transferred among organisms. Matter is cycled through the food chain.)

- As students share, highlight that ecosystems are most healthy when the flow of matter and energy is balanced and stable.
- Add student ideas to the **Criteria for Healthy Ecosystems anchor chart**. (Refer to the Criteria for Healthy Ecosystems anchor chart in the supporting materials for guidance.)
- Give students specific positive feedback for thinking like scientist. (Example: "I saw you thinking about how different components interact and making predictions based on what you observed.")
- Direct students' attention to the **Concepts Scientists Think About anchor chart**. Explain that by looking at the cycles of matter and energy and thinking about how all the organisms interact, they have been thinking about systems.
- Add the example "A system can be described in terms of its components and their interactions" to the Systems column on the Concepts Scientists Think About anchor chart.
- Using a total participation technique, invite responses from the group:

  "Remember, an ecosystem is system. A food web is a system. What parts of each system did we discuss interacting?" (organisms, matter, energy)

- Invite students to return to their seats.

Preparing to Teach: Self-Coaching Guide

1. This Scientists Meeting is a little shorter than the others. How can I quickly and efficiently gather students and begin the conversation?

Section 2: Engaging in Argument

A. Constructing an Argument: Health of Ecosystems (35 minutes)

- Remind students of the second lesson sequence learning target and focusing question and point out that they will use their new knowledge about balance and stability to construct an argument about the health of the ecosystem depicted in their group's expert ecosystem explanatory model [1].

- Direct students' attention to the **Scientists Do These Things anchor chart** to remind students of the steps in preparing and making an argument. Explain that, first, scientists prepare for the argument. To do that, they:
  - Pose the question: "Is your group's expert ecosystem explanatory model a healthy ecosystem based on the criteria listed on the Criteria for Healthy Ecosystems anchor chart?"
  - Identify evidence: Evidence is scientific data that answers the question.
  - Evaluate evidence: This is the process of deciding if the data is accurate and relevant enough to support the claim.
- After scientists have identified and evaluated the evidence, they make the argument. To do that, they:
  - Make a claim: This is a statement that answers the original question.
  - Use evidence and scientific reasoning to support claim: This further explains the claim and adds validity to the argument.
  - Explain why the evidence is sufficient and relevant.
- Remind students that they discussed evaluating evidence for being relevant and sufficient in Lesson Sequence 4. They will concentrate on evidence today.
- Invite students to move to sit with their ecosystem expert groups; distribute their **expert ecosystem explanatory models**.
- Direct students' attention back to the Criteria for Healthy Ecosystems anchor chart.
- Ask students to turn and talk to their expert group:

  "What kind of evidence do you have that your ecosystem is healthy and meets the three criteria for health?" (Responses will vary, but may include that they have many different organisms that get their needs met, they have a complete food web, and they have a cycle of matter and energy that flows.)
- Tell students that, working as a group, they will flag evidence on their explanatory model that answers the question "Is your group's expert ecosystem explanatory model a healthy ecosystem based on the criteria listed on the Criteria for Healthy Ecosystems anchor chart?" They should flag evidence for and/or against.
- Then, working as a group, they will look through the entries in their student science notebooks to identify information that may help them with the reasoning for their evidence. Every time they find a piece of relevant information, they will flag it with a sticky note or notecard [(2)].
- Distribute **sticky notes** or **notecards** and invite students to begin flagging evidence and reasoning.
- Circulate to monitor students as they work, checking for understanding with questions such as:

  "Is your evidence relevant and sufficient to make a claim about the health of the ecosystem depicted in your explanatory model?"

  "What additional evidence would strengthen your argument?"
- After 10 minutes, refocus whole group and ask for volunteers to share out the evidence they flagged.
- Tell students that it's time to make claim. Ask them to turn and talk with an elbow partner in their ecosystem expert group:

  "What does your evidence suggest? Is the ecosystem on your poster healthy?" (Responses will vary.)

- After 2 minutes, model how to construct the argument by combining the claim with evidence and reasoning [3].
- Tell students they are now ready to construct their own argument. Explain that they can plan their arguments with their ecosystem expert group, but each student must be prepared to present his or her own argument.
- Post and review the following checklist:
  - My claim is specific to my assigned ecosystem.
  - My evidence—marked with sticky notes or notecards in my student science notebook—is sufficient and relevant to my claim. If the evidence is not sufficient and relevant, I have explained what additional evidence is needed.
  - I have explained my evidence using reasoning.
- Invite students to begin outlining their argument in the "Developing Arguments about the Health of an Ecosystem" section in the Stability and Balance entry.
- Circulate to support students while they are constructing arguments [4].
- Assure them that this is a complex argument, and students could make several claims. Give them specific positive evidence on how they examined evidence closely. (Example: "I saw you really considering whether or not you had enough evidence to say your model met the criteria.")

Preparing to Teach: Self-Coaching Guide

1. Do my students need to review the parts of an argument? How much experience do they have with constructing arguments? How can I leverage that experience?
2. How can I support students who may be overwhelmed by looking back through a large amount of information? What specific entries might I point them to?
3. Use the Schoolyard Ecosystem Explanatory Model. Say something like: "I'm arguing that this model of the schoolyard ecosystem is not a very healthy ecosystem. My evidence comes from the organisms present in the ecosystem, the abiotic and biotic features, and the big cycles. This model clearly shows that matter and energy are flowing through the ecosystem without interruption right now. That's an important criterion for health. But, because there are not multiple types of organisms and not every level of the food web present, I think the ecosystem is not stable. I think the cycles could be interrupted and one change, like the bird leaving, would really affect the health of the ecosystem. There is also only one decomposer—the earthworm. There is no secondary consumer. Having an interconnected food web is important for the health of an ecosystem. I think this is sufficient evidence. The evidence could be made stronger if I gathered more evidence about the interaction of abiotic and biotic features."
4. At this point, I may want to give more time for students to write their arguments out in a paragraph. Or I may choose to ask them to write their arguments only after they have had a chance to orally present them for peer critique.

Section 2: Evaluating Information

A. Peer Critique: Health of Ecosystems (45 minutes)

- Tell students that they are now going to present their arguments about the health of their particular ecosystem to another ecosystem expert group and use the Praise, Question, Suggestion protocol to provide each other with feedback to improve their arguments. Refer to the Classroom Protocols pack on Curriculum.ELeducation.org for the full version of the protocol.
- Emphasize the importance of the classroom norms for peer critique [(1)]:
  - Be helpful.
  - Be kind.
  - Be specific.
- Distribute the **Peer Critique: Expert Ecosystem Explanatory Model Argument** and review the directions with students.
- Clarify that each expert group will be paired with another expert group. During each round of the peer critique cycle, one student from each group will present the group's argument about the health of the ecosystem depicted in their explanatory model. After the student is done sharing, the students from the other excerpt group will provide praise, ask questions, and give feedback [(2)].
- Consider modeling possible critique statements as necessary. (Example: "Your argument may not be strong enough because you don't have enough evidence about the organisms such as decomposers, and that information is necessary because a complete food web is one of things we look for when we assess the health of an ecosystem.")
- Move students so that each "new" group consists of two ecosystem expert groups. Consider using a **timer** to ensure that students have adequate time to share their argument and receive feedback during each round. Each round should last about 10 minutes.
- Ask students to begin the protocol.
  - After 10 minutes, refocus whole group. Instruct each expert group to move together to sit with a new expert group.
  - Invite a different student from each group to share his or her argument and receive feedback, again using a timer as necessary.
  - Continue this process until all students have shared their argument and received feedback.
- Invite students to return to their seats and revise their arguments based on the feedback they received.

Preparing to Teach: Self-Coaching Guide

1. What experience do my students have with peer critique? How can I best support them?
2. If I think students may need more time to revise their arguments, they may have time for only two rounds of peer critique. If that's the case, which students would most benefit from articulating their arguments orally before they revise them?

Section 3: Engaging in Argument

A. Revising an Argument: Health of Ecosystems (20 minutes)

- Tell students that they are now going to revise their arguments based on their peer feedback.
- Invite students to work individually to revise their arguments based on the feedback they received.
- After 10–15 minutes, refocus whole group.
- Give students specific and positive feedback on their ability to use their partner's feedback to improve their argument. (Example: "I am impressed with your ability to receive and readily implement feedback from your classmates.")
- Collect expert ecosystem explanatory models.
- Debrief the Praise, Question, Suggestion protocol by asking:

  "How did you revise your argument based on feedback you received?"

  "Can you imagine a change that would make your ecosystem unhealthy?"

  "Did your ecosystem meet all the criteria for a healthy ecosystem or just some? If just some, how did you determine it was enough to consider the ecosystem healthy? Are some criteria more important than others?"

  "Were any of the criteria particularly easy or difficult to gather evidence on?"

  "After using your model to help you create an argument, can you think of any limitations of your model?"
- Give students specific positive feedback on their ability to provide peer critique and construct arguments. Emphasize that they are doing the work of scientists. (Example: "Working with colleagues to make a stronger argument is an important part of being a scientist.") [1]

Preparing to Teach: Self-Coaching Guide

1. My students will be assessed on their ability to construct an argument in Lesson Sequence 11. What additional practice do they need?