Session 7
Energy Flow in Communities

In Session 1, we saw that one characteristic of life was the need for a constant supply of matter and energy. Why is this? What's the difference between the two? The next two sessions explore energy and matter and their connection to life.

The Video

One consequence of evolution is a living world that is both remarkably diverse and complex. Session 7 begins a study of life at the level of the community—where diversity and complexity are sustained, in part, by the flow of energy. Thinking about food chains in communities begins our study of the connection between energy and life.

Dr. Herbert Thier, representing the SCIS 3+ curriculum, highlights the importance of building understandings of community-level phenomena in the elementary school years. We see this happening in Melissa Minnick's fifth-grade classroom in Walkersville, Maryland, where the SCIS 3+ unit "Communities" is being used to explore energy flow along food chains in classroom terrariums.

Our own exploration of energy flow begins with a distinction between energy and matter and how both relate to food. We then proceed along the links of a food chain. Dr. Aaron Ellison, who researches carnivorous plants, looks at producers and examines photosynthesis as one key energy reaction. Dr. Marianne Farrington of The New England Aquarium goes behind the scenes to highlight consumers and their energy needs. This leads to the introduction of cell respiration as another key energy reaction in communities. We next look at decomposers as we visit a compost research facility, where Dr. Sanat Majumder describes their role in energy flow.

Dr. Les Kaufman, an ecologist, focuses on what happens to energy as it flows through a community—setting up what will ultimately be a distinction between energy and matter. And Dr. Paul Williams returns, highlighting progress with Bottle Biology and pointing out a system for studying energy flow: the EcoColumn.

Learning Goals

During this session, you will have an opportunity to build understandings to help you:

- Distinguish between energy and matter as they relate to the living world
- Distinguish between producers, consumers, and decomposers with regard to energy flow in a community
- Describe what happens to energy as it moves through a community

On-Site Activities

Getting Ready (60 minutes)

Activity One—Problem Set and Reading Discussion (20 minutes)

Work in small groups.

1. Begin the session by reviewing questions 1–4 from the problem set for Session 6. For each question, select a single group member's response and discuss. Use this as an opportunity to clarify understandings of content.
2. Each group member should share several children's ideas identified from the reading for this discussion. Make a list of the questions formed about the content and cite the evidence you are using to support your answers.

Activity Two—Energy and Life (10 minutes)

1. As a whole group, brainstorm how energy is connected to life. What concepts are important in the study of energy and life? What concepts are challenging? Include examples and your current understandings of them. Record your answers, without arguing their merit at this time.

Activity Three—Energy and Food Chains (30 minutes)

1. Work with a partner. To prepare for today's session, you were asked to make a community poster including at least 8–10 specimens, which represent key populations. You were also asked to identify a food chain four links long. Explain your poster to your partner.
2. Focus on the food chains. Starting with the first link and continuing to the last link, discuss the following questions:
   - What type of population does this specimen represent?
   - What, if anything, is the energy input to this link?
   - How is this energy used?
   - What, if anything, is the energy output?
   - What happens to the output?

   Answer these questions for both food chains. Record your answers.
3. Reconvene the group to discuss the following questions:
   - Is there a limit to the length of food chains? Why or why not?
   - Does energy have anything to do with the structure of a community (e.g., the types of populations and their numbers)? Explain your answers.
   - Why is a constant supply of energy needed?
   - Is all of this energy provided from an external source or is it "recycled" or both?

On-Site Activities, cont'd.

Watch the Video (60 minutes)

As you view the video, think about the following focus questions:

1. With regard to energy, what is the nature and role of each link in a food chain in a community?
2. How can the links in a food chain be described with regard to energy flow (i.e., input, use, output)?
3. The children in the Science Studio discuss sources of energy for each link in a food chain. Keep track of their ideas. How do they compare to yours?
4. In the Featured Classroom, the students discuss what happens to energy at the end of a food chain. Do you agree or disagree with their ideas?

Going Further (60 minutes)

1. As a whole group, revisit the ideas generated earlier about the connections between energy and life and revise as needed. Be sure to clarify the difference between energy and matter, and to check your understandings about the connection between energy and food, and energy and nutrients.
2. Rejoin your partner. Revisit your ideas about energy input, use, and output for each link in a food chain and revise as needed.
3. Work in small groups. Pick one community poster and evaluate it. Are all the key populations in a community present? Are the numbers of populations associated with each link in a food chain realistic? Why or why not?
4. Using the poster chosen above, create a "Communities Chart" similar to the one present in Melissa Minnick's classroom. Write the names of the populations at the appropriate levels, including any key populations that were not originally present. Use arrows and labels to show energy flow in a community, including input and output.
5. Reconvene the group to discuss the following:
   - the length of food chains
   - the influence of energy on the structure of a community
   - the need for a constant supply of energy
   - the source(s) of this constant supply
6. Revisit the questions generated from the reading assignment and check for remaining content issues.

Facilitators: Collect the community posters for use in the next session.

Between Sessions

Homework (* = required)

Reading Assignment*

Driver, R., et al. (1992). *Life and Living Processes.* Leeds National Curriculum Support Project, Part 2. Leeds City Council and the University of Leeds, UK.

Research Summary: Children's Ideas About Ecosystems (pp. 6–14: Decay; cycling of matter through the ecosystem; gas exchange and balance; respiration)

As you read:

1. Identify several children's ideas that compare to your own, represent some uncertainty to you, or are particularly prevalent among your students.
2. For each idea, form a question about the content involved and try to answer it.
3. Note what evidence you are using to support your answers.

Life Science Problem Set*

(Suggested answers are listed in the Appendix.)

1. Photosynthesis and cell respiration are often considered "complementary" processes with regard to energy flow. Write the chemical equations for these two processes and discuss whether or not this is an appropriate description.
2. In the video, Dr. Ellison demonstrates how energy flow applies to plants. In doing so, he describes a two-stage process. How does each stage work? When does each stage occur?
3. In creating your community poster, you included a food chain composed of four links. Dr. Kaufman talked about food chains that can be six links long. What would have to be true about a community where food chains are this long?
4. In Melissa Minnick's classroom, the students discuss a dead anole and claim that the microbes that decompose it will return raw materials to the soil. Do these raw materials represent a source of energy that can continue to sustain the community? Why or why not?

Ongoing Concept Mapping*

Develop a concept map around the central concept of energy flow. Be sure to include food, food chain, producers, consumers, decomposers, photosynthesis, cell respiration, the different energy inputs, energy uses, and the different energy outputs. Try to make connections between this map and previous maps (i.e., to the characteristics of life in Session 1; to domains and kingdoms in Session 2).

Guided Journal Entry

Some life scientists consider the process of energy flow through a community to be about energy conversions. In your journal entry, describe energy flow from this perspective. What is the nature of these energy conversions? How are the different links in a food chain involved?

Guided Channel-TalkLife Posting

During the video, we visited several locations that represent "designed" communities: a greenhouse, an aquarium, and a compost facility. This helped us explore energy by focusing on how scientists manage its flow. What sorts of local field trips and/or school facilities could you use to make energy flow along the links of a food chain concrete to your students? Discuss this in your Channel-TalkLife posting for this session. Be sure to share any experiences you've had with your colleagues.

Between Sessions, cont'd.

Textbook Reading Suggestions

- communities
- energy flow
- food
- food web
- heat energy
- photosynthesis
- producers
- decomposers
- energy
- matter
- food chain
- light energy
- chemical energy
- cell respiration
- consumers
- energy pyramid

Preparing for the Next Session*

For "Getting Ready"

The poster you created for this session will be used again in the next session. No additional preparation is needed.

Materials Needed for Next Time

- None

Ongoing Activities

Bottle Biology

Continue work on your Bottle Biology system. The bottle system that has been designed to accompany Session 7—Energy Flow in Communities—and Session 8—Material Cycles in Ecosystems—is called the "EcoColumn." In this system, an aquatic and terrestrial community are linked together in one bottle system. The organisms within include producers, consumers, and decomposers. What food chains exist within this community? How does energy flow? Visit the Web site for more information and check out Bottle Biology Spotlights to track the progress of our very own *Life Science* systems.

Bottle Biology Spotlights: Session 7

System	Activity
EcoColumn	What's on the Menu?
EcoColumn	Basically, I'm a Fungi!

Graduate Credit Activities

Continue your work on the annotated bibliography and action research.

Notes