

Session 8

Material Cycles in Ecosystems

Our final session looks at life at one of the highest levels of organization: the ecosystem. Shifting from Session 7's focus on energy, Session 8 explores matter and its connection to life.

The Video

We know that the living world is composed of matter, but there are some puzzles. New life is constantly appearing. On a planet where supplies of matter are finite, where does life get its matter? Death is an inevitable part of life. Where does the matter that composes dead things go? Dr. Adrien Finzi, an ecologist, acts as our guide in a forest ecosystem as we begin to explore these questions.

MaryAnn Bernstein's third-grade students in Burlington, Massachusetts consider questions about matter during an experiment involving worm tanks. Dr. Tina Grotzer, representing the Understandings of Consequence Project, talks about research on children's ideas about decomposition, and the importance of looking at cause and effect in building accurate scientific understandings. The fourth- and fifth-grade children in our Science Studio act as our own source of research data as they answer some tough questions about matter and life.

Our exploration starts, once again, with food chains—this time focusing on matter. Dr. Aaron Ellison looks at photosynthesis and producers, whose main source of matter may be surprising. We visit a sewage treatment plant, where Charles Tyler takes a closer look at the decomposers and decomposition. Next, Dr. Finzi introduces us to material cycles as he guides us through the cycling of carbon—the element that defines life. And we hear from Dr. Nicky Sheats, who walks us through the nitrogen cycle. Our study of material cycling closes with a consideration of balance in ecosystems.

Of course, Dr. Paul Williams returns, this time with parting looks at Bottle Biology and encouragement to bring ideas from this Web-based activity to K–6 classrooms.

Learning Goals

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

- Distinguish between producers, consumers, and decomposers with regard to material cycling in an ecosystem
- Describe examples of material cycling through an ecosystem
- Contrast energy flow with material cycling

On-Site Activities

Getting Ready (50 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 7. 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—Matter and Life (10 minutes)

1. As a whole group, discuss the following questions:
 - Why does life require a constant supply of matter?
 - What ideas are important in the study of matter and life?
 - How are matter and energy different with regard to their role in the living world?

Accept and record all answers without discussing their merit at this time.

Activity Three—Matter and Food Chains (20 minutes)

Facilitators: Hand out the community posters from the last session.

1. Work with a partner. For Session 7, you created a community poster and included a food chain with four links. Revisit each poster and add another food chain with at least three links.
2. With your partner, progress from the first link to the last link and discuss the following questions:
 - What matter, if any, enters this link?
 - How is this matter used?
 - What matter, if any, exits this link?
 - What happens to this matter?

Answer these questions for both food chains. Record your answers.

Watch the Video (60 minutes)

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

1. How can the links in a food chain be described with regard to matter (i.e., input, use, output)?
2. The children in the Science Studio discuss sources of matter for each link in a food chain. Keep track of their ideas. How do they compare to yours?
3. In our Featured Classroom, the students discuss the role of the decomposers. Listen for their ideas about the decomposers and matter. Do you agree or disagree with their ideas?

On-Site Activities, cont'd.

Going Further (30 minutes)

1. As a whole group, revisit the ideas generated earlier about matter and life. Use this as an opportunity to check your understandings as they relate to the questions posed.
2. Rejoin your partner. Revisit your ideas about the input of matter, its use, and the output of matter for each link in a food chain.
3. During the video, the pathways of carbon and nitrogen were traced through an ecosystem. Use your posters to show how an atom of carbon might cycle. Do the same for an atom of nitrogen. Be sure to identify the “key players” along the way.
4. Revisit the questions generated from the reading assignment and check for remaining content issues.
5. Reconvene the group. At the end of the video, Dr. Zook states the following: “Relating life’s organizational levels to one another is something we’ve emphasized throughout this course.” How did you benefit from studying life at these different levels (i.e., atoms, molecules, cells, organisms, populations, communities, ecosystems)? How can you integrate the study of life at different levels of organization into your science curriculum?

Track Your Understanding

Facilitators: Hand out the Track Your Understanding answers from Session 1.

At the first session, you answered a set of questions that were meant to help you assess your initial understandings of some of the big ideas in life science. Now that you have participated in eight *Life Science* sessions, we hope you will find it useful to assess how your understandings have changed. Your facilitator will pass out your original answers to the following questions. Please take some time to revisit your answers and to revise and/or add to them.

1. What distinguishes living things from dead and nonliving things?
2. How do scientists classify living things?
3. A new type of life form has been discovered. How could you tell whether it should be classified as an animal, plant, or something else?
4. There is a saying that like begets like. In the living world, we observe this as offspring that resemble parents and types of organisms that produce the same types. What ensures this continuity of life?
5. Describe the life cycle of a typical animal.
6. Describe the life cycle of a typical plant.
7. Distinguish between DNA, chromosomes, and genes.
8. What causes individuals of a species to vary from one another?
9. Explain the process of natural selection.
10. Describe the ideas underlying the theory of evolution.
11. What defines a species?
12. How does evolution result in new species?
13. Distinguish between producers, consumers, and decomposers.
14. How does energy travel through the living world?
15. How does matter travel through an ecosystem?

Wrapping Up

Even though this is the last session, we thought you might want to check your understandings of material cycling by completing the problem set. You might also wish to wrap-up with a final journal entry and sign-off in Channel-TalkLife with a final posting to your colleagues. Check with your facilitator or course instructor regarding continued work with the ongoing activities.

Life Science Problem Set*

(Suggested answers are listed in the Appendix.)

1. As with energy, photosynthesis and cell respiration are often considered complementary processes with regard to material cycling. Write the chemical equations for these two processes and discuss whether or not this is an appropriate description.
2. Producers are sometimes said to be the key players in energy flow—in fact, without them, there would be no energy flow. Which populations are the key players in material cycling? Explain your answer.
3. In Session 8, we focused upon two elements that are part of the SPONCH CaFe. What about the other elements? What do all cycles have in common? How do they differ? Support your answer by giving an example. Visit the *Life Science* Web site to learn more about material cycles (A Closer Look: Material Cycles):
<http://www.learner.org/channel/courses/essential/life/session8/>
4. At the beginning of the video, Dr. Grisham points out that studies of ecosystems involve the study of life at the extremes of its levels of organization. How does material cycling illustrate this?

Ongoing Concept Mapping*

Develop a concept map around the central concept of material cycling. Be sure to include ecosystem, matter, elements, atoms, food, food chain, nutrients, organic, inorganic, producers, consumers, decomposers, photosynthesis, and cell respiration. Try to make connections between this map and previous maps (i.e., to the characteristics of life in Session 1; to energy flow in Session 7).

Guided Journal Entry

Dr. Finzi discussed how a carbon atom might be transferred to different parts of an ecosystem. Apply your knowledge of material cycling by suggesting at least two different paths that a carbon atom might follow as it cycles in an ecosystem: a “short-cycle” path (a few steps) and a “long-cycle” path (many steps).

Guided Channel-TalkLife Posting

Energy and matter are often considered to be difficult subjects to integrate into elementary school science. Why do you think this is? Do you agree or disagree? How can some of the ideas presented about energy and matter in *Life Science* be introduced in an appropriate way at the grade level you teach? Discuss this with your colleagues in your final Channel-TalkLife posting.

Wrapping Up, cont'd.

Textbook Reading Suggestions

- ecosystem
- elements
- inorganic molecules
- material cycles
- carbon cycle
- photosynthesis
- producers
- decomposers
- eutrophication
- matter
- organic molecules
- conservation of matter
- biogeochemical cycles
- nitrogen cycle
- cell respiration
- consumers
- global warming

Ongoing Activities

Bottle Biology

Complete your Bottle Biology experiments. 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 evidence is there that materials are cycling in this system? 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 8

System	Activity
EcoColumn	Decomposition Tea

Graduate Credit Activities

Complete your work on the annotated bibliography and action research.

Notes
