Lesson 6: Earth: A Phenomenal Living System

Introduction

In the last lesson, you explored how other organisms, including decomposers, use aerobic cellular respiration and (anaerobic) fermentation to provide a net output of energy, some of which is used by the organism to rearrange molecules to form other compounds used in the organism's body. Other energy is used for movement, growth, and reproduction.

To think about the interactions of matter and energy in a system, you have explored the interactions in Mr. Latimer's terrarium. In this lesson, you will consider how the Earth can be considered a system and how the interactions of matter and energy keep all organisms on Earth alive.

Lesson Question

Process and Procedure

1. Write your best ideas about the lesson focus question in the space below. Leave space to revise your ideas as you learn throughout this lesson. As you have new ideas, record them in a different color.

The Earth as a System

2. To think more about how the Earth can be considered a system in which matter and energy interact to keep organisms alive, read and annotate the article, *The Biosphere*.

The Biosphere

Scientists often describe the Earth in terms of spheres. The solid, outer surface of the Earth is called the lithosphere. It is surrounded by a layer of air called the atmosphere. The hydrosphere is composed of all the water on Earth – in the air, on the surface, and in the ground. The biosphere consists of all life on Earth, and extends into the lithosphere, atmosphere, and hydrosphere. The lithosphere, atmosphere, and hydrosphere are often referred to as the environment in which organisms live and interact.

Within the biosphere, matter and energy interact in the chemical reactions of photosynthesis and cellular respiration. The Law of Conservation of Mass allows scientists to follow atoms of biologically important elements, such as carbon, as they move through living organisms and their environment. Because the atoms of these elements are very stable and are not created or destroyed in chemical reactions, elements cycle between living and nonliving parts of the biosphere. For example, the carbon cycle follows carbon from carbon dioxide in the atmosphere to glucose in a plant cell, to a molecule in an animal that eats the plant, and then back to carbon dioxide released into the atmosphere from the chemical reactions of a decomposer that has consumed the animal after its death.

3. Mr. Latimer's terrarium is a closed system in which the living organisms, plants and microorganisms in the soil have thrived for over fifty years. Scientists estimate that life in the Earth's biosphere has existed for about 3.5 billion years.

   Use the analogy map below to compare Mr. Latimer's terrarium with the Earth's biosphere. The last row is blank for you to add any additional comparisons.

Analogy Map

Feature of the Terrarium	is/are like	Feature of the Biosphere	They are alike because…
Spiderwort plant			
		decomposers	
water			
		lithosphere	
		atmosphere	

4. Scientists consider the biosphere to be a system. As a team, you will create an illustration of the biosphere system that shows the interactions of matter and energy.

   Your illustration should show the following criteria:

   - ❑ Boundary of the biosphere system
   - ❑ Components of the biosphere system
     - plants
     - animals
     - decomposers
     - air
     - soil
     - water
   - ❑ Interactions of matter through the biosphere system components
   - ❑ Interactions of energy through the biosphere system components
   - ❑ Inputs to the biosphere system
   - ❑ Outputs from the biosphere system
   - ❑ Zoomed in interactions of matter and energy in a plant
   - ❑ Zoomed in interactions of matter and energy in an animal
   - ❑ Zoomed in interactions of matter and energy in a decomposer

Rubric for Matter and Energy in the Biosphere Illustration

Task	Good	Best
Create an illustration that includes the interactions of matter and energy in the biosphere system.	I created an illustration, but it was missing some of the interactions of matter and energy or some of the components of the system.	I created an illustration that includes all the interactions of matter and energy as well as all of the components of the system.
Include the characteristics of a system.	I included some of the characteristics of the system and/or did not clearly identify all the characteristics of the system.	I included all the characteristics of the system with clear labels.
Include the components of the biosphere system.	I included some of the components of the biosphere system and/or did not clearly identify all the components of the system.	I included all the components of the biosphere system with clear labels.
Include the interactions of matter and energy in the system. Include important molecules: carbon dioxide, water, oxygen, and glucose.	I included some of the interactions of matter and energy, including carbon dioxide, water, oxygen, and glucose.	I included all of the interactions of matter and energy, including carbon dioxide, water, oxygen, and glucose.
Include interactions of matter and energy in zoomed in plant, animal, and decomposer systems.	I included some of the interactions of matter and energy in the zoomed in systems of a plant, animal, and decomposer.	I included all the interactions of matter and energy in the zoomed in systems of a plant, animal, and decomposer.
Present the information clearly so that it is easy to understand the illustration.	Most parts of my illustration were clear, but some parts were confusing.	My illustration is clear and includes the correct information, labels, arrows, and brief descriptions where needed.

5. Following your teacher's directions, discuss the feedback your team received.

   a) Which pieces of feedback are most helpful to your group? Why?

   b) Are there pieces of feedback that you do not plan to use as you revise your model? Why will you not use them?

Revise your model using the feedback that your team agrees with.

Synthesize and Summarize Ideas

6. How has your response to the lesson focus question changed over the course of this lesson? In the space below, write a reflection that summarizes the changes in your thinking and what caused your ideas to change. Be prepared to share your reflection with the whole class.

7. During the next lesson, we will return to the unit central question, **"How do matter and energy move through a system as living things interact with each other and the environment?"** You will think about this question and make predictions about what might happen to the system when one of the components is changed.

   How confident are you that you can answer this unit central question completely?
   Circle a number to show your confidence.

   Not very confident 1 2 3 4 Very confident

   Provide reasons for your rating in the space below.