Lesson 1: A Phenomenal Garden System

Introduction

In this unit, you will have a chance to figure out how matter and energy interact in a system. You will analyze and interpret data and develop models to explain how organisms interact each other and their environment to stay alive. Like scientists currently working with similar models, you will evaluate evidence about the effects of changing components of a system.

To help you learn more about these ideas, the unit will focus on the question below.

Unit Central Question

How do matter and energy move through a system as living things interact with each other and their environment?

Process and Procedure

1. Write your best ideas about the unit central question in the space below. Leave space to revise your ideas as you learn more in later lessons. As you have new ideas, record them in a different color.

Life in a Bottle

2. To begin to explore ideas about how matter and energy interact in a system, you will consider a terrarium, or bottle garden, that has been sealed since 1972. It represents a *natural phenomenon* that will help you understand what might happen in any closed system. A natural phenomenon is an observable event or process in nature that makes you ask questions like, *what happened?* Or *why did that happen?*

   Watch the video about the terrarium. You can watch the video more than once if needed. As you are watching, ask yourself questions such as, *"How does the plant stay alive?"*

3. To learn more about the terrarium, read the following article. As you read, underline ideas that might help you begin to answer your questions.

This Sealed Garden Was Only Watered Once Since 1960

For the last forty-five years, David Latimer's terrarium has been completely sealed from the outside world. On Easter Sunday in 1960, Mr. Latimer began an experiment that is still continuing today. He added compost and a small spiderwort plant to a ten-gallon round bottle. Then he added a half cup of water and sealed the bottle with a plastic stopper.

In 1972, he opened the bottle and added another half cup of water. Then he greased the stopper, wedged it in tightly, and has not opened it since. Mr. Latimer said the bottle sits under the stairs in the hallway of his home in England. "It's six feet from a window, so it gets a bit of sunlight. It grows toward the light, so it gets turned around every so often, so it grows evenly."

Despite being isolated from the rest of the world, the spiderwort is thriving, filling the bottle with healthy foliage. As leaves die, they fall to the bottom of the bottle where they rot. As the plant uses sunlight to photosynthesize, it also returns moisture to the air. The moisture builds up inside the bottle and 'rains' back down on the plant.

In 2013, Mr. Latimer submitted a photograph of his terrarium to a gardening segment on a British radio station. The radio station hosts were amazed by the miniature ecosystem, exclaiming, "This is a great example of… the cycle of life. The only input to this whole process has been solar energy, that's the thing it has needed to keep it going. Everything else, every other thing in there has been recycled. That's fantastic!"

4. To think about the question, *"How does the plant stay alive?"* a scientist would consider Mr. Latimer's terrarium to be a system. A system is an organized group of related objects or components that form the whole.

   Write the focus question for the lesson in the box below. Then, write your best ideas about the question under the box. Be sure to leave space to revise your answer as you learn more.

5. Draw a picture of your terrarium. Be sure to label the parts, or components, of the terrarium. Include any inputs into or outputs from the terrarium.

6. To learn more about systems, read the information below. Underline important ideas as you read.

Systems and System Models: A Way of Thinking in Science and Engineering

A part of the natural or designed world that a scientist or engineer wants to investigate can be referred to as a system. A system is an organized group of related objects or components that form the whole. Systems have boundaries, components, processes, and inputs and outputs. Often parts of a system are interdependent, and each one depends on or supports the functioning of the system's other parts.

A model of the system a scientist is studying is a useful tool not only for understanding the system, but also for sharing their ideas with others. Models of a system can be as simple as a sketch or as complicated as detailed computer simulations or functioning prototypes.

A good model of a system specifies the components of the system as well as how they interact with each other. It also shows the boundaries of the system and any inputs and outputs.

7. To think more about how a terrarium is a system, complete the chart below

Analogy Map

Feature of the Terrarium		Feature of a System	They are alike because…
	is like	boundary	
plant			
		component	
water			
		input	
		interaction	

Synthesize and Summarize Ideas

8. Revise and add to your initial drawing, or model, of the terrarium. Add labels showing characteristics, or key features of a system to your model.

9. Reread your initial response to the lesson focus question. Consider the ideas from the activities you completed. If you would like to add to or revise your ideas, do so in a different color.