Ecosystem Modeling

Activity Overview:

Students develop models of an ecosystem using a systems modeling approach.

Objectives: Students will

- Explore connections within an ecosystem
- Understand that ecosystems are made up of many interrelated parts
- Investigate how energy is stored and transferred within biological systems
- Design, build, evaluate and revise models based on previous knowledge

Subjects Covered: Science

Grades: 3 through 12

Activity Time: 1 hours, minimum

Season: Any

Materials:

Each group of 3-6 students should receive: 1 felt board (can be made by stapling felt on to soft particle board or corkboard), a set of modeling symbols cut out of cardstock paper, quilting or map pins, yarn, and marker.

A set of modeling symbols should contain at least:

30 component pieces

20 forcing function pieces

20 interaction pieces.

State Standards

Science:

Decide which questions to ask (A.4.1)

Collect and organize data that explains or critiques models (A.8.3)

Use models to predict actions and events (A.8.6)

Explain how science is shared (B.8.5)

Explain assumptions about natural world and themes (B.12.5)

Background

When we first begin to learn about an ecosystem, we often start by looking at the parts of the system, one by one. We walk through the grasses, watch the butterflies, feel the tree's bark texture, photograph the flowers and learn the names of the plants. As we become more familiar with the parts, we begin to think about the parts that are not as obvious, such as the roots, the seeds in the soil, the plant nutrients, and the microbes. When we begin to wonder how these parts are connected, then we are thinking like ecologists. This activity is designed to help students think about not only the parts of the system but also how those parts are connected and how the parts work together as a unit, as an ecosystem that persists over time.

Even the simplest ecosystems are complex. However, there are some processes that are basic to all such as energy flow, food chains and mineral cycling. These systems are so complex, people tend to look at the parts. However, when we examine only the parts, we miss something very important, fascinating and powerful. In addition, looking only at the pieces can give us grave misconceptions about the entire system. If we look at only the green pieces of a jigsaw puzzle, we may have a very skewed image of the entire puzzle.

Modeling is one approach ecologists use to simplify an ecosystem. Models can be simple diagrams or complex computer programs. Models can help us understand who eats what in a system or can predict the global weather affects of a shift of ozone gas in the atmosphere. By setting up a model we can begin to organize what we know and what we don't, as well as highlighting our assumptions and aiding us in making predictions. Modeling is usually a process of constant revision; it is through this process that we really learn.

The ecologist, Howard T. Odum, developed a method of modeling energy flow through an ecosystem. There are dozens of symbols that accompany this "systems modeling" approach. Four basic symbols are used in this activity. They are the following:

Component: A part of the ecosystem. It can affect other parts of the ecosystem and can be affected by other parts (For example, grasses, trees, insects).

Forcing Function: Something outside the ecosystem that can influence what happens in the ecosystem but is not influenced directly by the ecosystem (For example, sunlight, rainfall).

Line: Symbol used to show a direct connection between the parts of the ecosystem or between factors inside and outside of the ecosystem. May be used to show positive or negative effects (e.g., insects pollinating plants; trees competing with each other for space).

Interaction: Symbol used to show where two or more parts interact. For ex-

Ecosystem Modeling (cont.)

Analyze influence of living organisms on earth's systems (E.8.4)

Source
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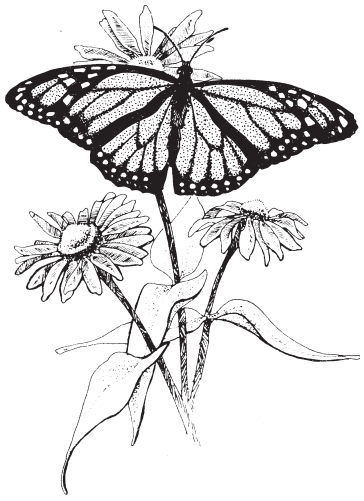


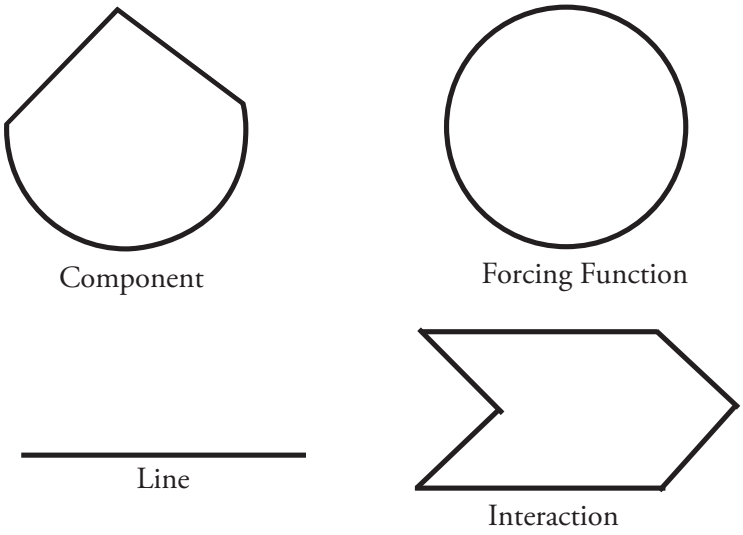
ample, sunlight, rainfall and nutrients interact to make plants grow. Lines and interaction symbols represent the process going on in the ecosystem.

In this activity, students will develop models of an ecosystem. They will, in essence, create a picture of the ecosystem using special symbols to represent parts. A model represents the student's perception; there is no best way to model a system. It is best to have the students work in groups of at least three and to provide them with background information about the ecosystem before the activity

Keep in mind, there are three reasons to model: to simplify, to organize knowledge and to identify gaps in knowledge.

Activity Description

Build a model of your selected ecosystem using the following four symbols:



Basic Guidelines:

1. Your model may be simple or complex according to your style.
2. Use your knowledge about the ecosystem, and your intuition. There is no right or wrong model; a model describes one's perception of how the ecosystem is structured.
3. Put a line between two parts *only* if you can name or describe a direct connection between the parts. Chief Seattle told us that "all things are connected," but we must also remember that all things are not strongly connected.
4. When the model is complete, identify one (and only one) factor that you consider to be crucially important to the integrity of the ecosystem. It

could be a component, a forcing function, a line, or an interaction. Identify it by using a different color for it. Speculate about what would happen if one factor were removed.

5. Present your model to the class explaining why you constructed it as you did.

Extensions

- For younger children, pictures of the components may be provided and the students can place the connecting lines.
- A classroom model can be built over time throughout a unit or throughout the entire year.
- Take any one ecosystem component to investigate more fully and create a classroom journal describing all the ecosystem interactions in greater detail.
- Go out to a natural area and observe interactions among living and non-living elements in a given area. Using samples of natural materials seen and/or drawings of those elements, students can create visual models on poster-board of the ecosystem interactions observed.

Additional Resources

- For more information on H. T. Odum's work see: Odum, H.T. (1971). *Environment, power and society*. New York: John Wiley.
- Odum, H.T. & E.C. Odum. (1982, 2ed.). *Energy basis for man and nature*. New York: McGraw Hill.

Assessments

- Modeling could be used in assessment of student knowledge before and/or after a unit.
- Have students make oral presentations describing their models.
- Write a short essay describing the ecosystem model and related interactions.