



Science Unit: *Ecosystem Models*

Lesson 6: *Models as Tools for Ecosystem Management*

School year: 2006/2007

Developed for: Nootka Elementary School, Vancouver School District

Developed by: Louise Kuchel (scientist), Libby Covernton & Angela Stewart (teachers)

Grade level: Presented to grades 6-7; Appropriate for grades 4-7 with appropriate modifications.

Duration of lesson: 1 hour and 20 minutes

Notes: The following lesson may require planning a couple of weeks in advance if you wish to use live plants (which we recommend for a more realistic and clearer result). The lesson can be run independently or in conjunction with preceding lessons in this series.

Objectives

1. Develop an understanding of scientific models
2. Learn how models inform decisions about environmental management
3. Make connection between models, management, and real work environmental decisions
4. Develop ability to explain results; 'Why did one hillside lose more soil than another?'

Background information

Ecosystems constantly experience change. Some change is easily tolerated and not detrimental to the overall existence of an ecosystem (e.g., tidal erosion on a beach or fallen trees in a forest). Some changes can be detrimental to the entire ecosystem (e.g., introduction of a poison or large scale clearance of vegetation). Most changes have both a negative and a positive side to them e.g., a fallen tree means that birds and squirrels lose a home, but detritivores and ground dwelling animals now have food and shelter. One of the problems humans face is that we need to use our environment to survive and in the process we destroy some ecosystems e.g., dredging a river, building a town or city, clearing trees to plant crops, digging holes to mine metals. The challenge we face is to manage these activities so that both human life and natural ecosystems can co-exist. The aim of environmental management is to maximize the efficiency of human use of the environment at the same time as minimizing the impact of human activities on the natural environment. Farmers, foresters, land developers, miners, road and housing builders, industry workers and managers, shipping companies, fishermen and ecotourism operators are all examples of people who employ environmental management as part of their daily business and routine. Even every household and school uses environmental management practices (e.g., recycling, gardening, drainage, can you think of other examples?). Some specific examples of environmental management include recycling garbage; fighting fires in forests to reduce or contain the destruction of forest ecosystems for the benefit of both humans and forest ecosystems; slowing or reducing the spread of pine beetle infestations; maintaining air quality by reducing car and industry exhaust fumes (have you ever had your car emissions checked by Air Care Canada?). This is an example of environmental management in action); issuing fishing licenses that allow only a certain number of salmon to be caught each year – this ensures that enough fish survive to reproduce each year and ensure the long term survival of salmon fisheries for both use by humans and the natural ecosystems (have you ever been fishing? Did you notice that there are rules about the size, type and number of fish you can catch – this is an example of environmental management in action).



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Although humans are very smart, ecosystems are very complex and we don't know everything about how they work so it is often difficult for humans to determine the best way to manage a particular ecosystem. One tool that environmental managers use to decide the best way to manage an environment is to use models: these may be computer models or physical models such as the one in the lesson below. Models allow managers to try out many different methods and see which one will work best. Because ecosystems are so complex and we don't understand exactly how they operate, the best management decision based on theory are not always the best ones in reality – models help us to check this. Thus models inform decisions about resources and environment while trying to maintain balance between human usage and environmental integrity.

Vocabulary

Word	Description
Management	To take care of something
Environmental management	To take care of our environment or to take care of the things around us
Erosion	The process where soil and rocks are worn away e.g., by the action of wind, rain, feet, waves, car tires, etc
Hypothesis	A guess or prediction
Experiment	A test that helps you to answer a question or discover something unknown
Model	A miniature copy of a something that we can alter to predict what might happen if we altered the real object or system

Material

This experiment can be run one of two ways depending on preparation time and materials available. We used ice-cream sticks to represent trees with limited success. We suggest as a better alternative that trays of soil be set up at least a week in advance of the class with each tray containing a different density of living plants, thus allowing time for a root structure to form.

- 3 deep trays
- soil
- 3 props (one for each tray to create a slope – slope should be about a 30 degree angle)
- multiple small plants (e.g. grass runners or any rooted plants) or ice-cream sticks
- 3+ litres of water
- Rainmaker e.g., a fine-holed watering can or water dripping system (such as from a garden irrigation system) or spray hose or bottle. The key is to find something that can apply water gently and evenly across the tray.

Introduction

1. As a class briefly recap the scientific posters students produced from their previous experiment using a miniature terrarium as a model ecosystem. Repeat that the experiment was done to test a hypothesis i.e., to see if the changes we thought would happen really did happen (refer to Lessons 3 and 4 in this series).
2. Remind students of the morning activities in Stanley Park (refer to lesson 5, the field trip in this series).
Summarize the students' results on the board or overhead projector about...
 - a) Changes caused by nature that were positive for the ecosystem and why
 - b) Changes caused by nature that were negative for the ecosystem and why
 - c) Changes caused by humans that were negative for the ecosystem and why
 - d) Changes caused by humans that were positive and why



3. Explain to students that everything humans do will have an impact on our environment and the ecosystems within our environment. It is our responsibility to make sure we minimize the negative changes and maximize the positive changes – give examples from real ecosystems that the students are familiar with e.g., from the Stanley Park field trip.
4. Explain that humans need to use the environment for certain things
Ask student for examples e.g. to grow food, timber for houses, mining for coal and metal, recreation, drinking water, etc.
5. Explain it is also the responsibility of people to care for the natural ecosystems as well as ourselves, especially if we want ecosystems to live into the future. To do this we **MANAGE** the environment.
6. Introduce the experiment we are going to do – see worksheet below.

Experiment :

How many trees should we plant to reduce erosion?

The experiment you are about to do will help us to decide how many trees we need to plant on a hill to stop the soil being washed away by the rain (= erosion). This **model** of our ecosystem will help us to decide the best way to take care of or manage the ecosystem for both human needs and the ecosystem's needs.

We will have 3 hillsides.

Each hill has a different number of trees planted on it.

- Hill A has only two trees.
- Hill B has more trees than hill A.
- Hill C has many, many trees.

Hypothesis

When the rain comes it will wash away the soil.

1. Which hill do you think will lose the **MOST** soil, A, B or C?
2. Which hill do you think will lose the **LEAST** soil, A, B, or C?
3. Explain why you think this is what will happen.

Congratulations, you have just made a hypothesis for the experiment the class is about to do!

Procedure

Now, add rain to your hills.

Sprinkle each 'hillside' gently for equal amount of time (assign someone to time the 'rain' with the same amount of rain (maintain angle, level of water etc)

Note to teachers on this experiment – make sure the rainfall you apply is evenly distributed. Practice with watering cans or cheesecloth over a spout. A very fine spray is best.

Observations

Describe what happens in each tray: be detailed and specific. Consider measuring on a grid (overhead transparency with grid pattern, laid over 3 trays.

Draw a picture; label

Results

Which hill lost the **MOST** soil? How could you tell?

Which hill lost the **LEAST** amount of soil? How could you tell?

Did your results match your hypotheses?



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It does not matter if your results were different from your hypothesis. Making a hypothesis then doing the experiment to see if what you thought would happen was correct helps you to learn new things.

Explain why the soil was washed away more on some hills than on others.

Are the changes that humans make to their environment good or bad for the ecosystems? Think about the experiment you just did and also think about the human changes you saw in Stanley Park, were they all bad? Choose one of two human made changes and explain how they are good or how they are bad for the ecosystem.

Extension

- If you are a farmer and want to stop the soil on your hills from being washed away by the rain, what could you do? Explain why.
- If you are a farmer who has cows that like to eat a lot of grass, why would you not plant lots of trees on your hills? When you answer this question think about...
 - What do cows eat?
 - What does grass need to grow?
 - What do trees need to grow?
 - Why does grass not grow under trees?
- How many trees should a farmer plant on his hills? Describe your answer using words, not numbers.
- Use the internet to research computer modeling as a way to make environmental Management decisions.

Resources

- National Institute of Environment Health Sciences Kids Page – Health and Science careers: interesting fun and rewarding!
<http://www.niehs.nih.gov/kids/labcoat.htm>
 - Forest Management Division, Northwest territories, includes extension activities
<http://forestmanagement.enr.gov.nt.ca/main/sitemap.htm>
 - Saskatchewan Environment Fire Management – information, facts sheets and kids activities
<http://www.se.gov.sk.ca/fire/>
 - Fort Worth Environmental management – includes information on air and water quality, garbage and chemicals and information and activities for kids <http://www.fortworthgov.org/DEM/kidspg.htm>
- Fisheries and Oceans Canada Audio visual catalogue of salmon and fishing related information
http://www-comm.pac.dfo-mpo.gc.ca/pages/vidcat_e.htm

Experiment :

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We will have 3 hillsides.

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1. When the rain comes it will wash away the soil.
2. Which hill do you think will lose the MOST soil, A, B or C?
3. Which hill do you think will lose the LEAST soil, A, B, or C?
4. Explain why you think this is what will happen.

Congratulations, you have just made a hypothesis for the experiment the class is about to do!

Now, add rain to your hills.

RESULTS

1. Which hill lost the MOST soil? How could you tell?

2. Which hill lost the LEAST amount of soil? How could you tell?

3. Did your results match your hypotheses?

It does not matter if your results were different from your hypothesis. Making a hypothesis then doing the experiment to see if what you thought would happen was correct helps you to learn new things.

4. Explain why the soil was washed away more on some hills than on others.

5. Are the changes that humans make to their environment good or bad for the ecosystems? Think about the experiment you just did and also think about the human changes you saw in Stanley Park, were they all bad? Choose one of two human made changes and explain how they are good or how they are bad for the ecosystem.

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- What do trees need to grow?
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3. How many trees should a farmer plant on his hills? Describe your answer using words, not numbers.
