



Ravine Formation

Overview

Erosion is a natural process that has occurred since the formation of the Earth. As water flows from its source to lakes and oceans, it erodes the land, sometimes creating ravines. In this lesson, students are given a variety of materials and asked to simulate the process of erosion by water, thereby creating a ravine. They “dig in” and manipulate factors such as soil type, water flow, and wind speed to determine the effect each has on their model.

Core Subject Area

science

Instructional Level

beginning

Learning Objectives

By completing this lesson, students should be able to:

- Identify factors that determine the creation of a ravine.
- Simulate the process of ravine formation in nature by using materials provided.

State Standards Addressed

This lesson addresses the following Illinois State Standards:

Science

State Goal 11: Understand the process of scientific inquiry and technological design to investigate questions, conduct experiments and solve problems.

11.B. Know and apply the concepts, principles and processes of technological design.

3a. Identify an actual design problem and establish criteria for determining the success of a solution.

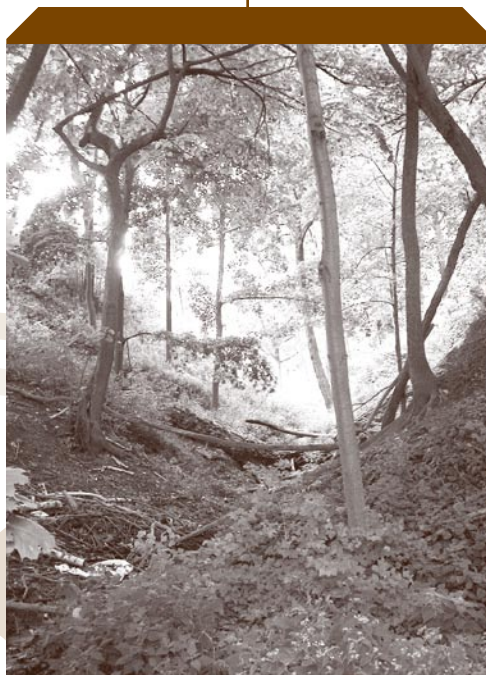
3c. Select the most appropriate design and build a prototype or simulation.

3d. Test the prototype using available materials, instruments and technology and record the data.

State Goal 12: Understand the fundamental concepts, principles and interconnections of the life, physical and earth/space sciences.

12.E. Know and apply concepts that describe the features and processes of the Earth and its resources.

3a. Analyze and explain large-scale dynamic forces and processes that affect the Earth’s land, water and atmospheric systems.



One of the six ravines located at Fort Sheridan

Suggested Time Allocation

Three to four 45-minute sessions

Materials Required

- *Building a Ravine – Teacher Guide*
- Photos of the Fort Sheridan ravines (12a – 12d)
- *Fort Sheridan: A History of Transition and Change* DVD
- *Research: Ravine Formation* reproducible
- *The Ravines of Fort Sheridan* reproducible
- *Design a Ravine!* worksheet (at least one per student)
- Materials for ravine models:
 - safety goggles
 - newspaper to cover tables
 - aprons
 - stream tables (or plastic tubs and coffee cans with holes punched in the bottom)
 - several varieties of soil material (e.g. sand, salt, clay, gravel, garden dirt, etc.)
 - 6 pitchers
 - water
 - 12 wooden blocks (1 inch height) to raise the height of one end of the tubs
 - small fans (to simulate wind)
- Computers with Internet access
- Digital cameras (optional)

Lesson Preparation

1. Become familiar with the process of ravine formation. Examine all materials (literature, DVD, etc.) before the lesson begins.

2. Read *Building a Ravine – Teacher Guide*. Practice building a ravine yourself to see first-hand the effects of varying factors.

3. Gather materials for the erosion simulation. Pull together an assortment of equipment (don't just stick with the list). The more materials you provide, the more creative the students will be in their design!

4. Display the selection of building materials from which students may choose.

5. Photocopy student design worksheets.

Important Terms

erosion: the gradual wearing away and removal of rock material by forces such as moving water, wind and ice

ravine: a small, steep-sided valley that is usually created by running water

Lesson Steps

Introduction

1. Introduce the topic by showing photos of the ravines at Fort Sheridan and/or showing the “Make Way! Here We Come!” chapter of the DVD (on mute so as not to give away too much information). Write the following questions on the board and answer them as a class.

- Describe the structure of the ravines.
- What factors do you think contributed to the formation of the ravine?
- Do you think the ravine was formed naturally? By humans? Or a combination of both?
- What organisms do you see living in or around the ravine?



Student Research

2. If time allows, students should research ravine ecology on the Internet. Students may use the *Research: Ravine Formation* reproducible. If time is short, distribute *The Ravines of Fort Sheridan* reproducible to students to read before they begin their plan design. Through this research, they should get a better understanding of how slope, water flow, and soil affect ravine formation.

Create a Ravine

3. Divide students into groups of 3-4 and tell them that they will be creating a ravine, similar to the ones found at Fort Sheridan, in a plastic tub or stream table. Ask them what else they might need to form a ravine. Students might suggest wind or a stream. Show the materials table to students and go over any safety procedures necessary. Encourage students to use items found on the materials table to simulate forces such as wind and water. For example, a fan could be used to create wind. Water running through a hole in a coffee can might be used to simulate a running stream. They should record their ideas, including a diagram, on the worksheet. This plan should include reasoning for the materials needed. Stress to the students that they need to provide as much detail as possible in their descriptions and diagrams.

4. If some groups struggle with creating a “river,” you can make suggestions (i.e., pour water through the coffee can), but allow the students some time to figure it out on their own.

5. After having their design approved by you (just check for safety), instruct the students to build their ravine, recording detailed observations along the way. This step may take more than one class period. As an optional part of their final presentation, students could take

digital photos that document the progression of their ravine formation.

6. If students are struggling with the design, point out how changing the size of the hole in the coffee can or tilting the tub will change the speed of water flow. Refer to the teacher supplement, *Building a Ravine – Teacher Guide*, for other hints. The key to making this lesson exploratory is allowing the students to experiment on their own, guiding them only when necessary.

Sharing with the Class

7. Allow students time to mingle with other groups and share ideas of what “works” and what doesn’t “work” with ravine formation.

8. Students should return to their groups and make any modifications to their systems.

9. Students present their final models to the rest of the class.

10. Each group’s ravine will be slightly different due to different factors such as “wind speed” or water flow. This will be a good opportunity to discuss the effects of different factors on ravine formation.

Assessment

11. Students prepare a lab write-up including the following information: original ravine design, observations, modifications made to the design, and a description of important factors that go into forming a ravine. There is not one correct answer. In this assessment, students should be graded on the process leading up to the product, rather than the product itself.



Lesson Extensions and Modifications

Extensions

- Have students design an experiment to show how erosion of ravines might be prevented.
- Have students create a new layout for Fort Sheridan as if the ravines did not exist. [They can refer to the Fort Sheridan web site at <http://www.explorethefort.org> to see the existing layout.]

Modifications

- If students need more than one class period to build their ravines, but you don't have enough materials or room to carry over to the second day, instruct students to take photos or draw sketches of their designs. Lead a discussion on the second day, using the photos or drawings for reference.



- To shorten the lesson to fit into one 45-minute class period, demonstrate the ravine formation using the above materials and have a follow-up discussion.
- To simplify the lesson, provide more explicit directions to the students for how to create the ravine (e.g., how to make the water flow, how to change the slope with the wooden block).

Writing Prompts

- Pretend you are a soldier training at Fort Sheridan in the ravines. Describe your experience. What are you training for? How are the ravines helpful to this training? What do you see in the ravines?

Additional Resources

- <http://www.fortsheridan.org>
- <http://www.explorethefort.org>
- Information on living near the Lake County ravines:
<http://www.ci.highland-park.il.us/govern/dept/commdev/erosion.html>
<http://www.ci.highland-park.il.us/govern/dept/commdev/geology.html>
- Lake County Forest Preserves web site: <http://www.lcfd.org>
- Additional information about the formation of ravines can be found at:
<http://www.shabica.com/portfolio/ravine.pdf>

Supplemental Photos

Look for the full-size versions of these photos in your Educator Kit.



12a



12b



12c



12d

Building a Ravine - Teacher Guide

Erosion Factor	Simulation	Effect
Wind	<ul style="list-style-type: none">• Use a fan at different speeds to simulate the wind.• Use a small, pocket fan to narrow the wind source.• See what happens if the wind blows from different directions.	Increasing the speed increases the amount of erosion. It will also affect the type of erosion – vertical (deepening of the ravine) versus lateral (widening of the ravine).
Water	<ul style="list-style-type: none">• Use a coffee can with a hole in the bottom to pour water through, creating the stream.• Vary the size of the hole to manipulate different rates of water flow.	Changing the speed of water flow will vary the rate of erosion.
Gravity	Use wooden blocks to tilt the tub, increasing the difference in elevation between the water source and endpoint.	Change in elevation affects speed of water flow, which in turn affects rate of erosion.
Soil Type	Use different soil types (i.e. gravel, clay, sand, etc.).	Different soil types will erode at different rates and in different patterns.

Research: Ravine Formation

What is a ravine?

Where are ravines found?

How are ravines formed?

What are the factors that affect the formation of ravines?

Describe how the factors you listed above might impact the shape of a ravine.

How has urbanization affected ravine ecology?

The Ravines of Fort Sheridan

The forest preserve surrounding Fort Sheridan is a unique natural resource. Its bluffs, ravines, shoreline, and the plants that grow there are unique to Illinois. Furthermore, these plants are usually found much farther north in Wisconsin, Michigan, and Canada, making the forest preserve a hidden treasure of the southern Lake Michigan coast.

The bluffs of the forest preserve contain some of the best examples of natural open prairie-like vegetation in Illinois. They are the only untouched bluffs on Lake Michigan for 60 miles in either direction.

The role of ravines

Fort Sheridan's ravines have played an important role in its history – and in the ecology that characterized the area long before the fort was established. At one time, Native Americans used the ravines as chipping stations, where they would collect flint and shape it into arrowheads. While Fort Sheridan was an active military installation, soldiers used the ravines for training purposes. Today, the ravines provide protection for several endangered and threatened species, and they serve as prime stopovers for migratory birds.

The Janes Ravine is one of the few remaining examples of mesic and dry mesic upland forest. The cool air from Lake Michigan creates a micro-climate that allows plants like witch-hazel, paper birch, and American arborvitae to thrive. These same plants wouldn't be able to survive twenty miles to the west in the Illinois prairie.

Ravine formation

Ravines, by definition, are narrow valleys in the earth's surface, worn down by running water. Ravines serve as natural drainage channels. In the case of Fort Sheridan, rainfall flows into the ravines and forms streams at the bottom, which flow into Lake Michigan.

The streams can cut channels in the ravines, but as long as their flow is slow, the erosion process is slow-going. Ravines can be damaged, however, when large quantities of water erode both the sides and bottoms of the ravines.

The changing landscape

Urbanization is often the main cause of this devastating ecological damage, since it reduces the amount of porous surface area available to absorb water. Additional roads, parking lots and homes result in water being forced into the ravines at much greater speeds and volumes, causing high levels of erosion in the drainage channels.

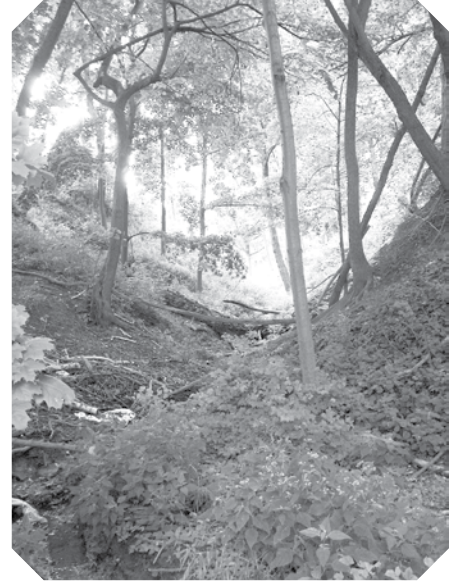
Because of the urbanization of Northern Illinois, the lake bluffs need extensive restoration work. The success of restoration will depend on conservationists' ability to prevent erosion by preserving a large part of the land on top of the bluffs. U.S. Congressman Mark Kirk, for example, has supported the preservation and restoration of the site, rather than proposed sales to developers. The Lake County Forest Preserves District is in the process of evaluating and preserving the site.

Design a Ravine! (page 1)

Ravines, by definition, are narrow valleys in the earth's surface, worn down by running water. In this activity, you will create a ravine similar to those at Fort Sheridan, using materials you might come into contact with every day. Once you've created your model, you will use water to simulate the erosion that takes place in an actual ravine.

1. Determine what materials you need to construct your ravine and list them below.

Materials Required:



2. Describe in detail how you will construct your ravine and how water will flow through the ravine model. Be sure to provide explanations for why and how the above materials will be used. Keep safety in mind.

Design a Ravine! (page 2)

3. Draw a diagram of your ravine model in the space below. (Use an additional sheet of paper if needed.)

4. Once your ravine design is approved, you can start to build your ravine. As you put the materials together and initiate the “erosion” process, record your observations below.

5. During the erosion process, list any modifications you need to make.