Model a Catchment Basin

Purpose

To introduce what a catchment basin is and how it works

Overview

Students will construct a 3-dimensional model of a catchment basin. They will use the model to explore catchment basins, water pathways, and manipulate the model to illustrate how catchment basins can change.

Student Outcomes

Students will be able to,

- define the concept of a catchment basin and a watershed;
- give examples of how their model relates to the real world; and
- give examples of basic concepts of catchment basins and watersheds, such as, water runs downhill, hills make divides, low-lying areas create pooling, water quality is affected by what is upstream.

Science Concepts

Earth and Space Science

Soils have properties of color, texture and composition; they support the growth of many kinds of plants.

Landforms are the result of destructive and constructive forces.

Soils consist of weathered rocks and decomposed organic matter.

Water circulates through the biosphere, lithosphere, atmosphere and hydrosphere (water cycle).

Water is a solvent.

Each element moves among different reservoirs (biosphere, lithosphere, atmosphere, hydrosphere).

Scientific Inquiry Abilities

Develop descriptions and explanations using evidence.

Communicate procedures and explanations.

Time

Class period

Level

All

Materials and Tools

Miscellaneous objects that may be used to create the model infrastructure

Outdoor models may use: sand, wood, rocks, etc.

Indoor models may use classroom items such as buckets, bowls, rolls of paper towels, etc.

Plastic sheet (2 x 2 meters)

Spray bottle with water

Sponges

Red food coloring

Permanent marker that will write on plastic or black electrical tape

Ruler

Topographic map

Preparation

None

Prerequisites

None

Teacher Support

Introduction

An understanding of the catchment basin (also called a river basin or water basin) is vital to analyzing data from the Hydrology Site. Water chemistry is a synthesis of everything that has happened to the water before it reaches the point at which a measurement is taken. This will include everything the water collects due to physical and chemical interactions with rocks, minerals, soil, and vegetation. It also is affected by contributions from aquatic life. Many natural and human activities that occur on that land can affect the water chemistry. There are so many things that might affect your water. But before you can explore them, you must find where your water comes from. That area is called your catchment basin. The boundary between adjacent catchment basin is called a watershed.

It is often difficult for students to imagine that rivers flow any direction but what their own experience has indicated. Even high school students when asked which direction rivers flow will often respond with a cardinal direction – south or east, for instance. The idea that water responds to the pull of gravity and is channeled by the materials it must pass through is an important concept.

Through manipulation of their basin model, students will gain an understanding of the constraints of a watershed. They will also be able to predict what happens when changes in the catchment basin occur, and test their predictions.

This is an excellent outdoor activity, although it can also be done easily in the classroom. Outdoors in a sandbox or on the grass students can freely rain on, pollute, and manipulate their model without fear of making a mess. Indoors, teachers may want to cover the modeling area floor with plastic in case of spills. Students may want to eventually create a model of their own basin. This may be built more permanently from plaster or clay before being covered with plastic wrap

How to Do Make the Model

1. Find an area about 1 meter square to build a catchment basin model. This could be a tabletop or plywood sheet if you are working inside or a grassy or sandy area outside.
2. You and your students gather the various objects to make the model, such as a plastic sheet, rocks, buckets, sponges, spray bottles with water, and food coloring.
3. Have the students arrange objects of various sizes inside the area. The tallest objects will become 'mountains'. Shorter objects or buckets or bowls may become hills, lakes, or plains.
4. Cover the entire area and all of the objects with a sheet of plastic. Have the students use their hands to mold the plastic loosely around the covered objects. This is a model of a landscape with hills, valleys, and connections between them.
5. Have the students predict what will happen if it 'rains' on their model. Where will the water go? Will it go faster in some places? Will some places form pools? How do you know?
6. Use the spray bottle to 'rain' on the top of your highest 'mountain'. Continue raining until you can see where streams, rivers, and lakes form.
7. Have the students choose a small pool on their model to be their GLOBE Hydrology Site. Mark the site with a marker, stone, or other object.
8. Ask the students to make it rain by using the spray bottle. Ask the students questions. Where does the water come from that flows to your Hydrology Site? Where does water flow away from your Site? What things on the landscape determine what will be part of your basin? What determines the watershed? Explain to the students that the places where water hits and flows into their Hydrology Site are in the catchment basin for their site, the watershed is the basin boundary.

9. Ask students: Where would be a good place on their model to have their school? Where would you like your house to be? Have the students mark these places on the model.
10. Have students explore the consequences of changes in their catchment basin. Here are some things you can do:
    a. What happens if you dam the stream that flows to your water site? (Use a sponge to create a dam).
    b. What happens if you plant a forest above your site? (Use a large flat sponge for the forest - it will soak up water for a time just like soil and vegetation) What happens if you remove the forest?
    c. What happens if someone builds an industry that causes pollution? (Use a small piece of sponge soaked in food color where your industry will be and watch the 'pollution plume' as it rains.)
    d. What happens if someone decides to use water from your stream for irrigation or urban use? (Make 'canals' that take the water away from your stream to other places.)

Extensions of Basic Learning Activity

Exploring Topographic Maps

This activity will help students better understand topographic maps. You will need a marker, tape, ruler, and topographic map.

Have students,

1. use a permanent marker or small pieces of tape to mark points on the model that are 10 cm above the surface of the table or ground;
2. use a marker to connect all of these points to make a ring around the model that is 10 cm above the surface;
3. measure points above the surface at 20 cm. Use a marker to connect them in a ring around the model;
4. continue measuring points at 30, 40, 50, etc. and connecting them until they reach the highest peak;
5. look at these rings from above. Ask students what they notice. Are they concentric (the higher ones inside the lower ones)? Are they all the same distance apart?
6. draw the rings on a flat piece of paper as if they were seeing them from above; and
7. examine a topographic map. Ask students if their rings look like topographic lines?

Defining a Watershed from a Topographic Map

Have students,

1. identify their Hydrology Site on a topographic map. Find the elevation of their site from the map;
2. use the topographic lines and benchmarks on the map to identify areas that are uphill from their site; and
3. look for 'ridges' or 'divides'. These are at mountain tops or places where the elevations start to decrease. Ask students to think about whether water falling on that place would flow toward or away from their Hydrology Site.

Student Assessment

After students have completed their model, pose questions about what would happen at the Hydrology Site if you made a change on the landscape.

1. What would happen if you poured a pile of salt on the 'mountain' above their site?

What would happen if you poured the pile on the other side of the mountain?

Ask students to use a marker to outline the watershed for their Hydrology Site.

Have students explain 3 things that might happen in their own basin that would affect their water temperature, transparency, or other GLOBE measurements.

Draw a simple set of concentric contour lines. Ask students to create a small clay model based on the drawing. Ask students to label the highest point on the topographic drawing. Ask them to find the steepest slope.