

EPA ENVIRONMENTAL EDUCATION

BUILD YOUR OWN WATERSHED

GRADE LEVEL: 8 – 12

BACKGROUND: The land we live on is divided into watersheds. A watershed is a land area whose runoff drains into any river, stream, lake, or ocean. Small watersheds, such as the watershed for the creek behind your house, or the watershed for the pond down the road, drain into small bodies of water, and cover small land areas. The runoff from small watersheds join together, and their combined areas become a new, larger watershed. Large watersheds, such as the Mississippi Basin and the Chesapeake Bay watershed, drain into large bodies of water, and cover immense land areas. Despite their differences in sizes, all watersheds share common properties. They all perform the same function of transporting water over the Earth's surface. The watersheds encompass suburban lawns, parking lots and city streets. Water seeps down through the soil to aquifers, which are underground rivers that slowly move water below watersheds to outlet points at springs, rivers, lakes, and oceans.

Many human activities have an effect on watersheds. Construction projects like dams can limit the flow of water; construction of roads and buildings can divert and even increase the flow of water. Agricultural fertilizers can run off of crop fields and inadvertently fertilize harmful microorganisms in rivers and lakes, having an adverse effect on water quality and marine life. The irresponsible disposal of household and industrial chemicals can be harmful because these chemicals travel through the watershed, poisoning life and damaging natural ecosystems.

Watersheds can also have an effect on humans. Many communities use rivers and streams as their source of drinking water. Water treatment prepares this water for human consumption, but if the water is laden with chemicals and microorganisms, it can be difficult to treat effectively. Floods are one of the major events in a watershed. Homes built on flood plains, low lying areas adjacent to rivers, are susceptible to flooding conditions when heavy precipitation exceeds the watershed's capacity to absorb water. Rivers, streams, and lakes overflow, threaten human lives, and damage or destroy roads, buildings, and flood control measures. Watersheds can also become dry, causing water shortages for those who depend on their lakes and rivers for drinking water.

It is clear that humans have a close relationship with watersheds. The responsible planning of watershed use and development is important to ensure that the ecosystems sustained by the watersheds are not destroyed, and to protect the health and safety of our communities.

NOTE: Prior to the demonstration, the teacher should engage the students in activities involving identification of a local watershed. Maps can be used to facilitate this activity, and a field trip to a local river or pond can serve to demonstrate the concept of a watershed. Ask students to identify where the water is coming from. How far does the watershed extend? For a small stream, the answer may be several hundred feet; but for a lake or river, the watershed may be much larger. Visit EPA's "Surf Your Watershed" for local watershed information (<http://www.epa.gov/surf/iwi>).

OBJECTIVE: This experiment illustrates the basic properties of a watershed: how water flows from higher elevations to lower elevations, and how watersheds are interconnected. The students will understand how the placement of buildings, roads, and parking lots can be important to watershed runoff, and how careless use and disposal of harmful contaminants can have a serious effect on downstream watershed denizens.

MATERIALS NEEDED:

- 1 large tupperware container (about 1.5'W x 3'L x 1'H)
- 2 lbs. of modeling clay
- 3 lbs. of sand (any type of sand will do)

- 2 lbs. of aquarium gravel
- 1 roll of wax paper (or any other impervious, water repellent surface, tin foil, plastic wrap, etc.)
- 1/4 cup of cocoa mix, iced tea mix, or other flavored drink mix (to represent chemicals)
- 1 spray bottle or bucket full of water

PROCEDURE:

(Note: prepare steps 1 to 4 before students are present)

1. Wash the aquarium gravel carefully to remove any powdery residue that may add cloudiness to the water. Fill the container to about 2 inches from the bottom with the gravel. Slope the gravel slightly so, that at one end (downslope), the gravel is only about 1/2 inch deep and, at the other end (upslope), the gravel is about 3 inches deep. This gravel layer will represent the aquifer.
2. Mix the clay and the sand. The consistency of this mix should be gritty, with slightly more clay than sand. This mixture should allow water to run freely over it, but if left standing, the water should slowly permeate the surface. Add this mixture to the container carefully, so as not to disturb the slope of the aquifer already placed. The slopes should be similar, with about 2 inches of sand/clay mix overlying the gravel already placed, and on the downhill end there should be about 3" of gravel left exposed.
3. Carve a channel in the middle of the clay/sand layer, about 1/2 inch deep and about 1 inch wide. This channel will represent the main river of the watershed. Near the top of the slope, split the channel into two or three separate channels to represent tributaries. You may wish to add other tributaries along the main branch of the "river" to further illustrate other watersheds.
4. With some extra clay/sand mix, build little hills between the tributaries. These hills separate the smaller watersheds, but when looked at as a whole, the entire "river" system is one watershed. You may also wish to add some small model trees or green felt to represent forests or fields. Buildings can be represented with small blocks of wood.
5. Along the main river, flatten out an area that is about 8 inches by 3 inches. Cut out a piece of wax paper to be about 4 inches by 3 inches in size. Stick this down onto the clay sand mix, sloping it slightly towards the river. If necessary, use some clay to hold the edges down. Explain to students that this wax paper represents the impervious surface of a parking lot.
6. Fill the bottom of the aquarium up to about 2 inches from the bottom with water. The water should fill all of the aquarium gravel "aquifer" area, and should just reach up to the lowest extent of the clay/sand mixture. Explain to students that the aquifer captures and transports water that seeps down through the soil.
7. Using the spray bottle, simulate rain over the flattened soil area and the parking lot. Ask the students to note that the "rain" soaks through the soil, but runs off the parking lot to the river. Ask them what the effect would be if the entire watershed was "paved".
8. Sprinkle some cocoa mix over the sides of one of the smaller watersheds. Tell the students that the cocoa represents pollution. Over one of the unpolluted "watersheds," cause some rain with the spray bottle (*it may be necessary to cause more rain by pouring water). Note that the runoff from the rain is clean. Now, make it rain over the polluted area. Ask the students to note how the pollution travels down through the watershed, contaminating all downstream areas. Discuss with the students why the pollution is a problem, and what can be done to fix the problem.

FOLLOW-UP QUESTIONS:

1. What are some possible sources of watershed pollution in your community?
2. What other impervious surfaces besides parking lots can cause excessive runoff in a watershed?
3. What can be done to reduce our impact on watersheds and their environment?
4. Using a map of the area around your house and EPA's "Surf Your Watershed," identify where the runoff from your driveway will end up. Can you track the path of potential pollution to a large body of water (*i.e.*, ocean or bay)?