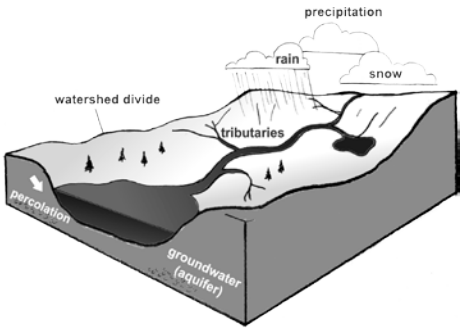
Watershed in a Box



Estuary Concept

Estuaries are interconnected with the world ocean and with major systems and cycles on Earth.

Learning Objectives

- Identify shapes and kinds of land and bodies of water in their area.
- Use a representative model to describe connections and interactions between landforms, land-use, and water bodies.
- Older students will be able to use a representative model to describe ways the hydrosphere interacts with the atmosphere, geosphere, and biosphere.

Teacher Background

A watershed is an area of land that channels rainfall and snowmelt to a specific creek, stream, or river, and eventually to a larger water body like a lake or estuary, and then to the ocean. Watersheds can be small, such as the area that drains into a seasonal creek, or very large, such as the area that drains into a big estuary like the San Francisco Bay. A big watershed is made up of many smaller watersheds. All watersheds eventually lead to the ocean.

Activity Information

Grade Level

2, 3-5, 6-8, 9-12

Adaptable grades 2nd and up, topic aligns to NGSS Earth Science at 2nd and 5th grades

Time Required

2 (45 minute) class periods

Topic

Water and Landforms

Overview

In this activity, students create a model of a watershed, create farms and urban areas within it, add pollution to some areas, and watch how “rain” flows through the watershed, picking up pollution as it goes. The basic watershed model can be easily adapted for specific student needs and learning objectives.

When rain falls on land, it flows into a small creek, which joins together with other small creeks as it flows into a river, which may then join with other rivers to flow into a larger body of water. As the water flows, it often picks up pollutants, which may have negative effects on the ecology of the watershed and on the lake, estuary, or ocean where it ends up. How land is used determines the types and amounts of pollutants being carried away by the water. For example, heavy rain falling on fallow farm fields may wash lots of dirt into a local waterway, where heavy rain falling on a city street may wash oil into a local waterway. Other types of non-point source pollutants include fertilizers, herbicides, and bacteria from septic systems and pet waste. Land use can also improve water quality. For example, if heavy rain falls on a farm with a small wetland or forest around it, the natural habitat will filter the dirt out of the water before it flows into the local waterway. Similarly, lining the side of a street with bioswales can filter out the pollution before it flows into the storm drain, and eventually into a larger body of water.

Not all water flows across the land surface directly to the sea. When rain falls on dry ground, it can also soak into the ground, where it can be taken up by plants, flow underground to a nearby creek, or seep deep underground into an aquifer. The model created in this activity includes only surface flowing water.

Materials Needed

Per student

- Student Master: Watershed in a Box
- Student Master: Assessment Questions

Per team

- 1 aluminum roasting pan
- Spray bottle with water
- Permanent markers: blue, green, and brown. Additional colors optional
- Newspaper
- Aluminum foil twice as big as roasting plan
- 2-3 types of unsweetened powdered drink mixes
- Unsweetened hot cocoa mix
- 3-4 empty salt shakers to put the drink mixes in (optional)
- Google map of local watershed printed or projected (or use the Weeks Bay Watershed Map)

Teacher Preparation

1. Watch the video, *Watershed Demo* to become familiar with how the model watersheds activity will work.
2. Buy large disposable, aluminum roasting pans for your students to use as their watershed model base. These pans are readily available, and can be rinsed and reused several times.
3. Gather newspaper works to create the crumpled paper to support your watershed land forms.
4. To avoid a sticky mess, purchase only unsweetened powdered drink mixes to use in this exercise. You need several flavor colors (red, green, purple) to represent fertilizer, pesticides, and oil from roads. Unsweetened hot cocoa mix is used to represent soil.
5. You may want to put the unsweetened powered drink mixes into salt shakers. This step is optional, but will make distributing the drink mixes easier and more even.
6. Make copies of Student Master: Watershed in a Box and Student Master: Assessment Questions.

Procedure or Activity Steps

1. Distribute copies of Student Master: *Watershed in a Box*. Use the watershed diagram to introduce students to the concept of watersheds. Ask students to describe and/or draw where the water in the watershed comes from and how it eventually ends up in lakes, estuaries, and the ocean. Use their descriptions or drawings to develop or review key vocabulary: watershed, runoff, pollution, pollutant, landform, land use, habitat, waterway, and estuary.

2. Project or print copies of a Google map of your local watershed and let students use it as they design their watershed model. Alternatively, you can also use the watershed illustration found on the Teacher Master: Weeks Bay Watershed Land Use Map as a guide. There are several tools online to help discover your watershed, if needed.

3. Students will follow the instructions on the Student Master: *Watershed in a Box* to build and use their watershed model.

4. In Steps 1–4 on the Student Master: *Watershed in a Box*, students will construct a model of a watershed. You may want to create a list of features, like specific landforms or landmarks that they are required to include.

5. In Steps 5–8, students designate areas for different types of land use in their model watershed and add pollutants to some areas.

6. In Step 9, students are asked to make predictions about how the water and pollutants will flow. This is a good point for a break or to pause until a second class period, if needed. This section can also be expanded to include more thorough predictions in student notebooks. To move beyond step 9, the students will need your approval to start spraying the model.

7. In Step 10, students create precipitation by gently spraying their model and recording their observations.

8. When students have completed the activity, have students answer some or all of the sample assessment questions. You may choose to have students write out their answers, either individually or in their small groups. Students might be asked to be prepared to discuss their answers in class.

9. This activity can be extended by asking the students to reflect on the sources and flow of runoff and pollution, and then to create a second watershed design that prevents the pollution from moving downstream. Alternatively or in addition, students can explore how what they observed in their watershed models relates to authentic issues in their local watershed. One way to do this is to look at water quality data after a large storm; scenarios with data sets using the SWMP Graphing Tool are available, if desired.

TEACHER MASTER

Assessment Questions

1. What is a watershed?

   Possible Answers: A watershed or drainage basin is an area of land that delivers runoff water, sediment, and dissolved substances to surface water bodies, such as rivers, lakes or oceans. Every watershed consists of boundaries (divides) and the drainage basin they surround.

2. List several types of land forms, habitats, land uses, and waterways found in your watershed model.

   Possible Answers: Students should be able to list and/or point out using their watershed model/box examples of landforms (mountains, hills, valleys), habitats or land cover (e.g., meadows, wetlands, lakes, forests), land use (e.g., crops, parking lots, roads), and waterways (creeks, streams, rivers, estuaries, lakes, oceans). The answers to this question will reveal which types of landforms, habitats, land uses, and waterways students are able to identify, and which they need more work on.

3. What did you notice about how the shape of the land affected the flow of the water?

   Possible Answers: This open-ended question will reveal student thinking about interactions between landforms and rainfall. They should notice that the water moved faster off the steeper hills, and more slowly in the flat area.

4. When the polluted runoff from the farm and urban areas flowed into your model's estuary, was it easy to tell where it came from? Why or why not?

   Possible Answers: As the "rain" was falling, it was easy to tell where the pollution came from. However, by the time pollutants reached the estuary, they had blended together. It was no longer possible to tell what they were or where they came from.

5. Water pollution is often categorized in two ways:

   Non-point source water pollution comes from many different sources, such as oil and gas from the many roadways in a city or pesticides from many adjacent farms.

   Point source water pollution is pollution from a single source at a specific location, such as a sewage outfall or oil spill.

   Based on those two above definitions, answer the following:

   Water enters an estuary from an urban area upstream. The runoff is carrying cooking oils from restaurants and salt washed from streets after winter snows. Is this an example of point source or non-point source pollution?

Possible Answers: The pollution coming from many different urban sources is non-point source pollution.

An oil supertanker sinks in a storm and results in an oil spill. Is this an example of point source or non-point source pollution?

Possible Answers: The pollution coming from a single wrecked oil tanker at a specific time and location is an example of point source pollution.

6. Where did the pollutants in your watershed collect? What area does this represent in an actual watershed?

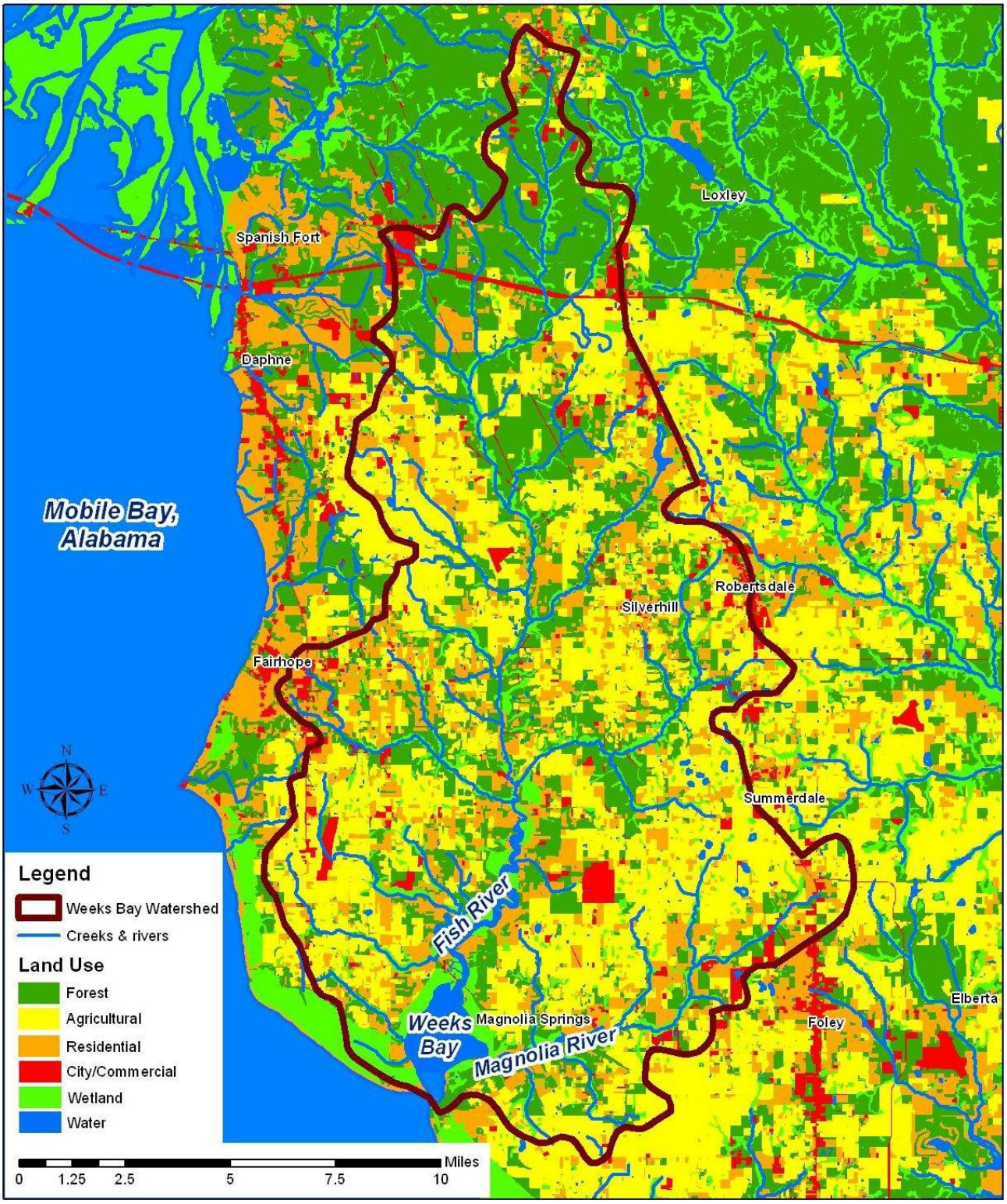
   Possible Answers: Water moves downhill in a watershed, making its way to the ocean. The pollution probably collected in the lake, estuary or ocean at the base of their watersheds. The students may be able to name the major water body in the local watershed. If not, you may want to return to the local watershed maps.

7. How could you have prevented pollutants from the watershed from collecting there?

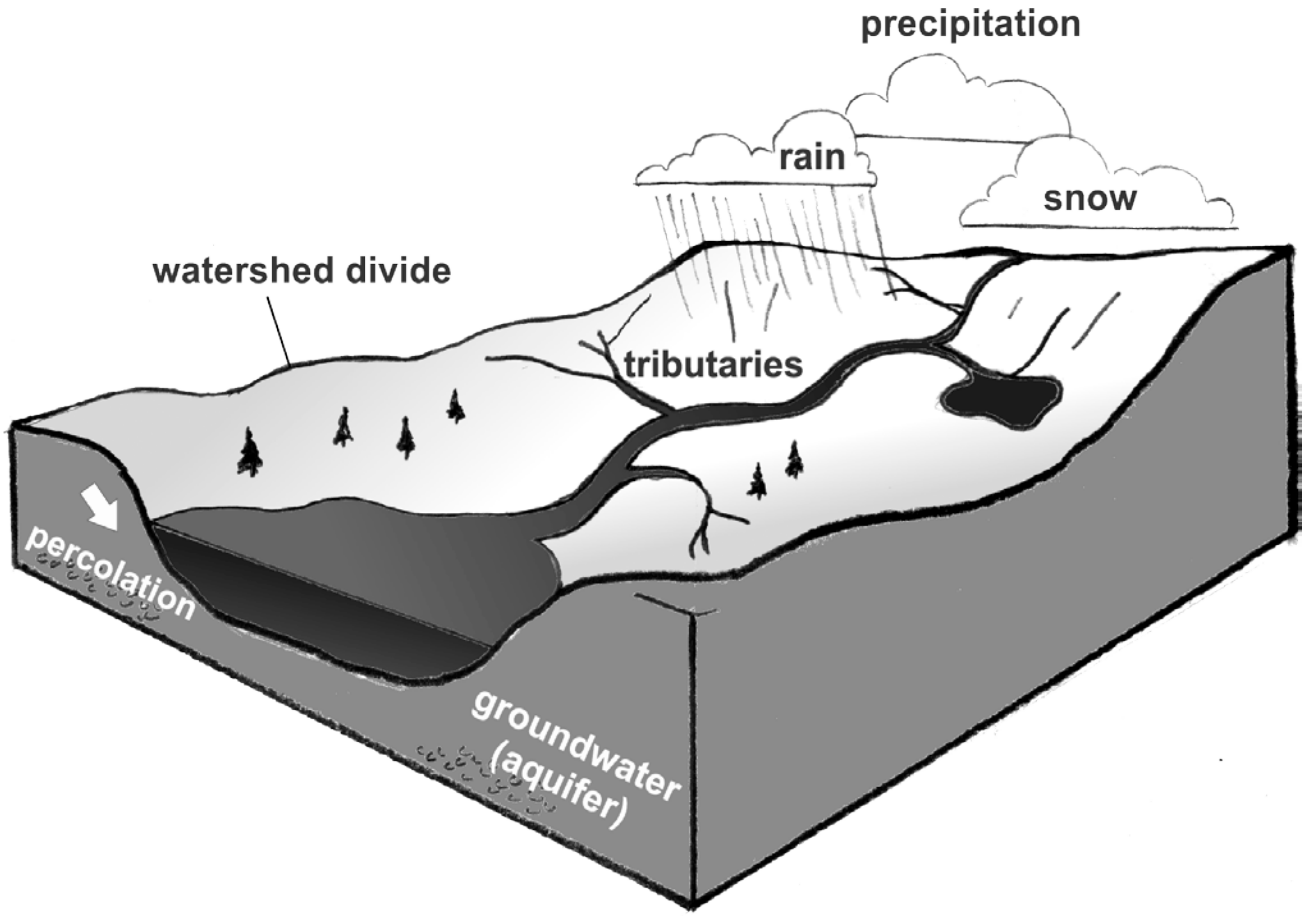
   Possible Answers: Water moves downhill in a watershed, making its way to the ocean. The pollution probably collected in the lake, estuary or ocean at the base of their watersheds. The only way to prevent pollutants from collecting in the lake, estuary, or ocean is to stop them from flowing downstream. The students may list ways they could change their model to improve water quality. If time allows, you may allow them to re-create their models or to draw or write about how they would re-create them. You can use this as a launching point for exploring ways your community is improving water quality.

TEACHER MASTER

Weeks Bay Watershed Land Use Map



Watershed in a Box



A watershed is an area of land in which much of the precipitation that falls runs off to the same downhill location. Every watershed consists of boundaries (also called divides) and the basin they surround. The water within the watershed flows from higher elevations to lower elevations moving toward the basin. Smaller watersheds are connected within larger watersheds.

The runoff water and whatever is carried with it gets carried into surface water bodies, such as streams and tributaries, rivers, lakes or oceans and into the groundwater. In this exercise, you are going to build your own model watershed and use it to explore how water and pollutants move through the watershed.

Watershed in a Box

Student Procedure

1. Look at the watershed map on the previous page – what landforms, land uses, habitats, and waterways do you see? You are going to recreate those in your watershed model.
2. Arrange pieces of crumpled paper in the bottom of the aluminum pan to represent hills and other landforms of the watershed.
3. Cover the crumpled paper land forms with a large piece of aluminum foil, shiny side up. This is the land surface.
4. Use a blue permanent marker to draw the river and streams in the main valley and tributary valleys of your model. Draw directly on the foil. The area at the lower end of the river is your model's lake, estuary, or ocean. If the model were larger, you might see that even this large water body is connected to an even larger one.
5. Use permanent markers to show different ways in which natural or wild land is covered or used in the watershed. Draw directly on the foil and show things such as farm fields, wetlands, forests, pastures, etc.
6. Next use markers to draw places on your watershed model that reflect how humans use the land. Draw such things as roads, homes, shopping centers, cities, factories, parking lots, etc.
7. Shake some brown powder (unsweetened cocoa powder) on to one of the farm fields to represent loose, bare soil.
8. Continue work on the watershed model by using a different color powdered drink to represent different pollutants. You should add one pollutant to the agriculture area and one to the urban area.
9. Finally, make predictions about where the water is going to flow and what is going to happen to the pollutants. When your watershed model and predictions are complete, ask your teacher for approval before you start spraying the model.
10. Use the spray bottle to gently mist water onto your watershed model, including over the agricultural and urban areas. What does this water represent? Take notes about what you notice. Where does the water go? Does it always move at the same speed? Where does the polluted runoff go?

Assessment Questions

1. What is a watershed?

2. List several types of land forms, habitats, land uses, and waterways found in your watershed model.

3. What did you notice about how the shape of the land affected the flow of the water?

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