Overview

Use simple stream models to explore the concept of watersheds, catchment basins, and to introduce California water resources.

Objectives

By the end of this activity, students will be able to:

- Define a watershed and a catchment basin
- Learn basic stream features and flow properties
- Understand sources of water in California

Subjects

Science

Grade level

4-12

Length of activity

2 hours to purchase materials and build stream table, 40 min to do activity

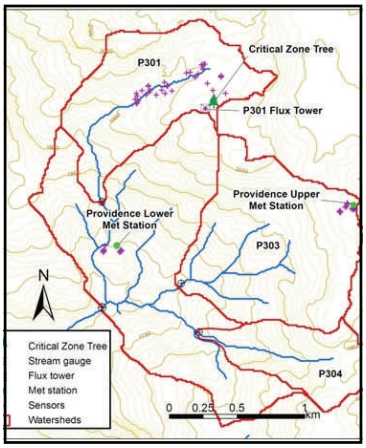
Activity location

Outside or inside

Materials

Long shallow plastic tubs, sand, 5 gallon buckets, scrap piece of pvc, vinyl tubing, plastic valves, drill, hacksaw, rubber washer, silicone sealant, access to water

Watersheds and Stream Models



Introduction

Watersheds are the boundary lines separating two adjoining catchment basins. A **catchment basin** is an area of land where all the surface water in that area drains into one particular spot. The boundary around the catchment basin is the watershed. Watersheds come in many shapes and sizes, and you can have numerous smaller watersheds within one large watershed.

One fun and interesting way to introduce the concept of catchment basins and watersheds is with a stream table. These tables can be as elaborate or simple as you want. When using a stream table to talk about catchment basins and watersheds, other concepts such as water stream features, flow properties, and regional water resources can be discussed.

In this stream table activity, the following terms will be introduced:

Streamflow - water collecting in a stream originating from rain, surface runoff, or groundwater.

Stream banks - The sides of a stream holding water inside the channel.

Runoff - water running off the land after a precipitation event.

Erosion - material (sediment) that comes off of a streambed or bank and is transported by water in a stream.

Deposition - sediment that comes to rest in a stream channel after being transported by water.

Point bar - The area of deposition across from the cut bank at the bend in a stream (meander).

Cut bank - The area of erosion across from a point bar at the bend in a stream.

Water in California is a precious resource. Water is needed for many uses such as drinking, irrigation, industry, animals, and forests. Seasonal changes in water resources makes California vulnerable to decreases in water content. Precipitation falling as snow in the Sierra Nevada mountains during winter forms a reservoir of water that melts slowly throughout the summer, providing much needed water during the dry summer season. 70% of the water used in California originates from the Sierra Nevada snowpack. The rest of the water comes from groundwater sources and rainfall. Reservoirs are used to collect runoff from snowmelt and rainfall, or to hold water transported via aqueducts throughout the state.

This activity can be used to introduce watersheds, catchment basins, stream parts and functions, as well as to discuss seasonal changes in stream flow and its impact on water resources for the state.

Building the stream model

Materials can be found at most hardware stores. You can also try to obtain parts from a Habitat for Humanity Restore in your area. Costs for this project are approximately $40 per stream model. The plastic tub is the greatest expense and costs around $25.

<u>Materials to make 1 stream table</u>

- Long, shallow plastic tub (one shown here is Sterilite 3 1/2’ L X 1 1/3’ W X 6” D). Works best if it has a flat bottom.
- 2-5 gal buckets or 1-5 gal and 1-2 gal buckets
- Silicone or other strong adhesive (like Amazing Goop pluming).
- 2 pipe valves - 1 each of EzconX Universal 3/8” tube to male and 3/8” tube to tube (call hardware store to see if they have this brand or order online). Other valves will work but you will have to modify tubing to fit.
- Vinyl tubing: 5’ of vinyl 1/4” ID (inside diameter), 3/8” OD (outside diameter), 5’ of 1/4” ID, 1/2” OD.
- 1/2” barb to male schedule 80 tube connector
- 5” length piece of 1-1/2” diameter PVC
- Approximately 2.5” diameter rubber washer with a 1/2” hole cut out (see Fig 1).
- Pipe thread tape
- 1-45 lb bag of sand (Quickrite sand works since there are different size grains and colors. More sand may be
- 12” piece of scrap wood (2X4 or 1X4)
- Binder clips

<u>Optional</u>

- Blocks, pieces of twig, plant leaves or fronds, and rocks to create homes and habitats along stream.

Directions for building a stream table

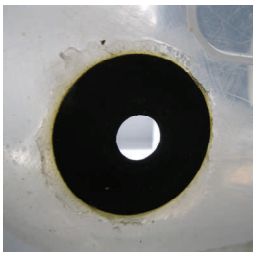


Fig 1. Drain hole and washer

1. CAREFULLY cut a 3/4" drain hole at the downstream end of your tub. It is very easy to crack the plastic so cut or drill into a block of wood. Lightly sand area around hole where rubber washer will attach and glue to the underside of the tub using adhesive (Fig 1). Use something heavy to weigh down washer while glue dries. Leave to dry outside so adhesive can off-gas and cure for at least 12 hrs.
2. Drill a 5/8" hole towards the bottom of your water reservoir bucket (Fig 2). Prep with pipe thread tape and screw in valve to secure - **OR -** to permanently attach valve use plumbing adhesive with no thread tape.

Fig 2. Valve attached to bucket

3. Cut a "V notch" into the PVC pipe (Fig 3). This can be done by drawing the V with pencil and cutting carefully with a hacksaw. Use gloves to cut.
4. A 6' table works best to set up stream table. Elevate water reservoir bucket to create enough pressure for water to drain freely (Fig 4). Attach ___ vinyl tubing to valve according to package instructions. Cut tubing to desired length based on distance to stilling well, leaving some slack (Fig 5). Attach a small length of tubing to other end of in-line valve and secure to stilling well using a binder clip (Fig 5).

Fig 3. V notch

Fig 4. Water reservoir and tubing

5. Use scrap wood to elevate stream tub towards top end. Empty bag of sand into tub. Place V notch PVC pipe in sand at upstream end.
6. Attach schedule 80 PVC barb to male fitting to 1/2" OD vinyl tubing (barb end). Screw into rubber washer, allowing to stick out a little bit. Place tubing in 5 gal bucket under table to collect downstream water.
7. Making sure valves are closed, and add water to reservoir bucket, allow sand to get saturated, and play with stream table until you get a sense of how the valves and stilling well control flow. For best results, pre dig a channel once sand is saturated, starting at stilling well and going all the way to the bottom (Fig 6).

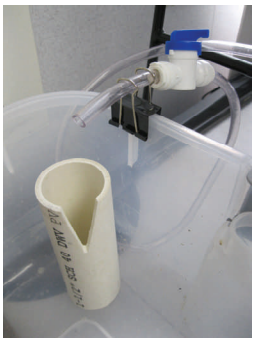


Fig 5. Valve attached to side of tub

8. Open reservoir valve. Slowly open second valve to start stream flow. V notch will fill up and trickle out into stream. Adjust flow based on how you run the activity.
9. When water in reservoir bucket is empty, you can use fresh water or recycle water from downstream bucket.
10. Small ponds can be dug in the sand to show groundwater effects. Ponds will fill up once stream is turned on and get shallow or empty when stream is at low flow. This illustrates how some wetlands and ponds wet and dry down seasonally.
11. Blocks, sticks and rocks can be used to show effects of erosion on objects in or near the stream. Having students create habitats along the stream is also a way to for them to get hands on with the stream model (Fig 7).
12. When finished, empty as much water as possible from sand while still in tub then transfer to 5 gal bucket. Leave lid off until sand is completely dry. This will take up to a week.
13. Allow all parts to completely dry before storing.

Fig 6. Wetted sand with stream channel dug out.

Fig 7. Use of objects to create habitats along the banks of the stream.

Final stream model setup without sand

Activity description

1. Introduce the concepts of watersheds and catchment basins. Begin by asking students the following questions and explain using maps of watersheds and their associated catchment basins.

What is a watershed? What is a catchment basin? What types of bodies of water might be in a catchment basin (lake, stream, pond, ditch). Where does the water in the catchment basin come from (rain and snow and the Sierra Nevada mountains)? Does it rain and snow all year in California? What seasons does it usually rain and snow? Where do we get our water in the summer if it rarely rains (snowmelt from the Sierra Nevada, groundwater, and water from reservoirs)?

2. Introduce local water resources by showing a map of your area. Ask students to identify and name the closest nearby natural body of water and the stream that feeds it. Point out natural versus man-manipulated bodies of water if possible. If you have reservoirs in your area, ask students why we need reservoirs? (Think back to where we get our water in summer). We need reservoirs in California for drinking water, irrigation for agriculture, animals, to produce energy and for industry.

3. Stream table function, basic stream features and observations

⇒ Try to work with small groups so students have enough room to gather stream table. Show them the stream table, its parts and how it works. Turn on valves, show how to increase and decrease water pressure. Tell them that the stream represents the closest natural nearby stream and the body of water at the bottom represents what this river flows into (can be a reservoir).

⇒ Open valve just a small amount and let stream run for a few minutes. Point out and introduce major stream features including, upstream, downstream, banks, meander, cut bank (erosion), point bar (deposition), and sediment. This represents the low flow time of year (summer into fall).

⇒ Open valve a little more to show them what happens in the stream when you increase water volume. Notice different sizes of sediment moving in the stream. Point out erosion at the cut banks and deposition at the point bars. This represents the high flow time of year after a rain storm or during spring snowmelt.

⇒ Turn off stream, discuss their observations. What size material was left in the center of the channel after the water was turned off? Larger material remains in the middle of the stream. Did erosion occur? Did the stream get narrower and deeper or shallower and wider? Why is this? Over time streams naturally get wider and shallower as material from the banks fall off (erode) and get deposited downstream. What happened to the body of water at the end of the stream? Is there more sediment in there?

4. Other scenarios – They love to see the stream flood!

⇒ Pretend its February and there has been a huge rain on snow event causing snow to melt quickly in the mountains. What will happen to the volume of water in the stream? Turn up water and observe changes.

⇒ What would happen if it only rained in the mountains? Would we have enough water in the late summer? Simulate a flood by turning up water even more. Observe changes. How did this impact the stream?

⇒ Another version of this activity involves allowing students to use rocks, vegetation, or wooden blocks to build. Do these objects change how the stream behaves? Tree roots hold in stream banks, but rocks and other objects can erode and fall in the stream during high flows.

5. Conclusions and wrap-up

⇒ Watersheds are the physical boundary lines between two catchment basins. All the surface water within a catchment basin drains to one place.

⇒ Most of the water in California comes from rain and snow melt. Precipitation occurs only a few months out of the year so we depend on reservoirs and Sierra Nevada snowpack to help meet our water needs. What do you think might happen to our water supply if there is less snow and rain in one year, or less snow and more rain? What might happen to plants and animals?

⇒ Finish by mentioning that the stream model speeds up time to show processes over a period of decades or centuries.

⇒ The stream model is a simulation of what can occur in California streams during different seasons.

Student Assessment

After students finish this activity, ask them to write down definitions of key terms mentioned in the introduction: streamflow, stream banks, runoff, etc.

Have students review how seasons effect water resources in California.

Extensions

Have students operate the stream model on their own, using notebooks to write notes about observations they find.

In groups, ask students to create experiments using the stream model, writing down their question, procedure, observations and results. Have them discuss their projects to the class.

Resources

USGS Science in Your Watershed

http://water.usgs.gov/wsc/

EPA Watershed Academy

http://water.epa.gov/learn/training/wacademy/index.cfm

California Department of Water Resources

http://www.water.ca.gov/

California State Science Standards

4-8th grade

4th: 5.a, 5.c, 6.d

5th: 3.d, 3.e, 6.c, 6.h

6th: 2.a, 2.b, 7.g, 7.h

7th: 7.d

8th: 9.a

High school

Earth Science: 9.a, 9.c

Investigation and Experimentation: 1.d, 1.g, 1.i