WILL THAT HOLD WATER?

Objectives:
The student will be able to:

- Be aware of and discuss the five major purposes of dams;
- Locate on a U.S. map the dams listed on the student sheet and;
- Build and test a model of a specific type of dam assigned to their team.

Suggested Grade Level:
6-8

Subjects:
Geography, Science, Art

Time:
3 45 minute periods

Materials:
- 5 half-gallon (2L) cartons
- 6-8 quarter-inch (0.6cm) dowel rods
- glue
- craft sticks
- gravel
- clay (use the cooked play dough recipe on teacher sheet)
- teacher sheets (included)
- paper towels
- water
- aluminum foil or aluminum pie pans
- student sheets (included)

B A C K G R O U N D I N F O R M A T I O N

People have built dams for thousands of years. Even earlier, beavers were damming streams to change their environment. Before 1905 no dam in the U.S. was taller than 200 feet. Fifty years later 159 dams 200 feet high or higher had been completed. Modern dams are designed to be multi-purpose dams. Their five major purposes are: water supply, irrigation, flood control, electric power production, and recreation. The lake created by damming a stream or river is called a reservoir. Some of the most famous dams in the U.S. are Hoover Dam in Arizona-Nevada; Grand Coulee Dam in Washington; Shasta in California; Bonneville in Oregon; Flaming Gorge in Wyoming-Utah; Kentucky Dam in Kentucky; Norris Dam in Tennessee; and Wheeler Dam in Alabama.

Hydroelectric dams use the energy of falling water from reservoirs to produce electricity by the use of turbines and generators. Hydroelectric power has become a widely used power supply across the U.S. for many years. Dams must be carefully planned so that they do not unnecessarily damage ecosystems when they flood an area and cause changes in the rivers they dam.

T E R M S

dam: a wall-like barrier across a stream or river to stop the flow of water.
drought: period of less-than-normal rainfall.
hydroelectricity: electricity produced by the power of falling water striking a turbine and turning a generator.
flood: period of more-than-average rainfall.
reservoir: a body of water stored in a natural or artificial lake.

A D V A N C E P R E P A R A T I O N

A. Cut one side and the top off of 5 half-gallon (2 L) cartons (or plastic milk jugs).

B. Cut 6-8 quarter-inch (0.6 cm) dowel rods into 3-inch (7.5 cm) pieces.

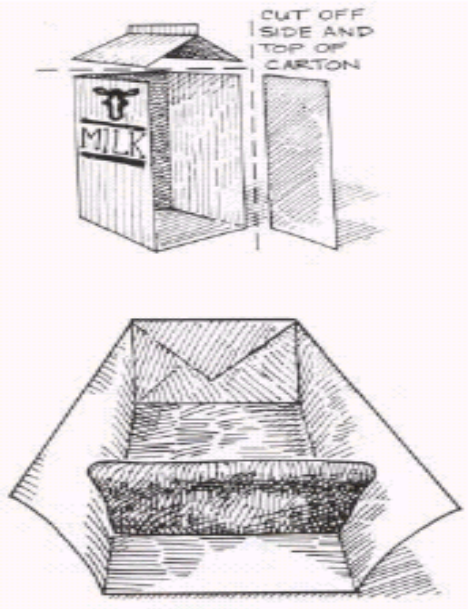
C. If you cannot get pottery clay, mix up 5 batches of the salt dough recipe and keep in an airtight bowl (see teacher sheet “Salt Dough Recipe”).

Optional Materials:

- Graph paper
- Plastic tray
- Stop watch

D. Copy the student sheets "History of Dams," "Types of Dams," and "Will It Hold?"; make one per student.
E. Write the names of the 5 types of dams (rock, timber, embankment, masonry, and concrete) on slips of paper and put them in a cup.

F. Gather sticks, gravel, and other dam-building materials such as aluminum foil or aluminum pie pans.



P R O C E D U R E

I. Setting the stage

A. Begin the discussion by asking the class these questions:

1. What happens sometimes when it rains too much? (*It floods. Write "flood" on the board and define.*)

2. What happens when it doesn't rain enough? (*There is a drought and plants and crops die. Write "drought" on the board and define*.)

3. Is there anything people can do to keep it from flooding and to save water to use during droughts? (*We can build dams. Write "dam" on the board and define. If some students are not familiar with dams, draw a simple diagram on the board showing that a dam blocks the flow of a river and causes a lake – reservoir – to fill up behind it. The dam has passageways in it through which we allow some water to pass, so there is still a river.)*

B. Tell the class they are going to learn about dams and what dams do for people.

1. Pass out the "History of Dams" student sheet and ask for volunteers to read it.

2. List the five purposes of dams on the board. For each (water supply, irrigation, flood control, electric power production, and recreation), give an explanatory comment about how dams accomplish these things.

3. List the types of dams (earthen, rock, timber, embankment, masonry, and concrete) on the board.

4. List the famous U.S. dams on the board.

5. Ask for volunteers to locate them on a large U.S. map.

II. Activity

A. Begin the dam-building experiment. (Dams will be built in the half gallon carton you prepared earlier.)

1. Divide the class into five even teams (e.g., 5 teams of 5 for 25 students).

2. Explain that each team will be assigned to build a model of one type of dam. The class will build all but the earthen dam. You will provide clay, sticks, gravel, and other materials. They must determine how to use these to simulate the materials shown on the diagrams.

3. Pass out the "Will It Hold?" student sheet and have each team predict which dam will last the longest. (NOTE: You may elect not to do the formal experimentation, but to simply have the groups build and demonstrate the models.)

4. Have each team draw one slip of paper from the cup to see which model they will make.

B. Re-arrange the students' seating into teams (cooperative learning groups) and do the following:

1. Pass out the "Types of Dams" student sheets to each team and have them study the diagram of the dam they will build.

2. Each team should have a record technician, a time technician, a supply technician, a water technician, and a group leader. Let the students choose their roles.

3. The team will plan together how to build their dam. The record technician should record the plan in steps.

4. The supply technician will go to the supply table and get the needed materials for their team.

5. You will be available for technical advice, but should not physically help teams.

C. Once all dams are complete, they must dry for 5-7 days, after which testing will begin. (NOTE: You may omit the testing in step 2 and use the models for demonstration and display only.)
1. The water technician will slowly pour water behind the dam.

2. The time technician will call time intervals while the data technician records information. Data will be recorded every 15 seconds for the first 2 minutes and then every 2 minutes for the next 8 minutes.

III. *Follow-Up*
A. Each team will graph their data from their experiment. The graphs can be used to make a bulletin board display on the strength of dams.
If you have omitted the testing, have each group draw a large diagram of their type of dam. (Supply the butcher paper and art supplies.) Display these drawings.

R E S O U R C E S

Arnold, Caroline, Bodies of Water: Fun, Facts, and Activities, Franklin Watts Publishing Co., New York, 1985.

"Dams," Encyclopedia Americana, Grolier, Inc., Danbury, Connecticut, 1987.
Hunt, Bernice K., Dams: Water Tamers of the World, Parents' Magazine Press, New York, 1977.

Miller, James E., "Beavers", Program Leader, Fish & Wildlife, USDA - Extension Service, Natural Resource and Rural Development Unit, Washington, DC, 1983.

Thank you to the Environmental Protection Agency *Water Sourcebook* for this activity!
http://water.epa.gov/learn/kids/drinkingwater/wsb_index.cfm

TEACHER SHEET

SALT DOUGH RECIPE

1. In a heavy sauce pan mix the following ingredients together:
    1 cup (250 mL) plain flour
    1/2 cup (125 mL) salt
    2 tsp (10 mL) cream of tartar

2. Add the following:
    1 cup (250 mL) water
    1 tbs (15 mL) cooking oil of wintergreen (optional)

3. Stir all together and cook at low temperature for 3 minutes or until it pulls away from the sides of the pan. Almost immediately, knead lightly and store in an airtight container. You may add a few drops of oil of wintergreen to help the aroma. It will take about a week for this to dry. Make one batch for each team.

STUDENT SHEET

HISTORY OF DAMS

The first dam builders were beavers. Beavers build dams to change their environment more to their liking. People followed the beavers' lead and began building dams thousands of years ago to control and change their environments, to hold water, to control flooding, and to use water power.

The earliest reported dam was built on the Nile river about 5000 years ago to control flooding. Ancient dams were built to control flooding, provide drinking water, and supply water for irrigation. The Kaerumataike Dam in Japan is 2200 years old and is still used today. A dam on the Prontes River in Syria built 3300 years ago is still being used. The Romans built dams throughout their empire to control the water supply.

After the fall of the Roman Empire, dam-building ceased until it was reborn as a science during the 19th century. Modern dams are designed to be multi-purpose. The five major purposes of dams are water supply, irrigation, flood control, electric power production, and recreation.

In a fifty-year period of time,159 dams 200 feet high or higher were built in the United States. Some of the most famous dams in the U.S. are: Hoover Dam in Arizona-Nevada, Grand Coulee Dam in Washington, Shasta in California,
Bonneville in Oregon, Flaming Gorge Dam in Wyoming-Utah, Kentucky Dam in Kentucky, Norris Dam in Tennessee, and Wheeler in Alabama.

Modern dams are built to provide water supplies, protection from floods, and hydroelectric power, as well as for other purposes.

STUDENT SHEET

Name _____
Date _____

WILL IT HOLD?

I. Predictions

A. Which type of dam will be less likely to leak?

B. Which type of dam will last the longest?

II. Building Plan (Record here.)

III. Testing (Record Observations)

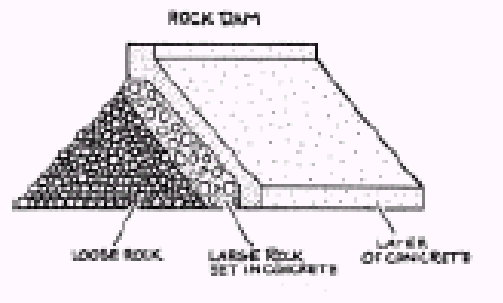
Time	Amount of Water
15 seconds	
30 seconds	
45 seconds	
60 seconds	
75 seconds	
90 seconds	
105 seconds	
2 minutes	
4 minutes	
6 minutes	
8 minutes	
10 minutes	

STUDENT INFORMATION SHEET

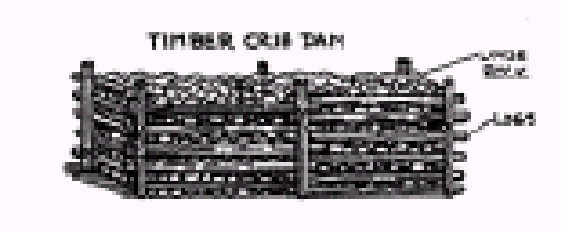
TYPES OF DAMS

The earliest dams were made of earth and are called earthen dams. Earthen dams are sometimes the most practical even today. Some other kinds of dams are rock dams, timber dams, embankment dams, masonry dams, and concrete dams.

Rock dams are used in rocky area. Often a concrete facing is added to a rock dam. Rock dams are used in rocky areas. Often a concrete facing is added to a rock dam.

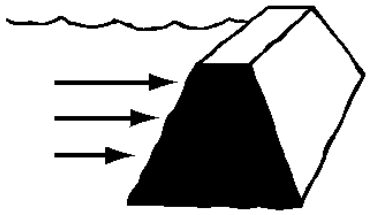


Timber dams are made of tightly fitting planks of wood supported and held together by rocks.

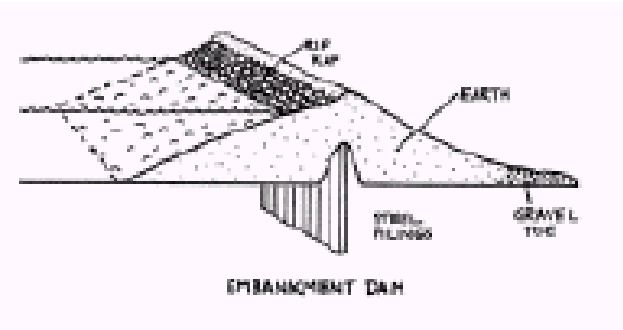


With a gravity dam, the weight caused by the rocks and concrete of the dam pushes down into the ground as the water pushes against it. This prevents the dam from falling over.

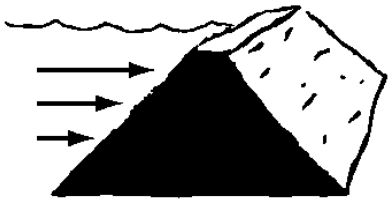
Gravity Dam Forces



Embankment dams are good for damming broad streams. Heaping up earth, clay, and gravel and then pressing it down until it is packed and watertight make them. The top layer is close-fitting stone called riprap.

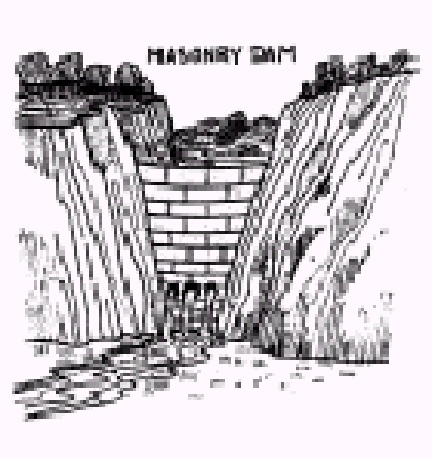


The Forces on an Embankment Dam

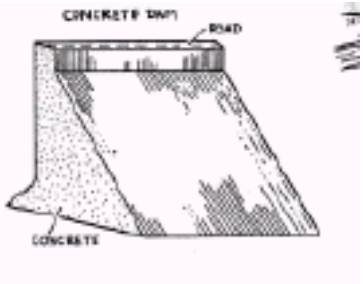


Like a gravity dam, the weight of the embankment dam pushes down into the ground as the water pushes against it. This prevents the dam from falling over.

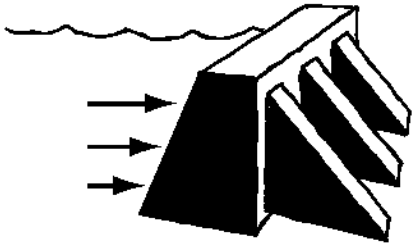
Masonry dams were used to dam narrow streams running through mountain gorges. They are made with blocks of stone or concrete. Masonry dams are not good for broad streams but may be built extremely high.



Concrete dams can be built in many different shapes such as a gravity dam, buttress dam, or multi-arch dam.

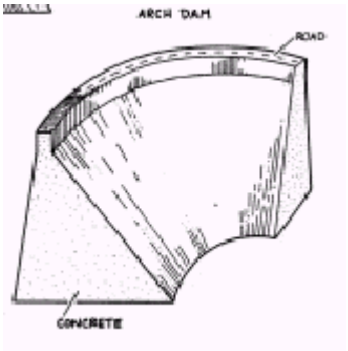


Buttress Dam Forces



Water pushes against this dam but the dam pushes back against the water. This prevents the dam from falling over. The weight of the dam also pushes downward as well.

Arch dams are built thicker at the bottom than the top so that they can stand up to the high pressure exerted by the water.



Arc Dam Forces

The arch is a very strong architecture structure. The arch pushes together as the water pushes against it. The weight of the dam also pushes it into the ground.