DragonflyTV: GPS Activity 10
H-2-Oh!

Montshire Museum
Norwich, VT
www.montshire.org

Gravity Fountain

We're Jesse and Chloe, and we play in the water every chance we get. When we go to our favorite water park, we have a blast playing with the fountains. That got us thinking: what does it take to make a high-spraying fountain? We went to the Montshire Museum in Norwich, Vermont, to do some hands-on experimenting with water. Our question: how can we make a gravity-fed water fountain that shoots 20 feet into the air?

While playing around at Montshire, we discovered that the higher the water level above a fountain, the greater the water pressure of the fountain. We decided to try some backyard science to test this idea. Our gear was simple: plastic tubing, a plastic soda bottle (to use as a reservoir), and different sized nozzles. We set up a little experiment to figure out how the height of the soda bottle affected the height of the spray coming out of the nozzle.

Montshire
Museum of Science

Icebreaker

Try this simple activity to wet your appetite for experimenting with water!

60 minutes

DragonflyTV Skill: Predicting

Guide your kids as they

1) Place a piece of masking tape along the length of a cup.
2) Make a hole near the bottom of the cup with a 6-penny nail. Place the hole about 1/4 the way around the cup from where the masking tape is.
3) While plugging the hole with a finger, fill the cup with water.
4) Hold the cup above a sink or bin (a cake pan would work well) and move their fingers to let the water flow out freely. Answer the question: How does the stream of water change as the water level gets lower?
5) While plugging the hole again with a finger, refill the cup with water.
6) Add some dark food coloring to the water so that it is easier to see through the paper cup. Place the cup on the edge of a sink, or on an upside down mug in the sink or basin.
7) On the masking tape, use a permanent marker to mark the level of water in the filled cup.
8) Let the water flow out of the hole by releasing their fingers.
9) Every 10 seconds, mark the water level on the tape. (This is tricky—they might want a friend to help!) Continue this until the cup is empty.
10) Notice the pattern of how the water level changed every 10 seconds. When were the marks closest together? When were they farthest apart?

You'll need:

- several tall paper cups
- a 6-penny nail
- masking tape
- a sink or bin to work in
- water
- a permanent marker
- string
- scissors
- a watch with a second hand

DFTV Science Helper

Parts of this activity are "four hands" in nature, meaning two kids will have to coordinate to collect accurate data. While this activity can be simply some splashy fun, emphasize the importance of collecting reliable data.

For more simple activities like this one, surf to pbskidsgo.org/dragonflytv/superdoit/index.html

Investigation
Gravity Fountains

1-2 hours

You'll need:

- a small collection of 1 and 2 liter empty soda bottles with caps
- a 4-penny or 6-penny nail
- a bucket with plenty of water
- rulers or tape measures/meters ticks
- markers that can write on plastic soda bottles
- an empty bucket

Phase 1 experiments/Guide your kids as they

1) Use the nail to make a small hole near the bottom of a soda bottle by twisting the nail back and forth. It is easiest to have the cap of the bottle screwed on tightly while doing this.
2) Use a centimeter ruler to make markings up the side of the bottle, one mark for every centimeter, starting at the hole. Number the marks with the lowest number near the hole.
3) Fill the bottle with water.
4) Answer the question: What happens when the bottle is filled and the cap is screwed on? Also, notice what happens when the cap is loosened.
5) Set the bottle on top of an empty inverted bucket, over a level surface (such as a sidewalk or stretch of pavement). Lay a meterstick or tape measure on the sidewalk. The bottle should be placed on the bucket so that the nail hole is directly above the beginning of the meter stick or tape measure.
6) Work together and prepare to take data. Take the cap off and allow the water to flow out the hole. As the water level in the bottle drops past each labeled mark, one partner calls out "now." The other partner observes where the stream is landing on the sidewalk, as indicated by the meterstick, and records the distance. This may take practice, and it is permissible, even recommended, to refill the bottle and collect the data several times.

Phase 2 experiments/Guide your kids as they

7) Create a second hole in the bottle a couple of centimeters above the first.
8) Again, fill the bottle with water, and notice what happens when the cap is screwed on and then taken off. Make a drawing in their notebooks that represents what the two streams of water look like.
9) Work out a plan to collect data, as in Phase 1, for each stream of water. It is permissible to collect data for one stream only, refill the bottle, then collect the data for the other stream.

DFTV Science Helper

It is common for kids to explain the observations in Phase 1 of this activity by saying, "Suction keeps the water in the bottle, until you loosen the cap." Help them work through the less-intuitive reasoning that air pressure holds the water in the bottle, and loosening the cap allows air pressure above the water to force it out the hole.

DFTV Kids Synthesize
Data and Analysis

Record the water stream data in a table similar to this one, and make a graph accordingly.

Phase 1 Experiment

Bottle mark number	Meterstick reading
20	24 cm
18	22 cm
16	14 cm
12	10 cm
9	6 cm
7	4 cm
4	3 cm
2	3 cm

DFTV Adult Tip

Kids may demonstrate a tendency to make their graph come out as a straight line. Assure them that the graph in all likelihood is NOT a straight line. The graph above may not represent your kids' results.

Keep Exploring!

Devise a way to connect a 1 meter length of flexible tubing to a hole in the cap of the bottle. Fill the bottle with water and screw on the cap. Turn the bottle upside down, hold it up in the air. (Hint: you'll need that nail hole won't you!) Experiment with how high a stream you can get by holding the bottle at different heights.