USING RAIN GAUGES FOR DATA COLLECTION ACTIVITIES

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Description:
Make your own simple rain gauge from a recycled plastic bottle, and learn to use it for data collection. As the wet season approaches, here is an opportunity to get students involved in real data collection and display, as well as understanding micro-climates.

Activities:
Cloud in a Bottle (Fog Chamber)
Build a Rain Gauge
Graphing Rain Data
Finding the Volume of Water in a Single Rain Event

I. Cloud in a Bottle (*Fog Chamber)*

Make a portable cloud in a bottle.

Materials:
• plastic bottle and cap
• small amount of water
• match
• dark background

To Do and Notice:
Place a small amount of water in the bottle. Place the cap back on tightly. Squeeze the bottle and release it rapidly. This causes a sudden change in air pressure. What do you notice?
Probably not much. It takes more than the presence of water vapor and a drop in pressure to form clouds.
Try this again, but add a smoking match to the bottle before you replace the cap.
Place the cap back on tightly. Squeeze the bottle and release it rapidly. This causes a sudden change in air pressure. What do you notice?

Water molecules are present in the air inside the bottle, but they are in the form of an invisible gas, or *vapor*, flying around individually and not sticking to one another. When you squeeze and then release the bottle, you allow the to expand. In expanding, the air must do work, which means that it loses some of its thermal energy, which in

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turn means that its molecules (including those of the water vapor), slow down slightly. This is a roundabout way of saying that the air becomes cooler!

When the water molecules slow down, they can stick to each other more easily, so they begin to bunch up in tiny droplets. The particles of smoke from the match help this process along: The water molecules bunch together more easily when there is a solid particle to act as a nucleus. When you squeeze the bottle, you warm the air slightly, which causes the tiny droplets to evaporate and again become invisible.

In the atmosphere, air expands as it rises to regions of lower pressure and cools off, forming clouds. This is why clouds often obscure mountain tops. Dust, smoke, and salt particles in the air all provide nuclei that help the droplets condense. Clouds form when invisible water vapor in the air is cooled enough to form tiny droplets of liquid water. In the atmosphere, this usually happens when moist air cools as it rises to higher altitudes. At higher altitudes the pressure is lower, so that the gas expands, loses internal energy, and cools. You can accomplish the same cooling effect by rapidly expanding the air in a plastic bottle.

II. Build a Rain Gauge

Materials:
- plastic soda or water bottle
- scissors
- 3 paper clips
- ruler
- permanent marker
- small pebbles
- water

Assembly:
1. Cut around the plastic bottle at the point where the diameter of the bottle starts to decrease near the top, creating a funnel shaped top, and a base.
2. Use the permanent pen to make your “zero” mark about 5 cm up from the bottom of the base.
3. Now mark every cm along the length of the base.
4. Put a handful of pebbles into the bottom of the bottle. This is to keep the rain gauge from blowing away in the wind.
5. Turn the funnel shaped top of the bottle upside down and place inside the opening of the base.
6. Use paper clips to keep the top funnel part firmly attached to the base.
7. Add water to the bottle up to the “zero” mark on the scale.

To Do and Notice;

1. Add water (rain) to the gauge and notice that the water level rises.
2. Practice reading the amount of "rainfall".
3. To "zero" the gauge again, remove the paper clips, pour out the water. Re-fill to the zero mark. Then replace the paper clips.

Using the Gauge:
Place the rain gauge at least 5 m from buildings or trees. Check it and re-''zero" it every day. Record the rainfall data each day.

III. Graphing Rain Data

Materials:
• graph paper
• rainfall data
To Do and Notice:
Collect rainfall data. Graph the data. Look for patterns. Compare your data to your friend's data.

Compare it to other rain data (in newspapers, on the internet). Compare this year's data to that from previous years.

Here are two web sites with rainfall data for Costa Rica.

Costa Rica Weather Data:
http://www.imn.ac.cr/prono/EstacionIDX.htm

Estacíon meteorológica Puntarenas data
http://www.tutiempo.net/clima/datos.php?stn=787600

IV. Finding the Volume of Water in a Single Rain Event

Last year, the first recorded rainfall in Puntarenas was 1.27 mm on March 4. We assume that the rainfall was uniform, so if the rain didn't run off into the sea, the land would have one layer of water, 1.27 mm deep, over every surface of the province. The province of Puntarenas is 11, 276 square km.

How much water is that?
We need to change the rainfall depth to a volume collected for the area of the rain gauge.

1. Find the area of the funnel of the rain gauge in cm^2. (Use pi x r^2.)
2. Convert 1.27 mm into cm.

3. Calculate the following:

.127 cm x Area = Volume of water in cm^3 or ml

4. $\frac{\text{ml rainfall}}{\text{Area of gauge } (cm^2)} \times \frac{10{,}000\ cm^2}{1\ m^2} \times \frac{1{,}000{,}000\ m^2}{1\ km^2} = \frac{\text{ml}}{km^2}$

$\frac{ml}{km^2} \times \frac{1\ l}{1000\ ml} = \frac{l}{km^2}$

$\frac{l}{km^2} \times 11{,}276\ km^2 =$ _____ liters water

For more information about rain in Costa Rica *en español,* go to:

http://www.cientec.or.cr/exploraciones/index.html

Then click on:
2. Carlos Valerio Gutiérrez, Instituto Nacional de Biodiversidad, INBio. Efecto del clima sobre la biodiversidad.