MONDAY MORNING SCIENCE BLAST
Raindrops, They Add Up - Earth Science - Weather

Rain is liquid precipitation, as opposed to other types of precipitation such as snow, hail and sleet. On Earth, it is the condensation of atmospheric water vapor into drops heavy enough to fall, often making it to the surface. Rain is the primary source of fresh water for most areas of the world, providing suitable conditions for diverse ecosystems, as well as water for hydroelectric power plants and crop irrigation. However, not all rain reaches the surface; some evaporates while falling through dry air. This is called virga, a phenomenon often seen in hot, dry desert regions.

Rain is also known or suspected on other worlds. On Titan, Saturn's largest moon, infrequent methane rain is thought to carve that moon's numerous surface channels. On Venus, sulfuric acid virga evaporates 25 km from the surface. There is likely to be rain of various compositions in the upper atmospheres of the gas giants, as well as precipitation of liquid neon and helium in the deep atmospheres.

Falling raindrops are often depicted in popular culture as "teardrop" shaped - round at the bottom and narrowing towards the top - but this is incorrect. Only drops of water dripping from some sources are tear-shaped at the moment of formation. Small raindrops are nearly spherical. Larger ones become increasingly flattened on the bottom, like hamburger buns; very large ones are shaped like parachutes.

The shape of raindrops was studied by Philipp Lenard in 1898. He found that small raindrops (less than about 2 mm diameter) are approximately spherical. As they get larger (to about 5 mm diameter) they become more doughnut shaped. Beyond about 5 mm they become unstable and fragment. On average, raindrops are 1 to 2 mm in diameter. The biggest raindrops on Earth were recorded over Brazil and the Marshall Islands in 2004 - some as large as 10 mm!

In this lab, students use science processes and math skills together as they investigate the question, “How many raindrops does it take to fill a baking pan?” To begin, instruct your students to place their pans in an area where they can collect rain over a period of several hours (less if the rainstorm is heavy). After the rain has been collected, they are to measure the depth of the water in the pan to the nearest 0.1 centimeter (cm) and record this depth in the Data Section. Have your students determine the inside length and width of their baking pan to the nearest 0.1 centimeter (cm), then record the dimensions of their baking pan in the Data Section. Now they are to calculate the surface area of the bottom of their pan by multiplying the length by the width, then record the area in the Data Section.

Next instruct your students to calculate the volume of rain water collected by multiplying the depth of the water in the pan by the surface area of the base of the pan (length x width) and record the volume (cm^3) of the rain water in the pan in the Data Section. Finally, your students are to calculate how many drops it took to fill the pan, following the steps listed, then record the number of raindrops in the Data Section.

Raindrops, They Add Up

QUESTION: How many raindrops are needed to fill a baking pan?

MATERIALS:

aluminum baking pan (9"x13")* metric ruler
calculator

***other sizes will work as well, just adjust the math**

PROCEDURE:

1. Place the pan in an area where it can collect rain over a period of several hours (less if the rainstorm is heavy).
2. After the rain has collected, measure the depth of the water in the pan to the nearest 0.1 centimeter (cm). Record this depth in the Data Section.
3. Determine the inside length and width of the baking pan to the nearest 0.1 centimeter (cm). Record the dimensions of the baking pan in the Data Section.
4. Calculate the surface area of the bottom of the pan by multiplying the length by the width. Record the area in the Data Section.

A = length x width

5. Calculate the volume of rain water collected by multiplying the depth of the water in the pan by the surface area of the base of the pan (length x width). Record the volume (cm^3) of the rain water in the pan in the Data Section.

V = depth x area

6. To calculate how many drops it took to fill the pan, follow these steps:

   - **Assume the volume of a raindrop is 0.00027 in^3 or 0.0044 cm^3**
   - **Divide the volume of the rain water calculated in Step 6 by the volume of the raindrop (0.0044 cm^3)**

$$\frac{\textbf{Volume of pan}}{\textbf{Volume of a raindrop}} = \textbf{raindrops it took to fill the pan}$$

7. Record the number of raindrops in the Data Section.

DATA:

	MEASUREMENT
Depth of Rain Water (0.1 cm	
Length of Pan (0.1 cm)	
Width of Pan (0.1 cm)	
Area of Pan (0.1 cm^2)	
Volume of Rain Water (0.1 cm^3)	
Number of Rain Drops in Pan	

QUESTIONS:

1. Why is it important to place the pan in an open area?

2. How could you calculate the number of drops that fell in the pan in one hour?

3. When it is drizzling outside, the volume of a raindrop decreases to about 0.00006 in^3. Are more or less raindrops needed to fill that container?

4. Suppose you collected 5 cm of rain in a rain gauge (a cylinder with a diameter of 2.5 cm). How many drops had to land in the rain gauge?

5. If drizzle is in the forecast (as opposed to rain), is the threat of flood altered?

EXTENSION:

- Find out the area of your town and determine how many raindrops fell if this area received 2 inches of rain.

- Determine how many raindrops fell in your town per person in a year.

- If you live where it snows, calculate how many snow flakes (rain drops) it takes to fill a baking pan with 10 cm of snow (remember, you will need to let the snow melt to find the depth of the water).