Magical Rain

Explore what happens when you make rain with holes in the bottom of a paper cup. Prepare to be surprised! Why does the water behave that way?

Strands:

Number & Quantity	
Algebra	
Functions	X
Geometry	X
Statistics & Probability	

Materials Needed:

- Four 5 oz paper cups, per learner
- Needle, pin, or safety pin, 1 per learner
- 1 cup capacity measuring cup with ml, teaspoon, tablespoon, or quarter oz markings
- Pencil
- Large cup
- Timer/stopwatch (on smartphone)
- Paper towels, or a cloth towel
- Waterproof surface on which to pour water
- *Magical Rain* worksheet, 1 per learner

Where:

Outside	
Inside	X
On-line	
On-site	

Set-Up:

1. Using a pin or other sharp object with a similar diameter, poke holes in the bottom of three 5 oz paper cups as follows: poke 5 holes in Cup 1, 10 holes in Cup 2 and 15 holes in Cup 3. To get better data, make sure the holes are all the same size.
2. Use a pencil to punch 1 pencil-sized-diameter hole in the bottom of Cup 4.
3. Place a large storage container or cookie sheet with tall sides on a table to catch any spills and magical rain.

To Experiment:

1. Carefully measure 4 oz of water ($\frac{1}{2}$ cup) with the measuring cup. Record this on the worksheet.
2. Start with Cup 2, the paper cup with 10 holes in it. In the directions below, 'paper cup' refers to a 5 oz paper cup.
3. Hold the paper cup over the large cup. Get a timer ready.
4. Predict what will happen when you pour the water into the paper cup. Will all of the water drain out? How long do you think it will take? Record your predictions on the *Magical Rain* worksheet.
5. Start the timer as you start to pour the water into the paper cup. The water draining out of the bottom of the cup should look like rain.
6. Press stop on the timer when the water stops draining. Recorded this time on the *Magical Rain* worksheet.
7. Pour the water remaining in the paper cup into the measuring cup. On the worksheet, record how much water stayed in the paper cup.
8. How much water drained from the cup? Record your answer on the worksheet.
9. Predict what will happen when you repeat Steps 3 through 8 with the 5-hole cup and then with the 15-hole cup. Will there be water remaining in the cup? Will the number of holes change how long it takes for the water to drain? Record your answers on the worksheet under your predictions.
10. Repeat Steps 3 through 8 using the 5-hole paper cup and then the 15-hole paper cup. Record all of your results on the worksheet.
11. What will happen if you use a larger hole instead of the pin holes you used earlier? Will a larger hole allow all the water to drain out? How quickly do you think it will take for the water to drain? Record your predictions on the worksheet.
12. Repeat Steps 3 through 8 using Cup 4 with the pencil hole in it. Record your findings on the worksheet.

Think About It:

- What did you find out?
- When you changed the number of holes, what effect did this have on the amount of water that drained from the cup?
- How about the amount of time it took to drain the water from the cup?
- How close were your predictions to the data you obtained from the experiment?
- What do you know now that you did not know when you started the experiment?
- What surprised you?

Variations:

For Fourth Grade Learners:

To get a feel for the different units shown on a measuring cup, repeat the experiment, each time using a different set of units: cups, ounces, and mL.

- For each experiment, record your data in the measurement system you are using.
- Compare the data. Which units are easier to use? Which are more familiar?

Graph your results to see patterns.

- Find graphs on the back of the *Magical Rain* worksheet. One graph is for plotting the number of holes versus the amount of time it takes for the water to drain. The other graph is for plotting the number of holes against the amount of water remaining in the cup.
- To get better data, include more data points by repeating the experiment with different amounts of holes in the bottom of the cup. Make sure the holes are the same size in each case!

For Fifth Grade:

There are three scales used on most measuring cups: ounces, cups, and millimeters. Measure the water amounts in one unit of measure. Convert the data to change to another unit of measure. Check your calculations by looking at the water level in the measuring cup for each of the different units of measure.

Magical Rain Worksheet

Directions: Record predictions and data in the table for each experiment.

Table 1: Measure water using ounces.

	Cup 1	Cup 2	Cup 3	Cup 4
Object used to poke holes	Pin	Pin	Pin	Pencil
Number of holes in cup bottom	5	10	15	1
Amount of water poured into cup				
Prediction: How much water remains in cup?				
Prediction: How long will it take the water to drain out of cup?				
Actual amount of water remaining in cup				
Actual amount of water that drained from cup				
Time it took for water to drain from cup				

Table 2: Measure water using cups.

	Cup 1	Cup 2	Cup 3	Cup 4
Object used to poke holes	Pin	Pin	Pin	Pencil
Number of holes in cup bottom	5	10	15	1
Amount of water poured into cup				
Prediction: How much water remains in cup?				
Prediction: How long will it take the water to drain out of cup?				
Actual amount of water remaining in cup				
Actual amount of water that drained from cup				
Time it took for water to drain from cup				

Table 3: Measure water using milliliters (mL).

	Cup 1	Cup 2	Cup 3	Cup 4
Object used to poke holes	Pin	Pin	Pin	Pencil
Number of holes in cup bottom	5	10	15	1
Amount of water poured into cup				
Prediction: How much water remains in cup?				
Prediction: How long will it take the water to drain out of cup?				
Actual amount of water remaining in cup				
Actual amount of water that drained from cup				
Time it took for water to drain from cup				

Directions: Graph the data from Table 1 or Table 2 on these graphs.