2A Observation, Question, and Hypothesis

Is the flow rate constant no matter how much water is in the bucket?

When scientists study the world around them they make observations, think about what they observed, then pose a question based on what they observed and what they think will or will not happen. Once they come up with a question based on what they want to know about the world, the question is rephrased in the form of a statement called a hypothesis. Then, they perform an experiment to prove or disprove their *hypothesis* by examining and analyzing the data collected during the experiment.

In this investigation, you will answer the key question after you state a hypothesis. You will collect new data and learn how to organize this data in the form of a graph.

Materials

- Stream table stage
- Bucket with spigot
- Bucket without spigot
- Displacement tank
- Data Collector
- Water
- Graph paper

1 Getting started

In this investigation you will begin by making some observations about a system. The system you will use is a bucket filled with water, and another bucket used to catch the water as it is allowed to flow out of the first bucket through an open spigot. To get started, you will need to set up all the parts of your system.

2 Setting up

1. Turn the spigot on the bucket to the closed position. Then, fill the bucket halfway with water.
2. Put the bucket on the stream table stage. Place the second bucket under the spigot of the water-filled bucket on the stage.

Safety note: Do not stand on the stage! This piece of equipment can only support up to a mass of 10 kilograms.

3 Making observations

In this part of the investigation, you will observe the flow of the water as it empties out of the bucket. You won't measure the flow, but you and the other members of your team will watch the flow of the water. Try and be specific with your observations. Use these questions to guide your observations.

1. Is the flow rate getting faster as the bucket empties?
2. Is the flow rate getting slower as the bucket empties?
3. In this part of the investigation, you are collecting *qualitative* data. What would you need to do to collect *quantitative* data?

4 Thinking about what you observed

Now that you have observed the water emptying out of the bucket, it is time to form a hypothesis based on the key question.

a. Make a prediction based on the key question: ***Is the flow rate constant no matter how much water is in the bucket?***

_____

_____

b. How do you think the flow rate will change?

- Will the flow rate increase and let more water out for each 20-second interval as the bucket empties?
- Will the flow rate decrease and let less water out for each 20-second interval as the bucket empties?
- Will the flow rate remain constant for each 20-second interval as the bucket empties?
- Will the flow rate increase for some intervals and decrease with others as the bucket empties with no obvious pattern that we can see?

_____

_____

c. Combine your answers to questions a and b. This will be your hypothesis. State if you think the flow rate will change. If you think it will change, say how it will change.

_____

_____

_____

5 Testing your hypothesis by doing an experiment

To test your hypothesis, you will measure the volume of water that flows out of the bucket for each 20-second interval until the bucket is empty. You will then calculate the flow rate during each of the 20-second intervals. From this data, you will decide if your hypothesis was correct or not.

1. Turn the spigot on the bucket to the closed position. Then, fill the bucket up to the fill line with water.
2. Put the bucket on the stream table stage. Place the displacement tank under the spigot of the bucket.
3. One partner will use the stopwatch mode of the Data Collector to time 20 seconds. Another partner will open, and then close the spigot when 20 seconds have elapsed. (Always open the spigot to the mark for each trial during this investigation).
4. Measure and record the amount of water (in mL) collected by the displacement tank in the second column of Table 1. Make sure the displacement tank is flat on the table when you read and record the volume in the data table.
5. Remember, do not pour the collected water back into the bucket on the stage. Pour the water into the collection bucket provided by your teacher.
6. Repeat the 20-second intervals until the bucket is empty, or no more water flows out of the spigot.

Note: You may not need all 12 interval rows on the data table.

Table 1: Volume when spigot is turned to the notch

Interval	Volume of water (mL)	Time (s)
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		

6 Using your measurements

1. Once you have completed your measurements, use your data to calculate the flow rate for each interval.
2. Record the values in Table 2.

Table 2: Flow rate when spigot is turned to the notch

Interval	Flow rate (mL/s)
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	

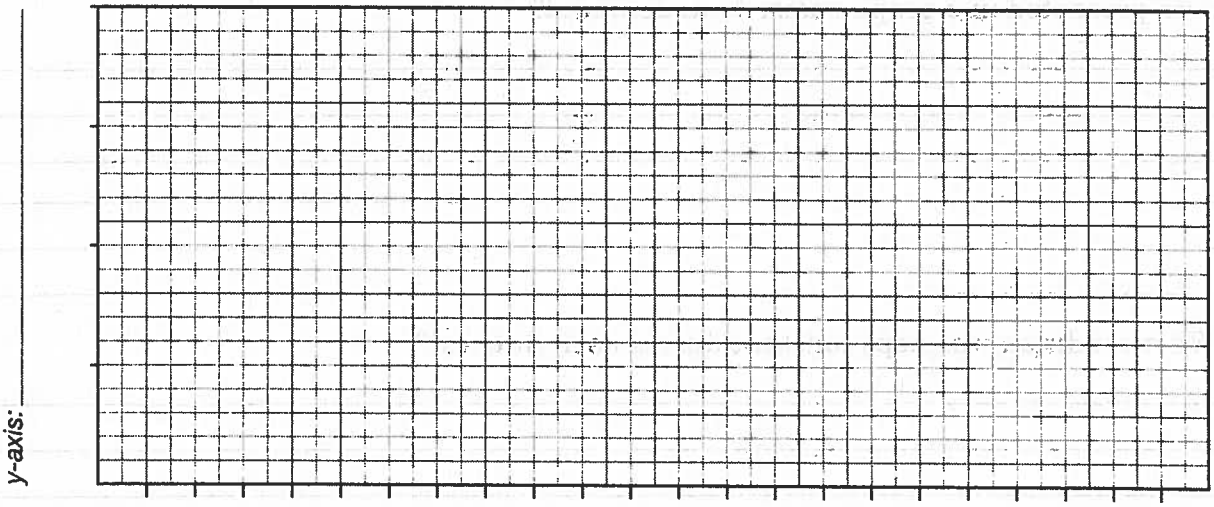
7 Making a graph

You have collected data. Now you need to interpret this data. One way to interpret data is to make a picture of it. A graph is a picture of data. It can help you identify patterns, trends, or

other important information that may help to verify a hypothesis or make a prediction. A graph compares two types of information.

1. The two types of data in this investigation are flow rate and the interval number. You are going to make a graph of flow rate versus interval number.
2. There are many kinds of graphs. Each is useful in certain situations. You are going to use a bar graph for this investigation. A bar graph is useful to indicate specific amounts of things, like flow rate at different time intervals.
3. On the graph below, plot your data. You will put the flow rate on the *y*-axis, and the interval number on the *x*-axis. Draw each bar so that it is two squares wide. The height of each bar equals the flow rate for one interval.
4. Color in all the bars the same color with a pencil, pen, or colored pencil.

Title: _____



x-axis: _____

8 Analyzing your data

a. Was your hypothesis correct? The answer to this question is known as your conclusion. Write a short paragraph to answer this question. Use your graph to help you answer this question.

b. Compare your data with the data collected by other lab groups. Did the data from the other lab groups support your hypothesis?

c. Did you find it easier to understand your data in number form on your data tables, or in picture form on your graph?

d. How can you make data presented in a table easier to understand? How can you make data presented in a graph easier to understand?

e. What condition was kept constant during each interval?

f. What condition changed and was not kept constant for each interval?