Investigating Siphons

Background Information

A siphon is a tube filled with liquid that connects two containers. Liquid can flow through the siphon from one container to the other. The direction of this flow depends on forces that act on the liquid. One of these forces is gravity. If one of the containers is higher than the other, the force of gravity will cause liquid to flow down through the siphon from the higher container into the lower one.

Fluid pressure due to fluid depth also affects the flow through a siphon. **Pressure** is the amount of force per unit area. All liquids exert pressure against their containers. The deeper a liquid is, the greater the pressure it can exert. The pressure exerted on the bottom of a beaker is due to the weight of the fluid above it. Therefore, fluid pressure due to fluid depth is also related to the force of gravity. If the two containers have different levels of liquid, the liquid will flow through the siphon from the container with greater fluid depth (and pressure) to the container with less fluid depth (and pressure).

In this investigation, you will predict how water will flow through a siphon. Then, you will perform an experiment to test your prediction.

Problem

How does water flow through a siphon?

Pre-Lab Discussion

Read the entire investigation. Then, work with a partner to answer the following questions.

1. **Formulating Hypotheses** State a hypothesis about how water flows through a siphon.

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2. **Predicting** Based on your hypothesis, predict how the water will flow through a siphon that connects each of the following pairs of identical beakers.

   a. Both beakers contain equal volumes of water, but one beaker is at a higher elevation than the other.

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b. Both beakers are at the same height, but one beaker contains more water than the other.

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c. Both beakers are at the same height and contain equal volumes of water.

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3. Controlling Variables Identify the manipulated, responding, and controlled variables in this investigation.

a. Manipulated variables

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_____

b. Responding variables

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_____

c. Controlled variables

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Materials *(per group)*

2 600-mL beakers
ring stand
iron ring
wire gauze
utility clamp
40 cm flexible tubing
clock or watch

Safety

Put on safety goggles and a lab apron. Be careful to avoid breakage when working with glassware. Wipe up any spilled water immediately to avoid slips and falls. Note all safety alert symbols next to the steps in the Procedure and review the meaning of each symbol by referring to the Safety Symbols on page xiii.

Procedure

1. Add approximately 275 mL of water to each beaker.

2. Position an iron ring and a wire gauze low on the ring stand, as shown in Figure 1. Use a utility clamp to secure one of the beakers on the wire gauze, as shown. Place the second beaker next to the ring stand.

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3. In the data table, record your prediction of what will happen to the water in the beakers when a siphon is used to connect the beakers. Predict whether you expect water to flow through the siphon. If you predict that water will flow through the siphon, which direction do you expect the water to flow?

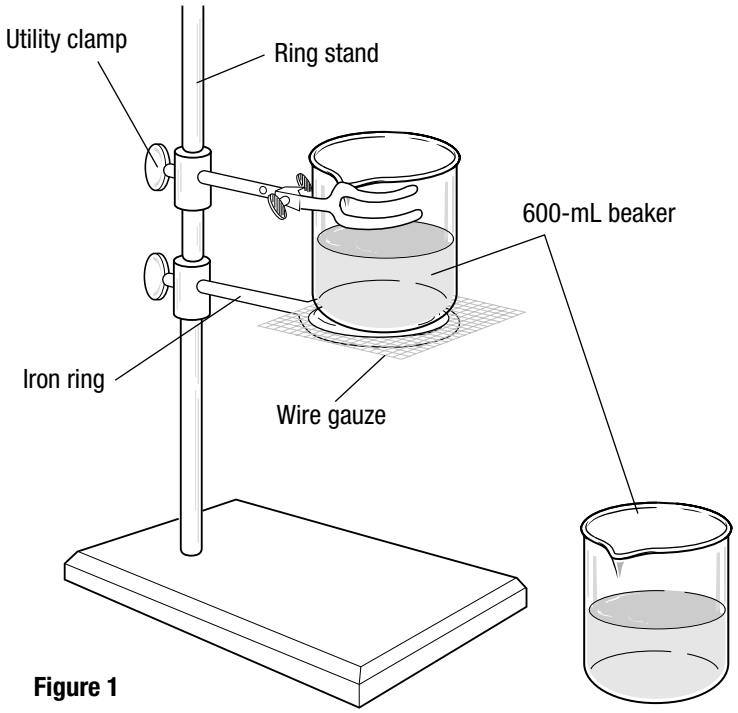

Figure 1

4. Place the flexible tubing in the sink. Hold one end of the tubing under the faucet and allow water to run through the tubing. When water begins to flow out the lower end of the tubing, use your finger to block the lower end. When the entire length of the tubing has filled with water, use another finger to cover the upper end. Be sure that no air remains in the tubing. Do not allow the water to flow out of the tubing.
5. Keeping the ends of the tubing covered, place one end of the tubing in the bottom of each beaker. Remove your finger from the ends of the tube only after both ends of the tube are submerged. Observe the beakers for 1 minute. Note any changes in the water level in the beakers. Record your observations in the data table.
6. Remove the elevated beaker from the ring stand. Add or remove water from each beaker so that one beaker contains 400 mL of water and the other contains 100 mL of water. Place both beakers on the tabletop. Repeat Steps 3 through 5.
7. Add or remove water from each beaker so that each beaker contains 300 mL of water. Place both beakers on the tabletop. Repeat Steps 3 through 5.

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Observations

DATA TABLE

Positions of Beakers	Volume of Water in Beakers (mL)	Predictions	Observations
One beaker at a higher elevation than the other	275 mL in each		
Both beakers on table	400 mL and 100 mL in the other		
Both beakers on table	300 mL in each		

Analysis and Conclusions

1. **Evaluating** Did your observations support your hypothesis?

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2. **Inferring** What force was responsible for the result you observed in Step 5?

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3. **Inferring** What was responsible for the result you observed in Step 6?

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4. **Predicting** Explain what you would have to do in order to move the water from the lower beaker to the upper beaker in the setup you used in Step 5.

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5. **Predicting** Suppose two beakers sitting side by side are filled to the same depth, but one beaker is wider than the other. What would you expect to observe when the beakers are connected by a siphon? Explain your answer.

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_____

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Go Further

How do you think the diameter of the tubing you used in this investigation affected the rate at which water flowed between the beakers? Design an experiment to answer this question. Write a detailed plan for your experiment. Your plan should state the hypothesis to be tested, identify the manipulated, responding, and controlled variables, and describe the procedures and safety precautions you will use. You will need to find a way to measure the rate at which water flows through a siphon. Show your plan to your teacher. When your teacher approves your plan, carry out your experiment, and report your results and conclusions.