Capillary Action Activity

Micropumps Learning Module

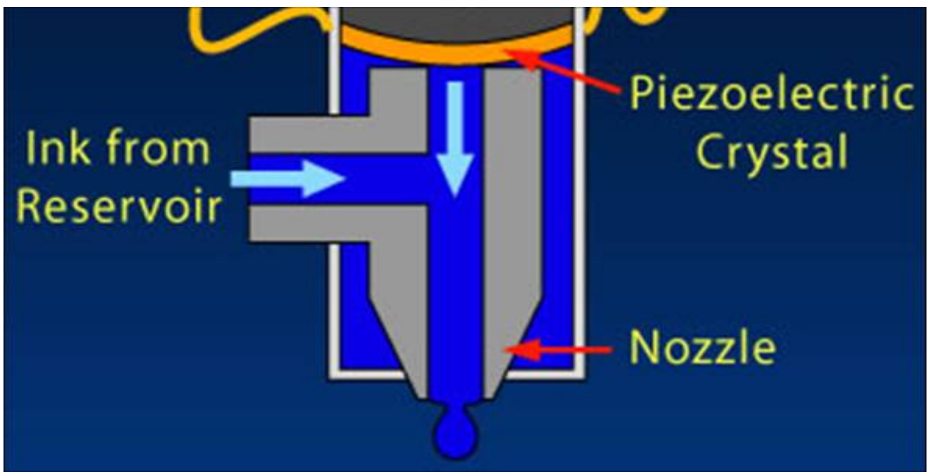
Participant Guide

Description and Estimated Time to Complete

This activity demonstrates the capillary effect, and how liquids can flow without external input energy. You explore the limits of capillary action and the scale at which this action occurs.

<u>Estimated Time to Complete</u>
Allow at least 30 minutes to complete this activity.

Introduction



Microchannel from a Piezoelectric Inkjet Printhead

A common application of micropumps is in inkjet printing. Inkjet printheads are actually an array of micropumps used to deliver small volumes of liquid (approximately a picoliter) onto paper creating images and text. Both mechanical and non-mechanical versions of inkjet micropumps are currently in production.

One scientific phenomenon used by inkjet technology is capillary action. Bubblejet and piezoelectric inkjet printers use microchannels filled with ink. Because the microchannels' dimensions are so small (approximately a micrometer in diameter) the liquid automatically fills the microchannel due to adhesive forces between the liquid and the surfaces of the channel, and the surface tension of the liquid.

Activity Objectives and Outcomes

<u>Activity Objectives</u>

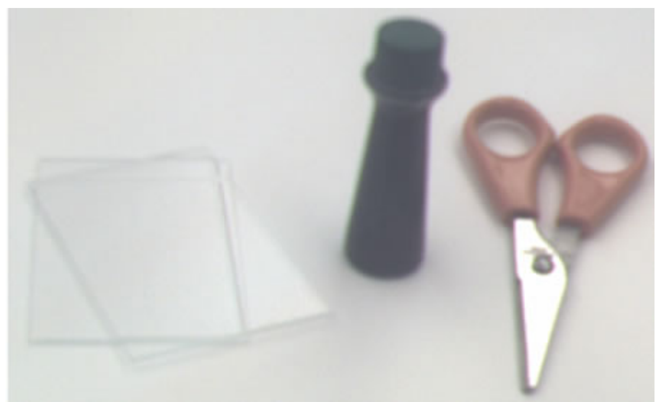
- Simulate the operation of an inkjet printhead by demonstrating capillary action between two narrow channels.
- Explain capillary action and how it is affected by the size of the microchannel.

<u>Activity Outcomes</u>

- After completing this experiment, you should have a better understanding of capillary action and how this phenomenon is used in inkjet printheads.

Supplies

- Four microscope slides
- Food color
- Sheet of paper
- Scissors
- Two Pennies



Activity: Capillary Action

Procedure:

1. From the sheet of paper, cut two ¼" x ¼" squares.

2. Place these squares of paper on two adjacent corners of a microscope slide.

3. Put the second microscope slide on top of the first, staggering it, leaving about ¼" of the bottom slide's glass exposed.

4. Put a few drops of food coloring on of the bottom slide's exposed glass. Observe how the food coloring moves up the slide. Let this sit while you prepare the second set of slides.

5. Using the other two microscope slides, make a similar setup using pennies instead of paper squares.

6. Put a few drops of food coloring on the bottom slide's exposed glass. Observe how the food coloring moves up the slide. Compare the motion of the food coloring in this configuration with the previous one.

7. If you have a camera, record the results for documentation and to illustrate your responses to the Post-Activity Questions. Compare your results with those shown in this video (https://youtu.be/vCVdSTUKwRQ).

8. Answer the Post-Activity Questions

Post-Activity Questions

1. In this activity, what is the purpose for using two different sized spacers?
2. How does the rate of flow compare between the two systems?
3. How does the flow distance compare between the two systems?
4. Write an explanation as to why the liquid behaves differently between the two systems.
5. What are three examples of capillary action (e.g., water wicking in a papertowel)

References

- SCME Micropumps Overview Primary Knowledge Unit
- Supporting video: Demonstration of Capillary Action https://youtu.be/vCVdSTUKwRQ

Support for this work was provided by the National Science Foundation's Advanced Technological Education (ATE) Program. For more MEMS learning modules from SCME, please check out our website (http://scme-nm.org).