Lab 5: Cellular Soap Opera

Background:
Every cell in your body needs to take in nutrients, oxygen, and raw materials and to export wastes and other substances. But it is not just a random traffic jam! The cell membrane regulates what comes in and goes out. Use a soap film to simulate a plasma membrane, and explore the ins and outs of cellular traffic.

Objective:
Explore the properties of soap films and relate them to the properties of plasma membranes and the mechanics of transport across membranes.

Concepts:
-Cells need to import some materials, such as oxygen and nutrients, and export others, such as wastes.
-At the boundary of every cell is a plasma membrane that regulates what is transported into and out of the cell.
-The plasma membrane is a mosaic of proteins inserted into a fluid bilayer of phospholipids. The proteins float laterally in the membrane.
-Substances most like the phospholipids in the membrane easily pass through it, as do very small molecules. Substances unlike the membrane, and very large molecules, can cross the plasma membrane only with assistance from the protein "channels".

Pre-Inquiry Questions:
-What types of substances do humans need to take in to their bodies and eliminate from their bodies? Do our individual cells need to do similar things?
-How does the oxygen collected by your lungs enter blood cells? Where do the blood cells take the oxygen, and what happens when they give up the oxygen?

Materials:
bubble solution
water
2 pieces of string, 1 long and 1 short
drinking straw
aluminum pie pan or similar container
2 film cans, with tops and bottoms removed
sheet of black construction paper
scissors

1. Using one straw and string, make a bubble frame.
2. Create a handle for the frame using the other piece of string. See Figure 1.
3. Fill the pie pan with soap solution, at least 2 cm deep.

*4. Immerse the bubble frame into the soap solution to get a soap film across the two straws. Continue to immerse until you see a soap film. Hold the soap film in front of a piece of black construction paper or other black material. Carefully observe the surface of the film. Blow gently on the film and watch what happens. What do you observe?

*5. Create a new soap film. Wet your finger in the bubble solution. Gently poke it through the soap film. What happens? Can you move your finger around in the film?

*6. Now wet your finger in plain water and poke it into the film. What happens?

*7. Try gently poking a dry finger through the soap film. What happens now?

*8. Make a new film on the frame. Roll a film can in the bubble solution to coat the surfaces of the can. Grasp the film can near one end and remove it from the solution. If films have formed across the openings of the can, pop them. Insert one end of the film can through the soap film on the frame. If the film pops, make another and try again. What happens?

*9. When you successfully insert a bubble-solution-coated film can through the soap film, leave the can in this position and have your partner or someone else pass an object (such as a pencil) through the openings in the can, from one side of the film to the other. Can you move the film can around in the soap film? What is this film can analogous to (the same as) in a cell?

*10. Try putting a dry film can through the soap film. What happens?

*11. Based on your observations, what conditions allow objects to pass through the soap film without popping it? What conditions cause the film to pop? Do you think the flexibility of the film influences its ability to resist popping? Why or why not?

*12. Describe at least two ways in which a soap film is like a plasma membrane.

*13. Describe at least two ways in which a soap film is not like a plasma membrane.