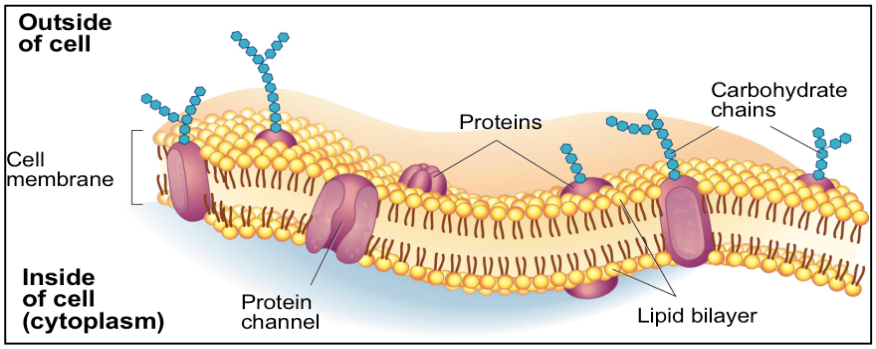
Name: _____ Date: _____ Block: _____

A Bubblicious Membrane Model

OBJECTIVES:

- To observe how a cell's plasma membrane behaves.
- To observe how objects are transported across a cell's plasma membrane.



BACKGROUND:

The cell's plasma membrane is a phospholipid bilayer with protein molecules imbedded in it as shown in the diagram above. The protein molecules transport other molecules through the membrane and into or out of the cell. All of the membranes in the cell (nuclear envelope, endoplasmic reticulum, membranes in the chloroplasts and mitochondria) are essentially the same as the plasma membrane.

The phospholipid bilayer is made of two layers of molecules. Each phospholipid molecule has a polar (hydrophilic) head and two non-polar (hydrophobic) tails. The hydrophobic tails of the two layers repel water and are attracted to each other. They form the inside of the membrane bilayer "sandwich" while the polar heads are on the outside closest to the water.

Soap bubbles are bilayers very similar to phospholipid membranes, so they can be used to investigate some of the properties of the cell membrane. The soap bubble bilayer is made of molecules with a hydrophilic head and a hydrophobic tail, except that the surrounding medium (air) is non-polar, so the tails of the bilayer face outward and the polar heads form the inside.

phospholipid molecule **soap molecule**

PRE-LAB QUESTIONS:

1. A cell membrane is composed of what three molecules (according to the diagram)?

2. Describe the structure of a phospholipid molecule.

3. How is a soap molecule similar to a phospholipid molecule?

4. Draw a soap bubble.

MATERIALS:

Flat pan
Straightened paper clip
Plastic knife
String
Thread circle
Drinking straw and string "membrane holder"
Soap mixture (900 mL water + 100 mL Joy liquid soap + 25 mL glycerin or corn syrup)

PROCEDURE:

1) Pour soap solution to about a 1 cm depth in your pan. Be careful not to make bubbles as you pour.

2) Holding the straws of the membrane holder, immerse it into the pan of soap solution.

3) Raise it out of the pan and allow the excess soap to drip off.

4) Hold up the soap film-filled membrane holder and demonstrate the following characteristics of a lipid bilayer:

A. Fluidity: ***The cell is very fluid – that means the molecules in the lipid bilayer move around a lot.***

- ❑ Hold your soap membrane up to the light.
- ✓ What do you see that suggests the membrane is fluid?

B. Flexibility: ***The parts of the lipid bilayer can move a lot. They can reorganize themselves into almost any shape.***

- ❑ Twist the two straw handles in opposite directions and bend the film into different configurations.
- ✓ What happens to the soap film when you bend it?

C. Self-Sealing: ***The lipid bilayer has two layers. The parts of the lipid bilayer can move and line up to repair small holes (punctures) in the cell.***

- ❑ Make another film in the membrane holder.
- ❑ Take the straightened paper clip and dip it in the soap solution.
- ❑ Stick the paperclip in the membrane and pass it through to the other side.
- ✓ What happens? Why?

- ❑ Make another film. Stick a ***dry*** paperclip through the membrane.
- ✓ What happens? Why?

- ❑ Make another film. Dip your finger into the soap solution, making sure that it is well covered, and stick it into the membrane.
- ❑ Remove your finger from the membrane.
- ✓ What happens to the membrane when you remove your finger?

- ✓ Can the membrane heal around small punctures? Why or why not?

D. Transport Proteins: ***In a cell membrane, small molecules such as water can sometimes move into the cell through small spaces in the lipid bilayer. Larger polar molecules cannot pass through the membrane because of the non-polar tails in the interior of the membrane. The only way these molecules can pass in and out of the cell is through channels created by protein molecules in the membrane. The proteins form a polar tunnel through which the molecules can pass.***

- ❑ Take a small piece of thread with a circle tied into it.
- ❑ Form another film in your membrane holder.
- ❑ Dip your thread circle in the soap solution and carefully stick it into the membrane.
- ❑ Pop the inside of the thread circle with a dry object. You now have a model of a transport protein in a cell membrane.
- ❑ To demonstrate the fluidity of the membrane, stick your finger in the pore created by the thread circle and gently move it around the membrane.

E. Cell Division: ***Cells divide when an organism is growing, when tissues need to be repaired, or when the surface area to volume ratio becomes too small (i.e. the cell grows too large).***

- ❑ Take a straw and dip the end in the soap solution.
- ❑ Hold it just above the surface of the soap solution and gently blow to create a bubble. Make a bubble about 8-10cm across.
- ❑ Take a knife, wet it with soap solution, and starting in the solution at one side of the bubble, cut the bubble in half. You have created a bilayer across the middle and made two bubbles. (Cell division is somewhat similar to this.)
- ❑ Cut the two new bubbles in half. Keep dividing the bubbles until you have 10-80. Notice how the bubbles fit together without any spaces between them. Your cells fit together in much the same manner.

F. Fusion: ***There are circumstances in a cell where two membranes fuse into a single larger structure. Researches even fuse two cells together in a laboratory to create a larger cell with properties of each. (e.g. They can fuse an antibody-making cell with a cancer cell to get cells that keep multiplying and making antibodies.)***

- ❑ Use a straw to create a few bubbles in your soap solution.
- ❑ Coax the bubbles toward each other and try to get them to fuse into a single big bubble.
- ✓ Is the resulting bubble smaller, larger, or the same size?

CLEAN UP:
Return all materials to the red trays as instructed. Take a sponge and wipe down your table to clean up any spills.

POST-LAB DISCUSSION QUESTION:
Using complete sentences, explain why the cell membrane is considered a "fluid mosaic." Use observations from this activity to back up your statements.