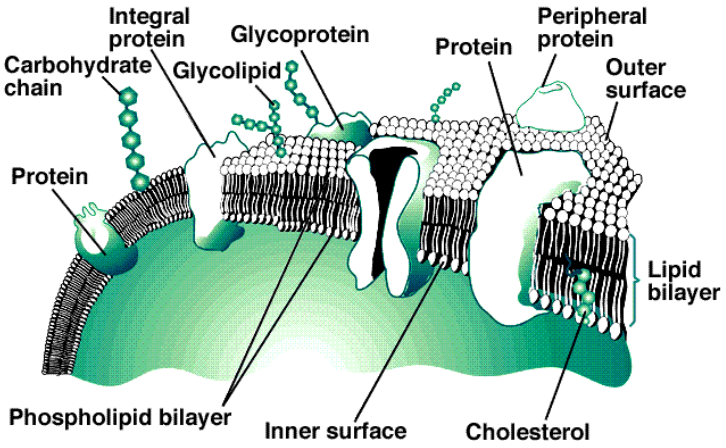
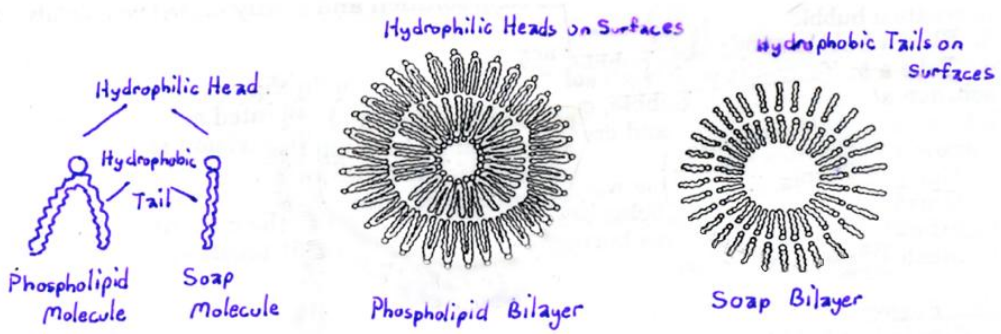
MEMBRANE MODEL: The Bubble Lab

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



Soap bubbles are bilayers very similar to phospholipids membranes, so they can be used to investigate some of the properties of the cell membrane.



Procedure:

1) Immerse the membrane holder into the pan of soap solution. Raise it out of the pan and allow the excess soap to drip off. Hold up the membrane holder and demonstrate the following characteristics of a lipid bilayer.

- ***Fluidity:*** *The cell membrane is called the* ***Fluid Mosaic Model****. This means that the membrane is made of a pattern of many small molecules that are moving around and shifting position.*

2) Observe the light shining of the surface of the soap film? Notice the movement in the light pattern, demonstrating that the molecules of the film are constantly in motion.

- ***Flexibility:*** *A lipid bilayer is a* <u>*fluid*</u> *arrangement in which the molecules move freely through the plane of the bilayer- reorganizing into almost any shape.*

3) Twist the two straw handles in opposite directions and bend the film into different configurations.

- *Note what happens to the soap film.*

The soap bilayer is actually less flexible than a cell membrane because a cell membrane is supported on both sides, one side by the cytoplasm and the other tissue fluids, or other cells. Whatever you are doing to the soap film, plus more, can be done to cell membranes without breaking them.

- ***Self-Sealing:*** *The membrane is not a solid- it is two layers of molecules attracted to each other.*

4) Make another film in the membrane holder. Stick a dry, straightened paperclip into the membrane and pass it through to the other side.

- *Did the membrane seal around the paperclip or did it pop?*

5) Repeat step 4 - This time, dip the paperclip in the soap solution before passing it through the membrane.

- *What happens? Why?*

6) Make a new film. Dip your finger into the soap solution, and stick it into the membrane. Move your finger around 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?*

Transport Proteins: In a cell membrane, small molecules can sometimes move through the lipid bilayer. *Larger molecules or polar molecules* ***cannot*** *pass through the membrane because of the non-polar tails in the interior of the membrane*. Proteins form a polar tunnel through which larger or polar molecules can pass.

7) Take the small circle of thread. Form another film in your membrane holder. Dip your thread circle in the soap solution and carefully stick it into the membrane. Next, pop the inside of the thread circle with a dry paperclip. You now have a model of a transport protein in a cell membrane.

8) To demonstrate the fluidity of the membrane, stick your finger in the pore created by the thread circle and gently move the circle around the membrane.

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).

9) Dip one end of a straw 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 8-10 cm across.

10) With your plastic 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.)

11) Cut the two new bubbles in half. Keep dividing the bubbles until you have at least 10. Notice how the bubbles fit together without any spaces between them. Your cells fit together in much the same manner.

Cell 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.)

12) 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.