The Plasma Membrane:

The plasma membrane (also known as the cell membrane) forms a barrier between the cytoplasm inside the cell and the environment outside the cell. It protects and supports the cell and also controls everything that enters and leaves the cell. It allows only certain substances to pass through, while keeping others in or out. The ability to allow only certain molecules in or out of the cell is referred to as selective permeability or semipermeability. To understand how the plasma membrane controls what crosses into or out of the cell, you need to know its composition.

A Phospholipid Bilayer: The plasma membrane is composed mainly of phospholipids, which consist of fatty acids and alcohol. The phospholipids in the plasma membrane are arranged in two layers, called a phospholipid bilayer. As shown in the image below, each phospholipid molecule has a head and two tails. The head “loves” water (hydrophilic) and the tails “hate” water (hydrophobic). The water-hating tails are on the interior of the membrane, whereas the water-loving heads point outwards, toward either the cytoplasm or the fluid that surrounds the cell.

Molecules that are hydrophobic can easily pass through the plasma membrane, if they are small enough, because they are water-hating like the interior of the membrane. Molecules that are hydrophilic, on the other hand, cannot pass through the plasma membrane—at least not without help—because they are water-loving like the exterior of the membrane, and are therefore excluded from the interior of the membrane.

Phospholipid Bilayer: The phospholipid bilayer consists of two layers of phospholipids, with a hydrophobic, or water-hating, interior and a hydrophilic, or water-loving, exterior. The hydrophilic (polar) head group and hydrophobic tails (fatty acid chains) are depicted in the single phospholipid molecule. The polar head group and fatty acid chains are attached by a 3-carbon glycerol unit.

Active and passive transport processes are two ways molecules and other materials move in and out of cells and across intracellular membranes. Active transport is the movement of materials against a concentration gradient (from an area of lower to higher concentration), which does not ordinarily occur, so energy is required for active transport to occur. Passive transport is the movement of molecules or ions from an area of higher to lower concentration. There are multiple forms of passive transport: simple diffusion, facilitated diffusion, filtration, and osmosis. Passive transport occurs naturally, so additional energy isn’t required for passive transport to occur.

Active Transport: Solutes move from a region of low concentration to high concentration. In a biological system, a membrane is crossed using enzymes and energy (ATP).

Passive Transport:
- **Simple Diffusion**: Solutes move from a region of higher concentration to lower concentration.
- **Facilitated Diffusion**: Solutes move across a membrane from higher to lower concentration with the aid of transmembrane proteins.
- **Osmosis**: Water molecules move from lower to higher solute concentration across a semipermeable membrane. Note this makes the solute molecules more dilute.
- **Note**: Simple diffusion and osmosis are similar, except osmosis is specific to the movement of water molecules.
**Task 1: Comprehension**

Use the text and images from the previous page to answer the following questions.

<table>
<thead>
<tr>
<th>Describe the function of the plasma membrane.</th>
<th>What is meant by the word semipermeability?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Describe the structure of the plasma membrane? What is it made of/What does it look like?</td>
<td>Explain why hydrophobic molecules can easily cross the plasma membrane, while hydrophilic molecules cannot.</td>
</tr>
</tbody>
</table>

Describe the difference between active and passive transport.
Task 2: Analyze Data
Check out the image below which shows the difference between isotonic, hypotonic and hypertonic solutions and the flow of water in and out of the cells (osmosis).

In an isotonic solution, water molecules move into and out of the cell at the same rate. This is shown in the model by arrows that are the same size and an equal number of water (shaded circles) and dissolved particles (open circles).

In hypotonic solution, water enters the cell by osmosis, causing the cell to fill with water and swell up.

In hypertonic solution, water leaves the cell by osmosis, causing the cell to shrink and shrivel up.

Students in a Biology class were interested in learning more about the movement of water molecules, or osmosis. They set up a U-tube experiment like the one shown here. At the bottom of the U-tube is a selectively permeable membrane, similar to the one found in cells. To begin with, the students set up a larger concentration of sugar molecules on the right side of the membrane than on the left. The students let the U-tube sit overnight and observed the results the next day. The results are shown in the image as well. Use this page to help answer the questions on the next page.
### Task 2 Continued: Analyze Data
Use the notes and the experiment setup from the previous page to help answer the questions below.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why did the number of water molecules on each side of the membrane change where as the number of sugar molecules stayed the same?</td>
<td>How does the plasma membrane of a cell compare with the membrane in the U-shaped tube?</td>
</tr>
<tr>
<td>Explain the behavior of water molecules in an isotonic solution.</td>
<td>Does osmosis occur if a cell is placed in an isotonic solution?</td>
</tr>
<tr>
<td>Why does water enter a cell that is placed in a hypotonic solution?</td>
<td>What happens to the pressure inside of a cell that is placed into a hypertonic solution?</td>
</tr>
<tr>
<td>Using this information, predict what could happen to animal cells when placed into a hypotonic solution.</td>
<td>Using this information, predict what causes plants to wilt.</td>
</tr>
</tbody>
</table>