# A CELL MEMBRANE MODEL

**Part I: Introduction to Diffusion**

**1. Diffusion** is the movement of a substance from where it is more concentrated to where it is less concentrated. *Concentrated* in this context means "gathered together." Think of *orange juice concentrate.*

2. Class example: If I open a bottle of perfume in a corner of the room, how will the smell spread?
**First**, _____ will smell it, because s/he is closest. **Then** _____, who's a bit further, will smell it. **Finally**, the last person to smell it is _____, because they're _____ away.

3. How does the smell change as it moves across the room?

4. *Why do things diffuse?* Diffusion happens because molecules and atoms are in random motion, and will consequently tend to spontaneously spread themselves out.

5. Visualizing ideas: Imagine that you dropped a sugar cube into a beaker of water. Draw a series of diagrams showing what will happen. Label one diagram "concentrated," and another "diffuse"

| At the start | In the middle | At the end |
|---|---|---|
| | | |

Now, explain this in words. Use sequencing language like "first," "next," "finally"

Grammar and vocabulary notes:
a. *Diffusion* is a noun. Example: *Diffusion caused the ink drop to spread out.*
b. The verb is *to diffuse*. Example. *The smell diffused across the room.*

6. Write down your own example of diffusion. This can be from experience, or you can make one up.

**7. Diffusion and membranes**

A **membrane** is any thin, sheet-like structure that acts as a boundary. Diffusion can also occur across membranes. In order for this to happen, the membrane has to be permeable to the substance we're talking about. Some membranes are permeable to almost anything. Others are permeable to only some substances, making them ***selectively permeable.***

**Concept Check**

1. Movement of a substance from more concentrated to less concentrated is called _____.
2. A thin structure that acts as a barrier or boundary is a _____
3. Membranes that let some things diffuse through, but not others are called _____ permeable.
4. How would you change the word *permeable* to describe something like a rubber raincoat, which won't let anything diffuse or soak through? _____.

## PART II. Understanding the Cell Membrane Model Lab

| **Table 1: Observations**<br>Color of pure starch solution: _____<br>Color of pure iodine solution: _____<br>Color of iodine mixed with starch: _____ | "Before" diagram | "After" diagram |
|---|---|---|

| | **Color at start of experiment** | **Color after 24 hours** |
|---|---|---|
| **Solution in Bag** | | |
| **Solution in beaker** | | |
| **Solution in test tube** | | |

**Table 2: Initial Analysis: In terms of the beaker and the bag, where were the starch and iodine molecules at the start and end of the experiment.**

| | Location at start of experiment | Location at end of experiment |
|---|---|---|
| IODINE | | |
| STARCH | | |

**More Analysis. Talk this through with your partner before writing down your answers.**

1. At the start of the experiment, where was the starch more concentrated?

2. Based on diffusion, where would the starch "want" to go?

3. Did the starch diffuse through the bag? How do you know?

4. Is the bag permeable to starch? Explain.

5. At the start of the experiment, where was the iodine more concentrated?_____

6. Based on diffusion, where did the iodine "want" to go?

7. Did the iodine diffuse through the bag? How do you know?

8. Is the bag permeable to iodine? Explain.

9. Starch, as a polymer of glucose, is a very big molecule. It's made of hundreds or thousands of glucose monomers. Iodine is an ion (an atom that has lost or gained electrons and acquired an electrical charge). How can this explain what happened?

10. If the membrane is like a chain link fence, then the starch molecules are like a

    _____ball, and the iodine ions are like a _____ ball.

11. Since the membrane was permeable to iodine but not to _____, we can say that it is _____ permeable.

12. We did this lab because the bag is like a cell membrane. How?

## CONCLUSION

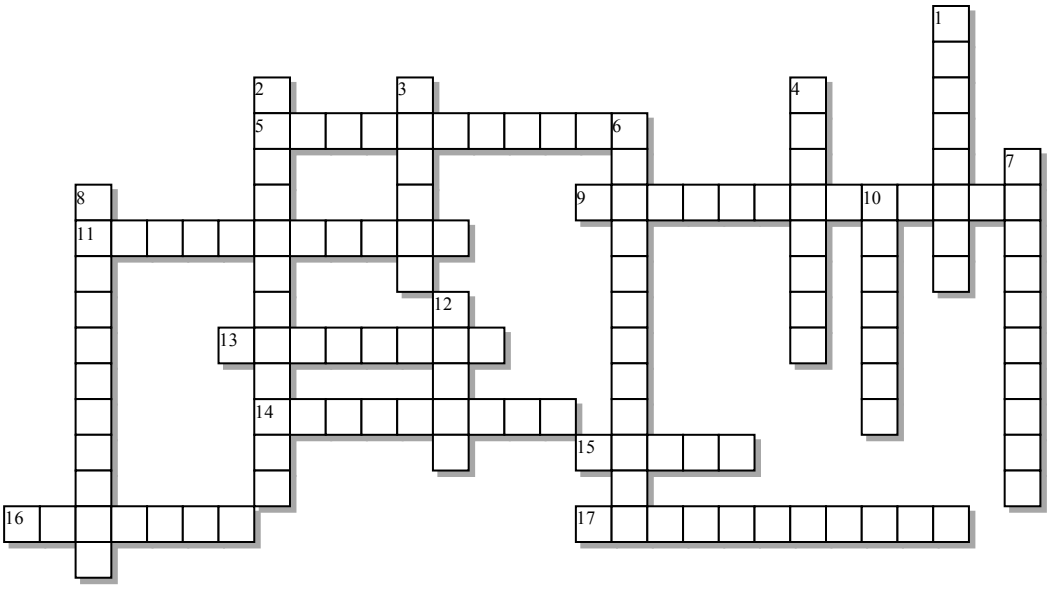
Prompt: Describe what happened in the cell membrane model lab. Specifically,

1. ___Define the term "diffusion," and explain why diffusion occurs.
2. ___Explain how we set up our cell membrane model lab
3. ___Explain what observations we made that told us which substances were diffusing in which direction.
4. ___Explain how this lab relates to the concept of selective permeability.
5. ___Explain how this lab relates to the concept of cell membranes

Use the following sentence frames as needed:

- _____ can be defined as…
- _____ occurs because…
- In our lab, we first…
- If the bag had been freely permeable then…
- However, because the bag was semi-permeable…
- The connection with cell membranes is that

## Membranes!



**Across:**
5 - The head, which dissolves in water, can be described as being
9 - A protein that spans the entire membrane is a(n) _____ protein
11 - The tails, which are non-polar, can also be described as being
13 - This three carbon molecule is what the phospholipid's head and tails attach to
14 - Allowing a substance to pass through it
15 - Two _____ acids make up the "tail" of a phospholipid
16 - A membrane component that can form channels or attached enzymes
17 - Membranes are _____ permeable: only some substances can pass through

**Down:**
1 - The barrier separating the cell from its external environment
2 - The key molecule making up the membrane
3 - The constant motion and varied nature of its components have led to the fluid _____ model of the membrane.
4 - A protein embedded in the membrane's hydophobic middle is a(n) _____ protein
6 - This membrane component typically acts as a cellular marker or flag
7 - A membrane protein that hangs on the outside or inside of the membrane is a(n) _____
8 - This membrane component keeps membranes stable in both hot and cold situations.
10 - A formation that phospholipids assume when dissolved in water.
12 - The head of a phospholipid dissolves in water, making it

**Possible Answers:**
bilayer, carbohydrate, cholesterol, fatty, glycerol, hydrophilic, hydrophobic, integral, membrane, mosaic, peripheral, permeable, phospholipid, polar, protein, selectively, transmembrane

# Teacher's Guide: The Cell Membrane Model Lab

1. SET-UP instructions for teacher

a. I try to use soluble starch, but if all you can get is corn starch from the local market, then just remember to tell your students to shake the solution well.

b. Dilute your IKI solution until it's orange, not dark red or pale yellow.

2. Set up for students:

**Cell Membrane Model Lab Set Up**

1. Use the big graduated cylinder to measure out 50mL of starch solution and pour it into the bag. Seal it and set it aside.
2. Rinse out the big graduated cylinder.
3. Use the big graduated cylinder to measure out 80 mL of water and pour it into the glass beaker.
4. Add 40 drops of iodine into the beaker.
5. Use the small graduated cylinder to measure out 10 mL of the iodine solution in the beaker. Pour it into the test tube.
6. Put the test tube and the bag into the beaker. Avoid spilling.
7. Write your names on a piece of tape and put the tape on the beaker.
8. Bring your beaker up to the tray on the teacher's desk.

3. Sample Student Response to conclusion

| *A sample response* |
|---|
| Diffusion is the movement of molecules from higher concentration to lower concentration. It occurs because all particles are in random motion. As a result, over time, they tend to spread out. Diffusion can occur in a gas or a liquid, and it can occur across membranes that are permeable to the diffusing substance. |
| In our lab, we poured iodine solution into a beaker, and starch solution into a plastic bag. We sealed the plastic bag, and placed it in the beaker. Then, we let it sit overnight. |
| Since the starch was more concentrated inside the bag than outside of it, we'd expect that, if the bag were permeable to starch, the starch would diffuse out, into the beaker. By contrast, because the iodine was in higher concentration in the beaker than in the bag, we'd expect that, if the bag were permeable to iodine, the iodine would diffuse from the beaker into the bag. |
| In fact, what happened was that the starch could not diffuse through the bag, but the iodine could. This was apparent because we observed a color change only inside the bag. Clearly, the iodine had diffused into the bag, where it contacted the starch. Once in contact, a chemical reaction occurred, changing the starch purple. |
| It's evident that the starch could not diffuse through the bag, because the color change occurred only inside the bag. If the starch had diffused through the bag, the purple color would have been observed in the beaker as well as in the bag. |
| The key idea behind this lab is the concept of selective permeability. The bag was permeable to iodine, but not to starch. In the same way, cell membranes are selectively permeable. They allow needed substances to enter, but keep out materials that would be harmful to the cell. Similarly, wastes are allowed to leave, while needed substances are maintained inside. |

4. The crossword puzzle:

Doesn't really fit with the lab, but it'll be useful later, after you've taught membrane structure.