

Name: _____ Period: _____ Date: _____

Open **peebedu.com** and navigate to **Membrane Fatty Acid Explorer**. Click the **Introduction** button to read about fish adaptations to cold water and the roles of saturated fatty acids, unsaturated fatty acids, and cholesterol in membrane fluidity. Then close the popup and use the temperature slider to observe how membrane fluidity changes.

Part 1 – Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Membrane Fatty Acid Explorer as a scientific model.

M – Mode

What type of model is the Membrane Fatty Acid Explorer? Describe how this computational simulation represents a cell membrane and its response to temperature changes. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about membrane structure and fluidity.

A – Accuracy

(a) Identify two things this simulation represents **accurately** about cell membrane structure and fluidity. For each, name the specific simulation feature and explain what aspect of the fluid mosaic model it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about membrane structure and fluidity. Consider what you cannot observe in the simulation that would be important for a complete understanding of how real cell membranes respond to temperature changes.

P – Purpose

What is the learning goal of this simulation? Explain how the Membrane Fatty Acid Explorer is designed to help you understand how the composition of a plasma membrane — including phospholipids, cholesterol, and proteins — affects its fluidity at different temperatures. In your answer, connect at least one specific simulation feature to a biological situation in which membrane fluidity is important for cell function.

P – Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries might change or improve a simulation like the Membrane Fatty Acid Explorer. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for the fluid mosaic model?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does the temperature slider help you connect molecular-level changes to whole-organism survival?

Part 2 – Free Response Questions

Conceptual Analysis

Question 1 – Membrane Fluidity and Fatty Acid Composition

Simulation Task: Set the temperature slider to 30°C and observe the phospholipid tails. Then slowly decrease the temperature to –10°C. Watch how the movement of the phospholipid tails changes as the temperature drops. Also note the cholesterol molecule (gold) positioned between the phospholipids.

(A) (1 pt) **Describe** the structural components of the plasma membrane shown in the simulation, including the phospholipid bilayer, embedded proteins, and cholesterol.

(B) (1 pt) **Explain** why the phospholipid tails in the simulation move more at low temperatures when the membrane contains a higher proportion of unsaturated fatty acids.

(C) (1 pt) **Predict** what would happen to the fluidity and function of a fish cell membrane in near-freezing water if the membrane contained only saturated fatty acids and no cholesterol.

(D) (1 pt) **Justify** your prediction using the relationship between membrane composition — including phospholipids, steroids, and proteins — and the ability of membrane components to move within the fluid mosaic model.

Analyze Model / Visual Representation

Question 2 – Membrane Components and the Fluid Mosaic Model

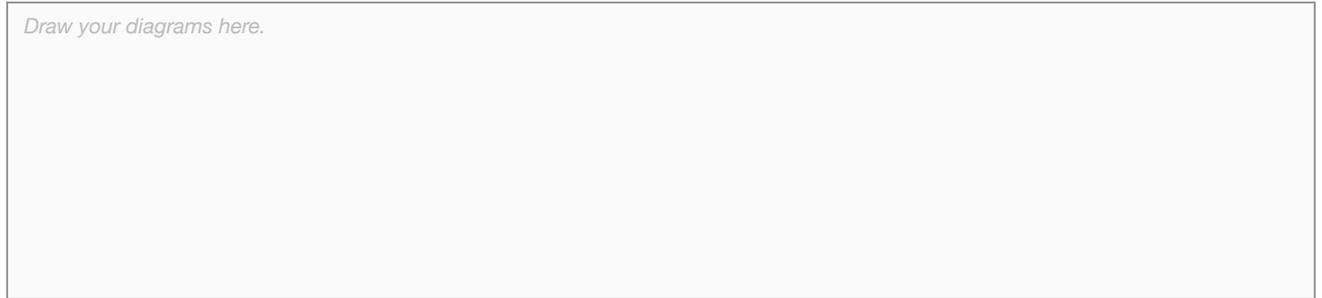
Simulation Task: Click the Introduction button and review the comparison between saturated and unsaturated fatty acids. Then close the popup and set the temperature to 10°C. Observe the positions of the channel protein (purple), the receptor protein (green) with its extensions, and the cholesterol molecule (gold) within the bilayer.

(A) (1 pt) **Describe** the components of the fluid mosaic model visible in the simulation, including phospholipids, cholesterol, channel proteins, and glycoproteins.

(B) (1 pt) **Explain** the relationship between the proportion of unsaturated fatty acids in a membrane and its fluidity at low temperatures.

(C) (1 pt) **Represent** the difference between a membrane rich in saturated fatty acids and a membrane rich in unsaturated fatty acids.

Draw your diagrams here.



(D) (1 pt) **Explain** how the ability of cold-water fish to incorporate more unsaturated fatty acids into their cell membranes could be the result of natural selection acting on populations exposed to low-temperature environments over many generations.

EK 2.3.B.1