Unit 2 Progress Check: FRQ

1. Read each question carefully. Write your response in the space provided for each part of each question. Answers must be written out in paragraph form. Outlines, bulleted lists, or diagrams alone are not acceptable and will not be scored.

Scientists are testing substance L to determine how it enters mammalian cells in a culture. The cells maintain a 120 millimolar (mM) intracellular concentration of substance L. The scientists determined the rate of entry of substance L into the cells at various external concentrations of substance L (10 to 100 mM) in culture medium (Table 1).

Table 1. Rate of entry of substance L into mammalian cells in culture

External concentration of substance L (mM)	Rate of entry of substance L into cell as a percent of maximum
10	5%
20	25%
30	45%
40	65%
50	80%
60	90%
70	95%
80	100%
90	100%
100	100%

The cells maintain substance L at an internal concentration of 120 mM.

(a) Identify the most likely mode of transport across the membrane for substance L. Explain how information provided helps determine the most likely mode of transport.

Please respond on separate paper, following directions from your teacher.

(b) On the axes provided, construct an appropriately labeled line graph with correct scale and units to illustrate the data in Table 1.

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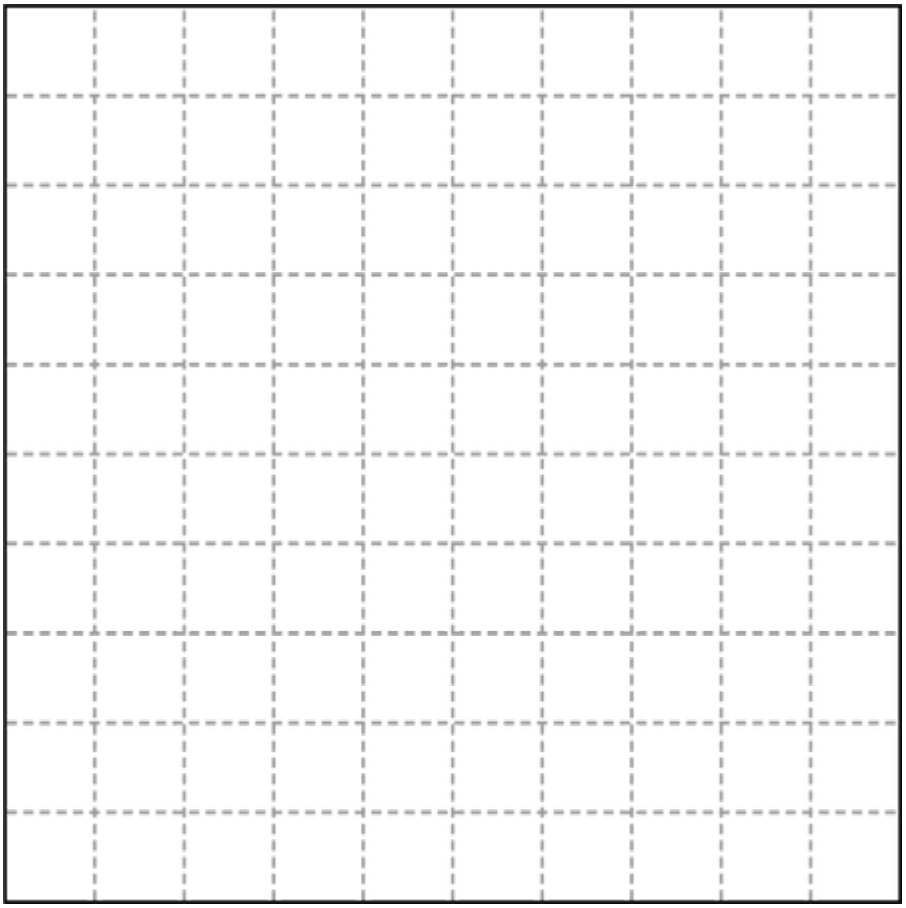

Please respond on separate paper, following directions from your teacher.

(c) Determine the external concentration of substance L that will result in one-half of the maximal entry rate.

Please respond on separate paper, following directions from your teacher.

(d) Predict the likely effect on the ability of substance L to enter the cells if substance L is attached to a large protein instead of free in the culture.

Please respond on separate paper, following directions from your teacher.

Part A (i)

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Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

0	1 ✓

The response indicates that substance L most likely crosses the membrane by active transport.

Part A (ii)

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

0	1 ✓

The response indicates that the cells maintain an intracellular concentration of 120 mM , which is always greater than the concentration of substance L in the culture medium.

Part B

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

0	1	2	3 ✓

The sketched curve meets all of the criteria below.

- ☐ Correct axis labeling
- ☐ Correct scale and units
- ☐ Correctly plotted line

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Part C (i)

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

0	1 ✓

The response indicates that the external concentration of substance L that will result in one-half of the maximal entry rate is between 31 mM and 34 mM.

Part D (i)

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

0	1 ✓

The response indicates that substance L will be unable to enter the cells if it is attached to a large protein OR the response indicates that substance L will be unable to enter the cells if it is attached to a large protein unless there is a specific cell membrane receptor for the protein.

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2. Read each question carefully. Write your response in the space provided for each part of each question. Answers must be written out in paragraph form. Outlines, bulleted lists, or diagrams alone are not acceptable and will not be scored.

Figure 1 represents a plasma membrane and molecules present on either side.

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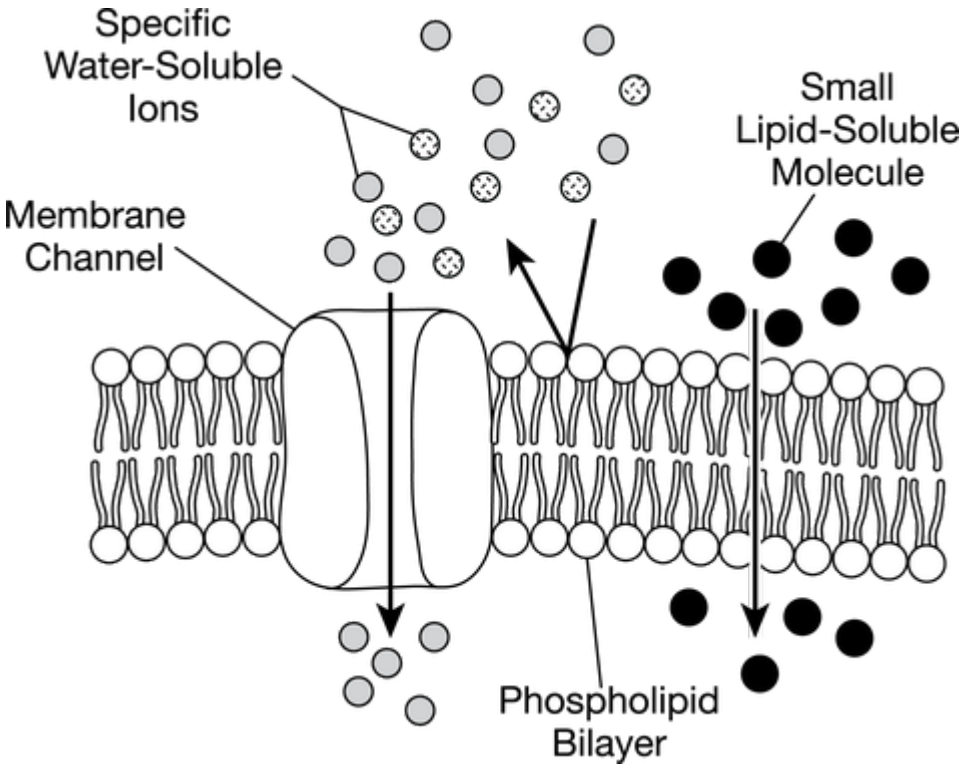

Figure 1. A model of a plasma membrane demonstrating selective permeability

(a) Describe the biological need for cells to be surrounded by a membrane that is selectively permeable for different materials.

Please respond on separate paper, following directions from your teacher.

(b) Explain how the model shows selective permeability of the membrane to specific ions.

Please respond on separate paper, following directions from your teacher.

(c) Describe the characteristics of the phospholipid bilayer that permit small hydrophobic lipid molecules to pass directly across the membrane.

Please respond on separate paper, following directions from your teacher.

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(d) Based on the model, explain whether the molecules shown crossing the membrane require energy to do so.

Please respond on separate paper, following directions from your teacher.

Part A

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

0	1 ✓

The response indicates that a cell membrane separates the internal environment of the cell from the external environment OR that a cell membrane that is selectively permeable can help to regulate what molecules move between the differing environments inside and outside of a cell.

Part B

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

0	1 ✓

The response indicates that a membrane channel protein is selective for a specific kind of ion because only one of the two kinds of ion represented can pass through the channel. The response also indicates that ions cannot simply cross directly between the phospholipids of the membrane (although a small lipid-soluble molecule can).

Part C

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

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0	1 ✓

The response indicates that the interior of a phospholipid bilayer is hydrophobic, which allows small hydrophobic molecules to diffuse across the membrane.

Part D

Select a point value to view scoring criteria, solutions, and/or examples and to score the response.

0	1 ✓

The response indicates that energy is not required for the substances to cross the membrane because the substances are being passively transported from a region of higher concentration to a region of lower concentration.