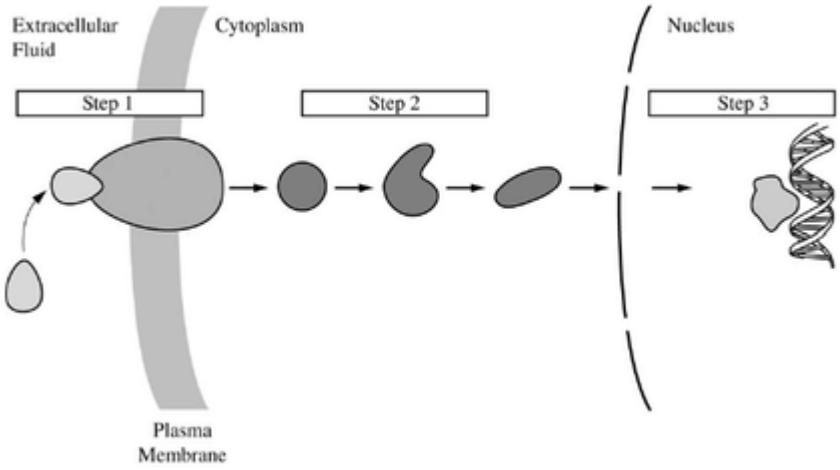
May 5th FRQs

1.



The figure above represents a generalized hormone-signaling pathway. Briefly **explain** the role of each numbered step in regulating target gene expression.

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

Explanation

3 points are earned maximum

• Step 1 = hormone/ligand binding to receptor to initiate/trigger/induce signaling OR signal reception

• Step 2 = an intracellular cascade that transduces/amplifies/transfers the signal from plasma membrane to nucleus (or other cellular effectors)

• Step 3 = transcription/expression of target genes is stimulated/repressed

0	1	2	3 ✓

The student response earns all of the following points:

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3 points are earned maximum

• Step 1 = hormone/ligand binding to receptor to initiate/trigger/induce signaling OR signal reception

• Step 2 = an intracellular cascade that transduces/amplifies/transfers the signal from plasma membrane to nucleus (or other cellular effectors)

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2. A student conducted an experiment to determine the molar concentration of solutes in chicken eggs. Eggs were soaked in vinegar to remove the shells. The eggs were then placed in sucrose solutions of different concentrations. The data are shown in the table below.

Sucrose Concentration (molar)	Initial Mass (g)	Final Mass (g)	Change in Mass (g)	Percent Change in Mass
0	78.50	81.73	3.23	4.11
0.5	79.11	77.50	−1.61	−2.04
1.0	80.75	75.14	−5.61	−7.12
2.0	76.99	66.64	−10.35	−13.44

a. Using the most appropriate data, **construct** a labeled graph on the axes provided below to best illustrate water movement into and out of the egg. **Explain** why there is a difference in percent of mass change of the eggs in the different sucrose solutions.

b. Using the data, **determine** the molar concentration of chicken egg cytoplasm and **justify** your answer.

c. Movement of water and nutrients is critical for the survival of plants. Using the concept of water potential, **explain** the role of positive and negative pressure in the transport of water and nutrients throughout a vascular plant.

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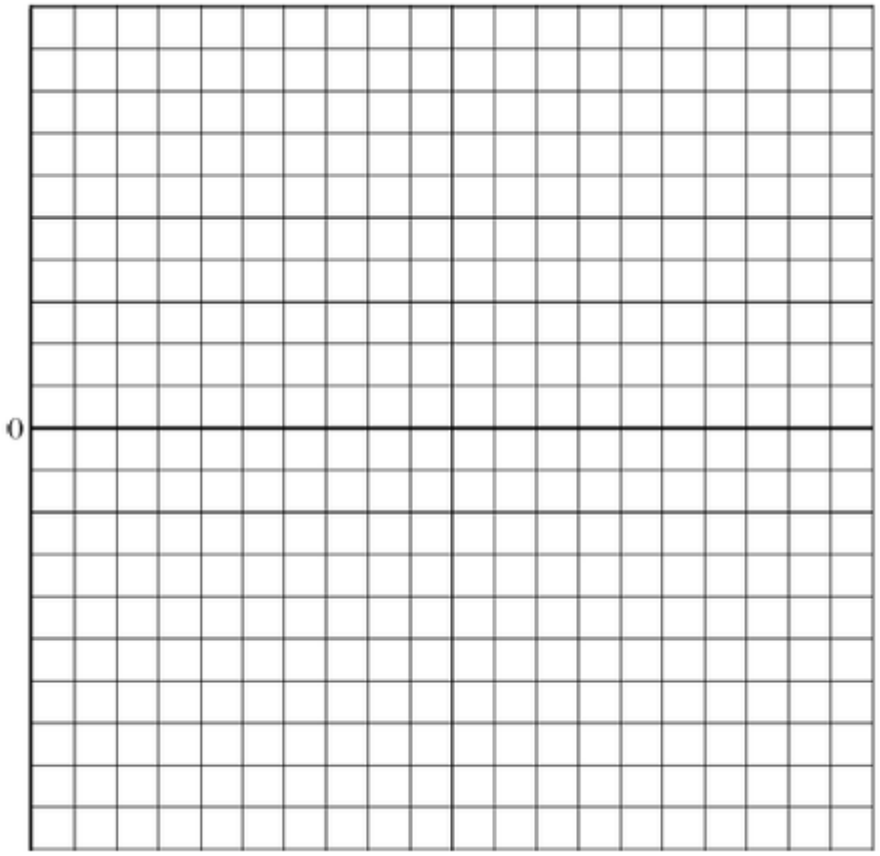

Please respond on separate paper, following directions from your teacher.

Part A

6 points are earned maximum

Graph (4 points maximum)

1— Title, labels of axes (X must be molar concentration, Y may be change jn mass or % change in mass)

1— Appropriate data selected (molar concentration vs. % change in mass)

1— Axis and data correctly scaled

1— Line graph correctly plotted according to data selected (X and Y axis positions are correct)

Explanation (2 points maximum)

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1— Egg gains mass if solute concentration is lower outside of egg (hypotonic) causing water to move into egg

1— Egg loses mass if solute concentration is higher outside of egg (hypertonic) causing water to move out of egg

1— Water moves from low solute/high water concentration to high solute/low water concentration

0	1	2	3	4	5	6 ✓

The student response earns all of the following points:

6 points are earned maximum

Graph (4 points maximum)

1— Title, labels of axes (X must be molar concentration, Y may be change jn mass or % change in mass)

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Part B

2 points are earned maximum

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1— Correct molar concentration based on graph -0.32M (0.3M to 0.5M)

1— Explanation: When y = 0, no change in mass = no net water movement = isotonic = solute concentration inside egg and outside egg are the same

0	1	2 ✔

The student response earns all of the following points:

2 points are earned maximum

1— Correct molar concentration based on graph -0.32M (0.3M to 0.5M)

1— Explanation: When y = 0, no change in mass = no net water movement = isotonic = solute concentration inside egg and outside egg are the same

Part C

1 point is earned per bullet; **4 points are earned maximum**

1— Water moves from areas with high water potential to areas with low water potential

1— Water potential has 2 components, solute and pressure ($\Psi = \Psi p + \Psi s$)

Transpirational movement of water and mineral nutrients

1—Loss of water from leaves to the atmosphere due to lower water potential of the air (transpiration)

1—Because of the cohesive property of water, water loss from leaves pulls replacement water molecules up from the xylem/soil

1—Water in the xylem is under tension because of lower water potential of the air (negative pressure)

Guttation

1—Root pressure (positive pressure) develops as ions enter the xylem, lowering water potential and causing osmosis into xylem

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1—Positive pressure in xylem moves water out of plants at leaf tips through hydathodes (guttation)

Phloem transport of sugars

1—Phloem cells accumulate sugars, which lowers the water potential of phloem cells

1—Loading phloem cells with sugars causes osmosis into the phloem cell; cell walls support buildup of water pressure in phloem

1—Unloading of sugar from phloem cells lowers water potential or pressure, resulting in loss of water from phloem cells

1—Water potential/pressure differential in phloem moves sugar solution through phloem (source to sink)

0	1	2	3	✔ 4

The student response earns all of the following points:

1 point is earned per bullet; **4 points are earned maximum**

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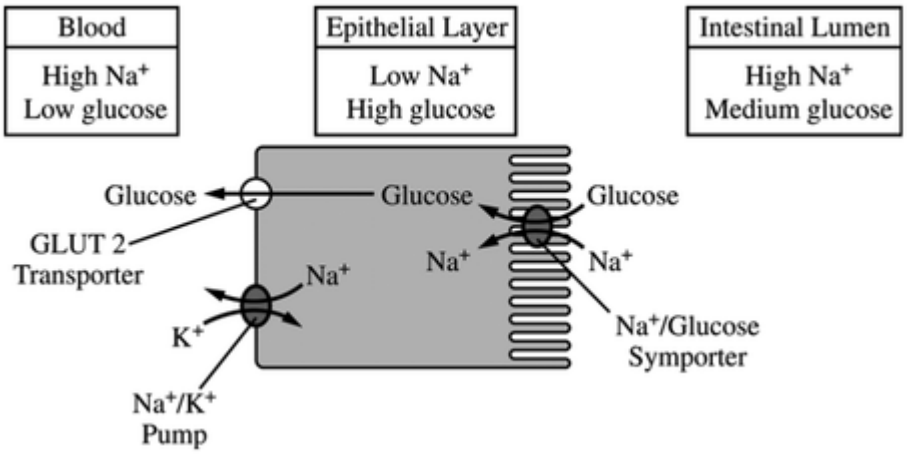

Figure 1. A single cell from the epithelial layer lining the intestine, illustrating movement of glucose and Na+ from the intestinal lumen to the blood

Glucose and sodium move from the lumen of the small intestine into the blood via transport proteins in the epithelial cells lining the small intestine (Figure 1). Based on Figure 1, **describe** the direct source of energy used to move glucose into the epithelial cell from the intestinal lumen. **Explain** how this system maximizes glucose absorption from the intestinal lumen into the epithelial cells and from the epithelial cells into the blood.

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

General

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3 point(s) maximum

Description (1 point)

• Energy from the sodium gradient

Explanation (2 points maximum)

• The Na^+/K^+ pump maintains the sodium concentration gradient and allows for the cotransport of glucose

• The symport/inflow of glucose maintains a glucose concentration gradient between the epithelial cells and the blood and allows for (facilitated) diffusion of glucose

• The microvilli/folds on the lumen side of the epithelial cell provide more surface area for uptake of glucose into the epithelial cell

0	1	2	3 ✔

Student response earns 3 of the following 3 points

3 point(s) maximum

Description (1 point)

• Energy from the sodium gradient

Explanation (2 points maximum)

• The Na^+/K^+ pump maintains the sodium concentration gradient and allows for the cotransport of glucose

• The symport/inflow of glucose maintains a glucose concentration gradient between the epithelial cells and the blood and allows for (facilitated) diffusion of glucose

• The microvilli/folds on the lumen side of the epithelial cell provide more surface area for uptake of glucose into the epithelial cell