

Traffic Light

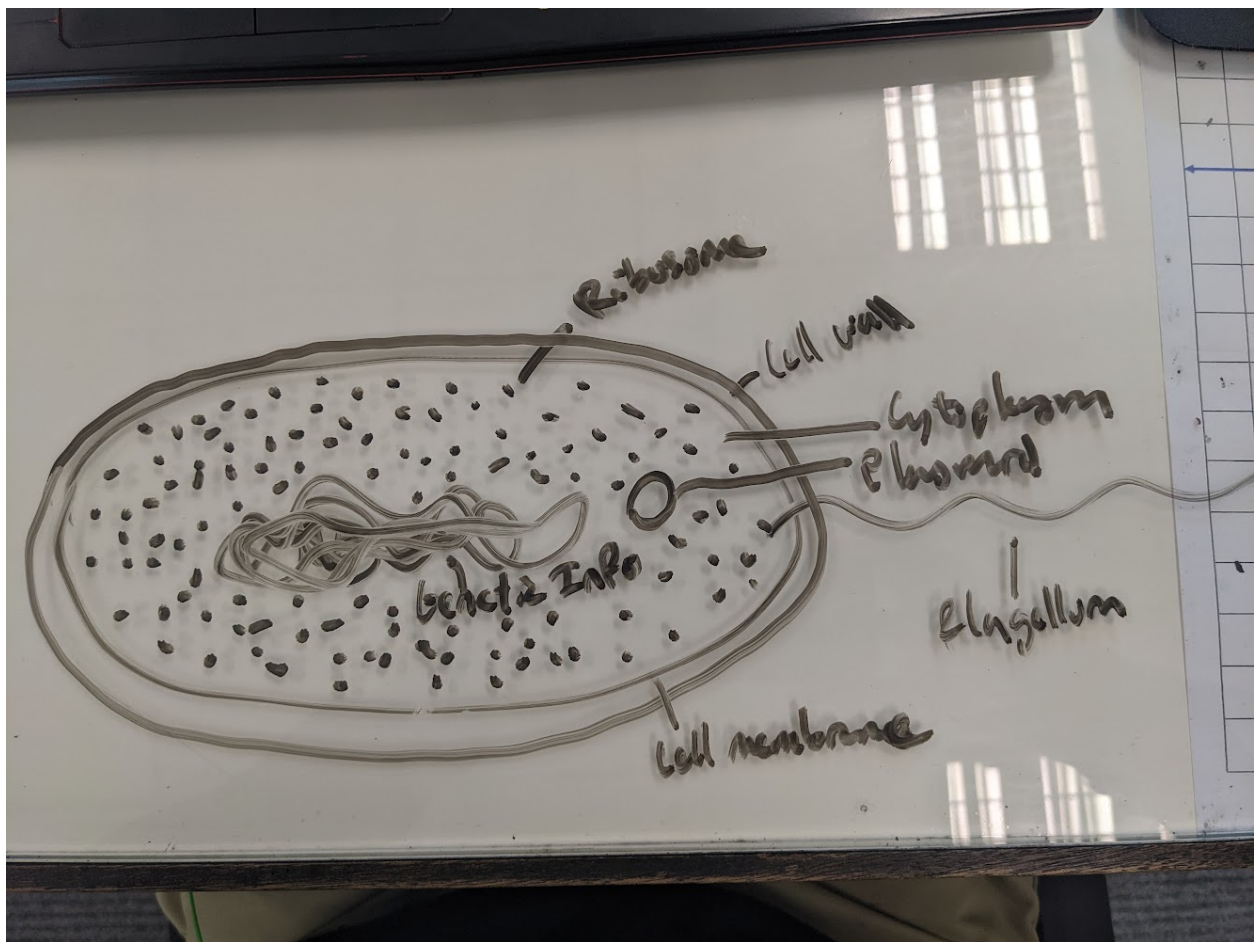
Term	Pre	Post
aero-	3	3
an-	3	3
chlor-	3	3
-elle	3	3
hapl-	3	3
homo-	3	3
re-	3	3
-sis	3	3
zyg-	3	3
hyper-	3	3
hypo-	3	3
endo-	3	3
exo-	3	3
osmo-	3	3
Prokaryotes	3	3
Eukaryotes	3	3
Diffusion	3	3
Osmosis	3	3
Aquaporin	3	3
Hypotonic	3	3
Hypertonic	3	3
Isotonic	3	3
Endocytosis	3	3
Exocytosis	3	3
Phospholipid	3	3
Amphipathic	3	3

Test Topics

- Prokaryotic vs. eukaryotic cells
- Why are cells small?
- Organelles – function and structure
- Where is DNA found?
- Plant vs. animal cells
- Endosymbiosis theory
- Endomembrane system
- Structure of the cell membrane – components and functions
- Fluid mosaic model
- Membrane responses to cold
- What does amphipathic mean?
- How do different types of molecules get through the cell membrane?
- Passive transport vs. active transport and types of each
- Types of bulk transport
- Specific types of transport – sodium/potassium pump and cotransporters
- Isotonic/hypotonic/hypertonic and effect on cells – difference in plants and animals
- How does water get through the cell membrane
- Water potential – factors that change movement of water
- Lab concepts – diffusion/osmosis

Topic Review Guides

2.1



- 1.
- 2.

Organelle	Structure	Function	Plant Animal
Plasma Membrane	Phospholipid bilayer	Protects cell and regulates cell contents	Both
Cytoplasm	Gooey liquid	Keeps organelles in place	Both
Cytoskeleton	Made of lots of poles and strings	Holds together the cell and maintains cell strength	Both
Ribosomes	A small and large subunit, literally just rRNA	Creates proteins	Both
Rough ER	Made of many folds and has ribosomes on it	Stores and processess proteins	Both

Smooth ER	Lots of folds and sacks	Makes lipids, phospholipids, and steroids	Both
Golgi Body	Made of a lot of folds and membranes	Processes Proteins and stores them, packages them for use later	Both
Vesicles	A bubble of membrane	Holds other materials that the cell needs	Both
Mitochondria	Bean shaped double membrane	Breaks down pyruvic acid into ATP	Both
Nucleus	A sphere with a protective membrane	Stores important DNA and RNA	Both
Nucleolus	Jumble of DNA	The bubble of DNA that is in the Nucleus	Both
Lysosome	Sphere shaped membrane	Cleans up the cell and breaks down unneeded materials	Both
Centrioles	Long stiff rods	Provides structure and support for the microtubules	Both
Cell Wall	Thick protective layer	Protects and provides structure	Plant
Chloroplast	Spherical Double membrane holding Photosynthetic compounds	Captures energy from the sun for the plant to use	Plant

3. Almost the same, except plant cells additionally have a wall and chloroplasts.

2.2 and 2.10

1. 1

1. No energy will be able to be produced and the cell will not be able to go through with its cellular functions
2. The cell will deflate and it'll be hard to transport molecules between the organelles
3. Larger molecules will not be transported in the cell

2. 2

1. Helps produce and process complicated proteins
 2. Processes and packages proteins
 3. Cleans up products that will not be needed later
3. Keeps different functions separate so that they do not interfere with each other
 4. It protects processed from unwanted molecules by not allowing it to ever reach that enzyme
 5. It relies on a high gradient, which could not be done without its own membranes
 6. It is easier to create a gradient in a smaller area rather than a large area

2.3

1. The smaller they are the easier it is for materials to be transported between cells because of the higher SA:V ratio. It cannot be too small because then there will not be enough space to hold the organelles and transport molecules between the organelles
2. 0.25, it has the highest SA:V ratio
3. It can transport molecules in and out of the cell faster

4. 4

1. Increase in efficiency of transporting in and out of the cell, but not within
2. Increase SA:V ratio, but would be hard to maintain its structure
3. Would be more efficient within the cell, but would waste more energy

5. 5

1. Smaller cells
2. Smaller cells
3. Smaller cells

2.4 and 2.5

1. It allows the transmittance of small polar molecules while it repels everything else
 2. They create things, offer stability, block things, and protect things
 3. Helps hold it together
 4. Offers structure for it
 5. It can move and flow very easily while keeping things out
 6. They are small and have channels
7. 7

1. Eukaryote, photosynthetic
2. Photosynthetic, Eukaryote
3. Prokaryotes, nonphotosynthetic

2.7 and 2.9

1. 1

1. Both transport molecules across the membrane
2. Passive transports from high to low and does not use a protein
3. Active transports from low to high and uses a protein to help

2. 2

1. All transport large amounts of molecules in and out of the cell
2. Endo goes in
3. Exo goes out
4. Receptor mediated also requires a molecule to bind to a receptor to begin endocytosis
3. It could happen passively, but could also happen with the help of a protein to complete something
4. Other molecules that cannot passively diffuse through the membrane need a protein to make a hole in the membrane to allow it to enter the cell
5. Without active transport, molecules will always flow down the gradient, leading everything to eventually flow to equilibrium. With active transport, we can pump them against the gradient to create a stronger gradient
6. ATP is what fuels the protein pumps to move molecules across the membrane

2.8

1. It depends on the concentration of different substances in the water, water will flow from high to low osmolarity (low concentration of solute to high)

2. 2

1. Hypertonic have more solute than another solution
2. Hypotonic have less solute than another solution
3. Isotonic have equal
3. Hypertonic solutions around a plant will actually suck water out of the organism. Hypotonic solutions would force more water into the plants.

4. $\Psi = \Psi_0 + \Psi_\pi + \Psi_p + \Psi_s + \Psi_v + \Psi_m$

1. Where 0 is the reference potential
2. π is the solute potential given by $\Psi_\pi = -MiRT$
3. p is pressure
4. s is gravity
5. v is humidity
6. m is surface tension and cohesion and other fluid effects

2.11

1. Eukaryotes have a membrane around the nucleus and the mitochondria, while the prokaryotes do not (but yes for mitochondria if they have a variant of that)
2. Mitochondria may have been its own cell at one point, but gotten incorporated into another cell at some point, explaining its own membrane. Chloroplasts are similar.
3. They have their own membranes and mitochondria has its own genetic information.
4. They are effectively the same, except they are inside another cell now (with minor modifications).

Unit Summary

Standards

- 2B1: Cell Membranes are selectively permeable due to their structures.
- 2B2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.
- 2B3: Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.
- 4A3: The structure and function of subcellular components, and their interactions, provide essential cellular processes.
- 1B1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.
- 1D1: There are several hypotheses about the natural origin of life on earth, each with supporting scientific evidence.

Objectives

1. Be able to discuss the evolution of cells including the endosymbiont theory.
2. Be able to differentiate between prokaryotic and eukaryotic cells according to the types of organelles are contained in each and in which organisms.
3. Be able to identify the differences between plant and animal cells (organelles).
4. Be able to diagram the structure of the cell membrane and discuss its function.
5. Be able to discuss the principles of osmosis and diffusion in plant and animal cells.
6. Be able to explain the difference between active and passive transport.
7. Be able to discuss and give examples of endocytosis and exocytosis in cells.

Essential Questions

- How do shared conserved cellular processes support the idea that all organisms are linked by lines of descent from common ancestry?

Its highly unlikely that two unrelated processes will create exactly equal processes.

- How do cells create and maintain internal environments that are different from their external environments?

Membranes and selective diffusion. Through passive diffusion, facilitated diffusion, and active diffusion, a cell can control what goes in and out of it.

- How do structure and function of subcellular components and their interactions provide essential cellular processes?

They all rely on each other to complete the actions that the cell needs to survive, grow, and divide

- How do cells maintain dynamic homeostasis by the movement of molecules across membranes?

It can pump out excess and let in more if necessary by controlling the diffusion through facilitated diffusion and active transport through cell signalling

BILL Activities

Cell Size POGIL

1. They are Animal Cells because they lack chloroplasts and don't have cell walls

2.

-

3. 3

1. Cell B

2. Cell B

4. 4

1. Cell B

2.

5. The cell would not get enough nutrients and resources, so it will fail to replicate and die

6. 6

1. Cell B

2. Smaller, everything is on average closer to the membranes

3. Smaller, there is a higher surface area to volume ratio

7. No, smaller cells can do stuff faster

8. 8

1. Cube

2. Sphere

3. Cylinder

9. 9

Cube			
Side	1	2	4

Cube			
Surface Area	6	24	96
Volume	1	8	64
SA:V	6:1	3:1	1.5:1
Sphere			
Diameter	1	2	4
Surface Area	3	13	50
Volume	0.5	4.2	34
SA:V	6:1	3.1:1	1.5:1
Cylinder			
Diameter x Height	1 × 1	1 × 2	1 × 4
Surface Area	4.7	7.9	14
Volume	0.8	1.6	3.1
SA:V	5.9:1	4.9:1	4.5:1

10. 10

1. The surface area increases by 4x, but not as fast as the volume
2. The volume increases by 8x, faster than the surface area
3. Volume

11. 11 (skipped?)

12. 12

13. The volume always increases faster than the surface area, leading the SA:V ratio to decrease as the shape increases in size

14. Higher ratio, so that things can be transported faster

15. 14

1. No
2. The Cylinder

16. Cylinders, as it keeps the SA:V ratio high while maintaining its larger size

17. 17

1. Cylinders
2. Cylinders
3. Large Spheres
4. Small Cubes
5. Small Spheres

18. They are unicellular, so all the functions of the organism needs to be carried out by the singular cell. Multicellular organisms may have multiple jobs for different cells, meaning each cell can be more specialised, allowing them to be smaller and more efficient.

BR: Cell Surface Area-Volume Ratio and Cell Size

Question	What do I see	What does it mean
1	Decreasing, inversely related graph between length of a side of a cube and its SA:V ratio	The larger a cube is, the lower its SA:V ratio is
2	Exponential, increasing relationship between surface area and volume of a cube	Volume increases faster than surface area as an object gets larger
3	As you increase the cube size, more sides of the mini-cubes are covered up	The larger it is, the more mini-cube covered sides there are, meaning the overall large-cube surface area is significantly less than that of small-cubes
4	Cilia is on the surface of the cell	More surface area \Rightarrow more cilia \Rightarrow more effectivity

Investigation: Limits on Cell Size

Cube Size	Surface Area	Volume	SA:V	Sketch
1×1×1 cm	6 cm ²	1 cm ³	6:1	[]
2×2×2 cm	24 cm ²	8 cm ³	3:1	[.]
3×3×3 cm	54 cm ²	27 cm ³	2:1	[o]

1. As the size increases, the SA:V ratio decreases
2. A larger SA:V ratio is better because it allows speedier diffusion of materials within the cell
3. Different Shapes:

Shape	Surface Area	Volume	SA:V(V)
Cube	$6w^2$	w^3	$6V^{-3}$
Sphere	πw^2	$\pi w^3/6$	$4.836V^{-3}$
Cylindrical (h=4w)	$5\pi w^2$	πw^3	$7.323V^{-3}$
Square Prism (h=4w)	$18w^2$	$4w^3$	$7.143V^{-3}$

4. The Cylinder has the best shape because it has the best surface area to volume ratio with respect to volume at $7.323V^{-3}$

BR: Cell Size and Surface Area

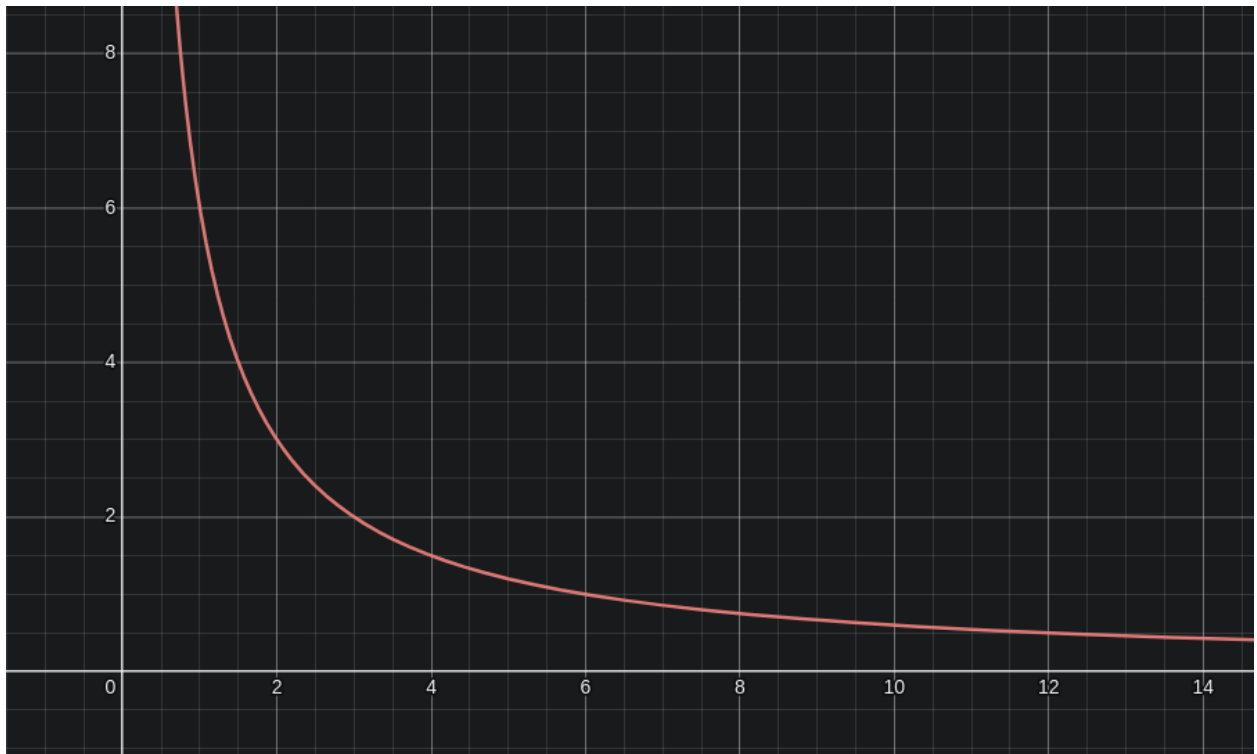
1. Which of these statements accurately reflects the relationship between cell size and surface area?
- Larger cells are most efficient at transporting materials across the membrane since their surface area is increased.
 - Smaller cells must have more phospholipids per area in order to adequately transport materials into the cell.
 - Cells must maximize their surface area to volume ratio in order to maintain homeostasis.
 - Cells must minimize their surface area exposure to the extracellular matrix in order to retain cytosol.

 Answer ▾

3

2. **Calculate** the surface area and volume of a cubic epithelial cell with sides of 8 micrometers. Then, **illustrate** the relationship between cell size (x axis) and surface area/volume ratio (y axis) on a graph.

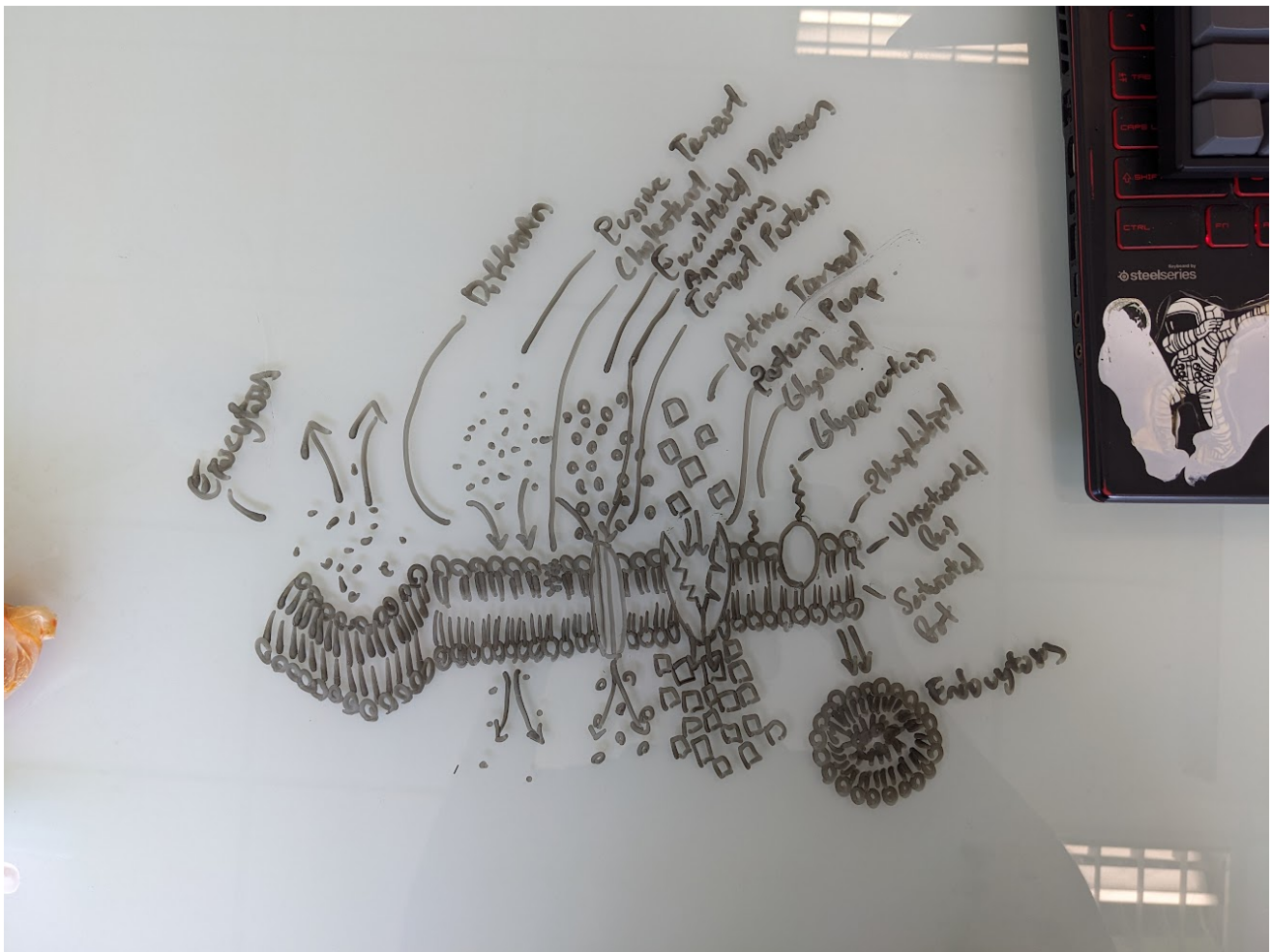
SA	Area
384 nm ²	512 nm ³



BR: Endomembrane System

1. It keeps the inside of the golgi apparatus clean, only containing the necessary items
2. More flaps and folds leads to higher surface area, but cells cannot hold strong to each other in this shape

Cell Transport



BR: Tonicity Practice Problem

1. B
2. Iso, Hypo, Hyper
3. B
4. D
5. B
6. E
7. Right, Hypertonic
8. Left, Hypo
9. Right
10.
 -
11. Out, In, None
12. None, In, Out; Normal, Turgid, Flaccid

BR: Water Potential Practice Problems

1. D
2. Pressure

Investigation: Osmosis Lab

Objective

See how different concentrations of a liquid effects the process of osmosis by measuring the amount of water moved in or out of some plant tissue over time.

Materials

- Carrots / Potatoes (plant tissue), equally cubed
- 6 glycosidic solutions with differing concentrations

Tools

- Scale
- Knife / Scapel
- Chopping board
- Storage containers

Procedure

1. The plant tissue was prepared by cubing it into equal sized cubes
2. The cubes were equally divided into containers
3. The weight of the plant tissue of each container was measured
4. an equal sufficient amount of glycosidic solution into each container was measured out, with differing concentrations for each container
5. Each container's concentration was noted down
6. 24 hours passed
7. The mass of the plant tissue after it has submerged for sufficient time was remeasured
8. The percentage change in the mass of the plant tissue was calculated
9. The concentrations with the percent change in mass were calculated
10. Conclusions were drawn

Data

Raw Data

Bowl Mass: 6.9g

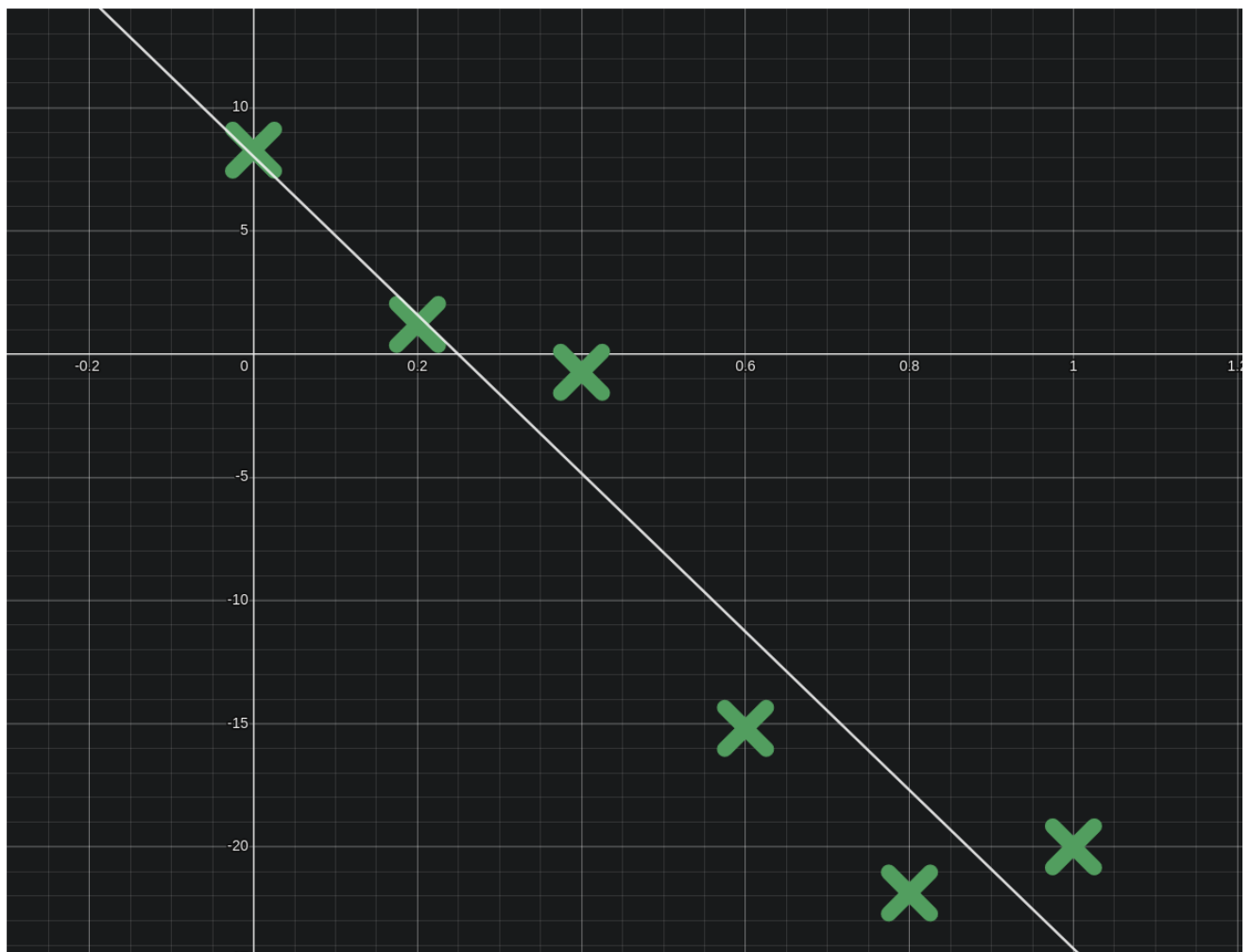
Plant Tissue: Carrot

Solution	Sucrose Solution Concentration	Initial Mass (bowl + plant) (g)	Mass of plant (g)	Mass with Sucrose (bowl + plant + solution)	Mass of Sucrose (g)	Mass after diffusion (g)	Mass Difference	% change
Red	1 mol	20.9	14.0	131.1	110.2	18.1	-2.8	-20
Orange	0.2 mol	23.5	16.6	122.4	98.9	23.7	0.2	1.204819277

Solution	Sucrose Solution Concentration	Initial Mass (bowl + plant) (g)	Mass of plant (g)	Mass with Sucrose (bowl + plant + solution)	Mass of Sucrose (g)	Mass after diffusion (g)	Mass Difference	% change
Yellow	0.4 mol	20.5	13.6	123.8	103.3	20.4	-0.1	-0.7352941176
Green	0 mol	22.6	15.7	121.1	98.5	23.9	1.3	8.280254777
Blue	0.6 mol	22.7	15.8	127.5	104.8	20.3	-2.4	-15.18987342
Purple	0.8 mol	22.9	16.0	129.0	106.1	19.4	-3.5	-21.875

Change from least mass change to most mass change:

1. Red (1 mol)
2. Purple (0.8 mol)
3. Blue (0.6 mol)
4. Yellow (0.4 mol)
5. Orange (0.2 mol)
6. Green (0 mol)



Analysis

As the concentration of the solution increases, it can be seen that the mass difference decreases. At 0 mol concentration, the mass can be seen to increase, but at 1 mol, the mass can be seen to decrease the most of out all the solutions in the test.

As the concentration of the solution increases, it decreases its water potential, making it more likely that it would be hypertonic in comparison to the insides of the plant tissue, pulling water out of the plant tissue. If the concentration is 0, then it increases its water potential, making it more likely to be hypotonic in comparison to the plant tissue, pushing water into the plant tissue. Since we can assume that the water potential of the plant tissue is constant due to it being the same plant, and same part of the plant, we can conclude that the change in mass can be attributed to the difference in concentration of the sucrose solution.

Conclusions

We conclude that as you increase the solution concentration surrounding plant tissue, more water will be sucked out of the plant tissue as the solution becomes more hypertonic, decreasing its water potential. As the water potential decreases, it steepens the water potential gradient, pulling more water out of the tissue.

BR: Endosymbiosis and Compartmentalization

1. 3, 5, 2, (1) || (6, 4)

•

2.
 1. They both have similar structures, containing its own DNA and a membrane
 2. They reproduce the same way as well, splitting its own DNA and producing two sub-cells
- BR: cell part card sort - BR: prokaryote vs eukaryote - BR: cell membrane labeling - Activity: diffusion and osmosis challenge

Additions

BR: cell part card sort

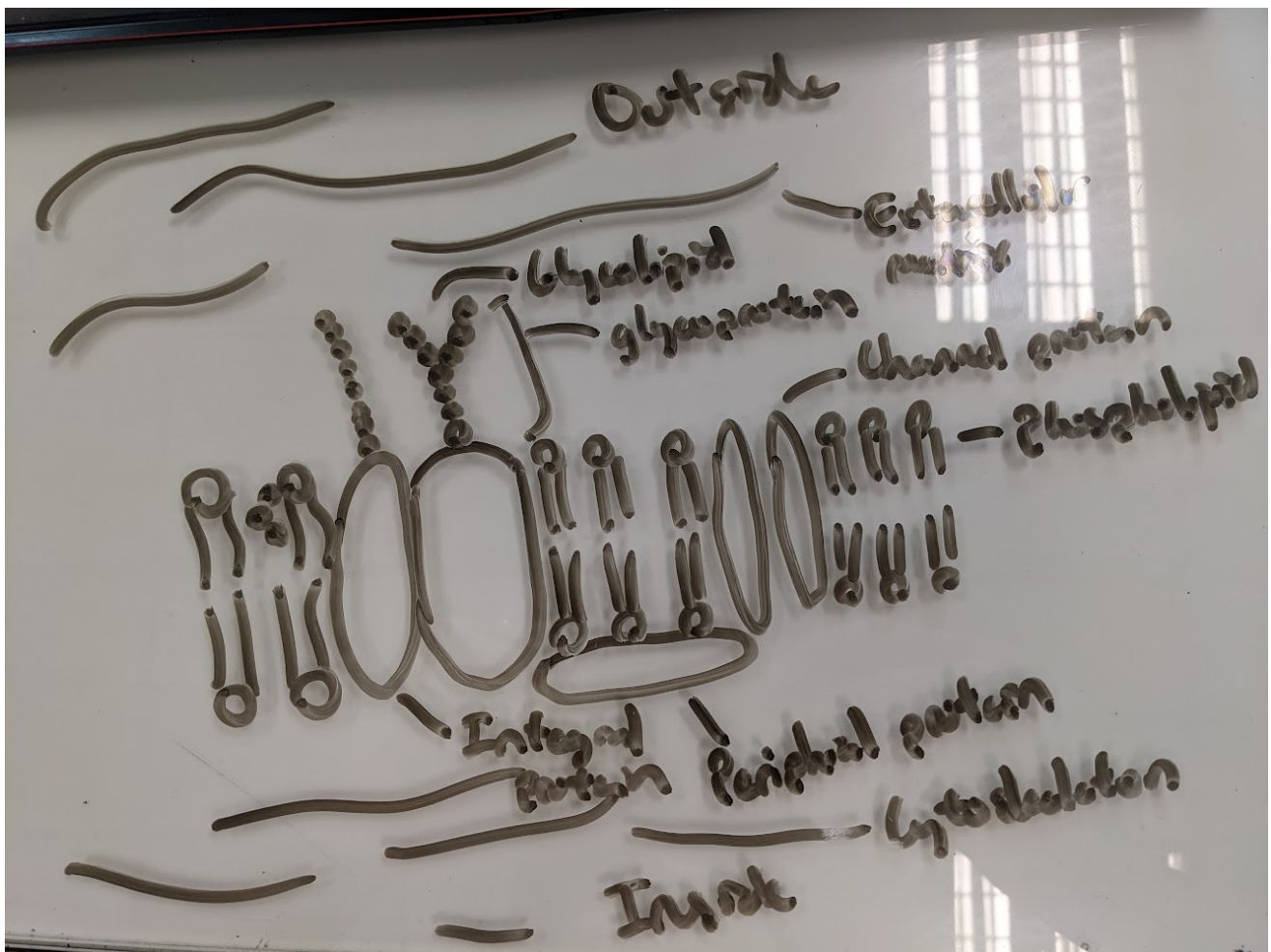
1. Rough endoplasmic reticulum
Channels proteins to transport vesicles, has attached ribosomes
2. Nucleus
Contains most of the genes that control the eukaryotic cell, contains the nucleolus and chromatin
3. Golgi apparatus
Consists of flattened membranous sacs; receives transport vesicles from the ER, modifies ER products, produces secretory vesicles
4. Vacuole
Membrane bound sacs, larger than vesicles, stores water and dissolved nutrients
5. Fungus cell wall
Protective layer external to the cell membrane, consists of chitin

6. Ribosomes
Site of protein synthesis; suspended in the cytosol or attached to the ER
7. Chromatin
Consists of DNA and protein, condenses to form chromosomes
8. Lysosome
Part of the endomembrane system, sacs of enzymes used to digest food and old, worn out cell parts
9. Mitochondria
Site of cellular respiration, produces ATP from sugar
10. Transport vesicle
Carries ER products to the Golgi
11. Plant cell wall
Protective layer external to the cell membrane, consists of cellulose
12. Cell membrane
Forms the boundary of the cell, acts as a selective barrier allowing certain materials to pass but not others
13. Chloroplast
Site of photosynthesis; produce food using light energy, CO₂ and H₂O
14. Cytoskeleton
Supports the shape of the cell, anchors organelles and serves as a "track" for organelles to move on.
15. Nuclear membrane
Double membrane that forms the boundary between the nuclear contents and the cytoplasm; perforated with pores
16. Extracellular Matrix
Proteins found outside an animal cell that function in support, adhesion and movement
17. Nucleolus
Where the components of the ribosome are synthesized and assembled; found in the nucleus

BR: prokaryote vs eukaryote

1. Eukaryote - has a nucleus
2. Eukaryote - has a nucleus
3. Prokaryote - it doesn't have a nucleus

BR: cell membrane labeling



Activity: diffusion and osmosis challenge

1. False, it will become more concentrated because the concentrations will balance with respect to water and glucose
2. True, although the amount of glucose cannot change, the percentage of glucose would change because the volume on each side could change
3. False, side X will eventually equal double of side Y because of the concentrations of glucose, which cannot change.
4. False The amount of Glucose stays the same, but the percentage with respect to volume will obviously change
5. False, it will move to make the ratios equal, meaning it will go to the side with more glucose
6. True
7. False, it moves towards the side with lower water concentration
8. False, it is a random process and water will move both ways, but it will move in NET to side X
9. True
10. False, the left has lower potential