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

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
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 ⇒ more cilia ⇒ 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?

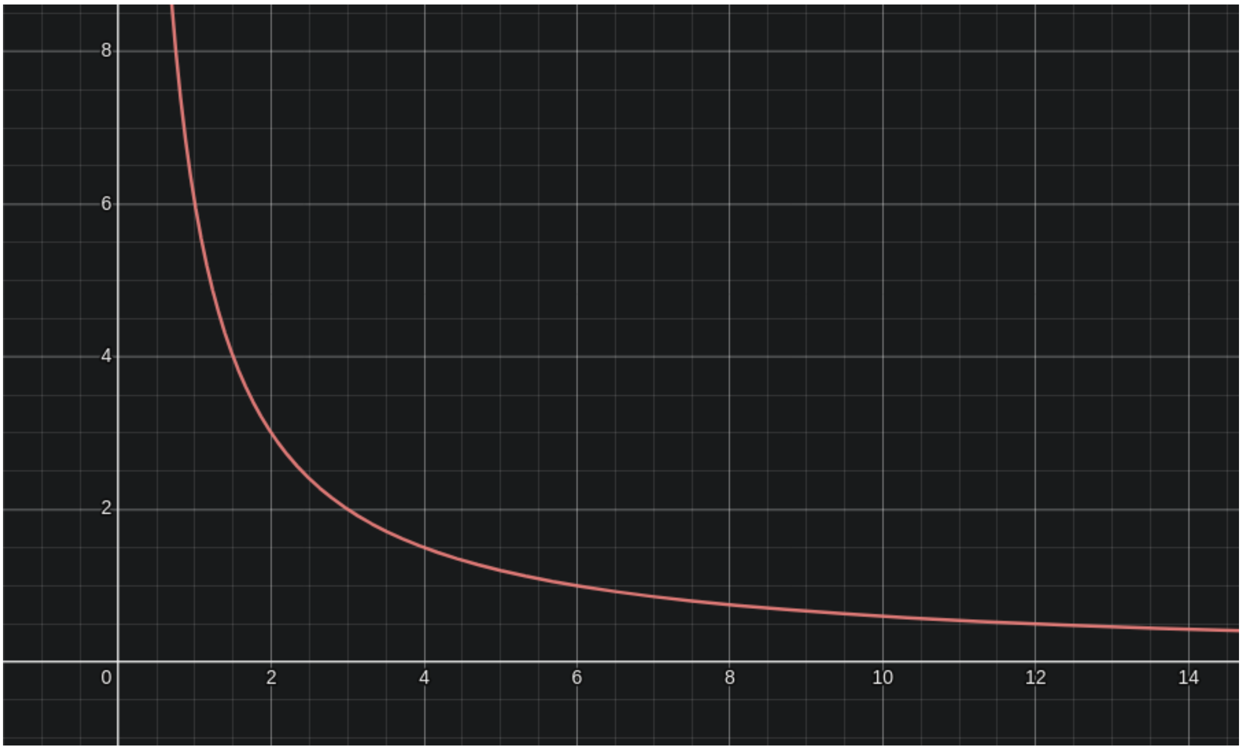
   - Larger cells are most efficient at transporting materials across the membrane since their surface area is increased.
   - Smaller cells must have more phospholipids per area in order to adequately transport materials into the cell.
   - Cells must maximize their surface area to volume ratio in order 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.

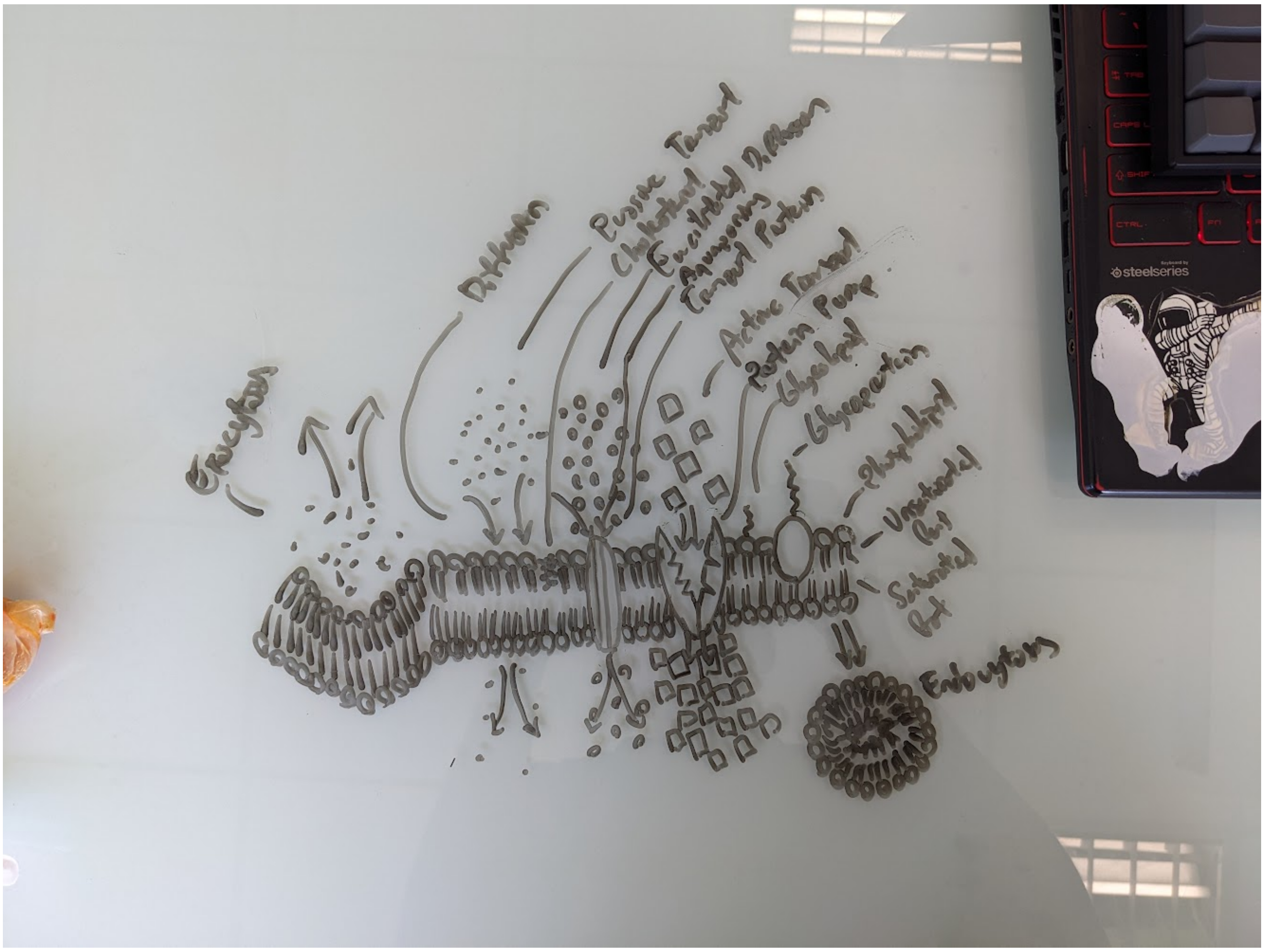
SA	Area
384 nm2	512 nm3



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
- Knive / 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

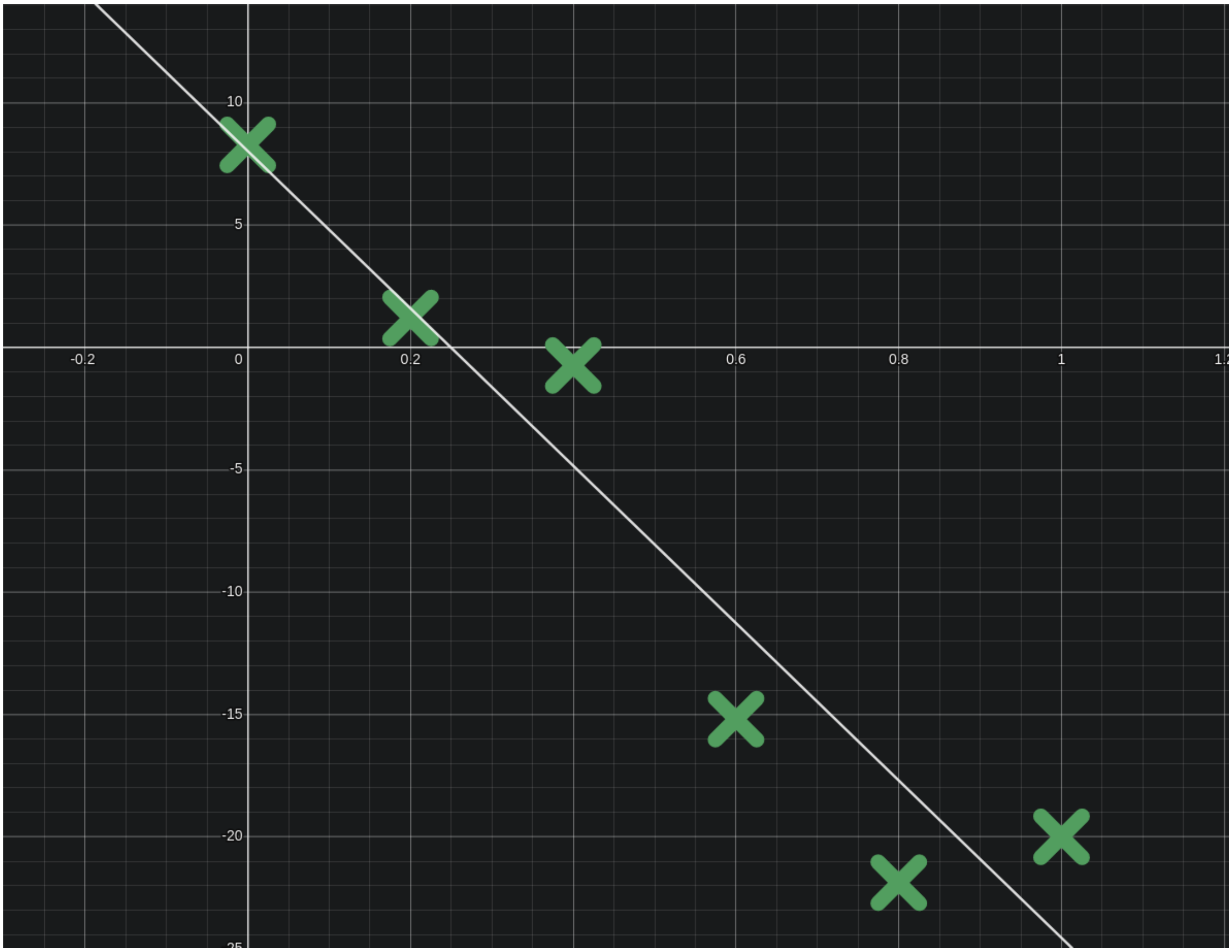
Bowl Mass: 6.9g
Plant Tissue: Carrot

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)	Ma: Differ

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)	Ma Differ
Red	1 mol	20.9	14.0	131.1	110.2	18.1	-2.8
Orange	0.2 mol	23.5	16.6	122.4	98.9	23.7	0.2
Yellow	0.4 mol	20.5	13.6	123.8	103.3	20.4	-0.1
Green	0 mol	22.6	15.7	121.1	98.5	23.9	1.3
Blue	0.6 mol	22.7	15.8	127.5	104.8	20.3	-2.4
Purple	0.8 mol	22.9	16.0	129.0	106.1	19.4	-3.5

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 it 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