

Name: _____ Period: _____

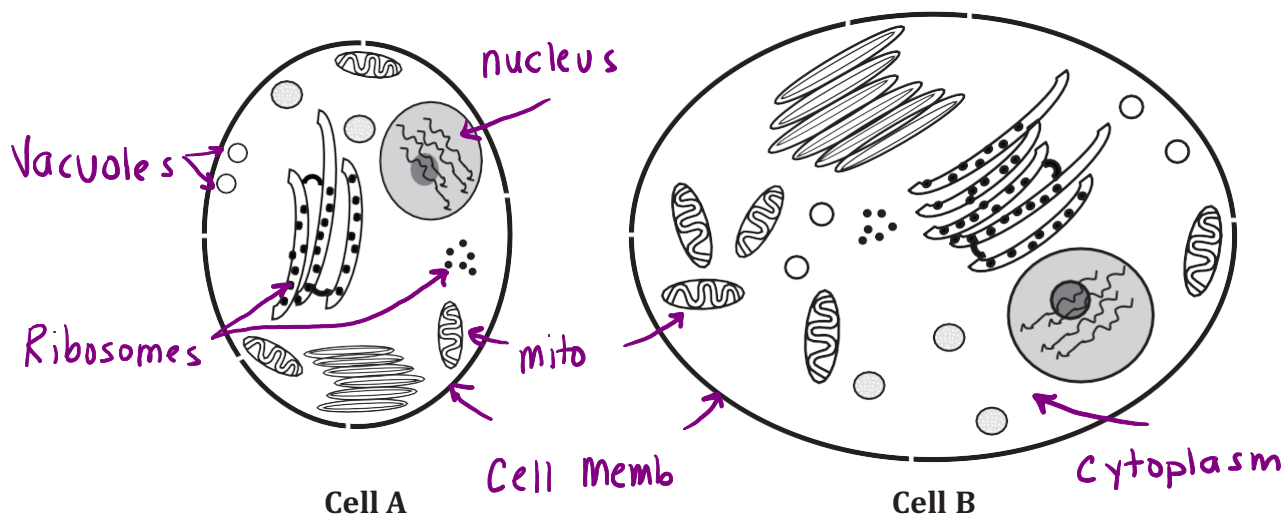
Cell Size

What determines the size of a cell?

Why?

Sometimes bigger is better—tall basketball players, more closet space, and savings accounts may come to mind. What about cells? Does having big cells make an organism bigger or better? Would having larger cells be an advantage to an organism? If so, why do cells divide rather than continue growing? Maybe there is an advantage to being small.

Model 1 – Investigating Cell Size



1. Are the cells shown in Model 1 plant or animal cells? Explain your answer.

Animal - Round shape No.. Cell wall or chloroplasts

2. Label Cell B in Model 1 with the following structures.

cell membrane	cytoplasm	nucleus
ribosomes	vacuole	mitochondria

3. Compare the smaller cell in Model 1 to the larger cell in Model 1.

- a. Which cell has a larger surface area (more cell membrane surface)?

Cell B

- b. Which cell has more channels in its cell membrane that can transport molecules (nutrients, oxygen, and waste products) in and out of the cell?

Cell B

4. Compare the smaller cell to the larger cell in Model 1.

a. Which cell has more mitochondria?

Larger (cell B) As cell grows → mito have time to reproduce inside the cell

b. Propose an explanation for why a cell would need more mitochondria.

Greater need for metabolic energy

5. What would be the consequences for a cell if the cell membrane did not have adequate channels for bringing in nutrients and removing wastes?

Not enough nutrients → cell could die

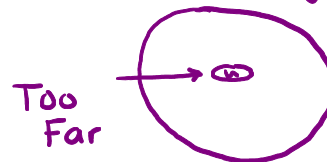
Not remove enough wastes → cell could die

6. Compare the smaller cell to the larger cell in Model 1.

a. Which cell has a larger volume? Cell B

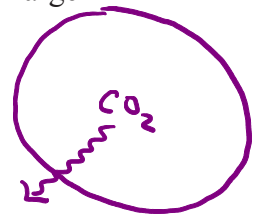
b. Imagine a glucose molecule passing through the cell membrane. Would that molecule be able to reach the mitochondria faster if the cell had a smaller volume or a larger volume?

Explain. Smaller → less cytoplasm to get through



c. As the mitochondria metabolize the glucose, they produce carbon dioxide waste. Would the CO_2 molecules be able to leave the cell faster if the cell had a smaller volume or larger volume? Explain.

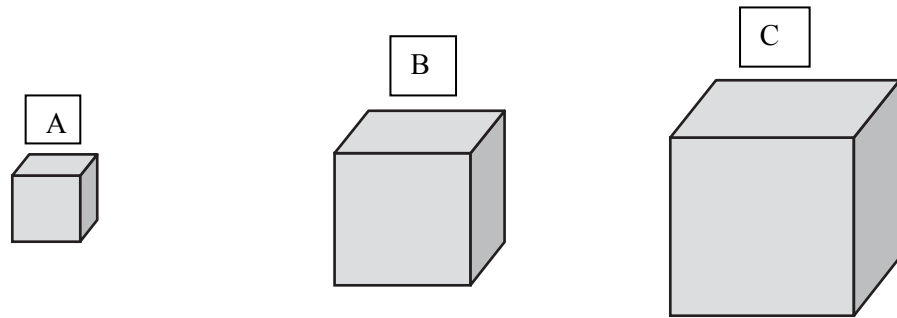
Smaller → less cytoplasm to get through



7. Consider your answers to the previous questions. Is bigger always better for a cell? Explain.

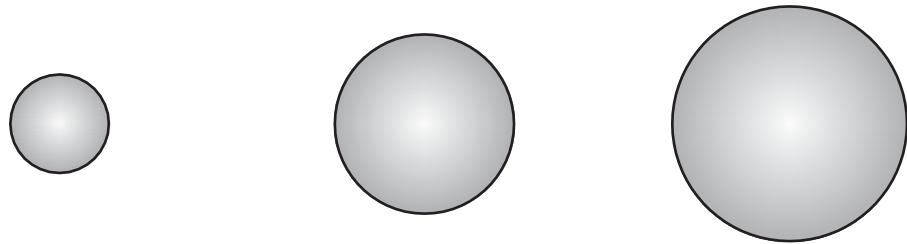
No.. If a cell is too big, materials will take too much time to move in/out of a cell





Model 2 – Comparing Shapes

	A	B	C
Side	1 cm	2 cm	4 cm
Surface area	6 cm^2	24 cm^2	96 cm^2
Volume	1 cm^3	8 cm^3	64 cm^3
Surface Area-to-Volume Ratio	6	3	1.5



Diameter	1 cm	2 cm	4 cm
Surface area	3.14	12.56	50.24
Volume	$.52$	4.18	33.4
Surface Area-to-Volume Ratio	6.04	3.0	1.5

Formula

Volume $V = \frac{4}{3}\pi r^3$

Surface area $A = 4\pi r^2$

Diameter $d = 2r$

Radius $r = \frac{d}{2}$



Sphere

$r \rightarrow$ radius
 $d \rightarrow$ diameter

getcalc.com

Formula

Volume $V = a^3$

Surface area $A = 6a^2$

Diagonal $d = \sqrt{3}a$

Edges $a = \sqrt[3]{V}$



Cube

$a \rightarrow$ edges
 $V \rightarrow$ Volume
 $d \rightarrow$ diagonal

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8. Label the sets of shapes in Model 2 with each of the following: cubes or spheres
9. Calculate the surface area and volume values that are missing in Model 2. Divide the work among the members of your group and check each other's work.



10. Consider the data in Model 2.

- a. Describe the change in the surface area of the cube when the length of the side doubles.

Increased by 4x

- b. Describe the change in the volume of the cube when the length of the side doubles.

Increased by 8x

- c. When a shape gets larger, which increases at a faster rate, surface area or volume?

Volume

12. Calculate the surface area-to-volume ratio for each shape in Model 2.
13. For all each shape set, describe the change in the surface area-to-volume ratio as the size of the shape increases.

SA/vol ration decreases

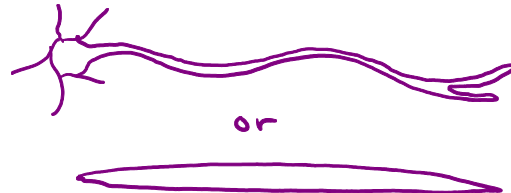


14. Is it more desirable for a cell to have a small surface area-to-volume ratio or a large surface area-to-volume ratio? Explain your answer in terms of the functions of a cell.

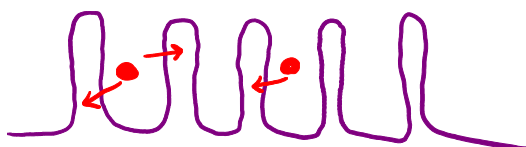
large SA/vol ratio means the cell can exchange materials faster.

15. In multicellular organisms some cells need to be large because of the functions they perform (i.e. nerve cells, muscle cells). What shape would be most desirable for these larger cells?

Long cylinders



16. Explain why the villi of the small intestines are not round, but columnar in structure.



Nutrients can enter quickly

Extension Questions

17. Propose, by means of a sketch, geometrical shapes of cells that would allow a balance of function and materials movement for each of the following situations. (*Hint*: Think about which aspect of shape would help the cell best carry out its given function.)
 - a. Long-distance communication.
 - b. Stretching.
 - c. Storage.
 - d. Covering and protecting.
 - e. Importing large quantities of material for transfer to other cells.
18. Among unicellular eukaryotes, cell sizes differ greatly. *Amoeba* and *Paramecium* organisms are animal-like protists that are heterotrophic, have no cell wall, and are several times larger than most human cells. What might be some reasons why these unicellular organisms have larger cells than cells with similar traits (heterotrophic, lacking cell walls) that are found in multicellular organisms?