Create a hypothesis about what happens to the surface area-to-volume ratio of a cell as the cell grows larger.

Hypothesis: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Next to the row marked formulas, write in the mathematical formulas that can be used to calculate the value described in the heading of each column. Use your formulas to calculate values for each of the three cell models.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Formulas: | L X W | L X W X 6 | L X W X H | L/2 | SA:V |
| Cell size (length of one side) | Area of one face | Total surface area | Volume of cell | Distance from center to edge | Total surface area to volume ratio |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 4 |  |  |  |  |  |

1. Anything that the cell takes in, such as oxygen or food, or let out, such as carbon dioxide, must pass through the cell membrane. Which of the measurements of your model cells best represents the surface area of the cell membrane?

2. The cell contents, including the nucleus and the cytoplasm, use food and oxygen and produce waste. Which measurement best represents the contents of one of you model cells?

3. As a cell grows larger and accumulates more contents, will it need more or less cell membrane to survive? Explain your answer.

4. As a cell grows larger, does the surface area-to-volume ratio get larger, get smaller, or remain the same?

5. Which cell model has the greatest surface area-to-volume ratio?

6. Why can cells not survive when the surface area-to-volume ratio becomes too small?

7. Which cell model then has the greatest chance of survival?

8. How many cells with s=1 would fit into a cell with s=3?

9. Which has more total surface area, one cell with s=3 or 27 cells, each with s=1?

10. How can the surface area-to-volume ratio be increased in a large cell?

11. Look at the figures below.

A. Measure the distance the food (dark line) diffused in to the cells.

Cell 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Cell 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

B. Measure the distance the food would have to go to get to the middle of the mitochondria.

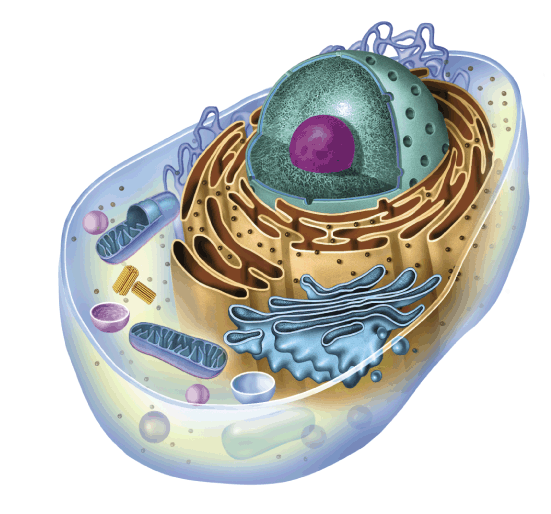
Cell 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Cell 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

C. Measure the distance the waste (CO2) has to go to get out of the cells.

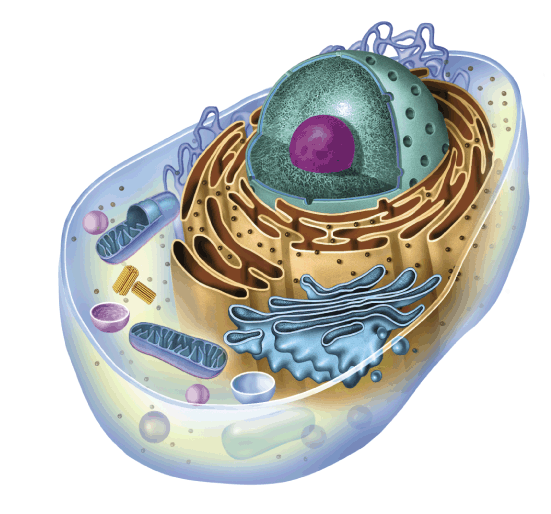
Cell 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Cell 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

D. Which cell would need more energy to move things in and out?

E. Which cell would have a better chance at surviving?



CO2



CO2