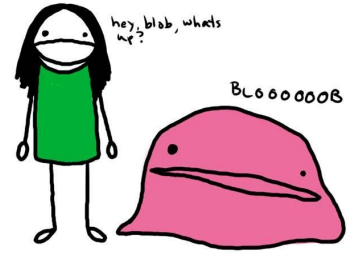


NAME _____

Why You Will Never See The Single Celled Blob on Your Street

Surface Area: Volume Lab



Question: Why can't organisms be just one giant cell?

Background:

Why don't we have gigantic cells? Why are most cells relatively the same size and shape? It's a question of surface area and volume. Surface area is a calculation of the total surface of exposed. For example, to calculate the surface area of a six-sided die, you would first calculate the area (length x width) of each of its six faces. The total area of all six exposed faces would be the total surface area. The volume is a measurement of the total amount the cell contains. The more "stuff" inside the cell, the further molecules must travel. (Volume = length x width x height). Cells with high surface area to volume ratio react at much faster rates, because more surface is available to react. Cells conduct much of the transport of substances in and out through *passive transport* across the cell membrane. A simple example of this is the experiment you are about to perform. Most living cells, however, are between 2 and 200 μm in diameter. *Why can't organisms be just one giant cell (use the idea of diffusion, cell respiration, definition of living to answer the question)?*

Diffusion limits cell size: cells require a constant supply of glucose and oxygen to carry out _____ and to produce large amounts of _____. These substances, and waste products such as carbon dioxide, move through the cytoplasm by diffusion. It has been estimated that it takes a molecule of oxygen only a fraction of a second to diffuse through the cytoplasm from the plasma membrane to the center of a typical cell that is 20 μm (micro meter 0.00002m).

2. A cell's DNA limits size: A reason why cells are small is because they usually only contain one nucleus. If a cell doesn't have enough DNA to program its metabolism (i.e. make proteins), it cannot live. In many large cells there are more than one nucleus.

3. Surface area-to-volume ratio: and that is one of the things we will be investigating today.

Note: **Surface area** = length of a side x width of a side x number of sides

Volume = length x width x height

Surface area to volume ratio = surface area / volume

Start your lab recording here

Experimental Procedure:

1. Each lab group should obtain 3 cubes. With a ruler, measure (in cm) the cubes. Calculate the surface area and volume of all the cubes.
2. Record all surface area/volume calculations in a table.
3. To a beaker, add 100 mL of vinegar.
4. Add all three of your measured cubes to the solution.
5. After 5 minutes, carefully remove your cubes from the solution.
6. Observe how far the dye has penetrated through the cube and measure in mm. (wash your hands after handling the cube)
7. Record your results in your table.
8. Repeat steps 5-7 until the cube is completely clear (keep track of the total time in the solution)
9. Record all measurements to table

Results:

Record all of your calculations.

		1cm Cube	2cm Cube	3cm Cube
Surface Area				
Volume				
Surface area to volume ratio (Surface Area ÷ Volume) =				
Trial 1	Penetration of dye			
	Penetration of dye %			
Trial 2	Penetration of dye			
	Penetration of dye %			
Time to become totally clear				

Conclusion:

Restate your results in a written explanation here, explaining the numbers above. **Then**, answer the following on a separate sheet of paper:

You must write the question.

1. Calculate the surface area to volume ratio for a “cell” with .25cm side length and for a 10cm side length “cell”.
- 1a. Make a graph that shows the relationship between side length and surface area to volume ratio for all the cell sizes (.25cm, 1cm, 2cm, 3cm, 10cm). Put side length on the x axis and ratio on the Y axis.
2. In your own words, why are most cells the same size and shape?
3. Rank the cubes, including the .25cm and the 10cm, from the largest surface area to volume ratio to the smallest surface area to volume ratio.
4. Why are most cells relatively small in size? Please include at least three reasons
5. Explain why cells have a limit to how big they can get.
6. In the introduction you learned that some cells have more than one nucleus. Why do you think that is?

Wrap up

What potential errors could have affected your experiment? (There will always be something! We are only human.)

What would you change in the future if you did this experiment again?

Share your results with another group. Did you get the same results? Did you come to similar conclusions?