Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Size Matters:**

**Understanding the Surface Area-to-Volume Ratio**

Ever wonder why cells are so small? Living cells require food, water, and oxygen and must excrete waste. This happens though a process called diffusion, or the movement of molecules across a membrane from an area of high concentration to an area of lower concentration. In the same way, oxygen enters a cell and carbon dioxide exits the cell. Cells are dependent upon diffusion and the surface area must be large enough to expel waste material at a rate to sustain metabolism.

**Surface area (SA)** is the area of material that would be needed to cover an object (e.g. the amount of wrapping paper to wrap a really expensive gift for your science teacher).

**Volume** **(V)** is the amount of space inside an object (e.g. how much water in a mug.

**Surface area-to-volume ratio (SA:V)** is the proportion of area of a material covering an object to the amount of material inside the object.

Cubes by definition, have 6 sides, each of the same length (length = s).

**SA = s2 \* 6** (# sides) for a cube.

**V = s3**or l x w x h (length x width x height, all side length s) for a cube

**Calculate the SA, V, and SA:V for each cube:**



**Cube A Cube B Cube C Cube D**

SA \_\_\_\_\_\_\_­\_\_\_\_\_\_ SA \_\_\_\_\_\_­­\_\_\_\_\_ SA \_\_\_\_\_\_­­\_\_\_\_\_ SA \_\_\_\_­­\_\_\_\_\_\_\_

V\_\_\_\_\_\_\_\_­\_\_\_\_\_\_\_ V\_\_\_\_\_\_\_\_­\_\_\_\_\_\_ V\_\_\_\_\_\_\_­\_\_\_\_\_ V\_\_\_\_\_­\_\_\_\_\_\_\_\_

SA:V \_\_\_\_\_­­­\_\_\_\_\_ SA:V \_\_\_\_\_\_\_\_\_\_ SA:V \_\_\_\_\_\_\_\_\_ SA:V \_\_\_\_\_\_\_\_\_\_

What happens to the SA:V ratio as the cube gets larger?

Do cells in your body need a high or low surface area to volume ratio? Why?

If these cubes were cells in your body, which one would have the highest rates of diffusion? Why?

As a cell grows in size, what happens to the volume of its cytoplasm relative to the surface area of its plasma membrane? (hint: is the rate of increase faster of slower?)

What is one challenge that a cell might have if it has a large volume of a cytoplasm relative to its surface area?