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| Anatomy & Physiology 12  **Why Cells are Small: SA to V ratio** | Name:  Block:  Date: |

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| Background Information |

In multicellular organisms, growth is accomplished by the production of more cells by cell division. Cell division will occur only when the cells have reached a size large enough to ensure that the resulting daughter cells will have all of the necessary materials entering (food, oxygen and water) and leaving (waste products) the cell through the cell membrane is determined by the cell’s surface area. The rate at which these materials are used within the cell depends upon the cell’s volume, or the amount of space within the cell.

To understand the sizes of cells, we first have to understand surface area to volume ratios. Let’s use a sugar cube to help explain surface area first. The surface area of the cube is calculated by finding the area (length x width) of one side, however we want to know the area of the whole surface. On a cube, there are 6 sides, so we multiply the area x 6. Volume is another simple calculation – we just multiply length x width x height

**Formulas:**

*Surface area of a cube = length x width x 6*

*Volume = length x width x height*

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| Purpose |

Determine an optimal cell shape.

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| Materials |

* Metric Ruler
* Lego (3 different Lego structures)

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| Safety |

Lego is sharp! Make sure you pick up dropped pieces and wear shoes.

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| Procedure |

*Part 1*

1. Determine the total number of cubes in each of the images below. Record this in the data table.
2. Calculate surface area and volume for each of the images below. Record this in the data table.
3. Calculate the surface area to volume ratio. Record this in the data.

**A B C D**

       

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| **Figure** | **Total number of Cubes** | **Surface Area** | **Volume** | **SA to V Ratio (SA / V)** |
| **A** |  |  |  |  |
| **B** |  |  |  |  |
| **C** |  |  |  |  |
| **D** |  |  |  |  |

*Part 2*

1. Using the Lego pieces, construct 3 different builds. They cannot be prisms!
2. Brainstorm the types of formulas you may need to calculate surface area and volume for some of the shapes of Lego you have chosen.
3. Draw a diagram of each Lego construction.
4. Measure the data required to calculate surface area and volume for each. Label this information on the diagram.
5. Calculate the surface area and volume for each. Record this in the data table. Be sure to include units!
6. Using the surface area and volume calculations, calculate the surface area to volume ratio. Record this in the data table.

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| **Figure** | **Diagram** | **Surface Area** | **Volume** | **SA to V Ratio (SA / V)** |
| **1** |  |  |  |  |
| **2** |  |  |  |  |
| **3** |  |  |  |  |

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| Follow up Questions |

*Part 1*

1. What happened to the surface area as the size increased?
2. What happened to the volume as the size increased?
3. What happened to the surface area to volume ratio as the size increased?
4. Now imagine you’re looking at a very large cell. Next to it is a very small cell. Which one has a larger surface area to volume ratio?

*Part 2*

1. Which figure had the highest SA/V ratio? Is this what you hypothesized?
2. Why is a low SA/V ratio limiting to a cell? Refer to intracellular distances in your answer!
3. Based on what you learned today, in what way may multicellular organisms have an advantage over single-celled ones?
4. Consider a mouse and an elephant. If both were left in the cold overnight, which would be in more danger of freezing to death? Why?