NAME\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9th Grade DATE\_\_\_\_\_\_\_\_\_\_\_\_\_\_

AP Biology: SCSh, BIG IDEA 2 and 4 (SB1 and 4)

Honors Geometry: MGSE9-12.G.SRT.1, MGSE9-12.G.GMD2, MGSE9-12.G.GMD3, MGSE9-12.G.GMD4

**Complete this in your STEM Journal and use your STEM Journal Rubric.**

**STEM PBL Question:** How do we calculate surface area and volume of something as small as a cell and large as a wetland? How do surface area and volume values relate to each other?

**Surface Area to Cell Size**

Cell size and shape are important factors in determining the rate of diffusion. Think about cells with specialized functions, such as the epithelial cells that line the small intestine or plant root hairs. Some questions to ponder: What is the shape of these cells? What size are the cells? How do small intestinal epithelial and root hair cells function in nutrient procurement?

**Surface Area and Volume Equation from your AP Biology Equation Sheet**



**Materials:**

* 3 agar cube(s)
* 1 clear plastic ruler
* 1 glass dish
* Enough HCl solution to cover the agar cubes once placed in the dish

**Procedure**

1. Record the initial dimensions of each agar cube in the table provided below.
2. Place the agar cubes in the glass dish with HCl.
3. Observe the initial color.
4. Pour enough solution to cover the agar cubes. Start timer immediately.
5. When the small cube completely changes color stop the timer. The next steps are time sensitive – be efficient.
6. Remove the cubes from the HCl.
7. Measure the distance of color change from the outside of the cube inward.
8. Record your observations and measurements in your STEM Journal.
9. Write down the variables in your STEM Journal.

Table 1. Phenolphthalein Agar Cubes Diffusion

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Cube Size (cm)** | **Volume of Cube** | **Area of Cube** | **Distance of Diffusion (cm)** | **Surface Area to Volume Ratio** | **Rate of Diffusion (cm/min)** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

**Make your Claim: Write down which cube had the greatest rate of diffusion.**

**Analysis Questions to be covered in your conclusions – written in paragraph form.**

1. Which cell has the largest surface area to volume ratio? How does this relate to the rate of diffusion that occurred?
2. Which cell has the smallest surface area to volume ratio? How does this relate to the rate of diffusion that occurred?
3. What type of cell would be the most efficient in its metabolic functions and communication with other cells? Why?
4. What process do cells undergo to maintain the proper surface area to volume ratio?

**Wetland Extension**

Surface area of the school that drains into the wetland = \_\_\_\_\_\_\_\_\_m2

 \*\*\*use the map provided to calculate the total surface area of the school.

Surface area of the wetland = 294.93m2

Volume of the wetland (assuming it is a cone) = 4614.71m3

1. The last rain event recorded by the school weather station was 1.9in. After converting inches to the metric system equivalent, use your knowledge to determine how much water drained into the wetland.
2. Based on your calculations above, under the assumption that the wetland is an upside down cone shape, determine how much the water level would raise from a 1.9in rain event.
3. Research and summarize the importance and functions of retention ponds.
4. After your research explain whether or not you think this is a good ratio of impervious area to wetland area and/or volume.
5. What impact(s) could large rain events have on retention ponds and their functionality?
6. In recent years, a majority of Paulding County was in a level D4 for current drought conditions, which means we are in an exceptional drought. The retention pond/wetland area would still have water. How might droughts impact the functionality of retention pond areas?

**Closing Discussion for class:** Compare the ratio you calculated for the agar cubes to the ratio of the wetland. What conclusions can you make how these two very different systems function?