Name:_____

# Biology K/H: Investigating the Limits of Cell Growth

Problem: What is one factor that limits cell growth?

Hypothesis:

Background:
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 the necessary materials and structures for survival.
The rate of exchange of 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. A number of factors, such as the reduction of food and changes in temperature can cause cells to stop growing and dividing.

Materials:
- Plastic spoon
- 2 agar phenolphthalein blocks or precut blocks of 1 cm, 2 cm and 3 cm
- Beaker
- Sodium hydroxide solution (wear eye shields)
- Plastic ruler

Procedure:
1. Place a 3 cm block into beaker.
2. Using a ruler, cut your second block into a 2 cm block and 1 cm block. If using pre-cut blocks go to next step.
3. Place the blocks (3cm, 2cm and 1cm) into the beaker.
4. Teacher will pour sodium hydroxide solution into the beaker.
5. Allow blocks to soak in solution for 5 minutes undisturbed.
6. While blocks are soaking use the formulas given below to determine surface area, volume, and surface area-to-volume ratio in data table 1.
7. After 5 minutes, discard sodium hydroxide solution in sink. Be careful not to lose blocks.
8. Pour blocks onto dissecting tray. Use ruler to cut blocks in half.
9. Collect data in data table 2.

Data and Observations:

Observations:

Data table 1

| Cube Size | Surface area ($cm^2$) | Volume ($cm^3$) | Surface Area-to-Volume Ratio |
|---|---|---|---|
| 3 cm | | | |
| 2 cm | | | |
| 1 cm | | | |

Data table 2

| Cube Size | Distance Pink Color Has Diffused into Block (mm) | Distance from End of Pink Color to Block's Center (mm) |
|---|---|---|
| 3 cm | | |
| 2 cm | | |
| 1 cm | | |

Calculations: Show step-by-step calculations in lab report for each block
Surface area = number of surfaces x length x width
Volume = length x width x height
Surface area- to- volume ratio = $\frac{\text{Surface area}}{\text{Volume}}$

Results and Conclusion:

Post-lab Questions: Answer in complete sentences.

1. Which block has the greatest surface area?

2. Which block has the greatest surface area-to- volume ratio?

3. In which block did the pink color diffuse the most? Explain.

4. If the blocks were actual cells, which would be the most efficient in terms of permitting materials to enter and leave the cell?

5. Based on this investigation, what one factor may limit the growth of an individual cell?

6. What happens to the surface area-to-volume ratio of a cell as it grows?

7. Calculate the surface area-to-volume ratio for cells that are 0.1cm and 0.01cm size. Show calculations for both.

8. Which has the greater surface-to-area ratio the 0.1 cm or .01 cm size?

9. Propose an explanation that states why the growth of a cell decreases as its size increases.