**Revised Assessment Rubric**

**This assessment will evaluate the students’ ability to use mathematical skills such as calculation of surface area and volume, which they will learn how to do in class; to evaluate an important structure - function relationship in biology, namely, the fact that the surface area of the cell ultimately limits the growth of the cell’s volume. The students will learn about the role of the cell membrane in regulating what enters and leaves the cell prior to this lesson.**

**The goal is for the students to develop the ability to synthesize information by connecting the structural limitation of surface area growth as it is related to volume and the role of the cell membrane in controlling the entry of nutrients and removal of waste from the cell. Specifically, cells cannot become too big because they will not have the surface area required to adequately feed the cell. The complexity of the lesson has been limited because it is planned as a 1 hour activity.**

**Assessment Rubric**

 (a) Knowledge and conceptual understanding – Questions 1 -3

**(1)** Students will be able to calculate the surface area and volume of hypothetical cells shaped like cubes.

(10 points)

**Full points (10 pnts) - students correctly calculate all surface area and volumes and ratios as required in the graph..**

**Partial points (5 pnts) - will be allocated according to the students demonstrating correct use of formulas even if there are arithmetic errors.**

**No points – students do not demonstrate correct use of formulas.**

**(2)** Students will be able to graph the rate of change of the surface area and volume of the cells as they get bigger.

(10 points)

**Full points - students will receive 5 points for correctly identifying scales for dependent and independent variables (2.5 points each). Another 5 points will be received for correctly plotting each data point, i.e. surface Area/Volume ratio.**

**Partial Points  ( 5 pnts) – will be given if students reverse scale but plot points correctly or if they identify the scales but incorrectly plot the points.**

**No credit – if both scales and plotting is incorrect.**

**(3)**  a. Think about the three types of cells you studied in laboratory 3, protist, plant and animal cells, of the three, the hypothetical cell would most closely resemble which type of cell.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(2pnts) Why\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(2 pnts)

            b. Are the above cells prokaryotic or eukaryotic cells? (1 pnt)

            c. Give at least two examples of differences between the three types of cells above.(6pnt)

            d. Describe the structure of the cell membrane. (4 pnts)

**Students will receive full points for the correct response in each case**

**Students will not receive partial credit for incorrect answers.**

(b) Thinking and other skills – Question 4 - 5

**(4)** Students will interpret the graphical data generated by comparing the rate of change of surface area to that of volume. They will use their stated comparison to suggest an answer to the question of why cells are small. (10 pnts)

**Students will receive full credit for correct interpretation of the data**

**Students will receive at least half credit if they can stated the observed trend but give the incorrect interpretation of the data**

**(5)** Briefly explain the function of the plasma membrane of the cell, relate this function to your earlier description of the structure of the plasma membrane.(10 pnts)

**Students will receive full points if they connect the structure to the function correctly**

**Students will receive half of the points if they are able to complete at least one aspect successfully.**

 (c) Attitudes, values, dispositions and habits of mind - Question 6

**(6)** Based on your observations of the effect of increasing cell size on surface area and volume and your description of the structure and function of the plasma membrane suggest an explanation of why cells are small? Students will then critique the answers generated as a means of assessing the validity of their answers.

(10 points)

**Students will receive full points if they are able to look at responses given by other groups to determine a consensus. If the students had errors in their own logic they will receive points for being able to identify these errors via the group discussions. Students who arrived at the correct conclusion will receive full points for their ability to explain the errors they observed in other groups.**

**Assessment Rubric**

(1) Students will be able to calculate the surface area and volume of hypothetical cells shaped like cubes.

(30 points)

**Full points - students correctly calculate all surface area and volumes and ratios as required in the graph. Points will be lost per incorrect calculation.**

(2) Students will be able to graph the rate of change of the surface area and volume of the cells as they get bigger.

(10 points)

**Full points - students will receive 5 points for correctly identifying scales for dependent and independent variables (2.5 points each). Another 5 points will be received for correctly plotting each data point, i.e. surface Area/Volume ratio.**

 (3) Students will interpret the graphical data generated by comparing the rate of change of surface area to that of volume. They will use their stated comparison to suggest an answer to the question of why cells are small. Students will then critique the answers generated as a means of assessing the validity of their answers.

(20 Points - 4 points each)

(1) Think about the three types of cells you studied in laboratory 3, protist, plant and animal cells, of the three, the hypothetical cell would most closely resemble which type of cell.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Why\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Students will receive full points (4 points) for application of previous information regarding cell structure if they can identify the cube shaped cells as most closely approximating plant (2 points) cells because of their rigid shapes (2 points).**

(2) In the smaller cells, that is cells between 1 - 5 cm long, as the length increases how does the ratio of surface area to volume change. What does this tell us about the relationship between surface area to volume in smaller cells?

­­­­­**Students will receive full points if they can indicate that the ratio is largest in smaller cells (2 points) and as the cells get bigger the ratio decreases but is still greater than one (2 points).**

(3) In the larger cells, that is cells between 7 - 10 cm long, as the length increases how does the ratio of surface area to volume change. What does this tell us about the relationship between surface area to volume in larger cells? (3 points)

**Students will receive full points if they indicate that in larger cells the ratio is smaller. Indicating that as cells get bigger the ratio decreases to less than one.**

 (3b)Based on your answer to the question above, small cells have a \_\_**larger**\_\_(1 point)

surface to volume ratio compared larger cells.

(4) Briefly describe the function of the plasma membrane of the cell. (4 points)

**Students will receive full points if they indicate that the plasma membrane controls what enters and leaves the cell. It allows nutrients and oxygen in and must let waste out.**

(5) Based on your observations of the effect of increasing cell size on surface area and volume and your description of the function of the plasma membrane suggest an explanation of why cells are small?

**Students will receive full points if they indicate that  (a) smaller cells have a larger surface to volume ratio (1 point). Therefore, there must be an advantage to the cells of having a larger surface to volume ratio (1 point). This is most likely because the plasma membrane that covers the surface of the cell is better able to supply nutrients and remove waste from smaller cells than larger cells (2 points).**