Elephant-Sized Amoebas?

An amoeba is a single-celled organism. Like most cells, amoebas are microscopic. Why can’t amoebas grow as large as elephants? If an amoeba grew to the size of a quarter, the amoeba would starve to death. To understand how this can be true, build a model of a cell and see for yourself.

Objectives

Explore why a single-celled organism cannot grow to the size of an elephant.

Create a model of a cell to illustrate the concept of surface area–to-volume ratio.

Procedure

1. Cut out each cell model, fold the sides to make a cube, and tape the tabs on the sides. These paper models represent the cell membrane, the part of a cell’s exterior through which food and wastes pass.

2. Fill in the data table. Use each formula to calculate the data about your cell models. Record your calculations in the table.

3. Carefully fill each model with fine sand until the sand is level with the top edge of the model. Find the mass of the filled models by using a scale or a balance.

4. Record the mass of each filled cell model in your Data Table for Measurements. (Always remember to use the appropriate mass unit.)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Cell** | **Length of side** | **Area of one side** | **Total surface area of cube cell** | **Volume of cube cell** | **Mass of filled cube cell** |
| A |  |  |  |  |  |
| B |  |  |  |  |  |
| C |  |  |  |  |  |
| D |  |  |  |  |  |

**Data:**

Analyze the Results

1. **Compute** the Ratio of **total surface area to volume** for all 4 cells. Use the data from your Data Table for Measurements to find the ratios for each of your cell models.

A=

B=

C =

D=

1. **Compute** the Ratio of **total surface area to mass** for all 4 cells. Use the data from your Data Table for Measurements to find the ratios for each of your cell models.

A=

B=

C =

D=

1. Constructing Tables Make a data table **showing length of side, the ratio of total surface area to volume (#1), and Ratio of total surface area to mass (#2).**

(Insert Table Here)

Draw Conclusions: Answer in COMPLETE Sentences

1. Making Connections What did the paper box represent in this model making lab? What did the sand represent?

1. Interpreting Information As a cell grows larger, what happens to the ratio of total surface area to volume?

1. Interpreting Information As a cell grows larger, what happens to the total surface area–to-mass ratio?

1. Drawing Conclusions Which is better able to supply food to all the cytoplasm of the cell: the cell membrane of a small cell or the cell membrane of a large cell? Explain your answer.

1. Evaluating Data In the experiment, which is better able to feed all of the cytoplasm of the cell: the cell membrane of a cell that has high mass or the cell membrane of a cell that has low mass?

1. Challenge Would a cell that was (1x1x8) have the same results as a cell that was (2x2x2)? Explain your reasoning.