ScienceCube

Reasons for Cell Division

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1. Understand the relationship between surface area and volume that changes with cell size.

2. Understand the relationship between cell size and the rate of material exchange.

Fundamental Concept

1. Growth and Cell Division

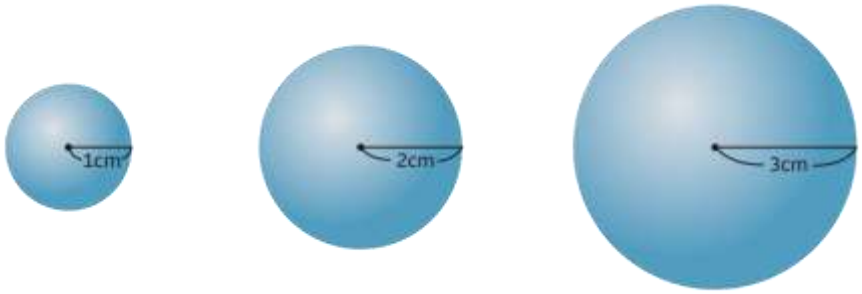
Growth is the phenomenon where a young organism grows in size, and this growth occurs through an increase in the number of cells via cell division.

2. Reasons for Cell Division

① As the cell size increases, $\frac{the\ surface\ area}{volume}$ (surface area per unit volume) decreases.

② Since the exchange of materials into and out of the cell occurs through the cell membrane, a relative decrease in surface area would hinder normal cell functions.

③ Therefore, as the cell size increases, cells need to divide to increase the surface area for material exchange.



Surface Area	12.56 cm^2	50.24 cm^2	113.04 cm^2
Volume	4.19 m^3	33.49 cm^3	113.04 cm^3

< Relationship between Cell Volume and Surface Area>

3. Growth Characteristics of Plants and Animals

① Plant Growth

Occurs continuously throughout life, with growth happening at the growth points (length growth) and the cambium (volume growth).

② Animal Growth

After reaching a certain size, animals no longer grow, and growth occurs throughout the entire body.

The growth rate varies depending on the growth period and body part.

Experiment

Materials Needed

Interface, Science# program, Conductivity sensor, 1L beaker, Three 500mL beakers, Ruler, Knife, Salt (sodium chloride), Agar powder, Distilled water, Aluminum foil (or plate), Filter , paper, Tissue, Glass rod, Scale, Alcohol lamp, Tripod, Wire mesh, Lighter, Milk carton (250mL)

Experiment Preparation

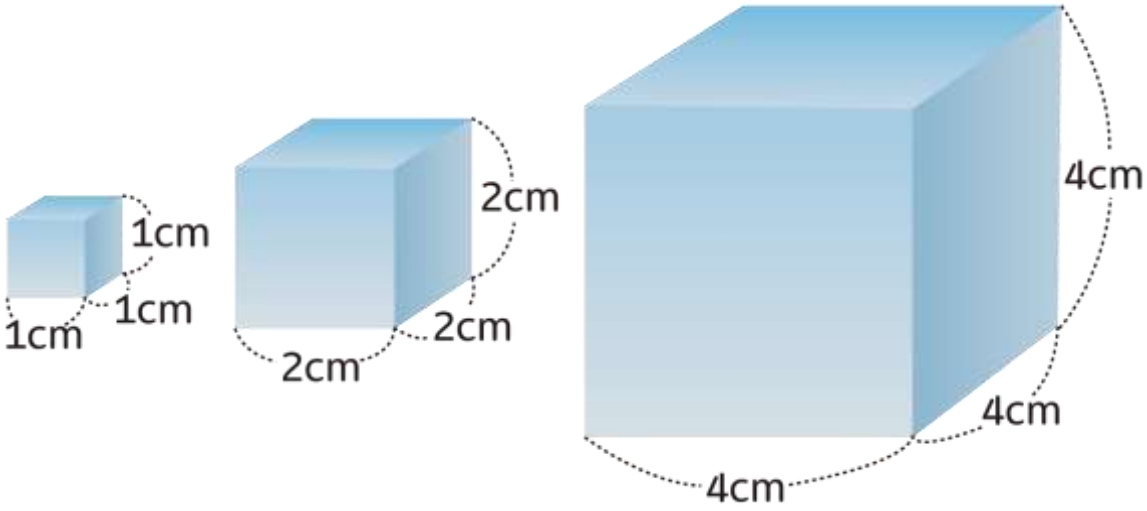
[Making Agar Pieces]

1. Add 600mL of distilled water and 12g of agar powder to a 1L beaker, stirring with a glass rod to prevent solidification while heating. (It doesn't need to boil completely.)
2. Add 45g of salt and continue stirring while heating.

3. After cooling the agar solution slightly, pour it into three milk cartons.
4. Store the solidified agar blocks in a refrigerator at around 4°C.
5. Cut the edges of the solidified agar with a knife and place them on aluminum foil. (Cover with plastic wrap when not in use to prevent drying.)

[Cutting Agar]

6. Cut the solidified agar into three 4cm cubic blocks.
7. Cut one block into eight 2cm cubic blocks.
8. Cut another block into sixty-four 1cm cubic blocks.
9. Calculate the surface area, volume, and surface area-to-volume ratio for each set of 1, 8, and 64 agar cubes.

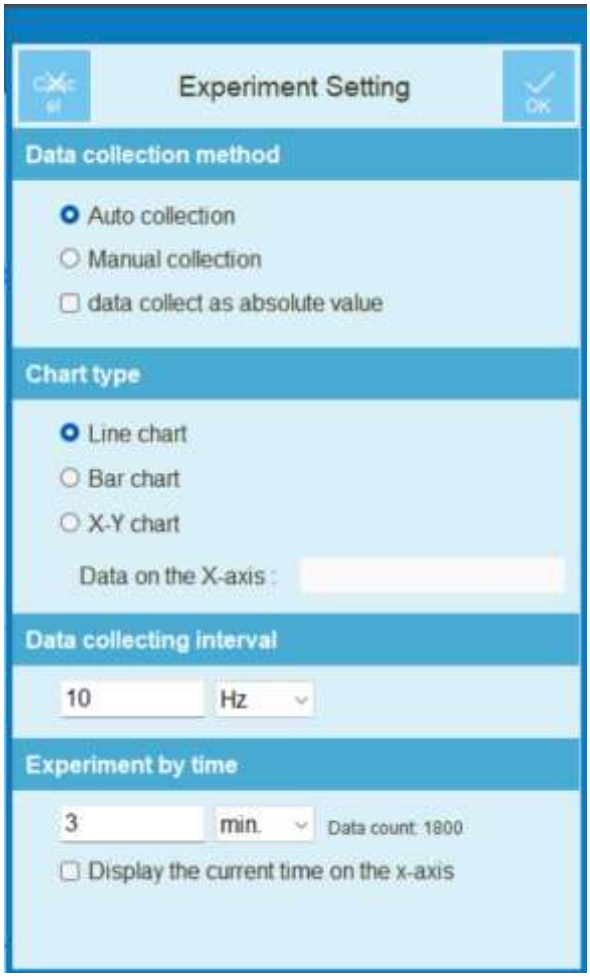


Interface Setup

1. Run the Science# program.

2. Connect the conductivity sensor to the interface. (Set the conductivity sensor to its maximum measurement range.)

3. Press to set up the experimental environment as shown below or press for automatic setup.



[Automatic Setup]

Data Collection

[Single 4cm Agar Cube]

1. Fill a 500mL beaker with 350mL of distilled water, insert the conductivity sensor, and press to start data collection..
2. After waiting for about 10 seconds, carefully place one 4cm agar cube into the beaker.
3. Stir the water with the conductivity sensor in a circular motion, ensuring the sensor does not touch the sides of the beaker. Stir slowly and evenly from the bottom up.
4. Once data collection is complete, rinse the conductivity sensor with distilled water and dry it with filter paper..

[Eight 2cm Agar Cubes]

Repeat steps #1 to #4 for eight 2cm agar cubes..

[Sixty-Four 1cm Agar Cubes]

Repeat steps #1 to #4 for sixty-four 1cm agar cubes.

Data Analysis

Recording Data

1. Represent the changes in conductivity according to the size of the agar pieces using a graph.

2. Describe what the slope of the graph indicates when the agar pieces are added.

3. Record and organize the experiment results in a table when the size of the agar pieces changes.

Size	Surface Area (cm^2)	Volume (cm^3)	Surface Area-to-Volume Ratio	Increase in Surface Area-to-Volume Ratio	Material Exchange Rate	Increase in Material Exchange Rate
4cm (1 piece)				↓ ( ) times ( )		↓ ( ) times ( )
2cm (8 pieces)				↓ ( ) times ( )		↓ ( ) times ( )
1cm (64 pieces)						

Data Application and Extension Activity

1. Describe what the agar pieces represent in the experiment.

2. Describe how the conductivity values changed during the experiment and explain why these results occurred.

3. Complete the following sentences by filling in the blanks with "increase" or "decrease."

- As the cell size decreases, the surface area to volume ratio ( ) .
- As the cell size decreases, the rate of material exchange ( ) .

4. Explain why cells must divide based on the experimental results.

5. Describe the phenomena that occur as a result of cell division.

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Report
(For Teachers)
Report
(For Students)