Science 10 Unit C: Biology

Surface Area to Volume Ratio

Review: Completethe following table. Make sure to statewhether these mechanisms are passive or active.

Mechanism for Crossing the cell Membrane	Brief Description	Passive or Active
Diffusion		
Osmosis		
Facilitated Diffusion		
Active Transport		
Endocytosis		
Exocytosis		

Review: Circle the correct statements

Diffusion is a process that:

a) Occurs in liquids and gases

b) Only occurs in liquids

c) Uses energy

d) Uses no energy

e) Occurs from low concentration to highconcentration

f) Occurs from high concentration to lowconcentration

g) Results in an even distribution of molecules

h) Only occurs with small molecules like water

i) Is more rapid at low temperatures

j) Is more rapid at high temperatures

Review: Circle the correct statements.

Osmosis:

a) Is a special kind of diffusion

b) Occurs only in gases

c) Us the diffusion of water molecules only

d) Is the diffusion of water molecules from a high concentration of water to a low concentration of water.

e) Requires a semi permeable membrane

f) Requires energy

g) Results in an even distribution of water molecules

h) Results in an even distribution of salt molecules

Review: Three bottles are filled with three different solutions. One with distilled water, one with 0.9% salt solution and the third with 9.0% salt solution. A few dried apricots are placed in each of the three bottles and left in solutions for an hour. The apricots in bottle A stay the same, the apricots in bottle B shrink and the apricots in bottle C swell.

a) Which bottle contains the most concentrated solution?

b) Which bottle contains water?

c) Which bottle contains an isotonic salt solution?

d) Which bottle contains the hypotonic solution?

Is Bigger Better?

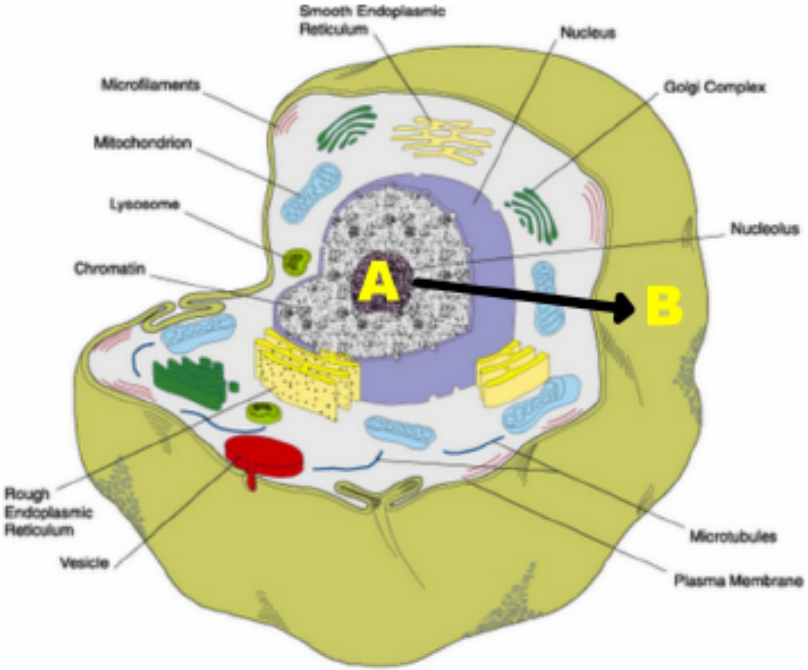
Hey, why are cells so small?

Why do we have lots and lots of small cells, instead of fewer big cells?

Isn't it better to be big?

Not if you're a cell...

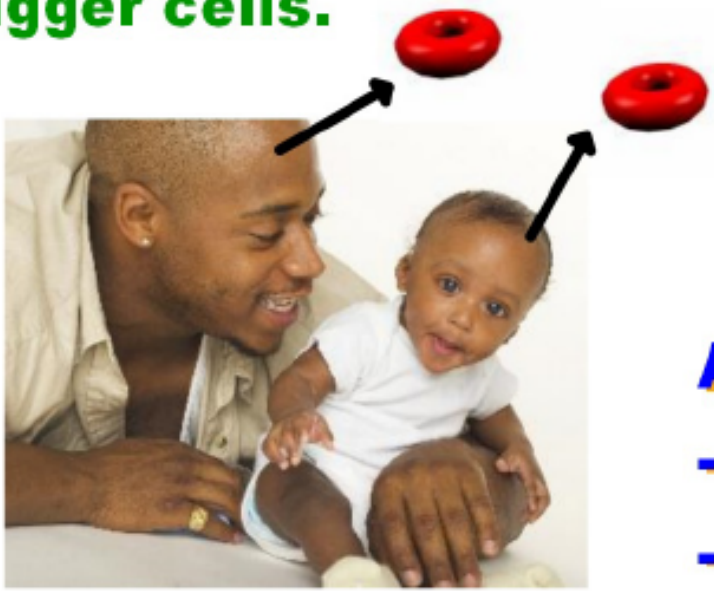
As a cell grows, information still needs to be communicated from the nucleus to all parts of the cell.



If a cell grows too large, nutrients and other chemicals take too long to reach all parts of the cell, and the cell may not respond quickly enough to changing conditions, thereby perishing.

Therefore, cells like to stay small. It keeps all of the organelles close together.

ex) Blood cells from a baby are the same size as blood cells from an adult. An adult has more cells, not bigger cells.



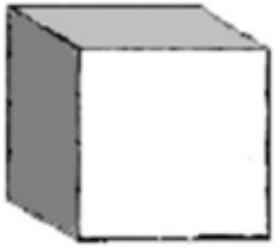
Average cell sizes (for fun)

- **Ostrich ovum 100. mm**
- **Human ovum 0.100 mm**
- **Red blood cell 0.007 mm**

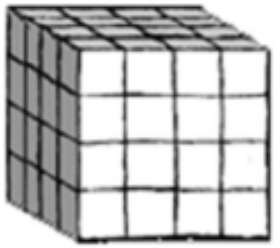
A greater number of smaller cells are more efficient than one big cell because they have a large surface area to volume ratio.

Cells must get everything they need from the surrounding fluids, thus more contact with the surrounding environment is better!!

Example: Notice that the cells occupy the same amount of space (volume) but because they are split the smaller cells have more surface area.



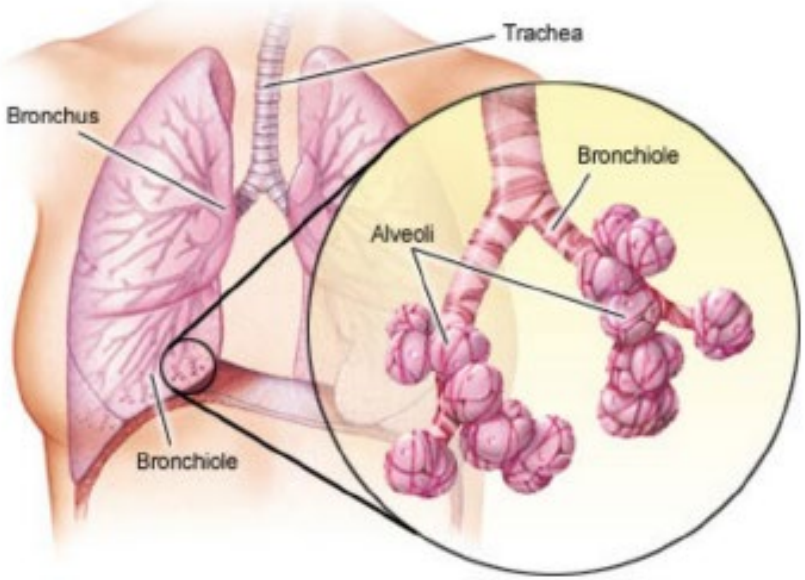
Cell A



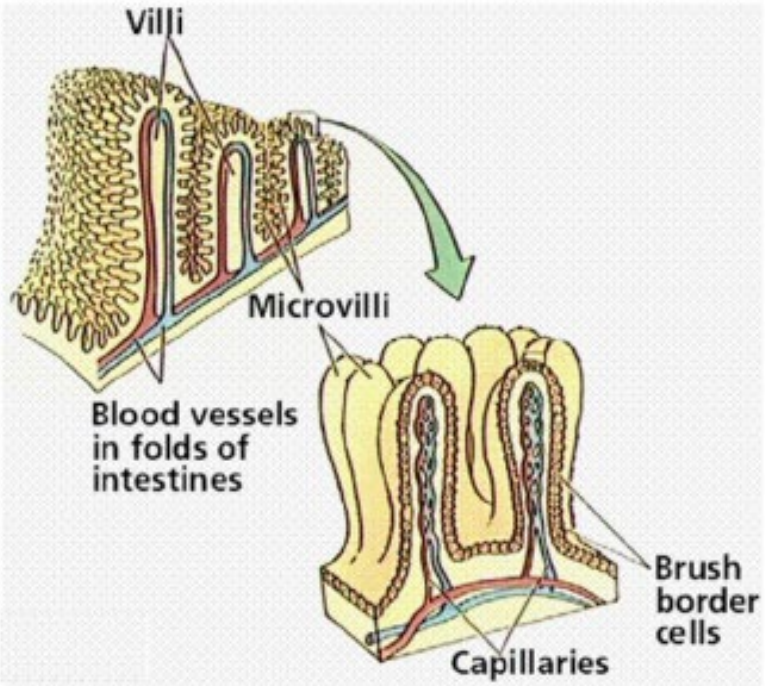
Cells B

A large surface area is needed in living things where absorption is critical.

ex) Air sacs in lungs (alveoli)



ex) Villi in the small intestine



Surface area may be increased without sacrificing volume by:

-elongation (eg. root hairs)

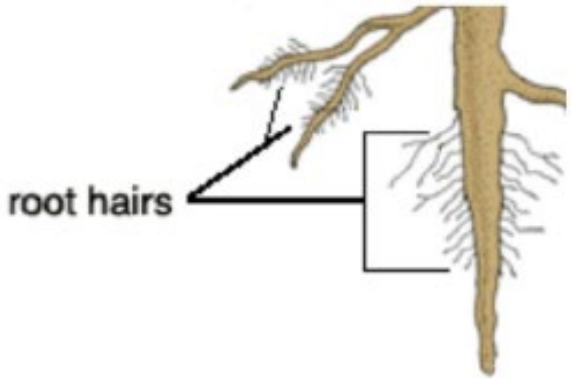
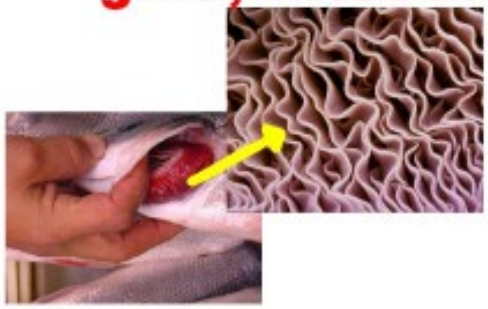
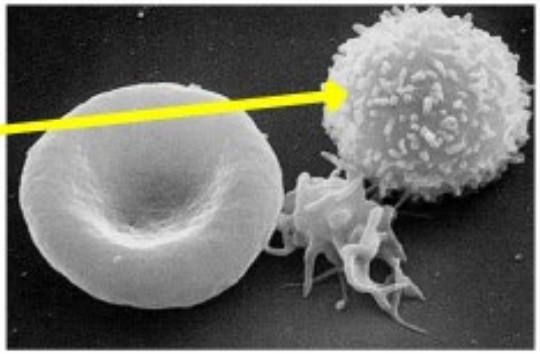


Figure 3b. Root hairs

-folding surfaces (eg. gills, intestinal villi)



-using projections on surfaces (i.e. microvilli on cells)



Calculating Surface Area to Volume Ratio

1. Determine the surface AREA of an object:

ex) Calculate the surface area of the following shapes:

a) a cube with side length of 2 cm

b) a rectangular prism with dimensions 1 cm x 2 cm x 4 cm.

2. Determine the VOLUME of the object:

ex) Calculate the volume of the following shapes:

a) a cube with side length of 2 cm

b) a rectangular prism with dimensions 1 cm x 2 cm x 4 cm.

3. Divide to get the surface area to volume ratio:

ex) Calculate the surface area to volume ratio of the following shapes:

a) a cube with side length of 2 cm

b) a rectangular prism with dimensions 1 cm x 2 cm x 4 cm.

ex) Determine the surface area to volume ratio of a sphere of radius 2 mm.

Hint: $SA = 4\pi r^2$

$V = 4/3\pi r^3$

Large SA/V ratios are good because…

The larger the ratio:

-the more surface area for a given volume

-the better the cell's ability to exchange materials with its environment

This explains why the size of single-celled organisms is limited, whereas multicellular organisms can become quite large.