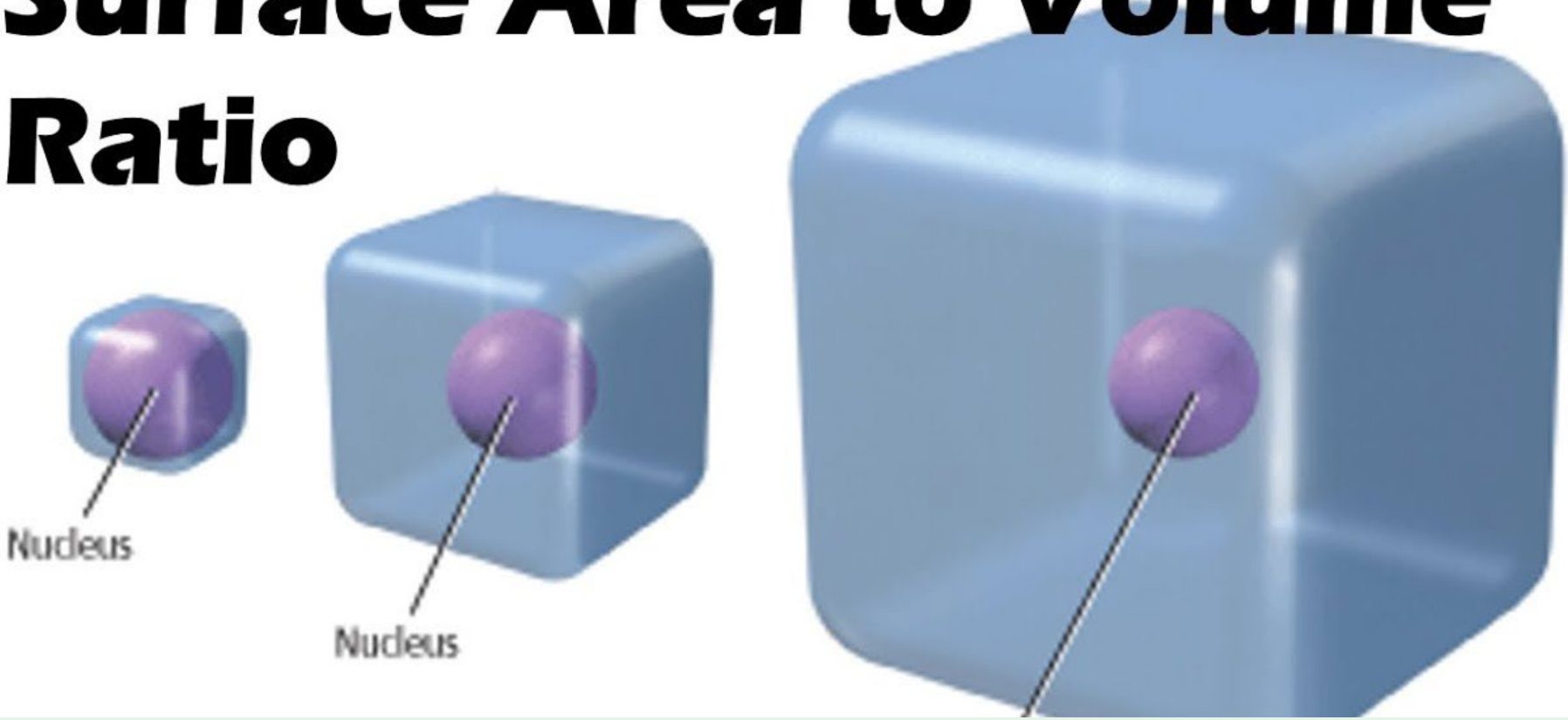
Surface Area to Volume Ratio



SCIENCE 10 UNIT C: BIOLOGY

Surface Area To Volume Ratio

REVIEW ACTIVITY: TABLE

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

REVIEW ACTIVITY: QUESTION

- Three bottles are filled with different solutions. One has distilled water, one has 0.9% salt solution, and one has 9.0% salt solution. One dried apricot is placed in each of the three bottles and left there for an hour.
  - Bottle 1's apricot stays the same
  - Bottle 2's apricot shrinks
  - Bottle 3's apricot grows

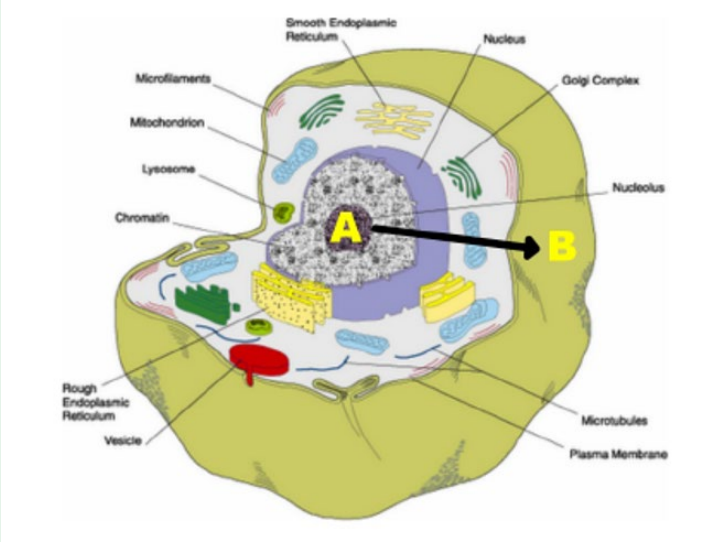
- 1. Which bottle contains the 9.0% salt solution?
- 2. Which bottle contains plain water?
- 3. Which bottle contains the 0.9% solution?

IS BIGGER BETTER?

- Why are cells so small?
- Why do we have lots of small cells instead of a few big ones?
- Isn’t it better to be big?

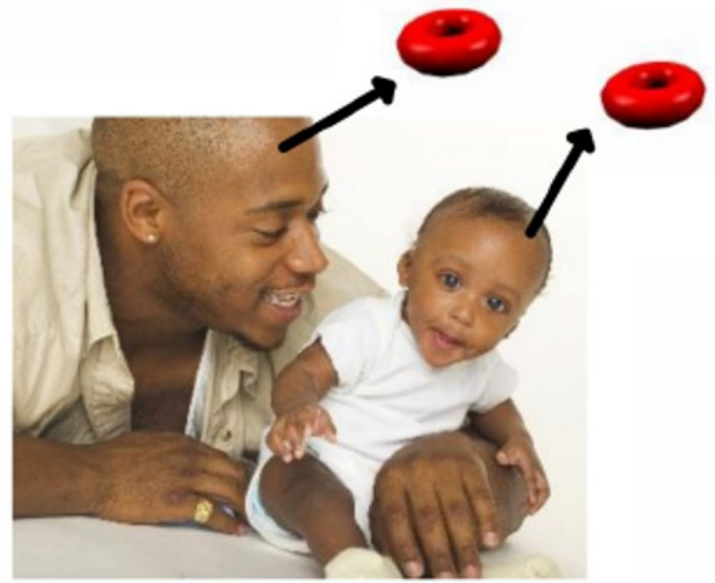
CELLS AND SIZE

- Information from the Nucleus takes **longer** to reach its destination as cells get bigger
- If a cell gets too large, chemicals and information take too long to reach all parts of it
- If a cell takes too long to respond to conditions, it will die



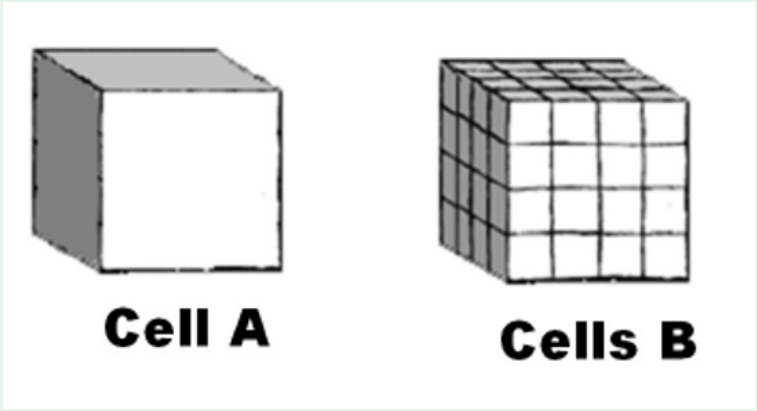
CELLS AND SIZE

- For this reason, cells like to stay small.
- For example, babies and adults have the same size of blood cells. Adults just have more.



CELLS AND SIZE

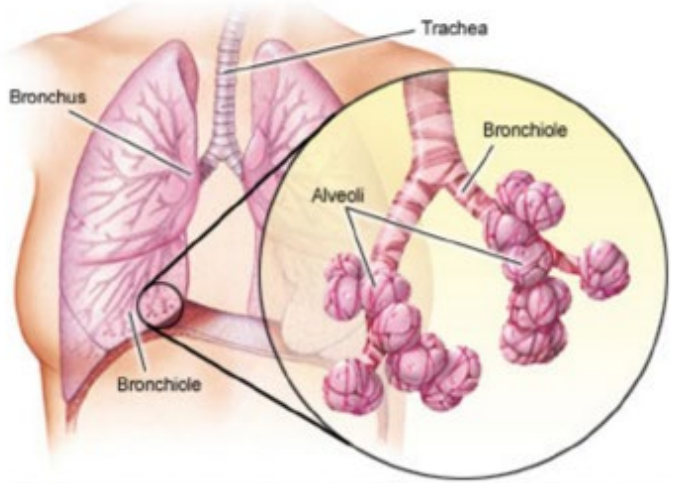
- Having more small cells is **more** efficient than a few larger cells because they have a **large surface area compared to their volume**
- Having a high **surface area to volume** ratio is key to **efficient exchange** with the environment



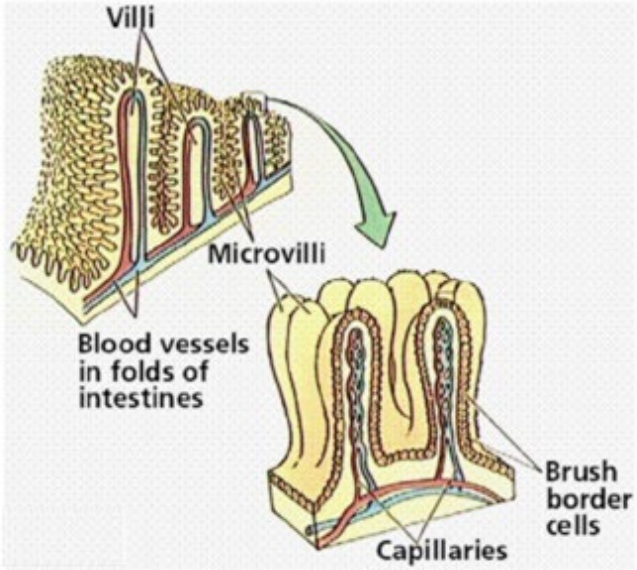
SURFACE AREA/VOLUME

- We see this priority for high surface area everywhere that exchange is needed

ex) Air sacs in lungs (alveoli)

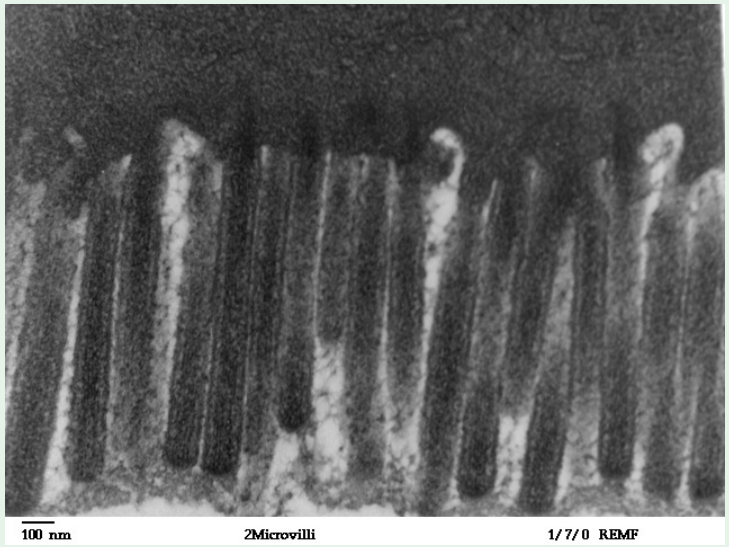


ex) Villi in the small intestine

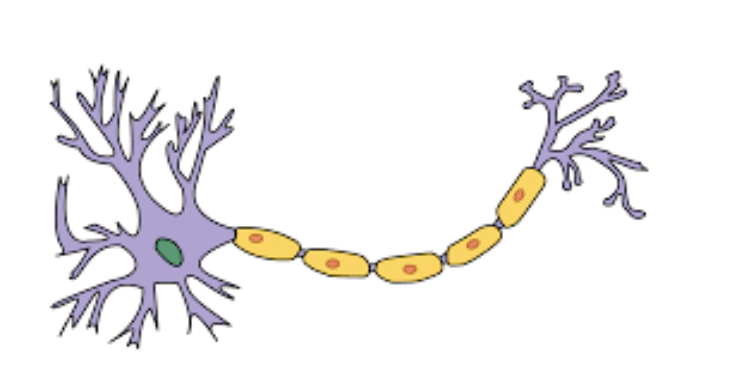


SURFACE AREA/VOLUME

- Strategies for increasing surface area
  - **Elongation** *(e.g. root hairs)*
  - **Folding** surfaces *(e.g. gills, intestinal villi, brain)*
  - **Projections** from surfaces (*e.g. microvilli on cells)*



SURFACE AREA EXAMPLES



CALCULATING SURFACE AREA/VOLUME

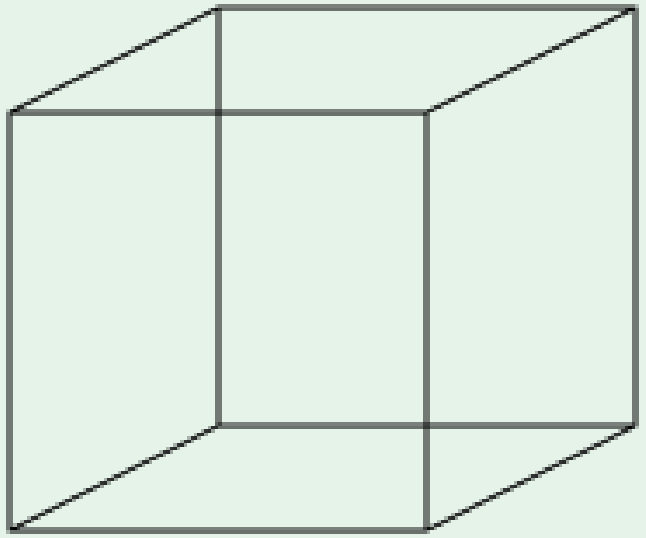
- It’s a straightforward 3-step process

- 1. Find the surface area of the object
- 2. Find the volume of the object
- 3. Divide surface area by volume to get the ratio

CALCULATING SURFACE AREA/VOLUME

- Example: Find the SA/V ratio of a 3cm cube

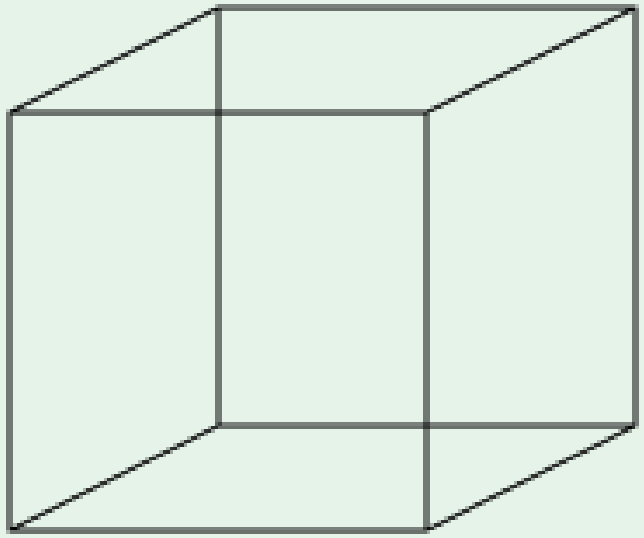
- 1. Surface Area
  - The surface area of a cube is equal $6s^2$
  - $6 \times 9 = 54\ cm^2$



CALCULATING SURFACE AREA/VOLUME

- Example: Find the SA/V ratio of a 3cm cube

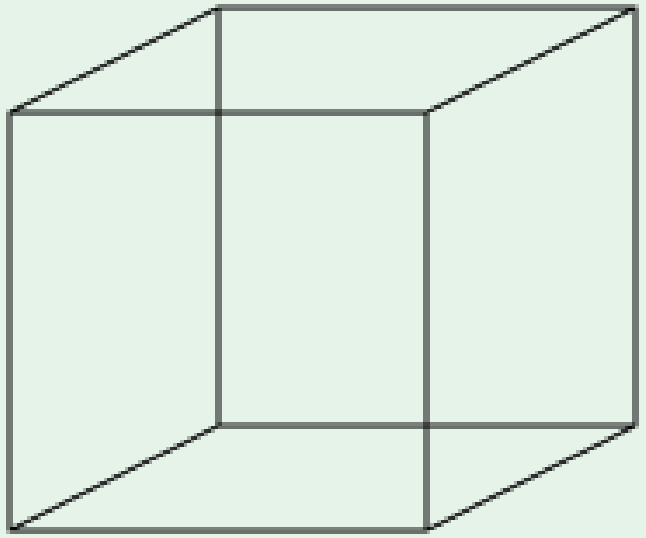
- 2. Volume
  - The surface area of a cube is equal s^3
  - $3^3 = 27\ cm^3$



CALCULATING SURFACE AREA/VOLUME

- Example: Find the SA/V ratio of a 3cm cube

- 3. Ratio
  - 54/27 = 2
  - The shape's surface area is double its volume



CALCULATING SURFACE AREA/VOLUME

- Let's see how the ratio changes with size
  - A cube of side length 4 cm has SA/V = 1.5
  - A cube of side length 6 cm has SA/V = 1
  - A cube of side length 12 cm has SA/V = 0.5

- As you can see, a **larger shape** has a **smaller surface area to volume ratio**
- This makes exchange **less efficient**