The Processes of the Cell

Essential Question:
What processes are necessary for the survival of a cell, tissue, organ, and organ system?

Standard:

S7L2a. Explain that cells take in nutrients in order to grow and divide and to make needed materials.

Activating Strategy:

Watch the time lapse video and answer the questions.

https://www.youtube.com/watch?v=RtyqS68ViWk

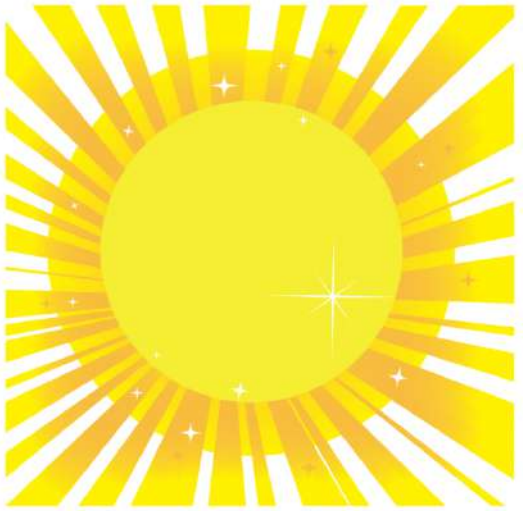
- What were your observations?
- In order for the changes you observed to occur, what has to happen to the cells in your body?

Your cells are constantly working to perform many activities such as getting food, removing wastes, growing, reproducing, and making new materials.

What do your cells need in order to conduct these necessary activities?

To stay alive, cells need a constant supply of energy.

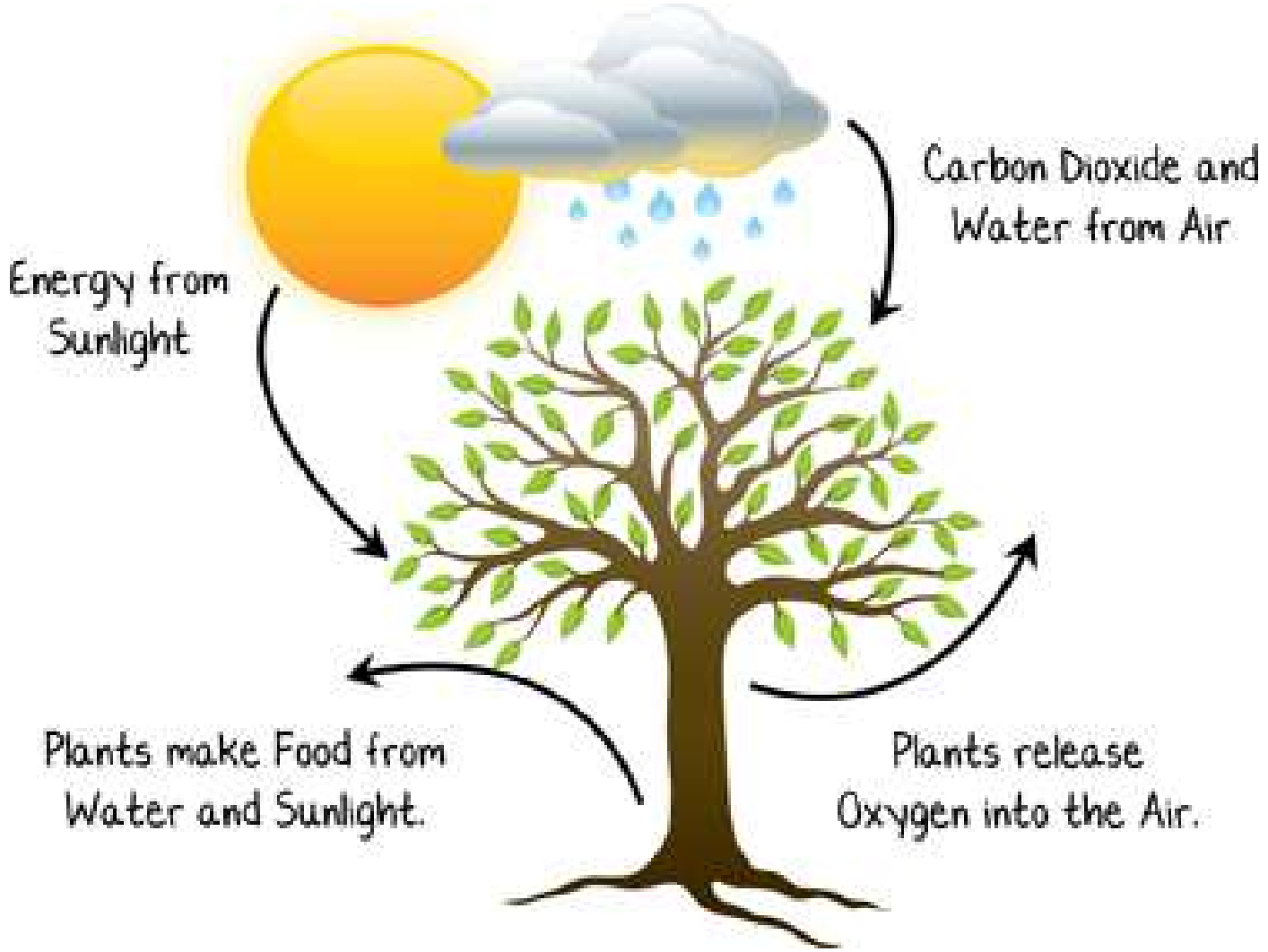
Animal cells get it from food, while plant cells get it from sunlight.



Cells need chemical energy. Chemical energy is stored in bonds between atoms of every molecule.

A major source of chemical energy for most cells is stored in a sugar molecule called glucose.

Photosynthesis



Plant cells make their own food through the process of photosynthesis.

In this process, plant cells take in light energy and change it into chemical energy in the form of glucose (food). Photosynthesis occurs in the chloroplasts.

What do plants need to survive?

Photosynthesis

Sunlight + Water + Carbon Dioxide
= $C_6H_{12}O_6$ (Glucose)
and Oxygen

So, why are plants so important to us?

http://www.pbs.org/wgbh/nova/nature/photosynthesis.html

Let's Review:

Plant cells make their own food by changing light energy into chemical energy (sugar/glucose) through the process of Photosynthesis which occurs in the Chloroplasts.

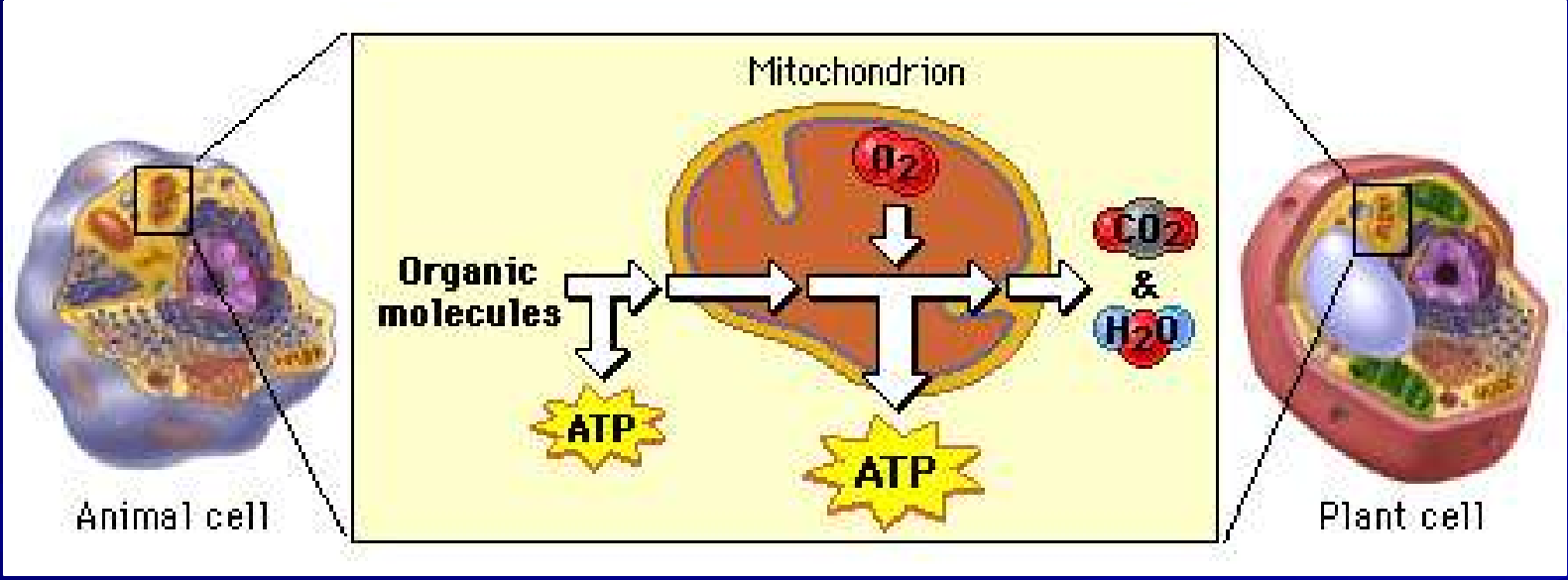
Where do animal cells get their chemical energy?

Once food is obtained in animal cells and made in plant cells, it must be broken down to release the chemical energy.

This process is called Cellular Respiration. Cellular respiration occurs in the Mitochondria.

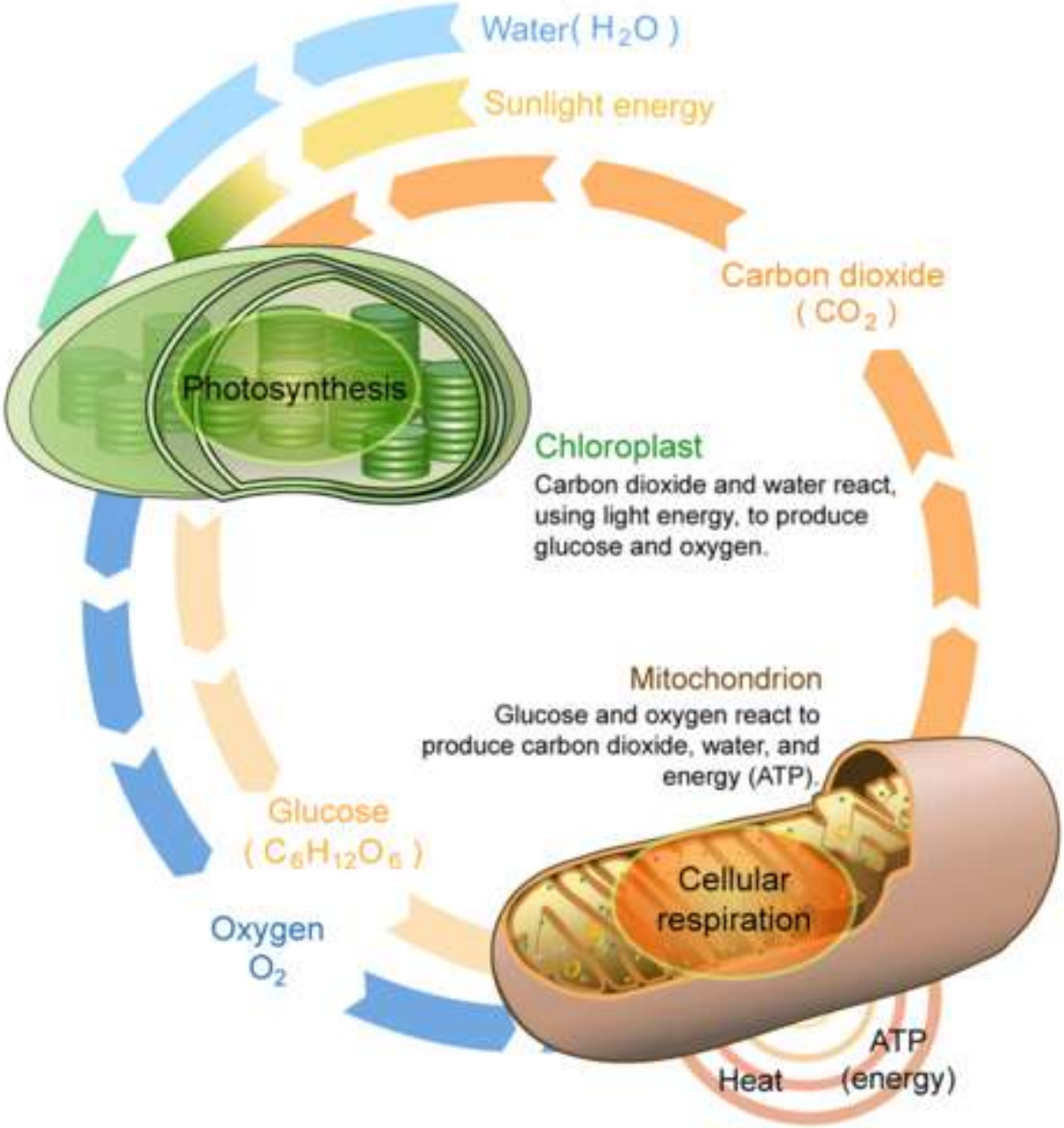
Cellular Respiration

$C_6H_{12}O_6$ (Glucose) + Oxygen = Carbon Dioxide, Water, and Energy (ATP)

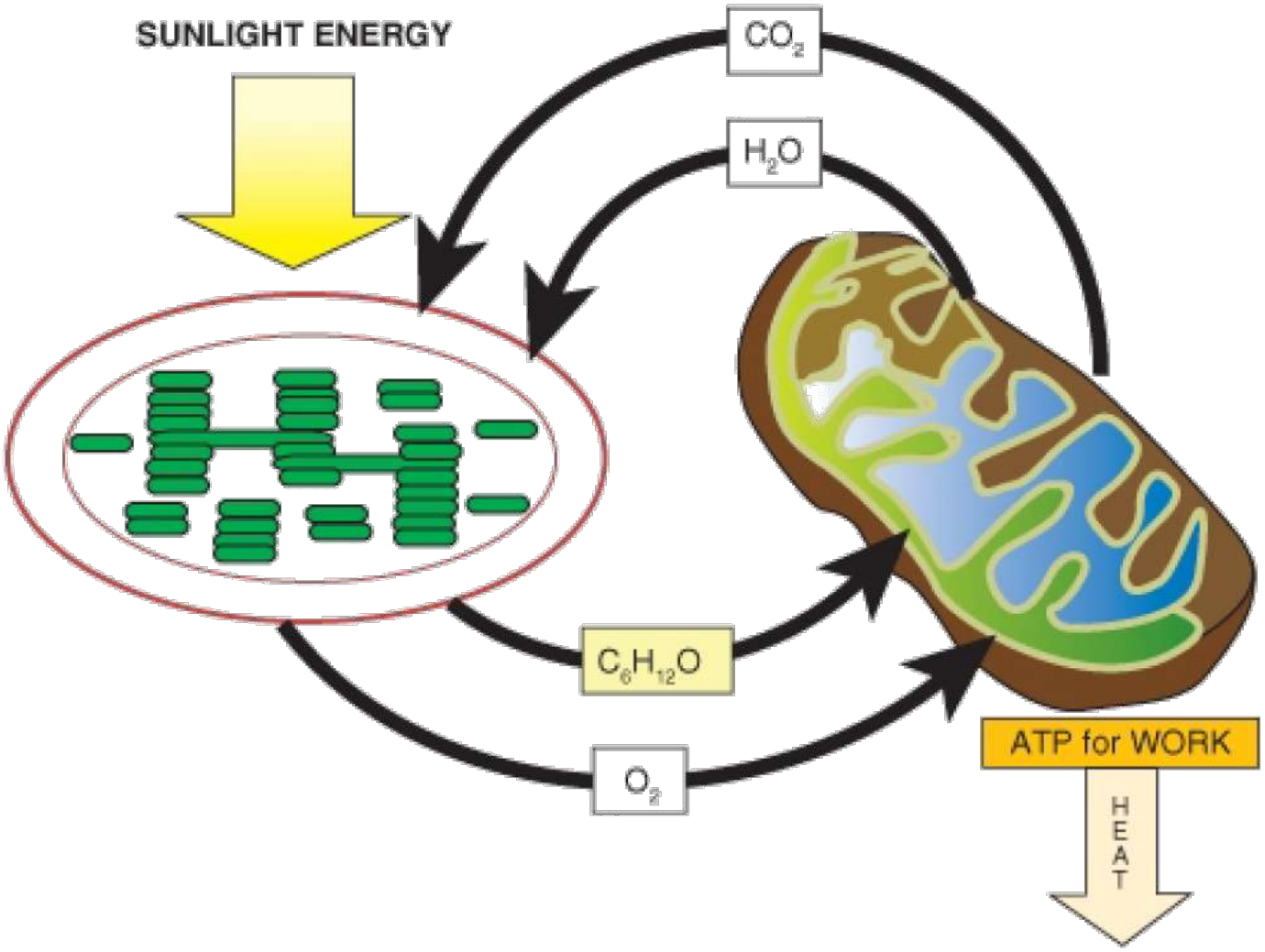


Photosynthesis and Cellular Respiration are the opposite of one another.

The input of one process is the output of the other process and vice versa.


Water(H_2O)
Sunlight energy
Carbon dioxide
(CO_2)
Photosynthesis
Chloroplast
Carbon dioxide and water react, using light energy, to produce glucose and oxygen.
Mitochondrion
Glucose and oxygen react to produce carbon dioxide, water, and energy (ATP).
Glucose
($C_6H_{12}O_6$)
Oxygen
O_2
Cellular respiration
ATP
(energy)
Heat

Which is Photosynthesis? Cellular Respiration? How do you know?



Animations/Video Clips on Photosynthesis and Cellular Respiration

Animation of Cellular Respiration and Photosynthesis:
http://www.exploratorium.edu/traits/cell_explorer.html

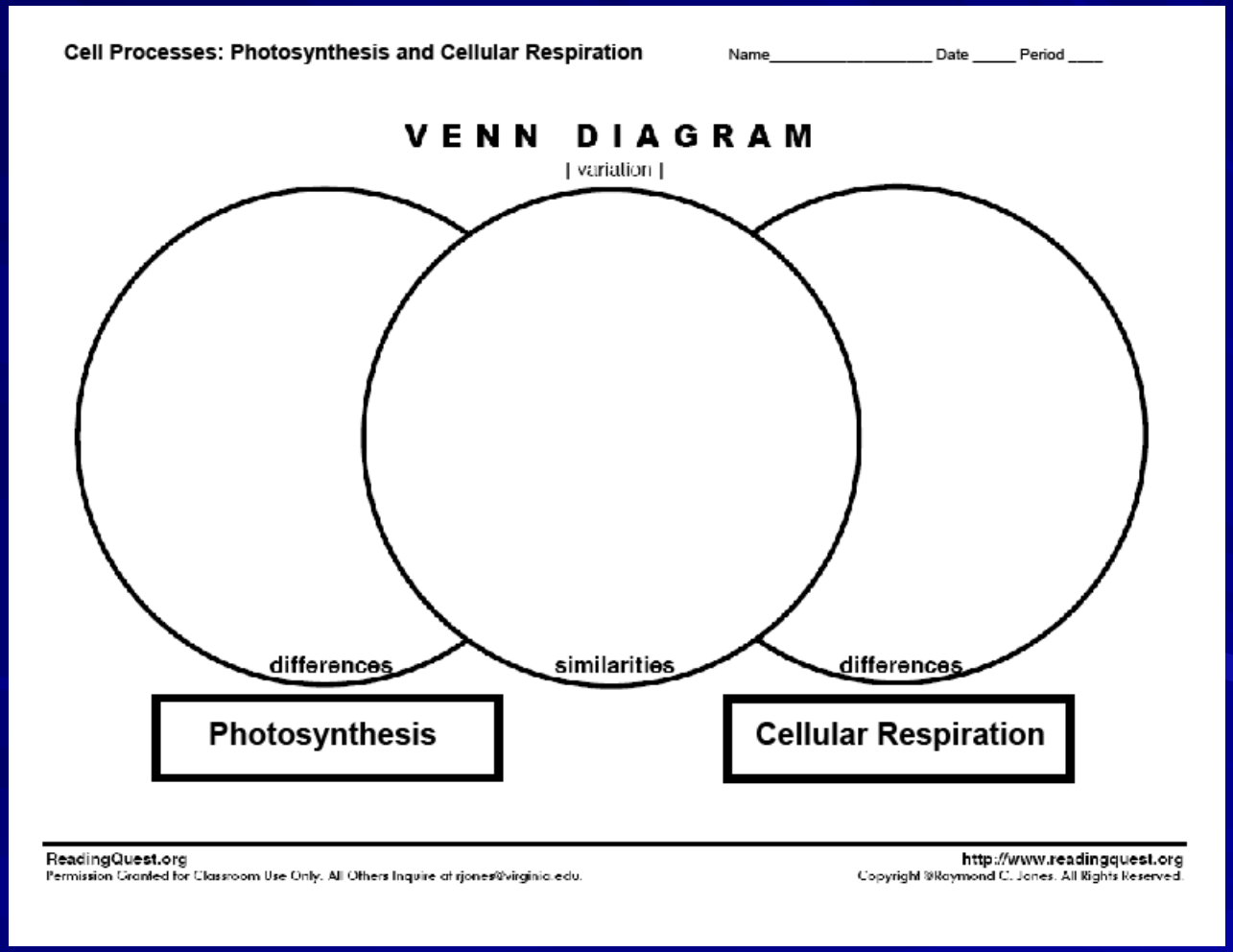
BrainPop Video on Photosynthesis and Cellular Respiration:
http://glencoe.mheducation.com/sites/dl/free/0078778425/164155/00053412.html

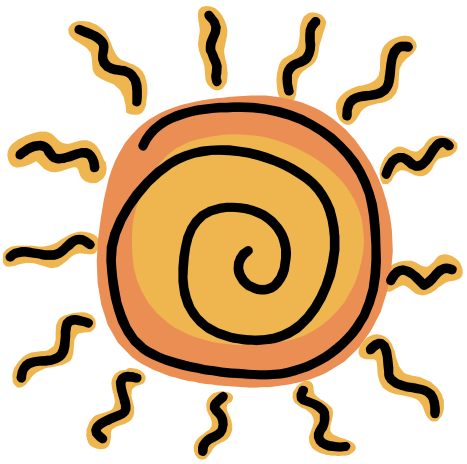
Video animation on Cellular Respiration and Photosynthesis:
http://www.sumanasinc.com/webcontent/animations/content/cellularrespiration.html [requires Adobe Plugin]

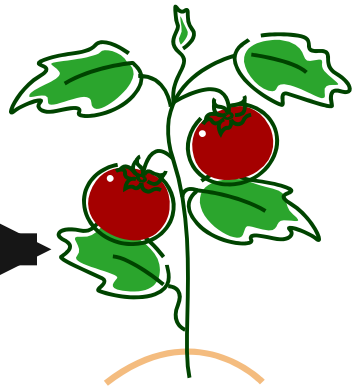
When learning the functions of cell organelles, we associated the Chloroplasts with solar panels and Mitochondria with Power Generators.

With a seat partner, discuss why these analogies fit.

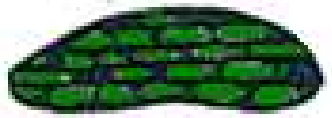
Comparing Photosynthesis and Cellular Respiration Venn Diagram







Tomato Plant



Photosynthesis
In Chloroplasts

Glucose

Tomatoes eaten

Cellular Respiration
in Mitochondria

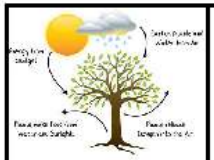
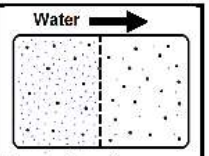
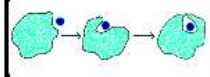
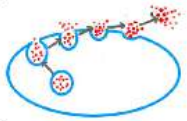
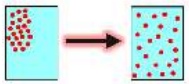
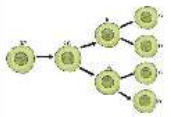
Energy

Distributed Summarizing:

Think, Pair, Share

Explain why plants and animals are so important to each other for survival?

Use your notes to complete the Cell Processes Foldable as you learn about the many processes cells need to stay alive.

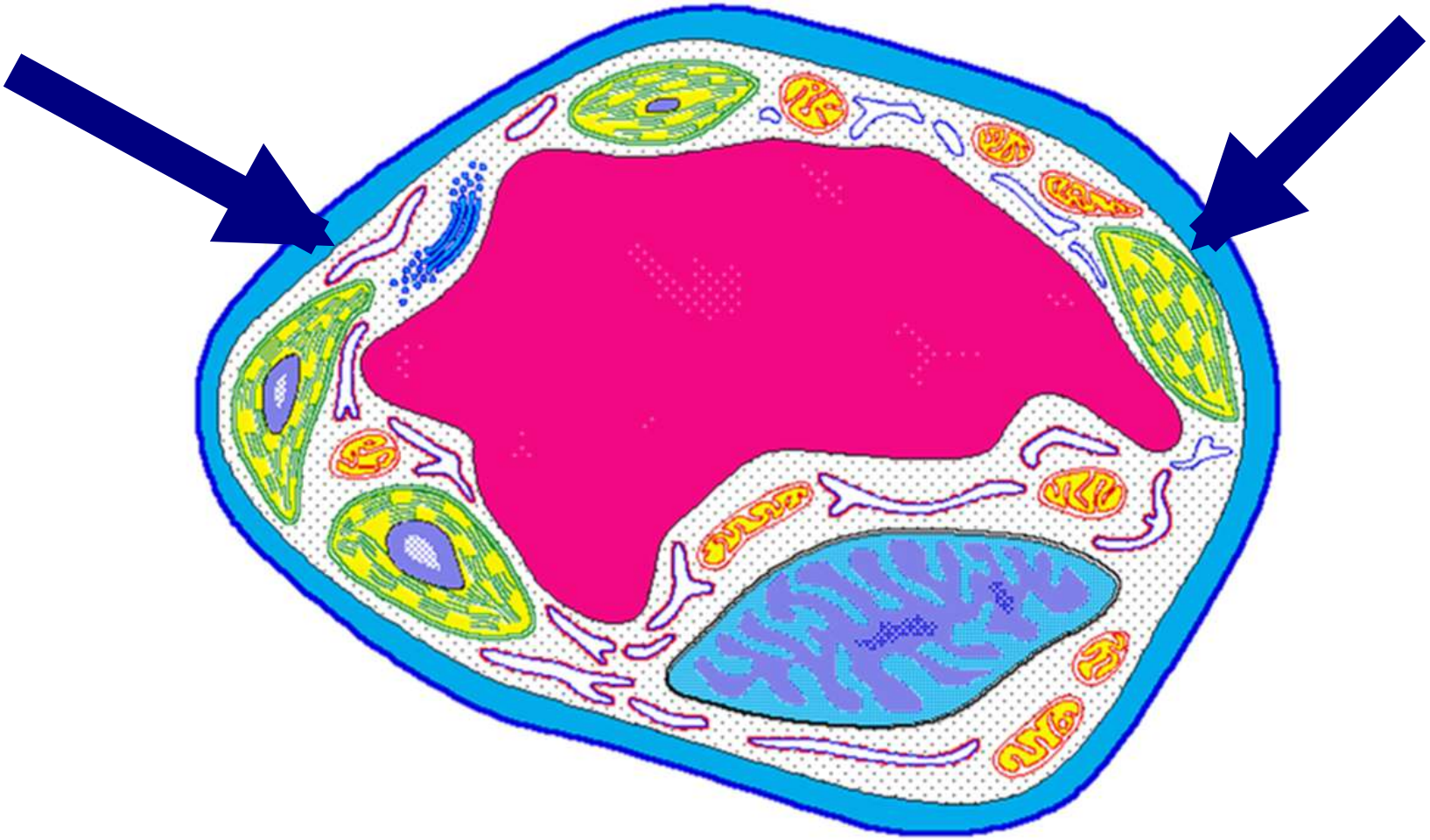
 Process: Photosynthesis			 Process: Osmosis
 Process: Cellular Respiration			 Process: Endocytosis
 Process: Passive Transport			 Process: Exocytosis
 Process: Active Transport			 Process: Mitosis
 Process: Diffusion			 Process: Meiosis

Movement of Material In and Out of the Cell

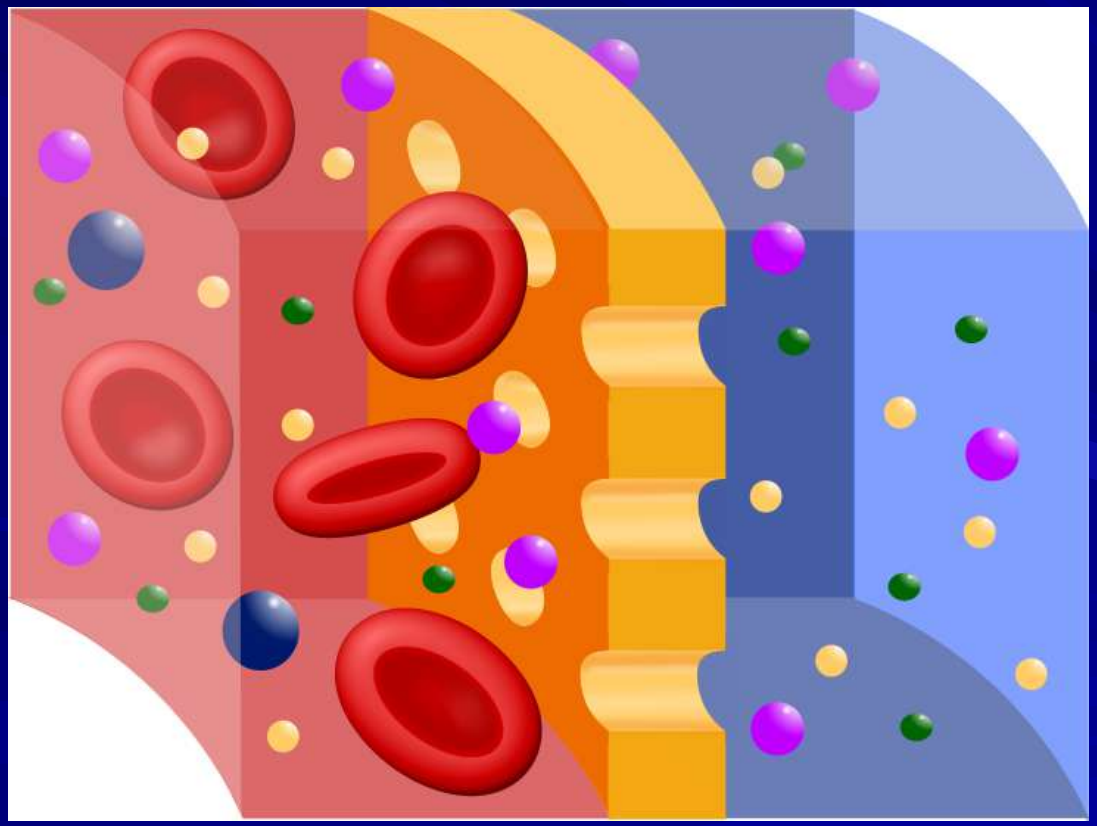
We learned through photosynthesis and cellular respiration that oxygen, carbon dioxide, water, glucose, and energy are constantly used in cells.

How then do these particles and many others get in and out of cells?

In our previous unit, we learned that the job of the cell membrane is to allow materials in and out of the cell.



The cell membrane is semi-permeable. This means that it can let some materials pass through while others can not.



Animation of Semi-Permeable

https://www.youtube.com/watch?v=Pt4Ch-YW-xs

Materials must move in and out of a cell in order for it to survive.

Let’s discuss the different ways in which this occurs.

Some materials can move in and out of the cell membrane easily.

Other materials require help or are forced to move in and out of the cell.

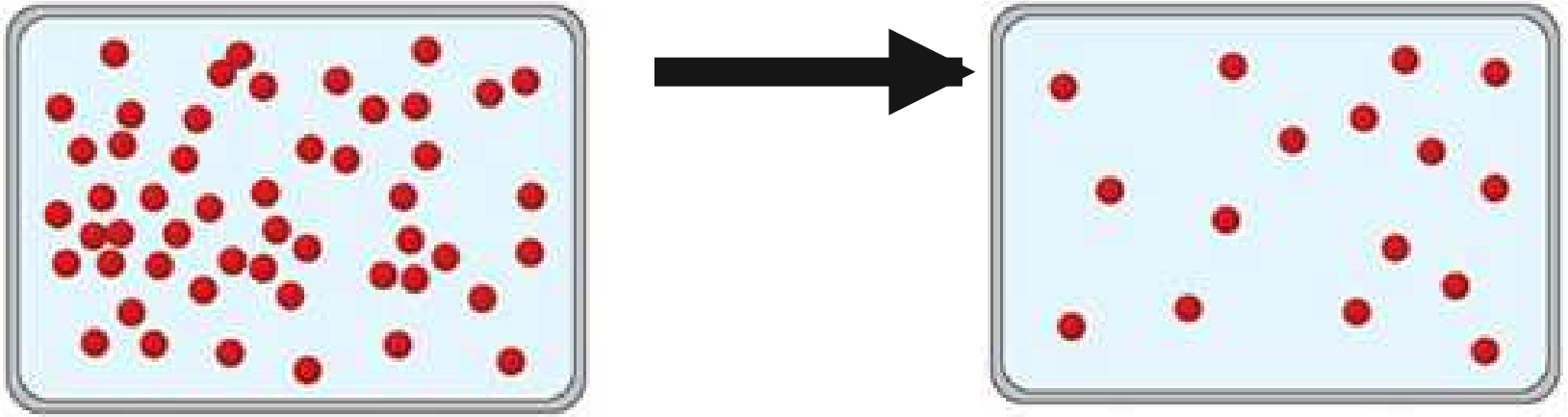
Natural Movement of Particles Demonstration

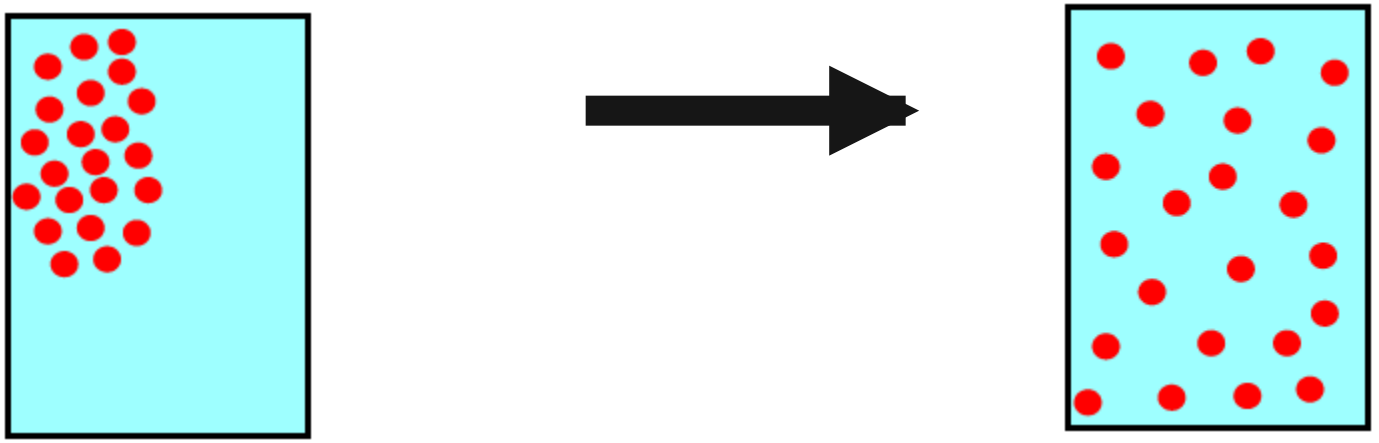
Particles naturally want to move from where they are more crowded to where they are less crowded.

Natural Movement of Particles

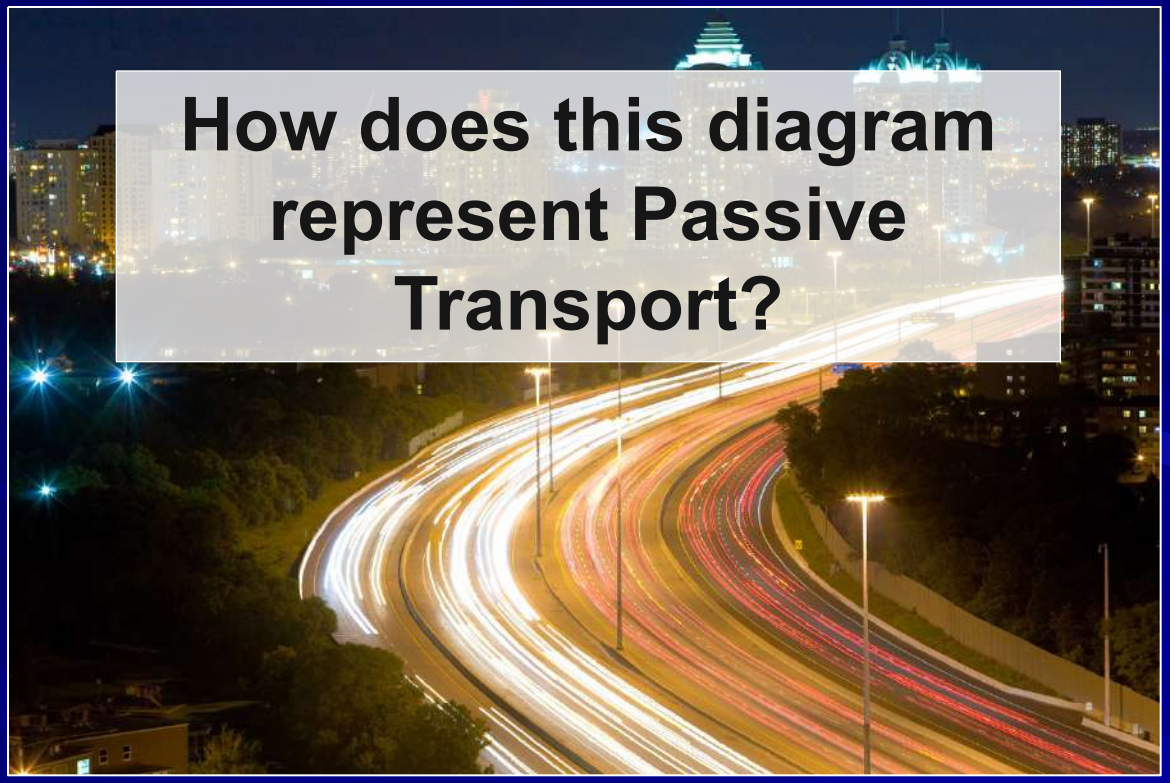
More Crowded
(High Concentration)

Less Crowded
(Low Concentration)





The transport (movement) of substances across cell membranes without the use of energy is called Passive Transport.



Passive Transport

In Passive Transport, substances or particles move from high concentration to low concentration.

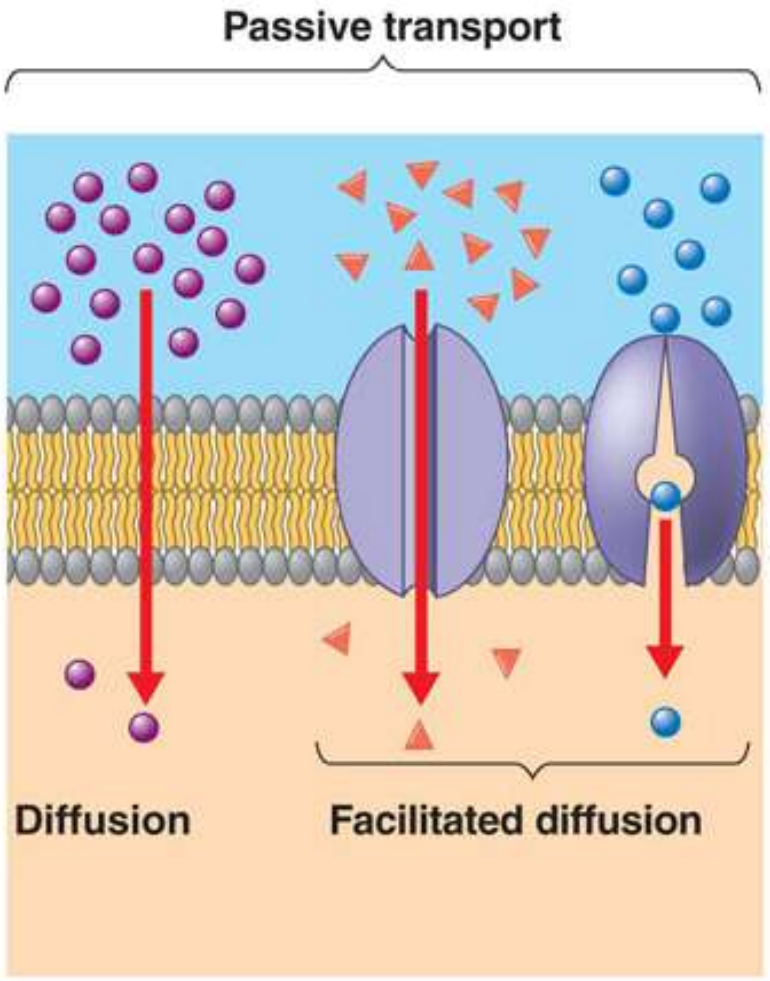
Why do you think energy is not required for passive transport?

Turn to an elbow partner and describe an experience that you could compare to Passive Transport

[ex. Easily moving from a crowded area to a less crowded area]

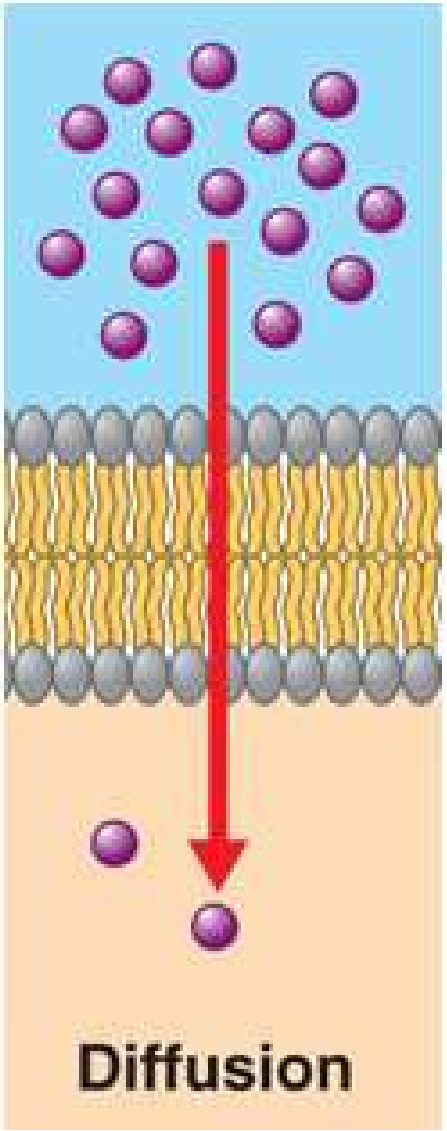
Passive Transport

There are different types of Passive Transport.



Diffusion

Small particles such as oxygen and carbon dioxide move easily across the cell membrane from areas of high concentration to low concentration.

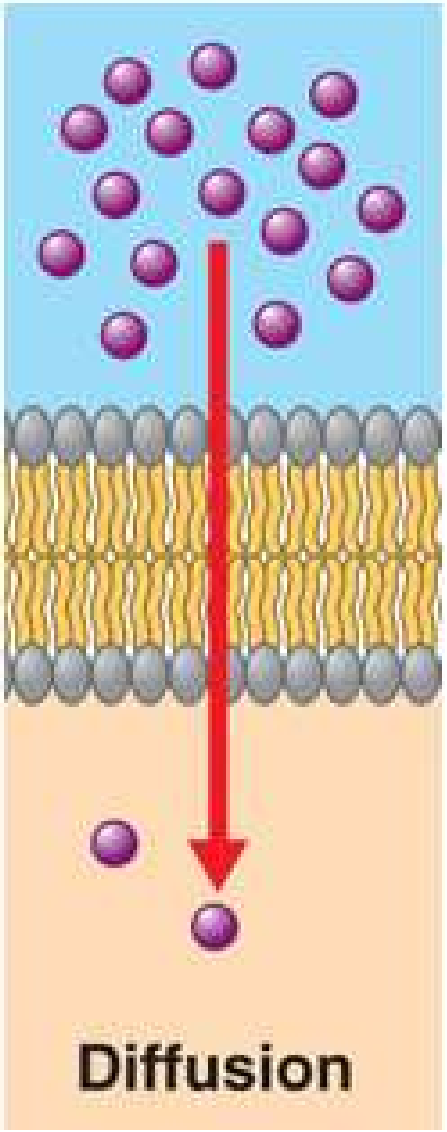


Diffusion is a type of passive transport. Why?

Diffusion

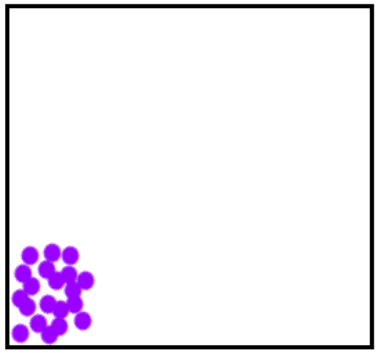
How is diffusion important for Photosynthesis and Cellular Respiration?

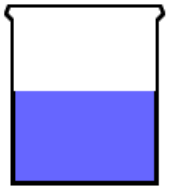
Oxygen and Carbon Dioxide easily diffuse through the cell membrane. Both are necessary for energy production.

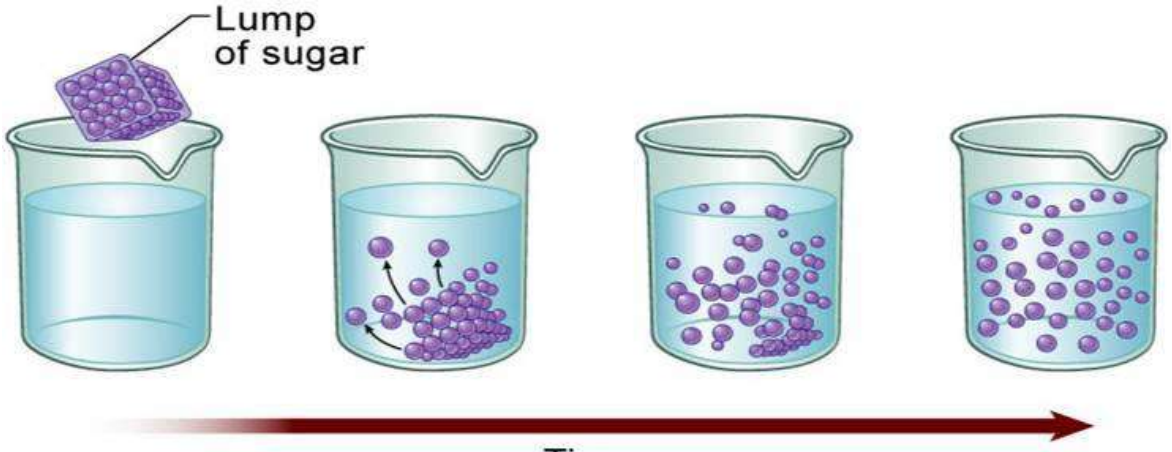


Everyday Examples of Diffusion

Smell of food, perfume, air freshener, and other substances.

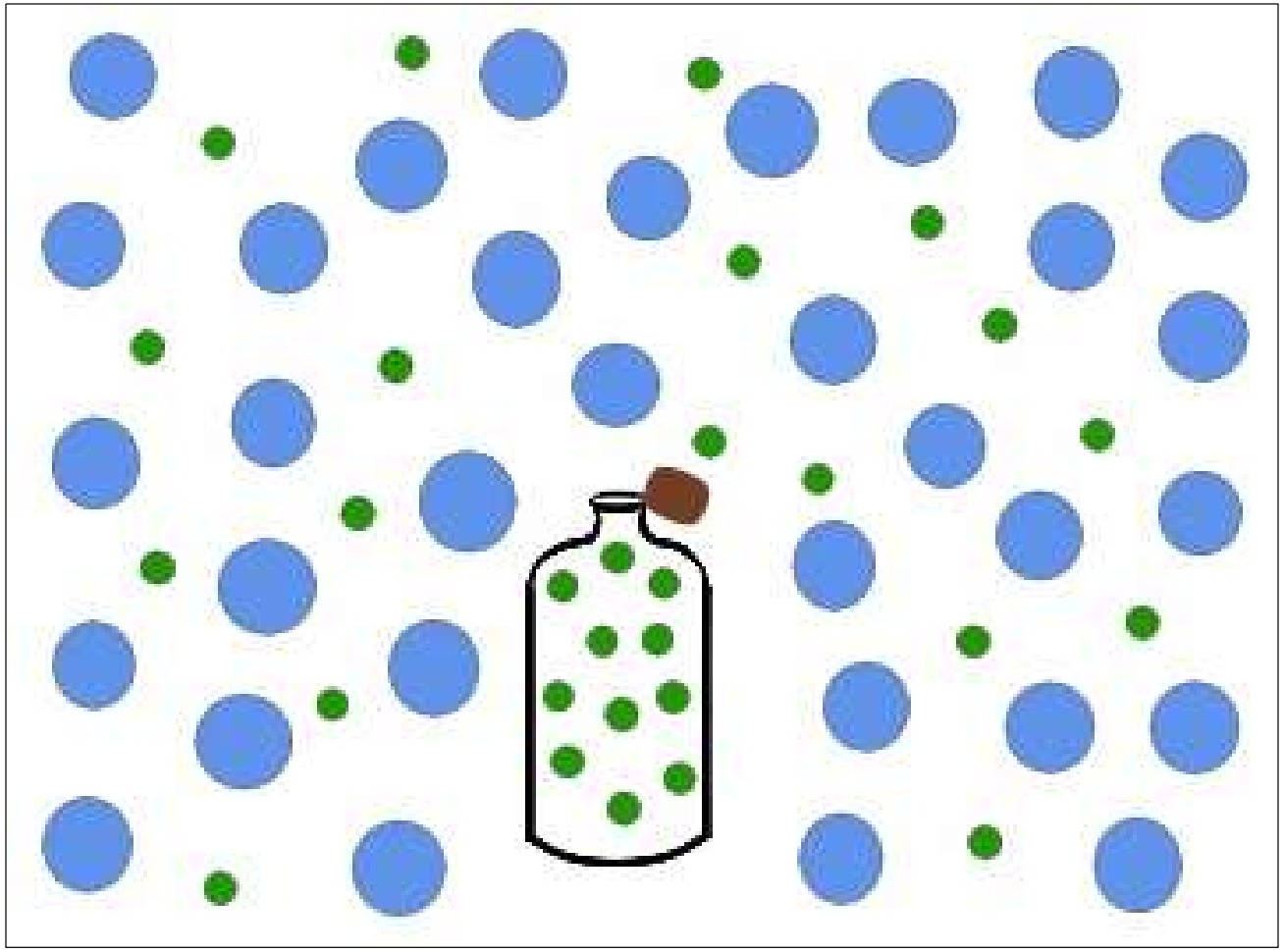






From Patton KT, Thibodeau GA: *Anatomy and physiology*, ed 7, St Louis, 2010, Mosby.

Everyday Examples of Diffusion



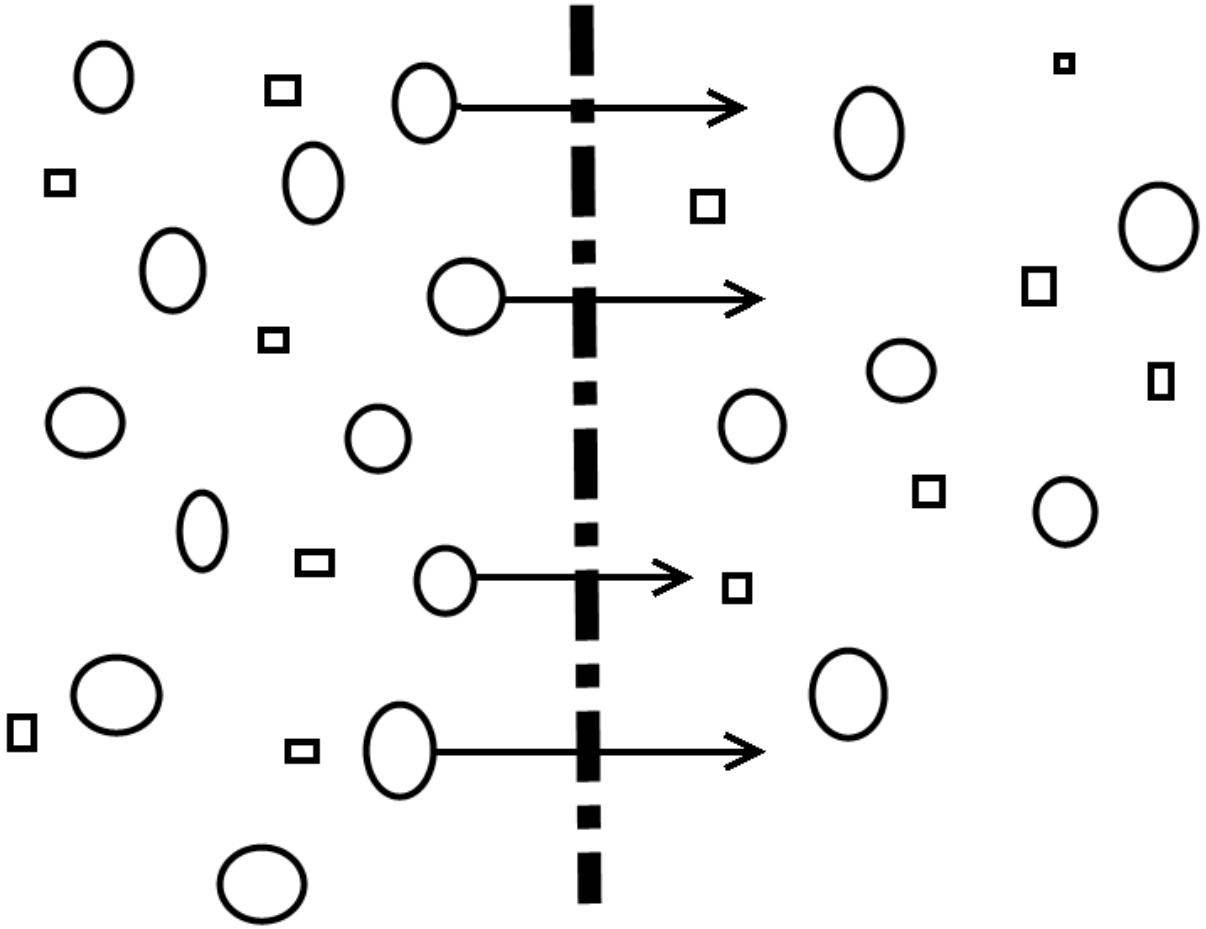
Diffusion Animations

http://www.sumanasinc.com/webcontent/animations/content/diffusion.html [Requires Adobe Plugin]

http://esminfo.prenhall.com/science/BiologyArchive/lectureanimations/closerlook/diffusion.html

http://highered.mheducation.com/sites/0072495855/student_view0/chapter2/animation__how_diffusion_works.html

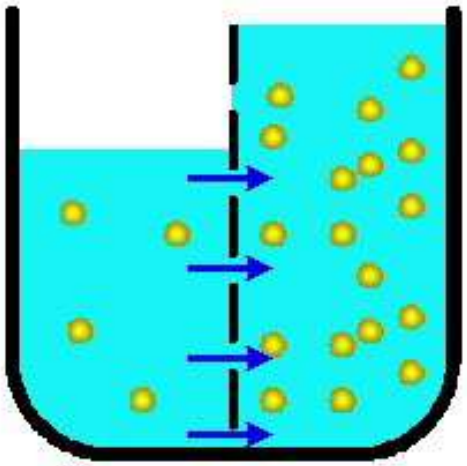
If the diagram below represents a cell membrane and particles, why are there arrows showing the movement of some of the oval objects?



Distributed Summarizing

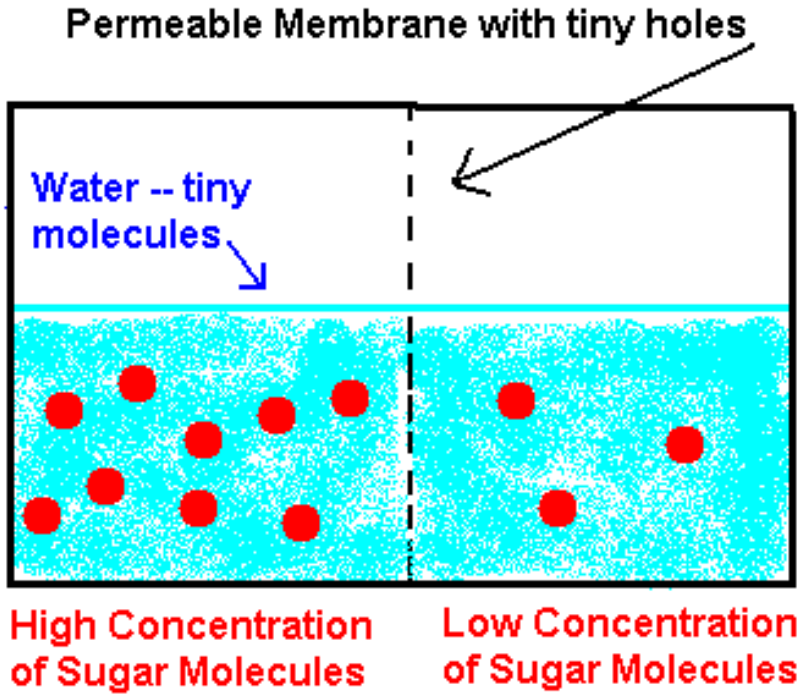
Draw a diagram illustrating particles diffusing across a cell membrane.

Osmosis is the diffusion of water. Water moving from where it is crowded (high concentration) to where it is less crowded (low concentration).

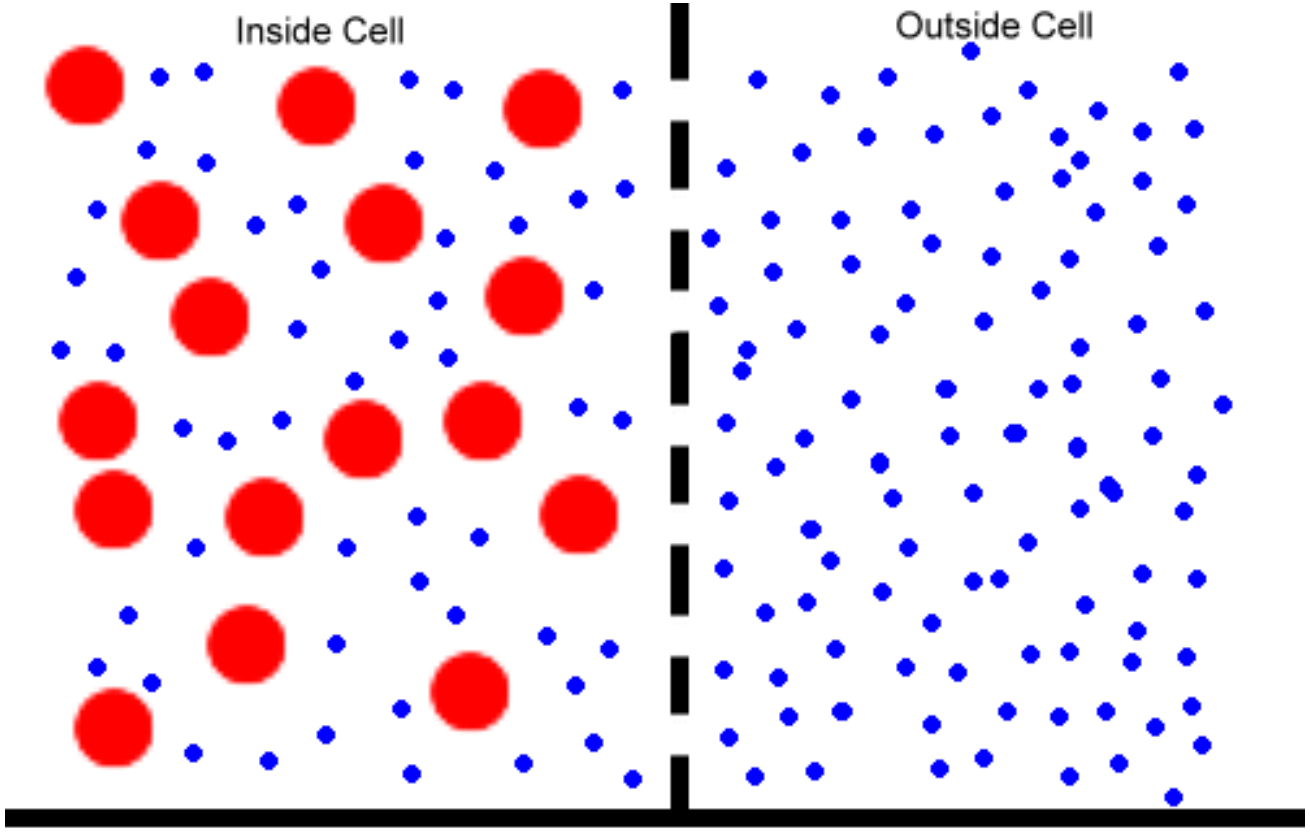


Osmosis

(Water moves by concentration gradient)

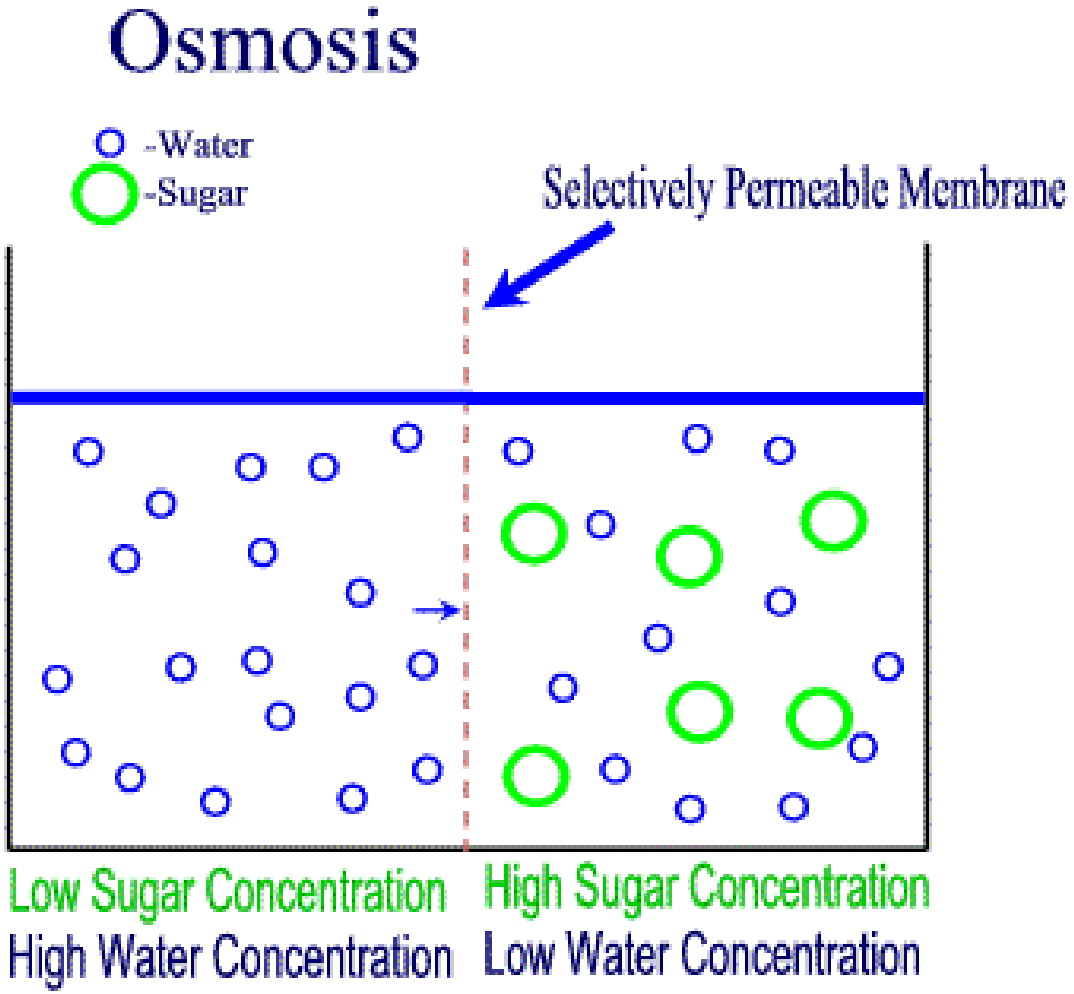


Osmosis
[Diffusion of Water] Illustration



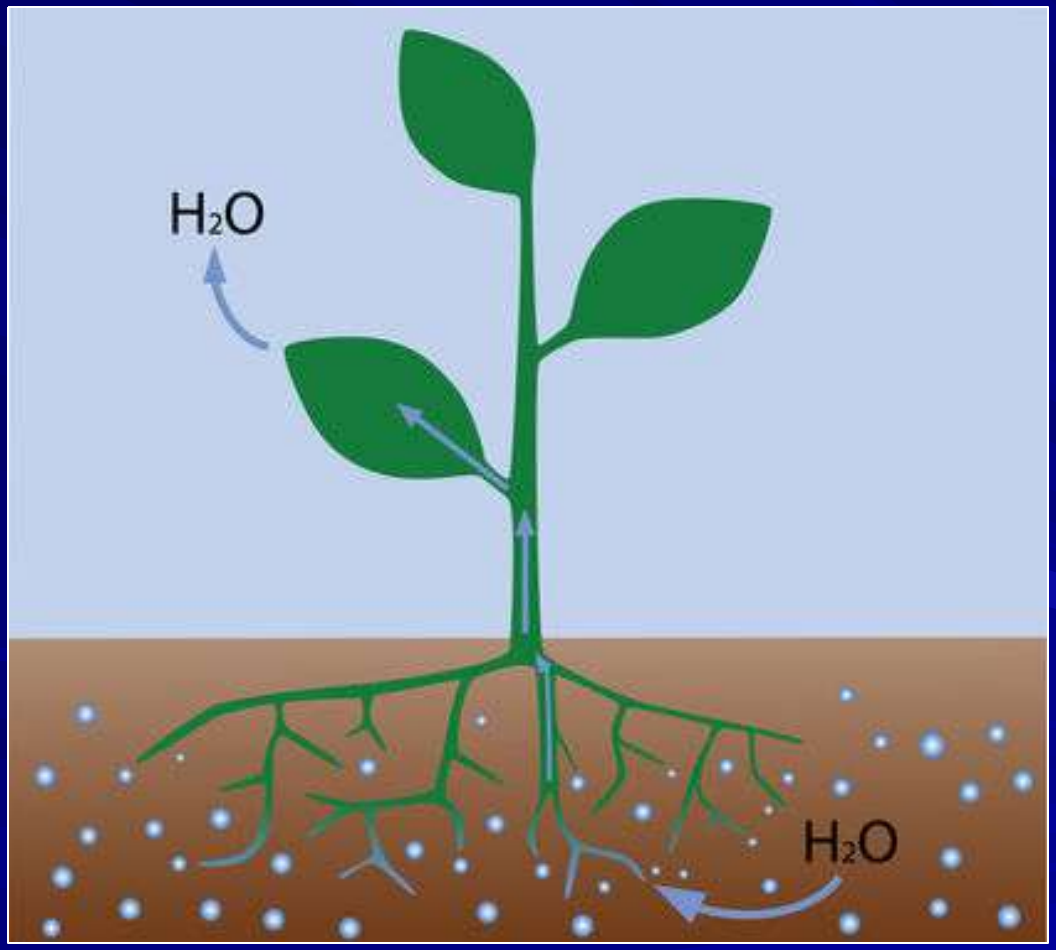
In this example the inside of the cell is loaded with solute particles (the solute particles are shown in red). There are also water molecules inside the cell (shown in blue). Outside the cell are just water molecules.

Osmosis
[Diffusion of Water] Illustration



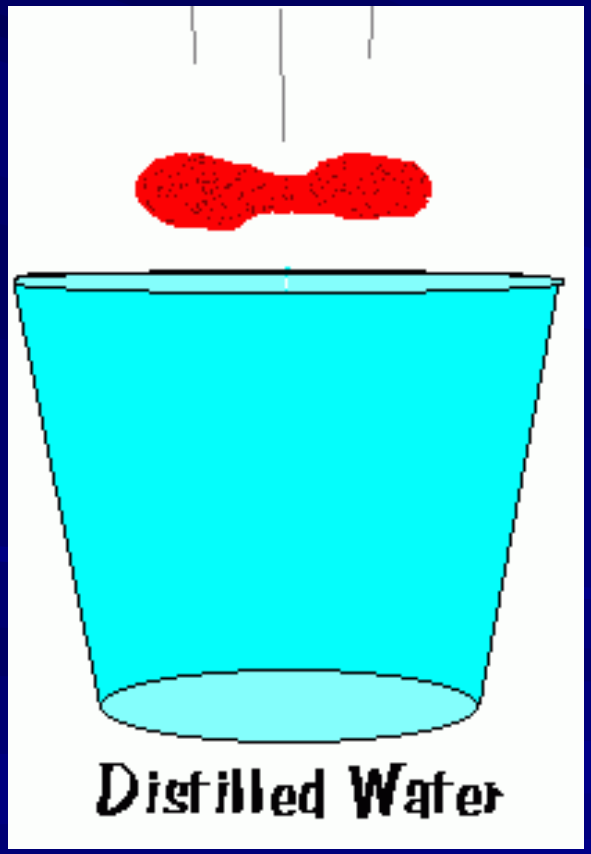
Example of Osmosis

Watering a plant



Pure water diffuses more than any other water mixture because it is more crowded (has a higher concentration) than any other water mixture.

In this picture a red blood cell is put in a glass of distilled water (pure water with no salt or sugar in it).



Because there is a higher concentration of water outside the cell, water enters the cell by OSMOSIS.
The cell bursts and dies.

Video Clip and Animations on Diffusion/Osmosis

http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/cells/osmosisact.shtml

http://www.stolaf.edu/people/giannini/flashanimat/transport/osmosis.swf

http://www.abpischools.org.uk/page/modules/homeostasis_kidneys/kidneys3.cfm?coSiteNavigation_allTopic=1

Distributed Summarizing:

Identify and Share some other examples of Diffusion/Osmosis.

Activities on Diffusion/Osmosis [see resources]

Egg-cellent Ideas for Osmosis and Diffusion

Diffusion Lab

Egg Osmosis | Egg Osmosis Demo

Gummy Bear Diffusion/Osmosis

Osmosis Vegetable Lab

The Perfect Taters Mystery

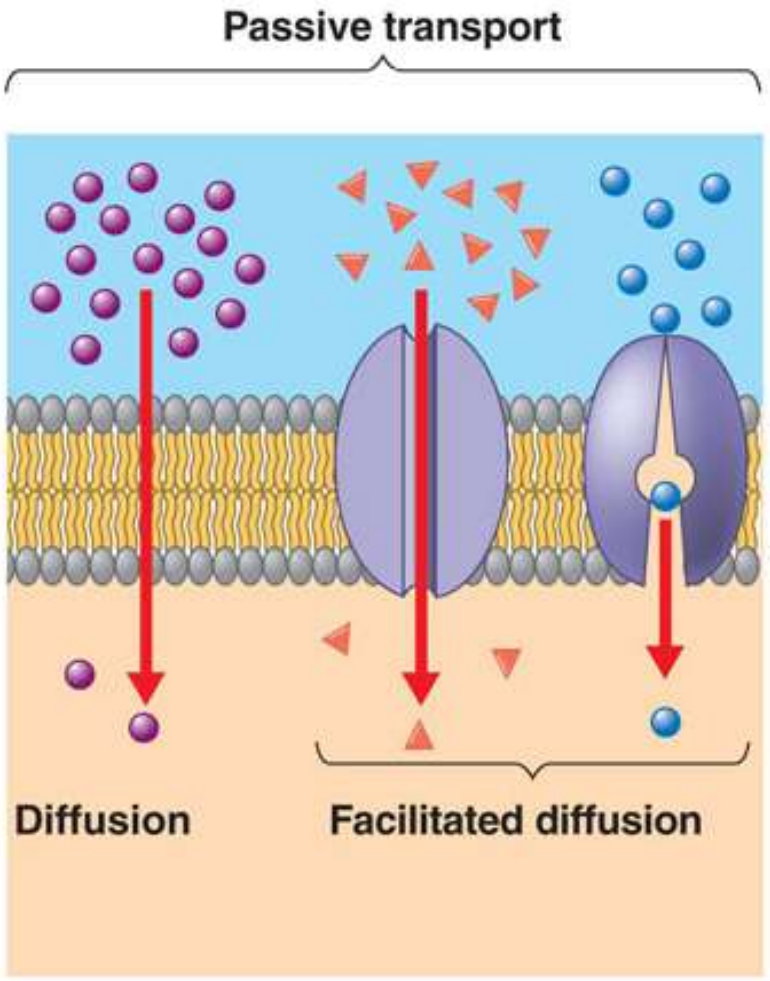
Some materials can move in and out of the cell membrane easily.

Other materials require help or are forced to move in and out of the cell.

Passive Transport

Some particles are not able to diffuse through the tiny openings in the cell membrane.

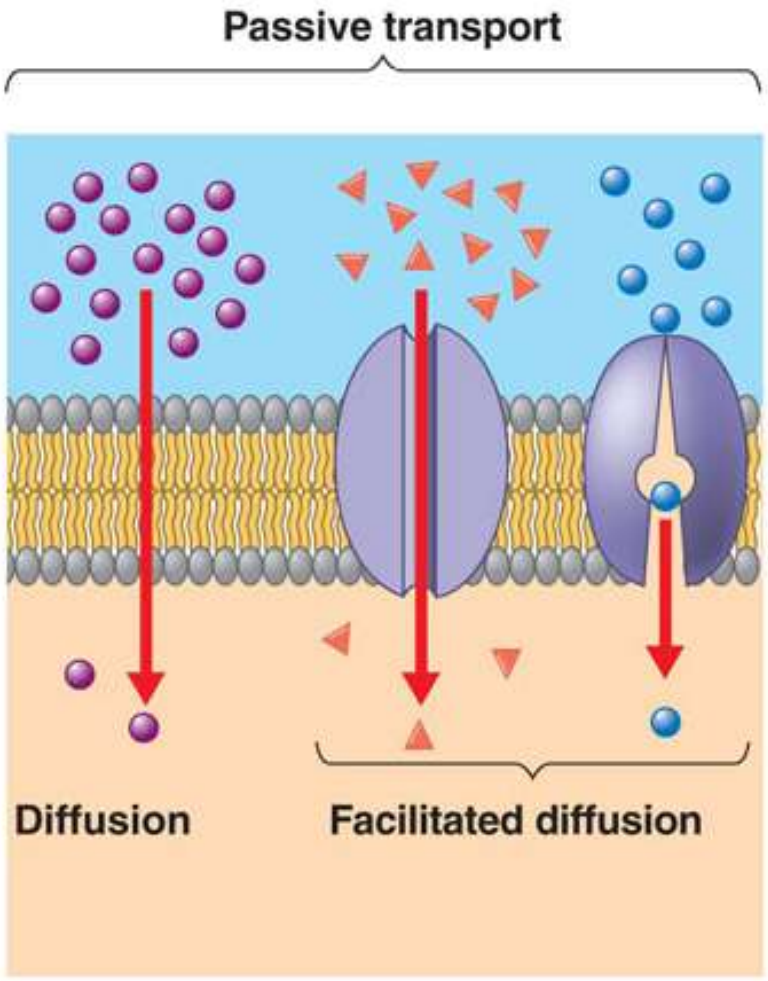
These particles need assistance.



Passive Transport

Some particles have to go through protein channels or doorways [shown as facilitated diffusion in the diagram to the right].

However, energy is not required and the particles still move from high concentration to low concentration.



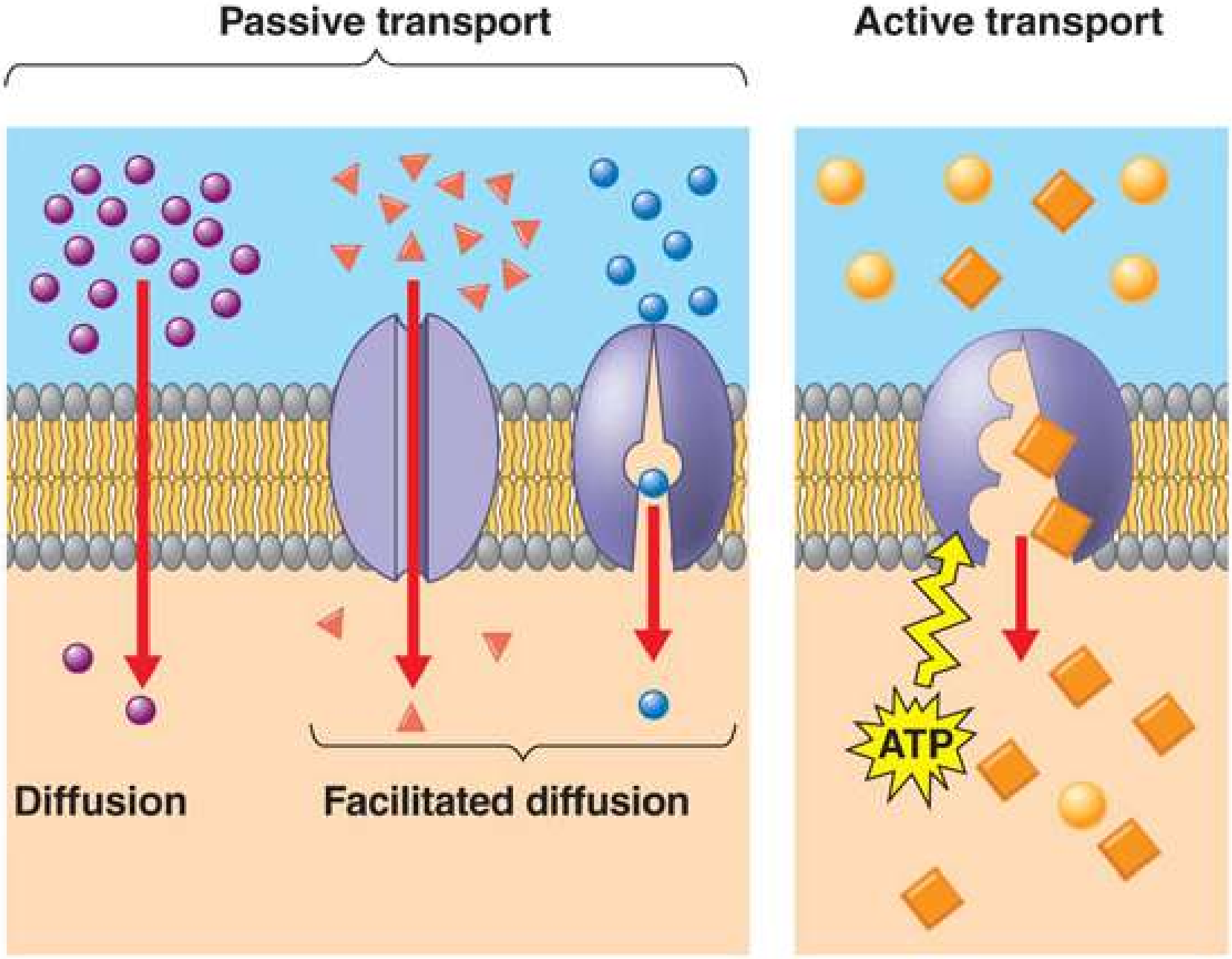
There are some particles that naturally want to diffuse, but cannot be allowed to diffuse.

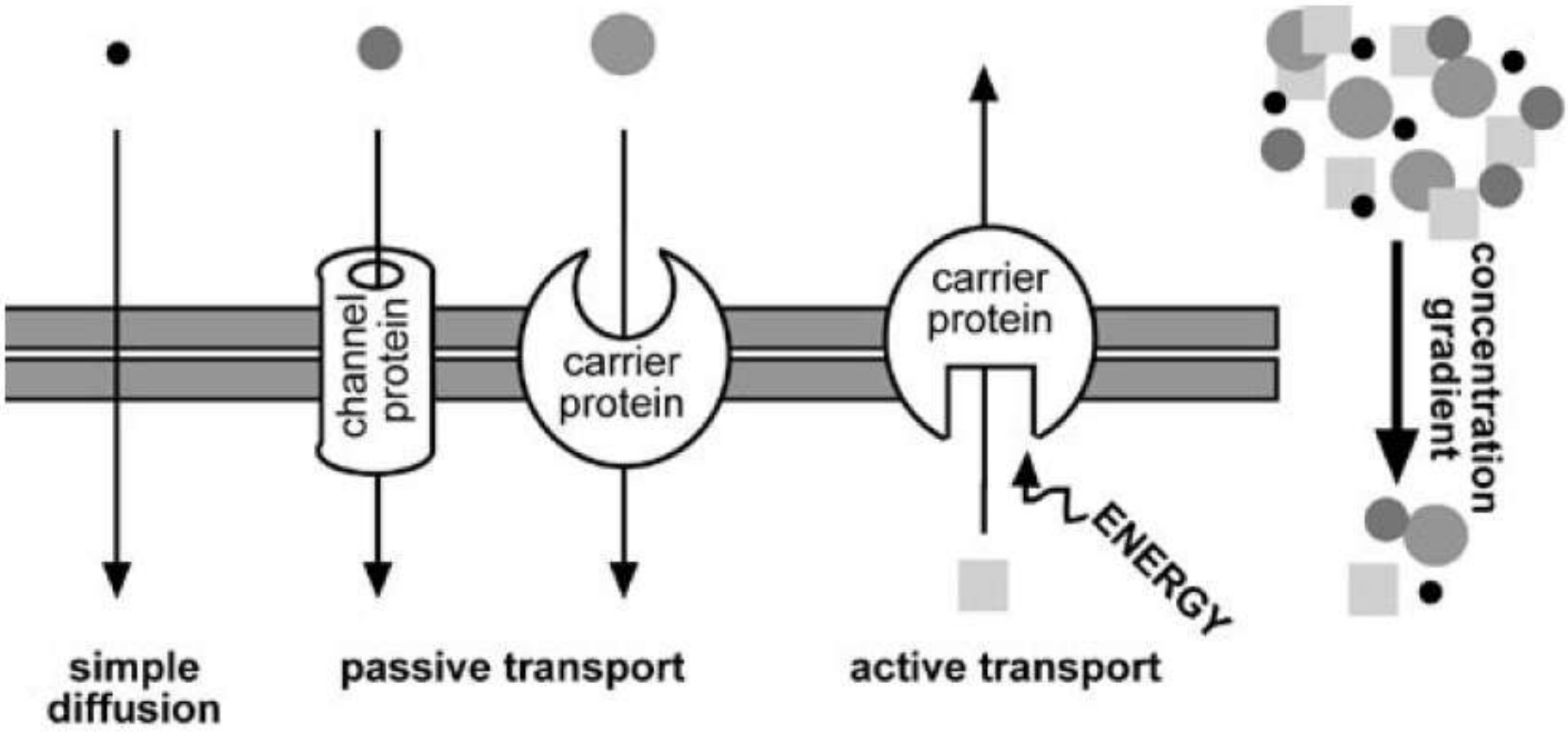
Energy must be used to make the particles stay where they are more crowded.

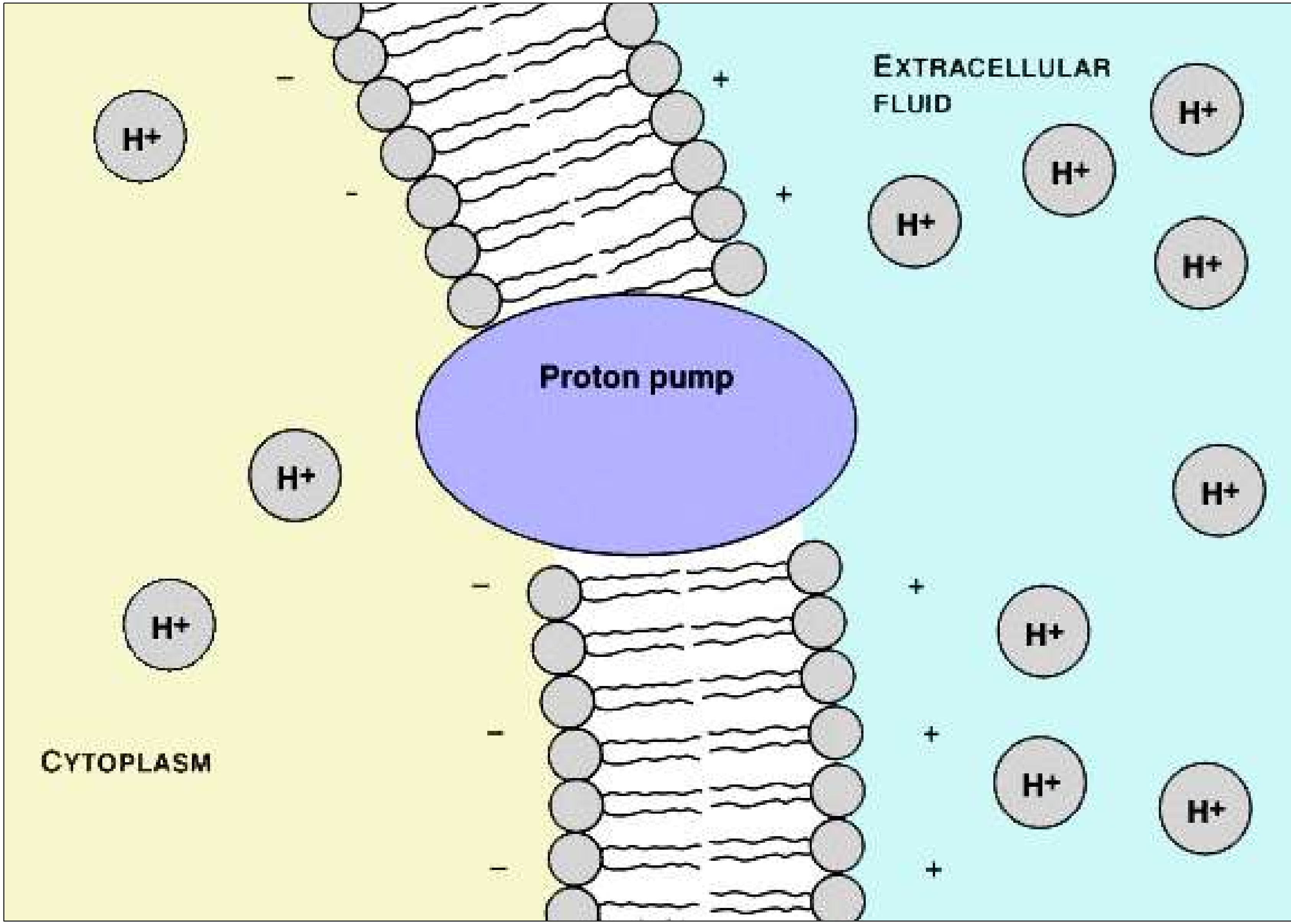
Active transport is different from passive transport because it requires energy. Active transport is necessary to make particles move against their natural tendency.

In active transport, particles move from less crowded (low concentration) to more crowded (high concentration).

Active transport is important in organs such as the kidneys when harmful particles are made to stay in the organ when they naturally want to diffuse


Passive transport
Active transport
Diffusion
Facilitated diffusion
ATP


channel protein
carrier protein
carrier protein
ENERGY
concentration gradient
simple diffusion
passive transport
active transport



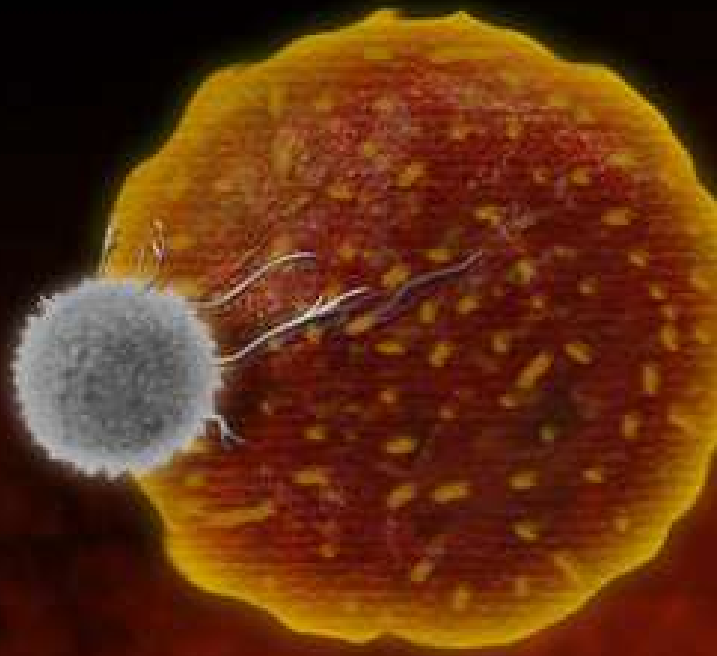
EXTRACELLULAR FLUID
H+
–
+
Proton pump
CYTOPLASM

Movement of Particles Activities

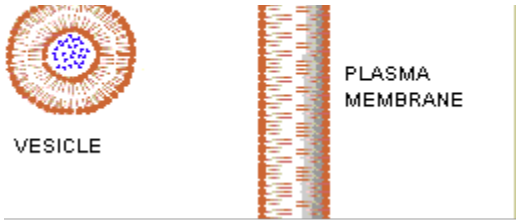
- Cellular Movement of Particles Practice worksheet
- Modeling Cellular Movement of Particles Activity
- Animated Cellular Processes: Passive Transport/Active Transport

If your cell needs a particle and the particle is too big to diffuse through the cell membrane and/or go through a protein channel or doorway, does your cell just go without that particle?

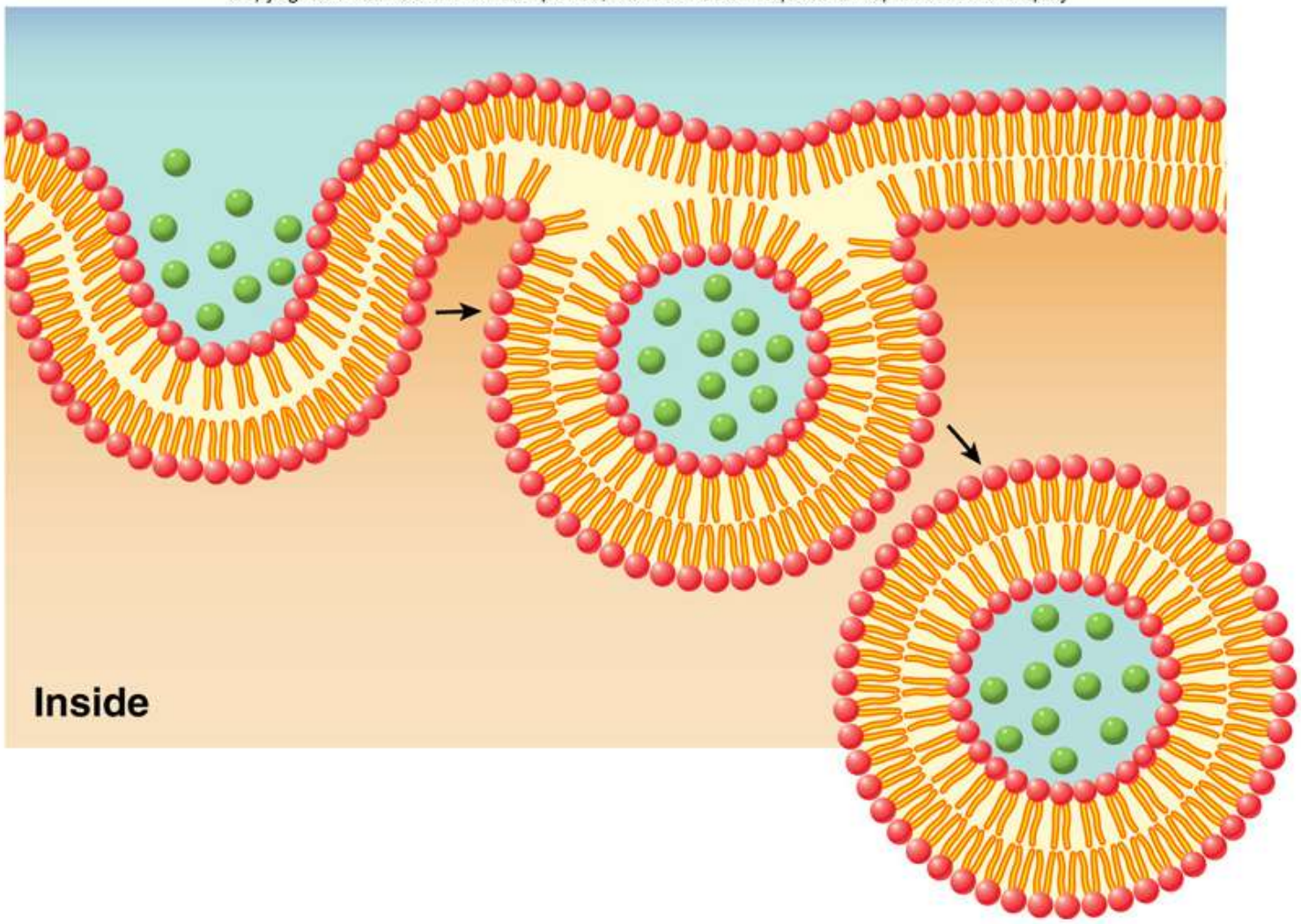
Although some particles are too large to go through the cell membrane, they can still get in or out of the cell through the process of Endocytosis and Exocytosis.



Endocytosis is the process by which the cell membrane envelops (engulfs) material that is too large to pass through the membrane and then pinches off inside the cell.

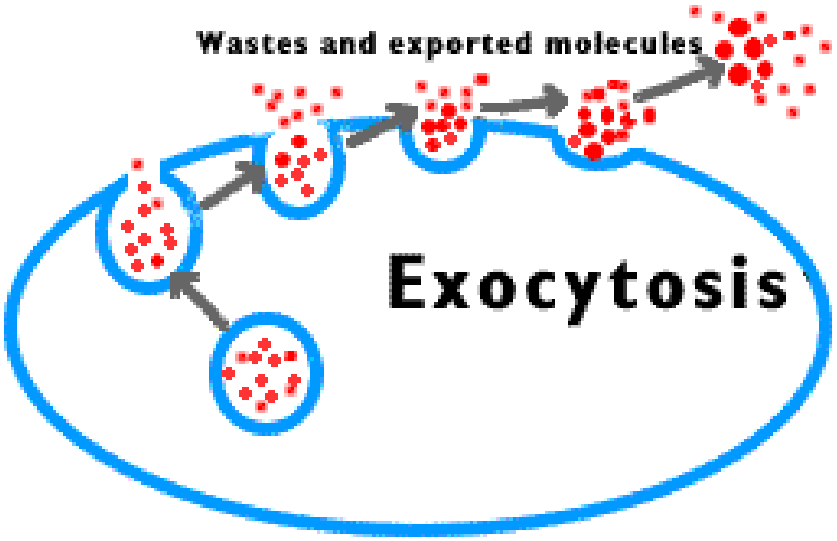


Endocytosis

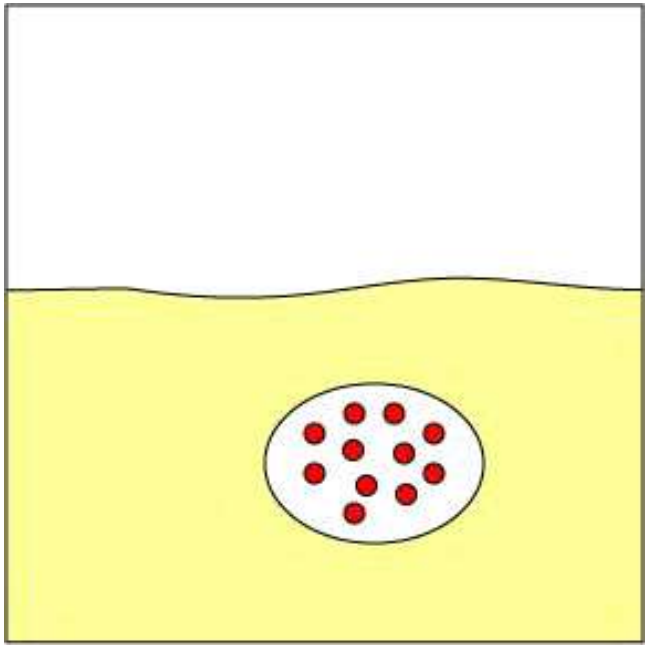


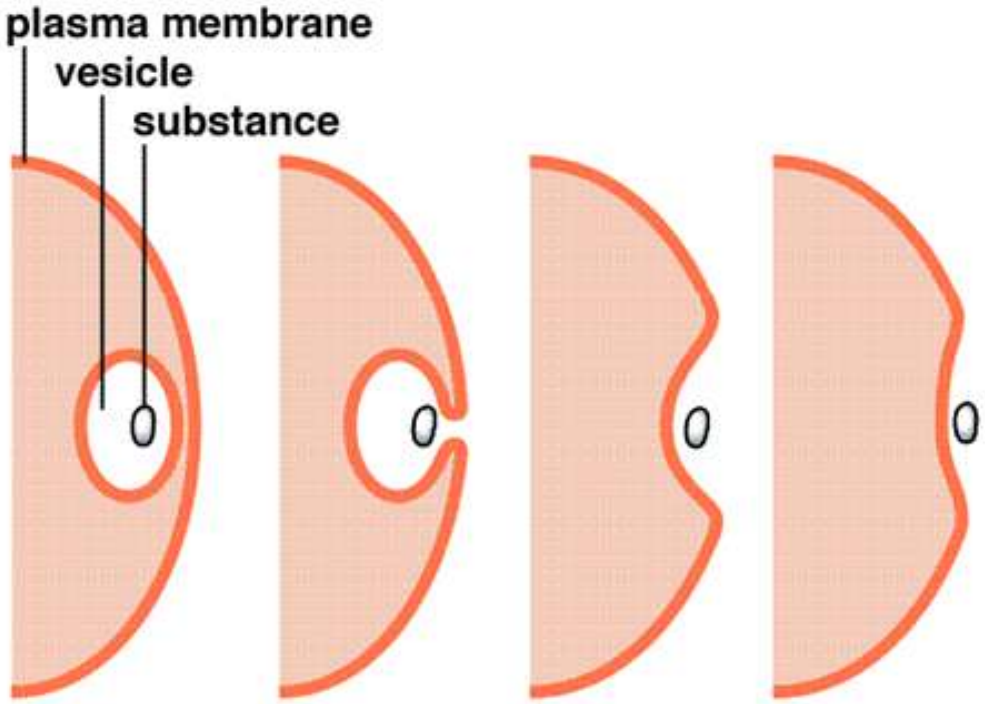
Exocytosis is the process by which the cell membrane removes material that is too large to pass through the membrane.

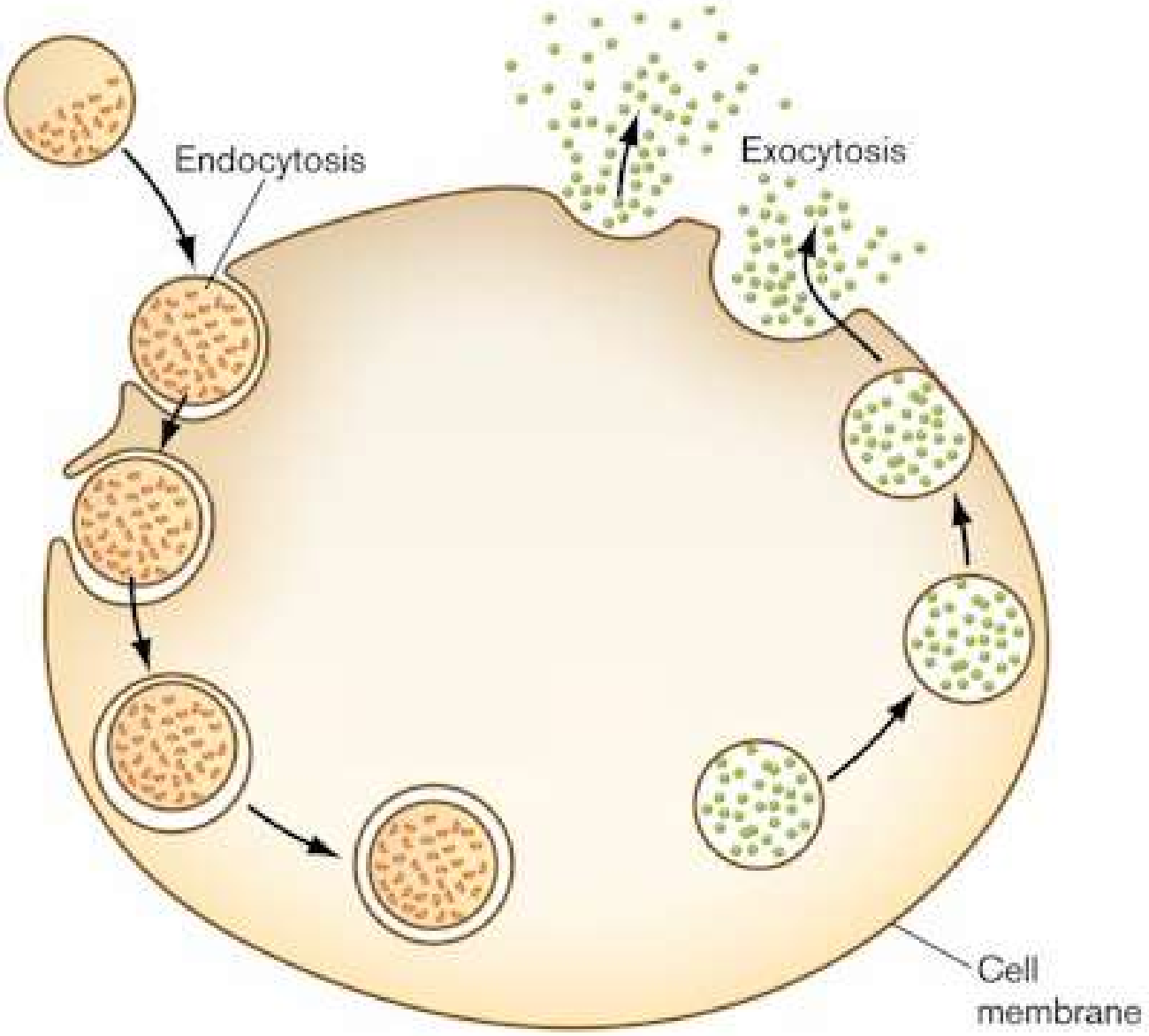
The material is surrounded by a membrane within the cell and then expelled by being pushed out of the cell.



Exocytosis






Endocytosis
Exocytosis
Cell
membrane

Endocytosis/Exocytosis Activities

- Endocytosis/Exocytosis Activity – classroom demonstration of the processes
- Modeling Endocytosis Activity – group activity demonstrating the process
- Animated Cellular Processes: Endocytosis/Exocytosis

Distributed Summarizing

Imagine that you are an oxygen molecule, carbon dioxide molecule, glucose molecule or food particle. Write a short story describing your journey into or out of a cell. Be sure to include which process is needed for your entrance/exit and why. Also, include your purpose for entering or exiting the cell.

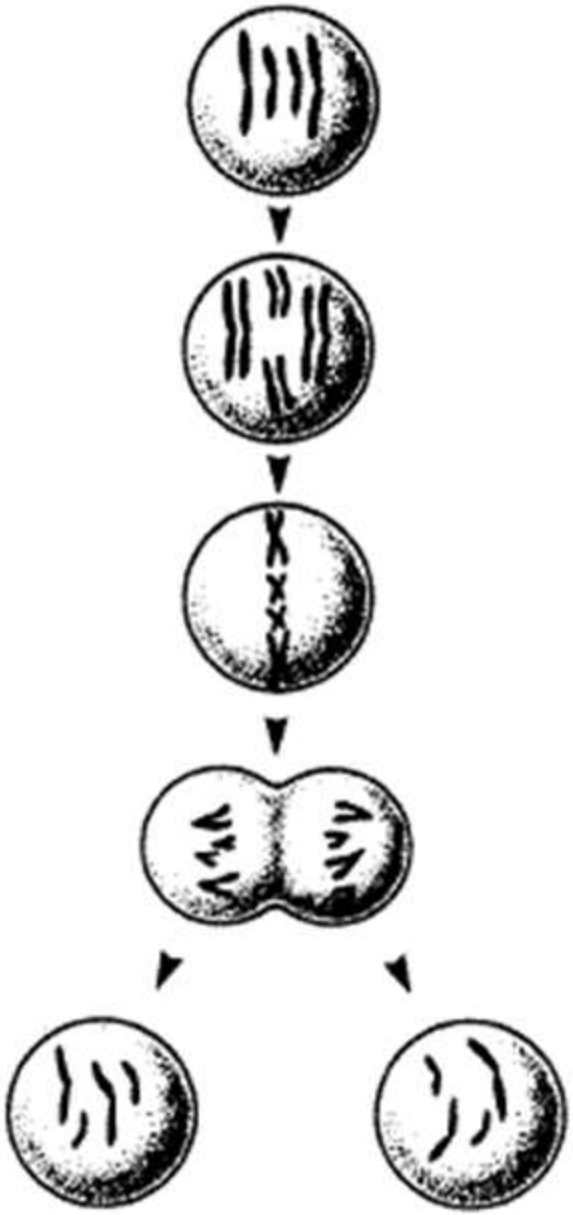
We have discussed ways in which cells live and grow by getting the nutrients they need, as well as, removing their wastes.

However, another important process must occur for growth and cell repair.

Think back to our activating strategy of the time lapse video of a little girl growing into a teenager. How does her body get larger?

Think of a time when you got a bad cut. Over time, what happened to the cut?

Organism's grow or cells are replaced through a process called Mitosis.



Cells make more cells or divide through a process called **mitosis** (one cell makes two).

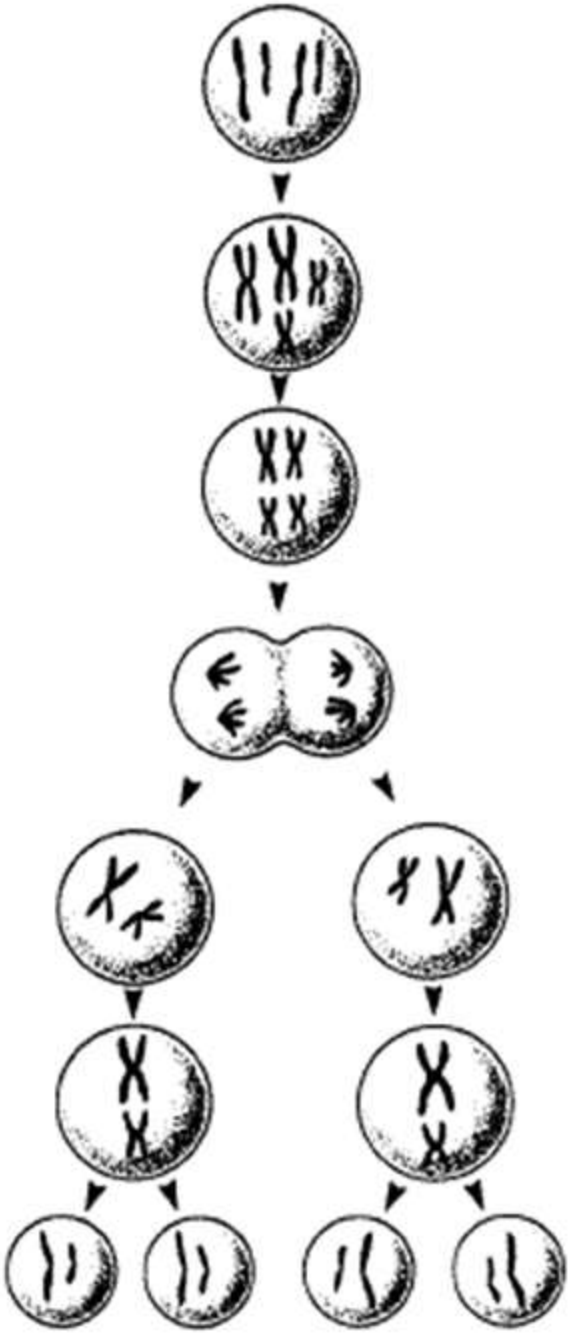
Video Clip of Growth by Cell Division: Mitosis

http://www.youtube.com/watch?v=GO5YN_t1fqw

Mitosis: The Amazing Cell Process that Uses Division to Multiply!

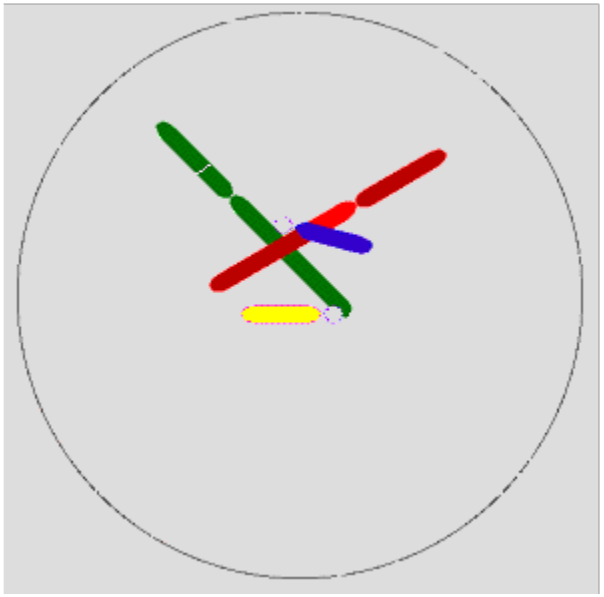
[see resources for handout]

http://www.youtube.com/watch?v=gwcwSZIfKIM



Cells make sex cells to help in the reproduction of multi-cellular organisms through a process called **meiosis** (one makes four).

Meiosis



Meiosis: The Great Divide Video Clip

http://www.youtube.com/watch?v=toWK0flyFIY

[watch first 3 minutes only]

Comparing Mitosis and Meiosis

http://www.pbs.org/wgbh/nova/body/how-cells-divide.html

http://www.bbc.co.uk/schools/gcsebitesize/science/add_edexcel/cells/mitosisact.shtml

Activities to Review Cell Processes

Cell Processes Image Shuffle Activity

Cell Processes QR Code Review

Cell Processes Review Cards [play Kaboom or other review game]

Cell Processes Summarizer

Organization of Living Things:

Name _____ Date _____ Period ____

Directions: Match the cell processes with their correct description.

____ 1. Photosynthesis	A. Small particles such as oxygen and carbon dioxide move easily across the cell membrane from areas of high concentration to low concentration.
____ 2. Cellular Respiration	B. Process by which the cell membrane envelops (engulfs) material that is too large to pass through the membrane.
____ 3. Passive Transport	C. Process where food is broken down to release chemical energy. Occurs in the mitochondria.
____ 4. Active Transport	D. Process in which particles move from less crowded (low concentration) to more crowded (high concentration) using energy.
____ 5. Diffusion	E. Water moving from areas of high concentration to low concentration.
____ 6. Osmosis	F. Process where cells make more cells or divide (one cell makes two).
____ 7. Endocytosis	G. Plant cells take in light energy and change it into chemical energy in the form of glucose (food). Occurs in the chloroplasts.
____ 8. Exocytosis	H. Process by which the cell membrane removes material that is too large to pass through the membrane.
____ 9. Mitosis	I. Process where cells make sex cells to help in the reproduction of multi-cellular organisms (one makes four).
____ 10. Meiosis	J. Process in which substances or particles move through the cell membrane, protein channel, or protein doorway from high concentration to low concentration without the use of energy.

Cell Processes Tiered Activity