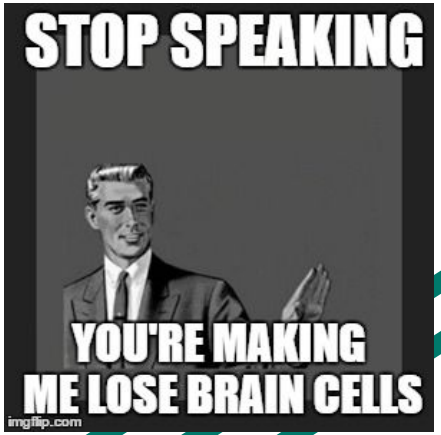
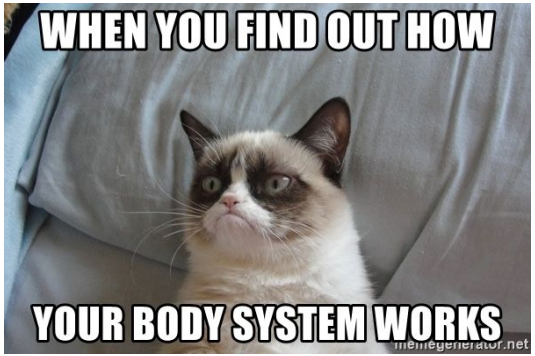
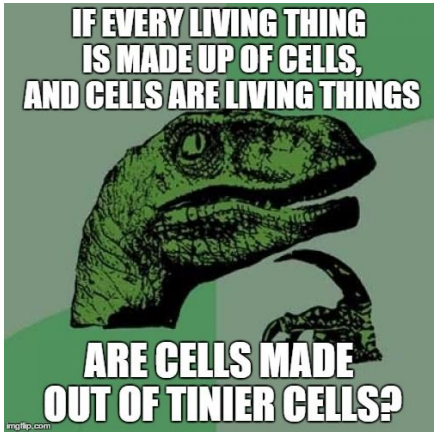
Unit 3
Cells and Systems





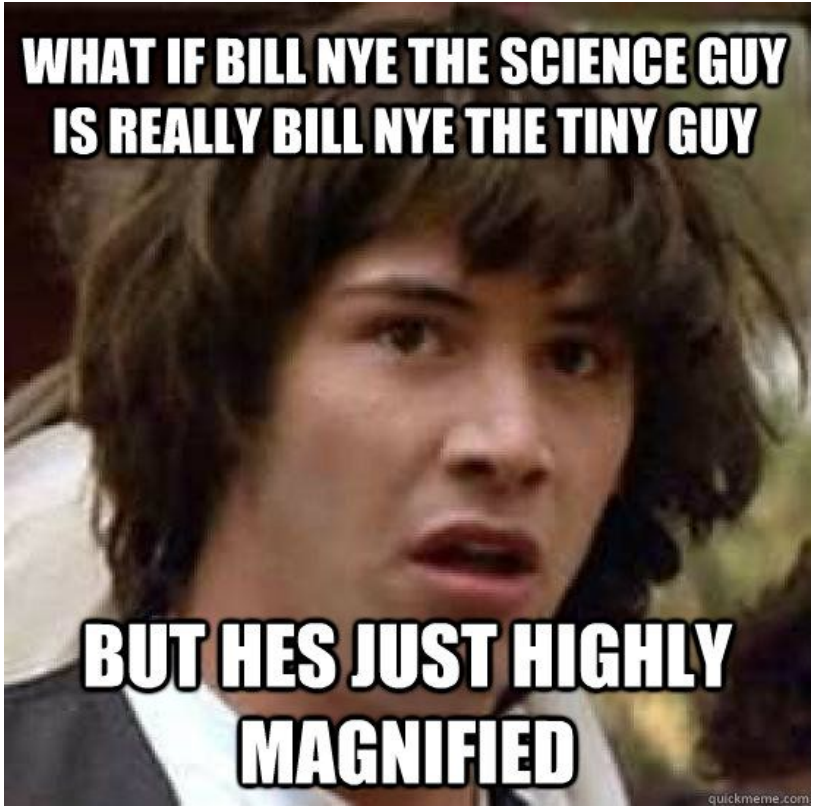


Why do we study anatomy?

Microscopes

A **microscope** is an optical instrument used for viewing very small objects, typically magnified several hundred times.

The microscope was first patented in 1590. This opened up a whole new area of science.



Fun fact!

It is unsure who created the first microscope.

Some historians say it was Hans Lippershey, most famous for filing the first patent for a telescope.

Other evidence points to Hans and Zacharias Janssen, a father-son team of spectacle makers living in the same town as Lippershey.

Microscopes

There are four types of microscopes;

1) Stereoscopic Microscopes
2) Transmission Electron Microscopes
3) Scanning Electron Microscopes
4) Compound Microscopes

Stereoscopic Microscope

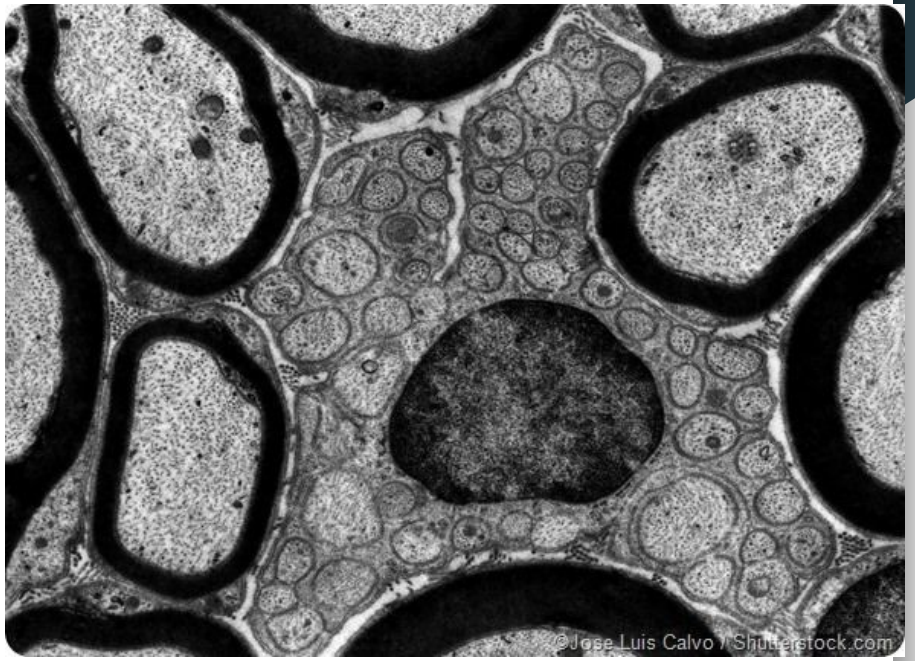
A stereo, or dissecting, microscope provides a three-dimensional view of the specimen.

It does this with separate objective lenses and eyepieces for each eye. They have lower magnification when compared to compound microscopes, but they also have a longer working distance.

Transmission Electron Microscopes

The transmission electron microscope is a very powerful tool. In TEM A high energy beam of electrons is shone through a very thin sample, and the interactions between the electrons and the atoms can be observed.

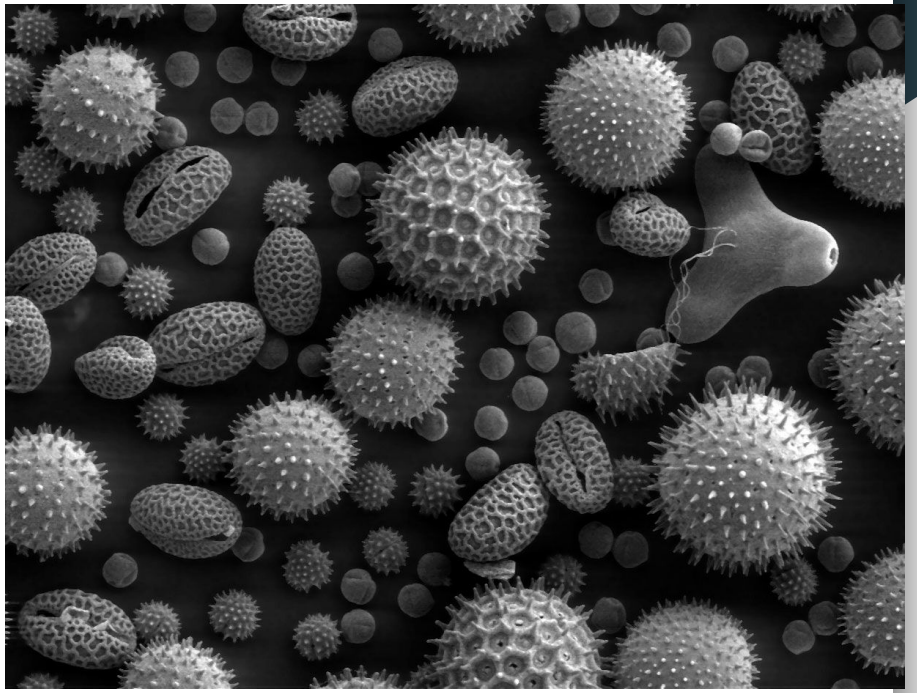
Chemical analysis can also be performed.



Scanning Electron Microscopes

A scanning electron microscope (SEM) scans a focused electron beam over a surface to create an image.

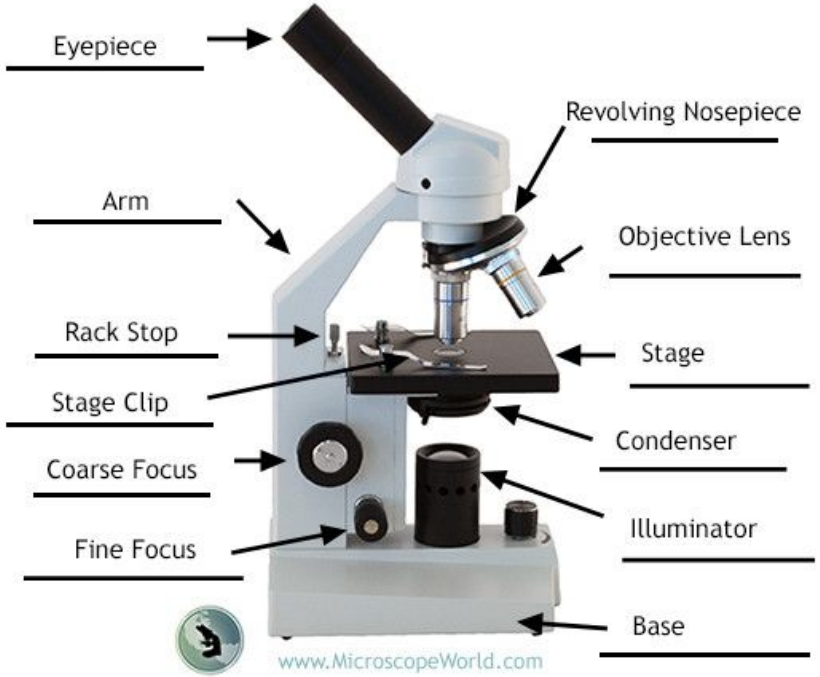
The electrons in the beam interact with the sample, producing various signals that can be used to obtain information about the surface topography and composition.



Compound Microscopes

A compound microscope is an instrument that is used to view magnified images of small objects on a glass slide.

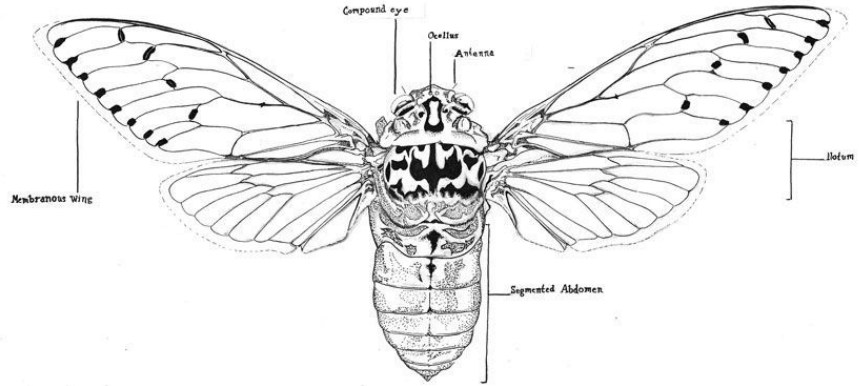
It can achieve higher levels of magnification than stereo or other low power microscopes.



Scientific Drawings

Scientific drawings are an important part of the science of biology and all biologists must be able to produce good quality scientific drawings regardless of their artistic ability.

Scientific drawings are used as a way to demonstrate your observations of a specimen in a simple way.

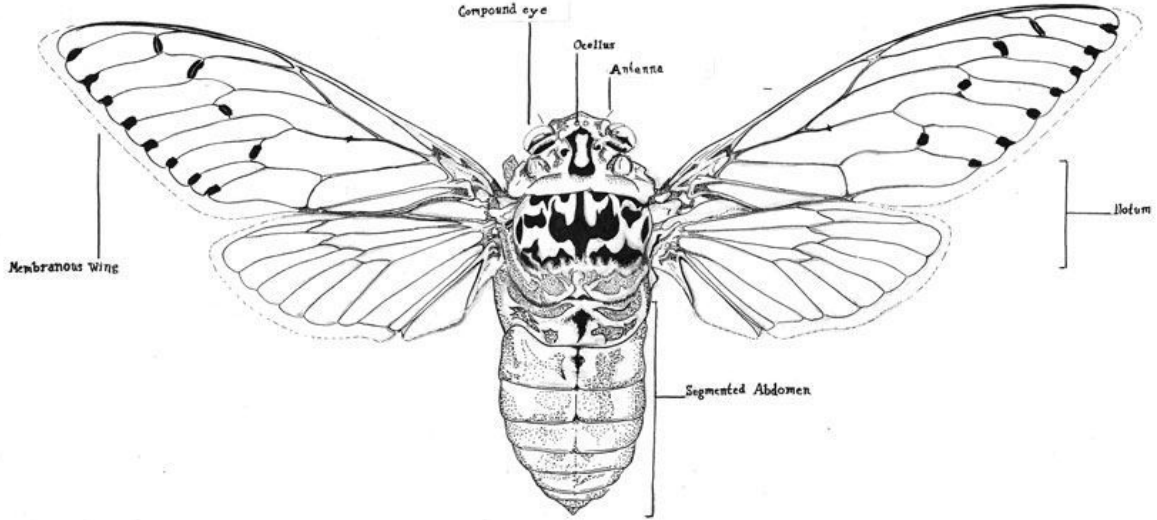


Scientific Drawings Rules

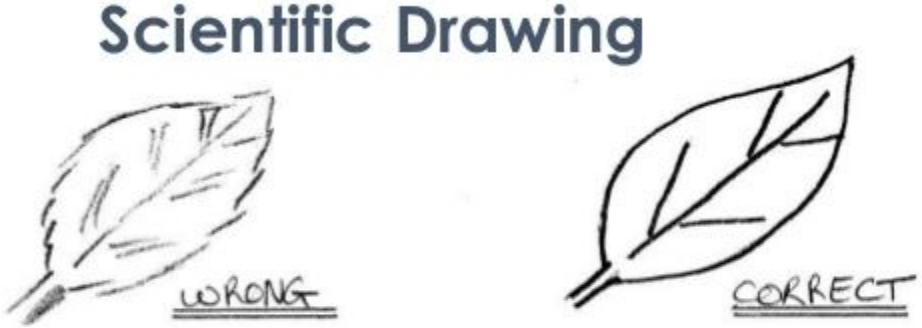
While drawing remember the rules for scientific drawings;

1) Look at the specimen carefully and examine the significant features that will be included in the drawing
2) Draw only what you see. Do not include what you think you should see
3) All drawings must be done in pencil
4) Drawings must be large and clear so that features can be easily distinguished
5) No more than two drawings should be on a single page
6) Always use distinct, single lines when drawing
7) To illustrate darker areas on a specimen, use stippling or dots. Do not shade in any area of your drawing
8) Include a title, magnification, and labels
9) Be sure to underline scientific names

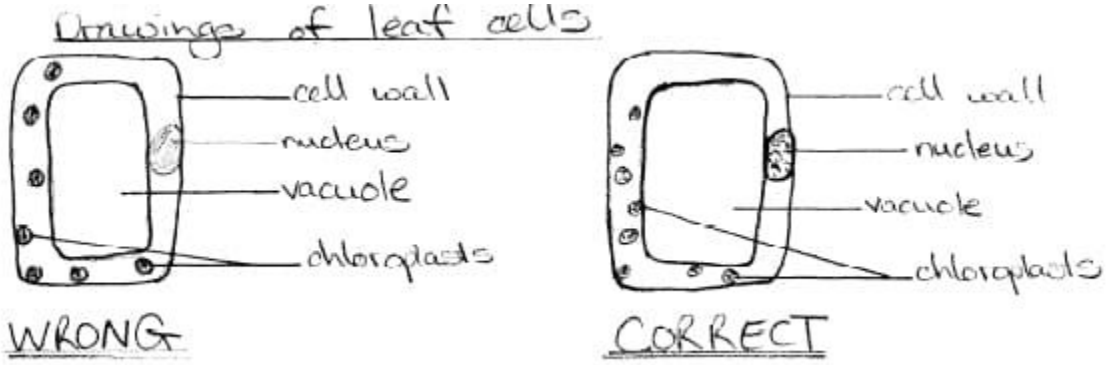
Example


Compound eye
Ocellus
Antenna
Membranous Wing
Notum
Segmented Abdomen

What is incorrect?



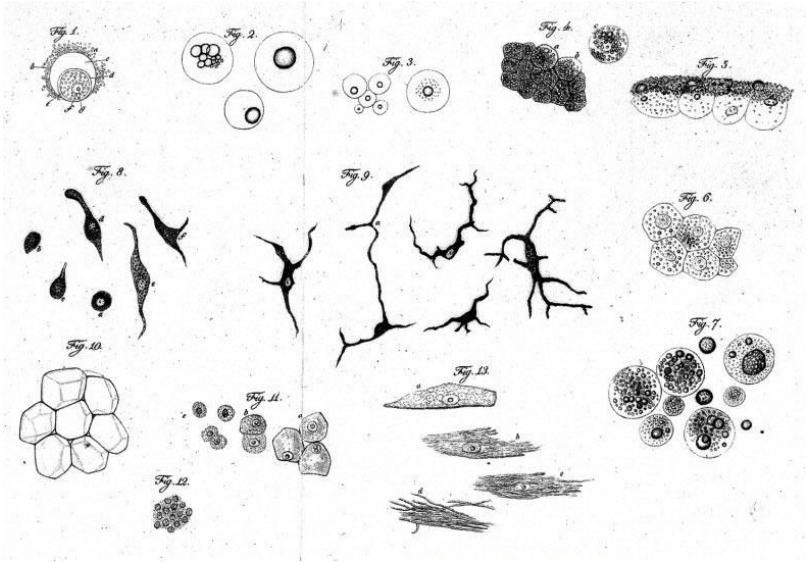
What is incorrect?



Scientific Drawing Practice

With a partner complete the following assignment.

Please refer to the assignment sheet handed out.

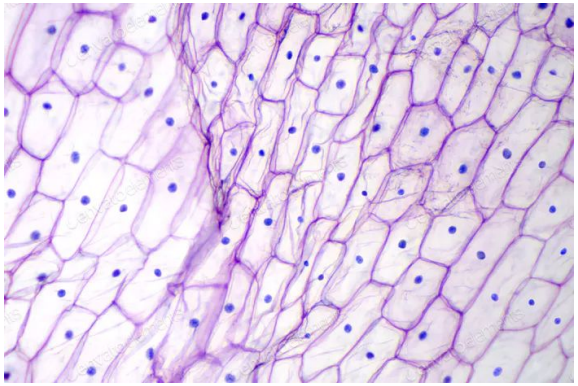


Review

What type of device or technology do we use to look at microscopic organisms?

What is one rule for scientific drawings?

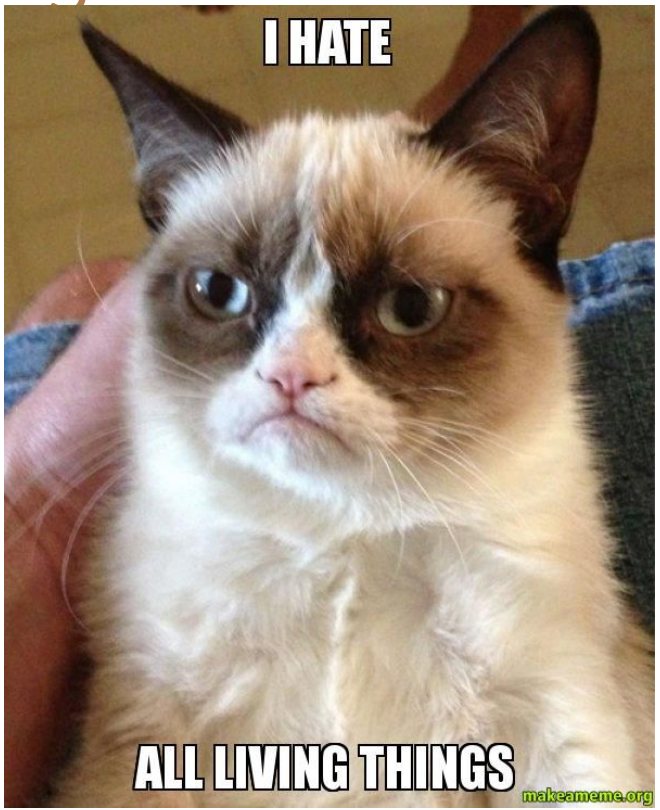
What type of microscope do we have in our lab?



7 Characteristics of living things

An individual living creature is called an **organism**. There are 7 characteristics that all living organisms share. All organisms;

1) Are made up of one or more cells
2) Require energy
3) Grow and develop
4) Reproduce
5) Possess adaptations that evolved over time
6) Respond to their environment
7) Maintain homeostasis



Cells

If you look closely at any organism you can see that it is made of structures called cells.

A cell is the basic unit of structure and function of all living organisms.

All living organisms are made of one or more cells, and all cells are created by cells.

Parts of a cell

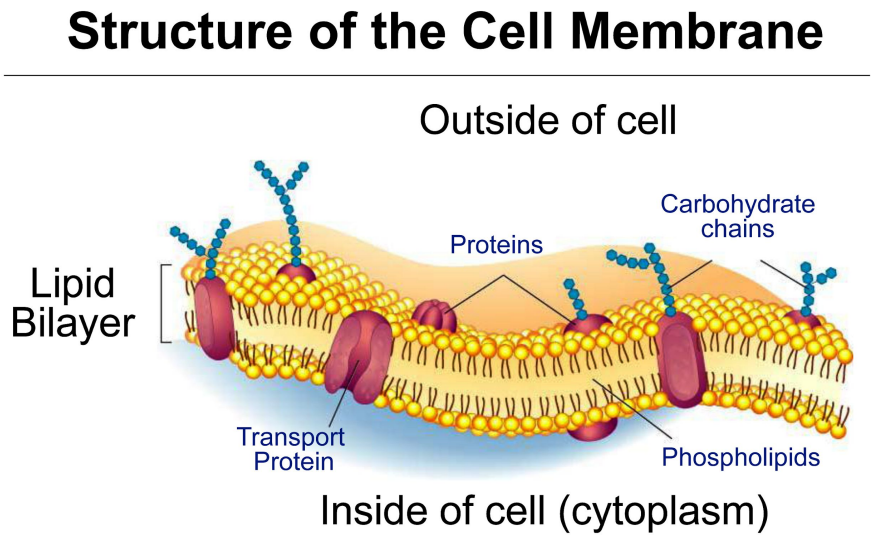
There are several different parts of a cell called organelles. However, we will focus mainly on the;

1) Cell membrane
2) Cytoplasm
3) Endoplasmic Reticulum
4) Ribosomes
5) Mitochondria
6) Lysosomes
7) Vacuoles
8) Golgi Bodies
9) Nucleus

Cell membrane

The cell membrane is present in both plant and animal cells, but it is the outermost layer of an animal cell.

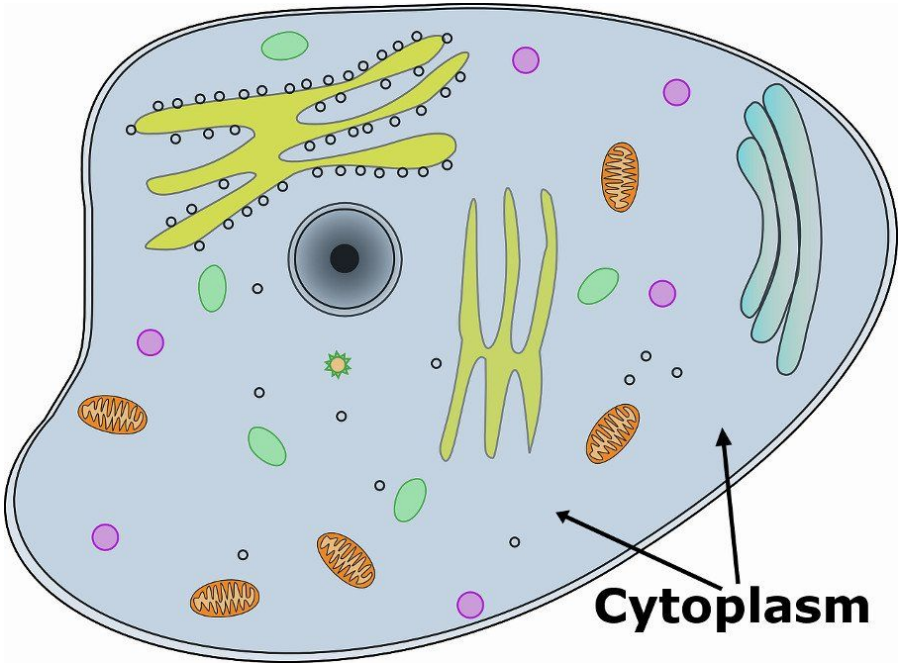
The cell membrane controls what materials go in and out of the cell.



Cytoplasm

Cytoplasm is a jelly-like substance inside the cell.

All of the cells organelles are located within the cytoplasm.



Endoplasmic Reticulum

The endoplasmic reticulum carries proteins and other materials from one part of the cell to another.

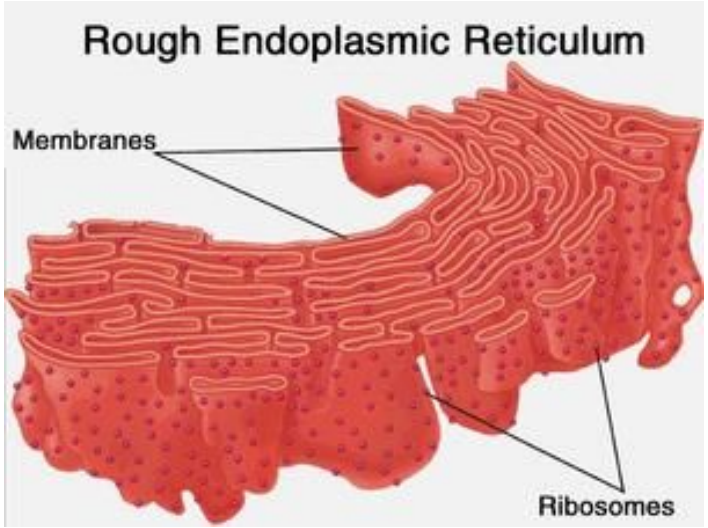
The endoplasmic reticulum is attached to the outside of the nucleus.

Ribosomes

Ribosomes are found both floating in the cytoplasm of a cell, and attached to the endoplasmic reticulum.

Ribosomes are responsible for making proteins for the cell.

In turn, proteins are used to make and repair parts of the cell.



Mitochondria

The mitochondria is referred to as the powerhouse of the cell.

The mitochondria change food into energy for the cell.

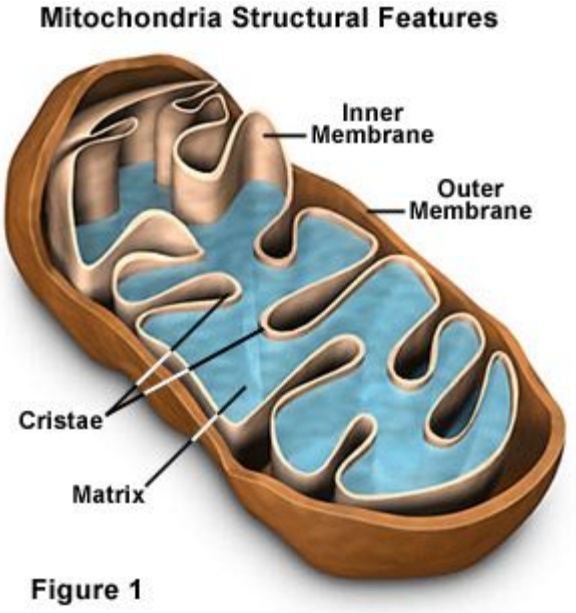
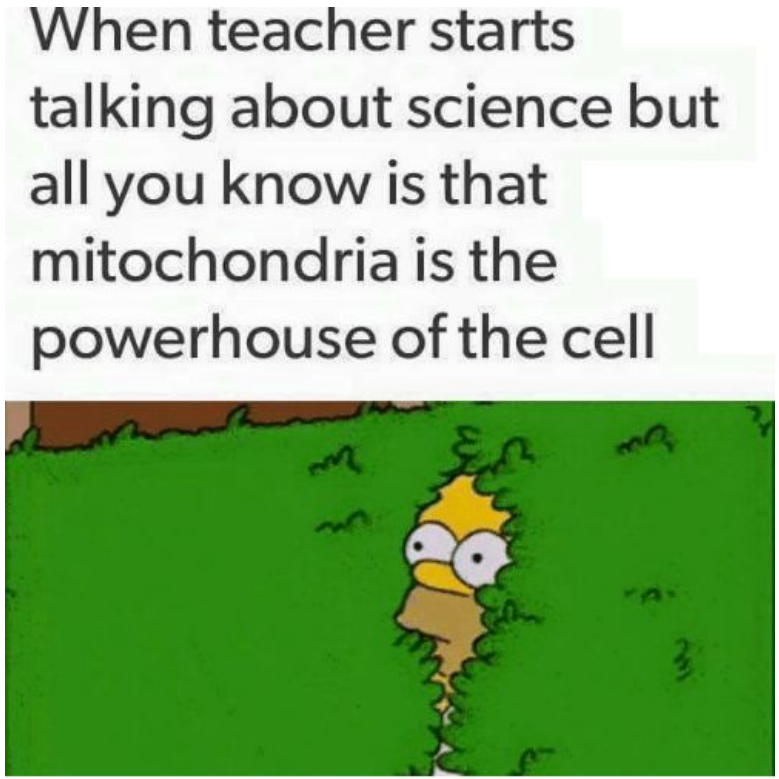


Figure 1

Fun Fact

For years the mitochondria was thought of being just a powerhouse for the cell. It is now known that the mitochondria is also responsible for; storing calcium, choosing which cells will be destroyed, and producing heat from brown fat.

It is also thought that Parkinson's disease, Alzheimer's disease, bipolar disorder, and schizophrenia are linked to a malfunctioning mitochondria.

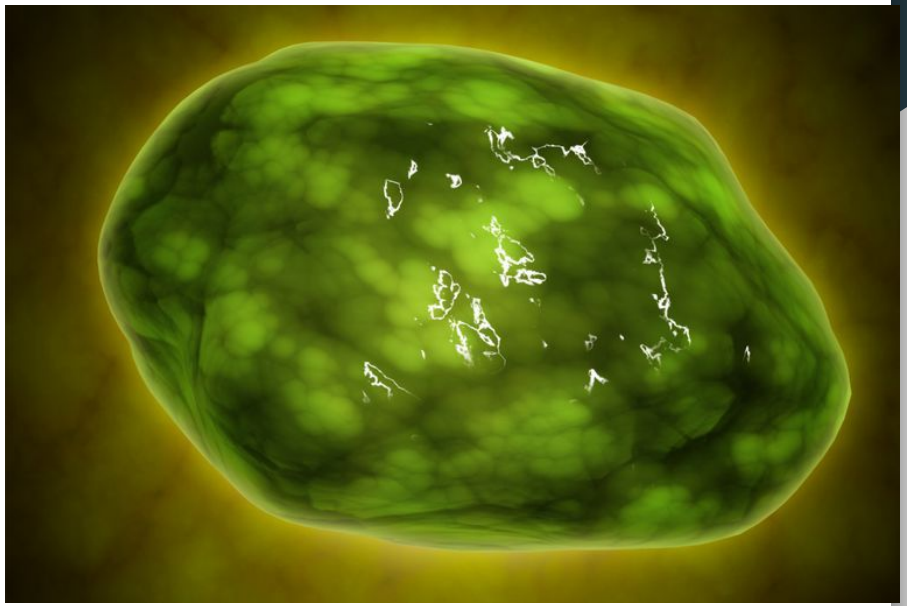


Lysosomes

Lysosomes contain chemicals that break down materials in the cell.

They are responsible for breaking down large food particles, and old cell parts.

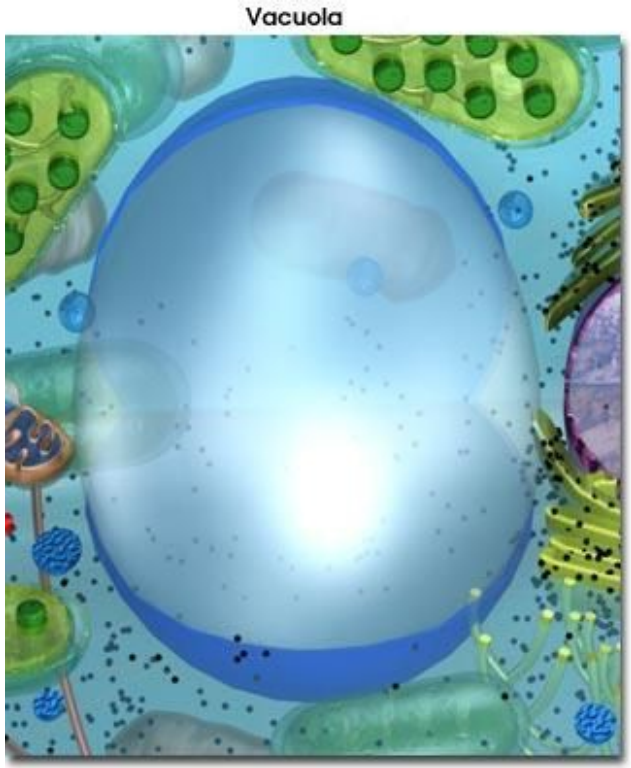
Lysosomes are thought of as the clean up crew of the cell.



Vacuoles

Vacuoles store water, food, and waste in the cell.

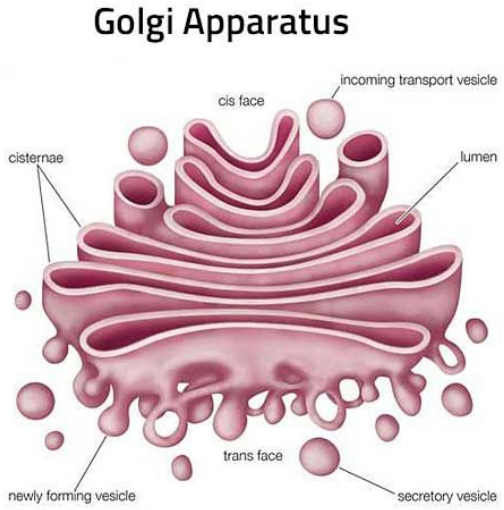
Animal cells have a few very small vacuoles, while plant cells have one large vacuole.



Golgi Body

The golgi body is responsible for collecting proteins and other newly created materials from the endoplasmic reticulum and packaging them to send to other parts of the cell.

The golgi body is located next to the endoplasmic reticulum.



Nucleus

The nucleus controls all of the cell's activity. It is considered to be the brain of the cell.

DNA is stored in the nucleus. The DNA found in the nucleus is the same in all cells of the organism.

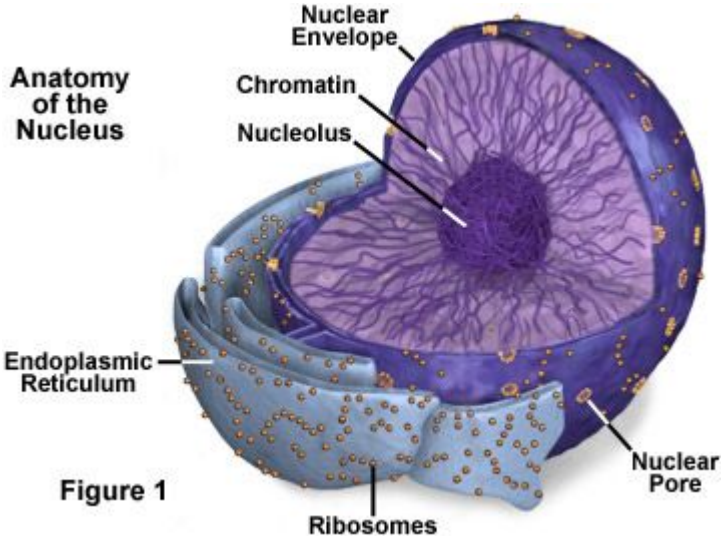
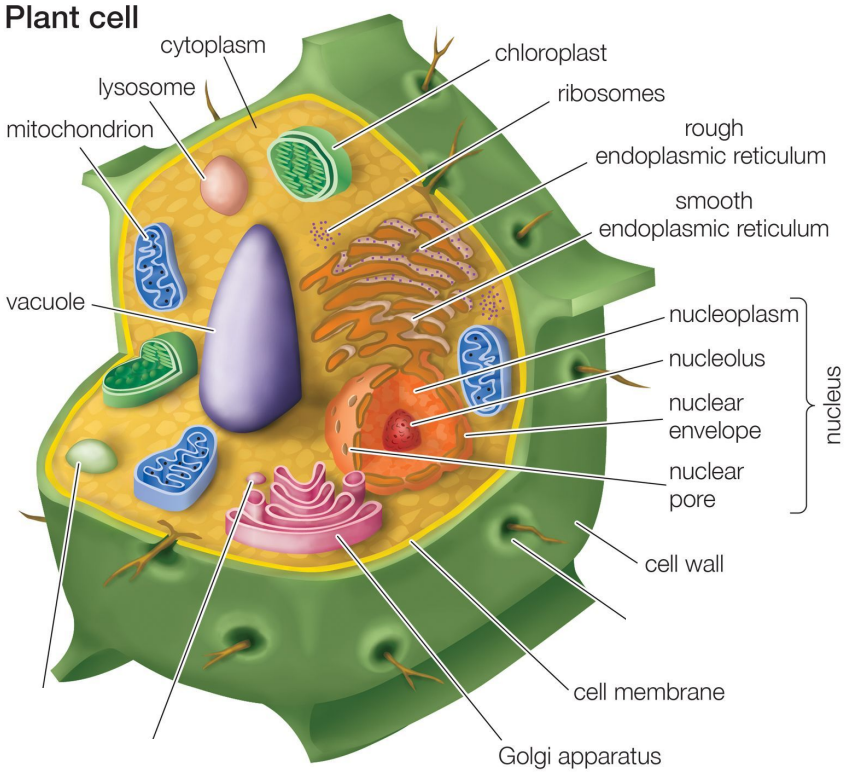
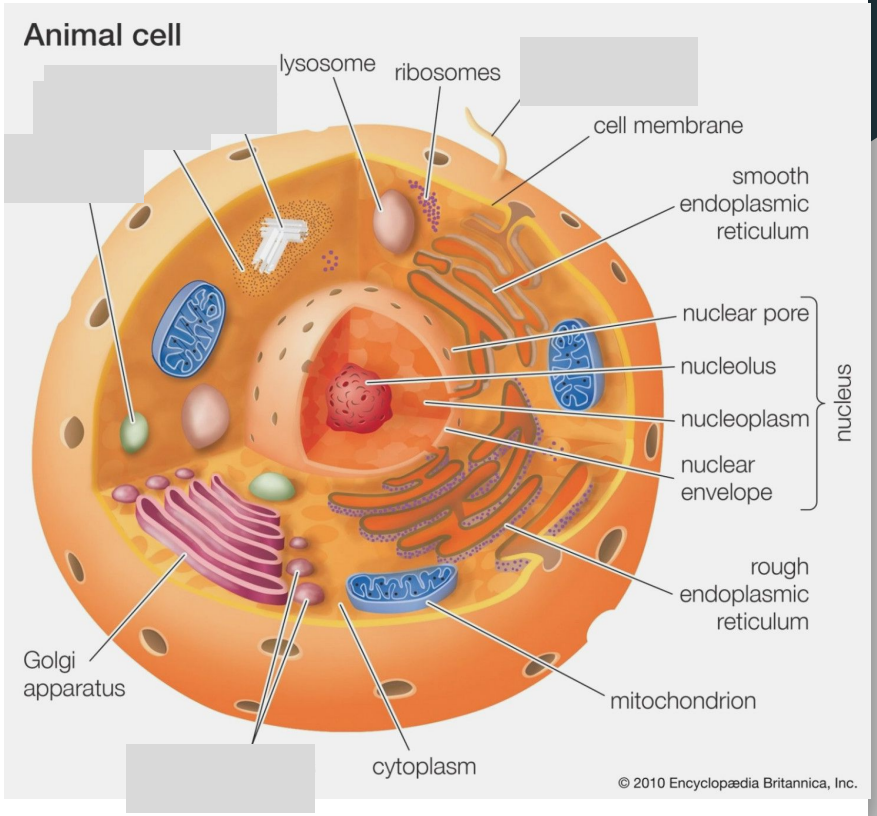


Figure 1

Plant and animal cells



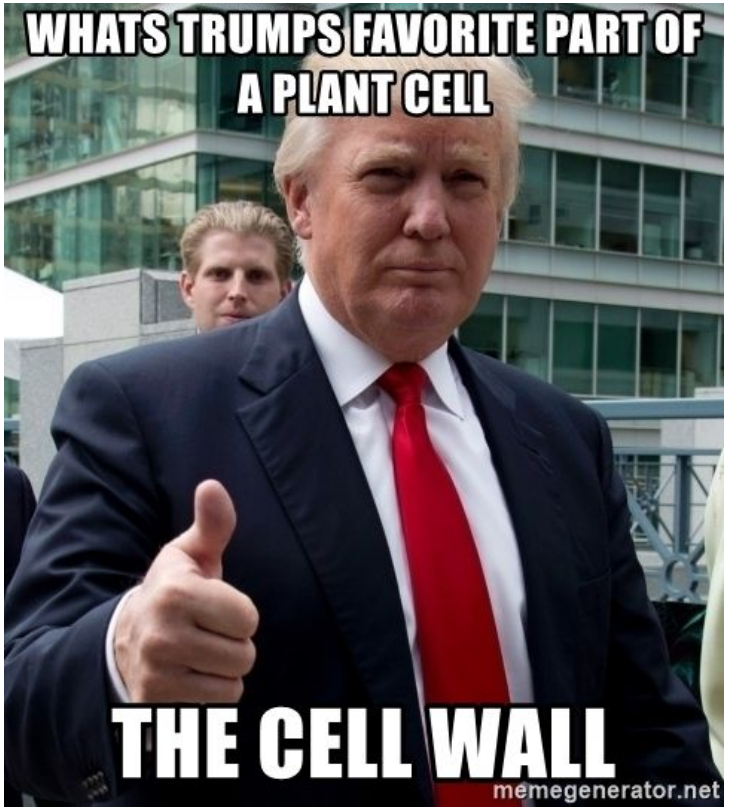


Difference between plant and animal cells

There are a few differences between animal and plant cells;

A plant cell has a cell wall, and chloroplasts. An animal cell has neither.

Plant cells also have a larger vacuole than animal cells.

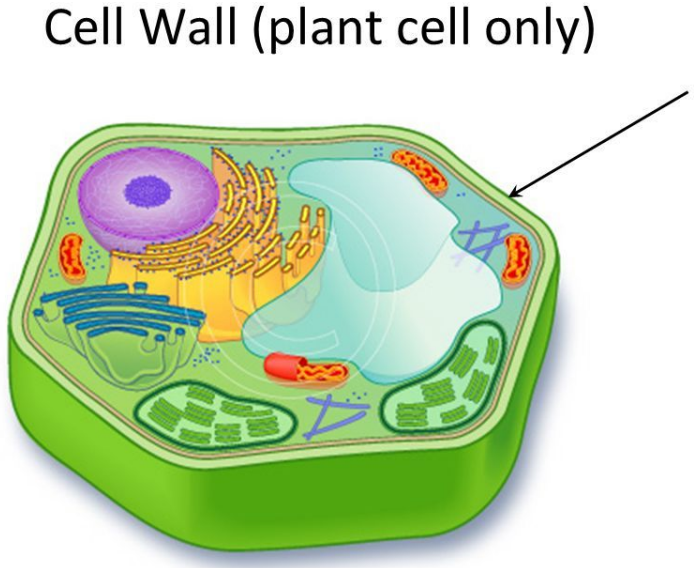


Cell wall

The cell wall protects and supports the cell. It is made of a tough, rigid, non-living material that surrounds the cell.

The cell wall lets water, oxygen, and other materials pass through it.

The cell membrane is located right behind the cell wall.

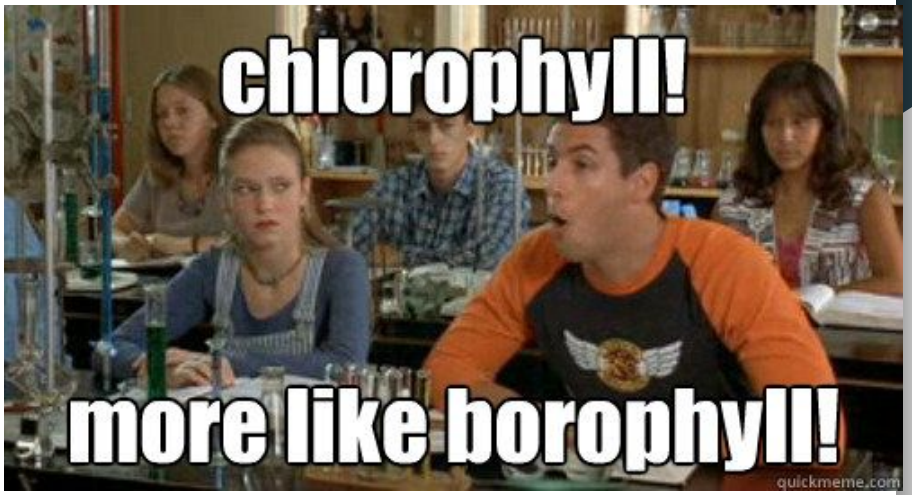


Chloroplasts

Chloroplasts get energy from the sun and use it to make food.

Chloroplasts contain chlorophyll, which is a green pigment largely responsible for the process of photosynthesis.

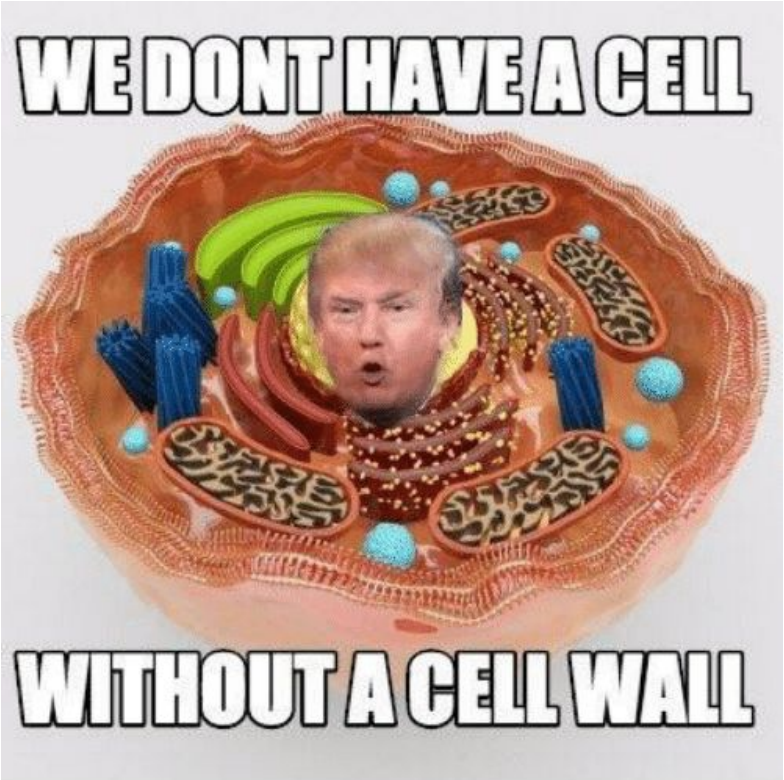
Chlorophyll gives the plants their green color.



Review

What is one difference between plant and animal cells?

Where is the DNA stored in a cell?

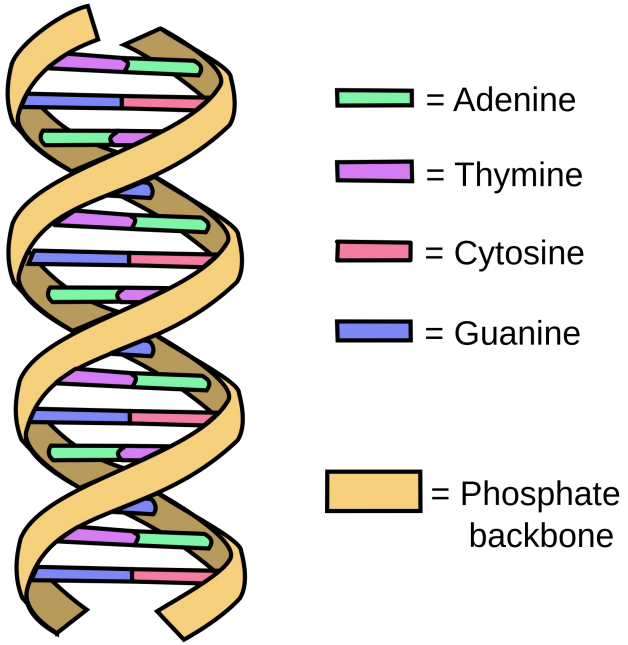


DNA

DNA stands for deoxyribonucleic acid it is found in the nucleus of all cells and is a carrier of genetic information.

DNA is considered a blueprint for a living thing, and is the backbone for cell replication.

DNA is holds the shape of a double helix.



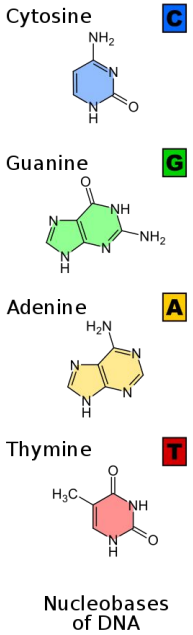
DNA

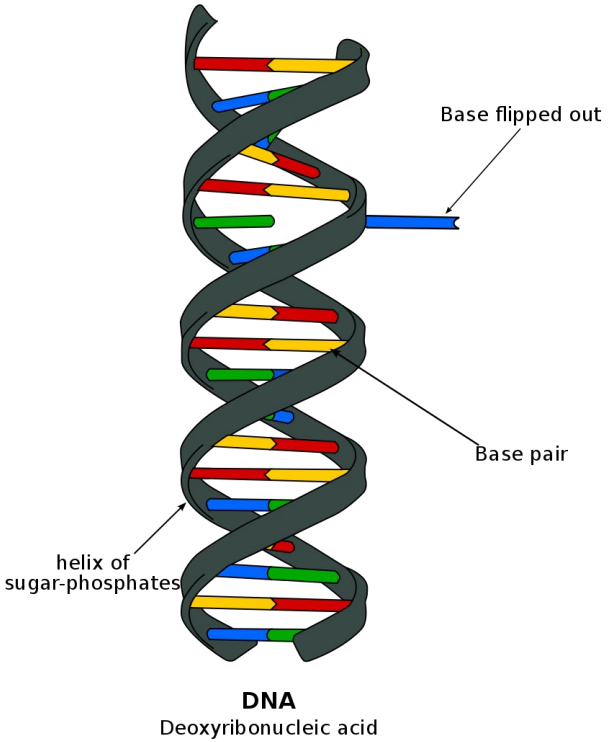
Nucleotides

Each chain of DNA is made up of repeating subunits called nucleotides.

There are four different types of nucleotides in DNA they are;

Adenine, Thymine, Guanine, and Cytosine.

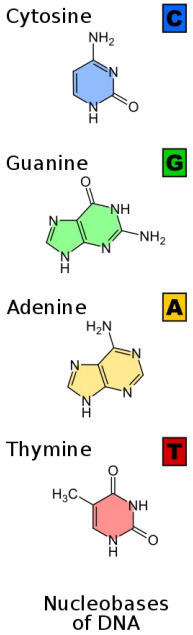




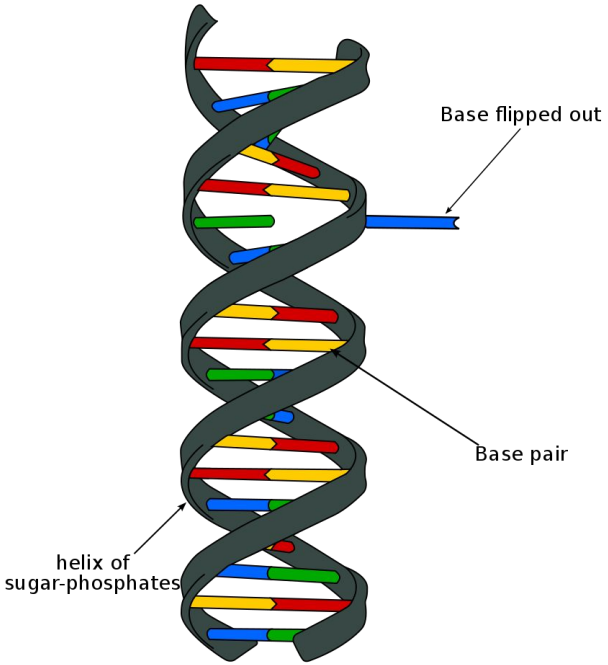
Complementary Bases

In DNA each nucleotide has a pairing. These pairings are called complementary bases.

Cytosine will always be paired with guanine, and adenine will always be paired with thymine.



Nucleobases of DNA

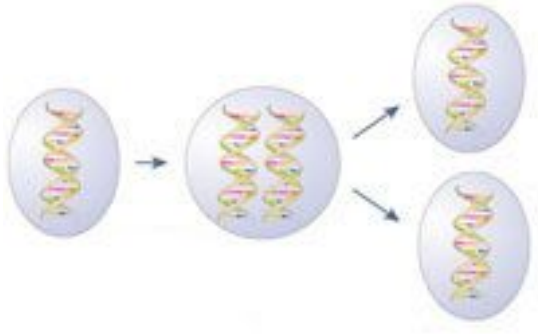


DNA
Deoxyribonucleic acid

Cell Replication

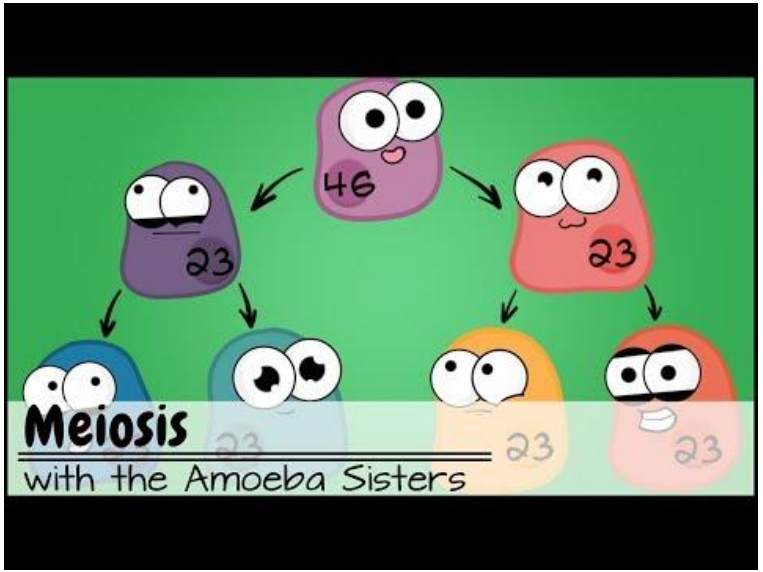
Replication is the process by which a cell uses the DNA within itself to duplicate and become two different, but identical, cells. Each time a cell divides, the two resulting daughter cells must contain exactly the same genetic information, or DNA, as the parent cell. This will increase the number of cells within the organism

Why might it be important for cells to replicate?



Mitosis-Cell Duplication

Meiosis- Gamete Duplication

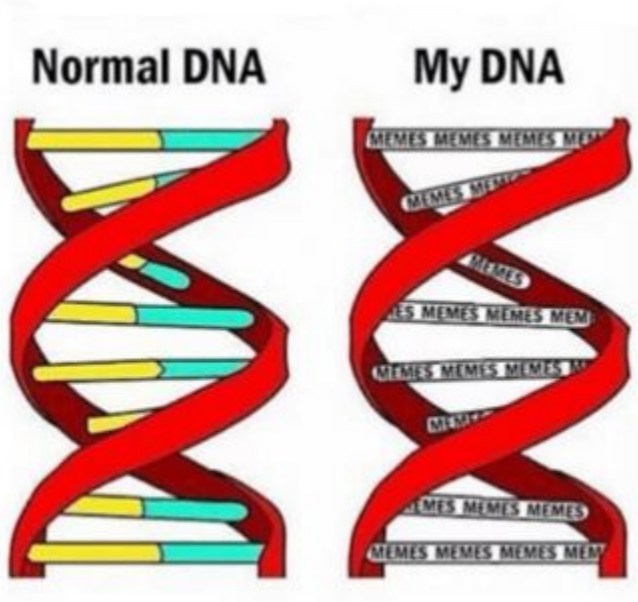


Review

What is Mitosis?

What are complementary bases?

Where is DNA located?

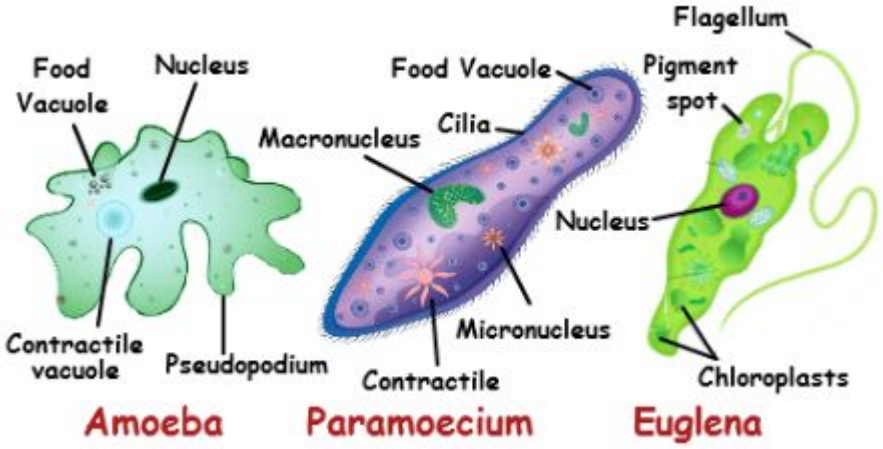


Unicellular

A unicellular organism, is an organism that consists of only one cell, unlike a multicellular organism that consists of more than one cell.

Unicellular organisms fall into two general categories;

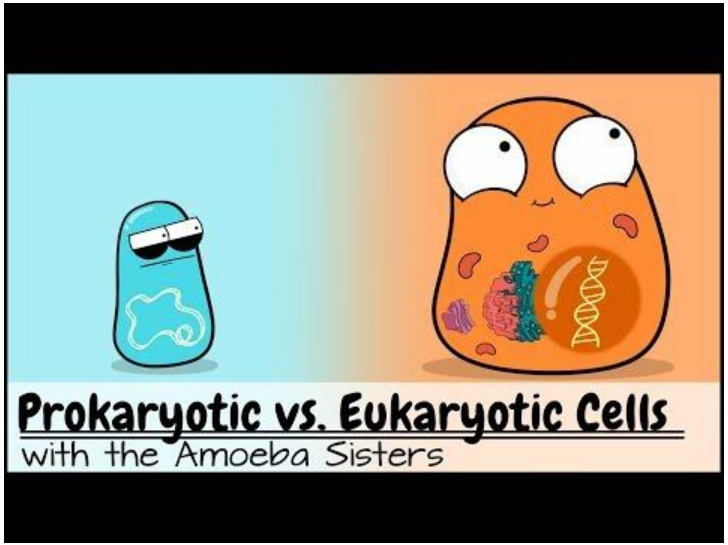
Prokaryotic organisms and eukaryotic organisms.



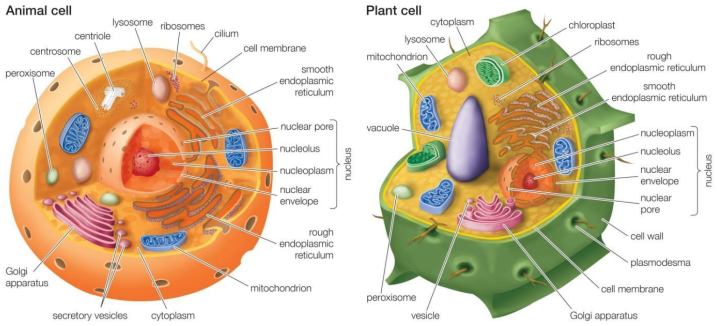
Fun Fact!

One of the largest unicellular organisms the Valonia ventricosa, a species of algae has a diameter anywhere from 1cm to 4cm.

Eukaryotes and Prokaryotes



Eukaryotic Cells



More complex

Larger cell

Contain a nucleus

Includes cells from plants, animals and fungi.

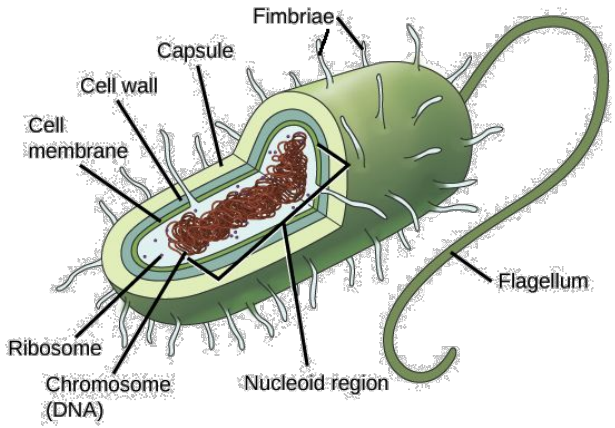
Eukaryotes are multicellular

Prokaryotic Cells

Single celled organisms

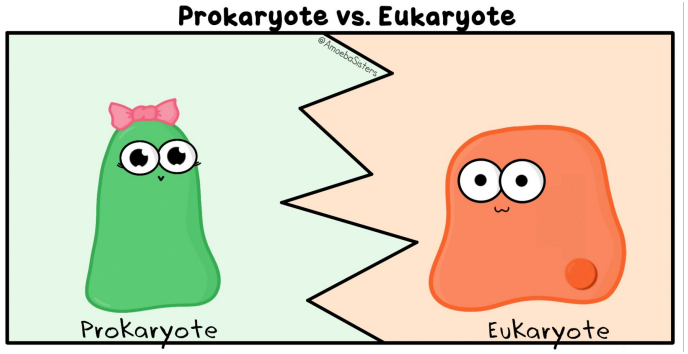
Simple Structure

No enclosed organelles within the cell



Prokaryotes include bacteria and archaea.

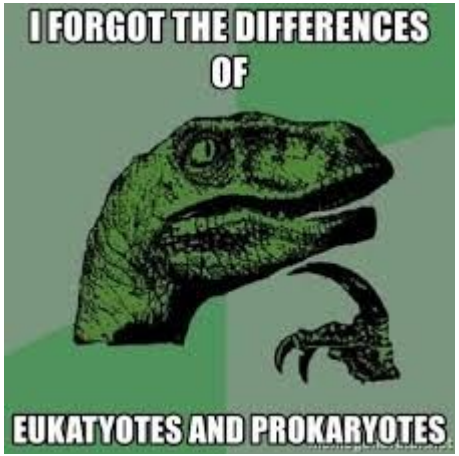
Review



What is the difference between eukaryotic and prokaryotic cells?

How do cells replicate?

What are the seven characteristics of living things?



Remember

An individual living creature is called an **organism**. There are 7 characteristics that all living organisms share. All organisms;

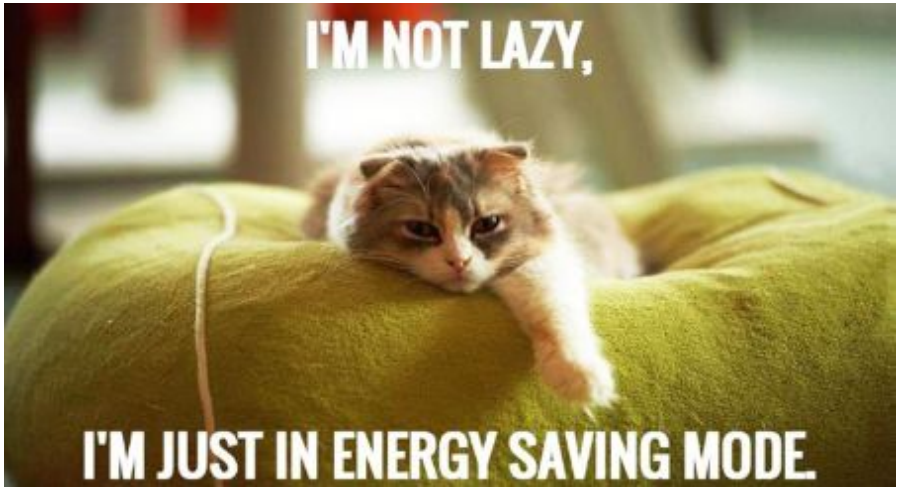
1)Are made up of one or more cells
2)Require energy
3)Grow and develop
4)Reproduce
5)Possess adaptations that evolved over time
6)Respond to their environment
7)Maintain homeostasis

Energy

Plants and animals use various forms of energy for the development of their bodies.

Plants use the energy of the sun to make their own food

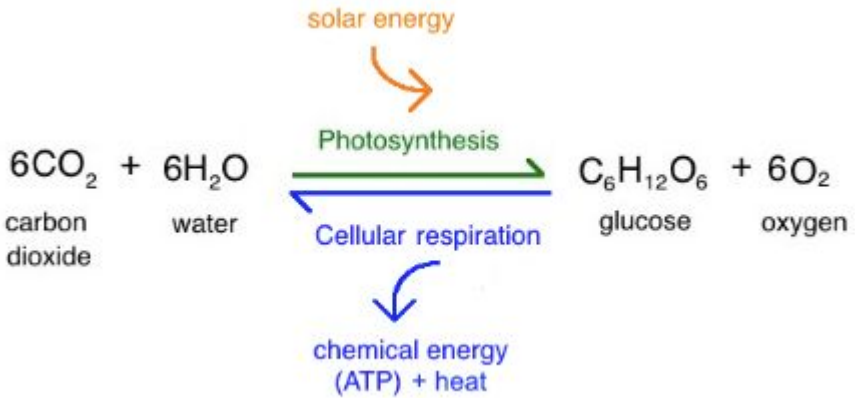
Animals get their food from the environment around them.



Photosynthesis and Cellular Respiration

Photosynthesis is the process by which green plants and some other organisms use sunlight to synthesize foods from carbon dioxide and water.

Cellular respiration is the process of oxidizing food molecules, like glucose, to carbon dioxide and water.



Fun Fact!

Living things that make or produce their own food, like plants are called **autotrophs.**

Living things that consume food, like animals are called **heterotrophs.**

Metabolism

The entire amount of chemical energy used by plants and animals to carry out their life processes is called **metabolism**.

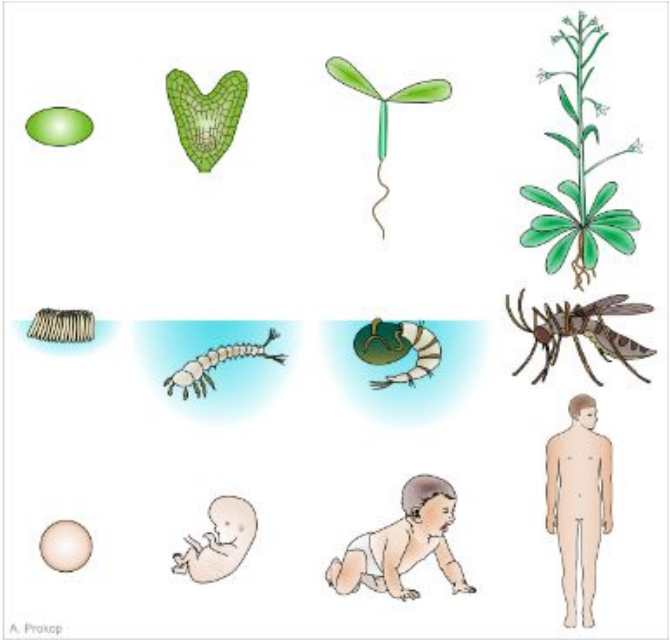
The chemical reactions provide energy for vital processes and for synthesizing new organic material.

Growth and Development

All living organisms grow and develop. However, Growth and development of living organisms are not the same things.

Growth is the increase in size and mass of that organism.

Development involves transformation of the organism as it goes through the growth process.



Growth and Development

Cell growth and development include repair. As cells grow old, they wear off. Sometimes they suffer injury and bruises, but they are able to repair themselves by growing new cells in a process called Mitosis.

Growth and Development

As living things grow, they undergo a process called aging.

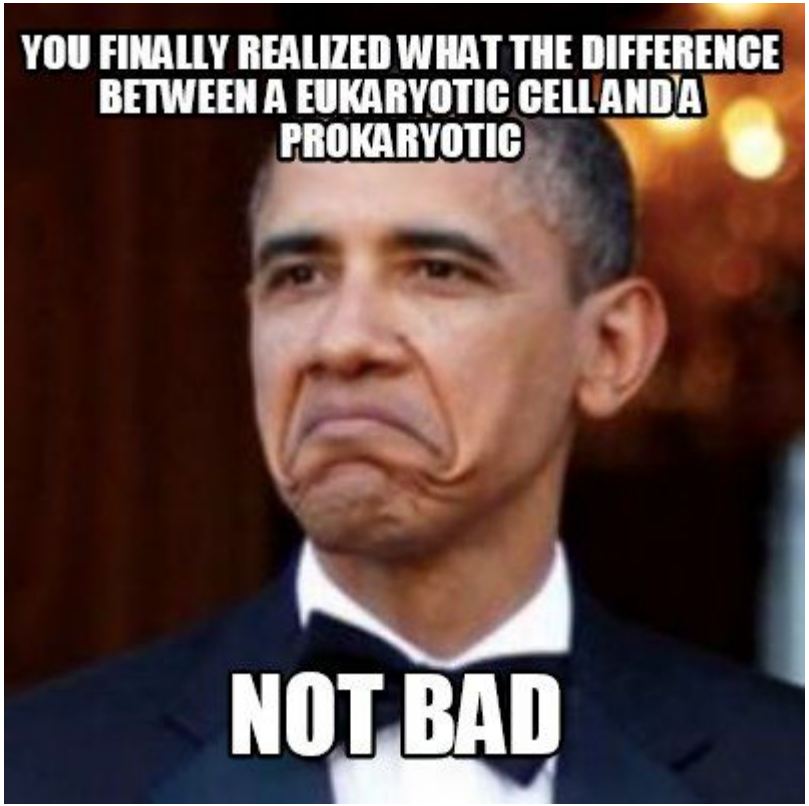
As they get close to the end of their lifespan, their ability to carry out life functions reduce. Eventually, they die to end the process of life.

Review

a) What is the difference between eukaryotic and prokaryotic cells?

b) How do cells replicate?

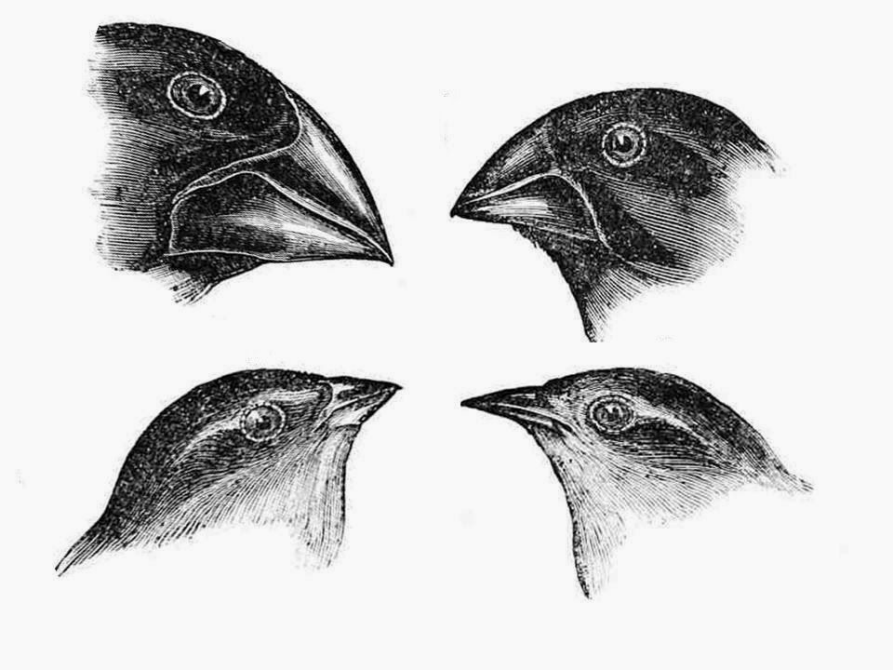
c) What are the seven characteristics of living things?



Darwin’s Finches

On his visit to the Galapagos Islands, Charles Darwin discovered several species of finches that varied from island to island, which helped him to develop his theory of natural selection.

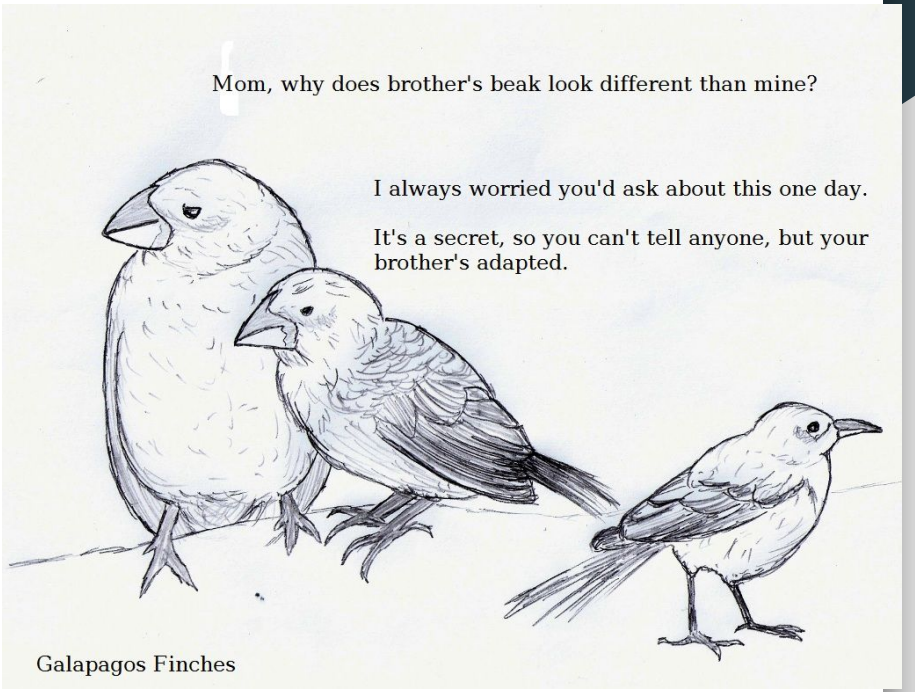
From these findings Darwin developed his theory of natural selection.



Adaptations

An adaptation is a mutation, or genetic change, that helps an organism, such as a plant or animal, survive in its' environment.

Due to the helpful nature of the mutation, it is passed down from one generation to the next. As more and more organisms inherit the mutation, the mutation becomes a typical part of the species.



Adaptations

Adaptations can be structural, meaning it is a physical part of the organism, or behavioural which affects the way an organism acts.

Meerkats have developed an immunity to scorpion stings that can paralyze a grown man or kill a small child.

Bird calls and migration are behavioral adaptations that help birds survive winter and find mates.

Birds!

Structure and Function

Living things are composed of different structures that allow them to perform different functions.

For example the wings of birds allow them to fly.

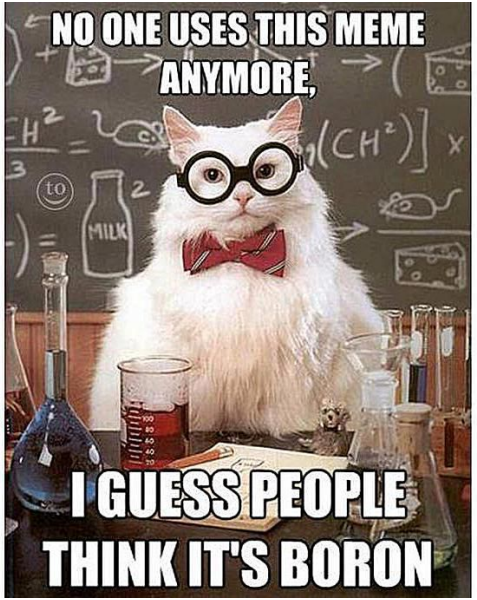
It is possible for one structure to have many different functions.

Review!

a) What is an example of a structure and its' function?

b) What is an adaptation?

c) What are the 7 characteristics of living things?



Response to environment

All living things adapt and respond to their environment.

A **stimulus** is anything that causes a response in an organism.

The organism's reaction to this stimulus is called a **response**.

Receptors

Receptors are specialised cells that detect a stimulus.

Some receptors can detect several different stimuli but they are usually specialised to detect one type of stimulus.

For example light is detected by photoreceptors in the eye, sound is detected by vibration receptors in the ears, and body position is detected by receptors in the ears.

Response to environment

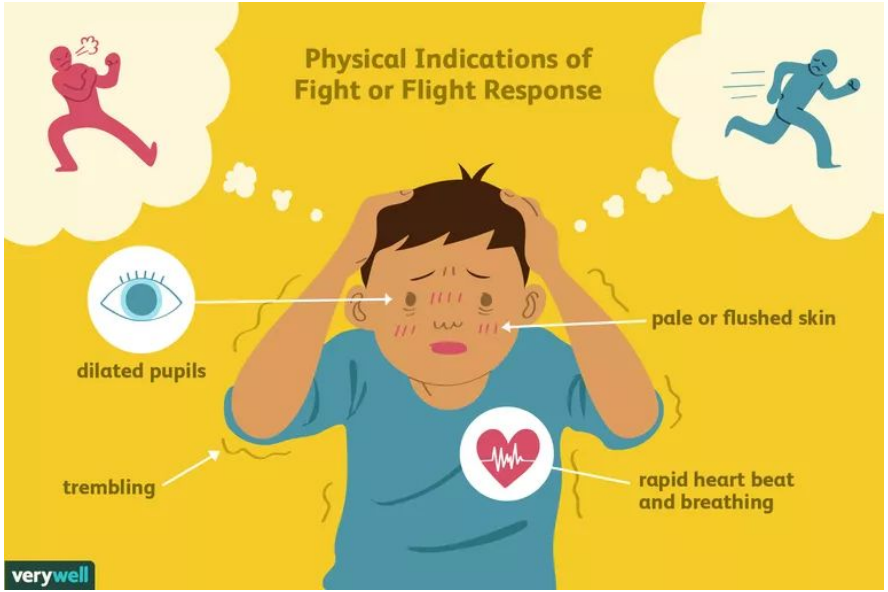
Although organisms respond to stimuli in different ways the pattern of events is always;

stimulus→detection→coordination→response

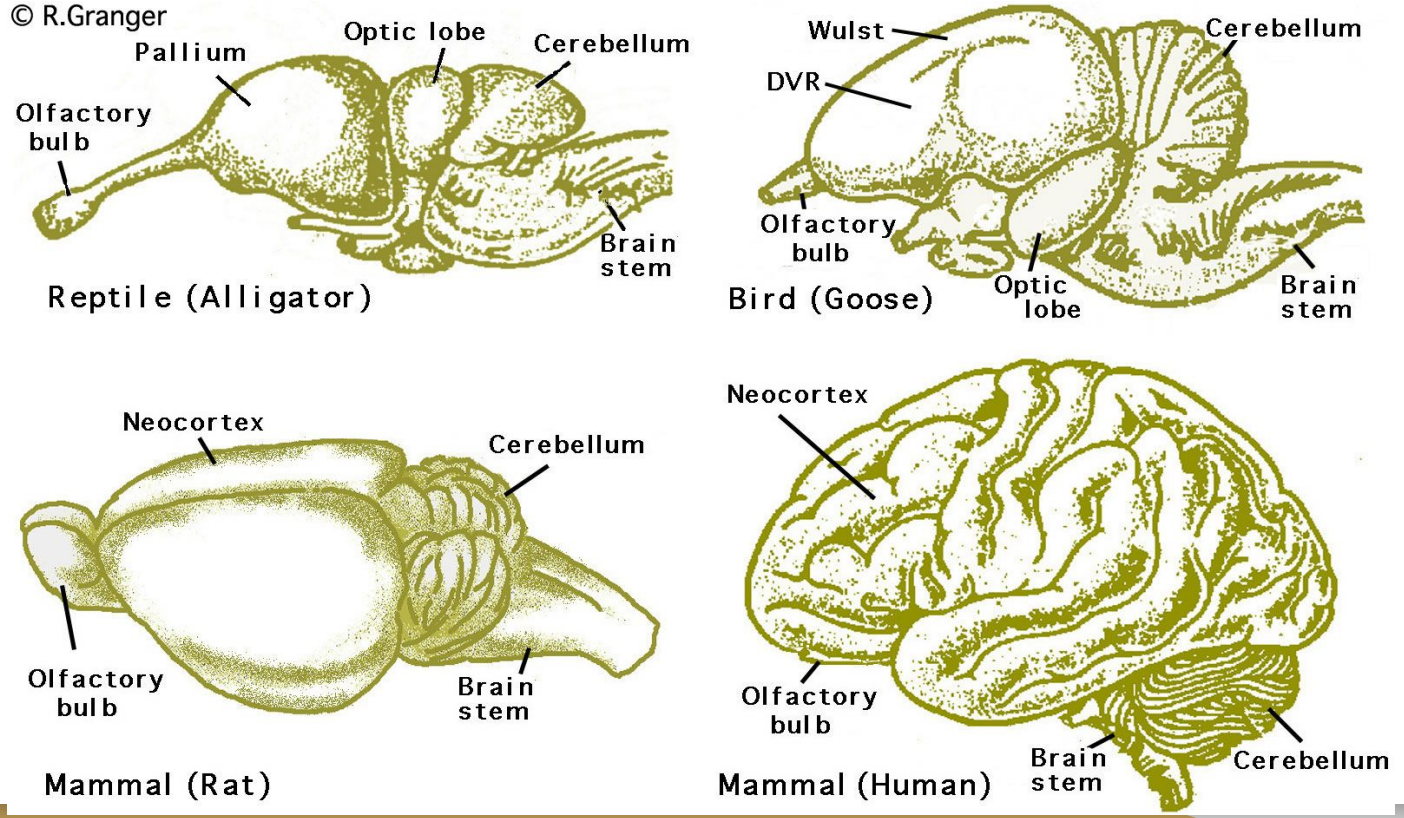
Fight or flight

The fight-or-flight response plays a critical role in how we deal with stress and danger in our environment. Essentially, it is the response that prepares the body to either fight or flee the threat.

During this response eyes begin to dilate, the heart starts beating rapidly and blood is redirected to important extremities.



Lizard Brain!



Fun Fact!

During the 1890s, Russian physiologist, Ivan Pavlov was researching salivation in dogs in response to being fed. He inserted a small test tube into the cheek of each dog to measure saliva when the dogs were fed.

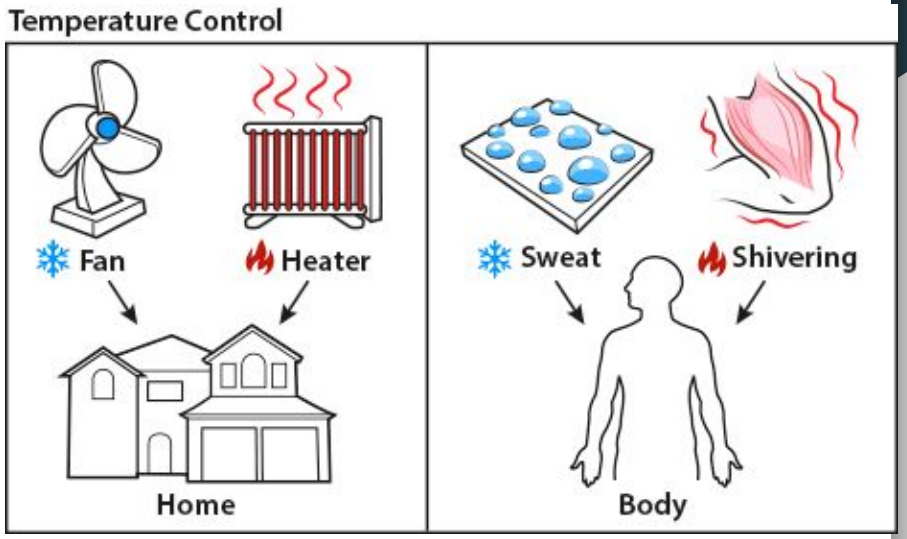
Pavlov noticed that his dogs would begin to salivate whenever they heard the footsteps of his assistant who was bringing them the food.

Homeostasis

Homeostasis is the tendency to resist change in order to maintain a stable, relatively constant internal environment.

When an organism responds to stimuli, the internal conditions of the organism must be maintained.

For example temperature can be regulated by sweating and shivering.



Review

a) What is homeostasis?

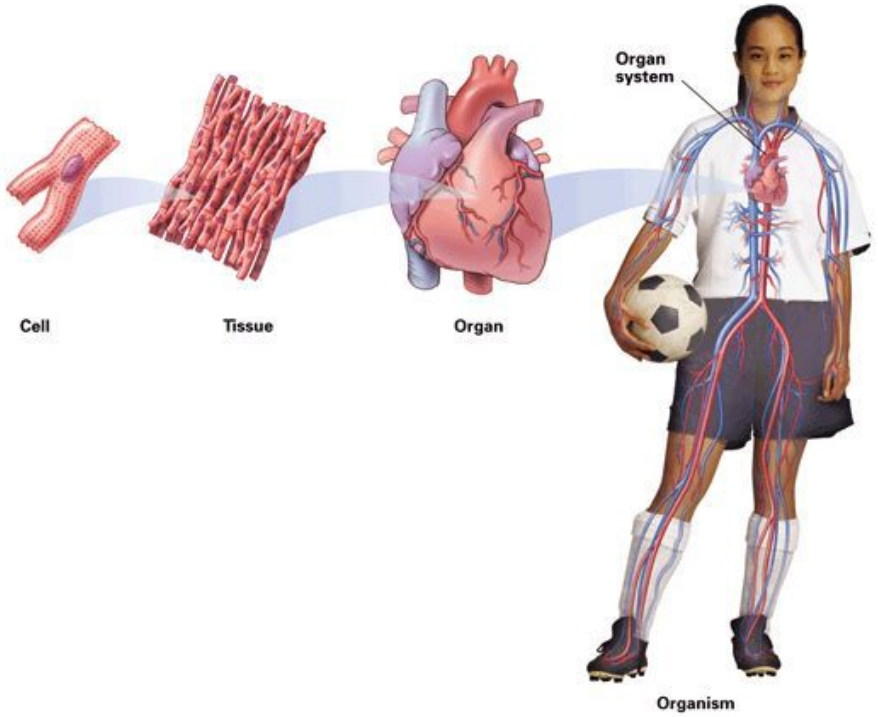
b) What is the basic unit of life?

c) How do cells reproduce?

Levels of organization

Humans, and other complex multicellular organisms have systems of organs that work together, carrying out processes that keep us alive.

The body has levels of organization that build on each other. Cells make up tissues, tissues make up organs, and organs make up organ systems.

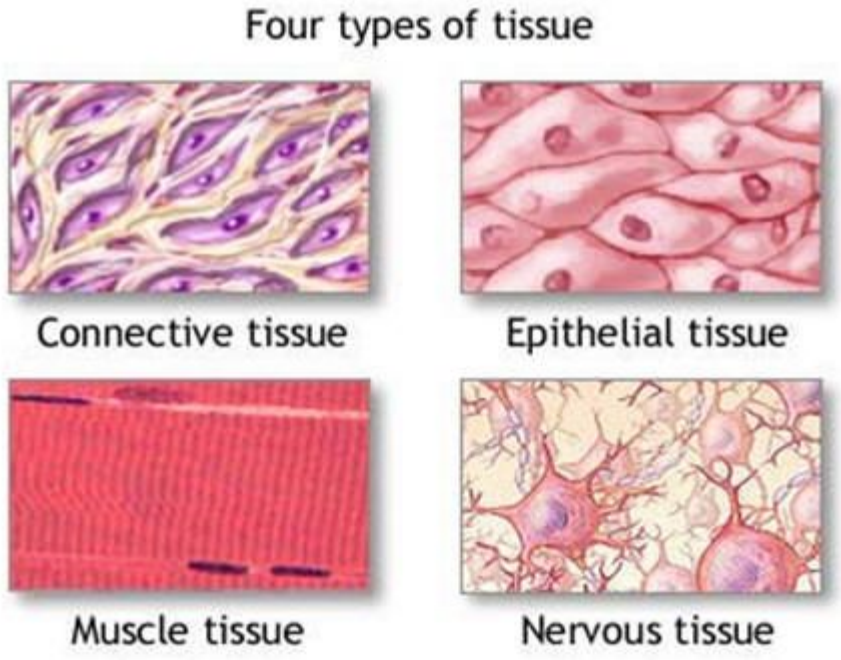


Types of Tissue

Tissues are groups of similar cells that work together to perform a specific task.

Humans and other large multicellular animals are made up of four basic types of tissue;

Epithelial tissue, connective tissue, muscle tissue, and nervous tissue.

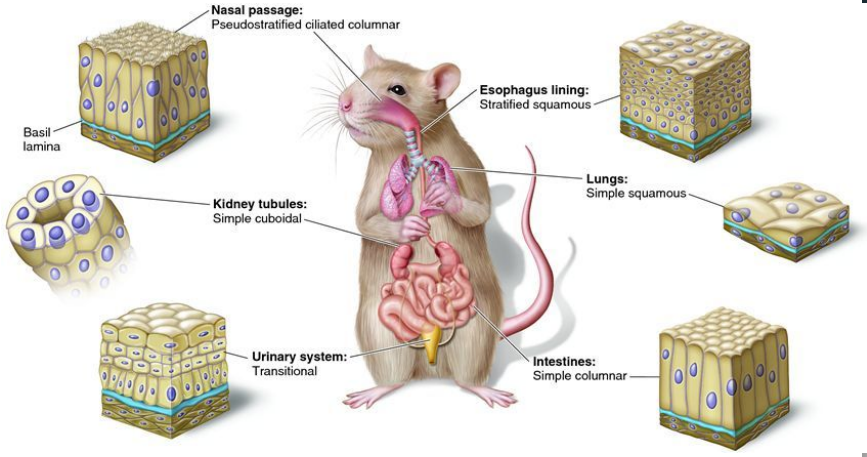


Epithelial tissue

Epithelial tissue consists of tightly packed sheets of cells that cover surfaces, and line body cavities.

Epithelial cells are tightly packed, letting them act as barriers to the movement of fluids and potentially harmful microbes.

Epithelial tissues include those that line the lungs, esophagus and your body!

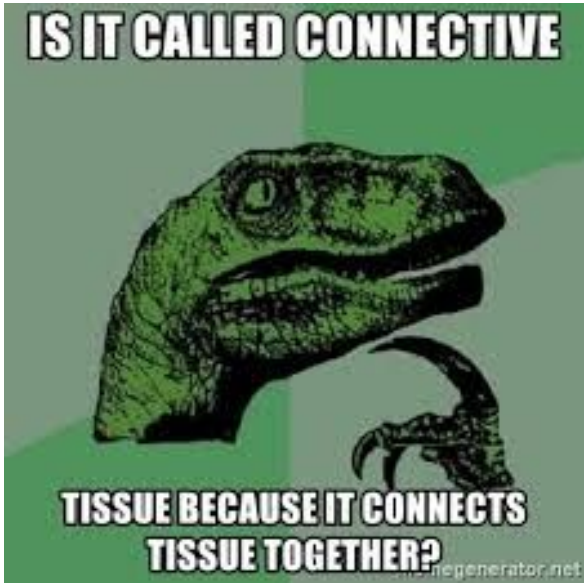


Connective Tissue

Connective tissue consists of cells suspended in an extracellular matrix. The matrix is made up of protein fibers like collagen and fibrin in a solid, liquid, or jellylike substance.

Connective tissue supports and, connects other tissues.

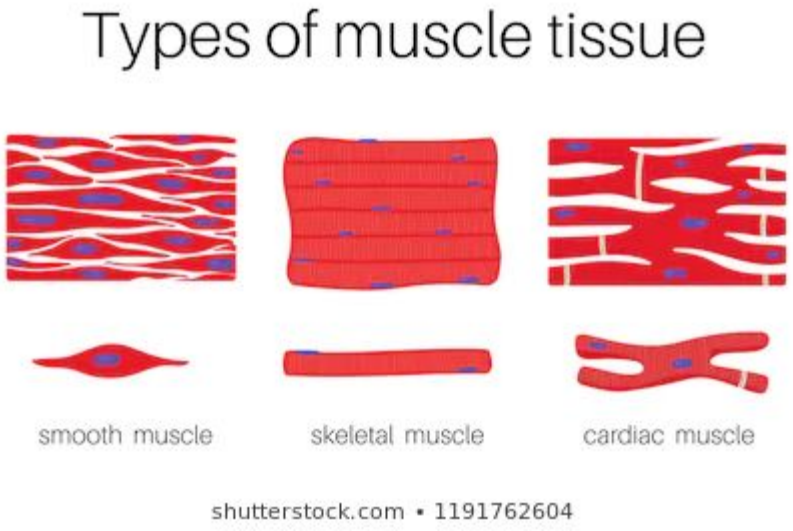
Forms of connective tissue include body fat, bone, cartilage, and blood.



Muscle Tissue

Muscle tissue is essential for keeping the body upright, allowing it to move, and even pumping blood and pushing food through the digestive tract.

There are three main types of muscle: skeletal muscle, cardiac muscle, and smooth muscle.

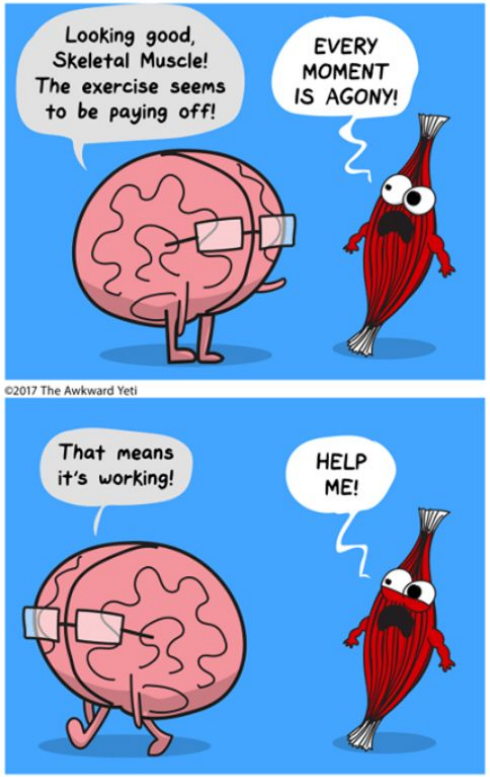


Skeletal Muscle

Skeletal muscle is what is generally referred to as muscle in everyday life.

Skeletal muscle is attached to bones by tendons, and it allows you to consciously control your movements.

For example, the quads in your legs or biceps in your arms are skeletal muscle.



Cardiac Muscle

Cardiac muscle is found only in the walls of the heart. Like skeletal muscle, cardiac muscle is striated, or striped.

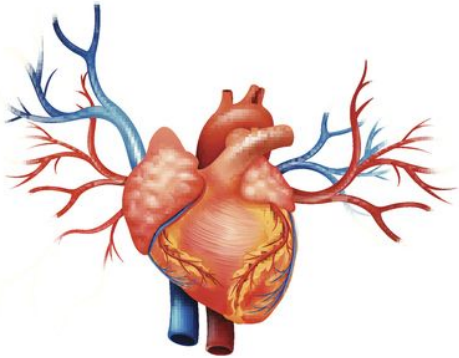
Cardiac muscle is not under voluntary control, so you don’t need to think about making your heart beat.

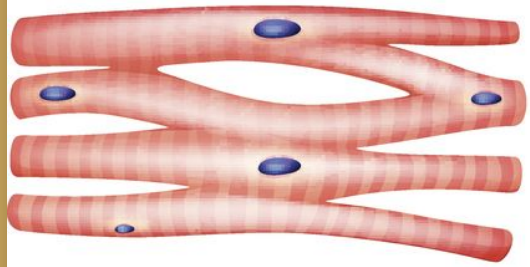
Smooth Muscle

Smooth muscle is found in the walls of blood vessels, as well as in the walls of the digestive tract, the uterus, the urinary bladder, and various other internal structures.

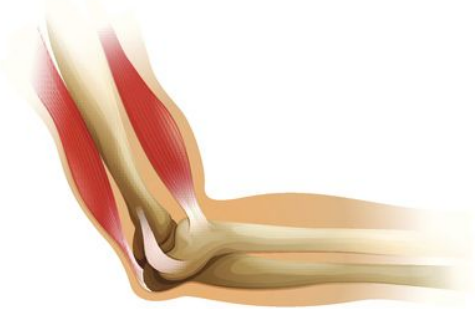
Smooth muscle is not striped, striated, and it's involuntary, which means you don't have to think about moving food through your digestive tract.

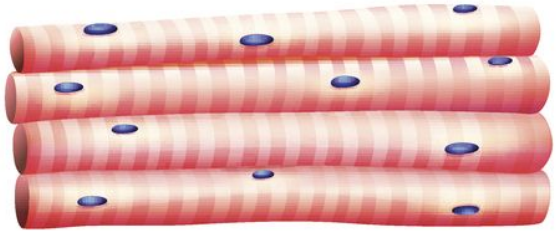
Types of Muscle



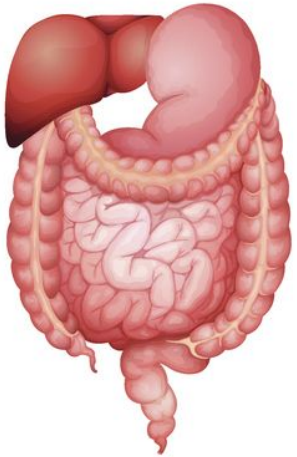


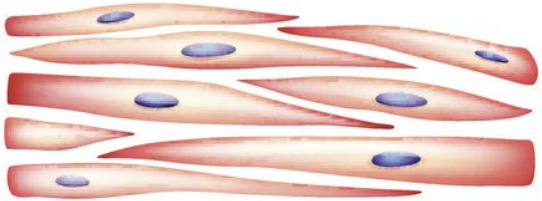
Cardiac muscle





Skeletal muscle



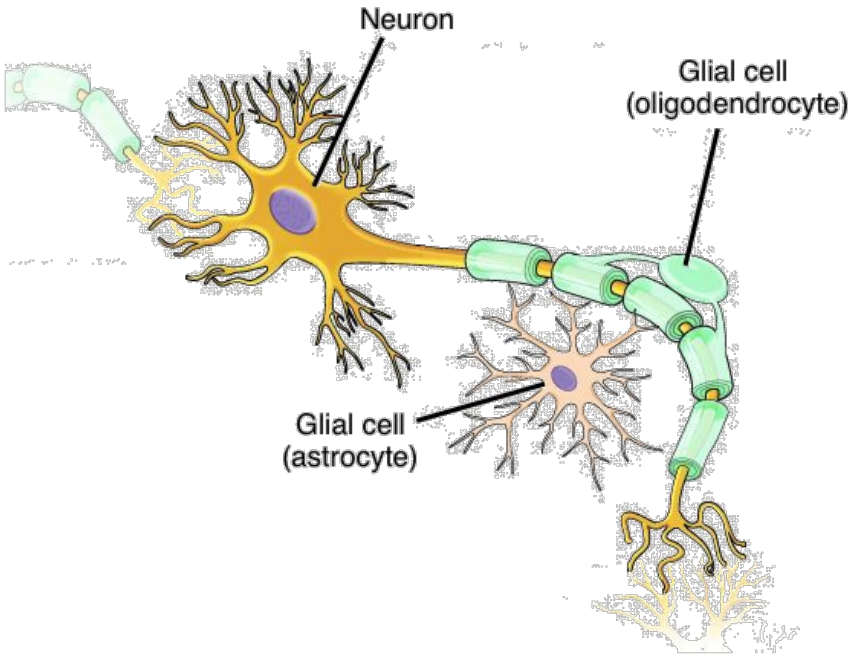


Smooth muscle

Nervous Tissue

Nervous tissue is involved in sensing stimuli, and processing and transmitting information. It consists of two main types of cells: neurons, or nerve cells, and glia.

The neurons are the basic functional unit of the nervous system. They generate electrical signals that allow the neurons to convey information very rapidly across long distances. The glia mainly act to support neuronal function.



What is better for you butter or margarine?

Review!

a) What are the levels of cell organization in the body?

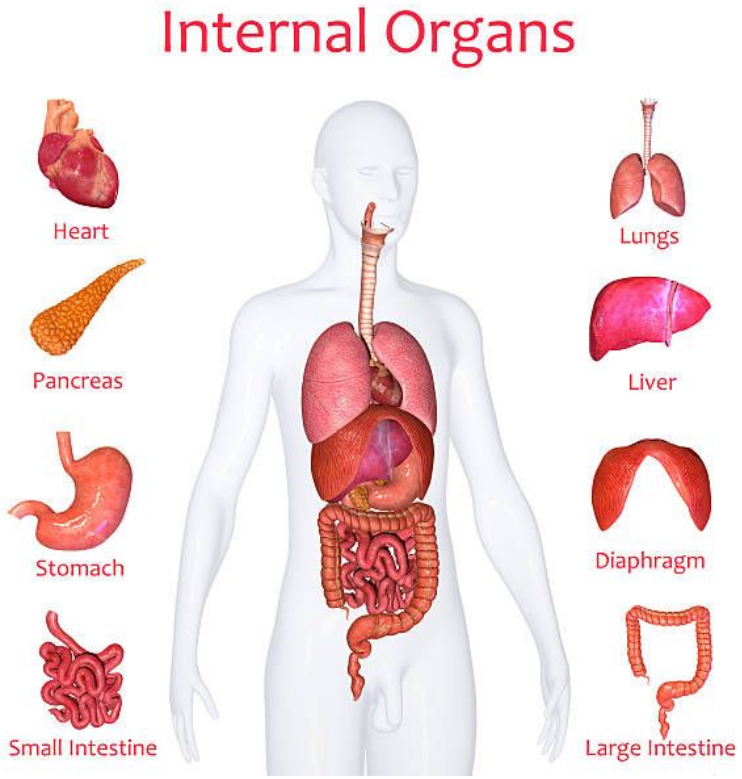
b) What are the four types of tissue?

c) What are the 3 types of muscle tissue?

Organs

Organs, such as the heart, the lungs, the stomach, the kidneys, the skin, and the liver, are made up of two or more types of tissue organized to serve a particular function.

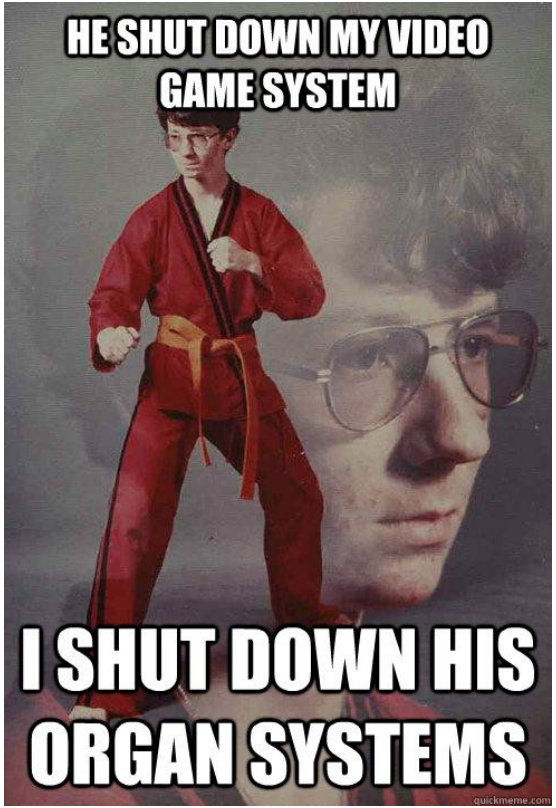
Even though by definition organs must only contain two or more types of tissue, most organs contain all four tissue types.



Organ Systems

Organs are grouped into organ systems, in which they work together to carry out a particular function for the organism. The organ systems we will focus on are the;

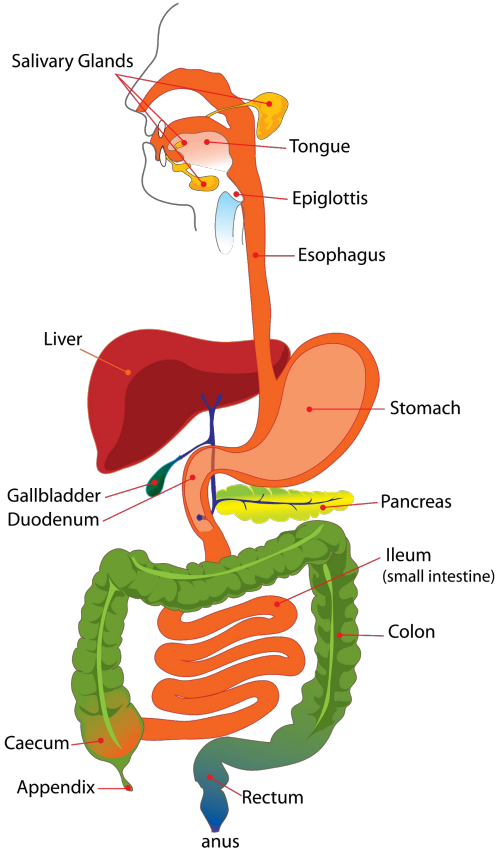
Circulatory system, respiratory system, digestive system, nervous system and excretory system.



The Digestive System

The digestive system is actually a long tube, with a few attachments that starts in your mouth, and ends at your rectum.

Food is broken down along the way into usable, soluble particles that can be used by different cells.

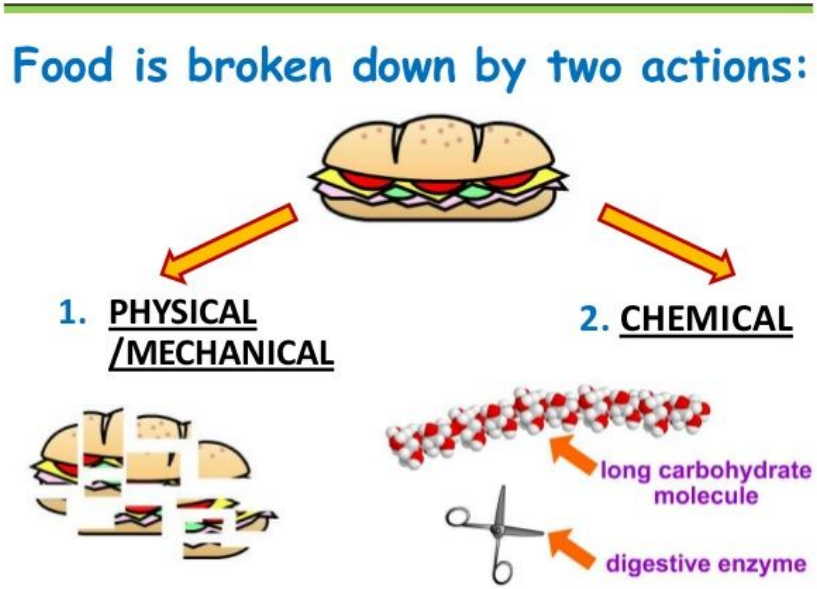


Digestive System

Living organisms require energy to survive. It is the role of the digestive system to process the fuel into a size, and form, cells can use.

There are two types of digestion;

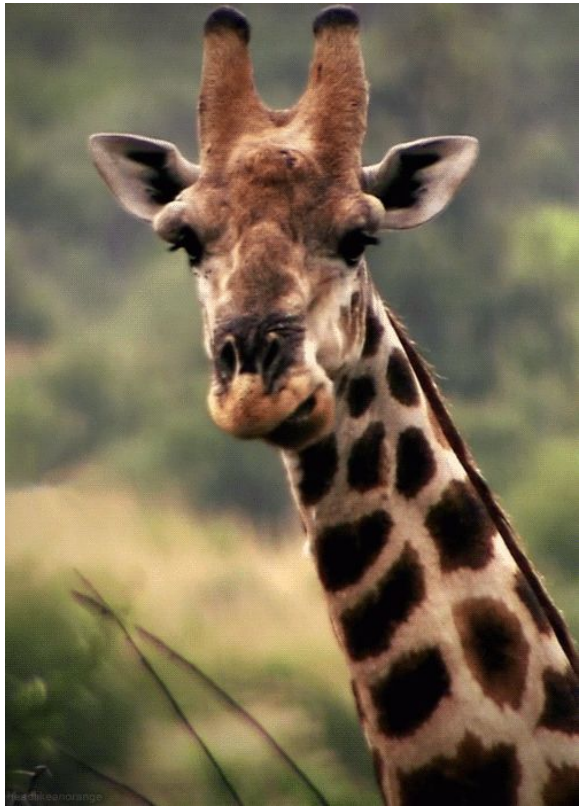
Mechanical digestion and chemical digestion.



Mechanical Digestion

In mechanical digestion, chunks of food are broken into smaller pieces.

Mechanical digestion, along with some initial chemical digestion, takes place in the mouth and stomach. Chewing breaks food into smaller pieces, and the stomach churns the food up into a fluid mixture.

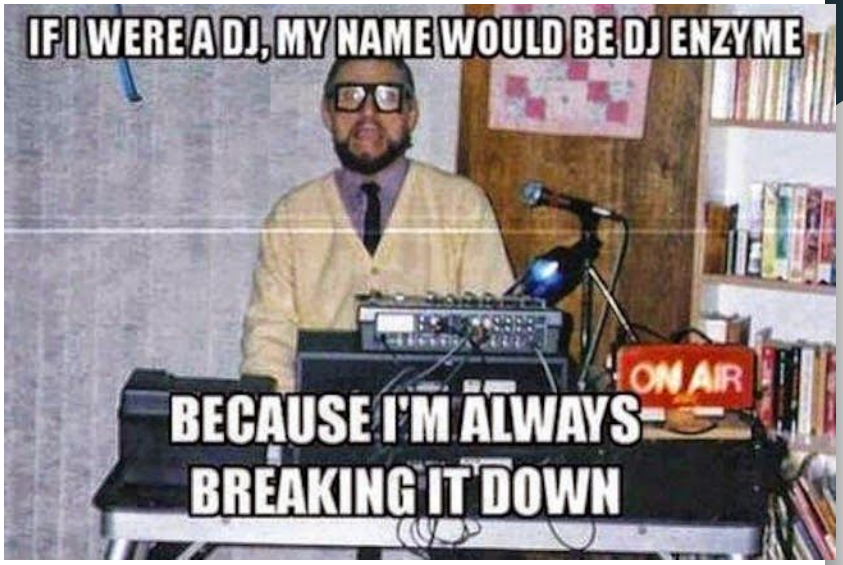


Chemical Digestion

In chemical digestion, large molecules like proteins and starches are broken into simpler units that can be readily absorbed by enzymes.

Enzymes are substances created by the body to carry out chemical digestion.

Enzymes can include amylase (starches), and lipase (fats).



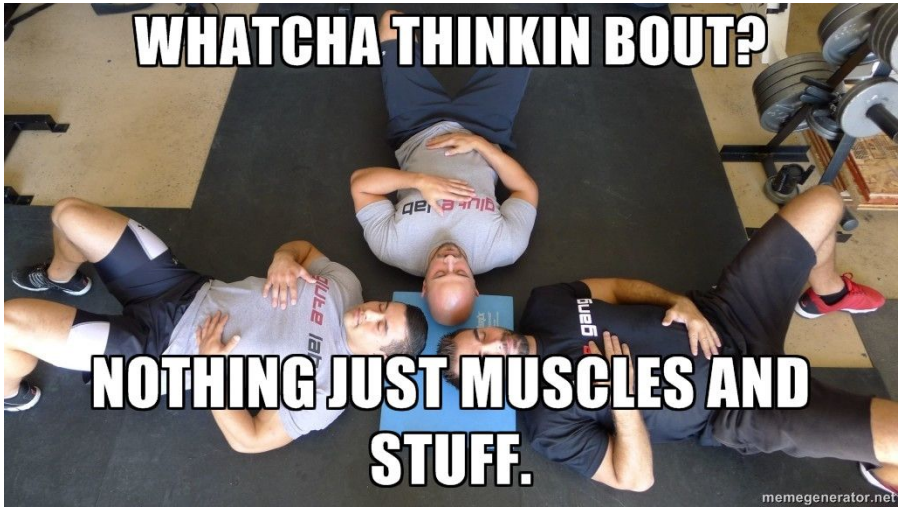
The Digestive System

Review!

a) What are the two types of digestion?

b) What are the three types of muscle tissue?

c) Where does the digestive system start and end?



The Mouth

Digestion begins in the mouth with the mechanical breakdown of food.

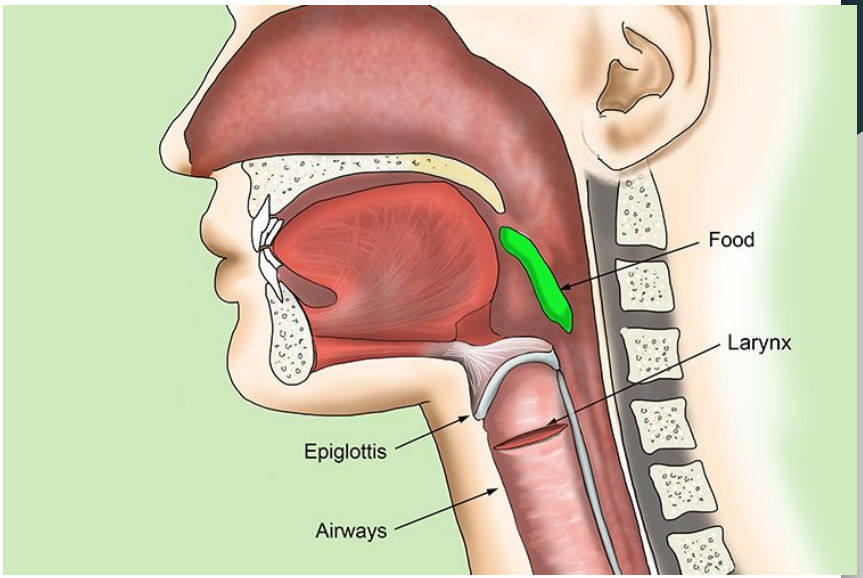
Saliva mixes with the food to make it easier to swallow. Salivary amylase, an enzyme, begins the chemical digestion process by breaking the large starch molecules into smaller sugar molecules.

When you are ready to swallow, your tongue pushes the food to the back of your throat.

The Epiglottis

Before entering the esophagus, the epiglottis, a flap of skin covers the trachea while you eat so that food does not enter the lungs.

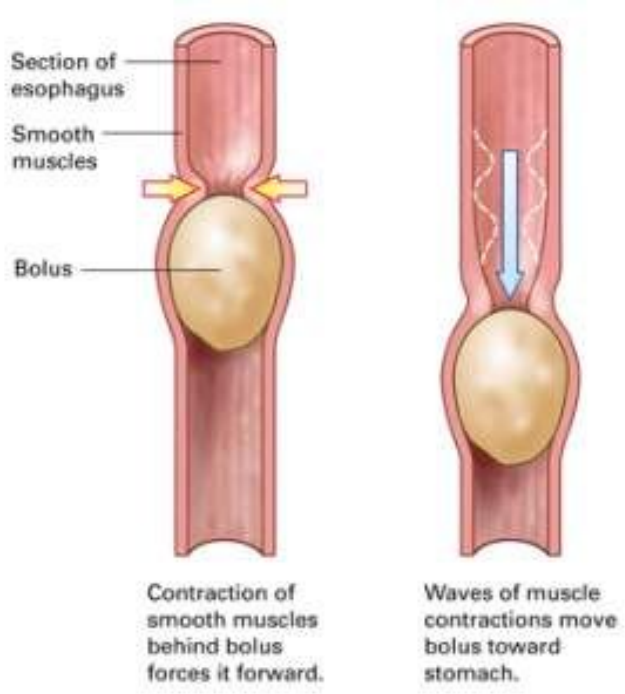
Once passed the epiglottis, food enters the esophagus.



The Esophagus

The esophagus is a muscular tube that connects the throat to the stomach. The esophagus is made of both striated muscle and smooth muscle.

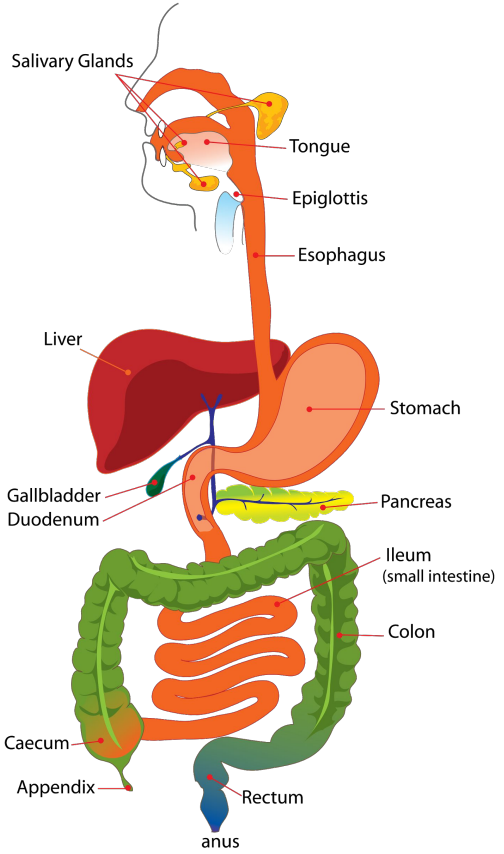
Food is forced down the esophagus by a series of wavelike muscle contractions called peristalsis.



The Stomach

When food enters the stomach, the muscular walls of the stomach begin to churn the food. The stomach then secretes gastric juices that mix with the fluid.

Gastric juices are a combination of mucus, hydrochloric acid, enzymes, and water that chemically digests food.



The Stomach

The mucus in Gastric Juice helps protect the stomach from being digested.

Once completed, the stomach slowly releases the food into the small intestine.

Review

a) Where does mechanical digestion take place?

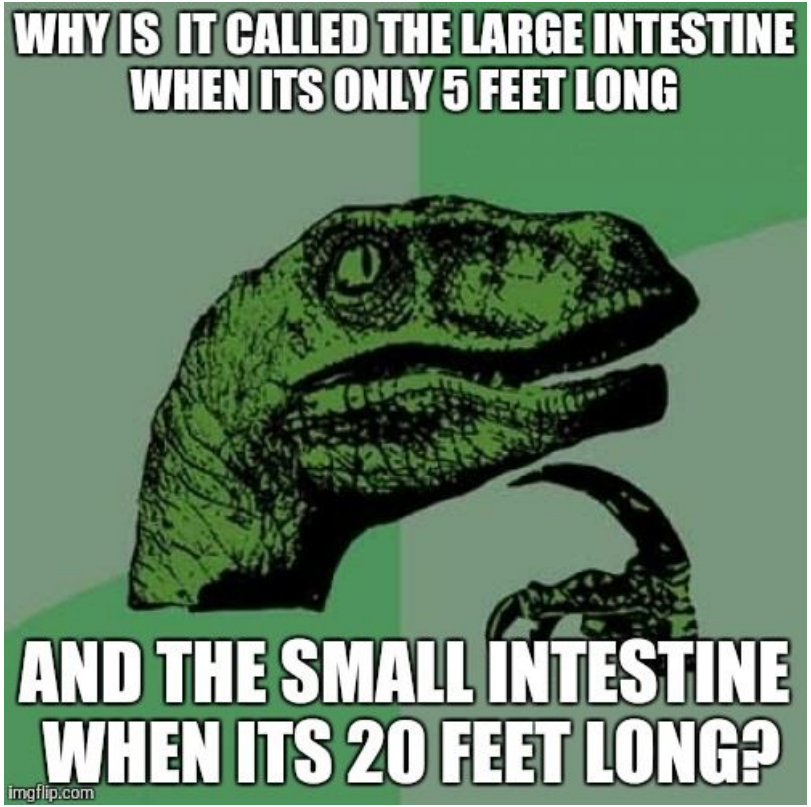
b) What is the epiglottis?

c) What is chemical digestion?

The small intestine

The small intestine is the part of the intestines where 90% of the digestion and absorption of food occurs. The small intestine is located between the stomach and large intestine.

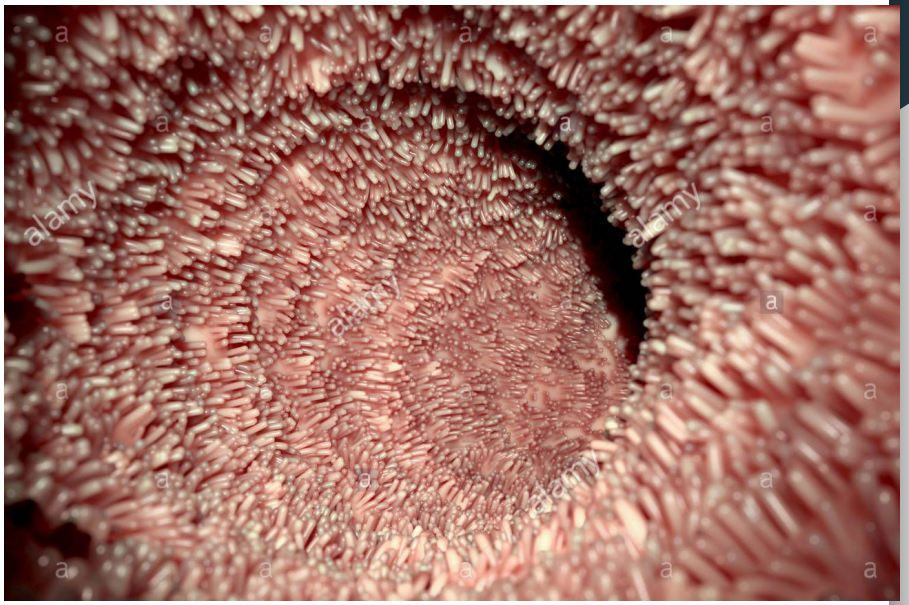
The main function of the small intestine is absorption of nutrients and minerals from food.



Villi

The small intestine contains small finger-like projections of tissue called villi, which increase the surface area of the intestine and contain specialized cells that transport substances into the bloodstream.

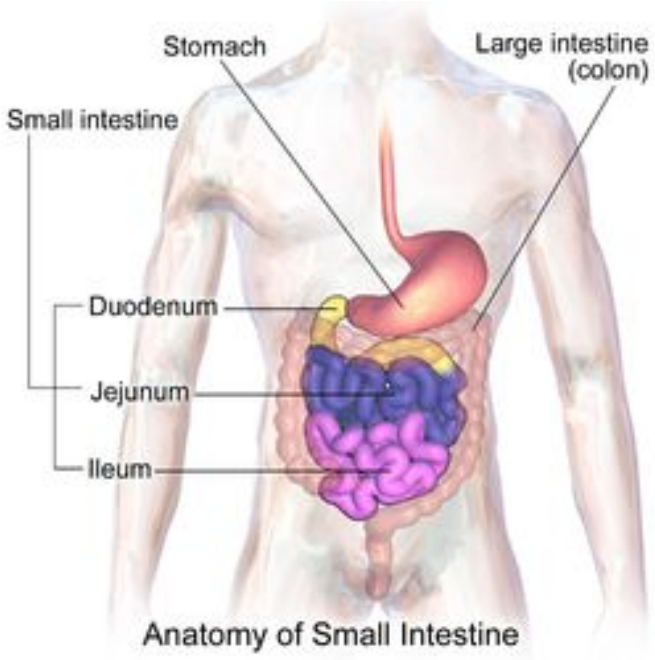
Although these villi do not aid in the digestion of nutrients, they do help with nutrient absorption.



The small intestine

There are three parts to the small intestine. They are the duodenum, jejunum, and ileum.

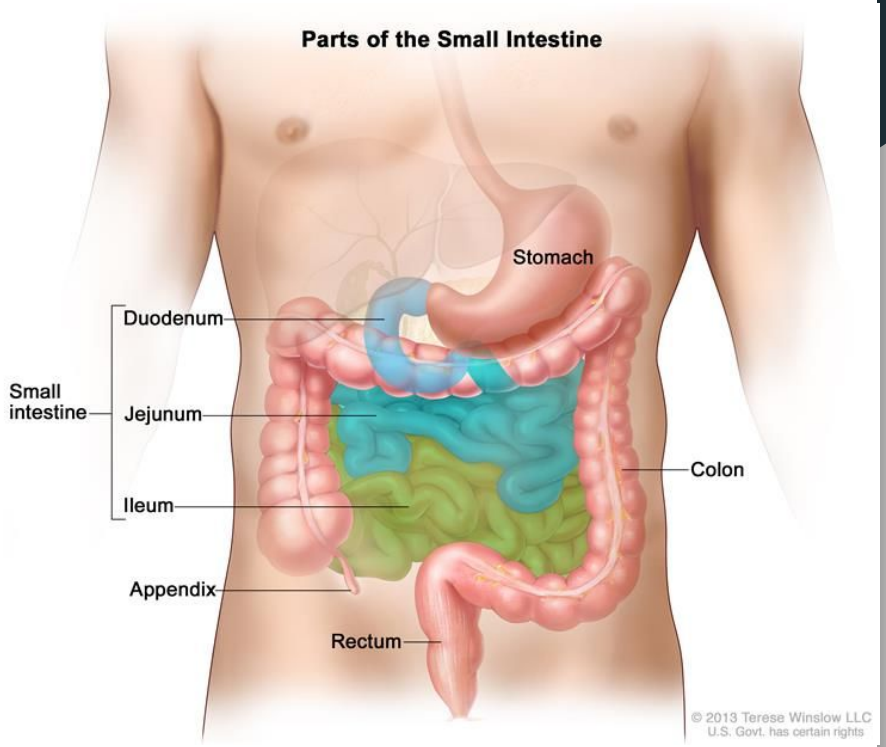
Each part plays an integral role in digestion.



The Duodenum

The duodenum receives partially digested food (known as chyme) from the stomach.

It plays a vital role in the chemical digestion of chyme in preparation for absorption in the small intestine. Many enzymes are released from the pancreas, liver and gallbladder and mix with the chyme in the duodenum to facilitate chemical digestion.



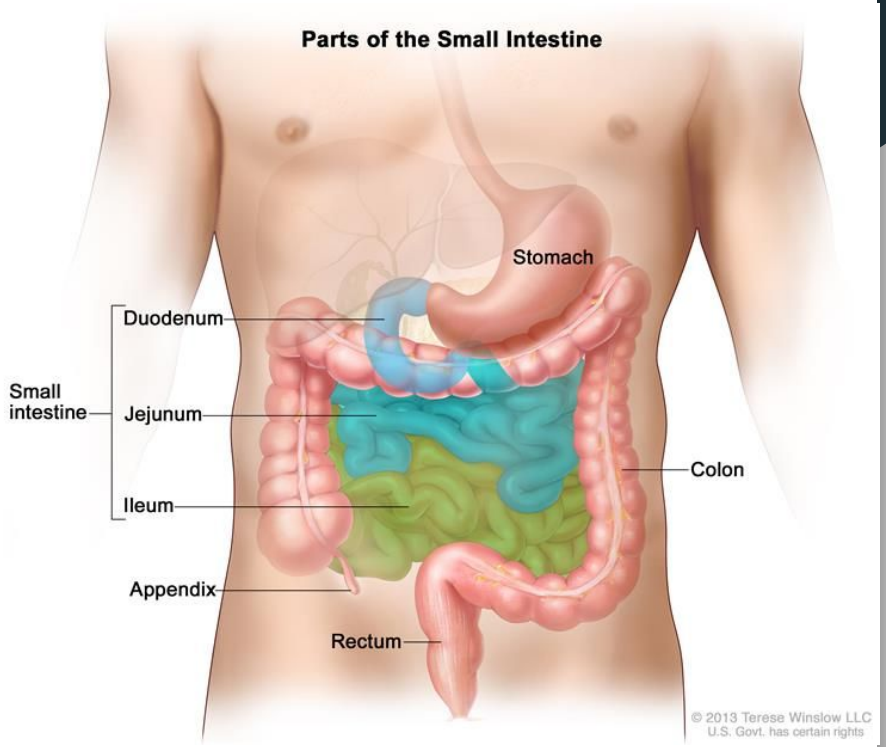
The Jejunum

The jejunum, along with the other areas of the small intestine, is responsible for absorbing nutrients from digested food into the bloodstream.

The jejunum is able to absorb these nutrients because it is lined with even bigger villi.

The Ileum

Ileum, the final and longest segment of the small intestine. It is specifically responsible for the absorption of vitamin B_{12} and the reabsorption of bile salts.

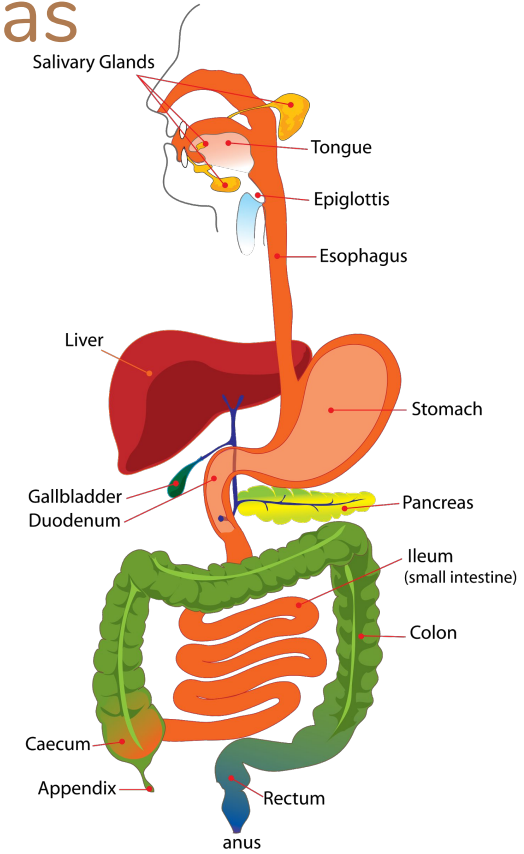


Liver, Gallbladder and Pancreas

The liver is responsible for producing and secreting bile into the small intestine.

The gallbladder holds bile produced in the liver until it is needed for digesting fatty foods in the duodenum of the small intestine.

The pancreas aids in digestion and releases insulin to help with blood sugar.



The Large Intestine

All chemical and mechanical digestion is complete before the remaining material enters into the large intestine.

The large intestine, absorbs water, vitamins and minerals.

The last part of the large intestine forms the rest into feces.

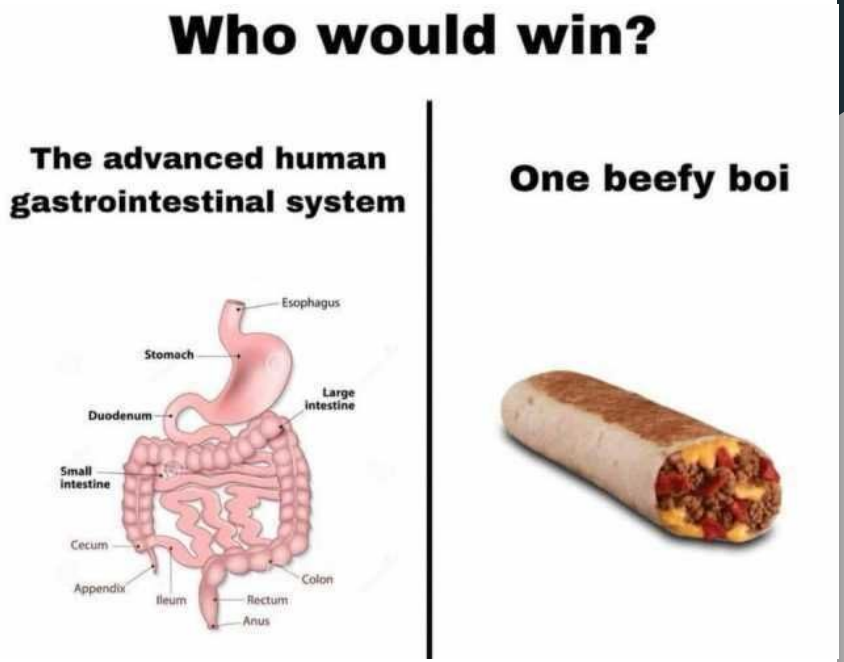
Whatever the body cannot digest is passed through the body out the rectum.

Review

a) What are the three parts of the small intestine?

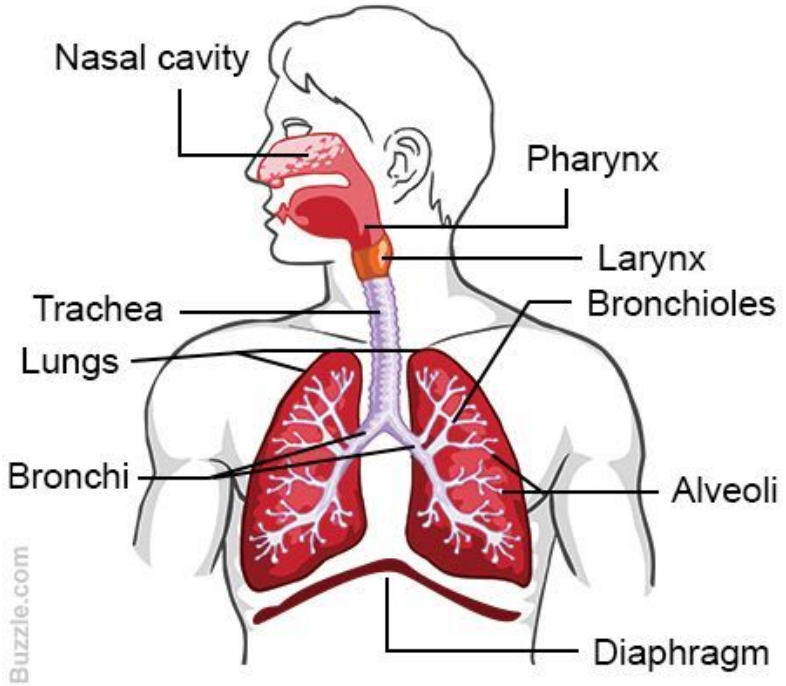
b) What is the responsibility of the large intestine?

c) What is the small intestine coated with?



The Respiratory System

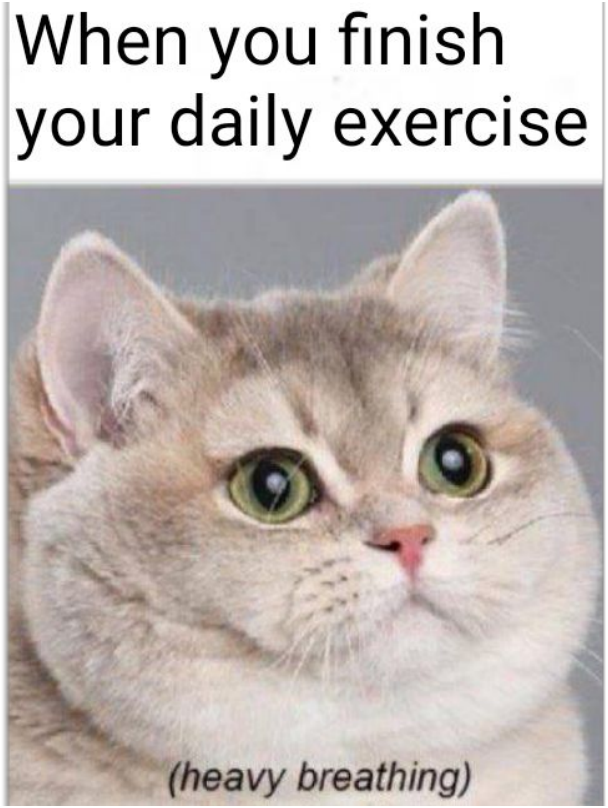
The respiratory system does two very important things; it brings oxygen into our bodies, which we need for our cells to live and function properly, and it helps us get rid of carbon dioxide, which is a waste product of cellular function.



Breathing

Is the process used to move air in and out of your lungs.

Breathing can occur because of your rib and diaphragm muscles.

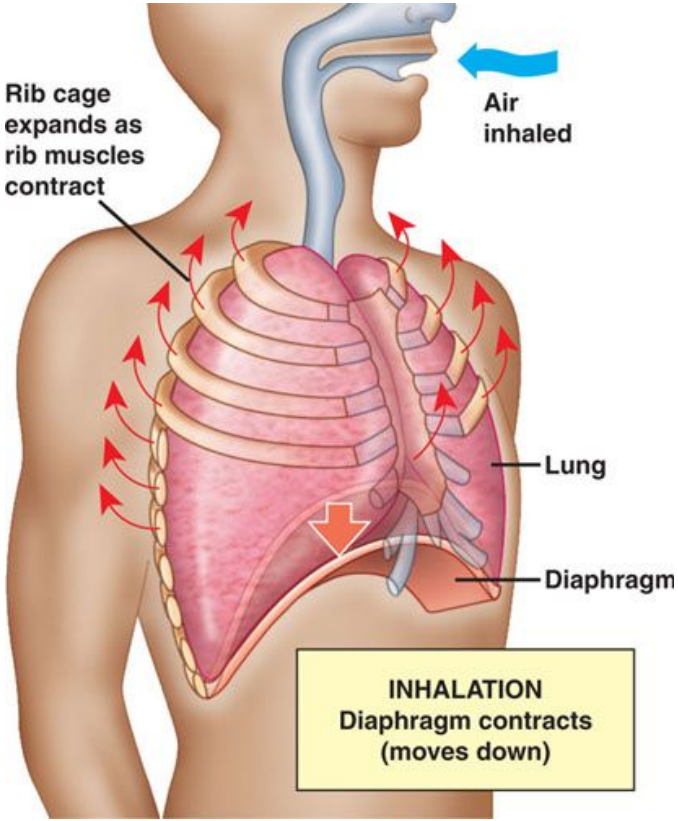


Inhalation

Inhalation is the act of breathing in. During inhalation, rib and diaphragm muscles contract.

The ribs are pulled upwards, and the diaphragm is pulled downwards.

The chest and lung size is increased and air is pulled into the lungs.

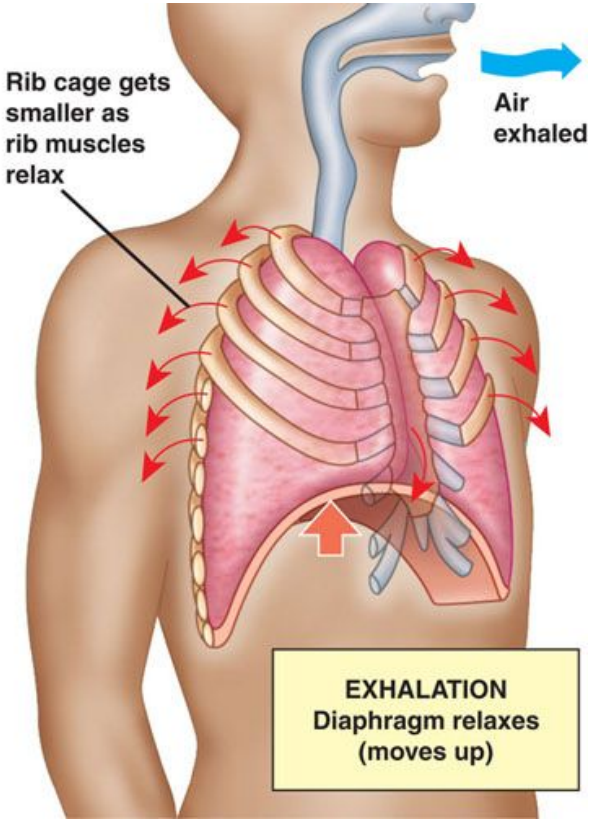


Exhalation

Exhalation is the act of breathing out. During exhalation, rib and diaphragm muscles relax.

The ribs move downwards, and the diaphragm moves upwards.

The chest and lung size is decreased forcing air out of the lungs.



The Gas Exchange Process

Your cells use oxygen to release energy from nutrients such as glucose, and to rid themselves of carbon dioxide.

Two body systems work together so that cells can exchange these gases:

The Respiratory system

Circulatory system

The Passage of Air

The passage of air through the respiratory system starts as air is drawn in through the nose/mouth and down the trachea.

The bottom of the trachea is branched so that air flows into either the right or the left lung.

takes place.