**The Earth was formed 4.5 billion years ago**

**CYANOBACTERIA**

* **The earliest life forms that we know of are called cyanobacteria**
* **They lived 3.8 billion years ago, when the atmosphere had a lot more carbon dioxide (CO2) and a lot less oxygen (O2)**
* **Cyanobacteria are able to photosynthesize AND chemosynthesize**
* **The cyanobacteria changed our early atmosphere to contain more oxygen - they did this because they do photosynthesis**
  + **​this is because in the process of photosynthesis, carbon dioxide and water in the presence of sunlight is used to create glucose and oxygen. In other words**
* **The cell is the fundamental unit of life / all life is made up of one or more cells**
* **Cells contain structures called organelles**
* **The word "organelles" means "*little organs" in Latin)***
* **Organelles of the cell function in a similar way as the organs of our body**
* **Intracellular = “inside of the cell”**
* **Extracellular = “outside of the cell"**

**Prokaryotic vs. Eukaryotic**

* **All Archaea and All Bacteria are Prokaryotic**
* **Prokaryotic cells are defined as those that...**
  + **DO NOT have a membrane-bound nucleus**
  + **DO NOT have membrane-bound organelles**
* **Key properties of prokaryotic cells include**
  + **​no membrane-bound nucleus**
  + **no membrane-bound organelles**
  + **DNA is in the form of a circular plasmid**
  + **evolved before eukaryotic cells**
  + **lived millions of years before eukaryotic cells evolved**
  + **are simpler than eukaryotic cells**
  + **are smaller that eukaryotic cells**
* **Eukaryotic cells are defined as those that ...**
  + **DO have a membrane bound nucleus**
  + **DO have membrane-bound organelles**
  + **DNA is in the nucleus and is in the form of a double helix**
  + **evolved after prokaryotic cells**
  + **are more complex than prokaryotic cells**
  + **are more highly evolved than prokaryotic cells**
  + **are significantly larger than prokaryotic cells**
  + **probably evolved from one prokaryotic cell engulfing another prokaryotic cell (this is the endosymbiotic theory)**

**Endosymbiotic theory**

* **endosymbiotic theory is the best theory we have that explains how eukaryotic cells evolved from prokaryotic cells.**
* **The steps of the symbiotic theory as are follows:**
  + **Before there were any eukaryotic cells, there were only prokaryotic cells (archaea and bacteria)**
  + **Some of these bacteria were able to use oxygen to make their own food (these were chemotrophs)**
  + **Other bacteria were able to use sunlight to make their own food using photosynthesis. (These are phototrophs)**

**​   SO.....**

* **​One day, a larger prokaryotic cell came by and engulfed one of these smaller chemotrophic bacteria.**
* **BUT, Instead of the bigger prokaryote digesting (or eating) the smaller prokaryote, they decided to co-exist.**
  + **The larger bacteria was happy and benefited from the relationship (a.k.a. the mutualistic symbiotic relationship) because it could use the energy that the smaller bacteria produced.**
  + **The smaller bacteria was happy and benefited from the relationship because the larger bacteria provided shelter, protection and it provided the oxygen it needed to make food (energy)**
  + **This type of relationship is called mutualism (a.k.a. it is an example of a mutualistic symbiotic relationship)**
  + **A mutualistic symbiotic relationship is defined as a relationship that persists over many generations that is beneficial to BOTH organisms.**
* **As time went on, this cell within a cell evolved into the forest eukaryotic cells.**
* **The cell on the inside evolved into what we now call the mitochondria**
  + in the same way, scientists believe an early cell may have engulfed a smaller photosynthetic bacteria which evolved to be the chloroplasts in plants that allow for photosynthesis to take place.

***Evidence that supports the endosymbiotic theory...***

1. Mitochondria have 2 membranes
2. Mitochondria reproduce within the cell
3. Mitochondria have their own DNA that is in the form of a bacterial circular plasmid

***Cool things about the mitochondria***

1. ***There can be 1000 mitochondria in one cell***
2. ***There are more mitochondria in cells that need lots of energy, like muscle cells***
3. The number of mitochondria in a muscle will increase with increased activity
4. The number of mitochondria in a muscle will decreased when that muscle is inactive for an extended period of time.
5. Mitochondria reproduce using binary fission
   1. binary fission is an asexual process
   2. one cell will split off into 2 new cells
   3. the parent cell has the exact same DNA as the 2 new cells
6. All of your mitochondria (as well as ALL of your cells organelles) were inherited from your mother (are maternally inherited).
7. The egg that made you have all of the organelles that is now in each of your cells.
8. The DNA in your mitochondria are the same as your mom, your mom's mom, your mom's mom's mom and so on

**Plant Cells vs. Animal Cells**

* **Both plant cells and animal cells are eukaryotic**
* **Plant cells contain 3 organelles that animal cells do not**  
  1. **​​chloroplasts - the function of the chloroplasts is to allow for photosynthesis to take place. Chloroplasts are found in the leaves of a plant.**
  2. **Vacuole - plant cells contain a large central vacuole that stores water and creates turgor pressure so the plant can stand up straight.**
  3. **Cell wall - plant cells have a rigid cell wall that surrounds the outside of the cell membrane (plasma membrane). The cell wall gives the plant a "brick-like" appearance under the microscope and gives the cell protection.**

**Cell Structures and Organelles of the Animal Cell**  
  
**Plasma membrane / cell membrane (cell skin?)**  
**Composition of the cell membrane**

* **the cell membrane is composed of a phospholipid bilayer.**
* **the phospholipids orient themselves so that the fatty acid tails are pointing inward toward each other, which shields them from water.**  
  + **​the fatty acid tails of the phospholipid are hydrophobic (hate water)**
* **the phospholipids orient themselves so that the phosphate group heads face the extracellular fluid and the intracellular fluid.**  
  + **the phosphate group of the phospholipid is hydrophillic (loves water)**

**​Function of the cell membrane**

* **The function of the cell membrane is regulate what comes into the cell and what goes out of the cell**
  + **the cell membrane is like a security guard or a gate keeper that only allows some things to pass through the membrane.**
  + **for this reason we say that the membrane is "selectively permeable".**
* **The fluid mosaic model -**  
  + **the fluid mosaic model states that the structure of the cell membrane is fluid (changeable)**
  + **the phospholipids behave like a bunch of rubber ducks in a pool.**
  + **proteins can move around the membrane to wherever the cell feels the proteins are needed**
  + **proteins can be inserted into the membrane or taken out of the membrane as the cell deems appropriate**

**Cell Structure**

* **The intracellular fluid is also called the cytoplasm or cytosol.**
  + **the cytoplasm or cytosol refers to the liquid substance inside the plasma membrane and outside the nucleus**

**Mitochondria (cell engine?)**

* **The mitochondria acts like the engine of the cell**
* **makes energy for the cell in the form of ATP**

**Ribosomes**

* **They are the Site of Protein synthesis**
* **Most of them are attached to the rough ER**
* **those that are not attached to the rough ER are called "free" ribosomes**

**Rough Endoplasmic reticulum**

* **Appears rough due to the presence of the ribosomes.**
* **Functions to hold the ribosomes which are the site of protein synthesis**
* **Also functions are a transportation highway for the proteins after they form.**
* **after the protein is formed it gets transported to the Golgi body**
* **Transport of proteins and synthesis of lipids**
* **BOTH Plant and Animal cells**
* **Cell Structure - Organelles**

**Golgi Bodies (cell post office)**

* **Modification, packaging and shipping of proteins, lipids and carbohydrates**
* **BOTH Plant and Animal cells**
* **Cell Structure - Organelles**

**Smooth Endoplasmic reticulum**

* **Appears smooth under the microscope due to the ABSENCE of ribosomes.**
* **Functions to make lipids**

**Lysosomes**

* **Lysosomes act like a stomach or a recycling center within the cell**
* **the lysosomes digests unwanted material and recycles the raw materials**

**Cytoskeleton**

* **the cytoskeleton refers to the semi-rigid proteins that make a web or scaffolding within the cell**
* **these are like cell bones**
* **functions as roads for vesicles to travel on**
* **also functions to anchor organelles in place**

**Centrosomes**

* **The centrosomes function to pull one parent cell into 2 daughter cells during mitosis (cell division)**

**Vesicles**

* **Vesicles function like little cars for transportation within the cell**
* **they can transport proteins and other substances from place to place within the cell**
* **they can be used to export substances out of the cell**
* **they can be used to import substances into the cell**
* **the vesicles are made up of phospholipids that form a small round membrane**