*From the smallest bacteria to the largest mammal (the blue whale), all living things are composed of cells.
*Simple organisms, like bacteria are made of just one cell (UNICELLULAR).
*Complex organisms, like humans and blue whales are made of many cells (MULTICELLULAR).

It would take you a very long time to count all the cells in your body – more than 300 trillion (300,000,000,000,000).

*Multicellular organisms are made of many different kinds of cells - each specialized to complete a single type of job (we have muscle cells for contracting, fat cells for storing high energy fat, nerve cells for detecting pain, etc.)

*All cells are filled with special, very tiny structures that allow the cell to function and give it life. These important structures that make up cells are called ORGANELLES. If a cell’s organelles ever quit working correctly the cell would die.

THE ORGANELLES

*CELL MEMBRANE - This thin layer of lipid (fat) molecules surrounds the outside of EVERY cell. This membrane is SEMI-PERMEABLE (it works like a gate letting some molecules pass freely in and out of the cell, while not allowing other molecules to pass through at all).

*CYTOPLASM - This thick, clear liquid fills up every cell. Dissolved in the cytoplasm are thousands of molecules the cell can use as needed.

*NUCLEUS - A large, round structure usually found near the center of the cell. The outside of the nucleus is made of the NUCLEAR MEMBRANE - a thin layer of lipid (fat). The inside of the nucleus holds and protects all the cell’s genetic information (DNA/chromosomes).

*DNA/CHROMOSOMES - These long, thin, string-like molecules are your genetic information. They are held and protected inside the nucleus. DNA molecules are like a large set of encyclopedias that contain all the instructions and information needed to make you who you are! Why didn’t you develop into an octopus?? Because the DNA in each of your cells contains the instructions to produce a human. Why don’t you look exactly like the other humans sitting next to you? This is because some of the instructions in your DNA encyclopedia are a little different from the DNA instructions in other humans (only identical twins have identical DNA instructions in their cells). Each human cell has 46 DNA molecules inside its nucleus (each dog cell has 78 DNA molecules in its nucleus, each housefly cell has 12 DNA inside its nucleus.)

*RIBOSOMES - These organelles look like little black dots all over the cell’s cytoplasm. They may look simple, but ribosomes are important because they make proteins for the cell (and you!). Ribosomes made all the muscle protein you use when moving and ribosomes made all the digestive enzymes you used to digest the last meal you ate.

*ENDOPLASMIC RETICULUM - (Just say ER for short!). These organelles are made of thin membranes folded back and forth all throughout the cytoplasm of the cell. They form a bunch of tunnels or caves inside the cell that act like highways to help move molecules around in the cell. There are two kinds of ER found in cells:

ROUGH ER - This ER is covered with ribosomes and looks bumpy or rough.

SMOOTH ER - This ER does not have ribosomes and, therefore, has a smooth surface.
**GOLGI BODY** - This organelle is made of thin membranes and can be mistaken for Smooth ER. A Golgi Body looks like several “C”-shaped, curved membranes sitting one inside the other (like nesting bowls), and usually is surrounded by many round, bubbly-looking things called Vesicles. The Golgi Body packages up important molecules that the cell has made and stores them in the bubbly Vesicles.

**VESICLES** - These are the round, bubbly-looking things around the Golgi Body. Vesicles are the packages made by the Golgi Body and are filled with important chemicals. The Vesicle can store these important chemicals for the cell until they are needed.

**LYSOSOME** - These are special Vesicles that contain strong digestive enzymes. When one of your white blood cells swallows a bacteria that is trying to infect you, the Lysosomes in the white blood cell break open and digest the swallowed bacteria. In cell drawings the round Lysosomes are usually colored differently, or are shaded in, to help you tell them apart from all the other round storage Vesicles that are present.

**MITOCHONDRIA** - This important organelle looks something like a jellybean. When you cut open a Mitochondria to look inside you will find that is filled with a membrane that is folded back and forth (cell drawings usually show Mitochondria that have been cut open). Mitochondria are the ENERGY factories for you and your cells. Bend your finger. You just used the Mitochondria in your muscle cells to supply the energy needed to make your muscle cells contract. To produce energy, the folded inner membrane of the Mitochondria completes a complex reaction called RESPIRATION. RESPIRATION takes the food you eat and the oxygen you breath and converts it into life giving ENERGY. Below is the RESPIRATION REACTION that occurs inside the Mitochondria:

<table>
<thead>
<tr>
<th>You eat sugar</th>
<th>You breathe in</th>
<th>You breathe out</th>
<th>You breathe out</th>
<th>Your cells get</th>
</tr>
</thead>
<tbody>
<tr>
<td>GLUCOSE</td>
<td>OXYGEN</td>
<td>CARBON DIOXIDE</td>
<td>WATER</td>
<td>ENERGY</td>
</tr>
<tr>
<td>C₆H₁₂O₆</td>
<td>O₂</td>
<td>CO₂</td>
<td>H₂O</td>
<td>ENERGY</td>
</tr>
</tbody>
</table>

**CILI / FLAGELLA** – Cilia and Flagella look like hairs on the outside of a cell. Most cells, however, do not have Cilia or Flagella. If present, CILIA are short and cover the entire cell. If present, FLAGELLA are much longer and only one or a few are present. Cells that live in a watery environment use their waving Cilia or Flagella to help move around.

**CELL WALL** - This structure is found in plant, bacteria, and fungus cells. Animal cells DO NOT have a Cell Wall. The Cell Wall is a thick, rigid layer that surrounds, supports, and protects the cell – like brick protects a house.

**CHLOROPLAST** - These organelles are found in plant cells only. They are green spheres scattered throughout a plant cell’s cytoplasm (and gives all plants their green color). Plants use their green chloroplasts to turn the sun’s energy into the sugar GLUCOSE – which becomes food for the plant cell and the source of GLUCOSE (food) for every animal on earth!! Animal cells never have chloroplasts, which is why animals can’t make their own food and must get their GLUCOSE by eating other things. The reaction that occurs in the chloroplast is called PHOTOSYNTHESIS and it looks like this:

<table>
<thead>
<tr>
<th>Sunlight</th>
<th>Leaf breathes in</th>
<th>Root absorbs</th>
<th>Plant cells get</th>
<th>Leaf breathes out</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENERGY</td>
<td>CARBON DIOXIDE</td>
<td>WATER</td>
<td>GLUCOSE</td>
<td>OXYGEN</td>
</tr>
<tr>
<td>+ CO₂</td>
<td>+ H₂O</td>
<td><em>PHOTOSYNTHESIS</em> in Chloroplast</td>
<td>C₆H₁₂O₆</td>
<td>+ O₂</td>
</tr>
</tbody>
</table>
THE ANIMAL CELL!!

NAME__________________________

Neatly color each organelle or cell part (see the list below) a different color. Color in each blank square from the list to match its organelle’s color.

☐ Cell Membrane          ☐ Smooth ER
☐ Cytoplasm              ☐ Golgi Body
☐ Nucleus                 ☐ Vesicles
☐ DNA/Chromosomes         ☐ Lysosomes
☐ Ribosomes               ☐ Mitochondria
☐ Rough ER

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1. Pick up a drawing of a typical animal cell and color it so that each organelle can easily be identified by its own color.

2. You are a Biology teacher ready to teach your students a unit on cells. Why do you think it is important to teach your students about cells and cell organelles?

3. Think of the FUNCTION of each organelle listed below (what job the organelle does for the cell), then write out an example of a familiar object you can think of that has a similar FUNCTION or job (it does not need to have a similar appearance). Next, briefly describe WHY you chose that object. For example:

   **CELL MEMBRANE** - Screens on doors and windows around a house because they are semi-permeable and let a cool breeze in the house, but keep out the mosquitoes.

   **NUCLEUS WITH DNA/CHROMOSOMES** -

   **ENDOPLASMIC RETICULUM** -

   **GOLGI BODY WITH VESICLES** -

   **MITOCHONDRIA** -

   **CILIA OR FLAGELLA** -
4. Take a deep breath and inhale a lung full of oxygen. This oxygen will enter your bloodstream and be carried to all the cells of your body. The oxygen will next pass through the cell membrane, go inside the cell, and end up in which special organelle?

5. When a person chokes they can no longer breathe in oxygen and will die (the same thing will happen to any plant or animal that can't get oxygen!!). Why does a lack of oxygen kill things?

6. The inside of a MITOCHONDRIA is filled with a membrane that is folded over and over – and it is on this membrane where RESPIRATION occurs. Explain why you think this inner membrane is folded over and over.

7. Do you have more CELLS or RIBOSOMES in your body?

8. Do you have more CELLS or NUCLEI (the plural of NUCLEUS) in your body?

9. If your cells suddenly developed chloroplasts your life would certainly change! You would, of course, now be green! Describe any other changes you would notice about your life.
10. You have just eaten a fresh hot slice of your favorite pizza and your stomach cells immediately go into action to start digesting the pizza with digestive enzymes. FIRST, a stomach cell needs to get the instructions that tells it how to make the digestive enzyme. SECOND, the cell uses the instructions to construct many of the digestive enzymes (a protein). THIRD, the digestive enzymes are transported through the cell’s tunnel system. FOURTH, the digestive enzymes end up at a location where they will be packaged. FIFTH, the digestive enzymes have been placed in packages that float to the outside edges of the cell. SIXTH, the packages reach the outside edges of the cell and “pop” open to release the digestive enzymes into your stomach! The pizza is digested!

Put the cell organelles/structures below in the correct order that your stomach cells would use them as they produce and release digestive enzymes:

DNA, CELL MEMBRANE, VESICLE, ER, GOLGI BODY, RIBOSOME

First ______________________

_______________________

_______________________

_______________________

_______________________

Last ______________________

11. Which cell organelle or structure do you find the most amazing. Why?