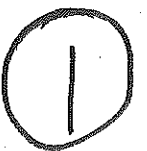


Complete Sentences, please!  
Neat!

# Bioquest

Cell Theory, Cell structure and Organelles

1. How did Robert Hooke discover the cell?
2. What did other scientists discover?
3. What is the "cell theory"?
4. What three structures are common to all cells?
5. Discuss the structure and function of the nucleus.
6. What is the difference between the cell wall and the cell membrane in both structure and function?
7. What is the difference between the prokaryotic cell and the eukaryotic cell?
8. What is an organelle?
9. Compare a chloroplast to a mitochondrion.
10. What are the two types of endoplasmic reticulum and how do they differ in function?
11. What are the two major parts of the cytoskeleton and why are they important?
12. Fill in the attached chart and identify if the organelles are proper to an animal cell or to a plant cell. *(any additional, please put on the back of the chart)*
12. Complete the coloring sheets and underline any important information.



Name: \_\_\_\_\_

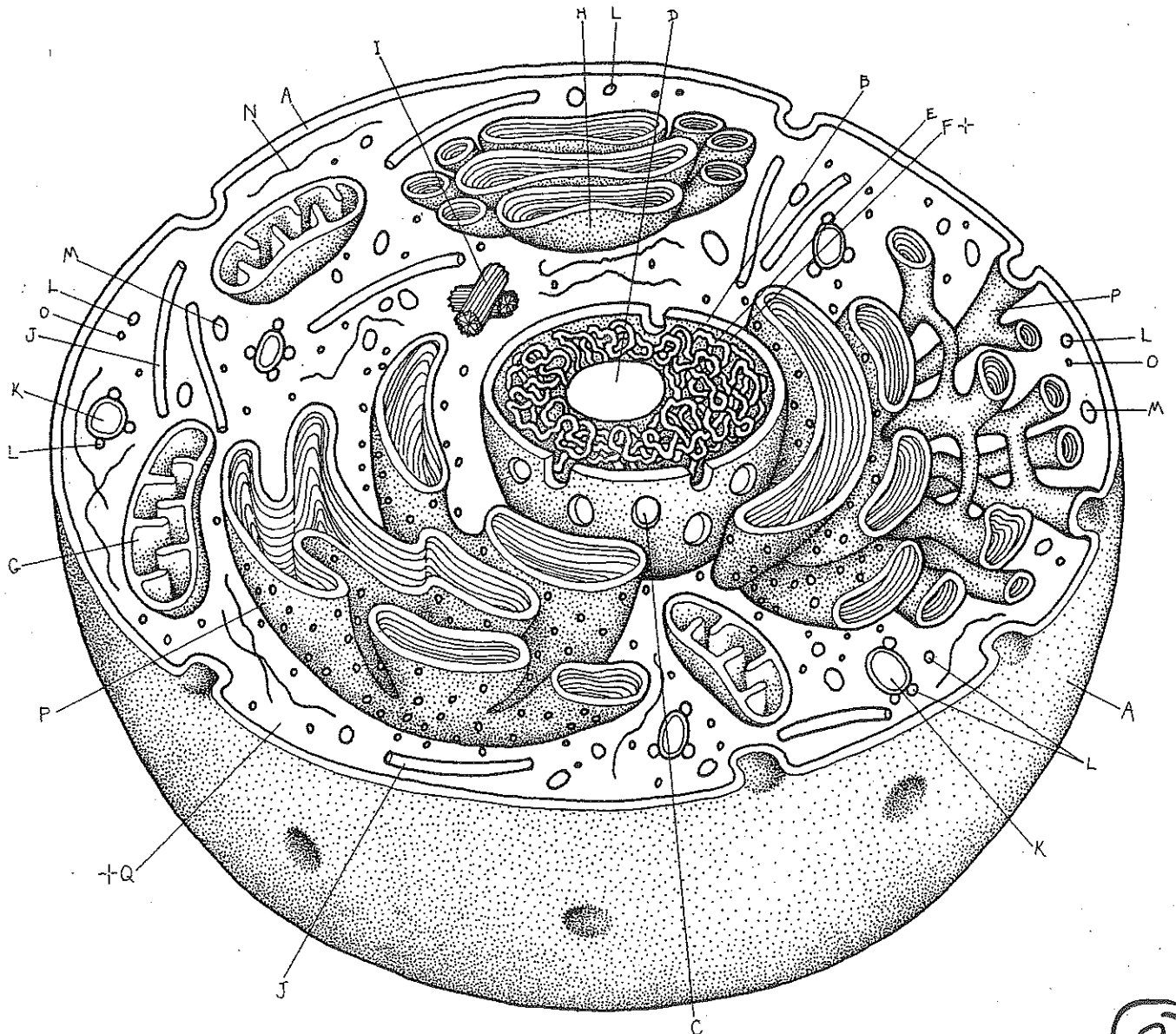
**Inside of a Cell**

Structure	Plant	Animal	Function	Material Used in Model	Why Material Used?
Cell Wall					
Cell Membrane					
Cytosol					
Chloroplast					
Golgi Complex					
Endoplasmic Reticulum					
Nucleus					
Mitochondrion					
Lysosome					

# ANIMAL CELL.

CELL MEMBRANE,  
NUCLEUS,  
NUCLEAR ENVELOPE,  
NUCLEAR PORE,  
NUCLEOLUS,  
CHROMATIN,  
NUCLEAR SAP<sub>F+</sub>  
CYTOPLASM,  
MITOCHONDRION,  
GOLGI COMPLEX,

CENTRIOLE,  
MICROTUBULE,  
VACUOLE,  
LYSOSOME,  
MICROBODY<sub>M</sub>,  
MICROFILAMENT,  
RIBOSOME,  
ENDOPLASMIC RETICULUM,  
HYALOPLASM<sub>+</sub>



## ANIMAL CELL

Although the earliest light microscopes showed the cell as hardly more than a mass of amorphous fluid enclosed within a membrane, modern research has shown that the cell is not only the structural unit of living organisms but also the functional unit. Each cell carries out all the physical and chemical reactions we associate with life. This plate is an artist's reconstruction of a typical animal cell as it might look with its upper half cut away. We see that the cell is organized into many distinct structures. These are called organelles, and each is specialized for a particular function. This plate gives you an overview of these organelles; the following plates will cover the details of structure and function.

**Color title A and the cell membrane with a pale color.**

The *cell membrane* (sometimes called the plasma membrane or plasmalemma) completely covers the entire cell and serves to hold it together. It also actively regulates what enters and leaves the cell. It is only about 10 nanometers thick, so its thickness has to be greatly exaggerated in the drawing to give you something thick enough to color. This is also true of the membranes within the cell. Everything else is drawn to scale.

**Color titles and structures B through F. Color the pores (C) with a darker color. Color D and E in rather dark colors, and leave F uncolored (all the remaining space within the nucleus).**

In animal cells (as well as in plant, protist, and fungus cells), the nucleus is separated from the rest of the cell by the *nuclear envelope*. Such cells are called eukaryotic (Greek: *eu*, "true"; *karyon*, "kernel" or "nucleus") to distinguish them from prokaryotic cells (Greek: *pro*, "before"), which lack a true membrane-enclosed nucleus and are more primitively organized. (Prokaryotic cells are found only among the bacteria and their close relatives.) The nuclear envelope is made up of two layers (not shown) of membrane. These are very similar to the cell membrane but have numerous *pores*. Within the nucleus is a prominent structure called the *nucleolus*—sometimes there are two or more nucleoli—and a network of thin threads called *chromatin*. The chromatin contains the hereditary material of the cell. The fluid that fills the rest of the space in the nucleus is called the *nuclear sap*.

**Color the heading Cytoplasm and titles and structures G through N. Color over the lines that represent microfilaments.**

The term "cytoplasm" is still used to designate all of the cell contents outside the nucleus but inside the cell membrane, although we realize that cytoplasm is not the homogeneous substance it was once thought to be. One of the prominent organelles in the cytoplasm is the *mitochondrion*, often called the "powerhouse of the cell" because about 90 percent of the energy that eukaryotic cells get from oxidizing food molecules is developed there. The *Golgi complex* is a stack of membranous sacs in which various molecules are manufactured and packaged for "export" from the cell. *Centrioles* are cylindrical bundles of microtubules that seem to give rise to the longer spindle microtubules (not shown) that separate the two duplicate sets of chromatin at the time of cell division. Most animal cells have a pair of centrioles lined up at 90 degrees to each other. Additional *microtubules* are found singly or in groups elsewhere in the cytoplasm. They appear to provide structural support to the cell and may be involved in movement. *Vacuoles* are fluid-filled sacs of membrane that may contain anything from food being digested to oil droplets. *Lysosomes* look like small vacuoles but contain digestive enzymes. *Microbodies* look like small vacuoles as well but contain various enzymes not involved in digestion. *Microfilaments* are found in various places around the cytoplasm and are involved in movement and attachment to other cells.

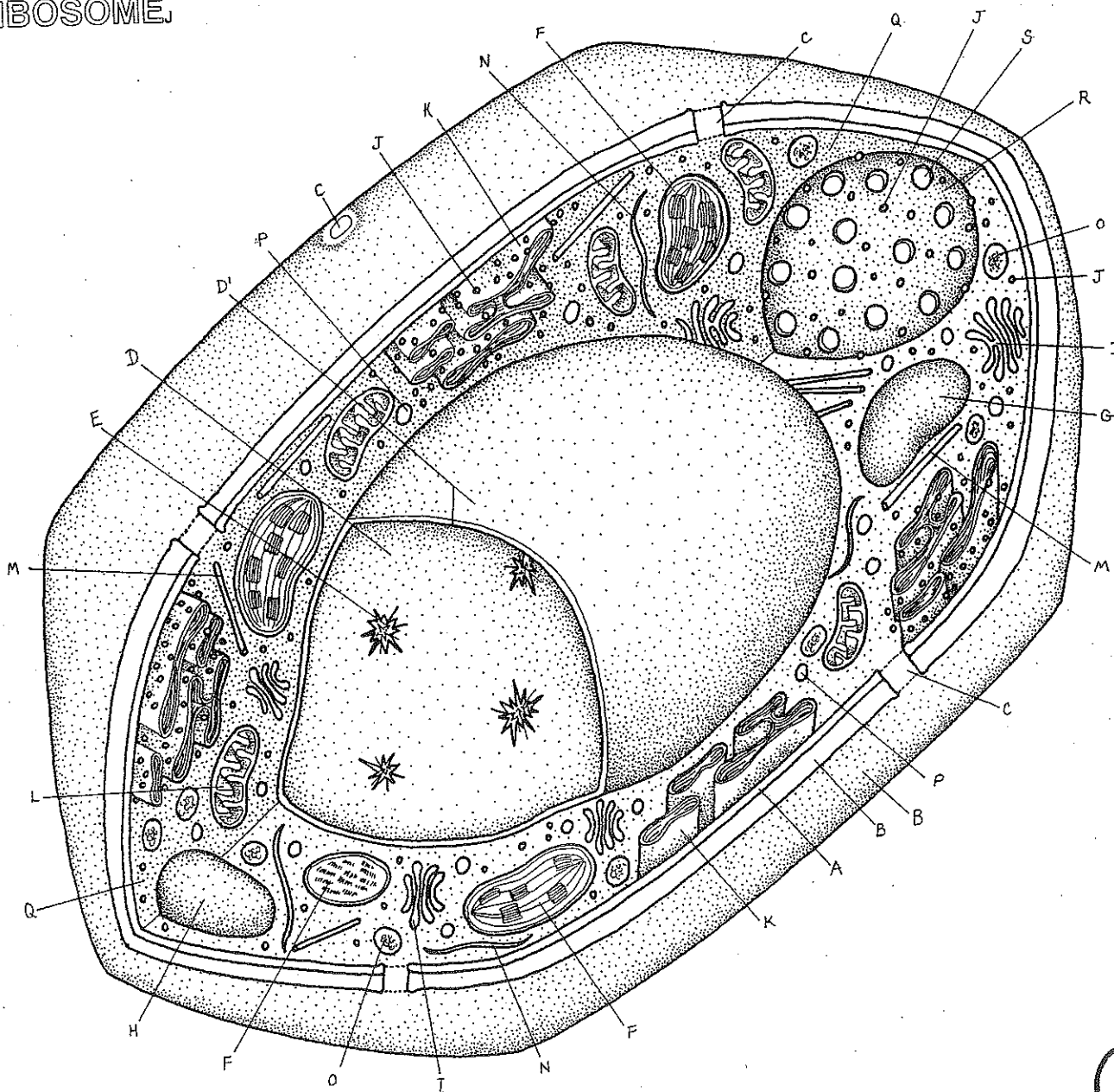
**Color titles and structures O and P. Be sure to use a pale color for P to avoid obscuring the ribosomes (O). Do not color Q.**

Throughout the cytoplasm are many tiny structures called *ribosomes*, which manufacture proteins. Some are free in the fluid portion of the cytoplasm, but many others are attached to the *endoplasmic reticulum* (ER), a system of membranes that extends throughout much of the cytoplasm. Some parts of the endoplasmic reticulum (known as the rough ER) have many ribosomes attached; other parts (known as the smooth ER) have none. The remaining portion of the cytoplasm, which seems to be a structureless fluid, is called the *hyaloplasm*. (Some biologists call it the cell sap or the cell matrix.)

# PLANT CELL.

CELL MEMBRANE<sub>A</sub>  
 CELL WALL<sub>B</sub>  
 PLASMODESMA<sub>C</sub>  
 VACUOLE<sub>D</sub>  
 TONOPLAST<sub>D'</sub>  
 CRYSTAL<sub>E</sub>  
 PLASTIDS<sub>F</sub>  
 CHLOROPLAST<sub>F</sub>  
 LEUCOPLAST<sub>G</sub>  
 CHROMOPLAST<sub>H</sub>  
 GOLGI COMPLEX<sub>I</sub>  
 RIBOSOME<sub>J</sub>

ENDOPLASMIC RETICULUM<sub>K</sub>  
 MITOCHONDRION<sub>L</sub>  
 MICROTUBULE<sub>M</sub>  
 MICROFILAMENT<sub>N</sub>  
 LYSOSOME<sub>O</sub>  
 MICROBODY<sub>P</sub>  
 HYALOPLASM<sub>Q</sub>  
 NUCLEUS<sub>R</sub>  
 NUCLEAR ENVELOPE<sub>R</sub>  
 NUCLEAR PORE<sub>S</sub>



## PLANT CELL

In a typical plant cell we see virtually all of the structures found in animal cells except for centrioles and certain protrusions used for locomotion or absorption. On the other hand, plant cells contain certain structures not found in animal cells at all.

Color titles and structures A through H, including the heading Plastids. Use green for F and a light color for D and D<sup>1</sup>. In nature, G is white. Color H with any bright color you wish. (If this were a ripening tomato, H would be red.)

The plant *cell membrane* is essentially the same as an animal cell membrane. Immediately outside the plant cell membrane, however, is a *cell wall* consisting mostly of fibers of cellulose, although other kinds of molecules also become incorporated into it. When a cell is first formed by division of its parent cell, the cell wall is relatively elastic and is called a primary cell wall. As the cell grows, the wall is made thicker and more rigid and becomes known as a secondary cell wall (shown in this plate). The cell wall is perforated by numerous small pores called *plasmodesmata* (singular, *plasmodesma*), which appear to allow a direct bridge of cytoplasm from one cell to the next.

Although animal cells often contain some small vacuoles, plant cells usually contain one or a few very large ones. As plant cells mature, the vacuoles tend to get larger and usually fuse to form a single very large *vacuole* that may comprise up to 90 percent of the cell's volume. These large vacuoles are sometimes called "water vacuoles" because they contain large quantities of water. However, they also contain a wide variety of dissolved substances, including nutrients stored for later use and toxic substances, which may be broken down into harmless subunits in the vacuole. It is because of the dissolved substances that water flows into the vacuole and creates osmotic pressure, which is responsible for the rigidity ("turgor") of plants. When water is in short supply, the vacuoles lose their osmotic pressure, and the plant wilts (see Plate 34). Sometimes substances are stored in vac-

uoles as solid *crystals*, and many flowers receive their coloring from the pigments dissolved or crystallized in their vacuoles. The membrane of the vacuole is often called the *tonoplast*.

Plants are also colored by their plastids, but *chloroplasts*, which are green, have a much more important function than merely making plants green. They trap light energy and convert it to chemical energy for the manufacture of food in the process called photosynthesis. *Leucoplasts* are whitish in color and serve to store starch, lipid, or protein. *Chromoplasts* are plastids that produce and store other pigments that impart color to particular parts of a plant, as when fruit ripens or leaves turn color in the fall. They are formed by modification of chloroplasts or leucoplasts.

Color all the remaining titles and structures in the plate, including the heading Nucleus. Use a dark color for J, light colors for K and R, and a very light color for Q.

*Golgi complexes* in plant cells are usually called dictyosomes. They are very much like the Golgi complexes in animal cells except that they are usually smaller and more numerous. In addition to synthesizing various complex molecules needed within the cell, they appear to be responsible for manufacturing the components of the cell wall, which animal cells never have. All the remaining structures are virtually identical to those found in animal cells: *ribosomes* synthesize proteins and are found attached to the *endoplasmic reticulum* and free in the cytoplasm; *mitochondria* provide energy by oxidizing the carbohydrate made in the chloroplasts; *microtubules* and *microfilaments* seem to provide support and produce movement; *lysosomes* and *microbodies* contain enzymes; and the apparently structureless fluid making up the rest of the cytoplasm is called the *hyaloplasm*. The nucleus, too, is virtually the same; for that reason, this plate shows only the exterior of the *nuclear envelope* with its numerous *pores*.

# ***MAKING AN Animal CELL MODEL***

## **CELLS ARE THE SMALLEST COMMON UNIT OF MOST LIVING ORGANISMS**

Some organisms are only as big as a single cell, such as bacteria. More complex species, like humans, are made of many different types of specialized cells. Brain cells, skin cells, bone cells, heart cells, and liver cells, are just a few examples of specialized cells. But all cells, complex or simple, share similar structural features called **organelles**.

*Read below to find out all about them. Student Instructions:*

1) Pour about 2 bottles of **light karo syrup** into a Ziploc baggie. It's smart to put that baggie inside another because if the first one leaks, the mess isn't any fun to clean up. (2 Total Ziploc Bags = Gallon Size)

The baggie is equivalent to the **cell membrane** and the karo syrup is like the **cytoplasm**.

a) Now, you have to figure out what else you're going to put inside.

b) Read below about all of the **organelles** and their functions. Then find some small objects to represent the structure of each organelle. Place those objects inside, seal up the baggie, and now you have your own touchable, squeezable cell.

c) To make the various organelles you can use *odds and ends* such as: beads, rocks, glitter, yarn, dental floss, marbles, and other art supplies.

*Remember to seal the 2 Ziploc Bags with tape and be careful not to puncture them*

*Don't use food to make your cell model*

2) Make a comparison sheet that shows the structure and function of each organelle.

3) **MEMORIZE IT!!**

**Organelle Structure and Function: *This is not a complete list- refer to your***

*textbook for other organelles*

### **Cell Membrane**

All cells have a fence, which is called a **cell membrane**, to protect the inside of the cell from the outside environment.

The membrane of animal cells is a double layer of molecules called a **lipid bilayer**. This structure can change shape easily and is also responsible for receiving messages from the cell's surroundings.

### **Nucleus**

The nucleus of a cell is the information center and it houses the DNA. The nucleus has its own membrane which is also a lipid bilayer. Inside the nucleus is the nucleolus. This "suborganelle" makes the **ribosomes**. The ribosomes are the organelles which make protein for the cell.

### **Proteins**

Proteins are one of the **basic structural and functional units** of the cell. Every protein molecule is made out of amino acids. The DNA holds the instructions that makes each protein different, that is, the order of the amino acids. A single protein molecule is not an organelle. The glitter in this model are proteins on their way to becoming part of an organelle. The protein molecules are built inside the cell by an organelle called the ribosome.

**Endoplasmic Reticulum (ER)**

The ER is a network of membranes inside the cell. There are two regions: rough and smooth. The rough ER got its name because ribosomes are bound to that area. There are no ribosomes bound to the smooth ER. Instead, that is where lipid molecules are made.

**Cytosol**

The **cytoplasm** is everything inside the cell membrane except the nucleus. The cytoplasm includes all of the other organelles and a fluid, which is called the **cytosol**. Proteins travel around the cell through this fluid guided by a network of fibers called the **cytoskeleton**. The cytoskeleton also determines the shape of the cell, and helps the cell move.

**Mitochondria**

The mitochondria are known as the "power plants" of the cell because they make the energy, called ATP (adenosine triphosphate). The ATP molecule is made from a sugar molecule called **glucose**. The process requires **oxygen** and produces **carbon dioxide**. When we breathe, we inhale oxygen and exhale carbon dioxide.

**Lysosomes**

The lysosomes are small sacks inside the cell which contain many **enzymes** (functional proteins). These enzymes degrade old molecules of DNA, protein, or lipid, into smaller units which can be reused to make new molecules.

**Golgi Complex**

The **Golgi Complex** sorts newly made proteins and sends them to their proper places. Some of these proteins are sent to sites within the cell and others are sent outside the cell (**secreted**). The proteins that are secreted often act as messengers and their signal is received by the membrane of another cell.



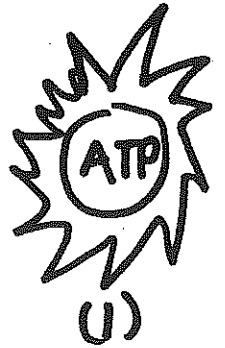
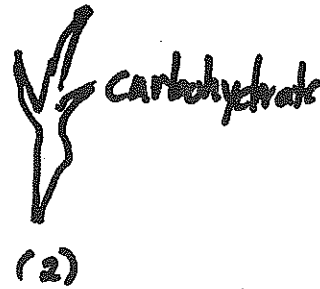
# Membrane Project

These should be with you on Tuesday or Wednesday when you come to class

Your job is to construct the following models for use in class, when we study the membrane of cells and how things move through the membrane.

(use construction paper)

Make the number of molecules listed.



Keep the following separate

Blue confetti: water (1 ziplock bag)  
white confetti: solute (1 ziplock bag) } make a lot of these small molecules

We will use these manipulatives to understand movement across a membrane

• Keep the pieces separate

Make two small signs: hypertonic hypotonic

Keep these in a Ziploc baggie.

Not in most plant cells

Flagellum  
Centriole  
Lysosome

Nucleus

Rough endoplasmic reticulum

Ribosomes

Smooth endoplasmic reticulum

Golgi apparatus

Peroxisome

Mitochondrion

Plasma membrane

Microtubule  
Microfilament } Cytoskeleton

Rough endoplasmic reticulum

Ribosomes

Smooth endoplasmic reticulum

Golgi apparatus

Cytoskeleton { Microtubule  
Microfilament

Nucleus

Cell wall

Central vacuole

Chloroplast

Not in animal cells

Peroxisome

Mitochondrion

Plasma membrane

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# Questions that will appear on the Oral Quiz *for the cell...*

## *Cell*

- What is the smallest unit of life?
- What are the two basic kinds of cells?
- What organism represents the prokaryotes?
- What organism represents the eukaryotes?
- What is a prokaryote?
- What is a eukaryote?

## *Nucleus*

- What are the two major parts of the nucleus?
- What is the nucleolus?
- What does it make?
- What does a ribosome make?
- What are the two parts of chromatin?
- What is the purpose of the DNA?
- Remember the importance of the nuclear pores and the nuclear membrane.

## *Endoplasmic Reticulum*

- What are the two types of ER?
- What does rough mean?
- What does smooth mean?
- What is the purpose of the ER?
- What is the name of the final part of the ER?

## *Mitochondria*

- What is the purpose of the mitochondrion?
- What sugar is used to make the ATP?
- What is the name of the process to convert glucose to ATP?

## *Lysosome*

- What is it?
- What is an enzyme?
- What things would it break down?

***Proteins***

**What are they?**

**What are they used for?**

***Golgi Complex***

**What is it?**

**What are its three major functions?**

***Cell Membrane***

**What is it made of? How is it arranged?**

***Centrioles***

**What is it?**

**What process is it used in?**

**All other organelles....**

**What is it?**

**What is its purpose?**