What is the Cell Theory?
1. All living things are made of cells.
2. Cells are the basic units of structure and function in living things.
3. New cells are produced from existing cells.
**Differences between Prokaryotic vs Eukaryotic Cells**

1. **Prokaryotic Cells:** Single-celled organisms that lack internal membrane Bound compartments (Genetic material (DNA) is in a circular molecule) (simple) i.e. bacteria.  
   - Hypothesized that the first type of cells on earth were prokaryotic

2. **Eukaryotic Cells:** Cells with membrane bound compartments with organelles such as, the nucleus. (more complex) i.e. animal and plant cells

**Directions:** Write a P if the statement refers to Prokaryotes and an E if the statement refers to Eukaryotes, if the statement refers to both Prokaryotes and Eukaryotes write a B on the line.

- **P** 1. This type(s) of cell does not have bound compartments.
- **B** 2. This type(s) of cell contains DNA.
- **E** 3. This type(s) of cell contains organelles.
- **P** 4. A bacteria cell is an example of this type of cell.
- **E** 5. This type(s) of cell contains a nucleus.

**Cell Structures & Functions**
All cells are enclosed by a cell membrane (plasma membrane). Within the membrane is the nucleus and the cytoplasm. Within the cytoplasm are organized structures that perform specific functions. These structures are called organelles.

Please Note-The letters next to the structure of the cell indicates if it is found in A =animal cells and P = plant cells.

(A, P) **Cell Membrane**- surrounds the cell. It plays an active role in determining which substances enter and exit the cell. Some substances can pass freely through the cell membrane and others cannot, the membrane is said to be selectively permeable, or semipermeable. The cell membrane is composed of lipids (phospholipids) and proteins.

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(A, P) **Nucleus**- control center for all cell functions. Within the nucleus are chromosomes and at least one nucleolus. The nucleolus is a site of RNA synthesis, and it may also be responsible for the production of ribosomes.

(A, P) **Cytoplasm**- the material in the cell outside the nucleus. It consists mainly of water. Within the cytoplasm are the various organelles of the cell. The cytoplasm provides the environment in which the organelles carry on the life processes of the cell.
(A, P) Mitochondria- are found in the cytoplasm. Most stages of cellular respiration occur in the mitochondria. The energy released during respiration is stored in the form of high-energy chemical bonds in molecules of ATP.

(P) Chloroplasts- contain green pigment called chlorophyll, which carries on the process of photosynthesis.

Mitochondria & Chloroplast- Developed from prokaryotic cells? WHAT?!?!
Check out this really good explanation... http://www.youtube.com/watch?v=fAjev01mDZM

Related questions:
1. Why are these two organelles unique?
   1. Both involve energy transfer
   2. Similar to each other - have own DNA , use the same process of cell division

2. What are two characteristics about mitochondria and chloroplast that make it similar to prokaryotic bacteria cells?
   DNA looks prokaryotic; single circular nucleoid
   Mitochondria, chloroplasts and prokaryotes use the same form of cell division

3. What is the endosymbiotic theory?
   the idea that mitochondria and chloroplasts evolved from bacteria

(A, P) Ribosomes- are small, dense granules (look like tiny circles on the diagrams) found free in the cytoplasm and the nucleus and lining the membranes of some endoplasmic reticulum. Ribosomes are composed mainly of RNA. They are the centers of protein synthesis in the cell.

(A, P) Endoplasmic reticulum- is a membrane-bound system of channels or tubes through which materials are transported within the cell. The membranes of the ER may also serve as sites of biochemical reactions. There are two types smooth and
rough. The rough appearance is due to the presence of ribosomes on the membrane. **Rough ER** is found mainly in cells involved in protein synthesis. **Smooth ER** which has no ribosomes, is found mainly in cells involved in synthesis of nonprotein substances.

(A, P) **Golgi Apparatus**- is made up of a series of membrane-enclosed sacs, and it is usually found near the nucleus. This organelle is associated with the production of lysosomes and with the synthesis of various secretions.

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(A) **Lysosomes**- are “packages” or sacs, of digestive enzymes. They keep the enzymes separated from the rest of the cell contents until they are needed.

(A, P) **Vacuoles**: are membrane-enclosed structures that are generally filled with water containing various dissolved substances. Vacuoles in animal cells are usually small, and vacuoles in plants are using large. The pressure created by the large vacuole helps to maintain the rigid structure of the plant cell and of the plant.

(A, P) **Centrosome**-are small organelles found just outside the nucleus in animal cells. Within the centrosome of animal cells are two small structures called **centrioles**, which are necessary for the movement of chromosomes during cell division.

(P) **Cell Wall**- structure found outside the cell membrane of plant cells. The cell wall is made up mostly of cellulose, and it provides support for the cell.

(A, P)**Cytoskeleton**- is a filamentous network of proteins that are associated with the processes that maintain and change cell shape and produce cell movements in animal and bacteria cells. In plants, it is responsible for maintaining structures within the plant cell, rather then whole cell movement. **The main types of filaments** the make up the cytoskeleton are Microfilaments and Microtubules.

3. **se the following structure letters to label the structures indicated in the eukaryotic plant and animal cells.**

A. Cell membrane  
B. Nucleus  
C. Nucleolus  
D. Chromosome  
E. Cell Wall  
AB. Centriole  
AC. Mitochondria  
D. Lysosome  
AE. Endoplasmic reticulum
4. Fill in the names of the structures whose functions are listed below. Use the list of structures above for help.

<table>
<thead>
<tr>
<th>Structure</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitochondria</td>
<td>Cellular Respiration</td>
</tr>
<tr>
<td>Ribosome</td>
<td>Protein Synthesis</td>
</tr>
<tr>
<td>Nucleus</td>
<td>Contains the hereditary information</td>
</tr>
<tr>
<td>Vacuoles</td>
<td>Storage of water, undigested food, and/or waste</td>
</tr>
<tr>
<td>Centrioles</td>
<td>Active in movement of the chromosomes during cell division</td>
</tr>
<tr>
<td>Lysosomes</td>
<td>Storage of digestive enzymes</td>
</tr>
<tr>
<td>ER</td>
<td>Transport within the cytoplasm</td>
</tr>
<tr>
<td>Golgi apparatus</td>
<td>Packages secretions</td>
</tr>
</tbody>
</table>

Two Types of Cellular Transport
The cell membrane is semipermeable, some substances can pass through it freely, while others cannot. The movement of substances that can pass freely through the membrane depends only on the concentration gradient for that substance.

1. Passive Transport
   – Does not use energy
   – Moves from a high concentration to a low concentration

Examples:

- **Diffusion**: The movement of particles from regions of higher density to regions of lower density across the cell membrane

- **Facilitated Diffusion**: Transport proteins help ions and polar molecules diffuse through the membrane
• **Osmosis**: The diffusion of water across a selectively permeable membrane.

2. **Active Transport**
   - Requires energy
   - Moves from a low concentration to a high concentration
     examples:
   - **Endocytosis**: The movement of a large substance **into** a cell by means of a vesicle
   - **Exocytosis**: The movement of material **out** of a cell by means of a vesicle

**Sodium-potassium pump**: One of the most important carrier proteins in animal cells. In nerve cells the pump is used to generate gradients of both sodium and potassium ions. These gradients are used to propagate electrical signals that travel along nerves.

→ **Watch this cool animation on the sodium-potassium pump, and take the quiz!** Record your answers to the questions below as you take the quiz.

http://highered.mcgraw-hill.com/sites/9834092339/student_view0/chapter38/sodium-potassium_exchange_pump.html

1. **A**  2. **A**  3. **D**  4. **A**  5. **A**
8. What is passive transport?

When a substance moves from an area of higher concentration to an area of lower concentration

Does not require energy

examples = simple diffusion, facilitated diffusion, osmosis

9. The paramecium is a fresh water protozoan. The salt content of its cytoplasm is greater than that of the surrounding medium.

a. Does water tend to enter or leave the paramecium? Is this process of passive or active transport?

Water would tend to go in. This is passive transport.

b. How does the paramecium expel water? Is this a process of passive or active transport? Explain.

They have a “contractile vacuole” that collects and then expels excess water. This is active transport; water is moving against the gradient

10. Where does the energy for active transport come from?

ATP, the result of cellular respiration

Practice Questions:

1. Using a microscope, a student observes a small, green organelle in a plant cell. Which energy transformation most likely occurs first within the observed organelle?
   A. ATP to light          C. heat to electrical
   B. light to chemical    D. chemical to chemical

2. Carbon dioxide and oxygen are molecules that can move freely across a plasma membrane. What determines the direction that carbon dioxide and oxygen molecules move?
   A. orientation of cholesterol in the plasma membrane
   B. concentration gradient across the plasma membrane
   C. configuration of phospholipids in the plasma membrane
   D. location of receptors on the surface of the plasma membrane

3. A sodium-potassium pump within a cell membrane requires energy to move sodium and potassium ions into or out of a cell. The movement of glucose into or out of a cell does not
require energy. Which statement best describes the movement of these materials across a cell membrane?
A. Sodium and potassium ions move by active transport, and glucose moves by osmosis.
B. **Sodium and potassium ions move by active transport, and glucose moves by facilitated diffusion.**
C. Sodium and potassium ions move by facilitated diffusion, and glucose moves by osmosis.
D. Sodium and potassium ions move by facilitated diffusion, and glucose moves by active transport.

4. The rough endoplasmic reticulum and Golgi apparatus work together in eukaryotic cells. What is one way that the rough endoplasmic reticulum assists the Golgi apparatus?
A. It assembles nucleic acids from monomers.
B. It breaks down old, damaged macromolecules.
C. **It packages new protein molecules into vesicles.**
D. It determines which protein molecules to synthesize.

5. In many eukaryotic cells, DNA stored in the nucleus is transcribed into messenger RNA. The mRNA is then transported into the cytoplasm where ribosomes assist in their translation into proteins. Finally, these proteins are packaged and sorted in the Golgi apparatus for use in other parts of the cell or in preparation for secretion into other cells.

5. Which of the following statements is supported by this description?
A. **Various organelles within a cell interact with each other to carry out life processes.**
B. Organelles within a cell act independently of each other at all times.
C. Some organelles are more important than other organelles within a cell.
D. Only up to three organelles may interact with each other at any given moment in time.

6. The cell membrane serves many functions. One of the cell membrane's functions is to help the cell maintain homeostasis. Which of the following statements best supports this claim?
A. The cell membrane contains a polar region and a nonpolar region.
B. The cell membrane contains proteins.
C. The cell membrane contains phospholipids.
D. **The cell membrane regulates what goes into and out of the cell.**
7. In order for nerve cells and muscle cells to function properly, they require a high concentration of potassium ions inside the cells and a high concentration of sodium ions outside the cells. To maintain this condition, cells utilize sodium-potassium pumps embedded within their cellular membranes to move the ions against their concentration gradients.

7. Since sodium-potassium pumps require an input of energy to operate, they are an example of...
   A. passive transport.  
   B. facilitated diffusion.  
   C. filtration.  
   D. active transport.

8. Most organisms can be divided into two categories - prokaryotes and eukaryotes. What is the main difference between these two categories?
   A. Eukaryotes are living organisms whereas prokaryotes include some nonliving matter.
   B. Prokaryotes do not possess any means of locomotion and are thus unable to move.
   C. Prokaryotes do not possess a nucleus or any other membrane-bound organelles.
   D. Eukaryotes are found in all of the six major taxonomic kingdoms.

9. When a person inhales, oxygen fills tiny air sacs in the person's lungs. Next, the oxygen moves from these air sacs into small blood vessels that line the lungs, and then it moves into the bloodstream so that it can be transported around the body. Oxygen moves by random molecular motion from the air sacs of the lungs to the blood vessels because the concentration of oxygen in the air sacs is higher than the concentration of oxygen in the blood vessels.

9. This movement of oxygen molecules from an area of higher concentration to an area of lower concentration is known as _______.
   A. diffusion  
   B. osmosis  
   C. respiration  
   D. photosynthesis
10. **Energy conversion within an animal cell would be severely limited by removal of the cell's**
   A. lysosomes.  
   B. plastids.  
   C. chloroplasts.  
   D. **mitochondria**.

**Open-ended Question:**

1. Some animals can produce a potassium ion concentration inside their cells that is twenty times greater than that of their environment. This ion concentration gradient is maintained by the plasma membrane.
   - **Part A:** Identify the process in the cell membrane that produces this difference in concentration.

   *Potassium ion pump. The process is active transport (needs energy).*

   **Part B:** Explain the process that occurs as the cell produces the ion concentration gradient.

   *There are specialized proteins in the cell membrane that act like "pumps with a toll". These pumps use ATP (small packets of energy) to power their transport of Na⁺ out of a cell, and K⁺ into the cell. Because different numbers of sodium ions and potassium ions are pumped back and forth, it creates an electrical gradient where one side of the cell is more positive than the other side.*

   **Part C:** Compare the process of potassium ion transport to another mechanism that moves material across the plasma membrane.

   *Active transport is specific and also uses energy, which is the key distinction, as opposed to facilitated diffusion which is also specific to a molecule (or ion) but does not require energy. An example would be glucose is too big to pass through the cell membrane on its own, but can do so the with help of a specific protein*