Cells and Their Organelles

Cells are the basic structural and functional units of life.

The cells of eukaryotes (protozoa, plants and animals) are highly structured. These cells tend to be larger than the cells of bacteria, and have developed specialized packaging and transport mechanisms that may be necessary to support their larger size.

**Nucleus**: The nucleus is the most obvious organelle in any ­­­­­\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cell. It is enclosed in a double membrane and communicates with the surrounding cytosol via numerous nuclear pores. Within each nucleus is nuclear \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that contains the organism’s genome. The chromatin is efficiently packaged within the small nuclear space. Genes within the chromatin are made of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_). The DNA stores the organism’s entire encoded genetic information. The DNA is similar in every cell of the body, but depending on the specific cell type, some genes may be turned on or off - that's why a liver cell is different from a muscle cell, and a muscle cell is different from a fat cell. When a cell is dividing, the nuclear chromatin (DNA and surrounding protein) condenses into chromosomes that are easily seen by microscopy.

**Nucleolus**: The prominent structure in the nucleus is the nucleolus. The nucleolus produces \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which move out of the nucleus and take positions on the rough endoplasmic reticulum where they are critical\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Cytosol**: The cytosol is the "\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_" within which all the other cell organelles reside and where most of the cellular \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ occurs. Though mostly water, the cytosol is full of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that control cell metabolism including signal transduction pathways, glycolysis, intracellular receptors, and transcription factors.

**Cytoplasm**: This is a collective term for the cytosol plus the organelles suspended within the cytosol.

**Centrosome**: The centrosome, or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is an area in the cell where microtubules are produced. Plant and animal cell centrosomes play similar roles in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and both include collections of microtubules, but the plant cell centrosome is simpler and does not have centrioles.

During animal cell division, the centrioles replicate (make new copies) and the centrosome divides. The result is two centrosomes, each with its own pair of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The two centrosomes move to opposite ends of the nucleus, and from each centrosome, microtubules grow into a "\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_" which is responsible for separating replicated chromosomes into the two daughter cells.

**Centriole** (animal cells only): Each centriole is a ring of \_\_\_\_\_ groups of fused \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. There are three microtubules in each group. Microtubules (and centrioles) are part of the cytoskeleton. In the complete animal cell centrosome, the two centrioles are arranged such that one is perpendicular to the other.

**Golgi**: The Golgi apparatus is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ structure with a single membrane. It is actually a stack of membrane-bound vesicles that are important in packaging macromolecules for transport elsewhere in the cell. The stack of larger vesicles is surrounded by numerous smaller vesicles containing those packaged macromolecules. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ contents of lysosomes, peroxisomes and secretory vesicles are packaged in membrane-bound vesicles at the periphery of the Golgi apparatus.

**Lysosome**: Lysosomes contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ enzymes necessary for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ digestion. They are common in animal cells, but rare in plant cells. Hydrolytic enzymes of plant cells are more often found in the vacuole.

**Peroxisome**: Peroxisomes are membrane-bound packets of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. In plant cells, peroxisomes play a variety of roles including \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and assisting chloroplasts in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. In animal cells, peroxisomes protect the cell from its own production of toxic hydrogen peroxide. As an example, white blood cells produce hydrogen peroxide to kill bacteria. The oxidative \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in peroxisomes break down the hydrogen peroxide into water and oxygen.

**Secretory Vesicle**: Cell secretions - e.g. hormones, neurotransmitters - are packaged in secretory vesicles at the Golgi apparatus. The secretory vesicles are then transported to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_for release.

**Cell Membrane**: Every cell is enclosed in a membrane, a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (lipid bilayer). The exposed heads of the bilayer are "\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_" (water loving), meaning that they are compatible with water both within the cytosol and outside of the cell. However, the hidden tails of the phosopholipids are "\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_" (water fearing), so the cell membrane acts as a protective barrier to the uncontrolled flow of water. The membrane is made more complex by the presence of numerous proteins that are crucial to cell activity. These proteins include \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for odors, tastes and hormones, as well as pores responsible for the controlled entry and exit of ions like sodium (Na+) potassium (K+), calcium (Ca++) and chloride (Cl-).

**Mitochondria**: Mitochondria provide the energy a cell needs to move, divide, produce secretory products, contract - in short, they are the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the cell. They are about the size of bacteria but may have different shapes depending on the cell type. Mitochondria are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ organelles, and like the nucleus have a double membrane. The outer membrane is fairly smooth. But the inner membrane is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, forming folds (cristae) when viewed in cross-section. The cristae greatly increase the inner membrane's \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. It is on these cristae that food (sugar) is combined with oxygen to produce\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- the primary energy source for the cell.

**Vacuole**: A vacuole is a membrane-bound sac that plays roles in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ digestion and the release of cellular \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. In animal cells, vacuoles are generally small. Vacuoles tend to be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells and play several roles: storing nutrients and waste products, helping increase cell size during growth, and even acting much like lysosomes of animal cells. The plant cell vacuole also regulates \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the cell. Water collects in cell vacuoles, pressing outward against the cell wall and producing rigidity in the plant. Without sufficient water, turgor pressure drops and the plant \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Cell Wall (plant cells only)**: Plant cells have a rigid, protective cell wall made up of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. In higher plant cells, that polysaccharide is usually \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The cell wall provides and maintains the shape of these cells and serves as a protective barrier. Fluid collects in the plant cell vacuole and pushes out against the cell wall. This \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pressure is responsible for the crispness of fresh vegetables.

**Chloroplast (plant cells only)**: Chloroplasts are specialized organelles found in all higher plant cells. These organelles contain the plant cell's \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ responsible for the plant's green color and the ability to absorb energy from sunlight. This energy is used to convert water plus atmospheric carbon dioxide into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ sugars by the biochemical process of photosynthesis. Chloroplasts have a double outer membrane. Within the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are other membrane structures - the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Thylakoids appear in stacks called "grana" (singular = granum).

**Smooth Endoplasmic Reticulum**: Throughout the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cell, especially those responsible for the production of hormones and other secretory products, is a vast network of membrane-bound \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ called the endoplasmic reticulum, or ER for short. The ER is a continuation of the outer nuclear membrane and its varied functions suggest the complexity of the eukaryotic cell.

The smooth endoplasmic reticulum is so named because it appears \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ by electron microscopy. Smooth ER plays different functions depending on the specific cell type including \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ synthesis, breakdown of lipid-soluble toxins in liver cells, and control of calcium release in muscle cell contraction.

**Rough Endoplasmic Reticulum**: Rough endoplasmic reticulum appears "\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_" by electron microscopy due to the presence of numerous ribosomes on its surface. Proteins synthesized on these ribosomes collect in the endoplasmic reticulum for transport throughout the cell.

**Ribosomes**: Ribosomes are packets of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and protein that play a crucial role in both \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells. They are the site of protein synthesis. Each ribosome comprises two parts, a large subunit and a small subunit. Messenger RNA from the cell nucleus is moved systematically along the ribosome where transfer RNA adds individual \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ molecules to the lengthening \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ chain.

**Cytoskeleton**: As its name implies, the cytoskeleton helps to maintain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. But the primary importance of the cytoskeleton is in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ . The internal movement of cell organelles, as well as cell locomotion and muscle fiber contraction could not take place without the cytoskeleton. The cytoskeleton is an organized network of three primary protein filaments:

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* actin filaments (\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_)
* intermediate fibers