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"Living Architecture"

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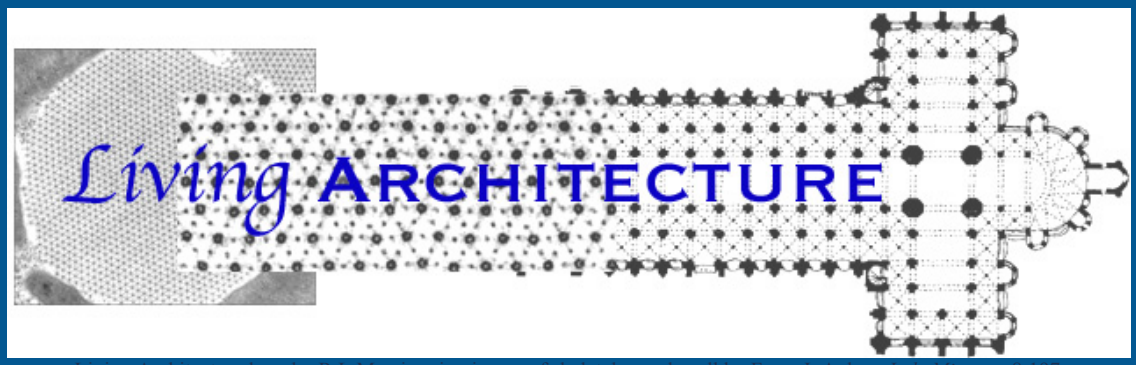

Living Architecture logo by R.L.Morris using image of skeletal muscle cell by From J. Auber, *J. de Microsc.* 8:197–232, 1969, available at http://www.ncbi.nlm.nih.gov/books/NBK26888/figure/A3068/?report=objectonly and image of floorplan of Basilica of Saint Sernin available on Laura Lyon's Romanesque Art Flashcards available at https://classconnection.s3.amazonaws.com/268/flashcards/716268/jpg/17-51330607485976.jpg

Eukaryotic Cell vs. College Campus

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Rule-to-Build-By:

"To conduct multiple activities simultaneously, subdivide spaces and assign different functions to each space" (Morris & Staudinger, n.d.).

What:

A eukaryotic cell contains compartments called organelles, each carrying out a specialized function, thus allowing multiple activities to occur simultaneously within the cell. A college campus has spaces and buildings, each serving a specific function or purpose, thus allowing multiple activities to occur simultaneously on the college campus.

How:

Eukaryotic cells, unlike prokaryotic cells, have membrane-bound organelles. This increased complexity allows for each organelle to not be continuous with the cytosol contained within the cell and therefore perform its own unique function. By there being many organelles within a eukaryotic cell, multiple activities are able to occur at the same time. The primary organelles or structures contained within eukaryotic cells include the nucleus, plasma membrane, cell wall, smooth endoplasmic reticulum (SER), rough endoplasmic reticulum (RER), Golgi apparatus, cytoskeleton, free ribosomes, mitochondria, chloroplasts, and vesicles. There are different kinds of eukaryotic cells: animal, plant, fungal, and protistic. The two most well-known eukaryotic cells are animal (see **Figure 1**) and plant (see **Figure 2**) cells. Animal cells have all of the primary organelles or structures listed above except for chloroplasts and cell walls. They also have centrioles and lysosomes, which are not found in plant cells (Campbell, 2002). Plant cells have all of the primary organelles or structures listed above (Campbell, 2002). They also have a central vacuole (Campbell, 2002). In a eukaryotic cell, the cytosol is the liquid “soup” in which the organelles reside, while the cytoplasm includes all of the inner contents of the cell except for the nucleus (Plopper, 2016). Each of the primary organelles or structures contained within eukaryotic cells is enclosed by a membrane, or is a membrane itself. This means that a different function can be carried out by each of the organelles or structures. The nucleus stores genetic information and is the control center of the cell (Plopper, 2016). It contains the nucleolus, which synthesizes ribosomal RNA (rRNA), and chromatin, which is composed of DNA and histones and is the material that makes up chromosomes (Campbell, 2002). The nucleus is surrounded by a double membrane known as the nuclear envelope, which separates it from the cytoplasm (Campbell, 2002). The nuclear envelope is perforated with pores, lined by a nuclear lamina, and

functions to control what enters and exits the nucleus (Plopper, 2016). The plasma membrane surrounds the cell and acts as a selective barrier, regulating what enters and exits the cell (Plopper, 2016). Small, hydrophobic molecules such as CO_2 and O_2 cross the membrane with ease, while ions, hydrophilic molecules, and large molecules like glucose find it harder to cross the membrane (Campbell, 2002). The cell wall, not found in animal cells, is a rigid layer surrounding the plasma membrane, and in plant cells, consists of cellulose. The SER is part of the endomembrane system and is continuous with the RER and nuclear envelope. It functions in lipid synthesis, metabolism of carbohydrates, and detoxification of drugs and poisons (Campbell, 2002). The RER is also part of the endomembrane system and is continuous with the SER and nuclear envelope. It is studded with ribosomes, making it "rough," and functions to produce membrane proteins and phospholipids (Plopper, 2016). The Golgi apparatus modifies and stores products of the ER and then sends them to other destinations (Plopper, 2016). The cytoskeleton gives structural support to the cell and maintains its shape. The cytoskeleton provides anchorage for many organelles and even cytosolic enzyme molecules. It is also involved with several types of cell motility (Campbell, 2002). Free ribosomes reside in the cytosol and carry out protein synthesis by the process of translation. Mitochondria generate ATP by the catabolic process of cellular respiration. Chloroplasts, not found in animal cells, produce glucose by the anabolic process of photosynthesis. Vesicles transport proteins and other molecules between different organelles or structures in the cell (Plopper, 2016). All of these organelles or structures function simultaneously to keep the cell alive.

A college campus, like Wheaton College for example, has separate spaces and buildings that serve specific functions. Each space or building is closed off, so multiple activities can occur at the same time on the college campus. The primary spaces or buildings that make up Wheaton College include athletic facilities, like Haas Athletic Center and Sidell Stadium; dining facilities, like Chase Dining Hall and Emerson Dining Hall; academic buildings, like Mars Center for Science and Technology and Knapton Hall; resource buildings, like Wallace Library and Kollett Hall; and residence buildings, like Beard Hall and White House (see **Figure 3**.) The athletic facilities provide students of Wheaton with spaces to exercise and get involved in sport. The dining facilities serve to provide nutrition and satisfy the hunger of Wheaton students. The academic buildings provide spaces of learning, and serve as teaching grounds, for students of Wheaton. The resource buildings supply information for Wheaton students in order to be successful during and after college. The residence buildings provide students of Wheaton with places to live. All of these spaces or buildings function simultaneously to keep the college "alive" or running smoothly.

Why:

The compartmentalization of eukaryotic cells allows for the organelles or structures within these cells to each have a specific function, and therefore, allows multiple activities to go on simultaneously. Prokaryotic cells do not exhibit compartmentalization. For this reason, eukaryotes are more complex and advanced than prokaryotes. Multiple hypotheses exist concerning how eukaryotic cells came into existence, and most of them include the idea that eukaryotic cells came from prokaryotes. The Serial Endosymbiotic Theory (SET), or endosymbiotic theory, proposes that "eukaryotes evolved through a process whereby different types of free-living prokaryotes became incorporated inside larger prokaryotic cells and eventually developed into mitochondria, chloroplasts, and possibly other organelles" ("Endosymbiotic Theory"). Specifically, mitochondria are believed to have originally been

aerobic bacteria engulfed by larger bacterial cells (Walker & Popov, 2008). That is, an aerobic bacterium engulfed by an ancestral host cell has evolved to become a mitochondrion inside a modern eukaryotic cell (Walker & Popov, 2008). Also, chloroplasts are believed to have originally been cyanobacteria engulfed by larger bacterial cells (Walker & Popov, 2008). That is, a cyanobacterium engulfed by an ancestral host cell has evolved to become a chloroplast inside modern plant cells and eukaryotic algae (Walker & Popov, 2008). There is genetic evidence for this theory. Mitochondria and chloroplasts are the only organelles that contain their own DNA (Campbell, 2002). This suggests that mitochondria and chloroplasts are capable of being free-living and most likely once were. Also, studies done on the DNA within these two organelles found that chloroplast DNA matched cyanobacterial DNA, and mitochondrial DNA resembled that of a typhus bacterium (Walker & Popov, 2008). Consequently, eukaryotic cells are the most advanced forms of cells and can therefore perform many specialized functions.

The diversity of spaces and buildings on a college campus allows multiple activities to go on simultaneously, and ultimately makes the college environment the most effective it can be. For the most part, each space or building fulfills a certain purpose independent of each other. This allows the college campus, or institution, to get a lot accomplished in a short amount of time. History has proven that being quick and efficient is evolutionarily advantageous. Therefore, a college campus, like Wheaton College, is organized in a way that allows it to get the most accomplished.

Figures:

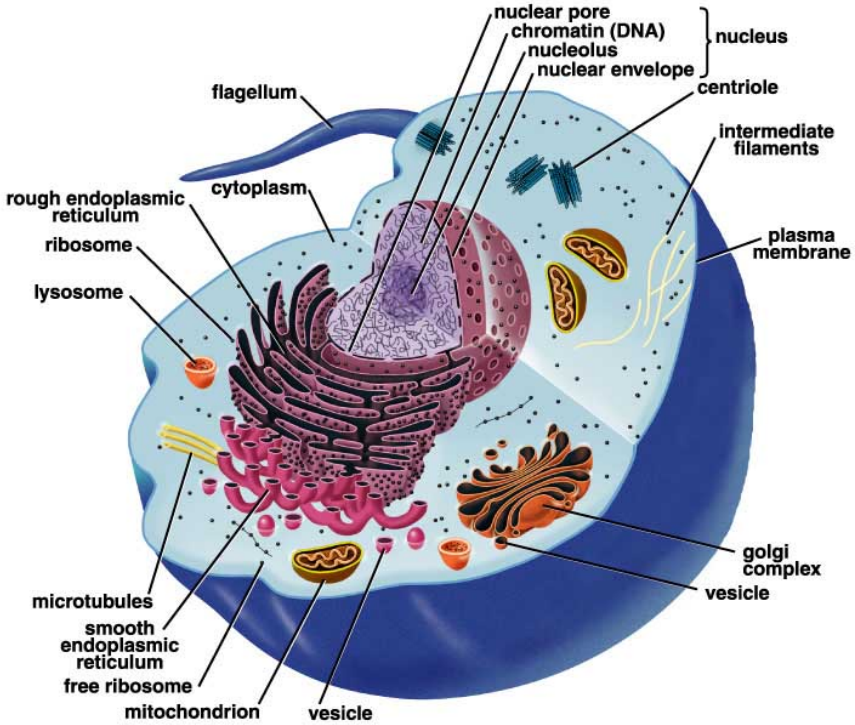

Figure 1: an animal cell. Many different compartments, or organelles, contained within eukaryotic cells, such as the nucleus, plasma membrane, and mitochondria, can be seen here. Lysosomes and centrioles, which are not found in plant cells, can also be seen (Williams, n.d.).

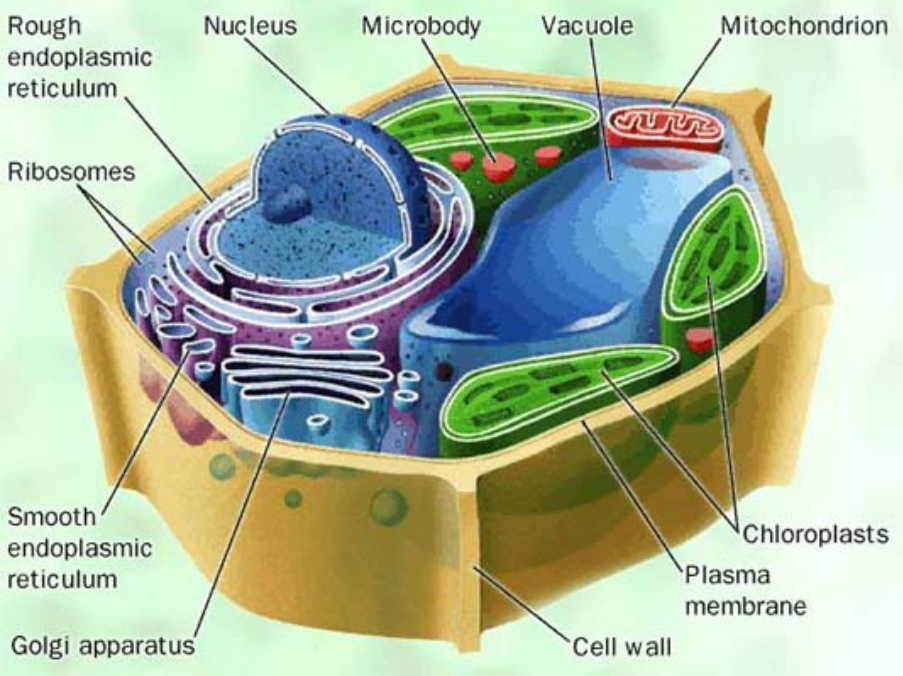

Figure 2: a plant cell. Many different compartments, or organelles, contained within eukaryotic cells, such as the nucleus, plasma membrane, and mitochondria, can be seen here. Chloroplasts, a central vacuole, and a cell wall, which are not found in animal cells, can also be seen ("Distinctive Features of the Plant Cell").

Figure 3: a campus map of Wheaton College. The different spaces and buildings that make up Wheaton College, like Mars Center for Science and Technology and Sidell Stadium, can be seen here (*WheatonCampusMap*).

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