# Topic 1: Cell Biology

## Subtopic 1.1 Introduction to Cells

1. The human skeletal muscle challenges the cell theory by not following the normal pattern of one nucleus per cell. The giant algae doesn't follow the cell theory by being large enough to be seen without a microscope and the aseptate fungal hyphae challenges the cell theory by having continuous cytoplasm due to lack of end cell walls and are multinucleated.
2. The seven functions of life are: nutrition; must be able to make (photosynthesis) or take in organic matter; metabolism; sum of all chemical reactions (anabolic and catabolic); growth; an increase in size; response; detecting changes in an environment and responding to them; reproduction; creating offspring; excretion; getting rid of metabolic wastes; and homeostasis; maintenance of a stable environment.
3. Two disorders treated by stem cells are Stargardt's Macular Dystrophy and Leukemia. Stargardt's Macular dystrophy treatment involves the treatment of stem cells to divide and become retinal cells -> retinal cells ae injected into retina -> retinal cells attach to the retina and become functional -> central vision improves because of functional retinal cells. Leukemia is treated by removing fluid from bone marrow -> stem cells are extracted from fluid and froze->high dosage of chemo is given to kill cancer cells in marrow, loses its ability to produce blood cells -> stem cells are returned and multiple to produce red and white blood cells.

## Subtopic 1.2 Ultrastructure of Cells

4. Binary fission is where prokaryotic cells divide. DNA replicates->DNA moves to the ends of cell-> cell membrane pinches inward->membrane meets and divides the cell into two.
5. Nucleus: makes ribosomes, chromosomes are located here. RER: has cisternae with 80s ribosomes, make proteins destined to leave cell, enclosed into vesicle that transport them. Free ribosomes: free floating 80s ribosomes that make proteins. Golgi apparatus: receive vesicles from RER, process proteins, and transport them to plasma membrane for secretion. Lysosomes: stained darkly and are made by Golgi and contain proteins. Mitochondrion: has a double membrane, make at via aerobic respiration and break down fat to use as an energy source. Chloroplast: double membrane, make glucose via photosynthesis. Vacuoles: expel water and maintain homeostasis. Vesicles: transports materials within the cell. Microtubules: move chromosomes during cell division. Centrioles: anchor other microtubules during cell division. Cilia and Flagella: only one flagellum but many cilia, cilia can cause movement of fluid next to a cell.
6. Omit

## Subtopic 1.3 Membrane Structure

7. The Davson-Danielli model states that in addition to the phospholipid bilayer, proteins were part of the cell membrane as well. The layer of protein was located on each side of the phospholipid bilayer of the phospholipid. Evidence disproving the model were the freeze etching of cells, structure of proteins and the fluorescent body tagging.
8. The Singer-Nicolson model theorized that proteins occupy a variety of positions in the membrane. It is also knows as the fluid mosaic model because both phospholipids and proteins are free to move within the membrane.
9. The role of cholesterol in membranes is disrupting the hydrophobic tails which keeps these tails from crystallizing and helps maintain fluidity. Also allows membranes to curve into a concave shape that helps in the formation of vesicles. Cholesterol reduces permeability to hydrophobic particles and keeps Na+ and H+ out of the cell. Also, it reduces membrane fluidity, which is if the membrane is too fluid, it won't be able to keep substances out.

## Subtopic 1.4 Membrane Transport

10. Simple Diffusion: net movement from high concentration to low concentration, doesn't require energy (passive), the higher the temperature, the more movement of molecules so the faster the rate of diffusion. Facilitated diffusion: down the concentration gradient, doesn't require energy, and number and type of channels allow the cells to control what can enter or leave the cell. Osmosis: depends on the concentration of solutes dissolved in water, water is polar and small and can move freely. Hypertonic, isotonic, and hypotonic. Active transport: low to high concentration, energy is required and carried out via pump proteins in membrane. Molecule can now exit and protein returns to original shape.
11. Hypertonic: concentration of solutes is higher than inside cells, animal cell shrinks, plant cell membrane pulls away from cell wall. Isotonic: cell maintains normal size and shape. Hypotonic: in animal cell, if too much water enters the cell, it may burst, in plant cell the pressure on the cell wall increases.

## Subtopic 1.5 The Origin of Cells

12. Redi's experiment: placed meat in an open jar and maggots appeared on meat, placed meat in a closed jar->no maggots, placed meat in a covered jar to allow ether to enter -> no maggots. Pasteur's experiments: broth is placed in a curved flask to prevent dust from entering-> broth is heated and after one year, no bacteria -> curved neck is broke, dust can now enter -> after one day, broth was cloudy and filled with bacteria.
13. The endosymbiotic theory states that cells arose form communtities of prokaryotic cells when small prokaryotes began to live inside other cells.

14. Evidence to support the endosymbiotic theory: have a double membrane, have 70s ribosomes, transcribe DNA, and can only be produced by division of pre-existing mitochondria and chloroplasts.

## Subtopic 1.6 Cell Division

15. Cell cycle-> divided into two parts: interphase and cell division. Interphase: g1-> cell just divided, growth and development of new cells. S: synthesis, chromosomes in nucleus replicate. G2: cell makes proteins and other materials necessary for division. G0: cell will not be dividing. Cell division: prophase-> chromatids supercoil, forms MTOC (forms mitotic spindle->spindle stretched between poles and attached centromere joing the chromatids-> nuclear envelope and nucleolus break down. Metaphase-> chromosmes pulled to center and line up on metaphase plate-> two attachment points allow the chromatids to attach to mictrobules from different poles -> microtubules put under tension -> if attachment is correct, chromomes remain on equator. Anaphase-> centromeres divide and spindle fibers pull chromatids towards opposite poles -> ends when chromosomes are at opposite ends of cells. Telophase-> chromatids reached the poles near MTOC, now called chromosomes-> 2 daughter nuclei form nucleoli appear and spindle dissembles-> chromosome uncoils to form chromatin.
16. Omit.
17. Mitotic index: number of cells in mitosis/ total number of cells.
18. Cell cycle is controlled by checkpoints ensuring that there are enough proteins in the cell and the cell is large enough to move on to division. Cyclin-dependent kinases activates and attaches phosphate groups to other proteins and unless these cylins reach a threshold concentration, the cell does not progress to the next stage of the cell cycle.

## Subtopic 2.1 Molecules to Metabolism

19. Omit
20. Anabolism is the synthesis of complex molecules into simpler molecules using condensation reaction. Catabolism is the breakdown of complex molecules into simpler molecules using hydrolysis reaction. Metabolism is the web of all enzyme catalyzed reactions in a cell or organism. Anabolism+Catabolism=Metabolism.
21.