7.013 Recitation 1 – Spring 2018

*(**Note:** The recitation summary should NOT be regarded as the substitute for lectures)*

Summary of Lecture 1 (2/7):

Why does biology matter? Biology in 21st century interfaces with many fields i.e. biochemistry, biochemical engineering, chemistry, computer science, medicine, agriculture, social science and ethics and many more. Understanding biology can help us modernize the agriculture and resolve the growing food demands, combat diseases, design rationale medicine, understand ecosystem and appreciate biodiversity and evolution. The fundamentals of life at the molecular level and the various examples of biological systems and diseases covered throughout 7.013 will help you appreciate why biology truly matters.

Cell and its organelles: The cell is the smallest biochemical factory that displays the properties of life. All living cells have a plasma membrane, an internal region called cytoplasm and a region where DNA is concentrated. The plasma membrane is selectively permeable and is composed of a lipid bilayer (predominantly phospholipids) with proteins embedded in it.

Prokaryotes & Eukaryotes: The organisms today are classified into three major domains: bacteria, archaea and eukarya. Of these, the bacteria and archaea are unicellular and prokaryotic (without nucleus) whereas eukarya are nucleated and are mostly multi- cellular. Please navigate through the following helpful links:

http://learn.genetics.utah.edu/content/begin/cells/scale/

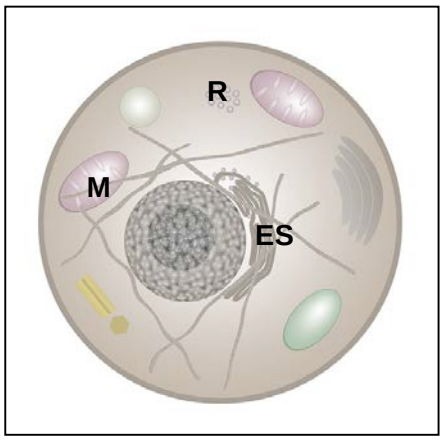
http://www.xvivo.net/animation/the-inner-life-of-the-cell/

Eukaryotic cell and its organelles: Eukaryotic cells have a nucleus and other organelles. Organelles are mostly membrane bound (with some exceptions such as ribosomes); they create physically distinct regions within the cell and have specific functions. The nucleus is a membrane-bound compartment that separates the DNA, the hereditary material from the cytoplasm. Pores across the nuclear membrane help control the passage of many substances between the nucleus and the cytoplasm. The endoplasmic reticulum (ER) is a membrane bound region where polypeptide chains are processed (Rough ER, studded with ribosomes) and lipids are assembled (Smooth ER, is not studded with ribosomes). The Golgi apparatus is where many of the proteins and lipids are further modified. Mitochondria break down glucose to make energy in the form of ATP. Unlike any other organelle the mitochondria (and chlororplasts in plant cells) have their own DNA (like the prokaryotes), ribosomes (similar to prokaryotic ribosomes) and proteins. The theory of **Endosymbiosis** explains the origin of chloroplasts and mitochondria and their double membranes. This concept postulates that chloroplasts and mitochondria are the result of years of evolution initiated by the endocytosis of bacteria and algae. According to this theory, algae and bacteria were not digested; they became symbiotic instead.The cells also have lysosomes and peroxisomes, which arise from Golgi body and which contain enzymes that are involved in digesting cell's own toxic material i.e. they are involved in phagocytosis and autophagy. The ER, Golgi and lysosomes together make the endomembrane system of the eukaryotic cell. The cells also have nucleolus where ribosomes are synthesized. Ribosomes are small organelles that are not surrounded by membrane, are involved in the synthesis of proteins and are comprised of RNA and proteins.

Eukaryotic cells also have a dynamic cytoskeleton of microtubules, microfilaments and intermediate filaments. The cytoskeleton imparts shape to the cell, supports and moves cell organelles, motile structures and often the cell as a whole. The cells are glued to and communicate with each other through the extracellular matrix (ECM), which is comprised of different proteins such as laminin.

Questions:

1. The following is the schematic of a cell.



a) Does the schematic represent a prokaryotic or a eukaryotic cell? ***Note:*** *Does the cell have a nucleus and membrane bound organelles?*

b) Put an **"X"** on the plasma membrane.

c) Put an "**N**" on the organelle that has the genome.

d) The Mitochondrion (shown as **M**) produces _____, which is the energy currency of the cell.

e) The endomembrane system (shown as **ES**) is comprised of _____, _____ and _____.

f) Circle the correct option(s). Ribosomes (shown as R) are involved in ***DNA/ protein*** synthesis. They are found in ***cytoplasm/ nucleus/ nucleolus/ ER/ Golgi/ Mitochondria***.

g) Autophagy is the process of _____ and it occurs in _____organelle**.**

2. Answer the questions using the following keywords: *Extracellular matrix (ECM), nucleus, mitochondria, organelles, cytoskeleton, cytosol, plasma membrane, endoplasmic reticulum (ER), lysosomes, prokaryotic*, *eukaryotic, nucleolus, ribosomes, Nuclear membrane, RNA, DNA, proteins*

a) A component of the cell that is involved in the synthesis of ribosomes.

b) Composition of ribosomes

c) A dynamic fibrous network that maintain cell shape and motility and participates in intracellular transport and cell division.

d) Filamentous structure that is present in between TWO cells and provides them with anchorage and is involved in intercellular communication.

e) Organisms that do not contain a nucleus.

f) Locations of the enzymes that digest the toxic substances produced within a cell.

g) Location of a protein that transports water in and out of cells.

h) Part of eukaryotic cell where DNA is synthesized and stored.

3. You label a eukaryotic cell with a nonradioactive chemical that specifically binds to its DNA. You remove the nucleus of this cell. Would you expect to see any label in the cell **AFTER** its nucleus has been removed? Why or why not?

7.013 Introductory Biology

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