Fall Semester WORKSHOP on Cell Structure and Function - **ANSWERS**

A. Prokaryotes vs. Eukaryotes:

Bacteria (bacterium) - any of a group of microscopic organisms that are prokaryotic, i.e., that lack a membrane-bound nucleus and organelles. Bacteria are unicellular (one-celled) and may have spherical (coccus), rod-like (bacillus), or curved (vibrio, spirillum, or spirochete) bodies. Different bacteria inhabit virtually all environments, including soil, water, organic matter, and the bodies of eukaryotes (multicellular animals). Some bacteria are known to be beneficial to humans and the higher animals, while many others are harmful; bacteria are the chief cause of infectious diseases in humans.

Prokaryote - also spelled PROCARYOTE, any self-contained cell or organism that lacks internal unit membranes. Bacteria are among the best-known procaryotic organisms. Procaryotes lack a nuclear membrane and most of the components of eucaryotic cells. The cell membrane consists of a phospholipid unit membrane and constitutes the cell's primary osmotic barrier. The cytoplasm includes ribosomes that carry out translation and protein synthesis. The nuclear region usually consists of circular, double-stranded deoxyribonucleic acid (DNA). Many procaryotes also contain accessory, self-replicating genetic structures, called plasmids, with additional dispensable cell functions, such as encoding proteins to inactivate antibiotics. The flagella are distinct from those of eucaryotes in design and movement. The organelles that are present, such as storage vesicles, are surrounded by a non-unit membrane consisting principally of proteins.

The ***Archaebacteria*** - are aquatic or terrestrial microorganisms that exhibit a diversity of shapes, including spherical, rod-shaped, and spiral forms. Archaebacteria lack murein (ester lipids) in the cell walls, which is characteristic of eubacteria; instead, they have ether lipids, as well as a number of different cell-wall constituents. Archaebacteria also differ from eubacteria in the structure of their ribosomal RNA's, which are used in genetic testing to assess the degree of genetic relatedness among different species. The archaebacteria reproduce using a wide variety of mechanisms, including binary and multiple fission, budding, and fragmentation. Archaebacteria survive in a number of extreme environments, including very hot or saline ones. Archaebacteria may be aerobic, anaerobic, or facultatively anaerobic in their metabolic requirements. Some archaebacteria, such as Halobacterium, require a highly saline environment. Others, such as Methanobacterium, produce methane (CH_4) as an end product, while still others are dependent on sulfur for their metabolism. The latter group are among the most thermophilic of the archaebacteria, surviving in temperatures higher than 45 to 50 C (113 to 122 F).

Eubacteria, any of a group of true bacteria species and one of two major groups of prokaryotic organisms. The other major group, the archaebacteria, are as different from eubacteria as either is from the eukaryotes. The division of the bacteria into two groups has been suggested by ribosomal RNA studies of the genetic information of the organisms. Eubacteria and archaebacteria are thought to have evolved separately from a common ancestor early in Earth's history. Eubacteria and archaebacteria differ in important characteristics, such as the number of ribosomal proteins and the size and shape of the ribosomal S unit.

Eucaryote - any cell or organism that possesses a clearly defined nucleus, a description that excludes bacteria and blue-green algae. The eucaryotic cell has a nuclear membrane, well-defined chromosomes (bodies containing the hereditary material), mitochondria (cellular energy exchangers), a Golgi apparatus (secretory device), an endoplasmic reticulum (a canal-like communication system within the cell), & lysosomes (digestive apparatus within many cell types).

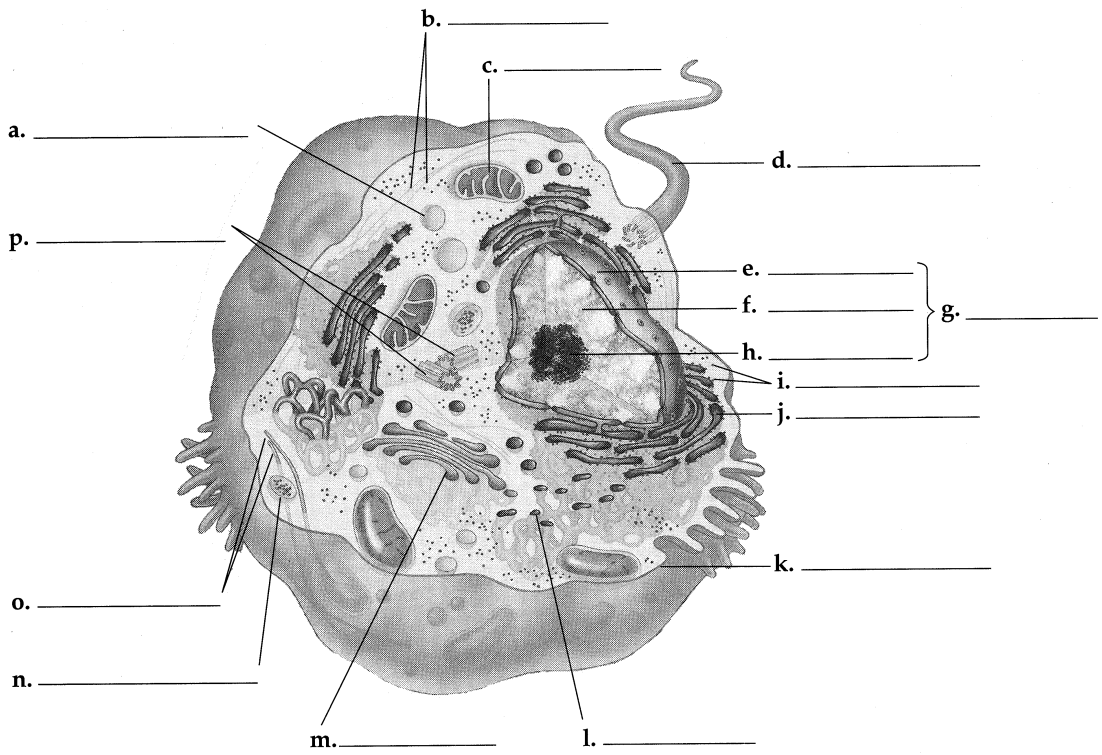
Virus - an infectious agent of small size and simple composition that can reproduce only in living cells of animals, plants, or bacteria. A virus consists of a single- or double-stranded nucleic acid and at least one protein surrounded by a protein shell, called a capsid. The nucleic acid carries the virus's genome--its collection of genes--and may consist of either DNA or RNA. The protein capsid provides protection for the nucleic acid and may contain enzymes that enable the virus to enter its appropriate host cell. Some viruses are rod-shaped, others are icosahedral (a roughly spherical shape that is actually a 20-sided polygon), and still others have complex shapes consisting of a multisided "head" and a cylindrical "tail."

B. Fill-in the table below: Prokaryotes vs. Eukaryotes Organelles Systems:

Organelle-Part	**Prokaryote**	**Eukaryote**
Genome is found in	has nucleoid (no membrane)	"*True*" nucleus (double membrane)
Chromosome structure	a single circular ***DNA molecule*** 4 x 10^6 np about 1.36 mm	Paired ***Chromosomes*** (circular DNA in mito/chlp) 2.9 x 10^9 np about 1 meter
Chromosome composition	DNA alone (little repetitive DNA)	DNA + histones (repepitive DNA)
Chromosome Division	DNA replication followed by **cell fission**	***Mitosis*** & ***Meiosis***
Glycolytic Enzymes	in cytoplasmic matrix	in cytoplasmic matrix
Oxidative Enzymes	on cell membranes	on cristae membranes in mitochondria
Hydrolytic Enzymes	on cell membranes	in lysosomes (compartmentalized)
Protein Synthesis	on ribosomes in cell matrix	on polysomes & rough E.R.
Ribosomes	Small (70s)	Large (80s)
Vacuoles	absent	animal - small/absent plant - 1 large single
Plastids	absent	present in plants many types
Cell Wall	Glycocalyx present (non-cellulosic)	cellulose based (only in plants)
Centrioles	In some lower plants	In animals cells + cilia & flagella

Cell Structure & Function:

3. In turn have each member of your learning community identify by name all the structures in the diagram below and their fill in respective functions on the table at the bottom of this page.



Organelle Table :

ORGANELLE	BASIC FUNCTION
a. microbody/peroxisome	respiration, oxygen consumption, processing of hydrogen peroxide
b. microfilament	cytoskeleton
c. mitochondria	cellular respiration; Krebs Cycle, Electron Transfer, ATP synthesis
d. flagella	movement
e. nuclear envelop	encloses nucleus and regulates transport
f. chromatin	condensed DNA ; heterochromatin (inactive) and euchromatin (active)
g. nucleus	site of genetic apparatus; controls cell processes
h. nucleolus	site of rRNA synthesis and ribosome synthesis
I. ribosome	site of cellular protein synthesis ; 2 subunits (large & small)
j. rough E.R.	site of protein synthesis and processing of protein for export; part of endomembranes
k. plasma membrane	transport, recognition, and support of cell
l. smooth E.R.	lipid synthesis, carbohydrate metabolism, and drug detoxification
m. Golgi apparatus	receiving and processing of transport vesicles from E.R.
n. lysosome	intracellular digestion: autophagy and phagocytosis
o. microtubule	cytoskeleton
p. centriole	animal; cell division

4. Structure and Function - A test of your knowledge:

The table below lists the general function performed by an animal and plant cells. Have one member, in turn, of your Learning Community list the cellular structure or organelle associated with each of these functions.

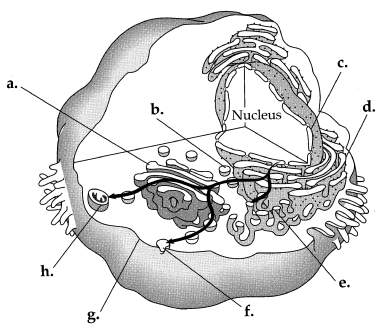
CELL FUNCTION	Associated Organelles and Structures
Cell division	*nucleus, chromosomes, centrioles, microtubules (spindle fibers) microfilaments (cell furrow pinching it apart)*
Information storage & transfer	*nucleus, chromosome, DNA--> mRNA --> ribosomes --> enzymes & proteins*
Energy conversion	*mitochondria*
Manufactures membranes & products	*ribosomes, rough E.R., smooth E.R., Golgi apparatus and its vesicles*
Lipid synthesis & drug detoxification	*smooth E.R.*
Digestion & recycling	*lysosomes and food vacuoles*
Conversion of H_2O_2 to water	*peroxisomes*
Structural integrity	*cytoskeleton: microtubules, microfilaments, intermediate filaments,*
Movement	*cilia and flagella, microtubules, microfilaments (actin in muscles) and pseudopodia*
Exchanges with the environment	*plasma membrane and vesicles*
Cell to cell connections	*tight junctions, desmosomes, gap junctions, plasmodesma*
Plant cell inter-cell communication	*plasmodesma*
photosynthesis	*chloroplast*
membrane cavity of metabolic waste	*vacuole*

5. Cytoskeleton Organization:

To help organize your knowledge of the cytoskeletal system select 3 members of your community & fill in the table below. All the other may contribute additional details if necessary.

Cytoskeleton	Monomers and Structure	Functions
Microtubules	*hollow tube, helix of a and b tubulin dimers, forming a hollow tube 25-nm diameter*	*cell shape and support, tracks for moving organelles around, chromosome movements, beating of cilia and flagella.*
Microfilaments (actin filaments)	*two twisted chains of actin monomers about 7 nm in diameter*	*muscle contraction, maintain cell shape, pseudopod movement, cytoplasmic streaming*
Intermediate filaments	*supercoiled fibrous protein in the keratin family about 1-12 nm in diameter*	*reinforce cell shape, anchor nucleus in place*

6. ENDOMEMBRANE SYSTEM



Have a member of your Learning Community, in turn, name the endomembrane system component in the diagram below and review the function of each of these components.

a. Golgi: processes products of E.R.; makes polysaccharides, packages products in vesicles targeted to specific locations

b. Transport vesicle - carries products of E.R. to various intracellular locations

c. Nuclear envelop - double membrane that encloses nucleus; pores regulate passage of materials

d. rough E.R. - attached ribosomes produce proteins that enter cisternae, and makes secretory protein and membranes

e. smooth E.R. - houses enzymes that synthesize lipids, metabolize carbohydrates, detoxify drugs and alcohol; stores/releases Ca for muscle cells

f. transport vesicle - fuses with plasma membrane secreting contents and adding to membrane

g. plasma membrane - selective barrier that regulates passage of material into & out of cell

h. lysosome - houses hydrolytic enzymes to digest macromolecules.

7. FILL in the BLANKS - with the appropriate cellular organelle or structure & explains.

1. transport membranes and products to various cellular locations — transport vesicles
2. infoldings of mitochondrial membrane with attached enzymes — cristae
3. consists of collagen, proteoglycans, and fibronectins — extracellular matrix
4. small sacs with specific enzymes for particular metabolic pathways — peroxisomes
5. stacks of flattened sacs inside chloroplasts — grana
6. anchoring structure for cilia or flagella — basal body
7. semi-fluid medium between nucleus and plasma membrane — cytosol - cytoplasm
8. system of fibers that maintain cell shape and anchors organelles — cytoskeleton
9. connections between animal cells that creates an impermeable layer — tight junctions
10. membrane surrounding central vacuole of plant cells — vacuolar membrane (tonoplast)