

Name: _____

TRASK

Zool 3200: Cell Biology

Exam 1

1/30/15

Answer each of the following short answer questions in the space provided; circle the BEST answer or answers for each multiple choice question. (70 points total)

Regarding the experimental results of Stanley Miller, what supports the conclusion that the chemicals that comprised earth's environment 3-4 billion years ago gave rise to life on this planet? What are the scientific arguments against it? (2 points)

In order for cells to “rise from the primordial soup”, it was necessary that organic/biologic molecules be contained. Which of the proposed methods of containment mentioned in class make the most sense to you and why (in other words, compare the advantages/disadvantages or likelihoods of each)? (2 points)

Explain how Fick's law of diffusion influences the regulation of cell size. (2 points)

Proteins that are destroyed by lysosomal enzymes are synthesized by: (1 point)

- a. Ribosomes in the cytoplasm
- b. Ribosomes at the endoplasmic reticulum
- c. Both a and b
- d. Neither a nor b

The matrix of a mitochondrion best corresponds to: (1 point)

- a. Nucleoplasm
- b. Eukaryotic cytoplasm
- c. Prokaryotic cytoplasm
- d. Extracellular fluid

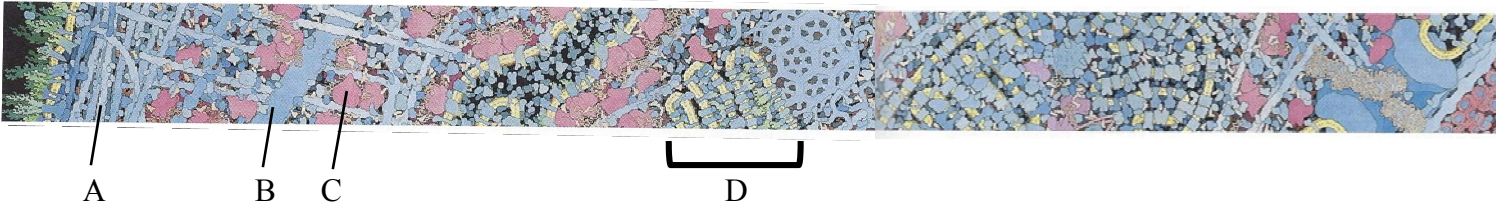
Explain your answer to the question above. (1 point)

Which membrane-bound structure(s) would you expect to be more abundant in cells that secrete testosterone relative to cells that function to secrete a protein hormone like insulin? Explain your answer. (2 points)

Which of the three types of cytoskeletal elements would likely be most abundant in an epithelial cell that makes up the lining of your gastrointestinal tract? (1 point)

Which cytoplasmic structures are involved in the destruction/degradation of molecules, and what specifically are the molecular targets that each destroys/degrades? (6 points)

Did you ever see that ‘Honey, I Shrunk the Kids’ movie? What about ‘Inner Space’? Imagine that you found yourself in front of the ‘shrinking’ machine that is in each of these movies. You’ve been minimized to the size of a molecule! Not only that, but you’ve somehow gotten in the predicament of having been injected into the cytoplasm of a eukaryotic cell! YIKES! Describe the environment you experience in the cytoplasm and, assuming that you’ll be stuck inside the cell until you can figure out how the hell to get out, where in the cell will you establish residence? Why? (3 points)



In the image of cytoplasm above, proteins are colored blue, nucleic acids are pink, lipids are yellow and polysaccharides are green. Using the image, answer the following questions:

Which side of the image represents the cell's exterior surface (left / right)? (1 point)

Which organelle is depicted in the bracketed region labeled 'D'? (1 point)

Which monomeric protein makes up the cytoskeletal element identified by 'A'? (1 point)

Which cytoskeletal element is item 'B', and what is its primary function in the cytoplasm? (2 points)

What cytosolic components are represented in the item labeled 'C' and where are they initially produced? (2 points)

Cell Biology is in the WSU catalog as ZOOL 3200, yet *chemistry* is a prerequisite for this class. Explain why an understanding of chemical principles is necessary when trying to understand cells and cellular processes. (2 points)

The individual monomers that make up biological macromolecules are linked together using a common chemical reaction. What is this chemical reaction, and why might it, as a reaction mechanism, have been a favorable one for which evolution selected? (3 points)

‘Model organisms’ are often used in experiments to understand how human cells and humans, in general, function. If you were interested in studying the processes below, what ‘model organisms’ might you use to study each process and why? (4 points)

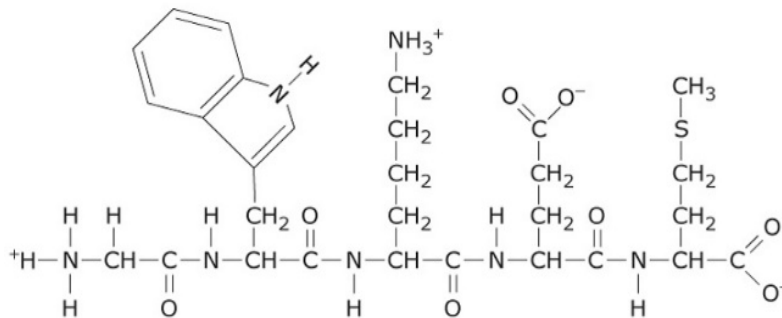
Repair of sunlight-induced DNA mutations:

The development of a spongiform disease like “mad cow” or Creutzfeldt-Jakob disease:

Complete the table below. (4 points)

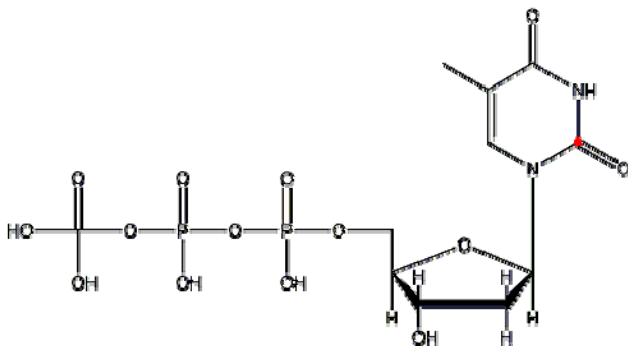
Chemical Formula	Class of biological molecule in which monomeric polymerization results	2 Functions of polymeric molecules
$C_8H_{16}O_8$		1. _____ 2. _____
NH_2CH_2COOH		1. _____ 2. _____
$C_9H_{16}N_{30}O_{14}P_3$		1. _____ 2. _____
$C_{17}H_{31}O_2$		1. _____ 2. _____

A short polypeptide is shown below. Identify and clearly label the amino and carboxyl ends, as well as each of the peptide bonds. Circle each “R” group. (3 points)



Define what is meant by a protein's tertiary structure. Which type(s) of chemical bonds are most responsible for maintaining these structures? Provide an example of a condition that might disrupt a protein's tertiary structure. (3 points)

RNA has been proposed to have been the first nucleic acid to develop on earth due to its variation in structure and its ability to catalyze chemical reactions. DNA, on the other hand, is much less variable in its shape and cannot perform cellular work, yet it is currently used—almost universally—to store and carry genetic information. Though we now know this to be true, it was a point of contention as recently as 65 years ago. What were the arguments against DNA serving a hereditary function, and what was the original data that first supported its currently-understood function? (3 points)

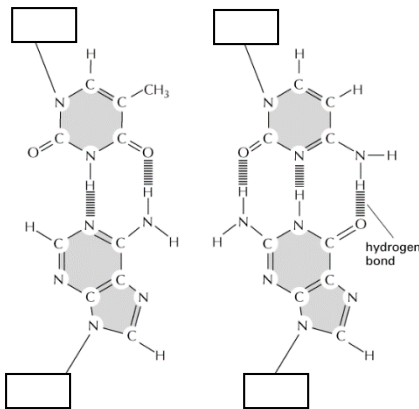


To incorporate radioactively-labeled nucleotides into newly synthesized DNA, researchers use α -phosphorus³²-labeled nucleotides in a DNA synthesis reaction where the α denotes the position of the radioactive phosphate—the α phosphate is closest to the 5' carbon of deoxyribose, followed by the β and then the γ phosphate as shown in the picture to the left. Explain why the α position and not the β or γ position is the best to use in these experiments. (2 points)

If the total weight of macromolecules in a cell is 27 picograms, how many picograms of protein would be predicted to comprise an average bacterial cell? (2 points)

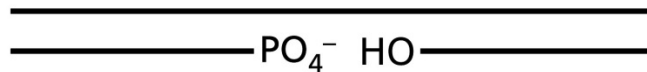
Which of the nitrogenous bases in RNA are pyrimidines? (2 points)

Which of the diagrams to the right best represents the form that DNA has? (1 point)



Label the bases (i.e., A, T, G, C) in the diagram to the left. (2)

The DNA fragment in the figure below is double-stranded at each end, but has a single-stranded region in the middle in one of the strands. Label the 5' and 3' ends of each strand. (2 points)



For a given stretch of DNA with the sequence 5'-CTGAGGCATCGTATCTGATGT-3', what is the complementary sequence, written in the 5' → 3' direction, left to right? (writing DNA sequences in this 5' → 3' 'direction' is conventional; 1 point)

Name two chromosomal regions that are associated with heterochromatin in all cells. (2 points)

If the DNA from the nucleus of a human cell were stripped of its proteins, the chromosomes were straightened and then aligned tightly side-by-side, how wide would the genome be? (2 points)

DNA is associated with proteins so that it can be packed into the nucleus in an organized manner. The DNA that will be 'used' more frequently is less-tightly packaged and associates with fewer proteins. This DNA is in the form of _____ . (1 point)

Isoleucine (Ile) is an essential amino acid, yet too much of it can lead to kidney failure if it is not properly destroyed. Normal degradation of Ile depends upon an enzyme coded by a gene that is located on human chromosome 11. Mutations within this gene result in the production of a non-functional enzyme; this leads to improper destruction of Ile, which leads to the production of a harmful byproduct that ultimately affects kidney function. Through an errant recombination event during meiosis, a mutant sperm cell in which this gene has been translocated (i.e., moved) to the X chromosome is generated. Although the gene is moved to a different chromosome, it remains intact and un-mutated. Will simply moving the gene for Ile destruction to the X chromosome have any effect on its ability to degrade ingested Ile? If so, what effects would you expect in an offspring that was produced with this mutant sperm? Explain. (3 points)