

1305

Midterm 1B
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Biology 2120
Spring 2005
Midterm Exam #1

Name: _____

EPSILON ZETA CHAPTER ALPHA PHI OMEGA

This exam contains 11 pages, including the multiple choice bubble sheet. Please verify that you have all pages.

Part I. Multiple Choice.

1. Which of the following is the correct order of the levels of DNA packaging in eukaryotic chromosomes?

- A) chromatin fiber > nucleosome > looped domains > heterochromatin
- B) nucleosome > looped domains > chromatin fiber > heterochromatin
- C) chromatin fiber > heterochromatin > nucleosome > looped domains
- D) nucleosome > chromatin fiber > looped domains > heterochromatin
- ☒ E) heterochromatin > nucleosome > chromatin fiber > looped domains

2. What point was I illustrating by scratching my skin in class?

- A) Proteins exhibit primary, secondary, and tertiary structure
- B) Disulfide bonds are stronger than non-ionic bonds
- C) Intermediate filaments are the strongest of the three classes of cytoskeletal proteins
- D) Desmosomes and hemidesmosomes can be found in the same cell type
- E) Actin is responsible for maintaining the shape of skin cells

3. Hydrogen bonding is *most* important in stabilizing the _____ structure of many proteins.

- A) primary
- ☒ B) secondary
- C) tertiary
- D) quaternary
- E) all of the above

4. Which of the following is NOT a characteristic of DNA?

- A) arranged as two antiparallel nucleic acids
- B) composed of nucleotides
- ☒ C) contains ribose
- D) complementary strands held together by hydrogen bonds
- E) contains sugar-phosphate ester bonds

5. What is the relationship between glycogen and starch?

- A) Both are polymers of cellulose, but only glycogen is found in animals.
- B) Both are polymers of sugars, but only starch contains $\beta 1 \rightarrow 4$ glycosidic bonds.
- C) Both can be digested by mammals to yield simple monosachharides, but glycogen contains glucose while starch contains fructose.
- ☒ D) Both are polysaccharides, but glycogen is found in animals while starch is found in plants.
- E) Glycogen is found in animals and contains $\alpha 1 \rightarrow 4$ glycosidic bonds, starch contains $\beta 1 \rightarrow 4$ glycosidic bonds and is found in plants.

6. The primary structure of a protein

- A) is the order of amino acids from one end of the protein to another.
- B) is encoded by the nucleotide sequence of a gene.
- C) is the linear sequence of amino acids that are linked together by peptide bonds.
- D) determines the secondary and tertiary structure of the protein.
- ☒ E) all of the above

2021

7. The MTOC is composed of numerous rings of _____ surrounding _____.

- A) alpha tubulin; GTP
- B) MAPs; gamma tubulin
- C) beta tubulin; alpha tubulin
- ☒ D) gamma tubulin; centrioles
- E) GTP; tubulin dimers

11-12 8. An elderly patient presents with blistering of the skin. You suspect an autoimmune disorder. If your suspicions are correct, you should find in the serum of the patient antibodies reactive to

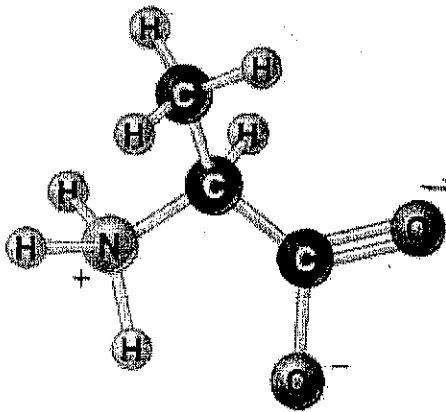
- A) BPAG
- ☒ B) actin
- C) vinculin
- D) talin
- E) alpha-actinin

9. Which of the following is NOT a function of the cytoskeleton?

- ☒ A) passive transport of ions
- ☒ B) moving of organelles
- ☒ C) cell division
- ☒ D) cell movement
- ☒ E) positioning/organization of enzymes

10. A prokaryotic organism is isolated from a hydrothermal vent, where it has been observed to be thriving. Based on your knowledge of the plasma membrane, you would expect to find a predominance of

- A) largely unsaturated fatty acids.
- B) cell wall to define the cell, as the cell membrane would not be present.
- ☒ C) largely saturated fatty acids.
- D) equal amounts of saturated and unsaturated fatty acids, as long as the chain was close to 12 carbons in length.
- ☒ E) none of the above



11. Which one the following statements about the structure shown at left is FALSE?

- ☒ A) It is a non-polar amino acid
- B) When contained in a polymer, it could be found in a transmembrane protein
- ☒ C) When contained in a polymer, it cannot be found in a sheet
- D) When contained in a polymer, it can be found in an helix
- ☒ E) It cannot form a disulfide bond

12. Which of the following is *least* likely to be found in a cell membrane?

- A) enzymes
- B) phospholipids
- ☒ C) nucleic acids
- D) glycoproteins
- E) transport proteins

13. Calcium ions do not pass into a neuron unless that neuron has been electrically stimulated by an adjacent cell. What function of membranes does this example illustrate?
- ☒ A) Selective transport
 - ☐ B) Cell-to-cell communication
 - ☐ C) Organization and compartmentalization of function
 - ☐ D) Signal transduction
 - ☐ E) Boundary and permeability barrier
14. Tubulin may assemble and disassemble *simultaneously* in a process known as
- ☐ A) dynamic instability.
 - ☐ B) actin-regulated assembly
 - ☐ C) MAP motoring
 - ☒ D) treadmilling
 - ☐ E) microtubule organizing
15. According to the current model, which of the following is the correct sequence of microtubule assembly?
- ☒ A) dimers, oligomers, sheets of protofilaments, protofilaments, closing of microtubule, elongating microtubule
 - ☐ B) dimers, sheets of protofilaments, closing of microtubule, oligomers, protofilaments, elongating microtubule
 - ☐ C) protofilaments, sheets of protofilaments, closing of microtubule, elongating microtubule, dimers, oligomers
 - ☐ D) dimers, oligomers, protofilaments, elongating microtubule, sheets of protofilaments, closing of microtubule
 - ☐ E) dimers, oligomers, protofilaments, sheets of protofilaments, closing of microtubule, elongating microtubule
16. What is most prominent function of fibronectins?
- ☐ A) To assist in cell-cell adhesion
 - ☐ B) To organize actin filaments
 - ☐ C) To bind BPAGs
 - ☒ D) To form a structural link between collagens and cells
 - ☐ E) To have multiple domains
17. Which one of the following statements about nucleosomes is false?
- ☒ A) They are found only in supercoiled DNA
 - ☐ B) They are comprised of both DNA and proteins
 - ☐ C) They are found in heterochromatin.
 - ☐ D) They are found in euchromatin.
 - ☐ E) They contain histones
18. Disulfide bonds are often found to stabilize which of the following levels of protein structure?
- ☐ A) primary structure
 - ☐ B) secondary structure
 - ☒ C) tertiary structure
 - ☐ D) alpha helices
 - ☐ E) beta sheets

19. Monosaccharides are joined together to form polysaccharides by:

- A) Phosphorylation of ribose to form ribose-5 phosphate, followed by cleavage of the phosphate
- ☒ B) A dehydration reaction joining the carboxyl groups of two sugars
- ☒ C) Oxidation of -SH groups to form covalent bonds
- D) A dehydration reaction joining an amino group and a carboxylic acid group on two sugars
- E) Formation of a phosphoester bond at the 5' carbons

*20. Phospholipids can form bilayer membranes because they are:

- A) Hydrophobic
- B) Lipids
- C) Hydrophilic
- D) Amphipathic
- E) Capable of forming hydrogen bonds with water

21. Which statement about collagens is **false**?

- ☒ A) They impart elasticity to tissues
- B) They are composed of triple helical fibrils
- C) They are not held together by disulfide bonds
- D) They exist in at least two forms: *fibrillar* and *non-fibrillar* collagens
- ☒ E) They are the most abundant proteins in the human body

22. Which one of the following statements is FALSE?

- ☒ A) Phospholipids are amphipathic.
- B) Fatty acids are added to phospholipids by dehydration reactions.
- ☒ C) Saturated fatty acids occupy less space in a membrane than do unsaturated fatty acids.
- D) Phospholipids are important in membrane structure.
- ☒ E) Sphingolipids are the predominant phospholipid in membranes.

23. The following five statements refer to the cytoskeleton:

- ☒ I Actin filament assembly is promoted by a rise in cytosolic ATP levels
- ☒ II Kinesin proteins move towards the plus ends of microtubules
- ☒ III Some intermediate filaments proteins are attached to hemidesmosomes
- IV. The intermediate filament network of one cell is coupled to that in an adjacent cell through covalent bonds between cadherin receptor proteins
- ☒ V Microtubules are used to transport membrane vesicles from one region to another within a single cell

Which of these statements are true?

- A) All of them
- ☒ B) I, II, and III
- ☒ C) III, IV, and V
- ☒ D) I, II, III, and V
- E) II, III, IV, and V

24. What are the chemical components of fatty acids?

- A) Hydrocarbons, carboxylic acid group, and glycerol
- B) Hydrocarbons, hydroxyl groups, and glycerol
- C) Hydrocarbons, glycerol, and phosphate
- ☒ D) Hydrocarbons and carboxylic acid group
- E) Hydrocarbons, glycerol, and phosphate

25. A nucleic acid is:

- ☒ A) A polynucleotide
- ☐ B) Hydrophobic
- ☐ C) Linked to an amino acid via a peptide bond
- ☐ D) A form of energy storage in the cell
- ☐ E) Linked to other nucleic acids by covalent bonds between bases

26. Intermediate filaments are

- ☐ A) composed of globular proteins only
- ☐ B) composed of tubulin
- ☒ C) identical in all cell types
- ☐ D) smaller than actin filaments
- ☐ E) none of the above statements is correct

27. What are desmosomes?

- ☐ A) Cell surface junctions that bind cells to the ECM
- ☐ B) Clusters of intermediate filaments that impart strength to a cell
- ☒ C) Cell surface junctions that link cells together
- ☐ D) Cell surface receptors that link the ECM with actin filaments
- ☐ E) Proteins that link actin to the red blood cell plasma membrane

28. _____ increase(s) membrane fluidity while _____ tend(s) to stabilize the fluidity of the phospholipid bilayer.

- ☐ A) Cholesterol, saturated fatty acid tails
- ☒ B) Unsaturated fatty acid tails, cholesterol
- ☐ C) Saturated fatty acid tails, cholesterol
- ☐ D) Cholesterol, unsaturated fatty acids
- ☐ E) glycolipids, phospholipids

29. Taxol is used as an anti-cancer drug. Why?

- ☐ A) It prevents microtubule depolymerization, and this inhibits division of cancer cells
- ☐ B) It induces microtubule depolymerization, and this disrupts microtubule motor function
- ☒ C) It crosslinks actin microfilaments, and this inhibits division of cancer cells
- ☐ D) It prevents microtubule depolymerization, and this blocks chromosome supercoiling
- ☐ E) It breaks disulfide bonds in tubulin, and that results in instant, catastrophic cell death

30. Which of the following is NOT a feature of the basal lamina?

- ☐ A) serves as a structural support to epithelial cells
- ☐ B) serves as a filter for large molecules
- ☒ C) contains collagen type IV, proteoglycans, laminins and entactin
- ☐ D) fibronectins are most abundant here
- ☐ E) can influence the migration of cells attached to it

31. Heterochromatin is:

- ☐ A) Transcriptionally active regions of prokaryotic chromosomes.
- ☐ B) A strand of chromatin 30 nm in diameter.
- ☒ C) DNA that is enriched in "A-T" base pairs.
- ☐ D) Tightly coiled chromatin found in cells that are in interphase.
- ☐ E) Chromatin lacking nucleosomes.

32. F-actin filaments

- ☐ A) are composed of four linear strands.
- ☐ B) are composed of G-actin dimers.
- ☒ C) are composed of polymerized G-actin monomers wound around each other in a helix.
- ☐ D) polymerize at the same rate in both directions from both ends of the filament.
- ☐ E) are oriented similar to DNA, with strands helical and antiparallel to one another.

33. Which one of the following statements about **all** transmembrane proteins is true?

- ☐ A) They can be easily extracted from cells with high salt buffers
- ☐ B) They are crosslinked to phospholipids by disulfide bonds
- ☒ C) They function as channels, allowing ions to pass across the membrane
- ☐ D) They are freely diffusible in the membrane
- ☐ E) They contain a region of nonpolar amino acids

34. The microtubule-organizing center (MTOC)

- ☐ A) acts as an anchor for both ends of the microtubule.
- ☐ B) serves as a site for microtubule and microfilament assembly.
- ☒ C) is positioned near the cell membrane.
- ☐ D) acts as a motor for driving chromosomes apart during mitosis.
- ☐ E) nucleates microtubule assembly.

35. Which of the following would change the **primary** structure of a protein?

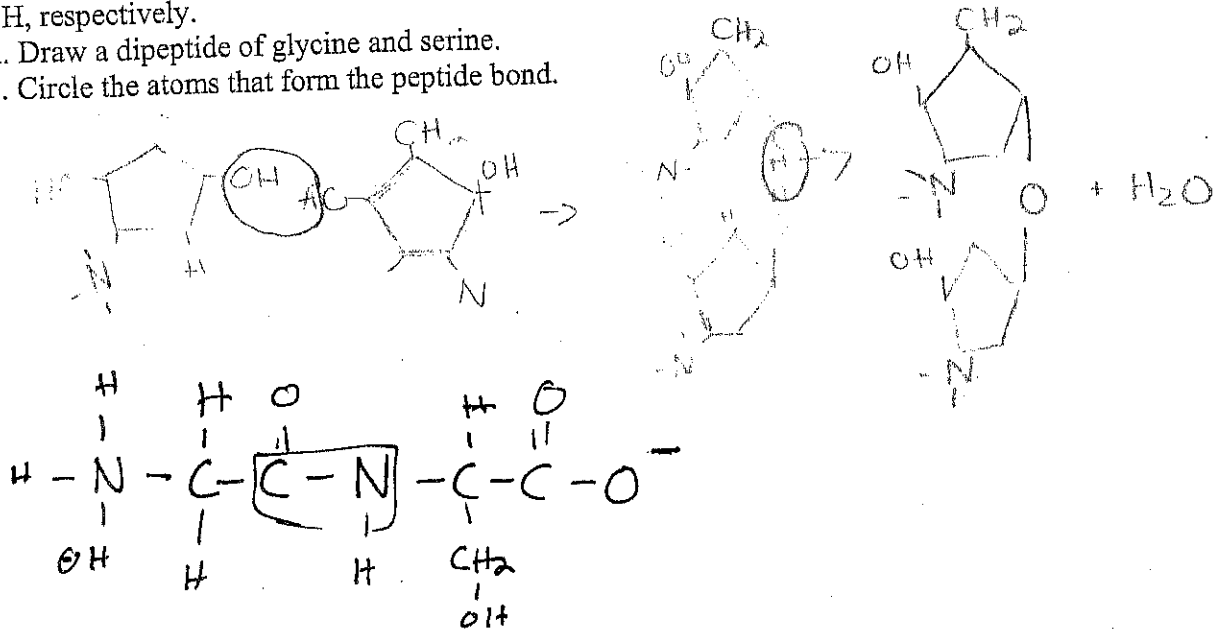
- ☒ A) Substituting one amino acid for another within the protein
- ☐ B) Altering the pH of the solution in which the protein is dissolved
- ☐ C) Adding reducing agents to the solution in which the protein is dissolved
- ☐ D) Binding an antibody to the protein
- ☐ E) Denaturing one of the subunits of the protein

Part II. Drawings.

1. The "R" groups (side chains) of the amino acids glycine and serine are $-H$ and $-CH_2OH$, respectively.

A. Draw a dipeptide of glycine and serine.

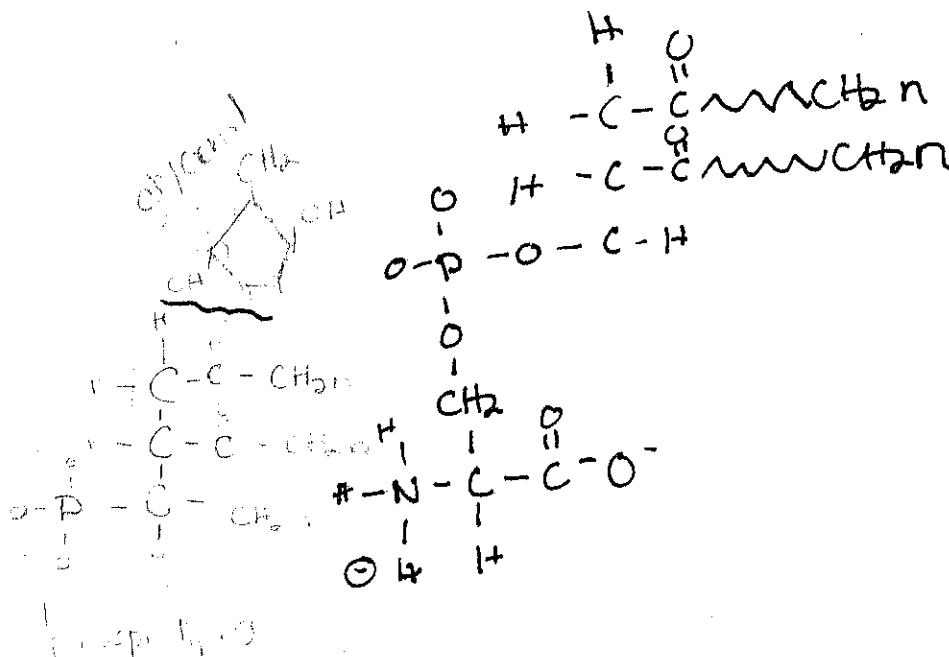
B. Circle the atoms that form the peptide bond.



2. The amino acid serine also serves as a "head group" in some phospholipids. It is joined to the phosphate group of the phospholipid via the O in its side chain.

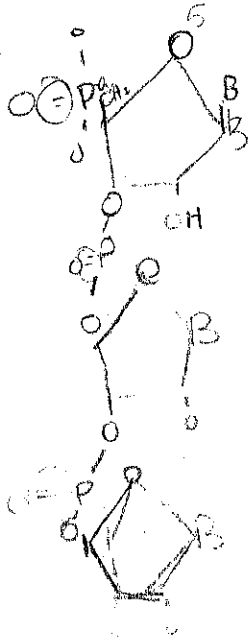
A. Draw the phospholipid *phosphatidylserine*, using $(CH_2)_n$ as an abbreviation for the hydrocarbon tails on the fatty acids.

B. Circle the carbons that belong to the glycerol portion of the phospholipid.

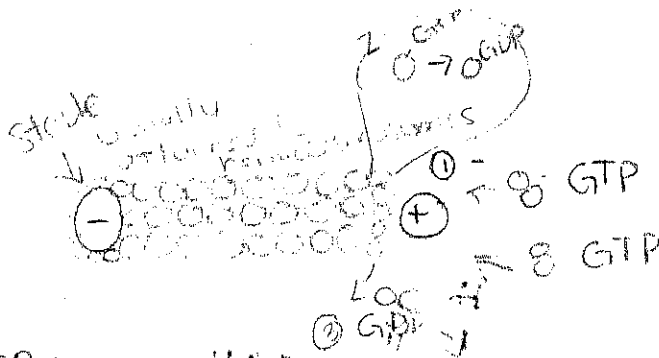


4/5 3. A. Draw three consecutive nucleotides in a single strand of RNA, using "B" as an abbreviation for the base in each nucleotide.

B. Circle the atoms that form the phosphoester bonds (note the PLURAL).



5/5 4. Illustrate the principle of *dynamic instability*. You may use a graph (be sure to label the axes) or a cartoon drawing of the structure(s) involved.



① GTP in → growing/elongating

② GTP → GDP → shrinking

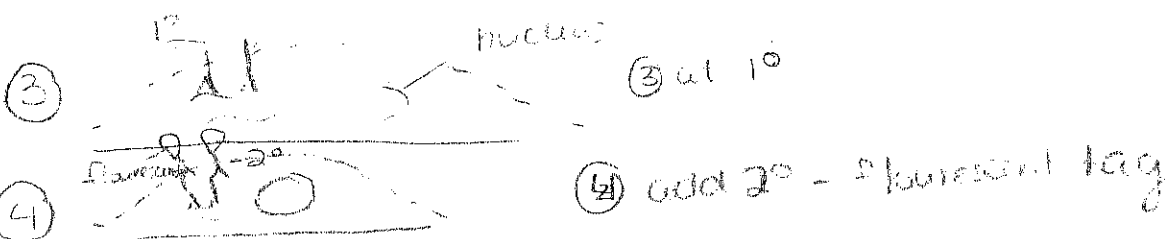
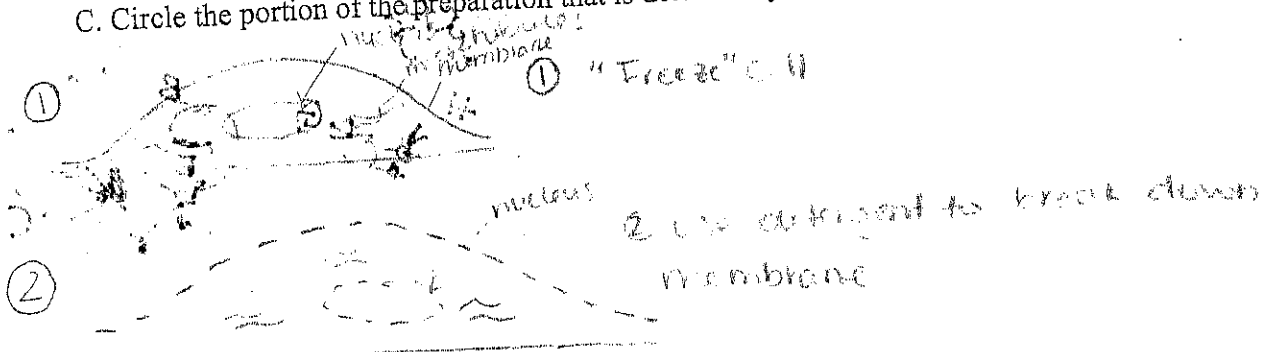
③ no longer growing - shattering

if cycle, on the opposite

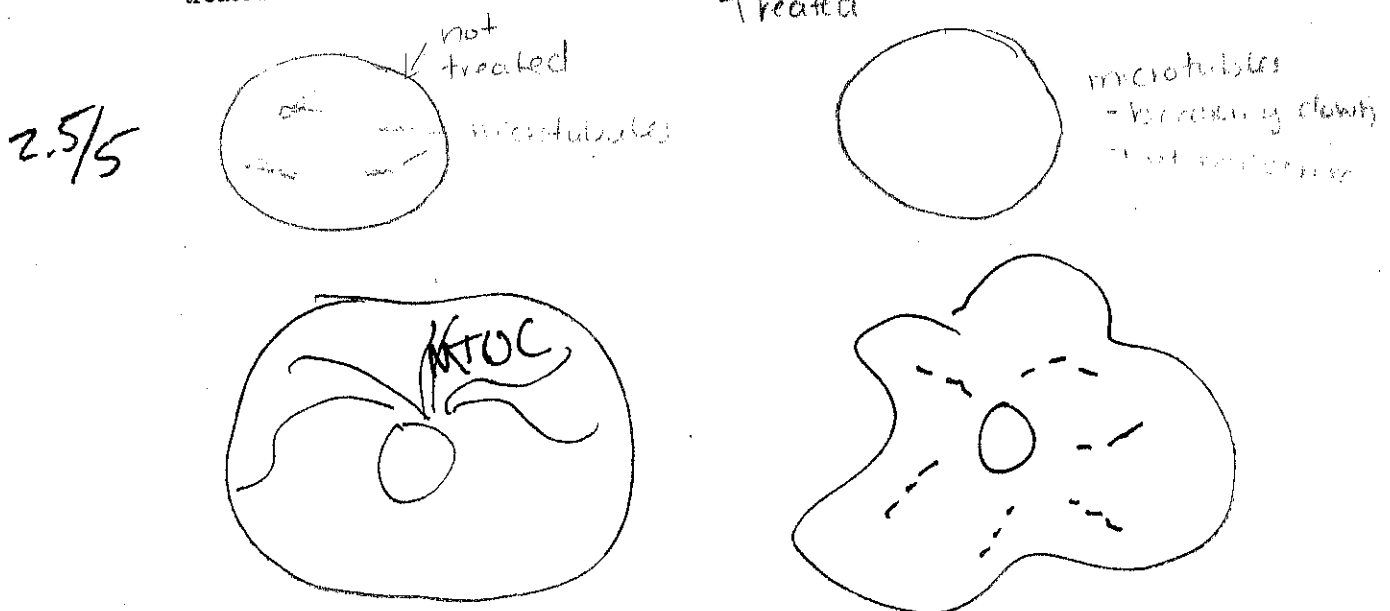
* may not attach

all occur on
per end.

5.
A. Illustrate the steps taken to prepare a cell sample for immunofluorescence microscopy.
B. Label all structures in your diagram.
C. Circle the portion of the preparation that is detected by the microscope.

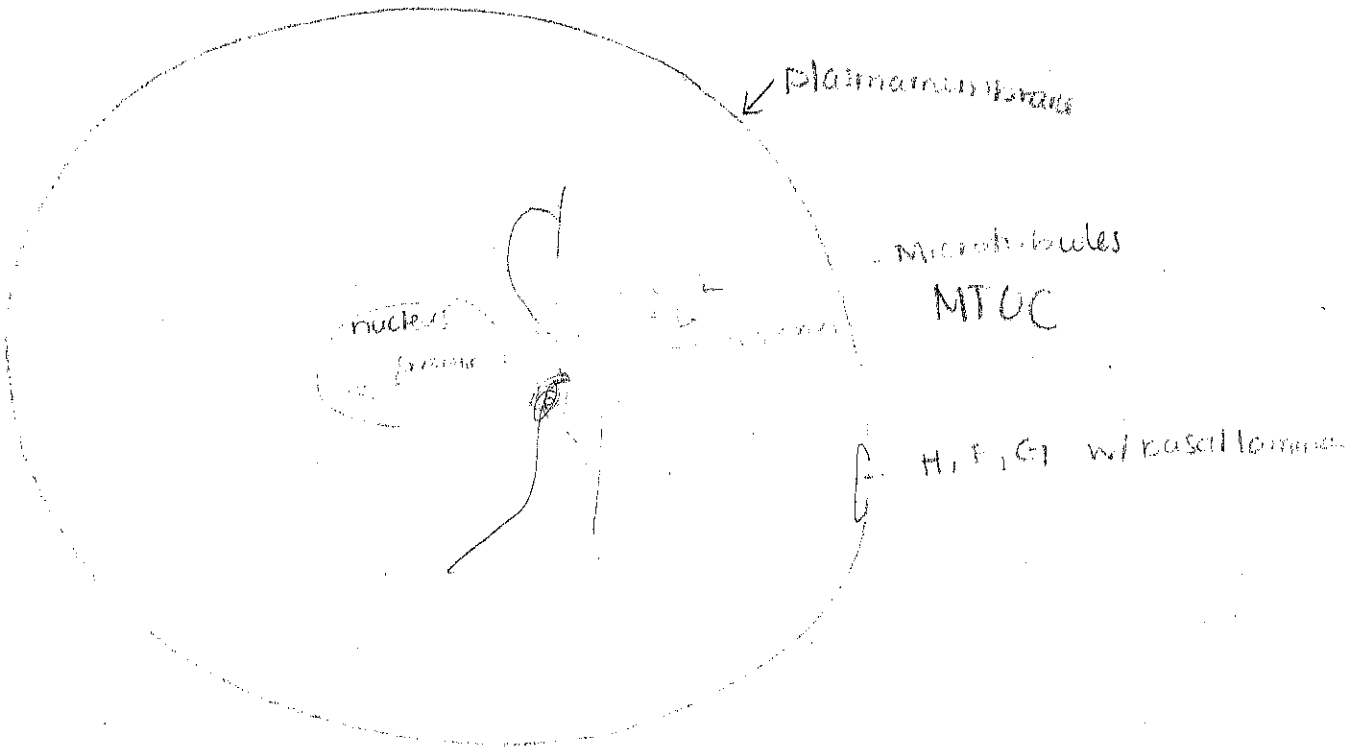
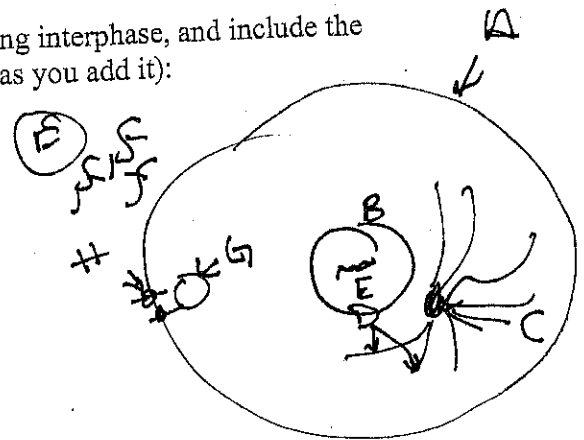


- ⑤ - you can see tagged microtubules only
6. Draw two representative images of cells "stained" for microtubules, using the procedure outlined in question 5 above. On the left, draw the image of a cell after it has been treated with nocodazole (or colchicine), on the right draw a cell that has not been treated. Label the structures you draw.



2/6 7. Draw a cartoon of a "typical" eukaryotic cell during interphase, and include the following structures (be sure to label each structure as you add it):

- ☒ A. Plasma Membrane
- ☒ B. Nucleus
- ☒ C. MTOC
- ☒ D. Microtubules
- ☒ E. Chromatin
- ☒ F. Elastin
- ☒ G. Talin
- ☒ H. Integrin



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