Molecular Cell Biology 5068 In class Exam 3   **Exam Number:**
December 15, 2015

Please print your name: _____

Instructions:

Please write only on these pages, in the spaces allotted. Write your number on <u>each</u> page (not your name), so that we can split them up and grade them anonymously. There are a total of 5 pages including this cover page. You may not use any books or notes, and no electronic aids, including calculators.

Answer only in the space provided; short, concise answers are preferred and will be rewarded.
Please be as neat as possible.

In Class Exam 3

Stewart Lecture (12 points)

1. Name the two cooperating oncogenes that are sufficient to transform murine cells. (2 points)

2. Name two functions of the telomere. (2 points)

3. According to the telomere hypothesis, cells can escape senescene and go into a crisis phase, where shortening of telomeres can lead to cell death and genetic catastrophe. In order to lengthen and maintain stable telomeres, cells can utilize either a mechanism or an enzyme. Name both the enzyme and the mechanism. (4 points)

4. Pre-neoplastic cells are precancerous cells that precede tumorigenesis. Their ability to become tumorigenic cells is partially dependent upon signaling by the microenvironment, including fibroblasts and other stromal cells. The table below shows four experimental conditions where the cells start out as either pre-neoplastic or tumorigenic. Based upon the fibroblasts these cells are exposed to in each situation, write whether each cell will be transformed or remain a pre-neoplastic or tumorigenic cell. (4 points)

Starting cell type	Type of fibroblast	Resulting cell type
Pre-neoplastic	Normal	
Pre-neoplastic	Cancer-associated	
Tumorigenic	Normal	
Pre-neoplastic	Old/Senescent	

Huettner Lecture (9 points)

1. Name the 2 properties that define a stem cell. (2 points)

2. Name the 4 types of potency. Briefly explain each type. (4 points)

3. There are 3 types of cellular reprogramming we discussed in class. Choose one of these and briefly explain how it is done. (3 points)

Weihl Lecture (12 points)

1. List two consequences of impaired protein degradation. (2 points)

2. True or false. If false, please correct: Protein degradation is an unregulated process that occurs at a constant rate in all tissue types. (2 points)

3. Please complete the following: The specificity of ubiquitin is conferred by the E____(#) ubiquitin ligase. It transfers the ubiquitin tag to a _____ (amino acid) residue on the "condemned" protein. (2 points)

4. The 26S Proteasome is made up of a 20S and a 19S component. Please list one function of each of these components and state if the function is dependent on ATP. (2 points)

5. Contrast microautophagy from macroautophagy (2 points)

6. Briefly state the function of the LC3 protein in autophagy and list one method through which it can be used to monitor autophagy. (2 points)

Amarasinghe Lecture (9 Points)

1. Name 3 pieces of information you can obtain from NMR. (3 points)

2. Name one advantage and one disadvantage of using NMR to study biomolecules. (2 points)

3. Match the following measured parameters to the information obtained from each of them. (3 points)

   (1) Chemical shift   (A) Bond vector orientation relative to the magnetic field

   (2) Spin-spin coupling constant   (B) Dihedral angle constraint, local environment
                                         information (i.e. covalent vs noncovalent bonds)

   (3) Dipolar coupling constant   (C) Through bond correlation and connections between
                                         nuclei

4. True/False. It is recommended to use the average NMR structure because it is a distorted structure that is not real. (1 point)

Fremont Lecture (6 Points)

1. What are the <u>first 3</u> steps for determining protein structure using X-ray crystallography? (3 points)

2. Name one method of crystallizing a protein other than "Random thinking processes, talisman, and luck."(1 point)

3. The phase problem can be solved either experimentally or computationally. Name one experimental or computational phasing method (not just the acronym). (1 point)

4. At what resolution (in angstrom) of electron density map do you begin to see the holes in aromatic rings of phenylalanine and tyrosine? (1 point)

Oh lecture (13 points)

1) Name the 2 basic functions of the cell cycle. (2 points)

2) Cyclin-dependent kinases, or Cdk's, are activated by the presence and association of cyclins. Name 2 forms of regulation of Cdk activity and an example of a protein that performs each type of regulation. (4 points)

Regulation of Cdk activity	Protein Example

3) SCF and APC both regulate the cell cycle via proteolysis. What type of protein are SCF and APC that allows them to target CKI's and cyclins for degradation? (1 point)

4) The Rb pathway regulates whether the cell initiates the S phase of the cell cycle. What protein does Rb inactivate in order to prevent S phase initiation? How is Rb inactivated? Describe one of the positive feedback loops within this Rb pathway that promote S phase initiation. (3 points)

5) Mitogens stimulate cell division by activating Ras and the MAP kinase cascade. This results in the expression of myc and production of the transcription factor Myc. Describe one of the three ways that Myc promotes entry into S phase. Include the target gene expressed and the steps involved with entry into S phase. (3 points)

Weber Lecture [12 points]

1) List the two features that make a cancer cell a cancer cell. (2 points)

2) List 3 genomic alterations by which proto-oncogenes can be activated. (3 points)

3) List the 5 classical features of a tumor suppressor as discussed in class. (5 points)

4) The CDKN2A gene encodes two tumor suppressors, Ink4a and Arf, at the same locus on chromosome 9 seen below. Alternative splicing of the exons at this locus allow for these two proteins to be encoded within the same region. Describe a genomic alteration that may occur to target and inactivate both of these tumor suppressors simultaneously, including where this event would have to occur. (2 points)
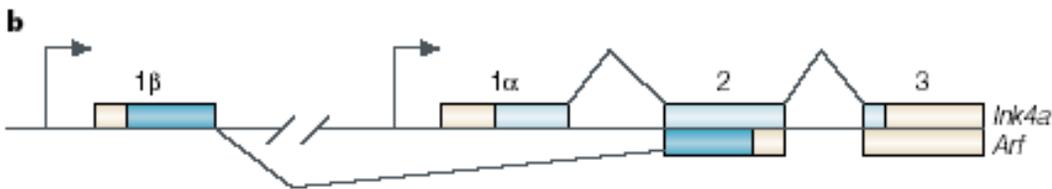
Miner Lectures [18 points]

1) Which two important basement membrane proteins can individually polymerize to a form a network? (2 points)

2) True or false. If false, please correct: Glycosaminoglycan (GAG) side chains are responsible most of the biological properties of proteoglycans. The positive charge they impart to the basement membrane is important for the lubrication of cartilage. (2 points)

3) Briefly describe the difference between dominant negative mutations and mutations that result in haploinsufficiency. Which do you expect to result in a more severe phenotype (assume a homodimer protein product)? (3 points)

4) Why do individuals deficient in Vitamin C / ascorbate develop Scurvy, an acquired disease of fibrillar collagen? Please be sure to name the enzymes involved and their function. (3 points)

5) Briefly explain how integrins direct fibronectin fibril formation. (3 points)

6) Please define Anoikis. (2 points)

7) True or false. If false, please correct: Palmitoylation and Depamitoylation of integrins is important in the formation and disassembly of hemidesmosomes (2 points)

8) What type of post translational modification is critical for the function of the extracellular matrix protein Dystroglycan? (1 point)

Schlesinger Lecture [8 points]

1) True or false. If false, please correct: During apoptosis, immense changes in membrane structure occur. However, membrane integrity is maintained throughout the process. (2 points)

2) True or false. If false, please correct: In healthy cells, phosphatidylcholine is normally restricted to the inner leaflet of the plasma membrane, but during apoptosis it flips to the outer leaflet and acts as a signal for phagocytosis (2 points)

3) Please outline the extrinsic pathway of apoptosis. Please be sure to include the name of any receptors or enzymes that are involved. (4 points)

Philosophical Question [1 point]:

Circle the best single answer. With the recent Chicago Cub additions, when the Cubs fail to win the National League Central Division, Cubs fans will cry a river of Cub's tears:

   A) That will cause Lake Michigan to rise to record highs

   B) If in California would end the current drought

   C) Flood the antiquated Wrigley Field restroom facilities

   D) Disrupt Cardinal celebratory ceremonies along the St. Louis Mississippi riverfront

   E) Cause the mayor of Chicago to declare a state of emergency as Chicago streets are flooded