a. G1, S, G2, M phase

b. G1- Gap 1 where the cell is growing and creating proteins and organelles necessary for the cell. Also, there is a checkpoint that makes sure the environment is suitable for DNA replication which is the next phase.

c. S Phase- Synthesis, DNA is replicated in this phase

d. G2- Gap 2 where the cell continues to grow and continues creating proteins and organelles necessary for the cell. There is a checkpoint here to make sure all of the DNA was replicated correctly. If not, it is fixed.

e. M Phase- consists of mitosis and cytokinesis, where the nucleus divides and then the cell divides. There is a checkpoint in mitosis between the tension between the kinetochores and the mitotic spindle to make sure the chromosomes are correctly lines up on the metaphase plate.

e. What are checkpoints in the cell cycle, when does each occur and what is being checked?

a. Answered above

f. How is the cell cycle regulated? Which cdks and cyclins are responsible for each phase of the cell cycle?

a. The cell cycle is regulated by cyclin-dependent kinase and cyclins.

b. G1-Cdk 6,4 and cyclin D (early in G1 to drive the cell through G1 toward S)

c. G1/S-Cdk 2 and cyclin E (late in G1 to trigger S Phase)

d. S-Cdk 2 and cyclin A (late in G1 to trigger S phase)

e. M-Cdk1 and cyclin B (in G2 to trigger into M phase)

g. What is the importance of the replication of different components of the cell during the cell cycle?

a. If the different components don't replicate then there won't be able to be two different functioning, reproducible cells after the cell cycle is complete.

h. What is M phase of the cell cycle?

a. The M phase consists of mitosis and cytokinesis. Mitosis is the division of the nucleus and cytokinesis is the division of the cytoplasm.

i. What are the six stages of M phase? Describe why the order of the stages is so important.

- Order is so important because you want to make sure that the chromosomes are properly lined up before you pull them apart and make two new cells. That is why there is the checkpoint in metaphase.

b. Prophase- mitotic spindle assembles, chromosomes condense, centrosomes move apart

c. Pro-metaphase- nuclear envelope disassembles, mitotic spindle fibers attach to chromosomes

d. Metaphase- chromosomes align in middle of cell, checkpoint of tension between fibers and kinetochores

b. In Eukaryotic cells, transcription and translation both occur in different places (nucleus and then cytosol). Therefore, they cannot occur at the same time and are called uncoupled transcription and translation.

p. What is the subunit that makes up proteins?

a. Amino acids

q. What is the structure of an amino acid?

a. A central carbon that bonds to a Hydrogen, an amine group, a carboxyl group, and a side chain that is different for each of the amino acids.

r. What determines the three-dimensional structure of a protein?

a. The weak non-covalent bonds are what determine the three-dimensional structure of a protein. They include Hydrogen bonds, electrostatic attractions, Van der Waals interactions, and hydrophillic/phobic interactions.

b. Also chaperone proteins help proteins fold properly. The conformation with the lowest free energy (G) is what is always done.

s. What are the various levels of organization of a protein?

a. Primary structure- amino acid sequence of the protein (covalent/ peptide bonds between the amino acids)

b. Secondary structure- alpha helices and beta pleated sheets that form in parts of the protein. H bonds in the backbone are what cause these to form.

c. Tertiary structure- 3 dimensional conformation of alpha helices, beta-pleated sheets, and all the other loops, folds and coils. The interactions here are all the non-covalent bonds such as Hydrogen bonds, electrostatic interactions, Van der Waals interactions, and hydrophobic/phillic interactions.

d. Quaternary structure- When more than one polypeptide chain form together to form a protein. In this, each polypeptide chain is called a subunit. When two form together, the structure is called a dimer. Only some proteins gain quaternary structure and it is only functional with all its subunits.

t. How do the functional groups of amino acids contribute to a protein's structure and function?

a. They can be either small or large and consist of hydroxide groups or acids or bases or can be hydrocarbon side groups. The hydrocarbon side groups make it not reactive with water, while the other groups make it able to react with water.

u. How does folding create areas on a protein that affect its function?

a. The folding changes the conformation and structure dictates function. For example, alpha helices and beta-pleated sheets.

v. What is a protein domain?

a. A Protein domain is part of a protein that folds in a particular way and makes a particular structure that does something

gradient because it goes from high concentration to low and like charge to unlike charge.

l. What dictates the direction of passive transport?
   a. The electrochemical gradient for ions and the concentration gradient for uncharged molecules. In passive transport, ions and uncharged molecules must go down their electrochemical gradient and concentration gradient because no energy is used in passive transport and can't move them up gradients.

m. What is coupled transport?
   a. Coupled transport is the coupling of an unfavorable reaction with a favorable one, where the energy released by the favorable one is used to power the unfavorable one. An example is the Na+/glucose symport.

n. How does transepithelial transport work?
   a. First, from the lumen, active transport is done to transport things such as nutrients across the apical surface of the epithelial cell into the epithelial cell. Active transport is done because the nutrients in the lumen are in lower concentration than in the epithelial cell. Therefore, the nutrients would not go in without energy so energy must be used to transport them in. What is done is symport where the transport of glucose is coupled with Na+ going down its electrochemical gradient into the cell. Then the Na+ is pumped back out coupled with the hydrolysis of ATP in the Na+/ K+ pump. There are many nutrients in the cell, so when a new macromolecule enters, the others are pushed down and one at the bottom diffuses out. Facilitated diffusion occurs across the basolateral surface of the epithelial cell which is possible because the concentration of nutrients in the cell is higher than in the extracellular fluid which is where it diffuses to. Therefore, no energy is required for this to occur and a channel is present for the nutrients to passively diffuse out of into the bloodstream. TALK ABOUT TIGHT JUNCTIONS SEPARATING ACTIVE AND PASSIVE TRANSPORT.

6. Know how cells transform, store and use energy.

   a. How is sunlight converted into chemical energy? Know details.
      a. A photon is received in PSII (in the thylakoid membrane), which boosts an electron to a higher energy state. The excited electron then goes down an ETC (in the thylakoid membrane) where a proton gradient is created and ATP is made with ATP Synthase. Then, the electron ends up in PSI. Then another photon of light strikes it and it once again is boosted. This high energy electron goes through a few proteins until it is given to NADP to make NADPH. The ATP and NADPH are used in the light-independent reactions to fix CO2 with Carbon compounds to make chemical energy in the form of sugars.