

Lesson II Problem Set: "Cell Cycle and Cancer"

Teacher's Answers

Multiple Choice:

1. In which stage of the cell cycle is each chromosome composed of two chromatids in preparation for mitosis?

- A. G₁
- B. S
- C. G₂
- D. M

A: G₂; S phase resulted in the duplication of each chromatid. Since there is only one centromere on the sister chromatids, we still call them one chromosome. When completed, the cells are in G₂ and preparing for M.

2. CDKs increase their enzymatic activity by complexing with:

- A. Rb
- B. Cyclins
- C. E2F transcription factors
- D. All of the above

A: Cyclins. CDKs or cyclin-dependent kinases do just that—they depend on cyclins for enzymatic activity. Once they are complexed with cyclins, and therefore active, they can phosphorylate their targets.

3. Vinblastine is a drug used to treat cancer, since it is known to stop the cell cycle. The drug interferes with the assembly of microtubules, and therefore its effectiveness must be related to:

- A. disruption of mitotic spindle formation
- B. inhibition of regulatory protein phosphorylation.
- C. suppression of cyclin production.
- D. inhibition of DNA synthesis.

A: A. Vinblastine disrupts the mitotic spindle formation by interfering with microtubule assembly.

Short Answer:

1. Describe what a checkpoint is and why it is important in preventing cancer cells from arising.

A: Checkpoints are surveillance mechanisms within the cell, throughout the cell cycle. At the checkpoints, the cell checks for various requirements necessary for progression through the cell cycle, and if the cell does not meet the requirements, it does not proceed to the next phase. If checkpoints become defective, a cell will proceed through the cell cycle without control and possibly with errors. If those errors are within the DNA causing mutations, those mutations will be allowed to be passed on to the next generation of cells.

2. What is G₀?

A: G₀ is a resting state for cells. Cells that exit mitosis can either continue to G₁ to divide again, or they can exit the cell cycle temporarily or permanently in G₀. G₀ cells are still alive, but not dividing.

3. Describe the function of a kinase. What specific kinases regulate the cell cycle?

A: Kinases add phosphate to molecules, and the modification can serve as a "switch" to turn events in the cell on or off. Cdk or cyclin dependent kinases regulate the cell cycle.

4. What are histones? How do they appear under an electron microscope?

A: The histones form structural complexes with DNA. In the electron microscope, these can take the appearance of beads on a string.

5. What is the difference between chromosomes and chromatids?

A: Chromatids are each of a pair of identical DNA molecules after DNA replication, joined at the centromere. Chromosomes are molecules of DNA complexed with specific proteins responsible in eukaryotes for storage and transmission of genetic information.

6. If a researcher treated a cancer cell that prevented it from synthesizing DNA. What stage of the cell cycle would the cell be trapped in? Explain.

A: G1; During G1, the cells prepare for replication of DNA. During S phase, the cells will proceed by actually replicating the DNA. If the replication of DNA is prevented, the cells would be stuck in G1.

True/False:

1. The stage in which cells are preparing for DNA replication is in S phase.

A: False; In S phase, DNA is being replicated. In G1 is when the cells are preparing for replication.

2. The first stage in which chromosomes become visible in mitosis is called anaphase.

A: False; Chromosomes are condensed and visible during prophase in mitosis.

3. Cancer cells are different from normal cells, in that, they have escaped cell cycle control.

A: True

4. Cells in G0 will eventually die.

A: False; Cells in G0 may stay there and eventually die, or they can reenter the cell cycle.

5. Interphase is a phase in mitosis:

A: False; Interphase encompasses G1, S, and G2 phases of the cell cycle. Mitosis includes prophase, anaphase, metaphase, and telophase.

Below are pictures taken of cells from an onion root tip. Please identify one cell that is in:

- A: Prophase
- B: Metaphase
- C: Anaphase
- D: Telophase

QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.