

Lesson 3 Problem Set: Oncogenes and Tumor Suppressor Genes Teacher's Answers

Short answer:

1. Explain how a proto-oncogene can be compared to a gas pedal in a car. What would an oncogene be the equivalent to?

A: A proto-oncogene normally functions in a way that is similar to a gas pedal -- it helps the cell grow and divide. An oncogene could be compared to a gas pedal that is stuck down, which causes the cell to divide out of control.

2. Explain how mutations in tumor suppressor genes can contribute to cancer.

A: Tumor suppressor genes function to regulate growth and can stop cell division during times of repair, or when errors are found in the cell. If a tumor suppressor were mutated and could not function, the cell would continue to divide without control.

3. What is an important difference between oncogenes and tumor suppressor genes when it comes to causing cancer?

A: An important difference between oncogenes and tumor suppressor genes is that oncogenes result from the *activation* (turning on) of proto-oncogenes, but tumor suppressor genes cause cancer when they are *inactivated* (turned off).

4. How can a protein be considered an oncogene, when its function is to shut off a tumor suppressor? Give an example of one such oncogene.

A: If a gene functions to inhibit a tumor suppressor, it can be considered an oncogene because it contributes to cancer. Mdm2, an inhibitor of tumor suppressor p53, can be considered an oncogene.

5. Knowing what you know about the cell cycle, explain why Rb would be considered a tumor suppressor.

A: Rb, when hypophosphorylated, is bound to the E2F transcription factor. When Rb becomes hyperphosphorylated, it releases E2F and E2F drives cell cycle progression into S phase. If Rb were to be mutated, E2F would be free to drive cell cycle progression all of the time. Therefore, since it needs to be inactivated to cause cancer, Rb is considered to be a tumor suppressor.

True/False: Determine whether the statements below are true or false. If you choose "false" please correct the part(s) of the statements that are incorrect.

1. A proto-oncogene can cause cancer.

A: False: A proto-oncogene is a normal gene whose function is to grow or signal for cell division, when appropriate. An oncogene could potentially cause cancer because it is signaling the cell to divide all of the time. It is not regulated at all.

2. Mutation in p53 alone can cause cancer in humans.

A: False; it takes many genetic changes to cause cancer, not just one. Cancer is a multi-step process.

3. Mutations in genes will always contribute to cancer.

A: False: Sometimes you can get mutations in genes that are not involved in cell cycle control or cell division and the mutation would have no consequence on the cell.

Vocabulary: Define the following terms.

1. proto-oncogene

A: Proto-oncogenes are the genes that normally control how often a cell divides and the degree to which it differentiates (or specializes).

2. oncogene

A: *Oncogenes* are normal genes that have been mutated and consequently cause normal cells to grow out of control and become cancer cells.

3. tumor suppressor gene

A: **Tumor suppressor genes** are normal genes that slow down cell division, repair DNA mistakes, and tell cells when to die (a process known as *apoptosis* or programmed cell death).