

Cellular Reproduction

section 9 Cell Cycle Regulation

MAIN Idea

The normal cell cycle is regulated by cyclin proteins.

What You'll Learn

- how cancer relates to the cell cycle
- the role of apoptosis
- the two types of stem cells and their potential uses

Mark the Text

Locate Information

Highlight every heading in the reading that asks a question. Then highlight each answer as you find it.

Picture This

1. Name When are some of the important combinations active?

Before You Read

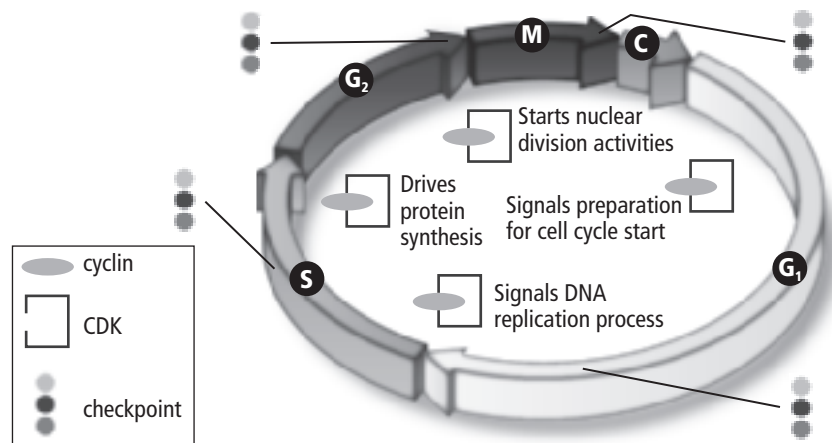
Cancer results when cells lose control of the cell cycle. A healthy lifestyle reduces the risk of cancer. On the lines below, write activities you think might reduce the risk of cancer. Then read to learn about how cancer forms.

Read to Learn

Normal Cell Cycle

The timing and rate of cell division are important to the health of an organism. The rate of cell division varies depending on the type of cell. A mechanism involving proteins and enzymes controls the cell cycle.

The cell cycle in eukaryotic cells is controlled by a combination of two substances that signals the cellular reproduction process. Proteins called **cyclin** bind to enzymes called **cyclin-dependent kinases** (CDKs) in the stages of interphase and mitosis to trigger the various activities that take place in the cell cycle, as shown below.




How do cells use cyclin/CDK combinations?

Cells use different combinations of cyclin/CDK to control activities at different stages in the cell cycle. For instance, in the G₁ stage, one cyclin/CDK combination signals the start of the cell cycle. Other cyclin/CDK combinations signal other activities, including DNA replication, protein synthesis, and nuclear division. Cyclin/CDK combinations also signal the end of the cell cycle.

How do quality control checkpoints work?

The cell cycle has built-in quality control checkpoints that monitor the cell cycle and can stop it if something goes wrong. For instance, near the end of the G₁ stage of interphase, the cell monitors its DNA for damage and can stop the cell cycle before entering the S stage if something is wrong. There are other quality control checkpoints during the S stage and after DNA duplication in the G₂ stage before entering mitosis. During mitosis, the cell checks the spindle fibers before it undergoes cytokinesis. If the cell detects a failure, the cell cycle stops.

Abnormal Cell Cycle: Cancer

Sometimes control of the cell cycle fails. When cells do not respond to control mechanisms, cancer results. **Cancer** is the uncontrolled growth and division of cells. 

Cancer cells grow and divide as long as they receive nutrients. They crowd normal cells causing tissues and organs to stop working. Cancer can kill an organism.

What causes cancer?

Cancer is caused by mutations, or changes, in segments of DNA that code for production of proteins, including those that regulate the cell cycle. Often, cells can fix mutations in DNA. If the repair system fails, cancer can result.

Environmental factors can increase the risk of cancer. Substances that are known to cause cancer are called **carcinogens** (kar SIH nuh junz). Tobacco, tobacco smoke, alcohol, some viruses, and radiation from the Sun or X-rays are examples of carcinogens.

Avoiding carcinogens can help reduce the risk of cancer. Federal laws protect people from exposure to carcinogens in the workplace and in the food supply. People can reduce their risk of cancer by avoiding all tobacco (including secondhand smoke and smokeless tobacco) and by using sunscreen to protect their skin from ultraviolet radiation from the Sun.

Reading Check

2. Define What is cancer?



Think it Over

3. Identify What is an example of a carcinogen that occurs in nature?



Think it Over

- 4. Identify** Which statement about apoptosis is correct? (Circle your answer.)
- a. Apoptosis can lead to cancer.
 - b. Apoptosis can prevent cancer.

Reading Check

- 5. Describe** What are stem cells?

Who can get cancer?

Cancer can occur in people of all ages, but older people have a higher risk. This might be because it takes more than one DNA mutation to change an abnormal cell into a cancer cell. Older cells have had more time to accumulate the mutations that lead to cancer.

Cancer runs in some families. People might inherit one or more DNA mutations from their parents, increasing their risk of developing cancer.

Apoptosis

Some cells in an organism are no longer needed. **Apoptosis** (a pup TOH sus) is a natural process of programmed cell death. Cells that are no longer needed are destroyed by apoptosis.

Apoptosis occurs in the embryo to remove tissue between developing fingers and toes. Apoptosis also occurs in cells that are damaged beyond repair or that could turn into cancer cells. It is also part of the process by which leaves fall from trees in autumn.

Stem Cells

Most cells in a multicellular organism are designed for a special purpose. Some cells might be part of your skin, and other cells might be part of your heart.

Some cells are not specialized. **Stem cells** are unspecialized cells that have the potential to develop into specialized cells. There are two types of stem cells—embryonic stem cells and adult stem cells.

What is the potential for stem cells?

Embryonic stem cells are created after fertilization, when the fertilized egg divides to create 100 to 150 stem cells. Each of these cells has the potential to develop into a wide variety of specialized cells. As the embryo develops, the cells specialize into tissues, organs, and organ systems. Adult stem cells are found in various tissues in the body. They are present in people from birth to adulthood.

Stem-cell research could lead to the treatment of many diseases and conditions. Embryonic stem-cell research is controversial. Ethical issues about the source of embryonic stem cells limit their availability to researchers. Adult stem cell research is less controversial because the cells can be obtained with the consent of the donor.