Getting Control

Finding Main Ideas As you read through the section on control of the cell cycle, answer the following questions.

Study Organizer

1. Enzymes control the cell cycle. What controls enzyme production?
2. What are two environmental factors that contribute to the development of cancer? List any possible ways you can influence these factors.
3. How does a person’s diet relate to the chances of getting cancer?

Normal Control of the Cell Cycle

Why do some types of cells divide rapidly, while others divide slowly? What tells a cell when it is time to leave one part of the cell cycle and begin the next?

Proteins and enzymes control the cell cycle

The cell cycle is controlled by proteins called cyclins and a set of enzymes that attach to the cyclin and become activated. The interaction of these molecules, based on conditions both in the cell's environment and inside the cell, control the cell cycle. Occasionally, cells lose control of the cell cycle. This uncontrolled dividing of cells can result from the failure to produce certain enzymes, the overproduction of enzymes, or the production of other enzymes at the wrong time. Cancer is a malignant growth resulting from uncontrolled cell division. This loss of control may be caused by environmental factors or by changes in enzyme production.

Enzyme production is directed by genes located on the chromosomes. A gene is a segment of DNA that controls the production of a protein.

Many studies point to the portion of interphase just before DNA replication as being a key control period in the cell cycle. Scientists have identified several enzymes that trigger DNA replication.
Currently, scientists consider cancer to be a result of changes in one or more of the genes that produce substances that are involved in controlling the cell cycle. These changes are expressed as cancer when something prompts the damaged genes into action. Cancerous cells form masses of tissue called tumors that deprive normal cells of nutrients. In later stages, cancer cells enter the circulatory system and spread throughout the body, a process called metastasis, forming new tumors that disrupt the function of organs, organ systems, and ultimately, the organism.

Cancer is the second leading cause of death in the United States, exceeded only by heart disease. Cancer can affect any tissue in the body. In the United States, lung, colon, breast, and prostate cancers are the most prevalent types. Use the Problem-Solving Lab on this page to estimate the number of people in the United States who will develop these kinds of cancers in this decade, and how many people are expected to die from cancers. The Connection to Health feature at the end of this chapter further discusses skin cancer.

The causes of cancer

The causes of cancer are difficult to pinpoint because both genetic and environmental factors are involved. The environmental influences of cancer become obvious when you consider that people in different countries develop different types of cancers at different rates. For example, the rate of breast cancer is relatively high in the United States, but relatively low in Japan. Similarly, stomach cancer is common in Japan, but rare in the United States.

Other environmental factors, such as cigarette smoke, air and water pollution, and exposure to ultraviolet radiation from the sun, are all known to damage the genes that control the cell cycle. Cancer may also be caused by viral infections that damage the genes.
Cancer prevention

From recent and ongoing investigations, scientists have established a clear link between a healthy lifestyle and the incidence of cancer. Physicians and dietary experts agree that diets low in fat and high in fiber content can reduce the risk of many kinds of cancer. For example, diets high in fat have been linked to increased risk for colon, breast, and prostate cancers, among others. People who consume only a minimal amount of fat reduce the potential risk for these and other cancers and may also maintain a healthy body weight more easily. In addition, recent studies suggest that diets high in fiber are associated with reduced risk for cancer, especially colon cancer. Fruits, vegetables, and grain products are excellent dietary options because of their fiber content and because they are naturally low in fat. The foods displayed in Figure 8.17 illustrate some of the choices that are associated with cancer prevention.

Vitamins and minerals may also help prevent cancer. Key in this category are carotenoids, vitamins A, C, and E, and calcium. Carotenoids are found in foods such as yellow and orange vegetables and green leafy vegetables. Citrus fruits are a great source of vitamin C, and many dairy products are rich in calcium.

In addition to diet, other healthy choices such as daily exercise and not using tobacco also are known to reduce the risk of cancer.

**Understanding Main Ideas**

1. Do all cells complete the cell cycle in the same amount of time?
2. Describe how enzymes control the cell cycle.
3. How can disruption of the cell cycle result in cancer?
4. How does cancer affect normal cell functioning?

**Thinking Critically**

5. What evidence shows that the environment influences the occurrence of cancer?

**Skill Review**

6. Recognize Cause and Effect  Although not all cancers are preventable, some lifestyle choices, such as a healthy diet and regular exercise, can decrease your cancer risk. Give a summary of how these two lifestyle choices could be implemented by teens. For more help, refer to Recognize Cause and Effect in the Skill Handbook.