

VOCABULARY

ACADEMIC VOCABULARY

Mature

to have reached full natural growth or development

After mitosis, the two new cells must mature before they divide.

Apoptosis

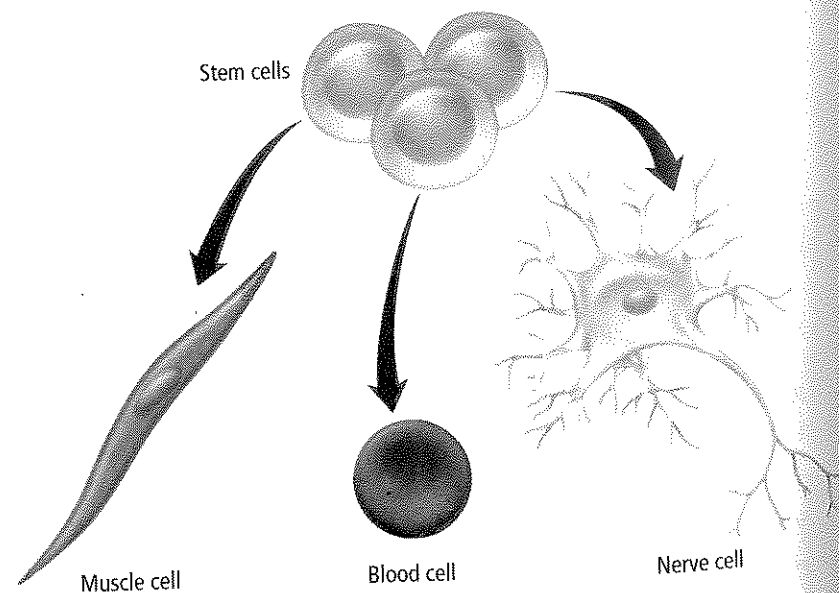
Not every cell is destined to survive. Some cells go through a process called **apoptosis** (a pup TOH sus), or programmed cell death. Cells going through apoptosis actually shrink and shrivel in a controlled process. All animal cells appear to have a “death program” that can be activated.

One example of apoptosis occurs during the development of the human hand and foot. When the hands and feet begin to develop, cells occupy the spaces between the fingers and toes. Normally, this tissue undergoes apoptosis, with the cells shriveling and dying at the appropriate time so that the webbing is not present in the mature organism. An example of apoptosis in plants is the localized death of cells that results in leaves falling from trees during autumn. Apoptosis also occurs in cells that are damaged beyond repair, including cells with DNA damage that could lead to cancer. Apoptosis can help to protect organisms from developing cancerous growths.

Stem Cells

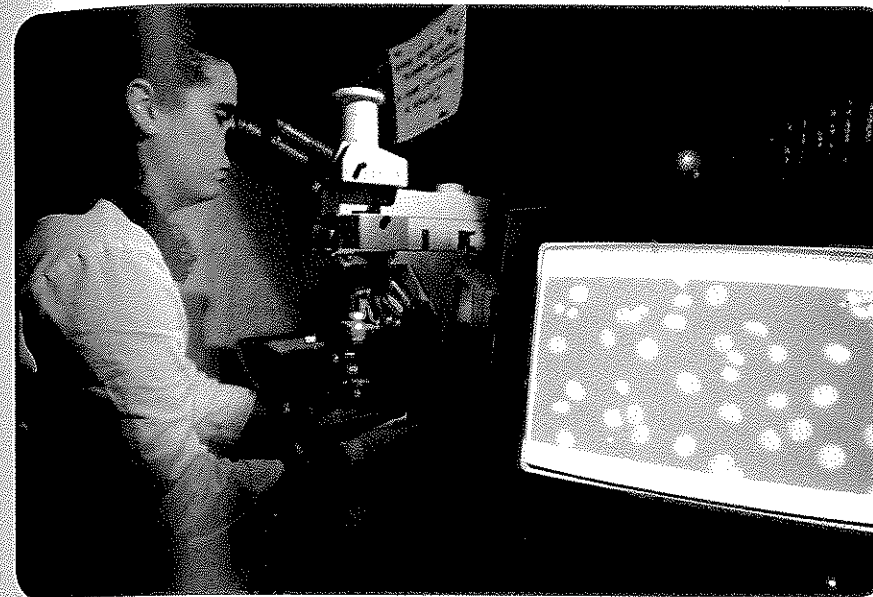
The majority of cells in a multicellular organism are designed for a specialized function. Some cells might be part of your skin, and other cells might be part of your heart. In 1998, scientists discovered a way to isolate a unique type of cell in humans called the stem cell. **Stem cells** are unspecialized cells that can develop into specialized cells under the right conditions, as illustrated in **Figure 13**. Stem cells can remain in an organism for many years while undergoing cell division. There are two basic types of stem cells: embryonic stem cells and adult stem cells.

Embryonic stem cells After a sperm fertilizes an egg, the resulting mass of cells divides repeatedly until there are about 100–150 cells. These cells have not become specialized and are called embryonic stem cells. If separated, each of these cells has the capability of developing into a wide variety of specialized cells. If the embryo continues to divide, the cells specialize into various tissues, organs, and organ systems. Embryonic stem cell research is controversial because of ethical concerns about the source of the cells.



■ **Figure 13** Because stem cells are not locked into becoming one particular type of cell, they might be the key to curing many medical conditions and genetic defects.

Explain how stem cells could be used to cure nerve damage.



■ **Figure 14** Research with adult stem cells has led to advances in treatments for numerous injuries and diseases.

Adult stem cells The second type of stem cells—adult stem cells—is found in various tissues in the body and might be used to maintain and repair the same kind of tissue in which they are found. The term “adult stem cells” might be somewhat misleading because even a newborn has adult stem cells. Like embryonic stem cells, certain kinds of adult stem cells also might be able to develop into different kinds of cells, providing new treatments for many diseases and conditions. In 1999, researchers at Harvard Medical School used nervous system stem cells to restore lost brain tissue in mice. In 2008, researchers used adult stem cells along with an enzyme called PKA to create new bone tissue for repair in mice. Research with adult stem cells, like that shown in **Figure 14**, is much less controversial because the adult stem cells can be obtained with the consent of their donors.

Section 3 Assessment

SC.912.L.16.8

Section Summary

- ▶ The cell cycle of eukaryotic cells is regulated by cyclins.
- ▶ Checkpoints occur during most of the stages of the cell cycle to ensure that the cell divides accurately.
- ▶ Cancer is the uncontrolled growth and division of cells.
- ▶ Apoptosis is a programmed cell death.
- ▶ Stem cells are unspecialized cells that can develop into specialized cells with the proper signals.

Understand Main Ideas

1. **MAIN Idea** Describe how cyclins control the cell cycle.
2. **Explain** how the cancer cell cycle is different from a normal cell cycle.
3. **Identify** three carcinogens.
4. **Contrast** apoptosis and cancer.
5. **Describe** a possible application for stem cells.
6. **Explain** the difference between embryonic stem cells and adult stem cells.

Think Critically

7. **Hypothesize** what might happen if apoptosis did not occur in cells that have significant DNA damage.

WRITING IN Biology

8. Write a public service announcement about carcinogens. Choose a specific type of cancer, and write about the carcinogens linked to it.

Assessment Online Quiz