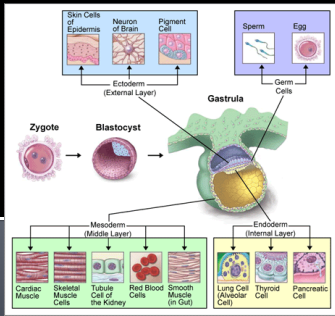


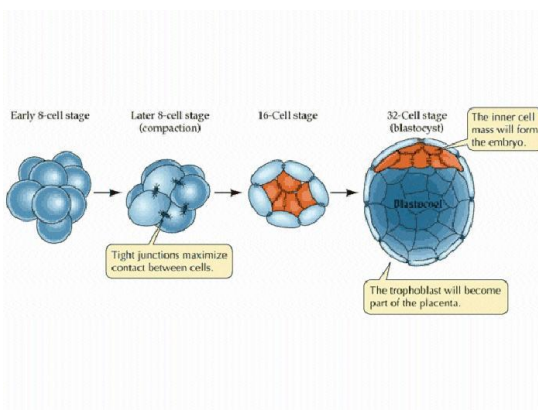
Chapter 10

Section 10.4: Cell Differentiation



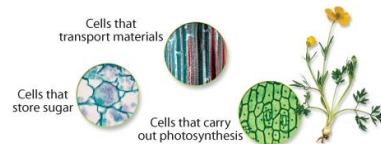
Lesson Overview Cell Differentiation

- All organisms start life as just one cell.
- Most multicellular organisms pass through an early stage of development called an **embryo**, which gradually develops into an adult organism.



Lesson Overview Cell Differentiation

- During development, an organism's cells become more differentiated and specialized for particular functions.



Lesson Overview Cell Differentiation

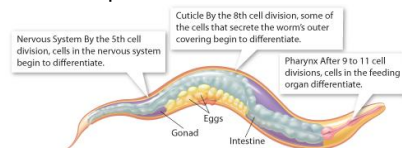
Defining Differentiation

- The process by which cells become specialized is known as **differentiation**.
- During development, cells differentiate into many different types and become specialized to perform certain tasks.
- Differentiated cells carry out the jobs that multicellular organisms need to stay alive.

Lesson Overview Cell Differentiation

Mapping Differentiation

- In some organisms, a cell's role is determined at a specific point in development.
- In the worm *C. elegans*, daughter cells from each cell division follow a specific path toward a role as a particular kind of cell.



Lesson Overview Cell Differentiation

Differentiation in Mammals

- Cell differentiation in mammals is controlled by a number of interacting factors in the embryo.
- Adult cells generally reach a point at which their differentiation is complete and they can no longer become other types of cells.

Lesson Overview Cell Differentiation

Stem Cells and Development

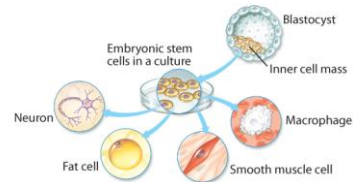
- One of the most important questions in biology is how all of the specialized, differentiated cell types in the body are formed from just a single cell.
- Biologists say that such a cell is **totipotent**, literally able to do everything, to form all the tissues of the body.
- Only the fertilized egg and the cells produced by the first few cell divisions of embryonic development are truly totipotent.

Lesson Overview Cell Differentiation Human Development

- After about four days of development, a human embryo forms into a **blastocyst**, a hollow ball of cells with a cluster of cells inside known as the inner cell mass.
- The cells of the inner cell mass are said to be **pluripotent**, which means that they are capable of developing into many, but not all, of the body's cell types.

Lesson Overview Cell Differentiation Stem Cells

- **Stem cells** are unspecialized cells from which differentiated cells develop.
- There are two types of stem cells: embryonic and adult stem cells.



Lesson Overview Cell Differentiation Embryonic Stem Cells

- Embryonic stem cells are found in the inner cells mass of the early embryo.
- Embryonic stem cells are pluripotent.
- Researchers have grown stem cells isolated from human embryos in culture. Their experiments confirmed that embryonic stem cells have the capacity to produce most cell types in the human body.

Lesson Overview Cell Differentiation Adult Stem Cells

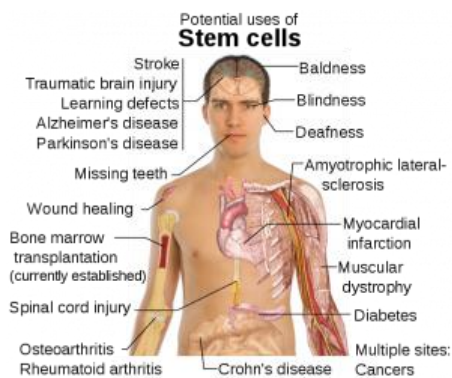
- Adult organisms contain some types of stem cells.
- Adult stem cells are **multipotent**. They can produce many types of differentiated cells.
- Adult stem cells of a given organ or tissue typically produce only the types of cells that are unique to that tissue.

Lesson Overview Cell Differentiation Frontiers in Stem Cell Research

- What are some possible benefits and issues associated with stem cell research?
- Stem cells offer the potential benefit of using undifferentiated cells to repair or replace badly damaged cells and tissues.
- Human embryonic stem cell research is controversial because the arguments for it and against it both involve ethical issues of life and death.

Lesson Overview Cell Differentiation Potential Benefits

- Stem cell research may lead to new ways to repair the cellular damage that results from heart attack, stroke, and spinal cord injuries.
- One example is the approach to reversing heart attack damage illustrated below.



Lesson Overview Cell Differentiation Ethical Issues

- Most techniques for **harvesting**, or gathering, embryonic stem cells cause destruction of the embryo.
- Government funding of embryonic stem cell research is an important political issue.
- Groups seeking to protect embryos oppose such research as unethical.
- Other groups support this research as essential to saving human lives and so view it as unethical to restrict the research.