Cell Differentiation
(cell specialization)  
http://www.pbslearningmedia.org/resource/tdc02.sci.life.stru.different/cell-differentiation/
What is Cell Differentiation?

- All of the cells within a complex multicellular organism, such as a human being, contain the same DNA.
- However, the body of such an organism is clearly composed of many different types of cells.
• What, then, makes a blood cell different from a skin or muscle cell, or a leaf cell from a root cell in a plant?
The answer lies in the way each cell deploys its genome.

In other words, the particular combination of genes that are turned on (expressed) or turned off (repressed) dictates cellular structure and function.
What is a STEM CELL?

- Stem cells are unspecialized cells that can **renew themselves** through cell division, and also have the ability to **develop into** one of many different kinds of **specialized cells**.

![Diagram of stem cells](image-url)
First, it is decided which genetic information will be expressed, thereby indicating the type of cell that is to be formed.

Then, through cell differentiation, those instructions are carried out and specialized cells are formed.
Thus, different cells can have very different physical characteristics despite having the same genome.
The cell size, shape, polarity, metabolism and responsiveness change dramatically as the stem cell acquires a more specific role.
“Do I have to declare a major? Couldn’t I just be a stem cell?”
When does differentiation occur?

- Differentiation occurs numerous times during the development of a multicellular organism as the organism changes from a simple zygote to a complex system of tissues and cell types. Differentiation is a common process in adults as well: adult stem cells divide and create fully differentiated daughter cells during tissue repair and during normal cell turnover.
Examples of Specialized Cells—blood cells

- Specific roles for specific cells
  - Red blood cells carry Oxygen to body cells.
  - White blood cells protect us from infection by attacking foreign substances.
Muscle Cells

- Muscle cells are specifically designed to contract, to cause movement. Their long, cylindrical shape is perfect for contracting.
Epithelial Cells

- Epithelial cells are found on biological surfaces. They can be designed for protection, absorption, secretion, etc.
In Plants:

- Specialized “hair cells” on roots are designed to increase absorption of water and nutrients, through increased surface area.
- Other cells in roots are designed for growth, and protection.
Plant stems have cells that are specialized for transporting water, nutrients, etc. throughout the plants.
Leaves of plants have many kinds of specialized cells.

Guard cells open and close to let out water vapor and allow for gas exchange.

Palisade cells have many chloroplasts for carrying out photosynthesis.
Implications and Ethics

- The exact processes behind cell differentiation and dedifferentiation are not fully understood, although researchers have studied cells capable of these feats extensively, as the mechanics of this process could have valuable implications for the medical field.

- [http://app.discoveryeducation.com/search](http://app.discoveryeducation.com/search)