**Cell Growth and Division Chapter 10 Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**10.1 Cell Growth and Division**

* Limits to Cell Size
  + 1) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – as size increases, DNA is not able to provide information for all the needs of the cell. (Library analogy)
  + 2) \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- If a cell gets too large, the surface area of the cell is not large enough to get oxygen and nutrients in and waste out

-surface area to volume ratio

-traffic analogy

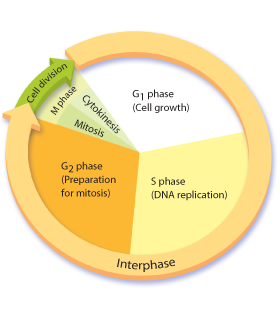
* **Cell Division** = the process in which a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **\_\_\_\_\_\_\_\_\_\_ Reproduction** = the production of genetically identical offspring from a single parent
* **\_\_\_\_\_\_\_\_\_\_ Reproduction** = offspring inherit some of their genetic information from each parent

**10.2 The process of Cell Division**

* **Chromosomes** – threadlike structures of DNA and protein that contains genetic information
  + Prokaryotes – chromosomes are in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Eukaryotes – chromosomes (chromatin) are in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Many eukaryotes have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ which make it possible to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Steps of the Cell Cycle

* Interphase (G1 Phase, S Phase, G2 Phase)
* Cell Division
  + Mitosis (Prophase, Metaphase, Anaphase, Telophase)
  + Cytokinesis



Important Cell Structures Involved in Mitosis

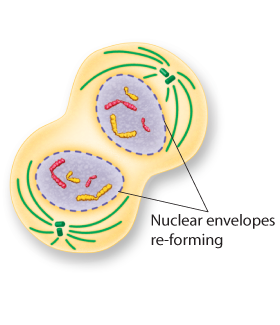
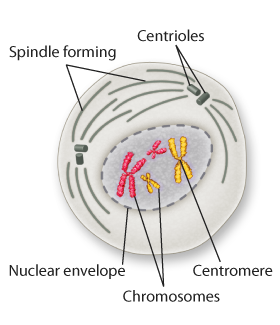
* **Chromatid** – each strand of a **duplicated** chromosome
* **Centromere** – the area where each pair of chromatids is joined
* **Centrioles** – tiny structures located in the cytoplasm of animal cells that help organize the spindle
* **Spindle** – a fanlike microtubule structure that helps separate the chromatids

Phases in the Cell Cycle

* **Interphase** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + **\_\_\_\_\_\_\_\_\_\_G1 Phase** = cell growth, make new proteins and organelles
  + **\_\_\_\_ Phase** = New DNA is made (doubles)
  + **\_\_\_\_\_\_\_\_\_\_ Phase** = Organelles needed for cell division are made
* **Mitosis** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + **Prophase**
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (Chromosomes become visible)
    - Centrioles separate
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ starts to form
  + **Metaphase**
    - Chromosomes \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ across the center of the cell.
    - Spindle fibers connect the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of each chromosome

to the two poles of the spindle.

* + **Anaphase**
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - Individual chromosomes are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ on spindle fibers
  + **Telophase** 
    - Chromosomes are at \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ ends of the cell
    - Chromosomes spread out into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ reforms
    - \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ breaks apart



\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_

* **Cytokinesis** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pinches in half
  + Each of the two daughter cells has an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ set of chromosomes

**10.3 Regulating the cell cycle**

* How do cells know when to divide?????
  + Some cells don’t divide once they are formed (muscle and nerve)
  + Cells in the bone marrow that make blood cells and digestive tract divide as fast as every few hours
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** = a family of proteins that regulates the cell cycle in eukaryotes
* **Regulatory proteins** instruct the cells when to divide
  + Internal regulatory proteins make sure that steps in the cell cycle are completed before the next step occurs
  + External regulatory proteins direct the cell to speed up or slow down the cycle
    - Ex. Growth factors – stimulate the division of the cell (embryonic development and wound healing)
* **Apoptosis** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Cells either are damaged and die or they have programmed cell death
  + In apoptosis the cell and chromatin shrink, cell membrane breaks and other cells recycle it
  + Ex – mouse foot, human hand

Cancer

* **Cancer** = occurs when some of the body’s cells \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + Cancer cells do not respond to the signals that regulate growth and divide uncontrollably
  + Cancer cells absorb nutrients needed by other cells, block nerve connections, and prevent organs from functioning.
* **Tumor** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_ tumors** = noncancerous tumors that do not spread to other tissue
  + **\_\_\_\_\_\_\_\_\_\_\_\_\_\_ tumor** = cancerous tumor that invade and destroy surrounding tissue
  + **Metastasis** = the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Causes of cancer
  + Caused by defects in the genes that regulate cell growth and development
    - Sources of gene defects include
      * Tobacco, radiation exposure, defective genes, viral infection
    - Many cancers have a defective p53 gene which halts the cell cycle until chromosomes have been replicated
* Treatment of cancer
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ – chemical compounds that kill cancer
    - Targets rapidly dividing cells and also interferes with cell division in normal cells (side effects)

**10.4 Cell Differentiation**

* During the development of an organism, cells differentiate into many types of cells.

Stem Cells

* **Stem cells** = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cells**= can develop into any type of cell in the body
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** = can develop into most (but not all) of the body’s cell types
  + Inner cells in the early embryo (a hollow ball called a blastocyst)

**Embryonic Stem Cells**

* + Found in the inner cells mass of the early embryo.
  + Embryonic stem cells are pluripotent. (cells have the capacity to produce most cell types in the human body)

**Adult 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.

**Stem Cell Research**

* + Repair or replace badly damaged cells and tissues.
    - heart attack
    - stroke
    - spinal cord injuries.

**Stem Cells – the ethical concerns**

* + Embryonic stem cells are harvested from early embryos
    - Most methods \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the embryo
    - In the past, US limited funding for the embryonic cell lines used for research - NIH has 136 embryonic stem lines in the US that are currently being used for research
    - Research is being done to
      * harvest embryonic stem cells without destroying the embryo
      * turning adult stem cells into pluripotent cells
      * Embryonic stem cells out of umbilical cord blood

