

DNA and Chromosomes

Chapter 3.1

What do you know about DNA? Chromosomes? Genetics?

<http://www.brainpop.com/science/cellularlifeandgenetics/dna/>

DNA

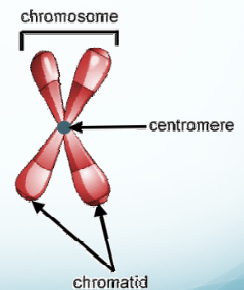
- The genetic material in cells is called DNA (or deoxyribonucleic acid).
- DNA is in the nucleus of a eukaryotic cell and it is a chemical that contains information growth and functions- it's like the brain of the cell telling it what to do.
- DNA is made of two strands and forms a twisted ladder or "double helix".
- DNA is wrapped around protein (like thread around a spool) and compacted into structures called chromosomes.



Human DNA would be 2 meters long if it wasn't wrapped up inside the chromosome!

Chromosomes

- Humans have 46 chromosomes, or 23 pair. The 23rd pair is what determines your gender.
- Other species have different numbers of chromosomes. For example, a dog has 78 (39 pair) and corn has 20 (10 pair).
- During cell division, chromosomes consist of 2 chromatids that are joined together by a centromere.



Why is cell division important anyway??

- We are very different than other species.
 - BUT what we do have in common with them is that almost all multicellular organisms are made of trillions of cells.
- Cell division is essential for growth, development, and repair.

Growth

- In general, a larger organism doesn't have larger cells than a smaller organism, it just has MORE.
- Individual cells grow in size but there are limits to how large they can grow.
- Cells need a high ratio of surface area to volume in order to function.
 - As a cell grows, that ratio decreases.
 - When a cell divides into two smaller cells, the ratio of surface area to volume for each cell increases again.
- As a cell grows, more processes are needed for it to function, so its demand for instructions from DNA increases, but the amount of DNA stays the same.

Development

- Although multicellular organisms begin as single cells, they grow into larger organisms through cell division, but cell division isn't the only reason organisms develop.
- During development, cells become specialized to perform particular functions.
 - They may take on different shapes or structures, become layered (skin cells), or become long and thin (nerve cells).
 - These cells still have the same DNA as the other cells, they are just specialized.

Repair

- Think about when you cut yourself or broke one of your bones. Over time your body healed itself, right?
- The body repairs injuries through cell division.
- As cells age and die, they have to be replaced.
- The human body is made of 200 different types of cells, which are replaced at different rates.
 - Every minute your skin loses about 40,000 cells and they are replaced with new ones.
 - Your brain cells last a very long time and don't divide often.

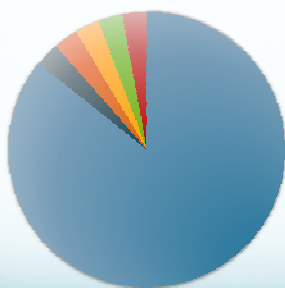
The Cell Cycle

Chapter 3.2

The Cell Cycle

- The cell cycle is the normal sequence of development and division of a cell.
- The cell cycle consists of two main parts:
 - Interphase- the cell carries out its functions
 - Cell division- consists of **mitosis** and **cytokinesis**
- ALL CELLS DIVIDE BUT ONLY EUKARYOTES UNDERGO MITOSIS!
- As a result of cell division, the original (parent) cell separates into two genetically identical daughter cells.

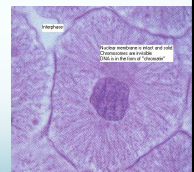
The Cell Cycle



- Interphase
- Prophase
- Metaphase
- Anaphase
- Telophase
- Cytokinesis

INTERPHASE

- THE PART OF THE CELL CYCLE WHERE THE CELL IS **NOT** DIVIDING.
- The cell grows about twice its original size.
- It carries out normal activities (cellular transport, cellular respiration).
- Changes that occur are in preparation for cell division. DNA is exactly duplicated so that after cell division occurs each new cell gets a complete set of DNA.



MITOSIS

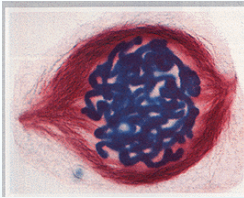
- Mitosis is the part of the cell cycle where the nucleus divides.
 - Remember the DNA is in the nucleus!
 - Prokaryotes DO NOT undergo mitosis because they have no nucleus.
- The function of mitosis is to move the DNA and other material in the parent cell into position for cell division.

Steps of Mitosis

- PROPHASE- *chromosomes form*
- METAPHASE- *chromosomes line up*
- ANAPHASE- *chromosomes separate*
- TELOPHASE- *nuclei form*

PROPHASE

- CHROMOSOMES FORM
- DNA in the nucleus condenses and becomes visible (under a microscope).
- Each chromosome consists of two chromatids held together by a centromere.
- The membrane around the nucleus disappears.



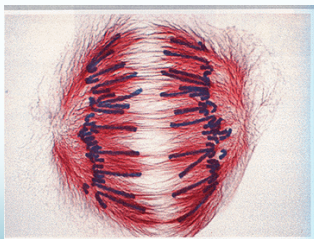
METAPHASE

- CHROMOSOMES LINE UP
- Chromosomes line up in the middle of the cell, "along the equator".



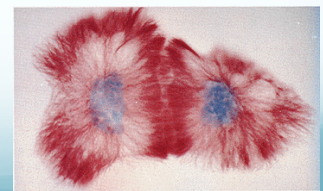
ANAPHASE

- CHROMOSOMES SEPARATE
- Chromatids split, resulting in two separate identical chromosomes.
- These chromosomes are pulled onto separate sides of the cell.



TELOPHASE

- NUCLEI FORM
- New nuclear membrane forms around each group of chromosomes.
- Chromosomes return to their threadlike form.



CYTOKINESIS

- Cytokinesis is the final stage of the cell cycle.
- It is the division of the parent cell's cytoplasm.
- Cytokinesis occurs immediately after mitosis.
- Once complete, the two daughter cells are completely separated, each surrounded by its own cell membrane. They are genetically identical to their parent cell, but smaller.