Review: Cell Division

Cell division is the process of a cell splitting itself into more cells. Binary fission, mitosis, and meiosis are all types of cell division. Binary fission is a process that takes place in prokaryotes. It starts with one diploid cell and it ends with two identical diploid cells. In eukaryotes, cell division can occur during two processes; mitosis and meiosis. Both mitosis and meiosis begin with one diploid cell, but the end product in these two processes differ.

Mitosis:

Mitosis is cell division which results in two diploid cells which are identical to each other. Mitosis is the process responsible for growth. Somatic cells, cells of the body, are able to undergo mitosis. Before beginning mitosis, a somatic cell will replicate its DNA. This preparation for cell division is important because each daughter cell must end up with a copy of the DNA.

Mitosis has four steps: prophase, metaphase, anaphase, and telophase. In prophase, the DNA will organize itself so it is easy to separate. Each chromosome of DNA will be coiled separately. Spindle fibers also begin to form during this stage. In metaphase, the chromosomes will line up along the metaphase plate, an imaginary line in the center of the cell. This marks an important timepoint for a cell because it can check that each chromosome is separate and the sister chromatids are attached to each other. The spindle fibers now attach to each sister chromatid. Anaphase is the step where the sister chromatids are separated and the spindle fibers begin to pull them towards opposite poles of the cell. In the last step, telophase, the cell starts to pinch in the center trapping genetic material in two distinct regions. The DNA is now also allowed to decondense into its resting state. Cytokinesis, the splitting of the cells, ends mitosis. Now two genetically identical cells exist.

Meiosis:

Meiosis is the splitting of a diploid cell that results in four haploid cells. Meiosis creates sperm and egg cells called gametes. In meiosis, two rounds of cell division happen without DNA replication occurring between them. It is because two rounds of cell division occur one after the other that meiosis produces haploid cells.

Meiosis has a similar set of steps to mitosis. The cell still divides using four distinct phases called prophase, metaphase, anaphase, and telophase. These same steps occur for both rounds of cell division. Because cell division occurs twice in meiosis, the names of the steps include a roman numeral to denote which round of cell division they are a part of. For example, prophase I is a step in the first round of cell division.

In meiosis, the first round of cell division separates the homologous chromosomes. These chromosomes contain similar genetic information because they have the same genes on them, however they often are not identical. Homologous chromosomes can contain different alleles for the genes. In the second round of cell division, sister chromatids are separated. Now, all resulting cells should have only one copy of each chromosome.

Genetic Diversity From Meiosis:

Meiosis has a few key steps which cause genetic diversity. In meiosis I, the homologous chromosomes can be separated into either new daughter cell. Below, you can see an example of what this may look like. Pretend that all of the blue chromosomes came from the person's father and the pink chromosomes came from the person's mother. This example only includes three chromosomes and two possible options for how to sort them. In a human with 23 chromosomes, there are many possible ways the chromosomes could be sorted into daughter cells.

Diploid Cell		
XX	XX	XX
Chromosome 1	Chromosome 2	Chromosome 3

Haploid Cell		
X	X	X
Chromosome 1	Chromosome 2	Chromosome 3

&

Haploid Cell		
X	X	X
Chromosome 1	Chromosome 2	Chromosome 3

OR

Haploid Cell		
X	X	X
Chromosome 1	Chromosome 2	Chromosome 3

&

Haploid Cell		
X	X	X
Chromosome 1	Chromosome 2	Chromosome 3

Crossing over also can produce genetic variation. At the end of prophase I, homologous chromosomes are very close together and can exchange pieces. This can result in a different combination of alleles on each chromosome.

Concluding Notes:

It is important to know the difference between the types of cell divisions. You must know which cells are produced by both, which cells in mitosis and meiosis are haploid and which are diploid, and what happens in each stage. The table below provides a way of organizing your notes on these topics.

Name	Mitosis	Meiosis
What type of cell is the mother cell?		Germ Cells
Does this process start with haploid or diploid cells?		
How many rounds of cell division occur?		
List the names of each step and write a brief description of each		
Are haploid or diploid cells produced?		
Type of cell that is produced		
Draw a picture illustrating this process.		