Chapter 6

Inheritance

Summary of Terms

- **Alleles** Versions of a gene.
- **Codominance** Describes a form of inheritance in which the traits of both alleles are expressed in the heterozygote.
- **Dominant** Describes an allele that is expressed in a heterozygote.
- **Heterozygote** An organism that has two different alleles for a given gene.
- **Homozygote** An organism that has two identical alleles for a given gene.
- **Incomplete Dominance** Describes a form of inheritance in which the heterozygote has a trait that is intermediate between the traits of the two homozygotes.
- **Linked Genes** When two or more genes are frequently inherited together, typically because they are found on the same chromosome.
- **Meiosis** A form of cell division in which one diploid cell divides to produce four haploid cells.
- **Mitosis** A form of cell division in which one cell divides into two daughter cells, each of which contains the same genetic information as the original cell.
- **Pleiotropy** A situation in which a single gene affects more than one trait.
- **Polygenic Traits** A trait that is determined by more than one gene.
- **Recessive** Describes an allele that is not expressed in a heterozygote.
- **Recombination** The production of new combinations of genes that differ from combinations found in the parental chromosomes resulting from crossing over during meiosis.
- **Sex-Linked Traits** A trait determined by a gene found on the X chromosome that is typically more commonly expressed in males due to the fact that males have only one X chromosome.

Detailed Chapter Summary

Cells reproduce when they make genetically identical copies of themselves. Dividing cells move through the stages of the cell cycle: gap 1, synthesis, gap 2, and mitosis and cytokinesis. During gap 1, a cell grows to double its original size. During synthesis, the cell creates an exact copy of its DNA. During gap 2 (G_2), the cell builds the machinery necessary for cell division. During mitosis and cytokinesis (M), the cell divides.

Mitosis describes the division of the cell nucleus and takes place in a series of phases: prophase, metaphase, anaphase, and telophase. During *prophase*, the chromosomes condense and the membranes

surrounding the nucleus break down. The mitotic spindle also forms. During *metaphase*, the chromosomes line up at the equatorial plane. During *anaphase*, the two identical chromatids are pulled apart by the shortening of the mitotic-spindle fibers and move to opposite poles of the cell. During *telophase*, new nuclear membranes form around each set of chromosomes, and the chromosomes return to their loosely packed state. Mitosis is followed by cytokinesis, the division of the cytoplasm. This results in the production of two daughter cells.

Meiosis is another type of cell division. Meiosis is used to produce haploid sperm and eggs. During meiosis, a single diploid cell divides to produce four haploid cells. Meiosis takes place in two steps, meiosis I and meiosis II, each of which is divided into further steps. The cells produced by meiosis are all genetically different for several reasons. First, there is crossing over, which results in the production of new combinations of genes. Second, there is the independent separation of chromosomes during meiosis.

The work of Gregor Mendel helped to establish how genes and traits are inherited. A gene is made up of two separate alleles. A homozygote has two identical alleles for a trait, and a heterozygote has two different alleles. The alleles for many genes are either dominant or recessive. The dominant allele is expressed in a heterozygote, and the recessive allele is not expressed in a heterozygote.

Mendel performed a series of breeding experiments in peas that led him to formulate his two "laws" of inheritance. Mendel's principle of segregation says that when an individual makes sex cells (such as sperm and eggs), half the sex cells carry one allele and the others carry the other allele. This explains the 3:1 ratio seen in breeding heterozygotes for a single trait.

Mendel's principle of independent assortment says that the inheritance of one trait is independent of the inheritance of a second trait. This explains the 9:3:3:1 ratio seen in breeding heterozygotes for two different traits.

More complex patterns of inheritance take us beyond Mendelian genetics. In *incomplete dominance*, there are two alleles where neither is dominant and the heterozygote has an intermediate trait. In *codominance*, there are two alleles where the heterozygote shows the traits of both alleles. In *polygenic traits*, a trait is determined by more than one gene. In *pleiotropy*, a single gene affects more than one trait. *Linked genes* are frequently inherited together because they are found on the same chromosome. *Sex-linked traits* are determined by alleles found on the X chromosome, so that inheritance patterns differ in males and females. Sex-linked traits are seen in more males than females since males have only one X chromosome. Finally, in horizontal gene transfer, genes are not inherited from parents but obtained from another means.