CHAPTER 4
Patterns of Heredity

Life Science
UNIFYING PRINCIPLES

PRINCIPLE 1
All living things share common characteristics.

PRINCIPLE 2
All living things share common needs.

PRINCIPLE 3
Living things meet their needs through interactions with the environment.

PRINCIPLE 4
The types and numbers of living things change over time.

Unit: Cells and Heredity
BIG IDEAS

CHAPTER 1
The Cell
All living things are made up of cells.

CHAPTER 2
How Cells Function
All cells need energy and materials for life processes.

CHAPTER 3
Cell Division
Organisms grow, reproduce, and maintain themselves through cell division.

CHAPTER 4
Patterns of Heredity
In sexual reproduction, genes are passed from parents to offspring in predictable patterns.

CHAPTER 5
DNA and Modern Genetics
DNA is a set of instructions for making cell parts.

CHAPTER 4
KEY CONCEPTS

SECTION 4.1
Living things inherit traits in patterns.
1. Parents and offspring are similar.
2. Genes are on chromosome pairs.
3. Gregor Mendel made some important discoveries about heredity.
4. Alleles interact to produce traits.

SECTION 4.2
Patterns of heredity can be predicted.
1. Punnett squares show possible outcomes for inheritance.
2. Ratios and percentages can express the probability of outcomes.

SECTION 4.3
Meiosis is a special form of cell division.
1. Meiosis is necessary for sexual reproduction.
2. Cells divide twice during meiosis.
3. Meiosis and mitosis differ in some important ways.

The Big Idea Flow Chart is available on p. T25 in the UNIT TRANSPARENCY BOOK.
SECTION 4.1 Living things inherit traits in patterns. pp. 101–109

1. Parents and offspring are similar.
   Some traits are inherited from parents, and some are acquired by learning or affected by environmental influence. Some traits combine both influences.

2. Genes are on chromosome pairs.
   A gene is a unit of heredity, a segment of DNA that carries a code for a particular function or trait and occupies a specific place on a chromosome. Most functions and traits are coded for by more than one gene.
   Humans have 23 pairs of chromosomes, consisting of a homolog from each parent. Homologs may have the same or different alleles, different variants of a gene. Human females have cells with two X-chromosomes and human males have cells with one X- and one Y-chromosome. Unlike other homologs (shown below), X- and Y-chromosomes in males have some alleles that are unpaired.

3. Gregor Mendel made some important discoveries about heredity.
   Mendel's experiments with pea plants demonstrated that each parent contributes factors of heredity, now known as genes, that affect the traits of their offspring.

4. Alleles interact to produce traits.
   An organism’s phenotype is its observable characteristics. Its genotype is the set of genes that it has. Alleles of a gene can be dominant or recessive.
   • Only one allele is necessary for a trait to be expressed if the allele is dominant.
   • If alleles are recessive, two recessive alleles must be present for the trait to be expressed.

SECTION 4.2 Patterns of heredity can be predicted. pp. 110–116

1. Punnett squares show possible outcomes for inheritance.
   A Punnett square shows all possible combinations of the parents' alleles that can combine in their offspring, and what proportion of the offspring is likely to express a particular trait. The Punnett square below shows the possible genotypes for a cross between a parent with two dominant alleles and one with two recessive alleles.

2. Ratios and percentages can express the probability of outcomes.
   A ratio compares two quantities. Probability is the likelihood of an outcome. The ratios in a Punnett square show the probability of an offspring inheriting certain genes. A percentage is another way to express probability. In the Punnett square above, the probability that an offspring will have the dominant trait is 4:4, a 100 percent chance.

Common Misconceptions

ACQUIRED TRAITS NOT INHERITED
Students sometimes think that all traits are inherited. However some traits are learned, or acquired. Each generation has to relearn or acquire these traits, such as the ability to read or write.

This misconception is addressed on p. 102.

TRAITS ON THE X- AND Y-CHROMOSOMES
Students may think that the sex chromosomes only determine the sex of offspring. The X- and Y-chromosomes, sometimes called sex chromosomes, also code for other important traits as well.

This misconception is addressed on p. 103.

PARENTS CONTRIBUTE EQUALLY
Students may think that if an offspring shows the same trait as one particular parent, then the gene for that trait must have come only from that parent. Offspring get genes from both parents, but not all genes are expressed.

This misconception is addressed on p. 104.