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CHAPTER 10 Patterns of Inheritance

Summary of Key Concepts

Concept 10.1 Genetics developed from curiosity about inheritance. (pp. 206–207)

People have had many questions about how organisms inherit various characters. A variation of a particular character is called a *trait*. In the 1800s, scientists developed the blending hypothesis, which states that an offspring's traits are formed from the blending of the traits of the two parents. Because the blending hypothesis does not explain many inheritance patterns, it is no longer accepted.

Genetics is the study of heredity. Gregor Mendel was one of the first scientists to use experiments to investigate inheritance patterns. Mendel developed the particulate hypothesis of inheritance, which states that parents pass to their offspring separate and distinct factors that are responsible for inherited traits. Today Mendel's factors are called "genes."

Mendel used true-breeding pea plants in his experiments. When self-fertilized, these plants always produce offspring identical to the parent. To test the particulate theory Mendel used the sperm from one true-breeding plant to fertilize the eggs of another true-breeding plant with a different trait. This process is called *cross-fertilization*.

1. Describe Mendel's particulate hypothesis of inheritance. _____

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2. How did Mendel test his particulate hypothesis? _____

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Concept 10.2 Mendel discovered that inheritance follows rules of chance. (pp. 208–214)

Mendel used true-breeding plants to study the inheritance patterns of seven different pea-plant characters. The offspring of two true-breeding plants are called *hybrids*. Mendel performed *monohybrid crosses*, which are matings (crosses) between plants that differ in only one character.

Mendel developed the following four hypotheses about inheritance patterns: **1.** There are alternative forms of genes, called *alleles*. **2.** For each inherited character, an organism has two alleles, one from each parent. A *homozygous* individual has two of the same allele for a character. A *heterozygous* individual has different alleles for that character. **3.** When only one of two different alleles seems to affect a trait, that allele is called the *dominant* allele. The allele that does not appear to affect the trait is called the *recessive* allele. **4.** When gametes form, the alleles separate. Each gamete carries one allele for each trait. This is called the principle of segregation.

Probability can be applied to genetics. The probability for certain combinations of alleles appearing in offspring can be determined if the genetic makeup of the parents is known. A *Punnett square* is a diagram that shows

the different possible combinations of alleles and the probability that each combination will occur.

The genetic makeup of an individual is its *genotype*. An observable trait, such as eye color, is a *phenotype*. If an organism shows the recessive phenotype, its genotype is homozygous recessive. If the organism shows the dominant phenotype, it could be heterozygous or homozygous dominant. A *testcross* breeds an individual with the dominant phenotype with a homozygous recessive individual to determine the dominate individual's genotype.

Mendel also studied *dihybrid crosses*, crosses of individuals with two differing characters. His results led him to develop the principle of independent assortment, which states that the alleles for different genes are sorted into gametes independently.

3. State Mendel's principle of segregation in your own words. _____

_____

_____

4. Describe Mendel's principle of independent assortment. _____

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Concept 10.3 There are many variations of inheritance patterns. (pp. 215–217)

Some characters have different inheritance patterns than those studied by Mendel. One example is *intermediate inheritance,* which occurs when neither allele for a trait is dominant. Individuals who are heterozygous have a phenotype that is "in-between" the phenotypes of the parents.

For some characters, such as human blood type, there are more than two alleles. The alleles for blood types A and B show *codominance*. When these alleles are both present, both traits are expressed, resulting in blood type AB. If one of these alleles is present with the third allele, the blood type is A or B. If only the third allele is present, the blood type is O.

Some characters, such as human height, are controlled by two or more genes. This pattern is called *polygenic inheritance.* Polygenic inheritance usually produces a wide range of phenotypes.

Environment can affect an organism's phenotype. For example, environmental factors like water, light, and soil can affect what color flowers a certain plant produces.

5. What is an example of a character controlled by multiple alleles? _____

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6. Explain polygenic inheritance and give an example of one human trait that has polygenic inheritance. _____

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Concept 10.4 Meiosis explains Mendel's principles. (pp. 218–219)

The *chromosome theory of inheritance* states that genes are located on chromosomes, and the behavior of chromosomes during meiosis and fertilization accounts for inheritance patterns.

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The location of a particular gene on a chromosome is called a *gene locus* (plural, *loci*). The alleles for a trait have the same gene loci on homologous chromosomes.

When genes are located on the same chromosome, they do not follow the law of independent assortment. Usually the alleles on a particular chromosome are inherited together, which is called *genetic linkage*. The only time the alleles on a chromosome sort independently is when crossing over separates them.

7. What is the chromosome theory of inheritance? _____

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8. How does genetic linkage affect inheritance patterns? _____

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Concept 10.5 Sex-linked traits have unique inheritance patterns. (pp. 220–221)

Many species have a pair of chromosomes, called sex chromosomes, that determine the sex of an individual. Genes located on sex chromosomes are called *sex-linked genes*. Many sex-linked genes have different inheritance patterns in males and females. For many of the gene loci on the human X chromosome, there is no corresponding gene locus on the smaller Y chromosome. So, for such a gene on the X chromosome, females receive two alleles for the gene. Males, however, have only one X chromosome, so they have only one allele for the gene. Even if the allele on a male's X chromosome is recessive, it will be expressed. Red-green color blindness and hemophilia are both sex-linked recessive traits. Both of these disorders are more common in males, because the genes for these traits are found on the X chromosome.

9. What is a sex-linked gene? _____

_____

10. Explain why sex-linked disorders on the X chromosome are more common in males than in females. _____

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Reading Skills Practice

Summarizing main ideas Write a sentence that summarizes the main idea under each heading in Concept 10.2.

Vocabulary Review and Reinforcement

In 1–8, write true *if the statement is true. If the statement is false, replace the underlined term with a term that makes the statement true.*

_____ **1.** Alternative forms of a gene are called <u>traits.</u>

_____ **2.** An observable trait is a(n) <u>phenotype.</u>

_____ **3.** An individual is <u>heterozygous</u> for a character if the individual's two alleles for that character are the same.

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_____ **4.** The chromosome theory of inheritance states that genes are located on chromosomes, and the behavior of chromosomes accounts for inheritance patterns.

_____ **5.** The tendency for the alleles on one chromosome to be inherited together is called intermediate inheritance.

_____ **6.** Any gene that is located on a sex chromosome is called a(n) hybrid.

_____ **7.** When two or more genes affect a single character, it is called cross-fertilization.

_____ **8.** A diagram that shows all possible outcomes of a genetic cross is called a(n) Punnett square.

WordWise

Use the clues to fill in the blanks with Key Terms. Then put the numbered letters in order to find the hidden Key Term. Write a definition for the hidden Key Term.

Clues

1. genetic makeup, or combination of alleles
2. breeding an individual of dominant phenotype with a homozygous recessive individual to determine the individual's genotype
3. inheritance pattern in which a heterozygote expresses both traits
4. in a heterozygote, the allele that does not affect the trait
5. in a heterozygote, the allele that does affect the trait
6. cross between organisms differing in two characters
7. cross between organisms differing in only one character
8. location of an allele on a chromosome

Key Terms

1. _ _ _ _ _ _ _ _
1

2. _ _ _ _ _ _ _ _ _
2

3. _ _ _ _ _ _ _ _ _ _ _
3

4. _ _ _ _ _ _ _ _ _
4

5. _ _ _ _ _ _ _ _
5

6. _ _ _ _ _ _ _ _ _ _ _ _ _
6

7. _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
7

8. _ _ _ _ _ _ _ _ _
8

Key Term: _ _ _ _ _ _ _ _
1 2 3 4 5 6 7 8

Definition: _____

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