

CHAPTER 14—PATTERNS OF HEREDITY

MULTIPLE CHOICE

1. The type of inheritance shown when a red-flowering plant is crossed with a white-flowering plant and only pink-flowering plants are produced is _____.
 a. inbreeding
 b. incomplete dominance
 c. polygenic inheritance
 d. codominance

ANS: B DIF: B OBJ: 14-1

2. A trait controlled by four alleles is said to have _____.
 a. homologous alleles
 b. autosomes
 c. hybridization
 d. multiple alleles

ANS: D DIF: B OBJ: 14-2

3. The 23rd pair of chromosomes that differ in males and females are called _____.
 a. autosomes
 b. sex chromosomes
 c. multiple alleles
 d. polygenes

ANS: B DIF: B OBJ: 14-1

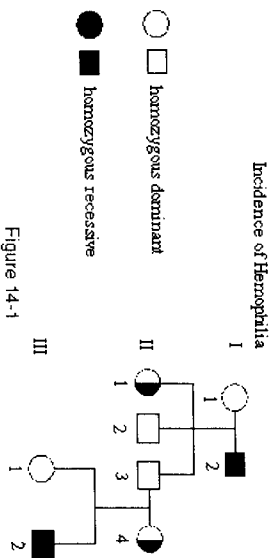


Figure 14-1

4. Refer to Figure 14-1. If individual III-2 marries a person with the same genotype as individual I-1, what is the chance that one of their children will be afflicted with hemophilia?

- a. 0%
 b. 25%
 c. 50%
 d. 75%

ANS: A DIF: A OBJ: 14-4

5. What type of inheritance pattern does the trait represented by the shaded symbols in Figure 14-1 illustrate?
 a. incomplete dominance
 b. multiple alleles
 c. codominance
 d. sex-linked

ANS: D DIF: A OBJ: 14-4

6. For the trait being followed in the pedigree, individuals II-1 and II-4 in Figure 14-1 can be classified as _____.
 a. homozygous dominant
 b. mutants
 c. homozygous recessive
 d. carriers

ANS: D DIF: B OBJ: 14-4

7. What is the relationship between individual I-1 and individual III-2 in Figure 14-1?
 a. grandfather-granddaughter
 b. grandmother-grandson
 c. great aunt-nephew
 d. mother-son

ANS: B DIF: B OBJ: 14-4

8. If a female fruit fly heterozygous for red eyes ($X^R X^r$) crossed with a white-eyed male ($X^r Y$), what percent of their offspring would have white eyes?

- a. 0%
 b. 25%
 c. 50%
 d. 75%

ANS: C DIF: A OBJ: 14-1

9. When roan cattle are mated, 25% of the offspring are red, 50% are roan, and 25% are white. Upon examination, it can be seen that the coat of a roan cow consists of both red and white hairs. This trait is one controlled by _____.
 a. multiple alleles
 b. codominant alleles
 c. sex-linked genes
 d. polygenic inheritance

ANS: B DIF: A OBJ: 14-1

10. In pea plants, inflated pods (R) are dominant to constricted pods (r). Which of the following crosses is a testcross?

- a. $RR \times RR$
 b. $RR \times Rr$
 c. $Rr \times rr$
 d. $Rr \times Rr$

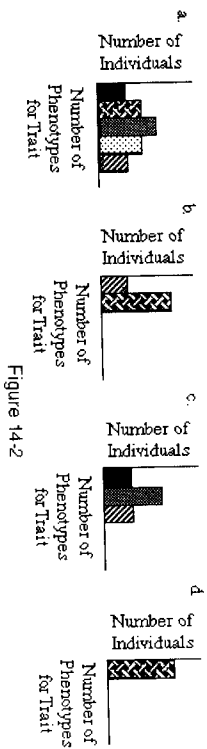
ANS: C DIF: B OBJ: 14-1

11. A cross between a white rooster and a black hen results in 100% blue Andalusian offspring. When two of these blue offspring are mated, the probable phenotypic ratio seen in their offspring would be _____.
- 100% blue
 - 75% black, 25% white
 - 75% blue, 25% white
 - 25% black, 50% blue, 25% white

ANS: D DIF: A OBJ: 14-1

12. Because the gene for red-green color blindness is located on the X chromosome, it is normally not possible for a _____.
- carrier mother to pass the gene on to her daughter
 - carrier mother to pass the gene on to her son
 - color blind father to pass the gene on to his daughter
 - color blind father to pass the gene on to his son

ANS: D DIF: A OBJ: 14-1



13. Which of the bar graphs shown in Figure 14-2 represents what the phenotypic frequencies might be for polygenic inheritance?

ANS: A DIF: A OBJ: 14-2

COMPLETION

- Traits controlled by genes located on the X or Y chromosome are _____.
ANS: sex-linked traits DIF: B OBJ: 14-1
- Humans have 22 pairs of _____ type of chromosomes.
ANS: autosome DIF: B OBJ: 14-1
- A graphic representation of an individual's family tree is a(n) _____.
ANS: pedigree DIF: B OBJ: 14-4
- The inheritance pattern of a trait controlled by two or more genes is _____.
ANS: polygenic inheritance DIF: B OBJ: 14-2

14-3

- The mating of an individual of unknown genotype with one that is homozygous recessive in order to determine the unknown genotype is a(n) _____.
ANS: testcross DIF: B OBJ: 14-4
- The mating of two closely related individuals is _____.
ANS: inbreeding DIF: B OBJ: 14-5
- _____ is when the phenotype of the heterozygote is intermediate between those phenotypes expressed by the homozygotes.
ANS: Incomplete dominance DIF: B OBJ: 14-1
- _____ are the result of crossing two varieties or closely related species.
ANS: Hybrids DIF: B OBJ: 14-4
- When phenotypes of both homozygotes are produced in the heterozygote, they are called _____.
ANS: codominant alleles DIF: B OBJ: 14-1

SHORT ANSWER

- How does incomplete dominance differ from multiple alleles?
ANS: In incomplete dominance, there are only two alleles, neither of which is dominant to the other. In multiple alleles, there are more than two alleles, any one of which may be dominant to any recessive allele.
DIF: A OBJ: 14-2
- How does polygenic inheritance differ from Mendelian inheritance?
ANS: In Mendelian inheritance, traits are determined by dominant and recessive paired alleles of single genes. In polygenic inheritance, a trait is controlled by two or more genes.
DIF: A OBJ: 14-2
- What impacts have pedigree analysis, inbreeding, and hybridization made on crop plants and farm animals?
ANS: Inbreeding is mating between closely related offspring and ensures that offspring are homozygous for most traits. Using pedigree analysis, the inheritance pattern of useful traits can be selected and maintained in farm animals such as sheep and cattle. Hybridization is the production of offspring from two varieties or closely related species. The impact of hybridization on corn, wheat, and similar crops has often been the production of larger and stronger plants than either of the parents.
DIF: A OBJ: 14-5

14-4

4. Discuss the importance of animal breeding to the pet industry.

ANS: Animals have been selectively bred for thousands of years. The many domestic breeds of dogs, cats, fishes, and similar pet animals are a result of this selective process. Dogs and cats are bred for such traits as body form, coat color, and behavior. With an increased understanding of genetics, it has been possible to produce new breeds in a shorter time.

DIF: A OBJ: 14-5

5. Discuss how the external environment of an organism can affect gene function.

ANS: Temperature, light, nutrition, chemicals, and infectious agents can all influence genes. Examples resulting from differences in temperature include colors in some bacteria and patterns in the coat color of rabbits. Similar phenotypes are controlled by many other genes in organisms.

DIF: A OBJ: 14-3

6. Discuss how the internal environment of an organism can affect gene function.

ANS: Age, gender, and sex hormones are three factors in the internal environment that can make a difference in gene function. Some traits, such as horns or breast development, are expressed differently in the sexes. Often, the genes that determine one phenotype depend on the function by a different set of genes.

DIF: A OBJ: 14-3

7. A male is said to be hemizygous for genes on the X chromosome. Explain why you think this term was chosen.

ANS: The prefix hemi- means "half." Because only one of a male's two sex chromosomes is an X chromosome, only half his sex chromosomes can carry the genes.

DIF: A OBJ: 14-1

8. The gene for color blindness in humans is found on the X chromosome. A boy has a color blind father. Will the boy be color blind? Explain.

ANS: Only if his mother carries the gene for color blindness; he cannot inherit color blindness from his father.

DIF: A OBJ: 14-1

9. A breeder wants to find out whether or not a certain golden retriever is a carrier of an undesirable recessive trait. What could the breeder do? Explain.

ANS: The breeder could perform a testcross by mating the questionable retriever with another retriever that has the recessive phenotype (is homozygous recessive). If any offspring show the recessive trait, the breeder knows the first dog is a carrier of the trait and should not be used for breeding.

DIF: A OBJ: 14-4

10. Choose the term that does not belong with the rest and explain your answer: *autosomes*, *X and Y chromosomes*, *sex-linked traits*, *sex chromosomes*.

ANS: *autosomes* because it is the only term not related to the sex chromosomes

DIF: A OBJ: 14-1

11. Choose the term that does not belong with the rest and explain your answer: *genotype*, *phenotype*, *heterozygous*, *homozygous*.

ANS: *Phenotype* because the other three terms describe the gene combinations an organism would possess and not the expression of those genes

DIF: A OBJ: 14-3

12. Choose the term that does not belong with the rest and explain your answer: *heterozygous*, *hybrid*, *carrier*, *homozygous*.

ANS: *Homozygous* because the other terms involve contrasting alleles for a trait. A homozygous individual possesses two identical alleles for a trait.

DIF: A OBJ: 14-1

PROBLEM

Geneticists are constantly on the lookout for organisms with mutations. Such individuals provide information about the heredity and development of the species of organism. When a mutation is discovered, phenotypic differences are examined. Then unique details of the mutation's genotype and inheritance pattern are carefully analyzed. This was true in the time of Thomas Morgan and is still true today. Historically, much work in the field of genetics has been done with fruit flies because huge numbers of them can be cultured in a relatively small space, and because large populations of offspring can be obtained in short periods of time.

Forearmed with this knowledge and seeking scientific fame, you search your garden for fruit flies. It's a good day! You trap one male with miniature wings and several normal females. You carefully place the flies in a culture vial and allow them to mate. When you see tiny larvae feeding on the culture medium, you place the adults in another culture vial. All that is left in the original culture vial is the F₁ generation of flies. When these mature, you note that none of the flies has miniature wings.

Next, you examine all of the flies with miniature wings. If you are to become famous for your work in genetics, you need to keep precise records. So, you carefully record information about each of the flies in your cultures. When you are finished, you notice something truly unusual. All of the flies with miniature wings are males.

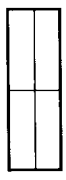


Figure 14-3

10. Watson and Crick, with the help of Rosalind Franklin, developed the _____ model of DNA.
ANS: double helix DIF: B OBJ: 13-1
11. A(n) _____ involves the addition or deletion of a single base in a DNA molecule.
ANS: frameshift mutation DIF: B OBJ: 13-5
12. During the process of transcription, DNA serves as the template for making _____, which leaves the nucleus and travels to the ribosomes.
ANS: mRNA DIF: B OBJ: 13-4
13. Translation is to protein as transcription is to _____.
ANS: messenger RNA DIF: A OBJ: 13-4
14. DNA is to RNA as double stranded is to _____.
ANS: single stranded DIF: A OBJ: 13-4
15. Adenine is to thymine as guanine is to _____.
ANS: cytosine DIF: A OBJ: 13-1

SHORT ANSWER

1. Why are triploid bananas reproduced by cuttings from plant stock?
ANS: Triploid bananas can't produce seeds because they are sterile, and thus must be reproduced in other ways, such as by cuttings from plant stock.
DIF: A OBJ: 13-6
2. What might happen to organisms that receive one chromosome more or less than normal?
ANS: They might have genetic disorders and they might die.
DIF: A OBJ: 13-6
3. Identify the following types of chromosome changes.
a. abcdef → abcdef
b. abcdef → abed + cd
c. abcdef → abcde56
123456 → 1234ef
ANS: a-inversion, b-deletion, c-translocation
DIF: A OBJ: 13-5

4. What is the difference between a codon and an anticodon?
ANS: A codon is a three-base code for a specific amino acid. An anticodon is a tRNA triplet of nitrogen bases that bonds to a complementary codon on the messenger RNA.
DIF: A OBJ: 13-4
5. Why is tRNA important in translation?
ANS: Transfer RNA brings an amino acid to the ribosome for translating the DNA code into a protein.
DIF: A OBJ: 13-4

PROBLEM

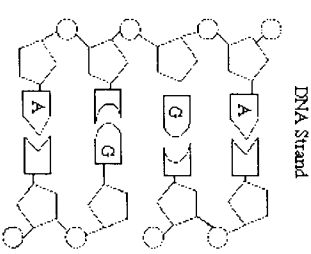
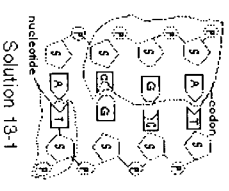


Figure 13-1

1. In Figure 13-1, use the letter P to label all of the phosphate groups. Use an S to label all the sugar molecules. For labeling the nitrogen bases, use a T for thymine and a C for cytosine. Guanine and adenine have been filled in for you. Circle and label a codon. Circle and label a nucleotide.
ANS: See Solution 13-1.



Solution 13-1