

Chapter 11 Study Guide

Study Tip

Give students various problems in genetics in which they must identify genotypes and phenotypes of parents and offspring, identify patterns of inheritance, or predict the outcomes of crosses with Punnett squares.

Thinking Visually

1. Each chromosome pairs with its corresponding homologous chromosome.
2. Spindle fibers pull homologous chromosomes toward opposite ends of the cell.
3. Sister chromatids separate and move toward opposite ends of the cell.

Chapter 11 Assessment

Reviewing Content

- | | | |
|------|------|-------|
| 1. c | 5. c | 9. d |
| 2. a | 6. d | 10. b |
| 3. a | 7. d | |
| 4. c | 8. d | |

Understanding Concepts

11. (1) The inheritance of biological characteristics is determined by genes. (2) Where there are two or more forms (alleles) of the gene for a single trait, some forms of the gene may be dominant and others recessive. (3) In most sexually reproducing organisms, each adult has two copies of each gene, one from each parent. These genes are segregated when gametes form. (4) The alleles for different genes (actually, the chromosomes) usually segregate independently.
12. Probability is the likelihood that an event will occur. This principle can be used to predict the outcomes of genetic crosses.

Chapter 11 Study Guide

11-1 The Work of Gregor Mendel

Key Concepts

- The principle of dominance states that some alleles are dominant and others are recessive.
- When each F_1 plant flowers, the two alleles segregate from each other so that each gamete carries only a single copy of each gene. Therefore, each F_1 plant produces two types of gametes—those with the allele for tallness and those with the allele for shortness.

Vocabulary

genetics, p. 263 • fertilization, p. 263
true-breeding, p. 263
trait, p. 264 • hybrid, p. 264
gene, p. 265 • allele, p. 265
segregation, p. 266 • gamete, p. 266

11-2 Probability and Punnett Squares

Key Concepts

- The principles of probability can be used to predict the outcomes of genetic crosses.
- Punnett squares can be used to predict and compare the genetic variations that will result from a cross.

Vocabulary

probability, p. 267 • Punnett square, p. 268
homozygous, p. 268 • heterozygous, p. 268
phenotype, p. 268 • genotype, p. 268

11-3 Exploring Mendelian Genetics

Key Concepts

- The principle of independent assortment states that genes for different traits can segregate independently during the formation of gametes. Independent assortment helps account for the many genetic variations observed in plants, animals, and other organisms.
- Some alleles are neither dominant nor recessive, and many traits are controlled by multiple alleles or multiple genes.

Vocabulary

independent assortment, p. 271
incomplete dominance, p. 272
codominance, p. 272
multiple alleles, p. 273
polygenic traits, p. 273

11-4 Meiosis

Key Concepts

- Meiosis is a process of reduction division in which the number of chromosomes per cell is cut in half through the separation of homologous chromosomes in a diploid cell.
- Mitosis results in the production of two genetically identical diploid cells, whereas meiosis produces four genetically different haploid cells.

Vocabulary

homologous, p. 275 • diploid, p. 275
haploid, p. 275 • meiosis, p. 276
tetrad, p. 276 • crossing-over, p. 277

11-5 Linkage and Gene Maps

Key Concept

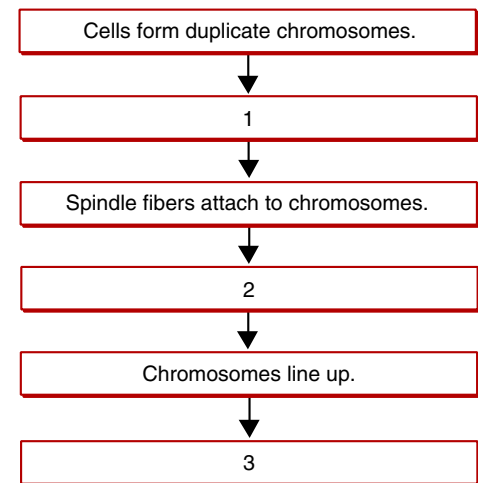
- Chromosomes assort independently; individual genes do not.

Vocabulary

gene map, p. 280

Thinking Visually

Using the information in this chapter, complete the following flowchart about meiosis.



CHAPTER RESOURCES

Print:

- **Teaching Resources**, Chapter Vocabulary Review, Graphic Organizer
- **Chapter Tests: Levels A and B**, Chapter 11 Test

Technology:

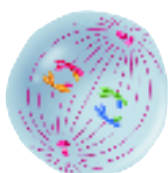
- **Computer Test Bank**, Chapter 11 Test
- **iText**, Chapter 11 Assessment

Chapter 11 Assessment

Reviewing Content

Choose the letter that best answers the question or completes the statement.

- Different forms of a gene are called
a. hybrids. c. alleles.
b. dominant factors. d. recessive factors.
- If a homozygous tall pea plant and a homozygous short pea plant are crossed,
a. the recessive trait seems to disappear.
b. the offspring are of medium height.
c. no hybrids are produced.
d. all the offspring are short.
- A Punnett square is used to determine the
a. probable outcome of a cross.
b. actual outcome of a cross.
c. result of mitosis.
d. result of meiosis.
- Organisms that have two identical alleles for a particular trait are said to be
a. hybrid. c. homozygous.
b. heterozygous. d. dominant.
- The physical characteristics of an organism are its
a. genetics. c. phenotype.
b. heredity. d. genotype.
- A situation in which a gene has more than two alleles is known as
a. complete dominance.
b. codominance.
c. polygenic dominance.
d. multiple alleles.
- The illustration below represents what stage of meiosis?
a. prophase I c. telophase I
b. anaphase II d. metaphase I



- Unlike mitosis, meiosis in male mammals results in the formation of
a. one haploid cell.
b. three diploid polar bodies.
c. four diploid gamete cells.
d. four haploid gamete cells.

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- To maintain the chromosome number of an organism, the gametes must
a. become diploid.
b. become recessive.
c. be produced by mitosis.
d. be produced by meiosis.
- A gene map shows
a. the number of possible alleles for a gene.
b. the relative locations of genes on a chromosome.
c. where chromosomes are in a cell.
d. how crossing-over occurs.

Understanding Concepts

- List the four basic principles of genetics that Mendel discovered in his experiments. Briefly describe each of these principles.
- What is probability? How does probability relate to genetics?
- In pea plants, the allele for yellow seeds is dominant to the allele for green seeds. Predict the genotypic ratio of offspring produced by crossing two parents heterozygous for this trait. Draw a Punnett square to illustrate your prediction.
- How do multiple alleles and polygenic traits differ?
- Why can multiple alleles provide many different phenotypes for a trait?
- Are an organism's characteristics determined only by its genes? Explain.
- Suppose that for an organism, $2N = 8$. How many chromosomes do the organism's gametes contain?
- In rabbits, B is an allele for black coat and b is an allele for brown coat. Write the genotypes for a rabbit that is homozygous for black coat and another rabbit that is heterozygous for black coat.
- Describe the process of meiosis.
- Compare the phases of meiosis I with the phases of meiosis II in terms of the number and arrangement of the chromosomes.
- Explain why it is chromosomes, not individual genes, that assort independently.



If your class subscribes to the iText, your students can go online to access an interactive version of the Student Edition and a self-test.

(Continued from page 282)

13. $1 YY : 2 Yy : 1 yy$

| | | |
|---|----|----|
| | Y | y |
| Y | YY | Yy |
| y | Yy | yy |

- A gene has multiple alleles if it has more than two alleles. Two or more genes control polygenic traits.
- With two alleles for a trait, up to three phenotypes are possible. With three alleles, up to six phenotypes are possible.
- No, genes provide a plan for development, but how the plan unfolds depends on the environment.
- Four
- Homozygous black coat: BB ; heterozygous black coat: Bb
- Meiosis is a process of reduction division in which the number of chromosomes per cell is cut in half through the separation of homologous chromosomes.
- DNA replicates during interphase so that during meiosis I, all of the chromosomes are doubled and consist of duplicate chromosomes (sister chromatids). At anaphase I, the homologous chromosomes separate, with the sister chromatids still together, as two haploid daughter cells form. During meiosis II, the sister chromatids separate to produce four haploid daughter cells.
- It is the chromosomes that are separated during gamete formation. The genes are linked to the chromosomes.



HOMEWORK GUIDE

| Section: | Questions: |
|--------------|------------------------------------|
| Section 11-1 | 1 |
| Section 11-2 | 2-5, 12, 13, 18, 22, 24-26, 29, 30 |
| Section 11-3 | 6, 11, 14-16, 28 |
| Section 11-4 | 7-9, 17, 19, 20, 23 |
| Section 11-5 | 10, 21, 27 |

Critical Thinking

22. By crossing the white ram to a number of black ewes; if any offspring are black, then the white ram is heterozygous

23.

| | Mitosis | Meiosis |
|--------------------------|--------------|-------------|
| Number of cells produced | 2 | 4 |
| Type of cell | body | gamete |
| Chromosome number | diploid (2N) | haploid (N) |

24. Both parents are heterozygous.

25. The predicted outcome of the cross is 50% rough and 50% smooth. However, since the result of each fertilization (joining of egg and sperm) is independent of any previous fertilization, it is possible for all offspring to have smooth coats.

26. The original genotypes and the crosses could have been $Tt \times tt$ or $Tt \times Tt$. The genotype TT could not have been present; if it were, all the offspring would be tall.

27. There would be less genetic variation in the F_2 generation between two closely linked genes because these genes will not be separated during the chromosomal movements of meiosis and the chances of crossing-over events separating the genes are slim.

28. The color helps the ptarmigan hide from predators. In winter, its white coat color blends in with its snowy surroundings. In summer, its brown coat blends in with the bare ground and grass.

29. The allele for black color is dominant, and the allele for brown color is recessive. The black parent is homozygous, and the brown parent is heterozygous.

30. Punnett squares could be used to raise questions for investigation, to predict the possible outcomes of a cross when writing the hypothesis, to analyze data, and to explain results.

Critical Thinking

22. **Designing Experiments** In sheep, the allele for white wool (A) is dominant over the allele for black wool (a). How would you determine the genotype of a white ram, or male sheep?

23. **Comparing and Contrasting** Design and complete a table to compare and contrast meiosis and mitosis.

24. **Applying Concepts** In dogs, the allele for short hair is dominant over the allele for long hair. Two short-haired dogs are the parents of a litter of eight puppies. Six puppies have short hair, and two have long hair. What are the genotypes of the parents?

25. **Applying Concepts** In guinea pigs, the allele for a rough coat (R) is dominant over the allele for a smooth coat (r). A heterozygous guinea pig (Rr) and a homozygous recessive guinea pig (rr) have a total of nine offspring. The Punnett square for this cross shows a 50 percent chance that any particular offspring will have smooth coats. Explain how all nine offspring can have smooth coats.

| | R | r |
|-----|------|------|
| r | Rr | rr |
| r | Rr | rr |

26. **Inferring** Suppose Mendel crossed two pea plants and got both tall and short offspring. What could have been the genotypes of the two original plants? What genotype could not have been present?

27. **Comparing and Contrasting** Suppose a plant geneticist uses true-breeding plants to make a two-factor cross involving genes that are closely linked on a chromosome. How would the genetic variation in the F_2 generation probably differ from a cross in which two genes assort independently?

28. **Interpreting Graphics** Genes that control hair or feather color in some animals have different effects in the winter than in the summer. How might such a difference be beneficial to the ptarmigan shown below?



29. **Formulating Hypotheses** Suppose you found out that a mating between a black animal and a brown animal produced all black offspring. Propose a hypothesis to explain the color of the offspring.

30. **Connecting Concepts** How might a scientist use a Punnett square in designing and carrying out an experiment?

Writing in Science

Write an explanation of dominant and recessive alleles that would be appropriate to give to an eighth-grade science class. You can assume that the eighth-grade students already know the meanings of *gene* and *allele*. (Hint: Use examples to make your explanation clear.)

Performance-Based Assessment

Creating Storyboards You are a writer for a TV station. The producer asks you to write a series that takes the viewer on an imaginary voyage back in time. Each week, a famous person in history will be visited. The show is designed to provide insight into the work of the person being interviewed and to give the viewers a feel for the events of that era. The first person you visit will be Gregor Mendel. Create storyboards that plan one scene for this program.

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