UNIT A GENETICS

READING REFERENCE STUDY GUIDE

Chapter 11 Study Guide

Information and Heredity Genetic information passes from parent to offspring during meiosis when gametes, each containing one representative from each chromosome pair, unite.

11.1 The Work of Gregor Mendel

Summary:

- An individual's characteristics are determined by factors that are passed from one parental generation to the next.

- During gamete formation, the alleles for each gene segregate from each other so that each gamete carries only one allele for each gene

Vocabulary:

Genetics, allele, fertilization, principle of dominance, trait, hybrid, segregation, gene, gamete

Answer all open questions with proper paragraph and sentence structure and spelling and punctuation

11.2 Applying Mendel's Principles

Summary:

- Punnett squares use mathematical probability to help predict the genotype and phenotype combinations in genetic crosses.

- The principle of independent assortment states that genes for different traits can segregate independently during the formation of gametes.

- Mendel's principles of heredity, observed through patterns of inheritance, form the basis of modern genetics

Vocabulary:

probability genotype homozygous Punnett square heterozygous independent phenotype assortment

11.3 Other Patterns of Inheritance

- Some alleles are neither dominant nor recessive. Many genes exist in several different forms and are therefore said to have multiple alleles. Many traits are produced by the interaction of several genes.

- Environmental conditions can affect gene expression and influence genetically determined traits.

Vocabulary

incomplete dominance, multiple allele, polygenic trait, codominance

Answer all open questions with proper paragraph and sentence structure and spelling and punctuation

11.4 Meiosis

- The diploid cells of most adult organisms contain two complete sets of inherited chromosomes and two complete sets of genes.

- (*In our class we don't go crazy on the details of these cycles*!) In prophase I, replicated chromosomes pair with corresponding homologous chromosomes. At metaphase I, paired chromosomes line up across the center of the cell. In anaphase I, chromosome pairs move toward opposite ends of the cell. In telophase I, a nuclear membrane forms around each cluster of chromosomes. Cytokinesis then forms two new cells. As the cells enter prophase II, their chromosomes become visible. The final four phases of meiosis II result in four haploid daughter cells.

- In **mitosis**, when the two sets of genetic material separate, each daughter cell receives one complete set of chromosomes. In **meiosis**, homologous chromosomes line up and then move to separate daughter cells. Mitosis does not normally change the chromosome number of the original cell. Meiosis reduces the chromosome number by half. Mitosis results in the production of two genetically identical diploid cells, whereas meiosis produces four genetically different haploid cells.

- Alleles of different genes tend to be inherited together from one generation from the next when those genes are located on the same chromosome.

Vocabulary

Homologous, tetrad, diploid, crossing-over,

Haploid, zygote, meiosis

Think Visually Use the following terms to create a concept map: alleles, genes, chromosomes, dominant, traits, recessive.

Chapter 11 Assessment

11.1 The Work of Gregor Mendel

Understand Key Concepts

1. Different forms of a gene are called

a. hybrids. b. dominant factors.
c. alleles. d. recessive factors.

2. Organisms that have two identical alleles for a particular trait are said to be

a. hybrid. b. heterozygous. c. homozygous. d. dominant.

Answer all open questions with proper paragraph and sentence structure and spelling and punctuation

3. Mendel had many stocks of pea plants that were true-breeding. What is meant by this term?

4. Explain how Mendel kept his pea plants from self-pollinating

Think Critically

5. **Design an Experiment** In sheep, the allele for white wool (A) is dominant over the allele for black wool (a). A ram is a male sheep, the female is called a 'ewe'. How would you determine the genotype of a white ram?

6. **Infer** Suppose Mendel crossed (*monohybrid cross*, only examining one trait) two pea plants and got both tall (T dominant) and short offspring (t recessive). What could have been the genotypes of the two original plants? What genotype could not have been present?

11.2 Applying Mendel's Principles

Understand Key Concepts

7. A Punnett square is used to determine the

a. probable outcome of a cross. b. actual outcome of a cross.

c. result of incomplete dominance. d. result of meiosis.

8. The physical characteristics of an organism are called its

a. genetics. b. heredity. c. phenotype. d. genotype.

9. Probability can: (select the one best answer)

a. predict what happens the very next time something happens
b. predict exactly how often something will likely happen after a hundred tries (experiments)
c. predict what will likely happen after many tries (experiments)
d. is just complete randomness

10. The probability of flipping a coin twice and getting two heads is

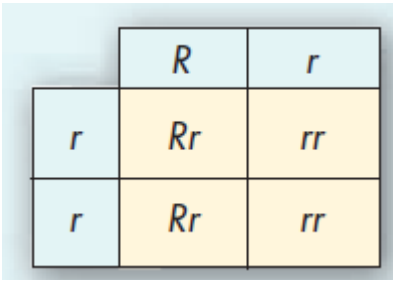
a. 1 b. 1/2 c. 1/4 d. ¾

11. If the probability of having a blue eye (or any trait actually) offspring is 25%, is it possible that after having 10 children a couple has all blue-eyed children? Give an example using standard playing cards! (*Hint: there are four suits in a deck*)

12. List the four basic principles of genetics that Mendel discovered in his experiments. Briefly describe each of these principles

13. In pea plants, the allele for yellow seeds is dominant over the allele for green seeds. Predict the genotypic ratio of offspring produced by crossing two parents that are heterozygous for this trait. Draw a Punnett square to illustrate your prediction.

Think Critically



	R	r
r	Rr	rr
r	Rr	rr

12. **Apply 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 a smooth coat.

a. Explain how all nine offspring can have smooth coats.
b. Have your teacher show you (or you yourself research) the mathematical explanation using Pascal's Triangle!

11.3 Other Patterns of Inheritance

Understand Key Concepts

13. 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.

15. What is the difference between multiple alleles and polygenic traits?

16. Why can multiple alleles result in many different phenotypes for a trait?

17. Are an organism's characteristics determined only by its genes? Explain.

11.4 Meiosis

Understand Key Concepts

19. The illustration represents what stage of meiosis?
    a. prophase I
    b. anaphase II
    c. telophase I
    d. metaphase I

Answer all open questions with proper paragraph and sentence structure and spelling and punctuation

20. Unlike mitosis, meiosis in male mammals results in the formation of

a. one haploid gamete.
b. three diploid gametes.
c. four diploid gametes.
d. four haploid gametes.

21. A gene map shows

a. the number of possible alleles for a gene.
b. the relative locations (locus) of genes on a chromosome.
c. where chromosomes are in a cell.
d. how crossing-over occurs.

22. Suppose that an organism has the diploid number 2N = 8. How many chromosomes do this organism's gametes contain?

23. Describe, simply, the process of meiosis.

24. Explain why chromosomes, not individual genes, assort independently.

Answer all open questions with proper paragraph and sentence structure and spelling and punctuation

Susan's birthday was coming up. Parakeets make great pets, so Susan's parents decided to give two birds to her as a birthday present. At the pet store, they selected two healthy green parakeets—one male and one female. They knew that green was Susan's favorite colour. Susan was delighted about her birthday present.

She fed the birds and kept their cage clean. A few weeks later, Susan found three small eggs in the birds' nest. She couldn't wait to welcome three new green parakeets. When the eggs finally hatched, however, Susan was amazed. None of the chicks was green—one chick was white, one was blue, and one was yellow. Why weren't any of them green? What had happened to the green colour of the birds' parents? As you read this chapter, look for clues to help you identify why the parakeet chicks were differently coloured than their parents. Then, solve the mystery.

GREEN PARAKEETS After consulting with the owner of the pet store, Susan realized she had a rare gift. White parakeets are very uncommon. The pet shop owner told Susan that two genes control feather colour. A dominant Y allele results in the production of a yellow pigment. The dominant B allele controls melanin production. If the genotype contains a capital Y (either YY or Yy) and a capital B, the offspring will be green. If the genotype contains two lowercase y alleles, and a capital B, the offspring will be blue. If the genotype contains two lowercase y's and two lowercase b's, the offspring will be white.

1. **Use Model**s Draw a Punnett square that accounts for the inheritance of blue pigment.

2. **Use Models** Construct a Punnett square that explains the inheritance of a white pigment.

3. **Apply Concepts** Solve the mystery by determining the genotypes and phenotypes of the parents and offspring.

4. **Connect to the Big Idea**. What ratio of coloured offspring would you expect if Susan breeds her original pair of parakeets in the years ahead? Would any offspring be green?

Answer all open questions with proper paragraph and sentence structure and spelling and punctuation

Use Science Graphics Seed coat was one trait that Mendel studied in pea plants. The coat, or covering, of the seed is either smooth or wrinkled. Suppose a researcher has two plants—one that makes smooth seeds and another that makes wrinkled seeds. The researcher crosses the wrinkled-seed plants and the smooth-seed plants, obtaining the following data. Use the data to answer questions 26–28.

Results of Seed Experiment

Phenotype	Number of Plants in the F_1 Generation	
	Expected	Observed
Smooth seeds		60
Wrinkled seeds		72

26. **Predict** Mendel knew that the allele for smooth (R) seeds was dominant over the allele for wrinkled (r) seeds. If this cross was Rr × rr, what numbers would fill the middle column?

27. **Analyze Data** Are the observed numbers consistent with the hypothesis that the cross is Rr × rr? Explain your answer.

28. **Draw Conclusions** Are the data from this experiment alone sufficient to conclude that the allele for smooth seeds is dominant over the allele for wrinkled seeds? Why or why not?

Answer all open questions with proper paragraph and sentence structure and spelling and punctuation

Write About Science

29. **Explain** 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 or sketch diagrams to make your explanation clear.)

30. **Cause and Effect** Explain why the alleles for reddish-orange eyes and miniature wings in Drosophila are usually inherited together. Describe the pattern of inheritance these alleles follow, and include the idea of gene linkage. (Hint: To organize your ideas, draw a diagram that shows what happens to the two alleles during meiosis.)

31. **Assess the Big Idea**. Explain why the gene pairs described by Mendel behave in a way that is consistent with the behavior of chromosomes during gamete formation, fertilization, and reproduction.

A researcher studying fruit flies finds a mutant fly with brown-coloured eyes. Almost all fruit flies in nature have bright red eyes. When the researcher crosses the mutant fly with a normal red-eyed fly, all of the F1 offspring have red eyes. The researcher then crosses two of the F1 red-eyed flies and obtains the following results in the F2 generation.

Eye Color in the F_2 Generation	
Red eyes	37
Brown eyes	14

32. **Calculate** What is the ratio of red-eyed flies to brown-eyed flies?

a. 1 : 1 b. 1 : 3 c. 3 : 1 d. 4 : 1 33.

33. **Draw Conclusions** The allele for red eyes in fruit flies is

a. dominant over brown eyes.
b. recessive to brown eyes.
c. codominant with the brown-eyed gene.
d. a multiple allele with the brown-eyed gene and others.

Standardized Test Prep

Multiple Choice

1. What happens to the chromosome number during meiosis?

A. It doubles. B. It stays the same.
C. It halves. D. It becomes diploid.

2. Which ratio did Mendel find in his F_2 generation?

A. 3 : 1 B. 1 : 3 : 1 C. 1 : 2 D. 3 : 4

3. **Optional**. During which phase of meiosis is the chromosome number reduced?

A. anaphase I B. metaphase I
C. telophase I D. telophase II

4. Two pink-flowering plants are crossed. The offspring flower as follows: 25% red, 25% white, and 50% pink. What pattern of inheritance does flower colour in these flowers follow?

A. dominance B. multiple alleles
C. incomplete dominance D. polygenic traits

5. Which of the following is used to construct a gene map?

A. chromosome number
B. mutation rate
C. rate of meiosis
D. recombination rate

Answer all open questions with proper paragraph and sentence structure and spelling and punctuation

6. **Optional**. Alleles for the same trait are separated from each other during the process of

A. cytokinesis. B. meiosis I.

C. meiosis II. D. metaphase II.

7. Which of the following is NOT one of Gregor Mendel's principles?

A. The alleles for different genes usually segregate independently.

B. Some forms of a gene may be dominant.

C. The inheritance of characteristics is determined by factors (genes).

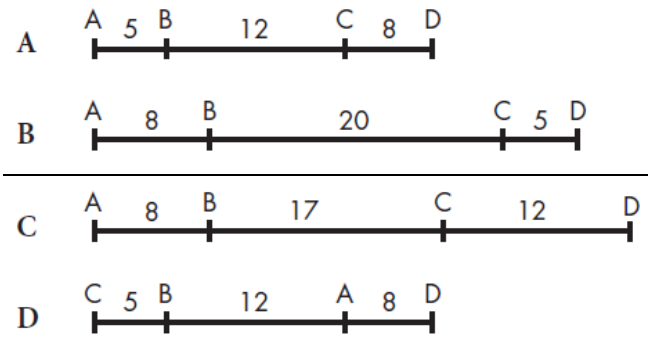
D. Crossing-over occurs during meiosis.

Genes A, B, C, and D are located on the same chromosome. After calculating recombination frequencies, a student determines that these genes are separated by the following map units: C–D, 25 map units; A–B, 12 map units; B–D, 20 map units; A–C, 17 map units.

8. How many map units apart are genes A and D?

A. 5 B. 8 C. 10 D. 12.5

9. Which gene map best reflects the student's data?



Answer all open questions with proper paragraph and sentence structure and spelling and punctuation

Open-Ended Response

10. Explain why meiosis allows organisms to maintain their chromosome numbers from one generation to the next.