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Chapter 11

Introduction to Genetics

Section 11–1 The Work of Gregor Mendel (pages 263–266)

This section describes how Gregor Mendel studied the inheritance of traits in garden peas and what his conclusions were.

Introduction (page 263)

1. The scientific study of heredity is called _____.

Gregor Mendel's Peas (pages 263–264)

2. Circle the letter of each sentence that is true about Gregor Mendel's peas.

a. The male parts of pea flowers produce eggs.

b. When pollen fertilizes an egg cell, a seed for a new plant is formed.

c. Pea plants normally reproduce by self-pollination.

d. Seeds that are produced by self-pollination inherit their characteristics from two different plants.

3. What does it mean when pea plants are described as being true-breeding? _____

_____

4. To perform his experiments, how did Mendel prevent pea flowers from self-pollinating and control their cross-pollination? _____

_____

_____

Genes and Dominance (pages 264–265)

Match the term with its definition.

	Definitions	Terms
_____	**5.** Specific characteristics that vary from one individual to another	**a.** genes
_____	**6.** The offspring of crosses between parents with different traits	**b.** hybrids
_____	**7.** Chemical factors that determine traits	**c.** traits
_____	**8.** The different forms of a gene	**d.** alleles

9. State the principle of dominance. _____

_____

10. Is the following sentence true or false? An organism with a recessive allele for a particular form of a trait will always have that form. _____

11. Circle the letters of the dominant alleles in Mendel's pea plants.

a. tall **b.** short **c.** yellow **d.** green

Segregation (pages 265–266)

12. How did Mendel find out whether the recessive alleles were still present in the F_1 plants? _____

_____

_____

13. About one fourth of the F_2 plants from Mendel's F_1 crosses showed the trait controlled by the _____ allele.

14. Circle the letter of each sentence that is true about Mendel's explanation of the results from his F_1 cross.

a. Mendel assumed that a dominant allele had masked the corresponding recessive allele in the F_1 generation.

b. The trait controlled by the recessive allele never showed up in any F_2 plants.

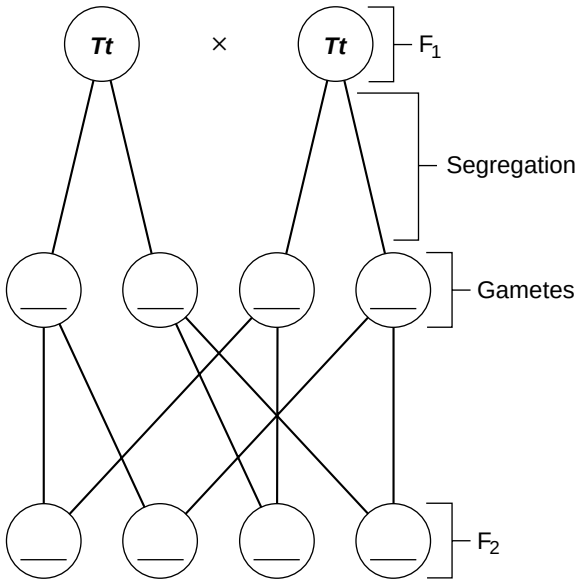
c. The allele for shortness was always inherited with the allele for tallness.

d. At some point, the allele for shortness was segregated, or separated, from the allele for tallness.

15. What are gametes? _____

_____

16. Complete the following diagram to show how alleles segregate during the formation of gametes.



17. In the diagram above, the dominant allele is represented by _____ and the recessive allele is represented by _____.

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Section 11–2 Probability and Punnett Squares (pages 267–269)

This section explains how geneticists use the principles of probability.

Genetics and Probability (page 267)

1. The likelihood that a particular event will occur is called _____.
2. Circle the letter of the probability that a single coin flip will come up heads.
   a. 100 percent **b.** 75 percent **c.** 50 percent **d.** 25 percent
3. Is the following sentence true or false? The past outcomes of coin flips greatly affect the outcomes of future coin flips.
   _____
4. Why can the principles of probability be used to predict the outcomes of genetic crosses? _____

Punnett Squares (page 268)

5. How do geneticists use Punnett squares? _____
6. Complete the Punnett square to show the possible gene combinations for the F_2 offspring.

PUNNETT SQUARE FOR Tt × Tt

	T	t
T		
t		

Match the terms with the definitions.

Definitions

_____ **7.** Organisms that have two identical alleles for a particular trait (TT or tt)

_____ **8.** Organisms that have two different alleles for the same trait (Tt)

_____ **9.** Physical characteristic of an organism (tall)

_____ **10.** Genetic makeup of an organism (Tt)

Terms

a. genotype
b. homozygous
c. phenotype
d. heterozygous

11. Is the following sentence true or false? Homozygous organisms are true-breeding for a particular trait. _____

12. Is the following sentence true or false? Plants with the same phenotype always have the same genotype. _____

Probability and Segregation (page 269)

13. Circle the letter of each sentence that is true about probability and segregation.

- **a.** In an F_1 cross between two hybrid tall pea plants (Tt), $\frac{1}{2}$ of the F_2 plants will have two alleles for tallness (TT).
- **b.** The F_2 ratio of tall plants to short plants produced in a cross between two hybrid tall pea plants (Tt) is 3 tall plants for every 1 short plant.
- **c.** Mendel observed that about $\frac{3}{4}$ of the F_2 offspring showed the dominant trait.
- **d.** Segregation occurs according to Mendel's model.

14. In Mendel's model of segregation, what was the ratio of tall plants to short plants in the F_2 generation? _____

_____

Probabilities Predict Averages (page 269)

15. Is the following sentence true or false? Probabilities predict the precise outcome of an individual event. _____

16. How can you be sure of getting the expected 50 : 50 ratio from flipping a coin? _____

_____

17. The _____ the number of offspring from a genetic cross, the closer the resulting offspring numbers will get to expected values.

18. Is the following sentence true or false? The ratios of an F_1 generation are more likely to match Mendelian predictions if the F_1 generation contains hundreds or thousands of individuals.

_____

Reading Skill Practice

Taking notes helps the reader focus on the main ideas and the vocabulary of the reading. Take notes while rereading Section 11–2. Note the main ideas and the boldfaced terms in the order in which they are presented. You may copy the ideas word for word or summarize them using your own words. Do your work on a separate sheet of paper.

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Section 11–3 Exploring Mendelian Genetics (pages 270–274)

This section describes Mendel's principle of independent assortment. It also tells about traits that are controlled by multiple alleles or multiple genes.

Independent Assortment (pages 270–271)

1. In a two-factor cross, Mendel followed _____ different genes as they passed from one generation to the next.

2. Write the genotypes of the true-breeding plants that Mendel used in his two-factor cross.

Phenotype	Genotype
a. round yellow peas	_____
b. wrinkled green peas	_____

3. Circle the letter that best describes the F_1 offspring of Mendel's two-factor cross.

a. Homozygous dominant with round yellow peas

b. Homozygous recessive with wrinkled green peas

c. Heterozygous dominant with round yellow peas

d. Heterozygous recessive with wrinkled green peas

4. Is the following sentence true or false? The genotypes of the F_1 offspring indicated to Mendel that genes assort independently.

_____

5. How did Mendel produce the F_2 offspring? _____

_____

6. Circle the letter of the phenotypes that Mendel would expect to see if genes segregated independently.

a. round and yellow

b. wrinkled and green

c. round and green

d. wrinkled and yellow

7. What did Mendel observe in the F_2 offspring that showed him that the alleles for seed shape segregate independently of those for seed color? _____

_____

_____

_____

8. What were the phenotypes of the F_2 generation that Mendel observed? _____

_____

9. What was the ratio of Mendel's F_2 generation for the two-factor cross? _____

10. Complete the Punnett square below to show the predicted results of Mendel's two-factor cross.

MENDEL'S TWO-FACTOR CROSS
RrYy × RrYy

	RY	Ry	rY	ry
RY				
Ry				
rY				
ry				

11. State Mendel's principle of independent assortment. _____

_____

_____

A Summary of Mendel's Principles (page 272)

12. Circle the letter of each sentence that is true about Mendel's principles.

- **a.** The inheritance of biological characteristics is determined by genes that are passed from parents to their offspring in organisms that reproduce sexually.
- **b.** Two or more forms of the gene for a single trait can never exist.
- **c.** The copies of genes are segregated from each other when gametes are formed.
- **d.** The alleles for different genes usually segregate independently of one another.

13. When two or more forms of the gene for a single trait exist, some forms of the gene may be _____ and others may be _____.

Beyond Dominant and Recessive Alleles (pages 272–273)

14. Is the following sentence true or false? All genes show simple patterns of dominant and recessive alleles. _____

15. Complete the compare-and-contrast table of the different patterns of inheritance.

PATTERNS OF INHERITANCE

Type	Description	Examples
	One allele is not completely dominant over another. The heterozygous phenotype is somewhere in between the two homozygous phenotypes.	
	Both alleles contribute to the phenotype of the organism.	
	Genes have more than two alleles.	
	Two or more genes control a trait.	

Applying Mendel's Principles (page 274)

16. List three criteria Thomas Hunt Morgan was looking for in a model organism for genetic studies.

a. _____

_____

b. _____

_____

c. _____

_____

17. Is the following sentence true or false? Mendel's principles apply not just to pea plants but to other organisms as well.

_____

18. In humans, the dominant allele for skin pigmentation produces skin coloration. Homozygous recessive individuals have _____; they lack melanin.

Section 11–4 Meiosis (pages 275–278)

This section explains how gametes form in the process of meiosis. It also explains how meiosis is different from mitosis.

Introduction (page 275)

1. List the two things that Mendel's principles of genetics required in order to be true.

a. _____

_____

b. _____

_____

Chromosome Number (page 275)

2. What does it mean when two sets of chromosomes are homologous? _____

_____

_____

3. Circle the letter of each way to describe a diploid cell.

a. 2N

b. Contains two sets of homologous chromosomes

c. Contains a single set of homologous chromosomes

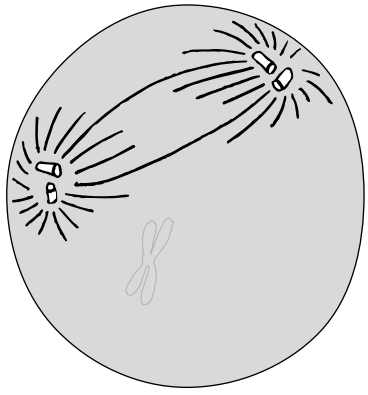
d. A gamete

4. Circle the letter of the number of chromosomes in a haploid *Drosophila* cell.

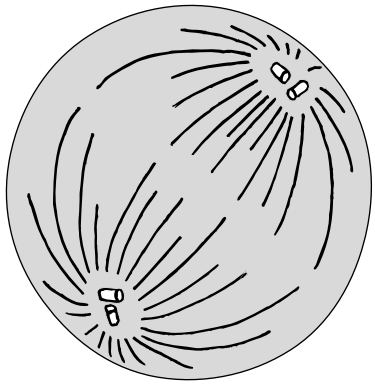
a. 8 **b.** 4 **c.** 2 **d.** 0

Phases of Meiosis (pages 276–277)

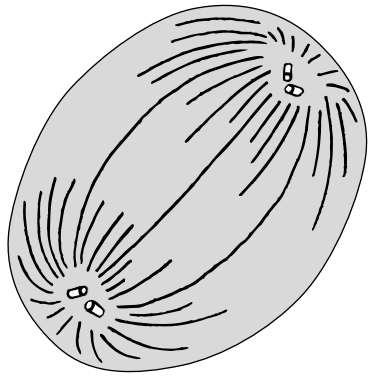
5. Draw the chromosomes in the diagrams below to show the correct phase of meiosis.



Prophase I



Metaphase I



Anaphase II

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6. Why is meiosis described as a process of reduction division? _____

_____

_____

7. What are the two distinct stages of meiosis?

a. _____ **b.** _____

8. Is the following sentence true or false? The diploid cell that enters meiosis becomes 4 haploid cells at the end of meiosis.

_____

9. How does a tetrad form in prophase I of meiosis? _____

_____

_____

10. Circle the number of chromatids in a tetrad.

a. 8 **b.** 6 **c.** 4 **d.** 2

11. What results from the process of crossing-over during prophase I? _____

_____

_____

_____

12. Circle the letter of each sentence that is true about meiosis.

a. During meiosis I, homologous chromosomes separate.

b. The two daughter cells produced by meiosis I still have the two complete sets of chromosomes as a diploid cell does.

c. During anaphase II, the paired chromatids separate.

d. After meiosis II, the four daughter cells contain the diploid number of chromosomes.

Gamete Formation (page 278)

Match the products of meiosis with the descriptions.

	Description	Product of Meiosis
_____	**13.** Haploid gametes produced in males	**a.** eggs
_____	**14.** Haploid gametes produced in females	**b.** sperm
_____	**15.** Cells produced in females that do not participate in reproduction	**c.** polar bodies

Comparing Mitosis and Meiosis (page 278)

16. Circle the letter of each sentence that is true about mitosis and meiosis.

a. Mitosis produces four genetically different haploid cells.

b. Meiosis produces two genetically identical diploid cells.

c. Mitosis begins with a diploid cell.

d. Meiosis begins with a diploid cell.

Section 11–5 Linkage and Gene Maps (pages 279–280)

This section describes how genes that are linked to the same chromosome assort during meiosis.

Gene Linkage (page 279)

1. Is the following sentence true or false? Thomas Hunt Morgan discovered that some genes violated the principle of independent assortment. _____

2. Morgan grouped the *Drosophila* genes that were inherited together into four _____ groups.

3. List the two conclusions that Morgan made about genes and chromosomes.

a. _____

_____

b. _____

_____

4. Why didn't Mendel observe gene linkage? _____

_____

_____

_____

Gene Maps (pages 279–280)

5. Explain why two genes found on the same chromosome are not always linked forever. _____

_____

_____

_____

6. The new combinations of alleles produced by crossover events help to generate genetic _____.

7. Is the following sentence true or false? Genes that are closer together are more likely to be separated by a crossover event in meiosis. _____

8. What is a gene map? _____

_____

9. How is a gene map constructed? _____

_____

_____

_____

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WordWise

Use the clues to identify vocabulary terms from Chapter 11. Write the words on the lines. Then, find the terms hidden in the puzzle and circle them.

Clues	Vocabulary Terms
1. Pattern of inheritance in which both alleles contribute to the phenotype of the organism	_____
2. Describes a cell that contains both sets of homologous chromosomes	_____
3. The physical characteristic of an organism	_____
4. Describes an organism that has two identical alleles for a particular trait	_____
5. A specific characteristic, such as seed color, that varies from one individual to another	_____
6. The offspring of a cross between parents with different traits	_____
7. The different forms of a gene	_____
8. Describes the two corresponding sets of chromosomes that come from the female parent and the male parent	_____

p t k a l h m e t z y s o p g f a p m h f r

a r d c e i t o m g s o h o m o l o g o u s

h a d p h e n o t y p e m o h u l g b a d p

u i c o z e a l m u h b g o u t e l m o i s

o t h o g v e t w l m y z o t b l u y b p g

y t b d w a o p m y e c b k n s e o i e l o

g s u o g y z o m o h l r r e j s l o t o g

n t b s q u l o g c o d o m i n a n c e i m

p j t v o k g u i z y o f w m d o i p g d f