Name<u>   </u>**Period**<u>   </u>

Chapter 14: Mendel and the Gene Idea

If you have completed a first-year high school biology course, some of this chapter will serve as a review for the basic concepts of Mendelian genetics. For other students, this may be your first exposure to genetics. In either case, this is a chapter that should be carefully mastered. Spending some time with this chapter, especially working genetics problems, will give you a solid foundation for the extensive genetics unit in the chapters to come.

Overview:

1.   In the 1800s the most widely favored explanation of genetics was blending. Explain the concept of blending, and then describe how Mendel's particulate (gene) theory was different.

Concept 14.1 Mendel used the scientific approach to identify two laws of inheritance

2.   One of the keys to success for Mendel was using pea plants. Explain how using pea plants allowed Mendel to control mating; that is, how did this approach let Mendel be positive about the exact characteristics of each parent?

3.   Define the following terms. Then, consider your own family. Which generation would your Mom's grandparents be? Your Mom? You?

P generation

F$_1$ generation

F$_2$ generation

4.   Explain how Mendel's simple cross of purple and white flowers did the following:

   refuted blending

   determined dominant and recessive characteristics

   demonstrated the merit of experiments that covered multiple generations

5.   Alternate versions of the same gene, like purple and white flower color, are termed

   _____.

6.   On the figure at below, label the *allele* for both purple and white flower color, a *homologous pair*, and the *locus* of the flower color gene.
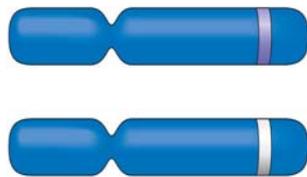
7.   In sexually reproducing organisms, why are there exactly two chromosomes in each homologue?

8.   Mendel's model consists of four concepts. Describe each concept in the appropriate space below. Indicate which of the concepts can be observed during meiosis by placing an asterisk by the concept.

Mendel's Four Concepts	Description of Concept
1st concept	
2nd concept	
3rd concept	
4th concept (*law of segregation*)	

9.   Using Figure 14.5 as your guide, provide the missing notations for the figure below. (P, F_1, F_2).

        a. What is the F_2 phenotypic and genotypic ratio?

        b. Which generation is completely heterozygous?

        c. Which generation has both heterozygous and homozygous offspring?
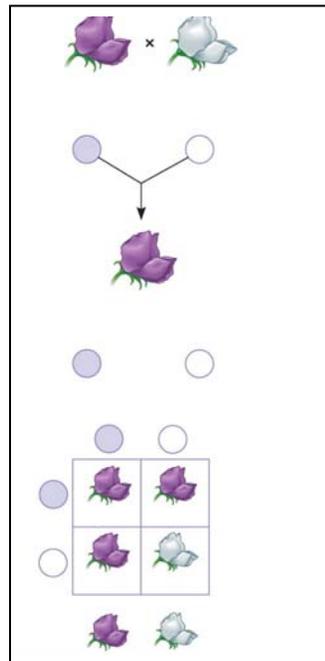
10.   In pea plants, *T* is the allele for tall plants, while *t* is the allele for dwarf plants. If you have a
        tall plant, demonstrate with a *test cross* how it could be determined if the plant is homozygous
        tall or heterozygous tall.

11.   Explain the difference between a *monohybrid* cross and a *dihybrid cross*.

12.   As you start to work word problems in genetics, two things are critical: the parent's genotype
        must be correct, and the gametes must be formed correctly. Using Figure 14.8 as your guide,
        explain how the gametes are derived for the following cross. (You should have four different
        gametes).

YyRr × YyRr

13.   Complete the cross given in questions 12 by placing the gametes in a *Punnett square*. Then
        provide the phenotypic ratio of the offspring.

Phenotypes/Phenotypic Ratio

14.   Explain Mendel's *law of independent assortment*.

Before leaving this concept, it would be helpful to complete the three problems in the 14.1 Concept
Check on page 269 of your textbook. The problems are worked and explained in the Answer section on
page A-10 at the back of the book.

Concept 14.2 The laws of probability govern Mendelian inheritance

15.   An event that is certain to occur has a probability of _____, while an event that is certain not

        to occur has a probability of _____.

16.   In probability, what is an *independent event*?

17.   State the *multiplication rule* and give an original example.

18.   State the *addition rule* and give an original example.

19.   What is the probability that a couple will have a girl, a boy, a girl, and a boy in this specific
       order?

**Concept 14.3 Inheritance patterns are often more complex than those predicted by simple
Mendelian genetics**

20.   Explain how *incomplete dominance* is different from *complete dominance*, and give an
       example of incomplete dominance.

21.   Compare and contrast *codominance* with *incomplete dominance*.

22.   Dominant alleles are not necessarily more common than recessive alleles in the gene pool.
       Explain why this is true.

23.   Explain what is meant when a gene is said to have *multiple alleles*.

24.   Blood groups are so important medically that you should be able to solve genetics
       problems based on blood types. The first step in accomplishing that is to understand the
       genotypes of each blood type. Before working any problems, complete this ABO blood type
       chart.

Genotype	Red Blood Cell Appearance	Phenotype (blood group)

25.   Question 2 in the 14.3 Concept Check is a blood type problem. Complete it here, and show
        your work.

26.   What is *pleiotropy*? Explain why this is important in diseases like cystic fibrosis and sickle-
        cell disease.

27.   Explain *epistasis*.

28.   Explain why the dihybrid cross detailed in Figure 14.12 has 4 white mice instead of the 3 that
   would have been predicted by Mendel's work.

29.   Why is height a good example of *polygenic inheritance*?

30.   *Quantitative variation* usually indicates _____.

31.   Using the terms *norm of reaction* and *multifactorial*, explain the potential influence of the
        environment on phenotypic expression.

Concept 14.4 Many human traits follow Mendelian patterns of inheritance

32.   Pedigree analysis is often used to determine the mode of inheritance (dominant or recessive, for example). Be sure to read the "Tips for pedigree analysis" in Figure 14.15; then complete the unlabeled pedigree by indicating the genotypes for all involved. What is the mode of inheritance for this pedigree?
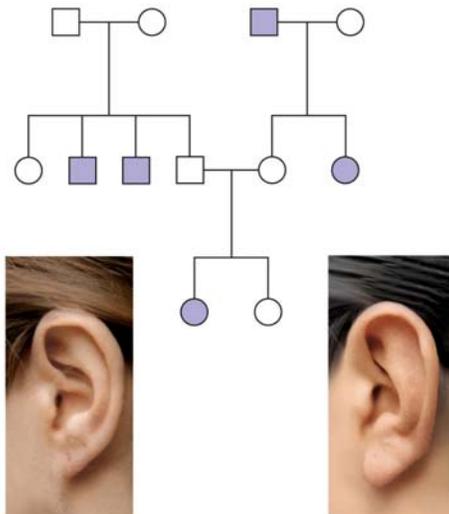
33.   Explain why you know the genotype of one female in the third generation, but are unsure of the other.

34.   Describe what you think is important to know medically about the behavior of recessive alleles.

35.   Students are expected to have a general knowledge of the pattern of inheritance and the common symptoms of a number of genetic disorders. Provide this information for the disorders listed below.
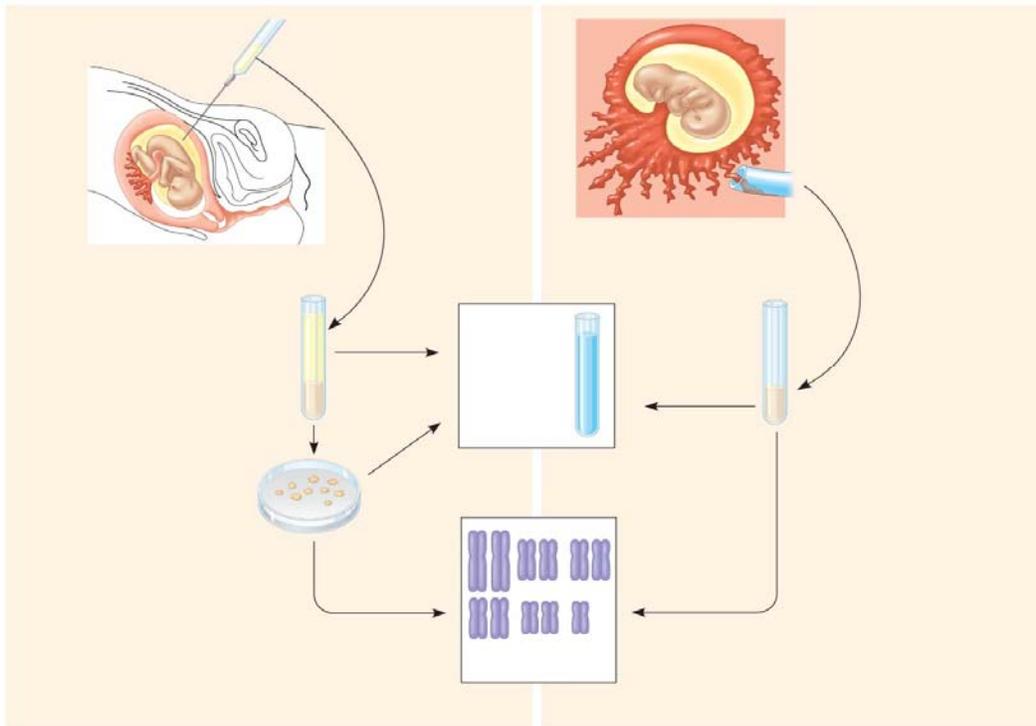
   a. cystic fibrosis

   b. sickle-cell disease

c. achondroplasia

d. Huntington's disease

36.   *Amniocentesis* and *chorionic villus sampling* are the two most widely used methods for testing a fetus for genetic disorders. Use the unlabeled diagram below to explain the three main steps in amniocentesis and the two main steps of CVS.

37.   What are the strengths and weaknesses of each fetal test?

38.   Explain the symptoms of *phenylketonuria*, and describe how newborn screening is used to identify children with this disorder.

Testing Your Knowledge: Genetics Problems (pg. 284)
Now you should be ready to test your knowledge.

This chapter does not have a Self-Quiz, but rather asks you to do a series of problems. One of the ways to determine your understanding of Mendelian genetics is to work many genetic problems. Complete the questions from the problems at the end of the chapter.

Before starting, it would be productive to read the "Tips for Genetic Problems" on page 283. Work neatly, and show all work. As you know, you can check your solutions in your text.

Questions 1, 2, 3, 5, 6, 7, 8, 9, 13, 16, 17, 19