

Getting Started

Objectives

- 14.1.1 Identify** the types of human chromosomes in a karyotype.
- 14.1.2 Describe** the patterns of the inheritance of human traits.
- 14.1.3 Explain** how pedigrees are used to study human traits.

Student Resources

Study Workbooks A and B, 14.1 Worksheets
Spanish Study Workbook, 14.1 Worksheets



Lesson Overview • Lesson Notes
 • Activities: Art Review, Data Analysis, InterActive Art, Tutor Tube • Assessment: Self-Test, Lesson Assessment



For corresponding lesson in the **Foundation Edition**, see pages 334–338.

Activate Prior Knowledge

Ask students if they know what a dog pedigree is or if any of them owns a dog with a pedigree. (*A pedigree is a record of the family tree, usually back at least three generations.*) Explain that a pedigree is often used to show a dog is a purebred, and it gives information about the dog's background and any hereditary health problems in its blood line. Tell them that human pedigrees also are used to show information about a person's background, most commonly to trace genetic disorders.



NEXT GENERATION SUNSHINE STATE STANDARDS

For the full text of all benchmarks, see the Course Overview in the front matter of this book.

Other key benchmarks: **SC.912.N.1.1** Define a problem based on a specific body of knowledge, for example: biology, chemistry, physics, and earth/space science.



Human Chromosomes



HE.912.C.1.4 Analyze how heredity and family history can impact personal health.
 Also covered: SC.912.N.1.1

Key Questions

- What is a karyotype?
- What patterns of inheritance do human traits follow?
- How can pedigrees be used to analyze human inheritance?

Vocabulary

- genome • karyotype • sex chromosome • autosome • sex-linked gene • pedigree

Taking Notes

Outline Before you read, make an outline of the major headings in the lesson. As you read, fill in main ideas and supporting details for each heading.

THINK ABOUT IT If you had to pick an ideal organism for the study of genetics, would you choose one that produced lots of offspring? How about one that was easy to grow in the lab? Would you select one with a short life span in order to do several crosses per month? How about all of the above? You certainly would not choose an organism that produced very few offspring, had a long life span, and could not be grown in a lab. Yet, when we study human genetics, this is exactly the sort of organism we deal with. Given all of these difficulties, it may seem a wonder that we know as much about human genetics as we do.

Karyotypes

What is a karyotype?

What makes us human? We might try to answer that question by looking under the microscope to see what is inside a human cell. Not surprisingly, human cells look much like the cells of other animals. To find what makes us uniquely human, we have to look deeper, into the genetic instructions that build each new individual. To begin this undertaking,

we have to explore the human genome. A **genome** is the full set of genetic information that an organism carries in its DNA.

The study of any genome starts with chromosomes—those bundles of DNA and protein found in the nuclei of eukaryotic cells. To see human chromosomes clearly, cell biologists photograph cells in mitosis, when the chromosomes are fully condensed and easy to view. Scientists then cut out the chromosomes from the photographs and arrange them in a picture known as a **karyotype** (KAR ee uh typ). **A karyotype shows the complete diploid set of chromosomes grouped together in pairs, arranged in order of decreasing size.**

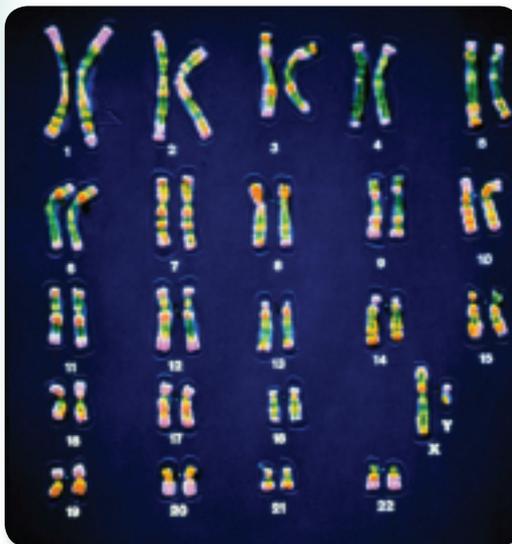


FIGURE 14-1 A Human Karyotype
 A typical human cell has 23 pairs of chromosomes. These chromosomes have been cut out of a photograph and arranged to form a karyotype.

Teach for Understanding

ENDURING UNDERSTANDING DNA is the universal code for life; it enables an organism to transmit hereditary information and, along with the environment, determines an organism's characteristics.

GUIDING QUESTION How does studying the human genome help us draw conclusions about the inheritance of traits?

EVIDENCE OF UNDERSTANDING *At the end of the lesson, give students the following assessment to show they understand how chromosomes and genes are related to the inheritance of traits.* Provide pairs of students with white, red, and green pipe cleaners to represent X and Y chromosomes that do not have the trait for colorblindness and X chromosomes that do. Ask them to model all six possible pairings between males and females with different genotypes for the trait of colorblindness and to construct Punnett squares showing the possible genotype outcomes for the male and female offspring (carrier, normal vision, or colorblind).

Teach

Use Visuals

Use **Figure 14–2** to have students identify the chromosomes that determine an individual's sex. Ask students to identify which boxes in the figure represent sperm cells. (*the two left-most boxes that contain either a single "X" or a single "Y"*) Point out that the sperm determines the sex of the child. Have students note the difference in size of the X and Y chromosomes in **Figure 14–3**. The sex chromosomes are the only pair of chromosomes that do not match in size and gene content. Then, ask students to identify the person's sex in **Figure 14–1**. (*male*)

DIFFERENTIATED INSTRUCTION

L1 Struggling Students Have students draw two simple diagrams of meiosis, contrasting the formation of sex cells in males and in females. Have them examine the diagrams to identify pairings of sex cells that would result in a male or a female offspring. Ask how the pairings show that the sperm determines the sex of the child. (*Male sex cells contain an X or a Y chromosome, whereas all female sex cells contain only an X chromosome.*)

ELL Focus on ELL: Build Background

ADVANCED AND ADVANCED HIGH SPEAKERS
 Help students make connections between the real world and what they will study by bringing to class current articles on human genetics from newspapers, magazines, or online news sources. Read aloud parts of the articles, and show visuals. Provide students with copies of the articles, and have them work in pairs to identify any science terms they recognize and any terms that they do not know. Invite students to comment on the articles and share any knowledge about the topic. Ask simple questions to give them an opportunity to practice their oral English.

BIOLOGY Students can drag and drop items to construct a karyotype in **Art Review: A Human Karyotype**.

Answers

FIGURE 14–2 It suggests that about half the population is male and about half is female.

IN YOUR NOTEBOOK A human karyotype is made up of the complete diploid set of chromosomes in a cell.

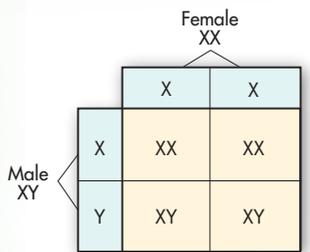


FIGURE 14–2 Sex Ratios Human egg cells contain a single X chromosome. Sperm cells contain either one X chromosome or one Y chromosome. **Interpret Tables** What does this Punnett square suggest about the sex ratio of the human population?

The karyotype in **Figure 14–1** is from a typical human cell, which contains 46 chromosomes, arranged in 23 pairs. Why do our chromosomes come in pairs? Remember that we begin life when a haploid sperm, carrying just 23 chromosomes, fertilizes a haploid egg, also with 23 chromosomes. The resulting diploid cell develops into a new individual and carries the full complement of 46 chromosomes—two sets of 23.

Sex Chromosomes Two of the 46 chromosomes in the human genome are known as **sex chromosomes**, because they determine an individual's sex. Females have two copies of the X chromosome. Males have one X chromosome and one Y chromosome. As you can see in **Figure 14–2**, this is the reason why males and females are born in a roughly 50 : 50 ratio. All human egg cells carry a single X chromosome (23,X). However, half of all sperm cells carry an X chromosome (23,X) and half carry a Y chromosome (23,Y). This ensures that just about half the zygotes will be males and half will be females.

More than 1200 genes are found on the X chromosome, some of which are shown in **Figure 14–3**. Note that the human Y chromosome is much smaller than the X chromosome and contains only about 140 genes, most of which are associated with male sex determination and sperm development.

Autosomal Chromosomes To distinguish them from the sex chromosomes, the remaining 44 human chromosomes are known as autosomal chromosomes, or **autosomes**. The complete human genome consists of 46 chromosomes, including 44 autosomes and 2 sex chromosomes. To quickly summarize the total number of chromosomes present in a human cell—both autosomes and sex chromosomes—biologists write 46,XX for females and 46,XY for males.

In Your Notebook Describe what makes up a human karyotype.

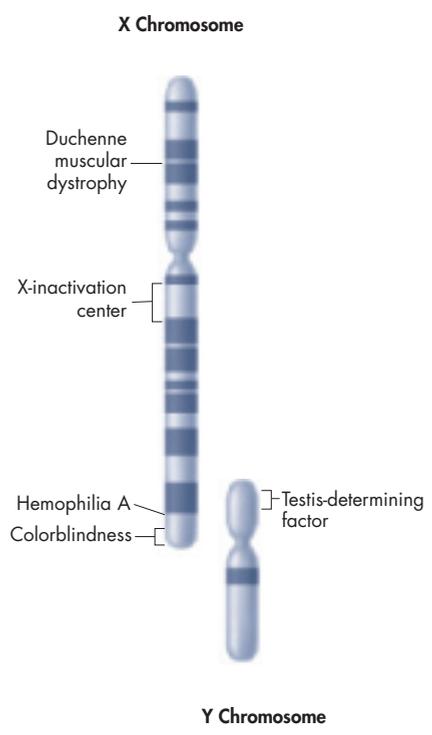


FIGURE 14–3 X and Y Chromosomes The human Y chromosome is smaller and carries fewer genes than the human X chromosome.

Quick Facts

DUCHENNE MUSCULAR DYSTROPHY

Duchenne muscular dystrophy is the most common form of the more than thirty kinds of muscular dystrophy. It is caused by a mutation in a gene on the X chromosome that codes for a muscle protein called dystrophin. The mutated gene causes defects in muscle proteins, leading to muscle degeneration. Because the gene is inherited in an X-linked recessive pattern, the disease affects mainly boys. Many children with the disease cannot walk and require respirators to breathe. Most do not live beyond their 30s. Researchers are experimenting with several approaches to a cure, including gene therapy that involves injecting children with altered viruses that can introduce normal genes to affected cells.

Teach continued

Build Science Skills

Ask students to recall what they know about simple inheritance patterns. Draw a blank Punnett square on the board. Ask them how to label the columns and rows and fill out the cells to show a cross between two people who are both heterozygous for the Rh factor. Have students explain how the results show a pattern of simple dominance. Then, use **Figure 14–5** to discuss codominant and multiple alleles. Have students work out crosses between different genotypes to see how different blood types can be inherited.

DIFFERENTIATED INSTRUCTION

L1 Struggling Students Make sure students understand that the superscripts in **Figure 14–5** are not exponents or additional alleles but labels that distinguish the two codominant alleles. Have them make a simpler version of the second column in the chart by rewriting the I^A , I^B , and i alleles as A , B , and O , respectively.

BIOLOGY.com

Have students determine the connection between blood type O and a higher susceptibility to cholera in the activity **Data Analysis: Blood Types and Cholera**.

Address Misconceptions

Frequencies of Dominant and Recessive Traits Some students think that dominant traits are more common in a population. This might stem from their observation that 75 percent of offspring in a heterozygous cross show the dominant trait. Use Punnett squares to show a cross between two homozygous recessive parents and a cross between two heterozygous parents. Point out that a Punnett square shows the phenotype frequencies for a specific cross, not for an entire population. Most individuals in a population will show a recessive trait if the population has many recessive alleles and therefore has more incidents of crosses involving homozygous recessive parents. Emphasize that allele frequencies can be high or low regardless of how the allele is expressed.

Answers

FIGURE 14–5 The allele for no antigens, i , is recessive to I^A and I^B , so it is hidden by the I^A and I^B genes. Thus, two different genotypes— $I^A I^A$ and $I^A i$ —result in the A phenotype, and two other genotypes— $I^B I^B$ and $I^B i$ —result in the B phenotype.



FIGURE 14–4 Recessive Alleles Some of the recessive alleles of the *MC1R* gene cause red hair. An individual with red hair usually has two of these recessive alleles.

Transmission of Human Traits

What patterns of inheritance do human traits follow?

It has not been easy studying our species using traditional genetic techniques. Despite the difficulties, human genetics has progressed rapidly, especially in recent years, with the use of molecular techniques to study human DNA. What have these studies shown? Human genes follow the same Mendelian patterns of inheritance as the genes of other organisms.

Dominant and Recessive Alleles Many human traits follow a pattern of simple dominance. For instance, a gene known as *MC1R* helps determine skin and hair color. Some of *MC1R*'s recessive alleles produce red hair. An individual with red hair usually has two of these recessive alleles, inheriting a copy from each parent. Dominant alleles for the *MC1R* gene help produce darker hair colors.

Another trait that displays simple dominance is the Rhesus, or Rh blood group. The allele for Rh factor comes in two forms: Rh^+ and Rh^- . Rh^+ is dominant, so an individual with both alleles (Rh^+/Rh^-) is said to have Rh positive blood. Rh negative blood is found in individuals with two recessive alleles (Rh^-/Rh^-).

Codominant and Multiple Alleles The alleles for many human genes display codominant inheritance. One example is the ABO blood group, determined by a gene with three alleles: I^A , I^B , and i . Alleles I^A and I^B are codominant. They produce molecules known as antigens on the surface of red blood cells. As **Figure 14–5** shows, individuals with alleles I^A and I^B produce both A and B antigens, making them blood type AB. The i allele is recessive. Individuals with alleles $I^A I^A$ or $I^A i$ produce only the A antigen, making them blood type A. Those with $I^B I^B$ or $I^B i$ alleles are type B. Those homozygous for the i allele (ii) produce no antigen and are said to have blood type O. If a patient has AB-negative blood, it means the individual has I^A and I^B alleles from the ABO gene and two Rh^- alleles from the Rh gene.

FIGURE 14–5 Human Blood Groups This table shows the relationship between genotype and phenotype for the ABO blood group. It also shows which blood types can safely be transfused into people with other blood types. **Apply Concepts** How can there be four different phenotypes even though there are six different genotypes?

Blood Groups				
Phenotype (Blood Type)	Genotype	Antigen on Red Blood Cell	Safe Transfusions	
			To	From
A	$I^A I^A$ or $I^A i$	A	A, AB	A, O
B	$I^B I^B$ or $I^B i$	B	B, AB	B, O
AB	$I^A I^B$	A and B	AB	A, B, AB, O
O	ii	None	A, B, AB, O	O

Biology In-Depth

BLOOD TYPES AND TRANSFUSIONS

Knowing a person's blood group is critical because using the wrong type of blood for a transfusion can be fatal. Type A and type B red blood cells have antigens for their respective type on their surface. The immune system of a person with type B blood would recognize type A cells as foreign and produce antibodies against the type A antigen, and vice versa. The immune system of a person with type O blood would recognize both A and B cells as foreign and produce antibodies against both type A and type B antigens. People with type AB blood have both type A and type B antigens, so they do not produce antibodies against these types of blood. They are called "universal recipients" because they can receive all types of blood in a transfusion. People with type O blood are called "universal donors" because their red blood cells have no antigens to elicit an antibody response, and thus, their blood can be safely donated to people of all blood types.

Sex-Linked Inheritance Because the X and Y chromosomes determine sex, the genes located on them show a pattern of inheritance called sex-linkage. A **sex-linked gene** is a gene located on a sex chromosome. As you might expect, genes on the Y chromosome are found only in males and are passed directly from father to son. Genes located on the X chromosome are found in both sexes, but the fact that men have just one X chromosome leads to some interesting consequences.

For example, humans have three genes responsible for color vision, all located on the X chromosome. In males, a defective allele for any of these genes results in colorblindness, an inability to distinguish certain colors. The most common form, red-green colorblindness, occurs in about 1 in 12 males. Among females, however, colorblindness affects only about 1 in 200. Why is there such a difference? In order for a recessive allele, like colorblindness, to be expressed in females, it must be present in two copies—one on each of the X chromosomes. This means that the recessive phenotype of a sex-linked genetic disorder tends to be much more common among males than among females.

MYSTERY CLUE

The presence of two sickle cell alleles is needed to produce sickle cell disease. Males and females develop sickle cell disease in equal frequencies. What do these statements suggest about the location of the gene responsible for the disorder?



Build Science Skills

Help students explore sex-linked inheritance by examining a specific cross involving colorblindness. Have students construct a Punnett square to show a cross between a father with normal vision and a mother who is a carrier of the colorblindness trait. Tell them to use the symbols X^B to represent the dominant allele on the X chromosome and X^b for the recessive one. Refer them to **Figure 14–2** for help in constructing the cross.

Ask What percent of the children have normal vision? (75%)

Ask Are both daughters carriers? Explain. (*No, only one daughter has the X^b allele.*)

DIFFERENTIATED INSTRUCTION

1B Advanced Students Challenge students to infer whether a trait controlled by a dominant allele on the X chromosome is more common in male offspring. (*A trait controlled by a dominant allele is not more common in males because females, like males, would need to inherit just one dominant allele to have the trait.*) Have students make a Punnett square to show how a sex-linked dominant allele would be passed to offspring.

MYSTERY CLUE

If students need help answering the question, have them reread the last paragraph under **Sex-Linked Inheritance** and think about the number of alleles needed to cause disease in a sex-linked disease. Guide them to infer that the location of the sickle cell allele is not on a sex chromosome. Students can go online to Biology.com to gather their evidence.

Quick Lab

GUIDED INQUIRY

SC.912.N.1.1, HE.912.C.1.4

How Is Colorblindness Transmitted?

1 Make a data table with the column headings Trial, Colors, Sex of Individual, and Number of X-Linked Alleles. Draw ten rows under the headings and fill in the numbers 1 through 10 in the Trial column. Label one plastic cup Mother and a second plastic cup Father.

2 The white beans represent X chromosomes. Use a black marker to make a dot on 1 white bean to represent the X-linked allele for colorblindness. Place this bean, plus 1 unmarked white bean, into the cup labeled Mother.

3 Mark a black dot on 1 more white bean. Place this bean, plus 1 red bean, into the cup labeled Father. The red bean represents a Y chromosome.



4 Close your eyes and pick one bean from each cup to represent how each parent contributes to a sex chromosome and a fertilized egg.

5 In your data table, record the color of each bean and the sex of an individual who would carry this pair of sex chromosomes. Also record how many X-linked alleles the individual has. Put the beans back in the cups they came from.

6 Determine whether the individual would have colorblindness.

7 Repeat steps 4 to 6 for a total of 10 pairs of beans.

Analyze and Conclude

1. Draw Conclusions How do human sex chromosomes keep the numbers of males and females roughly equal?

2. Calculate Calculate the class totals for each data column. How many females were colorblind? How many males? Explain these results. [MATH](#)

3. Use Models Evaluate your model. How accurately does it represent the transmission of colorblindness in a population? Why?

Human Heredity 395

Quick Lab

PURPOSE Students will model how colorblindness is transmitted and draw conclusions about frequencies of inheritance of the disorder.

MATERIALS 2 plastic cups, black marker, 3 white beans, 1 red bean

PLANNING Remind students to keep their eyes closed while picking the beans so they choose randomly.

ANALYZE AND CONCLUDE

1. Only the father's chromosome will determine sex. The chance is 50/50 a child will receive an X chromosome from the father, and 50/50 a child will receive a Y chromosome from the father.

2. About 50 percent of the females and 50 percent of the males will be colorblind. The mother is heterozygous, which means her sons have a 50 percent chance of inheriting the X chromosome that carries the allele for colorblindness. The father is colorblind, which means the daughters have a 50

percent chance of inheriting an X chromosome from each parent that carries the allele for colorblindness.

3. The model represents only one type of cross within a population. In an actual human population, the ratio of colorblind to non-colorblind people will be much lower, because not all parents carry the allele for colorblindness.

Teach continued

Use Visuals

Use **Figure 14–7** to explain that a pedigree helps trace inheritance patterns by looking at known phenotypes for a single trait. Copy the pedigree on the board. Have volunteers identify what each of the symbols means. Then, walk students through the pedigree. Remind them that the allele for the white forelock trait is dominant, and given this information, have them identify the phenotype and possible genotypes for each individual as you write them beside the appropriate symbols.

Then, ask students to consider the phenotypes as if the allele for the white forelock trait was recessive rather than dominant. Have them point out where the pedigree shows that this is not possible. (*The gene cannot be recessive because if it were, the parents in the second generation who both show the phenotype would be homozygous recessive and could not have a child who shows the opposite phenotype.*) Reinforce that pedigree analysis provides information on the nature of genes and alleles. Ask students to infer a reason for constructing a pedigree chart. (*to trace the inheritance of genetic disorders*)

DIFFERENTIATED INSTRUCTION

L1 Struggling Students For students who are having difficulty understanding how a pedigree can help show how traits are inherited, draw a pedigree showing a wife with a genetic disorder and a husband without it who have a daughter with the disorder and a son without it. Ask students whether they can tell if the trait is controlled by a dominant or a recessive allele. (*no*) Extend the pedigree back one generation by adding two parents without the disorder for the wife. Then, ask the same question. (*The trait must be recessive; otherwise, at least one of the wife’s parents would also have the trait.*) Point out that often, the more generations a pedigree has, the more obvious the pattern of inheritance is.

Answers

IN YOUR NOTEBOOK Answers will vary. Check that students have written three questions and that their answers are accurate. Consider having students work in pairs to quiz each other.



FIGURE 14–6 X-Chromosome Inactivation Female calico cats are tri-colored. The color of spots on their fur is controlled by a gene on the X chromosome. Spots are either orange or black, depending on which X chromosome is inactivated in different patches of their skin.

X-Chromosome Inactivation If just one X chromosome is enough for cells in males, how does the cell “adjust” to the extra X chromosome in female cells? The answer was discovered by the British geneticist Mary Lyon. In female cells, most of the genes in one of the X chromosomes are randomly switched off, forming a dense region in the nucleus known as a Barr body. Barr bodies are generally not found in males because their single X chromosome is still active.

The same process happens in other mammals. In cats, for example, a gene that controls the color of coat spots is located on the X chromosome. One X chromosome may have an allele for orange spots and the other X chromosome may have an allele for black spots. In cells in some parts of the body, one X chromosome is switched off. In other parts of the body, the other X chromosome is switched off. As a result, the cat’s fur has a mixture of orange and black spots, like those in **Figure 14–6**. Male cats, which have just one X chromosome, can have spots of only one color. Therefore, if the cat’s fur has three colors—white with orange and black spots, for example—you can almost be certain that the cat is female.

In Your Notebook Write three quiz questions about the transmission of human traits and answer them.

Human Pedigrees

How can pedigrees be used to analyze human inheritance?

Given the complexities of genetics, how would you go about determining whether a trait is caused by a dominant or recessive allele and whether the gene for that trait is autosomal or sex-linked? The answers, not surprisingly, can be found by applying Mendel’s basic principles of genetics.

To analyze the pattern of inheritance followed by a particular trait, you can use a chart that shows the relationships within a family. Such a chart is called a **pedigree**. A pedigree shows the presence or absence of a trait according to the relationships between parents, siblings, and offspring. It can be used for any species, not just humans.

The pedigree in **Figure 14–7** shows how one human trait—a white lock of hair just above the forehead—passes through three generations of a family. The allele for the white forelock trait is dominant. At the top of the chart is a grandfather who had the white forelock trait. Two of his three children inherited the trait. Three grandchildren have the trait, but two do not.

BUILD Vocabulary

WORD ORIGINS The word **pedigree** combines the Latin words *pedem*, meaning “foot,” and *gruem*, meaning “crane.” A crane is a long-legged waterbird. On old manuscripts, a forked sign resembling a crane’s footprint indicated a line of ancestral descent.

Check for Understanding

VISUAL REPRESENTATION

Ask students to work in pairs to construct a pedigree that shows the inheritance of a single recessive allele, starting with the first generation having genotypes $Aa \times Aa$ and producing three children that represent all three genotypes that could result from a heterozygous cross. Then, have students extend the pedigree to show the members of a third generation, who represent the possible genotypes produced if each member of the second generation crossed with a person having the genotype Aa . Discuss the resulting pedigree as a class.

ADJUST INSTRUCTION

If students have trouble identifying the genotypes that result from a cross, draw Punnett squares to show the possibilities. If students are confusing symbols and shading, review **Figure 14–7**.

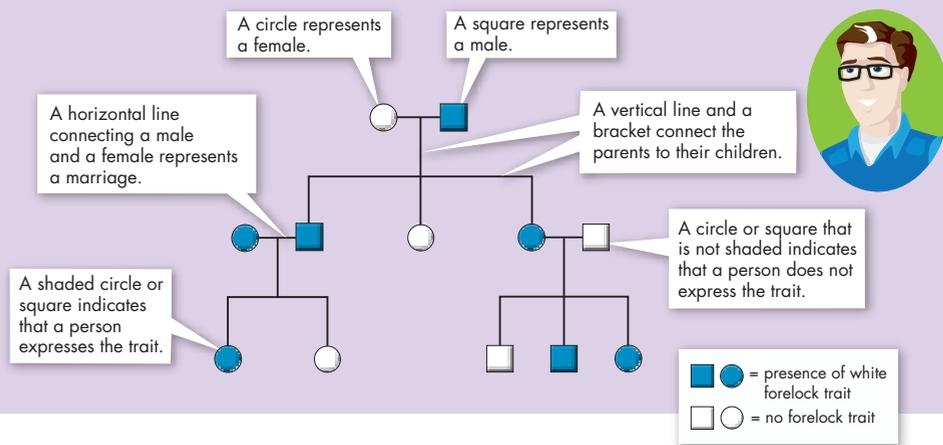


FIGURE 14-7 Pedigree Example
 This diagram shows what the symbols in a pedigree represent.
Interpret Visuals What are the genotypes of both parents on the left in the second row? How do you know?

By analyzing a pedigree, we can often infer the genotypes of family members. For example, because the white forelock trait is dominant, all the family members in **Figure 14-7** lacking this trait must have homozygous recessive alleles. One of the grandfather's children lacks the white forelock trait, so the grandfather must be heterozygous for this trait.

With pedigree analysis, it is possible to apply the principles of Mendelian genetics to humans. **The information gained from pedigree analysis makes it possible to determine the nature of genes and alleles associated with inherited human traits.** Based on a pedigree, you can often determine if an allele for a trait is dominant or recessive, autosomal or sex-linked.

BIOLOGY.com Students can interact with a pedigree online in **InterActive Art: Pedigrees**. For more help with pedigrees, access **Tutor Tube: Skipping a Generation**.

Assess and Remediate

EVALUATE UNDERSTANDING

Tell students to make up a word problem about human genetics that can be solved using a Punnett square or a pedigree. Have students solve a partner's word problem. Then, have students complete the 14.1 Assessment.

REMIEDIATION SUGGESTION

L1 Struggling Students If students have trouble with **Question 3b**, turn the question around and ask them to assume the Y chromosome has all the genes necessary for survival. Then, have them look at **Figure 14-2**. Ask whether all children receive the Y chromosome. (*no*) Ask what would happen to the children who do not have the Y chromosome. (*They would die.*)

BIOLOGY.com Students can check their understanding of lesson concepts with the **Self-Test** assessment. They can then take an online version of the **Lesson Assessment**.

Answers

FIGURE 14-7 Both are heterozygous, because they have a child with the recessive phenotype who must have received two copies of the recessive allele.

14.1 Assessment

HE.912.C.1.4

Review Key Concepts

1. **a. Review** What are autosomes?
b. Explain What determines whether a person is male or female?
c. Propose a Solution How can you use karyotypes to identify a species?
2. **a. Review** Explain how sex-linked traits are inherited.
b. Predict If a woman with type O blood and a man with type AB blood have children, what are the children's possible genotypes?

3. **a. Review** What does a pedigree show?
b. Infer Why would the Y chromosome be unlikely to contain any of the genes that are absolutely necessary for survival?

VISUAL THINKING

4. Choose a family and a trait, such as facial dimples, that you can trace through three generations. Find out who in the family has had the trait and who has not. Then, draw a pedigree to represent the family history of the trait.

BIOLOGY.com Search Lesson 14.1 GO Self-Test Lesson Assessment

Assessment Answers

- 1a. Autosomes are chromosomes that are not sex chromosomes.
- 1b. Females have two X chromosomes; males have one X chromosome and one Y chromosome.
- 1c. Sample answer: A karyotype shows the complete set of chromosomes in a cell, and they are displayed in order by size. The number and size of chromosomes varies from one species to the next.
- 2a. A sex-linked trait is controlled by a recessive allele on the X chromosome. Because

males have only one X chromosome, they will show the trait when they inherit an X chromosome with the allele. For a female to show the trait, both of her X chromosomes must have the allele for the trait.

- 2b. $I^A i$ and $I^B i$
- 3a. A pedigree shows the presence or absence of a trait over several generations within a family. It can be used to determine inheritance patterns or the possibility of inheritance for a future generation.

- 3b. A female child would not survive because females do not have a Y chromosome.

VISUAL THINKING

4. If students have difficulty finding a family to use for the pedigree, allow them to make up one. Answers will vary but pedigrees should use the standard pedigree symbols and include a key. Students may choose other traits besides facial dimples, such as having a widow's peak, having attached earlobes, or having a cleft chin.