

section 2 Genetics Since Mendel

● Before You Read

At dog and cat shows, an animal's owner may be asked to show its pedigree. What do you think a pedigree shows?

● Read to Learn

Incomplete Dominance

A scientist crossed purebred red four-o'clock plants with purebred white four-o'clock plants. He thought the new plants would have all red flowers, but they were pink. Neither allele for flower color was dominant. Next, he crossed the pink-flowered plants with each other. The new plants had red, white, and pink flowers.

He discovered that when the allele for red flowers and the allele for white flowers combined, the result included red flowers, white flowers, and an intermediate, or in-between, phenotype—pink flowers. When the offspring of two homozygous parents show an intermediate phenotype, this inheritance is called **incomplete dominance**.

What are multiple alleles?

A trait that is controlled by more than two alleles is said to be controlled by multiple alleles. A trait controlled by multiple alleles will produce more than three phenotypes of that trait.

What You'll Learn

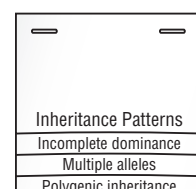
- how traits are inherited by incomplete dominance
- the difference between multiple alleles and polygenic inheritance
- how sex-linked traits are passed to offspring

▶ Mark the Text

Build Vocabulary Skim the section, circling any words you do not know. After you read the section, review the circled words. Write any words you cannot define on a separate sheet of paper and look up the definitions.

FOLDABLES™

B Explain Make a layered-look Foldable, as shown below. Write notes under the flaps to explain inheritance patterns.




 **Reading Check**

1. Identify What are the six different blood type genotypes?

 **Think it Over**

2. Draw Conclusions
What environmental factors might affect the size of leaves on a tree?

What traits are controlled by multiple alleles?

Blood type in humans is an example of a trait controlled by multiple alleles. The alleles for blood type produce six genotypes but only four phenotypes. The alleles for blood type are called A, B, and O. The O allele is recessive to both the A and B alleles. When a person inherits one A allele and one B allele, his or her phenotype is AB. A person with phenotype A blood has the genotype AA or AO. Someone with the phenotype B blood has the genotype BB or BO. A person with phenotype O blood has the genotype OO. 

Polygenic Inheritance

Eye color is an example of a trait that is produced by a combination of many genes, or polygenic (pah lih JEH nihk) inheritance. **Polygenic inheritance** occurs when a group of gene pairs acts together to produce a trait. Polygenic inheritance results in a wide variety of phenotypes. Examine the eye colors of your classmates. You will likely notice many different shades. For example, you may notice several shades of brown, several shades of green, and so on.

How does the environment affect your genes?

Your environment plays a role in how some of your genes are expressed. Genes can be influenced by an organism's internal or external environment. For example, most male birds are more brightly colored than females. Chemicals in their bodies determine whether or not the gene for brightly colored feathers is expressed.

Your environment plays a role in whether your genes are expressed at all. For example, some people have genes that make them at risk for developing skin cancer. Whether or not they get cancer might depend on external environmental factors. If people who are at risk for skin cancer limit their time in the sun and take care of their skin, they may never develop skin cancer.


Human Genes and Mutations

Sometimes genes change. Also, sometimes errors occur in the DNA when it is being copied during cell division. These changes and errors are called mutations. Many mutations are harmful. Some mutations are helpful or have no effect on an organism. Certain chemicals, X rays, and radioactive materials can cause mutations.

What are chromosome disorders?

Problems can happen if the incorrect number of chromosomes is inherited. Mistakes in the process of meiosis can result in an organism with more or fewer chromosomes than normal. Down syndrome is a disorder in which the person has one more chromosome than normal.


Recessive Genetic Disorders

Many human genetic disorders are caused by recessive genes. Such genetic disorders occur when both parents have a recessive allele responsible for the disorder. Because the parents are heterozygous, they do not show any symptoms of the disorder. However, if each parent passes a recessive allele to the child, the child inherits two recessive alleles and will have the disorder. Cystic fibrosis is a homozygous recessive disorder. It is the most common genetic disorder that can lead to death among Caucasian Americans. People with cystic fibrosis produce thicker mucus than normal. The thick mucus builds up in the lungs and makes it hard to breathe. 

Gender Determination

Each egg produced by a female normally contains one X chromosome. Males produce sperm that normally have either one X or one Y chromosome. When a sperm with an X chromosome fertilizes an egg, the offspring is a female, XX. When a sperm with a Y chromosome fertilizes an egg, the offspring is a male, XY. Sometimes chromosomes do not separate during meiosis. When this happens, a person can inherit an unusual number of sex chromosomes.

Sex-Linked Disorders

A sex-linked gene is an allele on a sex chromosome. Some conditions that result from inheriting sex-linked genes are called sex-linked disorders. Red-green colorblindness in humans is a sex-linked disorder because the related genes are on the X chromosome. People with this disorder have difficulty seeing the difference between green and red, and sometimes yellow. A female is color-blind when each of her X chromosomes has the recessive allele. A male has only one X chromosome. If his X chromosome has the recessive allele, he will be color-blind. 

Reading Check

3. **Explain** How is cystic fibrosis inherited?

Reading Check

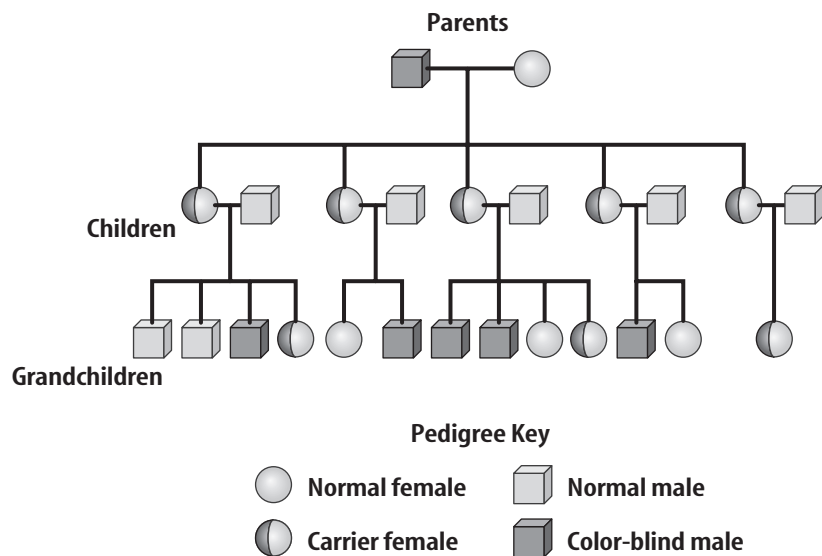
4. **Identify** What is one sex-linked disorder?

Pedigrees Trace Traits

You can trace a trait through a family using a pedigree like the one shown below. Males are represented by squares. Females are represented by circles. A completely filled square or circle shows that the person has the trait. A half-colored square or circle shows that the person carries an allele for the trait, but does not have the trait. The pedigree in the figure below shows how the trait for color blindness is carried through a family. In this pedigree, the grandfather was color blind. He married a woman who did not carry the color-blind allele.

Picture This

5. **Infer** In the pedigree, why are there no color-blind women in this family?



How can pedigrees be helpful?

A pedigree can be used by a geneticist to trace a trait in members of a family over several generations. The pedigree allows the geneticist to determine the trait's pattern of inheritance. The geneticist can identify if the trait is recessive, dominant, sex-linked, or follows some other pattern. Geneticists use this information to predict the probability that a baby will be born with a specific trait.

Pedigrees also are used to breed animals and plants for desirable traits. Livestock and plant crops are food sources for humans. Using pedigrees, these organisms can be bred to increase their yield and nutritional content.

Think it Over

6. **Draw Conclusions**

Why do you think pedigrees are important for animals bred for show, such as dogs?

● After You Read

Mini Glossary

incomplete dominance: the offspring of two homozygous parents show an intermediate phenotype

polygenic (pah lih JEH nihk) inheritance: a group of gene pairs act together to produce a trait

sex-linked gene: an allele inherited on a sex chromosome

1. Review the terms and their definitions in the Mini Glossary. Choose one term and use it to explain one way that traits can be inherited.

2. Choose one of the question headings in the Read to Learn section. Write the question in the space below. Then write your answer to that question on the lines that follow.

Write your question here.

3. List the words that you circled in the Read to Learn section. Select one of those words and write its definition below.

