

Chapter Quiz

Write your answers on a separate sheet of paper.

1. How do plants differ from animals?
2. What four parts do all seed plants have?
3. What are three things roots do for plants?
4. What does a stem carry up a plant?
5. What does a stem carry down a plant?
6. What process in plants requires sunlight, water, chlorophyll, and carbon dioxide?
7. What happens during photosynthesis?
8. How do plants help you breathe?
9. What happens during pollination?
10. What part of a plant contains and protects the seeds?

Test Tip

Review the diagrams and the captions in the chapter before a test. Make sure you read the labels, too.

Research Project

Take a notebook and pencil to a grocery store. Create a chart of “Plant Parts We Eat.” Make five headings on your paper: Stems, Leaves, Roots, Seeds, Fruits. Find as many foods as you can to list under each heading. Be sure to look at the canned and frozen foods as well as the fresh foods. Research where each of these foods is grown. Include this information in your chart. Finally, plan and write a menu for a meal that includes foods from different plant parts.



The puppies look like their mother and father. Why do you think the puppies resemble their parents?

Learning Objectives

- Explain how an organism passes on its traits.
- Compare dominant and recessive traits.
- Describe how DNA, genes, and chromosomes are related.
- Compare the number of chromosomes in body cells and sex cells.
- Explain the occurrence of mutation.
- Describe how the science of genetics is used in breeding.
- Give examples of how environment can affect an organism's traits.
- **LAB ACTIVITY:** Observe dominant and recessive traits.
- **ON-THE-JOB SCIENCE:** Relate an understanding of traits to cattle breeding.

Words to Know

trait	a characteristic that can be inherited from parents; it identifies an organism as an individual
offspring	a new organism that results from reproduction
heredity	the passing down of traits from parents to offspring
crossbreeding	the matching of parents with different traits to produce offspring with new traits
hybrid	the offspring of parents that have been crossbred
dominant	describes a trait that will show its effect no matter the effect of its partner trait
recessive	describes a trait that will be masked by a dominant partner trait
chromosome	a threadlike structure in a cell nucleus that holds thousands of bits of information about an organism's traits
gene	a bit of information in a chromosome
mutation	a change in the genetic code of an organism

8-1

The Same But Different

Words to Know

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What Is Heredity?

Have you ever wondered why you look the way you do? Do you look like some members of your family but not like others? Which of your features are like your mother's? Is your nose like hers? Which features are like your father's? Are your height and body shape like his? Do you talk or act like any of your sisters or brothers?

How are you different from the members of your family? Do you have features that none of them have?

A **trait** is a characteristic that can be inherited from parents. It identifies an organism as an individual. The way you look and act are traits. The color of your skin, hair, and eyes, and your height and shape are traits. You also have personality traits. Are you quiet or talkative? Are you careful or reckless? These are different personality traits.

Where do traits come from? All living things reproduce. This means that they produce new organisms to take their place when they die. For example, humans have babies. Plants make seeds that grow into plants. A new organism that results from reproduction is called an **offspring**. Offspring get many of their traits directly from their parents. The passing down of traits from parents to offspring is called **heredity**.

Genetics is the scientific study of heredity. The science of genetics is very new compared to other sciences. The study of genes began about 135 years ago. Yet, today, genetics is one of the fastest growing sciences.

✓ How do people get many of their traits?

The Beginning of Genetics

Some basic laws of genetics were first discovered in the mid-1800s. An Austrian monk named Gregor Johann Mendel grew 22 different kinds of pea plants in his garden. He bred these plants to study how their traits were passed from parents to offspring. *Breeding* means producing offspring, especially with the idea of getting new or better kinds.

Some of Mendel's pea plants were short and bushy. Others were tall and climbing. Some plants had white flowers. Others had purple flowers. Some produced round seeds. Others produced wrinkled seeds.

Mendel used the pollen from a tall plant to pollinate a short plant. This is called **crossbreeding**. Crossbreeding is the matching of parents with different traits to produce offspring with new traits.

Mendel also crossbred white-flowered plants with purple-flowered plants. Then he crossbred plants that had round seeds with plants that had wrinkled seeds. When parents with different traits are crossbred, the offspring is called a **hybrid**.

Science Fact



Gregor Mendel was ahead of his time. He first announced his discoveries in 1865. However, his results were ignored until the beginning of the 20th century.



Gregor Mendel
(1822–1884)















	Dominant Trait	Recessive Trait
Seed Shape	 Round	 Wrinkled
Seed Color	 Yellow	 Green
Pod Shape	 Full	 Pinched
Pod Color	 Green	 Yellow
Flower Color	 Purple	 White
Flower Position	 Side	 End
Stem Height	 Tall	 Short

Figure 8-1 This table shows the seven characteristics that Mendel studied in pea plants.

Mendel's results may surprise you. When he crossed tall plants with short plants, he always got tall plants. When he crossed purple-flowered plants with white-flowered plants, he always got purple-flowered plants. When he crossed round seeds with wrinkled seeds, he always got round seeds.

Mendel had discovered that there are two kinds of traits. One kind may cover or hide the other kind. In pea plants, being tall is a trait that can hide the trait of shortness. The color purple can hide the color white. Roundness can hide wrinkling in seeds.

In an organism, a **dominant** trait is one that will show its effect no matter the effect of its partner trait. A **recessive** trait is one that will be masked by a dominant partner trait. Recessive traits are not lost. They may show up in later generations. This explains how two brown-eyed parents can have a blue-eyed child. Both parents carry a recessive trait for blue eyes. They both pass on that trait to the child.

✓ What two kinds of traits did Gregor Mendel discover?

Lesson Review

1. What are four traits that you inherited from your parents?
2. What are three traits that Mendel studied in pea plants?
3. How is a hybrid created?
4. **CRITICAL THINKING** If you crossed a short pea plant with another short pea plant, what kind of offspring would be produced?

8.2

The Building Blocks of Heredity

Words to Know

chromosome	a threadlike structure in a cell nucleus that holds thousands of bits of information about an organism's traits
gene	a bit of information in a chromosome
mutation	a change in the genetic code of an organism

Remember

DNA is a special kind of molecule found in the nuclei of cells. It controls many of the characteristics of living things.

**Science Fact**

Scientists often use fruit flies to study genetics. That is because fruit flies have hundreds of offspring at a time, and they reproduce every ten days. Scientists can easily and quickly observe the passing of traits over many generations.

Chromosomes and Genes

A **chromosome** is a threadlike structure in a cell nucleus. It is made up of DNA. Scientists now know that traits are controlled by DNA. Each chromosome holds thousands of bits of information about an organism's traits. Each of these bits of information is called a **gene**. A gene consists of a DNA code that controls a trait. Genes are the basic building blocks of heredity. They form the *genetic code* of life.

Chromosomes come in pairs. Half an organism's chromosomes are from the father. Half are from the mother. Genes come in pairs, too. Most inherited traits are controlled by at least one pair of genes. These genes will be either dominant or recessive, like the traits they control. However, traits are often controlled by more than one pair of genes.

Each species has a certain number of chromosomes. Humans have 23 pairs. This means that every nucleus in every human body cell has 46 chromosomes. Fruit flies have only 4 pairs. Every body cell in a fruit fly has 8 chromosomes in its nucleus.

✓ **What is the relationship between a chromosome and a gene?**

On the Cutting Edge

A POWERFUL WEAPON AGAINST DIABETES

Scientists have found the gene in human cells that controls the making of a hormone called insulin. Insulin is made by the pancreas, an organ in the digestive system. A serious disease called diabetes keeps the body from making insulin or using it properly.

When you eat carbohydrates, your body breaks them down into a simple sugar called glucose. The body uses glucose for energy. In 1922, researchers found that glucose was controlled by insulin.

Insulin can be injected into the body to control diabetes. Insulin used to be very expensive and hard to get. Today, however, insulin can be made in the laboratory. The gene from human DNA is removed and attached to the DNA of bacteria. This causes the bacteria to make insulin. Bacteria reproduce very quickly. Today, bacteria “factories” make insulin quickly and at little cost.

CRITICAL THINKING How does the making of insulin-producing bacteria help people who have diabetes?



This lab uses bacteria to produce insulin.

Remember

All living things are made of cells. The male sex cells are called sperm cells, and the female sex cells are called egg cells.

Fertilization

Most cells reproduce by dividing in half. One cell divides into two cells. However, before the cell divides, it copies its chromosomes exactly. This way, both of the new cells are complete and are exactly the same.

Many organisms, including humans, begin with two special kinds of cells called sex cells. Like body cells, the sex cells reproduce by dividing. However, sex cells divide twice. The second time, they do not make copies of the chromosomes. As a result, each new sex cell gets only half the number of chromosomes found in body cells.

When organisms reproduce, a sperm cell and an egg cell join. This is fertilization. The two cells become one cell with a full set of chromosomes. The offspring that results has genes from both the sperm cell and the egg cell.

✓ **What happens to the chromosomes of the parents during fertilization?**

Where Do New Traits Come From?

New traits may suddenly appear in organisms. For example, a purple-flowered plant may have a single red flower. Then some of its offspring may have only red flowers. The new trait may be the result of a change in the organism's DNA. This change in the genetic code of an organism is called a **mutation**.

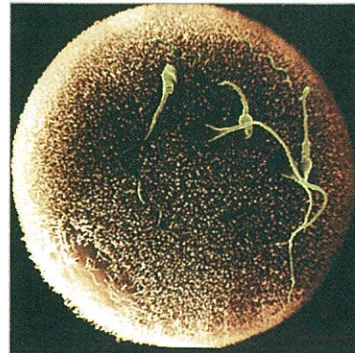
Most mutations are harmful and can cause an organism's early death. These mutations are not usually passed on to offspring. For example, a bird born with a soft beak would not be able to crack nuts or dig for worms. It would die young.

Sometimes, a helpful mutation occurs. Imagine a mutation that causes a giraffe to have a longer neck. The giraffe could reach more leaves on a tree than other giraffes could. The giraffe would pass along this mutation to its offspring.

✓ **What can cause a new trait to appear in an organism?**

Lesson Review

1. On what structures are genes located?
2. How are sex cells different from body cells?
3. **CRITICAL THINKING** What might cause a frog to be born with only one leg?



Fertilization

8-3

Controlling Heredity

Plant and Animal Breeding

Long before scientists knew anything about DNA, people used genetics. For example, farmers have used genetics to control the traits of the offspring of their plant crops and animals. Even in ancient times, farmers bred the best fruit trees to get better fruit. They bred the best milk cows to get better milk.

Today, scientists, farmers, and gardeners carefully choose plants and animals for breeding. This is called *selective breeding*.

✓ What is selective breeding?

The Environment and Traits

Your genes do not control everything about you. Your environment also plays a big part in forming your traits. Your environment includes the air you breathe, the food you eat, the education you get, and other things in your surroundings.

Suppose, for example, that a woman has the genes to be a very fast runner. Yet, she has a poor diet and never exercises. These environmental influences would probably keep the woman from running very fast.

A tomato plant may be the offspring of parents that produced big, juicy tomatoes. The young plant has very good genes for producing delicious fruit. Yet, suppose the plant is rooted in poor soil and does not get enough water. Despite its good genes, the tomato plant may not produce any fruit at all because of its environment.

✓ Besides genes, what else can affect the traits of an organism?

Transferring Genes

Today, scientists can produce new traits in organisms by removing a gene from the DNA of one organism and transferring it to the DNA of another organism. As a result, the organism that receives the gene has the trait that is controlled by that gene. You read on page 114 that scientists transferred a human insulin gene into bacteria. With this gene, the bacteria produce human insulin. The process of transferring a gene from one organism to another is called *genetic engineering*.

✓ How does genetic engineering produce new traits?

Lesson Review

1. How do farmers use genetics to produce better plants?
2. What is the result of genetic engineering?
3. **CRITICAL THINKING** How might a person's environment affect his or her height?

A Closer Look

CLONING ANIMALS

An animal has a combination of traits from its mother and its father. But scientists have found a way of producing an animal that gets all its traits from one parent. The animal, which is identical to the parent, is called a clone.

Scientists make a clone by removing the nucleus from an animal's egg cell. Then they remove the nucleus from a body cell of an animal of the same species. This nucleus is inserted into the egg cell. The egg cell now has a full set of chromosomes. Scientists place the egg cell into an adult female, where it grows. The offspring is identical to the animal from which it got its chromosomes.

CRITICAL THINKING How can cloning be helpful to farmers?



Science Fact

Some people think that scientists should not change the genetic codes of organisms. They fear that the change may be harmful to those organisms. The change may also produce new kinds of organisms that are harmful to other organisms.



This sheep, called Dolly, is a clone.



LAB ACTIVITY

Observing Dominant and Recessive Traits

BACKGROUND

All organisms have traits. Your eye color, skin color, and height are a few human traits. Some traits are dominant. Others are recessive. A dominant trait will show its effect no matter the effect of its partner trait.

PURPOSE

You will observe some dominant and recessive human traits.

MATERIALS

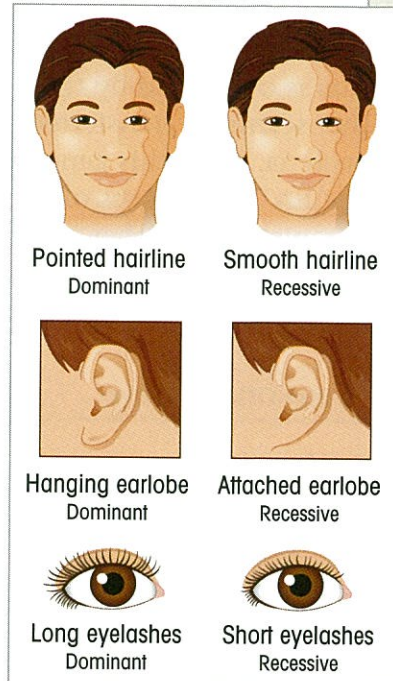
mirror

WHAT TO DO

1. Copy the chart.
2. Look at the three human traits shown in the drawing. Note whether each trait is dominant or recessive.
3. Find out which of the traits you have. Use a mirror to observe your features.
4. In the chart, record your traits. Then write whether each trait is dominant or recessive.
5. Count up and record the number of students in your class who have the dominant trait for each feature. Then count up and record the number of students who have the recessive trait for each feature.

DRAW CONCLUSIONS

- Which dominant traits do you have?
- Which recessive traits do you have?
- Do more students in your class have dominant traits or recessive traits for each feature? Why do you think this is so?



Human traits

Feature	Trait	Dominant or Recessive?
Hairline		
Earlobe		
Eyelashes		

ON-THE-JOB SCIENCE

Cattle Breeder

Jacob is a cattle breeder. He selects cattle for their traits. For example, the cattle may be selected for producing high-quality meat or large amounts of milk. When the selected cattle produce offspring, Jacob chooses the offspring that show the best traits. Then these offspring reproduce. Jacob continues to select the best offspring for several generations. Eventually, a new breed of cattle with the best traits is produced. The chart below describes some traits of four breeds of dairy cattle.



Cattle breeders select cattle for certain traits.

Name of Dairy-Cattle Breed	Size	Average Amount of Milk Produced Each Year	Average Percent of Milk That Is Butterfat
Holstein-Friesian	Largest	14,700 lb	3.5%
Brown Swiss	↓	12,800 lb	4.0 %
Guernsey		10,300 lb	4.8 %
Jersey	Smallest	9,400 lb	5.2 %

Suppose you wanted to produce a new breed of dairy cattle with improved traits. Think about the following questions: *Do you want the new breed to be large or small? Do you want the breed to produce large amounts of milk? Should the milk have a lot of butterfat?*

On a separate sheet of paper, describe the new cattle breed that you would like to produce.

Tell which of the breeds in the chart you would allow to reproduce to create the new breed. Explain why you selected those breeds.

Critical Thinking

Some cattle produce good-tasting meat *and* a lot of milk. How do you think breeders produced these cattle?

Summary

Genetics is the study of heredity. Heredity, along with other things, determines who and what you are.

Lesson 8.1

Many traits are passed from parents to offspring. This is heredity. Gregor Mendel used pea plants to study genetics. He discovered that some traits can be dominant or recessive.

Lesson 8.2

Genes are parts of chromosomes. A gene contains DNA, which controls traits in an organism. Offspring get half their chromosomes from each parent. A change in the genetic code is called a mutation.

Lesson 8.3

Selective breeding can produce plants and animals with better traits. The environment also affects the traits of organisms. Genetic engineering also can produce new traits.

Vocabulary Review

Write *true* or *false* for each sentence. If the sentence is false, replace the underlined term to make the sentence true.

1. In pea plants, white flower color is a dominant trait because it is masked by purple flower color.
2. A mutation may result in a new trait in an organism.
3. Crossbreeding matches parents with different traits.
4. A trait is a new organism that results from reproduction.
5. Heredity is the passing of traits from parents to offspring.
6. A clone results from crossbreeding.
7. A gene contains a DNA code.
8. A chromosome is found in the nucleus of a cell.

Chapter Quiz

Write your answers on a separate sheet of paper.

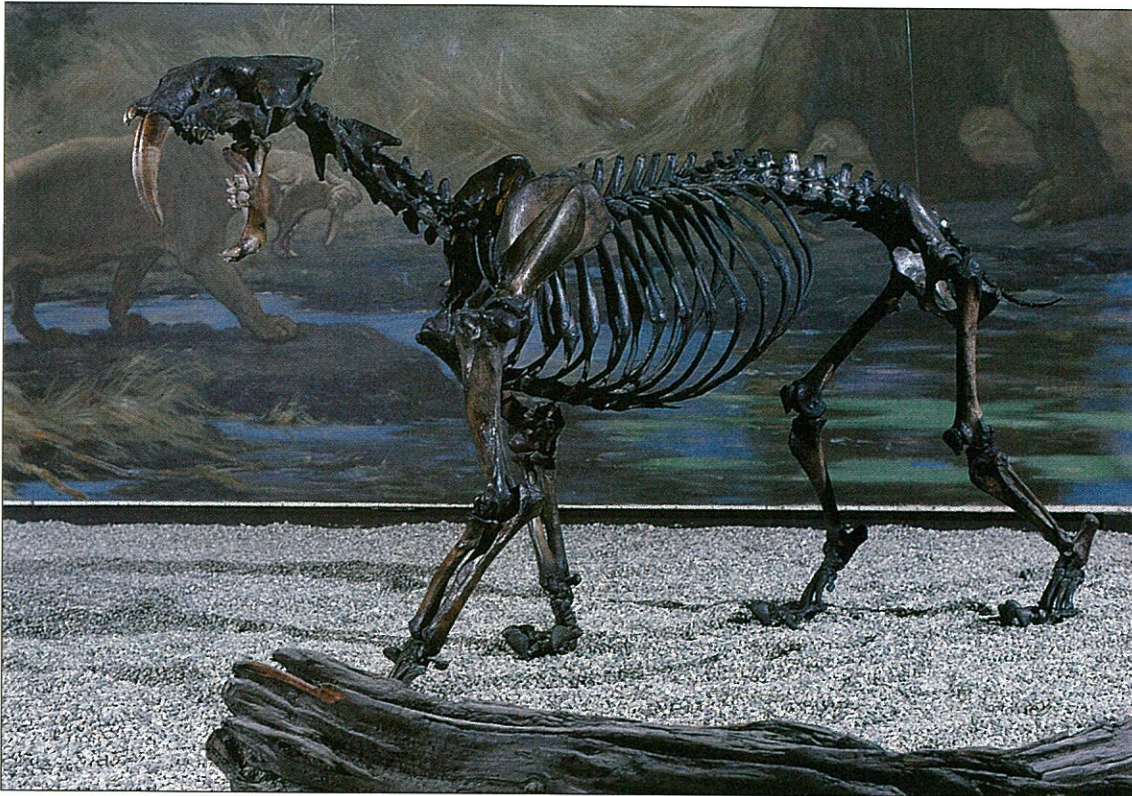
1. What does an organism pass along to its offspring?
2. Does a recessive trait disappear forever?
If not, when may it reappear?
3. Mendel produced pea plants that were hybrid for seed shape. Why did the hybrid plants have round seeds instead of wrinkled seeds?
4. Where are the genes in your cells located?
5. How many chromosomes are in human sex cells?
How many chromosomes are in human body cells?
6. What does a cell make copies of before it divides?
7. Why are harmful mutations usually not passed on to offspring?
8. How do farmers use genetics to produce better livestock?
9. How can the environment affect an organism's traits?
Give two examples.
10. How did scientists produce bacteria that make human insulin?

Test Tip

Before you begin a test, look it over. Try to decide how much time you will need for each question. Set aside enough time for more difficult questions.

Research Project

Choose any plant or animal to research. The organism might be at home or near your school. On a separate sheet of paper, name as many of the organism's traits as you can. Be sure to include its size, shape, and color. Describe how the organism acts. Name three traits that are caused by the organism's genes. Name a trait that is caused by the organism's environment.



This is a skeleton of a saber-toothed tiger that lived millions of years ago. There are no saber-toothed tigers on Earth today. How was this animal like the tigers of today? How was it different?

Learning Objectives

- List the ways scientists learn about theories of evolution.
- Describe Lamarck's theory of evolution.
- Identify the four main parts of Darwin's theory of evolution.
- Compare and contrast natural selection and mutation.
- Explain the role of mutations in the theory of evolution.
- LAB ACTIVITY: Explore how natural selection works.
- SCIENCE IN YOUR LIFE: Relate use of pesticides to natural selection of pests.