

Mendel and His Peas

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What is heredity?
- How did Gregor Mendel study heredity?

National Science Education Standards
LS 2b, 2e

What Is Heredity?

Why don't you look like a rhinoceros? The answer to that question seems simple. Neither of your parents is a rhinoceros. Only a human can pass on its traits to make another human. Your parents passed some of their traits on to you. The passing of traits from parents to offspring is called **heredity**.

About 150 years ago, a monk named Gregor Mendel performed experiments on heredity. His discoveries helped establish the field of genetics. *Genetics* is the study of how traits are passed on, or inherited. ✓



Define As you read this section, make a list of all of the underlined and italicized words. Write a definition for each of the words.

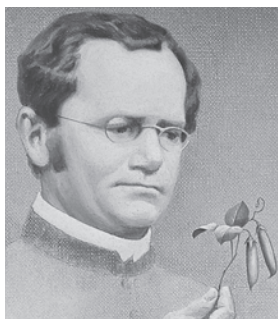
Who Was Gregor Mendel?

Gregor Mendel was born in Austria in 1822. He grew up on a farm where he learned a lot about flowers and fruit trees. When he was 21 years old, Mendel entered a monastery. A monastery is a place where monks study and practice religion. The monks at Mendel's monastery also taught science and performed scientific experiments.

Mendel studied pea plants in the monastery garden to learn how traits are passed from parents to offspring. He used garden peas because they grow quickly. They also have many traits, such as height and seed color, that are easy to see. His results changed the way people think about how traits are passed on. ✓



1. Define What is genetics?



Gregor Mendel discovered the principles of heredity while studying pea plants.



2. Explain Why did Mendel choose to study pea plants?

SECTION 1 Mendel and His Peas *continued*

REPRODUCTION IN PEAS

Like many flowering plants, pea plants have both male and female reproductive parts. Many flowering plants can reproduce by cross-pollination. In most plants, sperm are carried in structures called pollen. In *cross-pollination*, sperm in the pollen of one plant fertilize eggs in the flower of another plant. Pollen can be carried by organisms, such as insects. It may also be carried by the wind from one flower to another.

Some flowering plants must use cross-pollination. They need another plant to reproduce. However, some plants, including pea plants, can also reproduce by self-pollination. In *self-pollination*, sperm from one plant fertilize the eggs of the same plant.

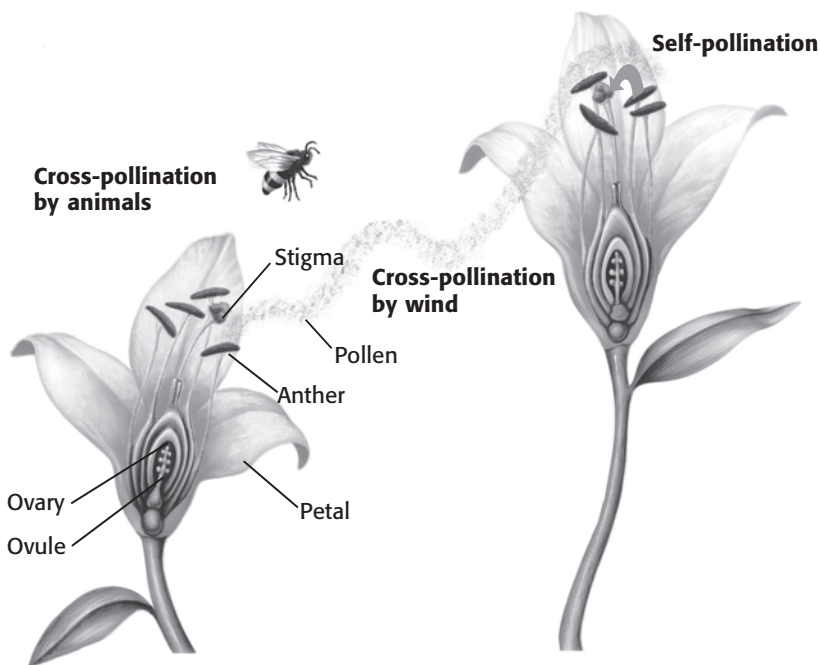
Mendel used self-pollination in pea plants to grow true-breeding plants for his experiments. When a *true-breeding* plant self-pollinates, its offspring all have the same traits as the parent. For example, a true-breeding plant with purple flowers always has offspring with purple flowers.

Critical Thinking

3. Compare What is the difference between cross-pollination and self-pollination?

TAKE A LOOK

4. Identify What are two ways pollen can travel from one plant to another during cross-pollination?



During pollination, pollen from the anther (male) is carried to the stigma (female). Fertilization happens when a sperm from the pollen moves through the stigma and enters an egg in an ovule.

SECTION 1 Mendel and His Peas *continued*

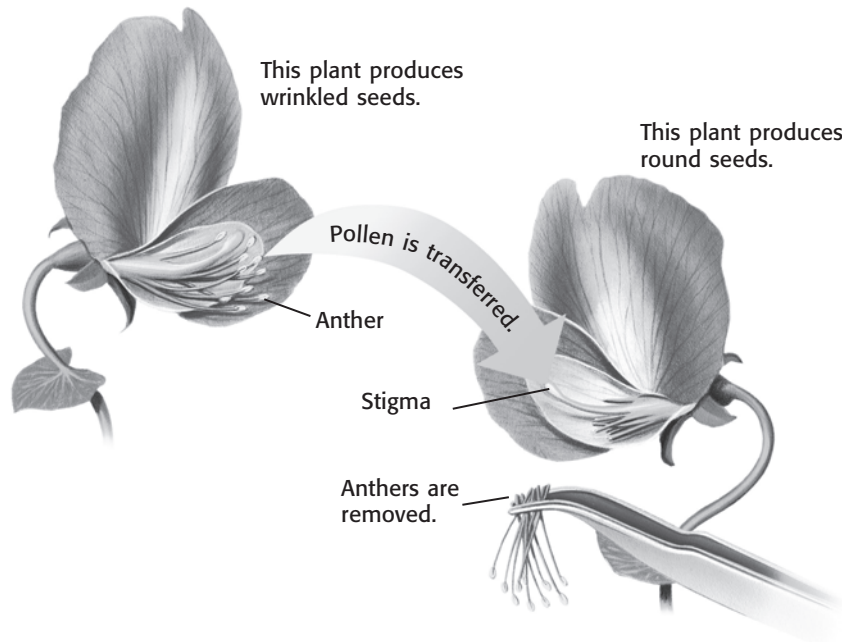
CHARACTERISTICS

A *characteristic* is a feature that has different forms. For example, hair color is a characteristic of humans. The different forms or colors, such as brown or red hair, are *traits*. ✓

Mendel studied one characteristic of peas at a time. He used plants that had different traits for each characteristic he studied. One characteristic he studied was flower color. He chose plants that had purple flowers and plants that had white flowers. He also studied other characteristics, such as seed shape, pod color, and plant height.

CROSSING PEA PLANTS

Mendel was careful to use true-breeding plants in his experiments. By choosing these plants, he would know what to expect if his plants self-pollinated. He decided to find out what would happen if he bred, or crossed, two plants that had different traits.



Mendel removed the anthers from a plant that made round seeds. Then, he used pollen from a plant that made wrinkled seeds to fertilize the plant that made round seeds.

READING CHECK

5. Explain How are characteristics and traits related?

Say It

Describe How would you describe yourself? Make a list of your physical traits, such as height, hair color, and eye color. List other traits you have that you weren't born with. Share this list with your classmates. Which of these traits did you inherit?

TAKE A LOOK

6. Describe How did Mendel make sure that the plant with round seeds did not self-pollinate?

SECTION 1 Mendel and His Peas *continued*

What Happened in Mendel’s First Experiments?

Mendel studied seven different characteristics in his first experiments with peas. He crossed plants that were true-breeding for different traits. For example, he crossed plants that had purple flowers with plants that had white flowers. The offspring from such a cross are called *first-generation plants*. All of the first-generation plants in this cross had purple flowers. What happened to the trait for white flowers?

Mendel got similar results for each cross. One trait was always present in the first generation and the other trait seemed to disappear. Mendel called the trait that appeared the **dominant trait**. He called the other trait the **recessive trait**. To *recede* means “to go away or back off.” To find out what happened to the recessive trait, Mendel did another set of experiments. ✓

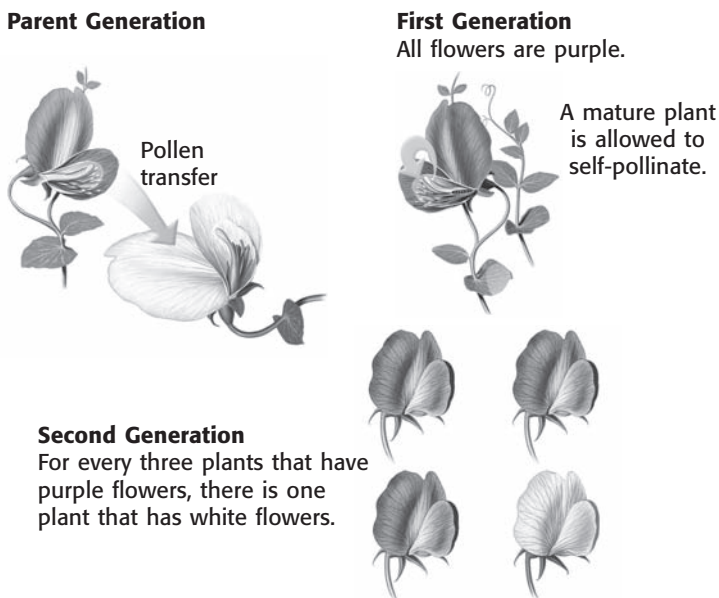
READING CHECK

7. Identify What kind of trait appeared in the first generation?

What Happened in Mendel’s Second Experiment?

Mendel let the first-generation plants self-pollinate. Some of the offspring were white-flowered, even though the parent was purple-flowered. The recessive trait for white flowers had reappeared in the second generation.

Mendel did the same experiment on plants with seven different characteristics. Each time, some of the second-generation plants had the recessive trait.



TAKE A LOOK















8. Identify What type of traits appeared in the second generation?

SECTION 1 Mendel and His Peas *continued***RATIOS IN MENDEL'S EXPERIMENTS**

Mendel counted the number of plants that had each trait in the second generation. He hoped that this might help him explain his results.

As you can see from the table below, the recessive trait did not show up as often as the dominant trait. Mendel decided to figure out the ratio of dominant traits to recessive traits. A *ratio* is a relationship between two numbers. It is often written as a fraction. For example, the second generation produced 705 plants with purple flowers and 224 plants with white flowers. Mendel used this formula to calculate the ratios:

$$\frac{705}{224} = \frac{3.15}{1} \text{ or } 3.15:1$$

Characteristic	Dominant trait	Recessive trait	Ratio
Flower color	705 purple 	224 white 	3.15:1
Seed color	6,002 yellow 	2,001 green 	
Seed shape	5,474 round 	1,850 wrinkled 	
Pod color	428 green 	152 yellow 	
Pod shape	882 smooth 	299 bumpy 	
Flower position	651 along stem 	207 at tip 	
Plant height	787 tall 	277 short 	

Math Focus

9. Find Ratios Calculate the ratios of the other pea plant characteristics in the table.

Math Focus

10. Round Round off all numbers in the ratios to whole numbers. What ratio do you get?

What Did Mendel Conclude?

Mendel knew that his results could be explained only if each plant had two sets of instructions for each characteristic. He concluded that each parent gives one set of instructions to the offspring. The dominant set of instructions determines the offspring's traits.

Section 1 Review

NSES LS 2b, 2e

SECTION VOCABULARY

dominant trait the trait observed in the first generation when parents that have different traits are bred

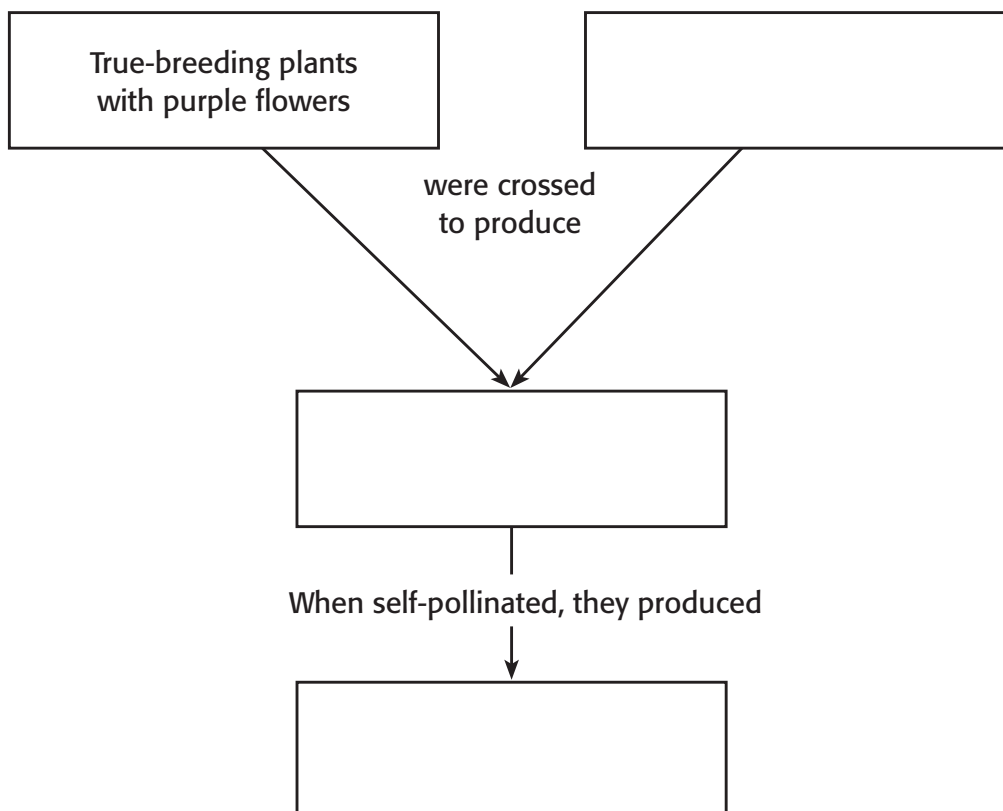
heredity the passing of genetic traits from parent to offspring

recessive trait a trait that is apparent only when two recessive alleles for the same characteristic are inherited

1. Define What is a true-breeding plant?

2. Apply Concepts Cats may have straight or curly ears. A curly-eared cat mated with a straight-eared cat. All the kittens had curly ears. Are curly ears a dominant or recessive trait? Explain your answer.

3. Summarize Complete the cause and effect map to summarize Mendel's experiments on flower color in pea plants.



2. During interphase, chromosomes are copied.
Mitosis begins with prophase. The chromosomes condense.
During metaphase, the nuclear membrane dissolves. The chromosomes align.
During anaphase, the chromatids separate and move to opposite sides of the cell.
During telophase, the nuclear membrane forms. The chromosomes lengthen, and mitosis ends.
During cytokinesis, the cytoplasm divides.
3. A cell makes a copy of its DNA before it divides so that each new cell will receive a copy. Each new cell will be an exact copy of the parent cell.
4. Eukaryotic cells have more chromosomes to copy than prokaryotic cells. The nuclear membrane of a eukaryotic cell also has to break down before the cell can divide.

Chapter 3 Heredity

SECTION 1 MENDEL AND HIS PEAS

1. the study of how traits are inherited
2. They grow quickly, and they have many traits that are easy to see.
3. In cross-pollination, sperm from one plant fertilize eggs of another. In self-pollination, sperm fertilize eggs of the same plant.
4. Pollen can be carried by organisms, such as insects, or by the wind.
5. Traits are the different forms of a characteristic.
6. Mendel removed the anthers from the flower of the plant with round seeds.
7. the dominant trait
8. dominant and recessive
9. Correct ratios, from top to bottom:
3.00:1, 2.96:1, 2.82:1, 2.95:1, 3.14:1, 2.84:1
10. 3:1

Review

1. A true-breeding plant is one that will produce offspring with all its same traits when it self-pollinates.
2. Dominant; in the first generation, a recessive trait disappears.

3. True-breeding plants with white flowers were crossed to produce plants that all had purple flowers. When self-pollinated, they produced three plants with purple flowers and one with white.

SECTION 2 TRAITS AND INHERITANCE

1. a version of a gene
2. the appearance of an organism
3. one recessive allele and one dominant allele
4. Homozygous; both of its alleles are the same
5. PP , Pp , and pp
6. They all have at least one dominant allele.
7. 50% of the offspring are homozygous.

	P	p
P	PP	Pp
p	Pp	pp

8. There are only two alleles for each trait.
9. The offspring would probably be one color. They would be the color of the dominant allele.
10. In pea plants, one gene affects flower color. The gene that controls fur color in tigers affects more than one trait.
11. Possible answers: hair color, skin color, eye color, height

Review

1. Genes carry the instructions for a trait. Alleles are the different versions of a gene.
2. If one individual is homozygous for a dominant trait, and the other individual is heterozygous for a dominant trait, the two individuals have different genotypes. However, their phenotype is the same, because they show the same trait.
3. 25% of the offspring will have green seeds.

	Y	y
Y	YY	Yy
y	Yy	yy

4. Each trait that Mendel studied in peas was controlled by a single gene. Height in humans is determined by the interaction of many genes. Height can also be affected by environment.

SECTION 3 MEIOSIS

1. a pair of chromosomes that carry the same genes
2. 46