

# SECTION 1 Mendel's Work

## DISCOVER

## ACTIVITY

### What Does the Father Look Like?

1. Observe the colors of each kitten in the photo. Record each kitten's coat colors and patterns. Include as many details as you can.
2. Observe the mother cat in the photo. Record her coat color and pattern.



## Think It Over

**Inferring** Based on your observations, predict what you think the kittens' father looks like. Identify the evidence on which you based your inference.

## GUIDE FOR READING

- What controls the inherited characteristics of organisms?

**Reading Tip** Before you read, list the boldfaced terms. As you read, write a definition for each term in your own words.

**Key Terms** • [trait](#) • [heredity](#)  
 • [genetics](#) • [purebred](#) • [gene](#)  
 • [alleles](#) • [dominant allele](#)  
 • [recessive allele](#) • [hybrid](#)

The year was 1851. Gregor Mendel, a young priest from a monastery in Central Europe, entered the University of Vienna to study mathematics and science. Two years later, Mendel returned to the monastery and began teaching at a nearby high school.

Mendel also cared for the monastery's garden, where he grew hundreds of pea plants. He became curious about why some of the plants had different physical characteristics, or [traits](#). Some pea plants grew tall while others were short. Some plants produced green seeds, while others had yellow seeds.

Mendel observed that the pea plants' traits were often similar to those of their parents. Sometimes, however, the pea plants had different traits than their parents. The passing of traits from parents to offspring is called [heredity](#). For more than ten years, Mendel experimented with thousands of pea plants to understand the process of heredity. Mendel's work formed the foundation of [genetics](#), the scientific study of heredity.

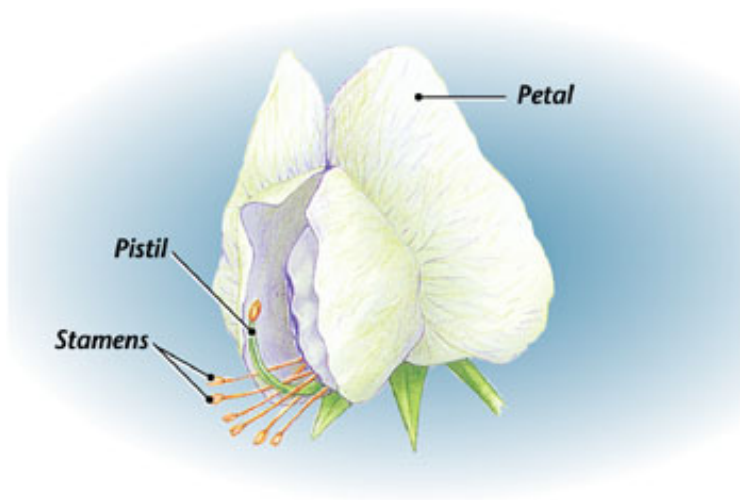
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# SECTION 1

## Mendel's Peas

Mendel made a wise decision when he chose to study peas rather than other plants in the monastery garden. Pea plants are easy to study because they have many traits that exist in only two forms. For example, pea plant stems are either tall or short, but not medium height. Also, garden peas produce a large number of offspring in one generation. Thus, it is easy to collect large amounts of data to analyze.

The diagram below shows a flowering pea plant. Notice that the flower's petals surround the pistil and the stamens. The pistil produces female sex cells, or eggs, while the stamens produce pollen, which contains the male sex cells.



**Garden Peas** Garden peas usually reproduce by self-pollination. Pollen from a flower's stamens lands on the pistil of the same flower. Plants that result from self-pollination inherit all of their characteristics from the same parent plant. **Relating Cause and Effect** Why was it important for Mendel to prevent his pea plants from self-pollinating?

In nature, pea plants usually self-pollinate. This means that pollen from one flower lands on the pistil of the same flower. Mendel developed a method by which he could cross-pollinate, or "cross," pea plants. To cross two plants, he removed pollen from a flower on one plant and brushed it onto a flower on a second plant. To prevent the pea plants from self-pollinating, he carefully removed the stamens from the flowers on the second plant.

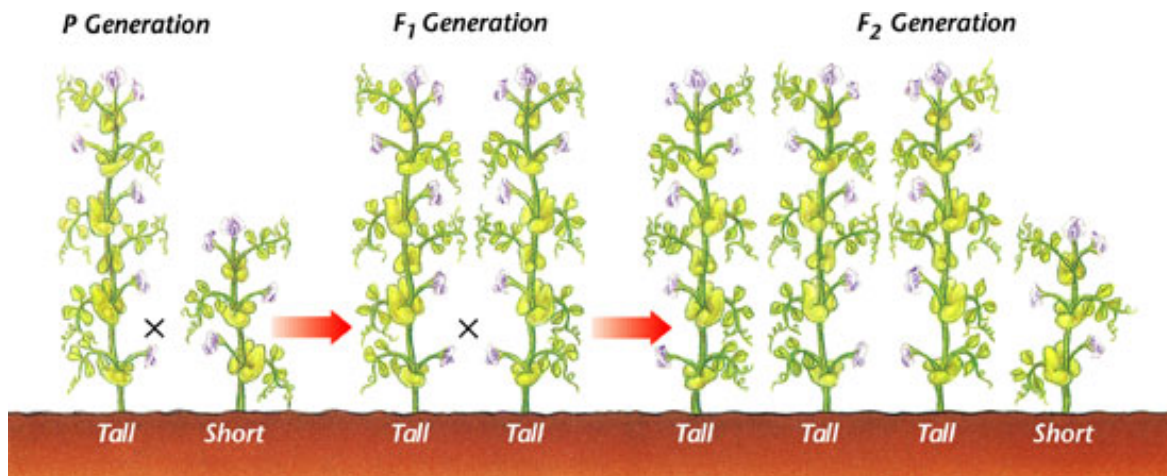
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## Mendel's Experiments

Suppose you had some pea plants, and wanted to study their inherited characteristics. What would you do? Mendel decided to cross plants with opposite forms of a trait. For example, he crossed tall plants with short plants to study the trait of height. He started with purebred plants. A **purebred** plant is one that always produces offspring with the same form of a trait as the parent. For example, purebred short pea plants always produce short offspring. To produce purebred plants, Mendel allowed peas with one specific trait to self-pollinate for many generations. By using purebred plants, Mendel knew that the offspring's trait would always be identical to that of the parents.

In his first experiment, Mendel crossed purebred tall plants with purebred short plants. He called these parent plants the parental generation, or P generation. He called the offspring from this cross the first filial (fil ee ul) generation, or the  $F_1$  generation. The word *filial* means "son" or "daughter" in Latin.

You can see the results of Mendel's first cross below. To Mendel's surprise, all of the offspring in the  $F_1$  generation were tall. Despite the fact that one of the parent plants was short, none of the offspring were short. The shortness trait had disappeared!



**Crossing Pea Plants** When Mendel crossed purebred tall and short pea plants, all the offspring in the  $F_1$  generation were tall. In the  $F_2$  generation, three fourths of the plants were tall, while one fourth were short.

Mendel let the plants in the  $F_1$  generation grow and allowed them to self-pollinate. The results of this experiment also surprised Mendel. The plants in the  $F_2$  (second filial) generation were a mix of tall and short plants. This occurred even though none of the  $F_1$  parent plants were short. The shortness trait had reappeared. Mendel counted the number of tall and short plants in the  $F_2$  generation. He found that about three fourths of the plants were tall, while one fourth of the plants were short.



## Language Arts **CONNECTION**

Gregor Mendel presented a detailed description of his observations in a scientific paper in 1866. In the excerpt that follows, notice how clearly he describes his observations of the two different seed shapes in peas.

“These are either round or roundish, the depressions, if any, occur on the surface, being always only shallow; or they are irregularly angular and deeply wrinkled.”

### *In Your Journal*















Choose an everyday object, such as a piece of fruit or a pen. Make a list of the object’s features. Then write a short paragraph describing the object. Use clear, precise language in your description.

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## Other Inherited Characteristics

In addition to stem height, Mendel studied six other traits in garden peas: seed shape, seed color, seed coat color, pod shape, pod color, and flower position. Compare the two forms of each trait in the chart below. Mendel crossed plants with these traits in the same manner as he did for stem height. The results in each experiment were similar to those that he observed with stem height. Only one form of the trait appeared in the  $F_1$  generation. However, in the  $F_2$  generation the “lost” form of the trait always reappeared in about one fourth of the plants.

Genetics of Pea Plants							
Traits	Seed Shape	Seed Color	Seed Coat Color	Pod Shape	Pod Color	Flower Position	Stem Height
Controlled by Dominant Allele	 Round	 Yellow	 Gray	 Smooth	 Green	 Side	 Tall
Controlled by Recessive Allele	 Wrinkled	 Green	 White	 Pinched	 Yellow	 End	 Short

**Genetics of Pea Plants** Mendel studied seven inherited characteristics in pea plants. Each trait has two different forms. **Interpreting Diagrams** Is yellow seed color controlled by a dominant allele or a recessive allele? What type of allele controls pinched pod shape?



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## Dominant and Recessive Alleles

From his results, Mendel reasoned that individual factors must control the inheritance of traits in peas. The factors that control each trait exist in pairs. The female parent contributes one factor, while the male parent contributes the other factor.

Mendel went on to reason that one factor in a pair can mask, or hide, the other factor. The tallness factor, for example, masked the shortness factor in the  $F_1$  generation.

Today, scientists call the factors that control traits [genes](#). They call the different forms of a gene [alleles](#) (uh leelz). The gene that controls stem height in peas, for example, has two forms: one allele for tall stems and one allele for short stems. Each pea plant inherits two height alleles from its parents—either two alleles for tall stems, two alleles for short stems, or one for each.

**Individual alleles control the inheritance of traits. Some alleles are dominant, while other alleles are recessive.** A [dominant allele](#) is one whose trait always shows up in the organism when the allele is present. A [recessive allele](#), on the other hand, is masked, or covered up, whenever the dominant allele is present. A trait controlled by a recessive allele will only show up if the organism does not have the dominant allele.

In pea plants, the allele for tall stems is dominant over the allele for short stems. Therefore, pea plants with one allele for tall stems and one allele for short stems will be tall. The allele for tall stems masks the allele for short stems. Only pea plants that inherit two recessive alleles for short stems will be short.

Genes and Alleles



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## Understanding Mendel's Crosses

You can understand Mendel's results by following the inheritance of alleles in his experiments. Each of the purebred plants in the P generation had two identical alleles for stem height. The purebred tall plants had two alleles for tall stems. The purebred short plants had two alleles for short stems. In the F<sub>1</sub> generation, all of the plants received one allele for tall stems from the tall parent. They received one allele for short stems from the short parent. The F<sub>1</sub> plants are called [hybrids](#) (hy bridz) because they have two different alleles for the trait. All the F<sub>1</sub> plants are tall because the dominant allele for tall stems masks the recessive allele for short stems.

When Mendel crossed the hybrid plants in the F<sub>1</sub> generation, some of the plants inherited two dominant alleles for tall stems. These plants were tall. Other plants inherited one dominant allele for tall stems and one recessive allele for short stems. These plants were also tall. Other plants inherited two recessive alleles for short stems. These plants were short.



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## SECTION 1

### Mendel's Contribution

In 1866, Mendel presented his results to a scientific society that met regularly near the monastery. In his paper, Mendel described the principles of heredity he had discovered. Unfortunately, other scientists did not understand the importance of Mendel's work. Some scientists thought that Mendel had oversimplified the process of inheritance. Others never read his paper, or even heard about his work. Remember, at that time there were no telephones or other types of electronic communication. Scientists in different parts of the world were isolated from each other. Mendel was especially isolated because he wasn't at a university.

Mendel's work was forgotten for 34 years. In 1900, three different scientists rediscovered Mendel's work. They had made many of the same observations as Mendel had. The scientists quickly recognized the importance of Mendel's work. Many of the genetic principles that Mendel discovered still stand to this day. Because of his work, Mendel is often called the Father of Genetics.

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