

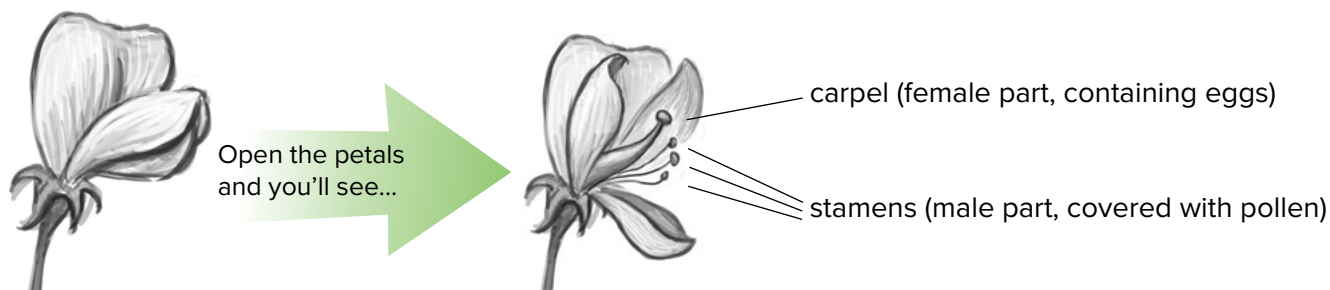


Mendel came from a family of farmers, and he knew a thing or two about plants. So he decided to study inheritance by doing experiments with the common pea plant. Here's what he already knew:

## Fertilization of the common pea plant

Flowers contain the reproductive organs of plants. Like many flowering plants, pea plants combine their male and female parts in the same flower. For fertilization to occur and new plants to grow, pollen from the male parts must reach eggs in the female parts.

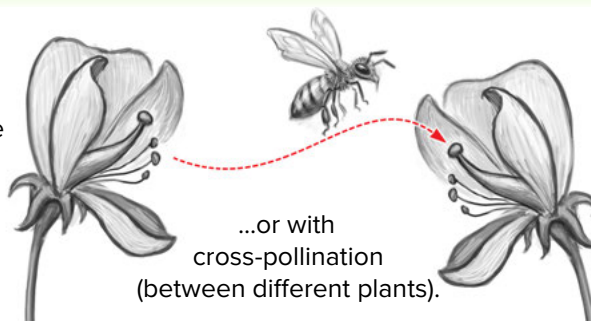
### Flower Anatomy



### Pollination by Bees

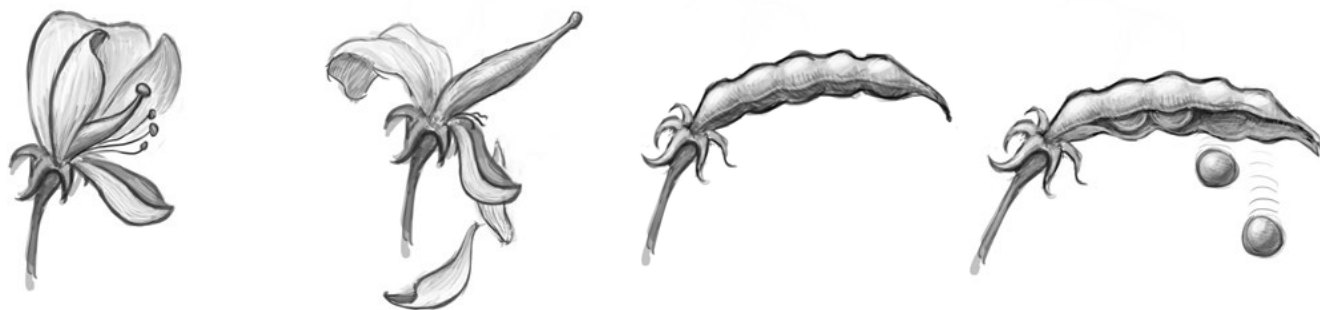
Bees get their food from flowers. While they do this, pollen from stamens clings to their legs, and the bees carry the pollen to the carpels. The bees get fed, and the flowers get fertilized.

Bees can help with self-pollination...



### From Flower to Seedpod

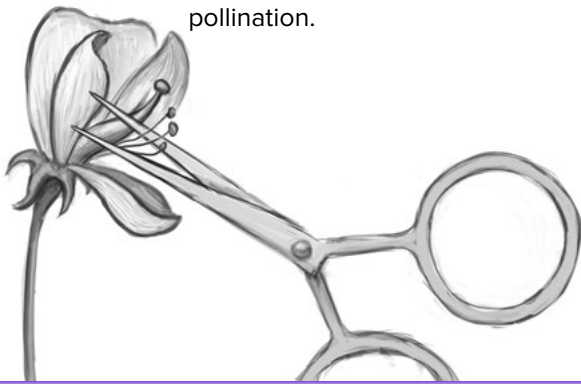
After the pollen fertilizes the eggs, the carpel grows into a pea pod. The peas inside are the fertile seeds that can grow into new plants.



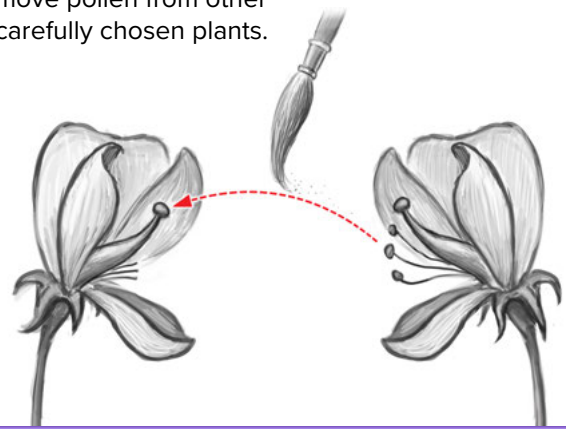
## Mendel messes with Mother Nature

Starting with what he knew about pea plant fertilization, Mendel developed a clever strategy for studying **heredity** in the plants. Basically, he took over the job of the bees!

Mendel snipped off the stamens of plants he chose to fertilize, to prevent self-pollination.



Then he used a brush to move pollen from other carefully chosen plants.



Mendel controlled which of his pea plants bred with which. He kept records of what **traits** the starting parent plants had and what **traits** later **generations** had. He focused on certain features: flower color, stem length, and pea pod shape. Each of these features had two possible **traits**:

Flowers were either  
**PURPLE** or **WHITE**.



Stems were either  
**LONG** or **SHORT**.



Pods were either  
**SMOOTH** or **BUMPY**.

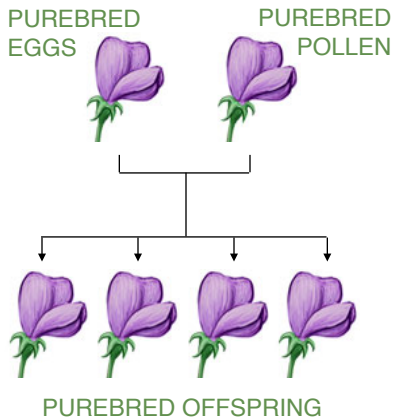


## Unit L3 • Traits and Heredity

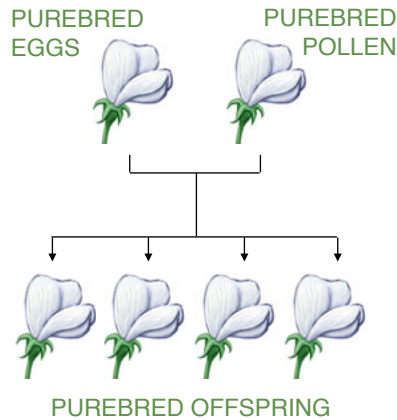
### Mendel's Experiments

To begin with, Mendel carefully chose parent plants that were “purebred” for the **traits** he was focusing on. A purebred plant that self-pollinates (or two plants that are purebred for the same **trait**) will always produce **offspring** with the same **trait**.

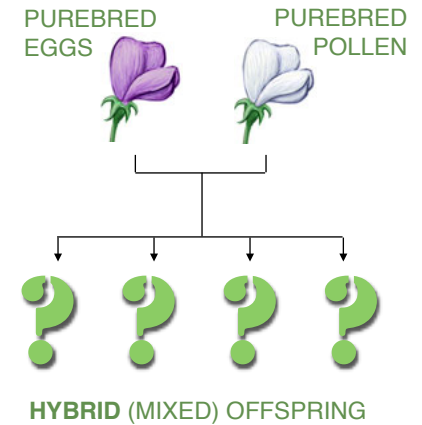
For example, a purebred purple-flowering pea plant that self-pollinates always produces purple-flowering **offspring**.



And a purebred white-flowering pea plant that self-pollinates always produces white-flowering **offspring**.



But Mendel decided to see what would happen if he cross-pollinated a purebred purple-flowering plant with a purebred white-flowering plant.



 Discuss the following questions with a partner and write down your answers.

1. What is the difference between self-pollination and cross-pollination? Explain in your own words how Mendel prevented the self-pollination of his pea plants, and why.

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2. What would you guess happened when Mendel used pollen from a purebred purple-flowering pea plant to pollinate a purebred white-flowering pea plant? (Use the theories from the rabbit breeding discussion in the Reader's Theater to explain your guess.)

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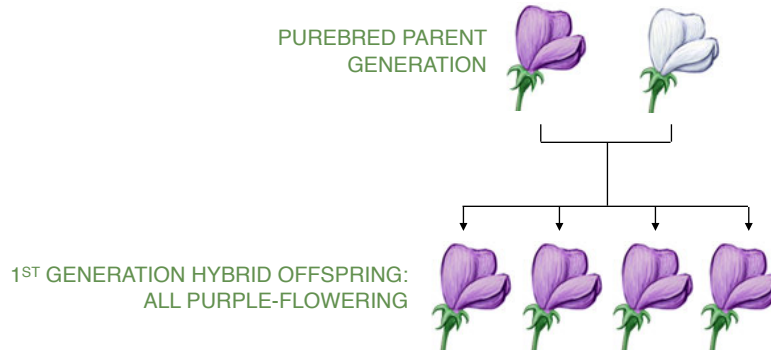
**DATELINE: 1866, BRÜNN, AUSTRIA-HUNGARY:**

## PEA PLANTS LEAD TO SCIENTIFIC BREAKTHROUGH

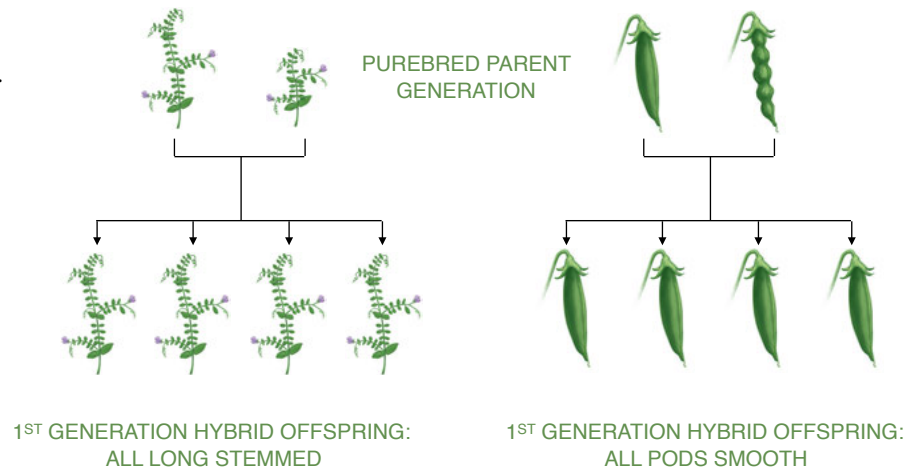
A monk named Gregor Mendel has just published a paper entitled "Experiments on Plant Hybridization," which he read last year at two meetings of the Natural History Society of Brünn. Despite a polite reception, no one seems to have the least idea what he is talking about, and it will probably be several decades before he receives his rightful recognition as the father of modern genetics. Said one reader, "Huh?" Mendel's unusual statistical



What would you guess happened when Mendel crossed purebred purple-flowering pea plants with purebred white-flowering pea plants? Well, in the first **generation** of **hybrids** (meaning **offspring** from different kinds of parents), all of the flowers were purple. The white flowers had completely disappeared!



A similar thing happened with stem length and with pod shape. In each case, the first **generation** of **hybrids** showed only one of the **traits**.

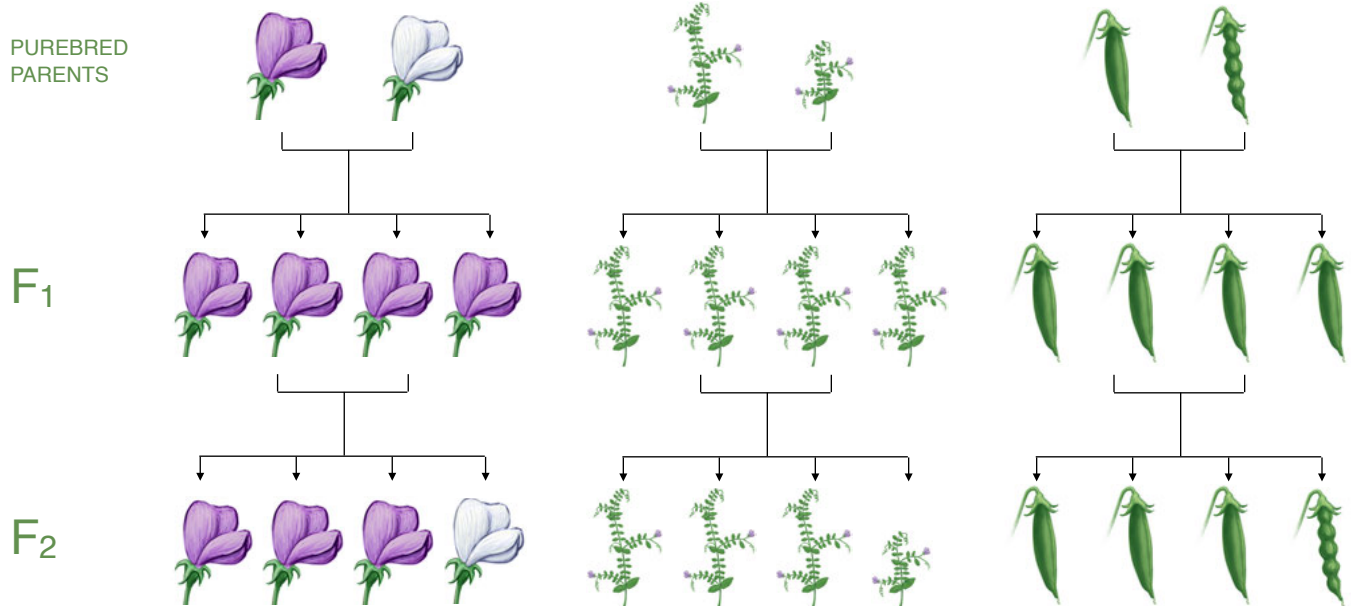


Mendel's Experiments

Mendel called the first **generation** of **hybrids** the **F<sub>1</sub> generation**, and he went on to call *their offspring* the **F<sub>2</sub> generation**. (He could have used G, X, or any other letter; but he chose F, so that's what we use.) The fact that certain **traits** disappeared completely in the **F<sub>1</sub> generation** may seem odd, but what happened next was even more surprising.

Combining Hybrids

The diagrams below show what happened when Mendel used his **F<sub>1</sub> generation** plants to breed an **F<sub>2</sub> generation**.



Describe what happened when the **F<sub>1</sub> hybrid** pea plants were bred with each other:

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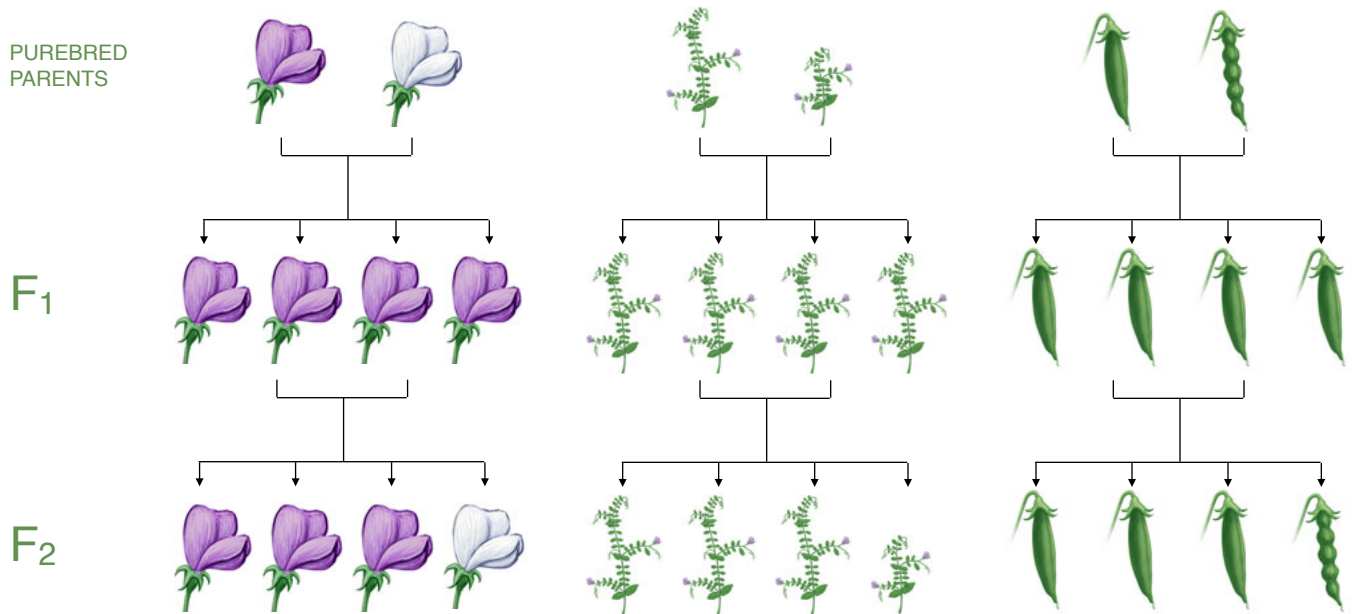


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## Unit L3 • Traits and Heredity

### Mendel's Experiments

Look again at the diagrams showing the results of Mendel's pea breeding experiments. As you now know, the purple-flower **trait** is **dominant** and the white-flower **trait** is **recessive**.



For stem length and pod shape, which alleles do you think are **dominant** and which do you think are **recessive**?

allele for...	(circle one)
long stems	<b>dominant</b> or <b>recessive</b> ?
short stems	<b>dominant</b> or <b>recessive</b> ?
smooth pod	<b>dominant</b> or <b>recessive</b> ?
bumpy pod	<b>dominant</b> or <b>recessive</b> ?

## Unit L3 • Traits and Heredity

### Mendel's Experiments

The first table below shows what happened when Mendel crossed purebred purple-flowering pea plants with purebred white-flowering pea plants. Each F<sub>1</sub> **hybrid inherits** one purple-flower allele and one white-flower allele. Because the purple-flower allele is **dominant**, the flowers on all the F<sub>1</sub> plants are purple.

#### FLOWER COLOR: Making the F<sub>1</sub> generation

All allele pairs <b>inherited</b> from the purebreds are the same	<b>purple</b> white	<b>purple</b> white	<b>purple</b> white	<b>purple</b> white
F <sub>1</sub> flower color will be:	purple	purple	purple	purple

But when the F<sub>1</sub> **hybrids** produce the next **generation** of **hybrids**, things are different. Each F<sub>1</sub> parent has an equal chance of giving a purple-flower or a white-flower allele to each of its F<sub>2</sub> **offspring**. The four possible outcomes shown below are all equally likely, and will tend to show up in equal numbers when two plants have a large number of **offspring**.

#### FLOWER COLOR: Making the F<sub>2</sub> generation

The 4 equally likely allele pairs <b>inherited</b> from the F <sub>1</sub> <b>generation</b>	<b>purple</b> <b>purple</b>	<b>purple</b> white	white <b>purple</b>	white white
F <sub>2</sub> flower color will be:	purple	purple	purple	white

The two tables above show why Mendel found that none of the F<sub>1</sub> plants showed **recessive traits**, but **recessive traits** showed again in about one quarter of the F<sub>2</sub> **generation** plants. Compare these tables to the F<sub>1</sub> and F<sub>2</sub> rows in the diagrams earlier in this section.

Complete the tables below by writing in the **traits** for the F<sub>2</sub> **generation** plants in the stem-length and pod-shape breeding experiments:

#### STEM LENGTH: Making the F<sub>2</sub> generation

The 4 equally likely allele pairs <b>inherited</b> from the F <sub>1</sub> <b>generation</b>	<b>long</b> <b>long</b>	<b>long</b> short	short <b>long</b>	short short
F <sub>2</sub> stem length will be:				

#### POD SHAPE: Making the F<sub>2</sub> generation

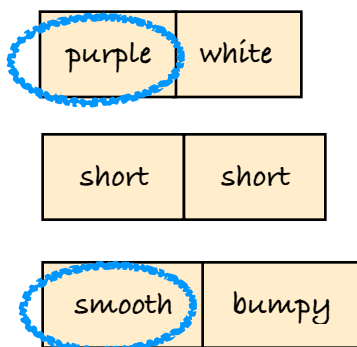
The 4 equally likely allele pairs <b>inherited</b> from the F <sub>1</sub> <b>generation</b>	<b>smooth</b> <b>smooth</b>	<b>smooth</b> bumpy	bumpy <b>smooth</b>	bumpy bumpy
F <sub>2</sub> pod shape will be:				

## Unit L3 • Traits and Heredity

### Mendel's Experiments

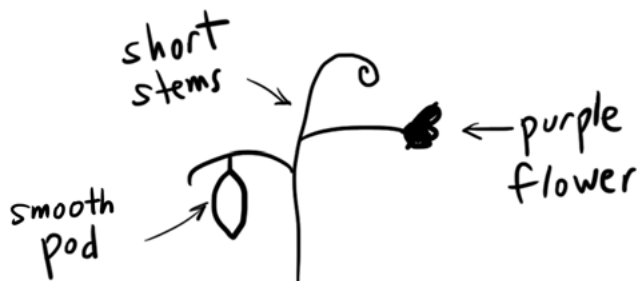
Mendel discovered one more important thing in his breeding experiments: the flower-color allele a parent plant passes on to a particular **offspring** has nothing to do with which stem-length allele it passes on. The same is true for pod shape. In other words, all of these **traits** are **inherited** independently of one another. So any combination of **traits** is possible in pea plants. Human **genetic inheritance** works basically the same way, which is why people come in such an amazing variety of appearances.

Here are the pairs that this pea plant **inherited**. The **dominant** alleles are circled.



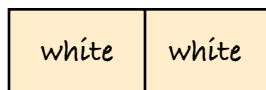
#### TURN AND TALK

Why does this pea plant look the way it does?

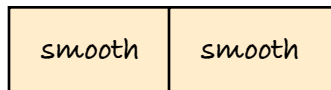
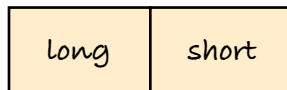


#### Your turn!

First, circle the names of any **dominant** alleles in these pairs.

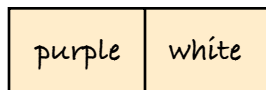


Then sketch and label what the plant would look like.



#### Your turn!

First, circle the names of any **dominant** alleles in these pairs.



Then sketch and label what the plant would look like.

