Mendel's Experiments

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

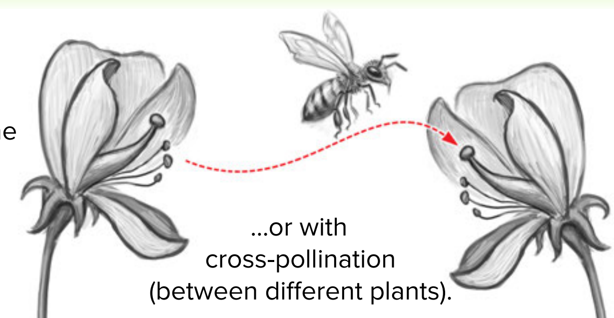
Flowers contain the reproductive organs of plants. Like many flowering plants, pea plants combine their male and female parts in the same flower. For fertilization to occur and new plants to grow, pollen from the male parts must reach eggs in the female parts.

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.

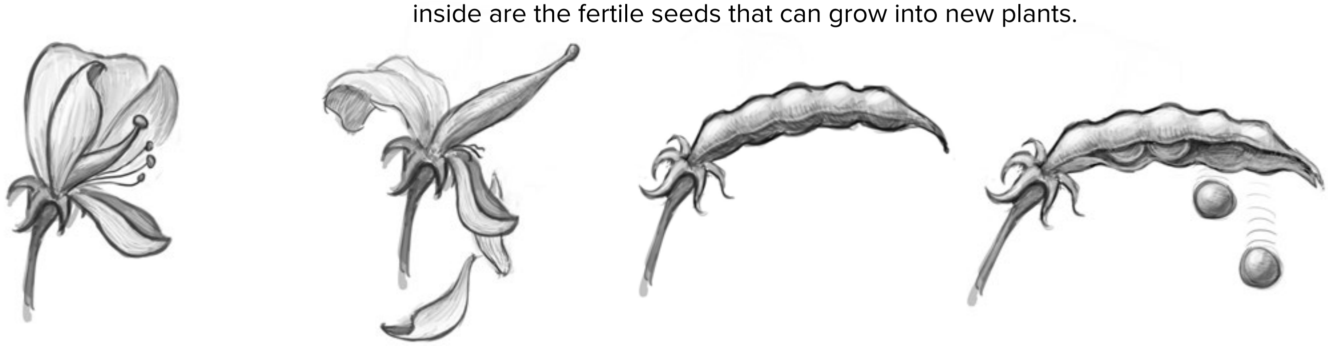
Bees can help with self-pollination...



...or with cross-pollination (between different plants).

From Flower to Seedpod

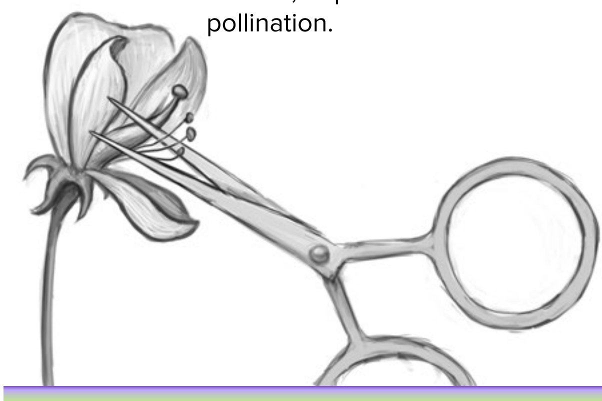
After the pollen fertilizes the eggs, the carpal grows into a pea pod. The peas inside are the fertile seeds that can grow into new plants.



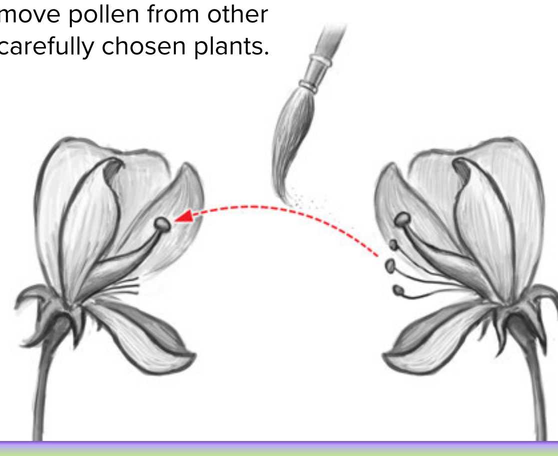
Mendel messes with Mother Nature

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**:

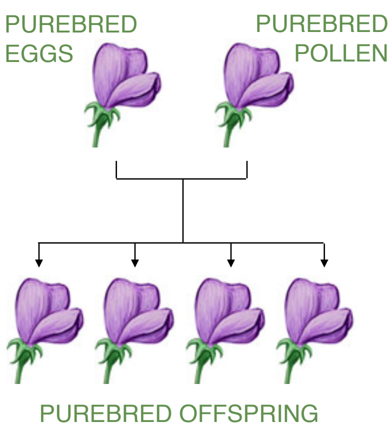
Flowers were either PURPLE or WHITE.

Stems were either LONG or SHORT.

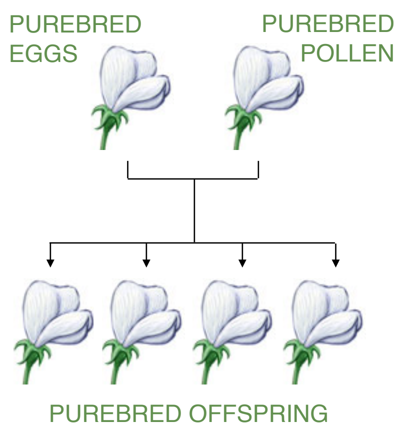
Pods were either SMOOTH or BUMPY.

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**.

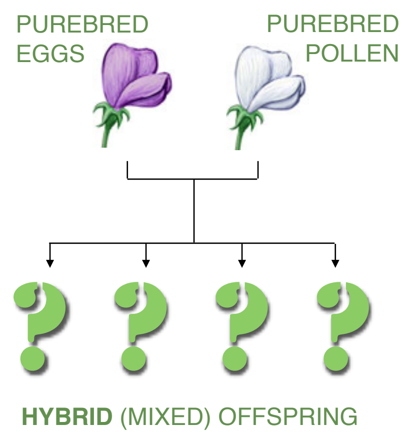
For example, a purebred purple-flowering pea plant that self-pollinates always produces purple-flowering **offspring**.



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.

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.)

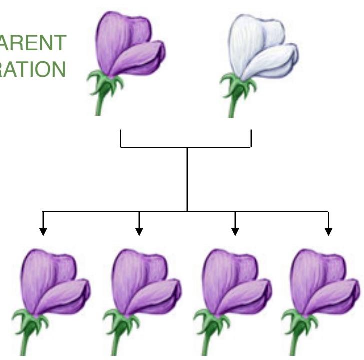
DATELINE: 1866, BRÜNN, AUSTRIA-HUNGARY:

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

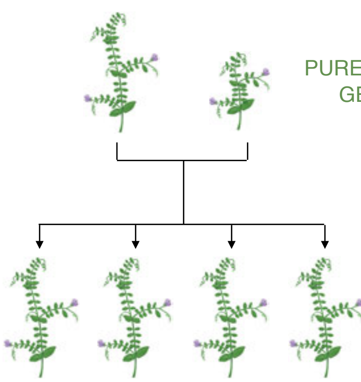
What would you guess happened when Mendel crossed purebred purple-flowering pea plants with purebred white-flowering pea plants? Well, in the first **generation** of **hybrids** (meaning **offspring** from different kinds of parents), all of the flowers were purple. The white flowers had completely disappeared!

PUREBRED PARENT GENERATION

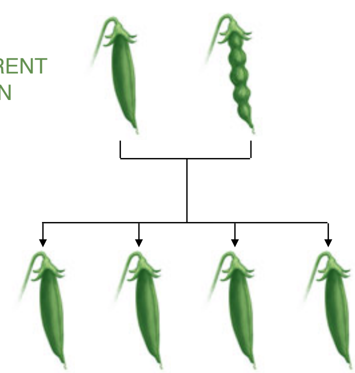


1ST GENERATION HYBRID OFFSPRING: ALL PURPLE-FLOWERING

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**.



PUREBRED PARENT GENERATION



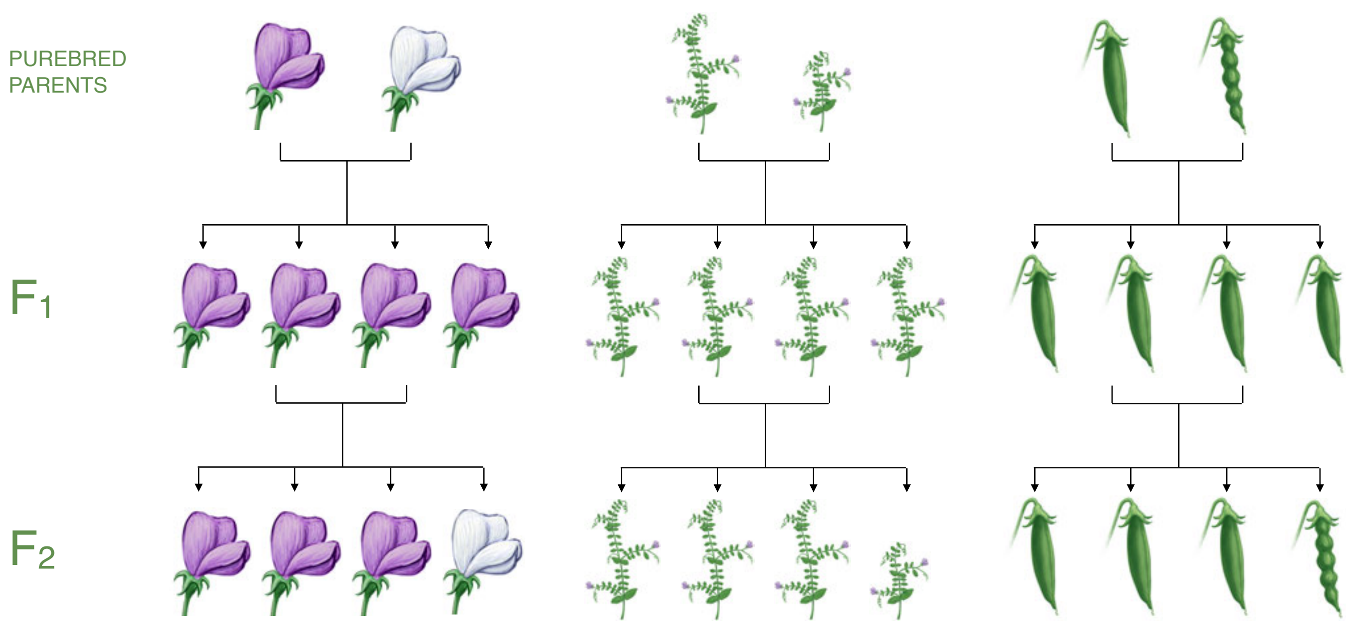
1ST GENERATION HYBRID OFFSPRING: ALL LONG STEMMED

1ST GENERATION HYBRID OFFSPRING: ALL PODS SMOOTH

Mendel called the first **generation** of **hybrids** the F_1 **generation**, and he went on to call *their* **offspring** the F_2 **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_1 **generation** may seem odd, but what happened next was even more surprising.

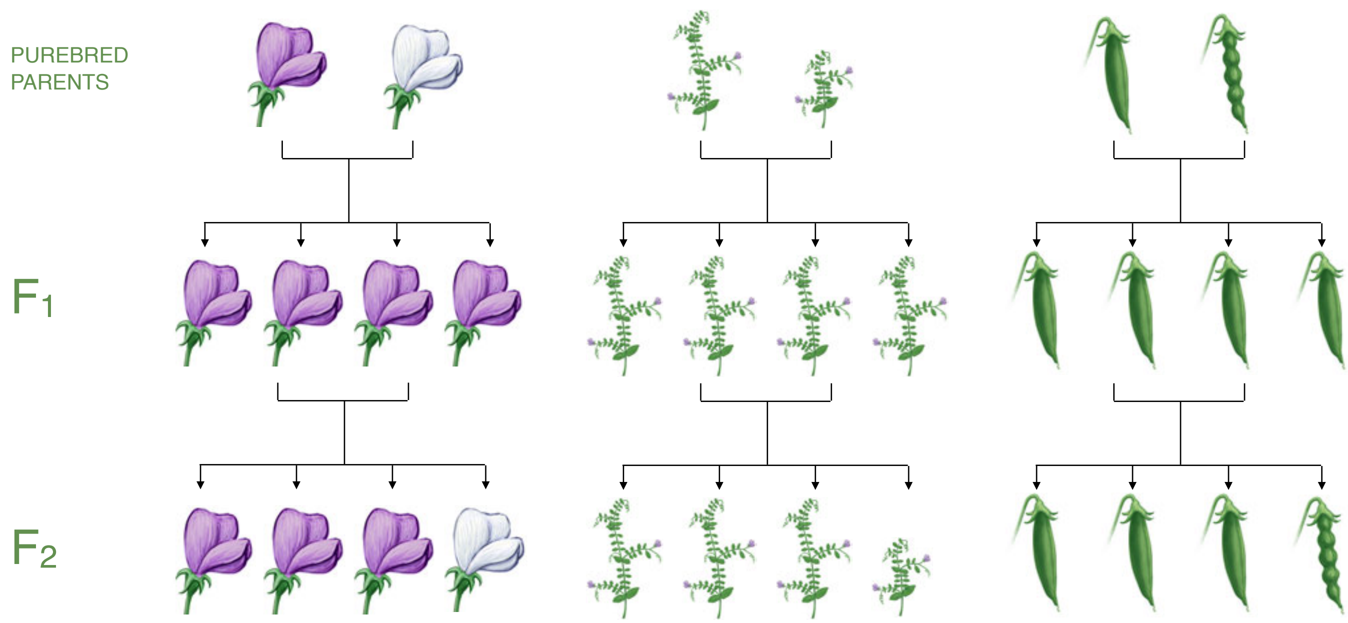
Combining Hybrids

The diagrams below show what happened when Mendel used his F_1 **generation** plants to breed an F_2 **generation**.



Describe what happened when the F_1 **hybrid** pea plants were bred with each other:

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	**dominant** or **recessive**?
short stems	**dominant** or **recessive**?
smooth pod	**dominant** or **recessive**?
bumpy pod	**dominant** or **recessive**?

The first table below shows what happened when Mendel crossed purebred purple-flowering pea plants with purebred white-flowering pea plants. Each F_1 **hybrid inherits** one purple-flower allele and one white-flower allele. Because the purple-flower allele is **dominant**, the flowers on all the F_1 plants are purple.

FLOWER COLOR: Making the **F_1 generation**

All allele pairs **inherited** from the purebreds are the same	**purple** white	**purple** white	**purple** white	**purple** white
F_1 flower color will be:	purple	purple	purple	purple

But when the F_1 **hybrids** produce the next **generation** of **hybrids**, things are different. Each F_1 parent has an equal chance of giving a purple-flower or a white-flower allele to each of its F_2 **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_2 generation**

The 4 equally likely allele pairs **inherited** from the F_1 **generation**	**purple** **purple**	**purple** white	white **purple**	white white
F_2 flower color will be:	purple	purple	purple	white

The two tables above show why Mendel found that none of the F_1 plants showed **recessive traits**, but **recessive traits** showed again in about one quarter of the F_2 **generation** plants. Compare these tables to the F_1 and F_2 rows in the diagrams earlier in this section.

Complete the tables below by writing in the **traits** for the F_2 **generation** plants in the stem-length and pod-shape breeding experiments:

STEM LENGTH: Making the **F_2 generation**

The 4 equally likely allele pairs **inherited** from the F_1 **generation**	**long** **long**	**long** short	short **long**	short short
F_2 stem length will be:				

POD SHAPE: Making the **F_2 generation**

The 4 equally likely allele pairs **inherited** from the F_1 **generation**	**smooth** **smooth**	**smooth** bumpy	bumpy **smooth**	bumpy bumpy
F_2 pod shape will be:				

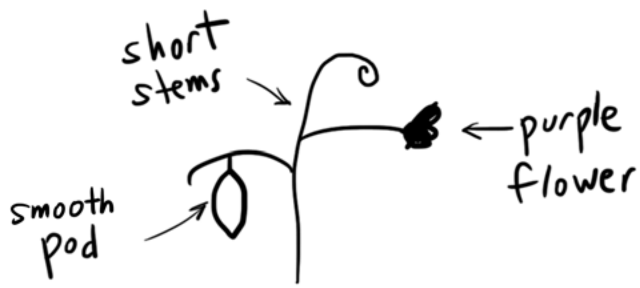
Mendel discovered one more important thing in his breeding experiments: The flower-color allele a parent plant passes on to a particular **offspring** has nothing to do with which stem-length allele it passes on. The same is true for pod shape. In other words, all of these **traits** are **inherited** 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.

purple	white
short	short
smooth	bumpy

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.

white	white
long	short
smooth	smooth

Your turn!

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

Then sketch and label what the plant would look like.

purple	white
long	long
bumpy	smooth
