Lecture 4:

Mendel's monohybrid experiments

Course 371

Lessons for life

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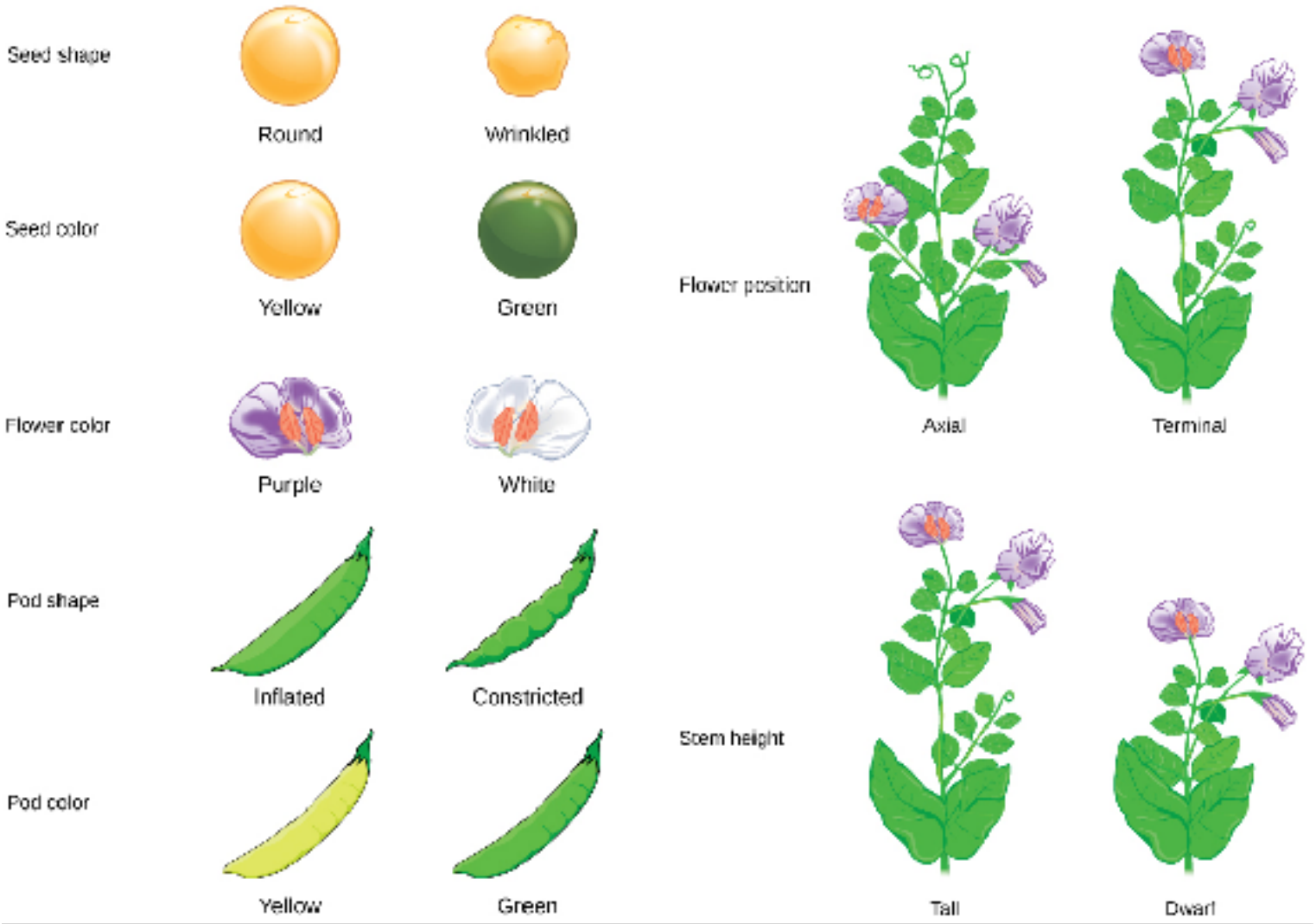
Never stop learning, because life never stops teaching.

AIMS

- Introduce Mendel's monohybrid experiment.
- Explain Mendel's experimental procedure.
- Explain Mendel's results and what they mean.
- Prepare students for Mendel's dihybrid experiment.

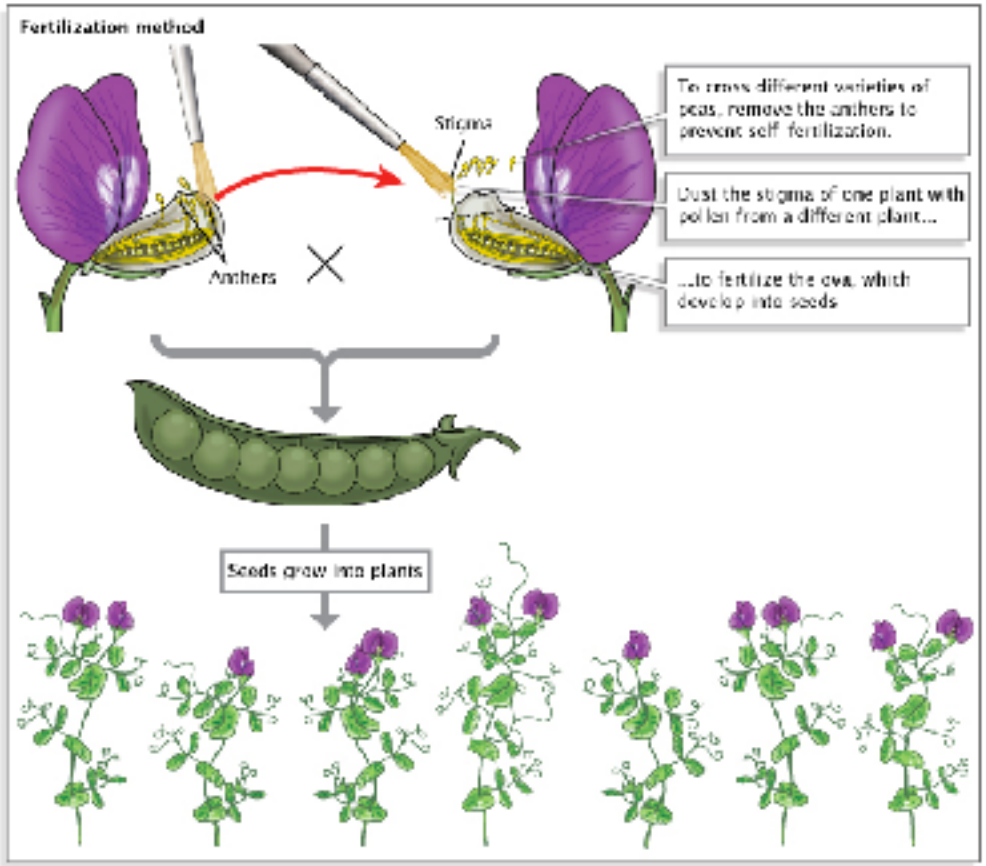
Review Mendel's traits



Crossing plants

1) Transfer the pollen from one flower to the stigma of another.
2) Plant resulting seeds and inspect phenotype

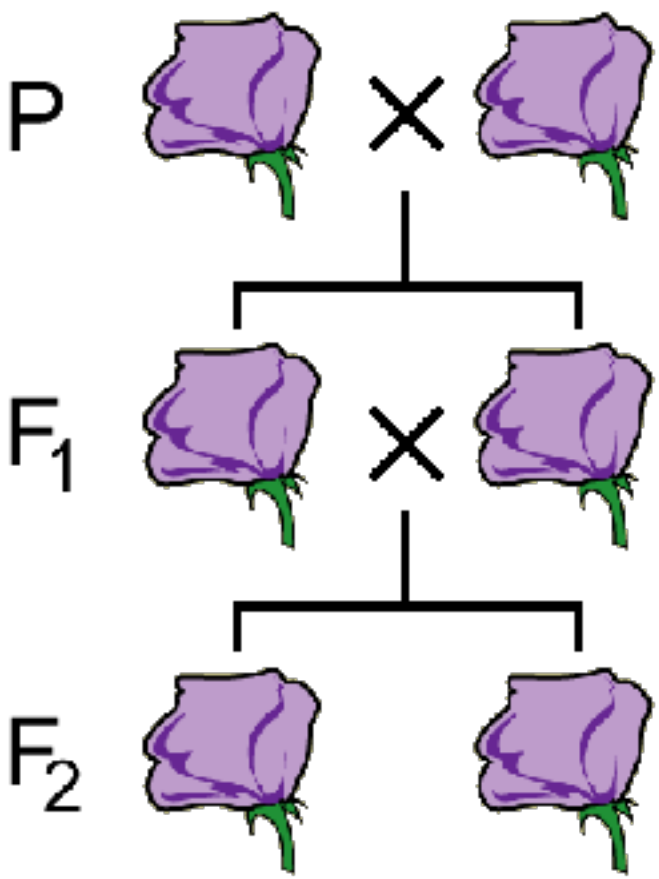
What about selfing?

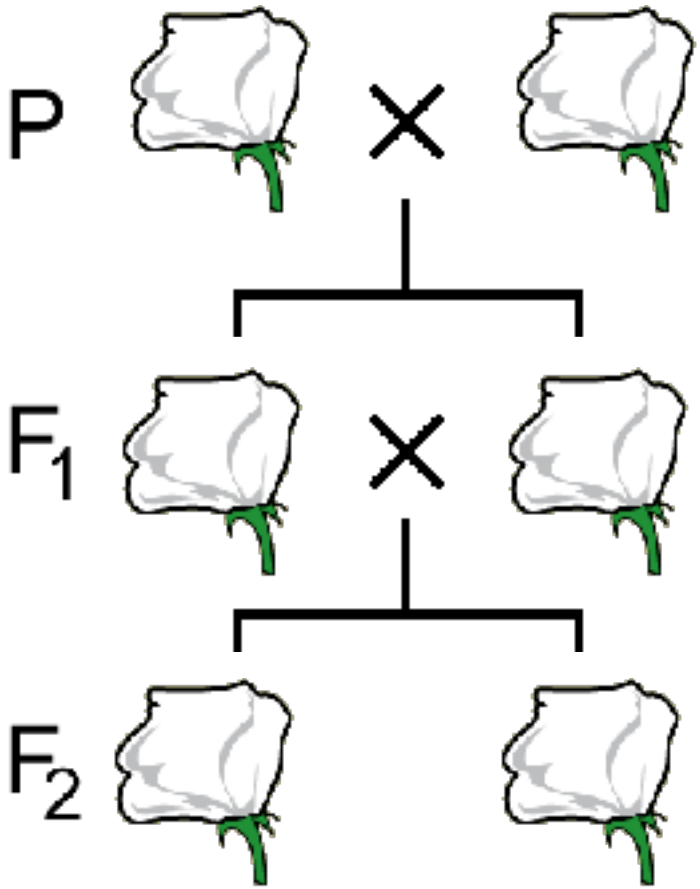


Citation: Miko, I. (2008) Gregor Mendel and the principles of inheritance. Nature Education 1(1):134

Mendel's pure single trait lines

1) Establish pure lines of each character.
Which characters?





Mendel's Monohybrid Experiment

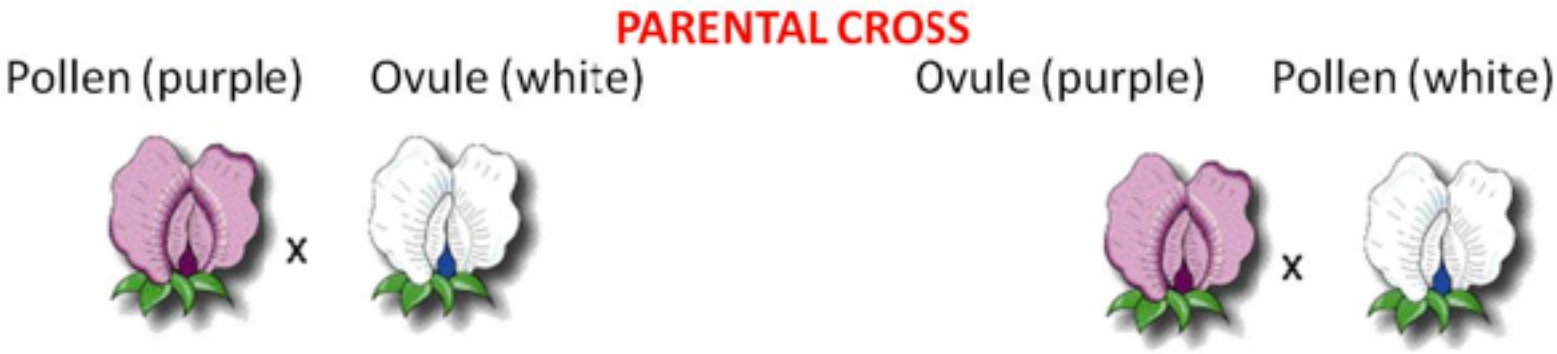
Some terms

P: **Parental** generation

F1: first **Filial** generation

F2: second **Filial** generation

Mendel's careful crosses



Reciprocal cross?

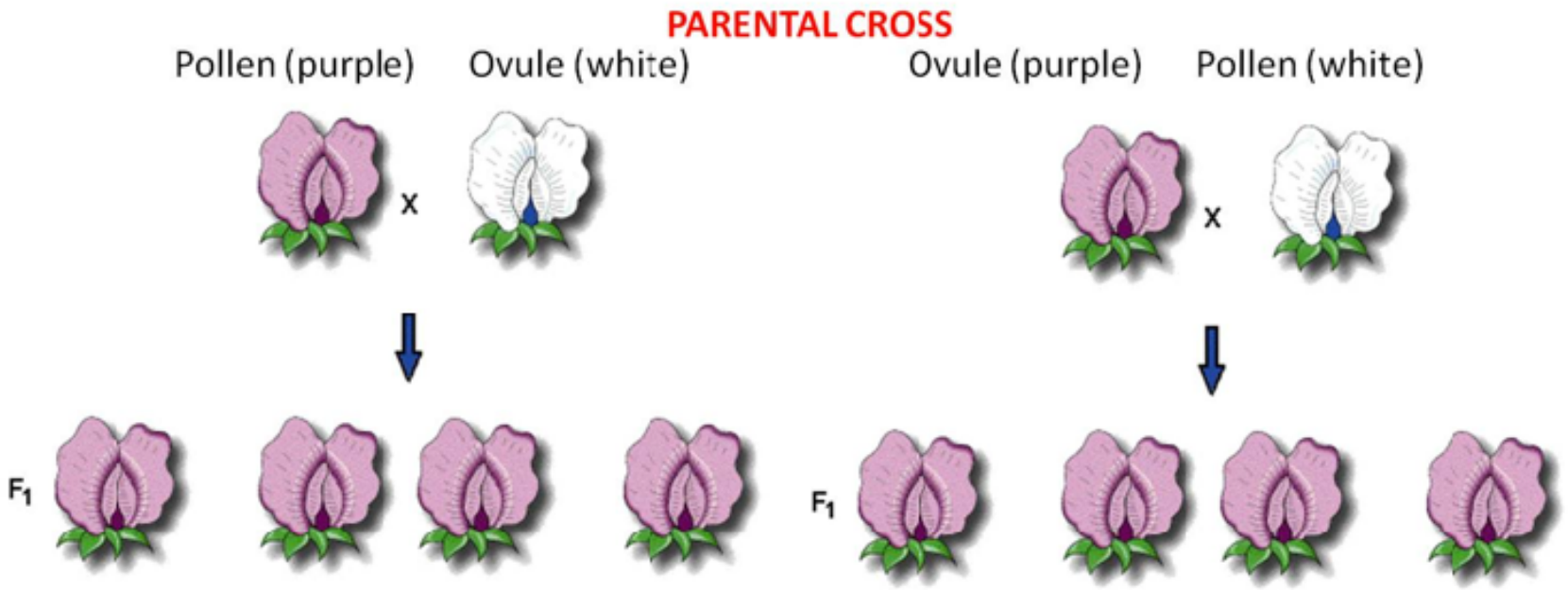
Why?

Is it an equal contribution of "factors" by males and females parental plants?

First generation

2) Cross breed the pure lines.
3) Resulting plants are hybrids.
4) Inspect the phenotypes of the first generation.

How do we inspect the phenotype?
Why?



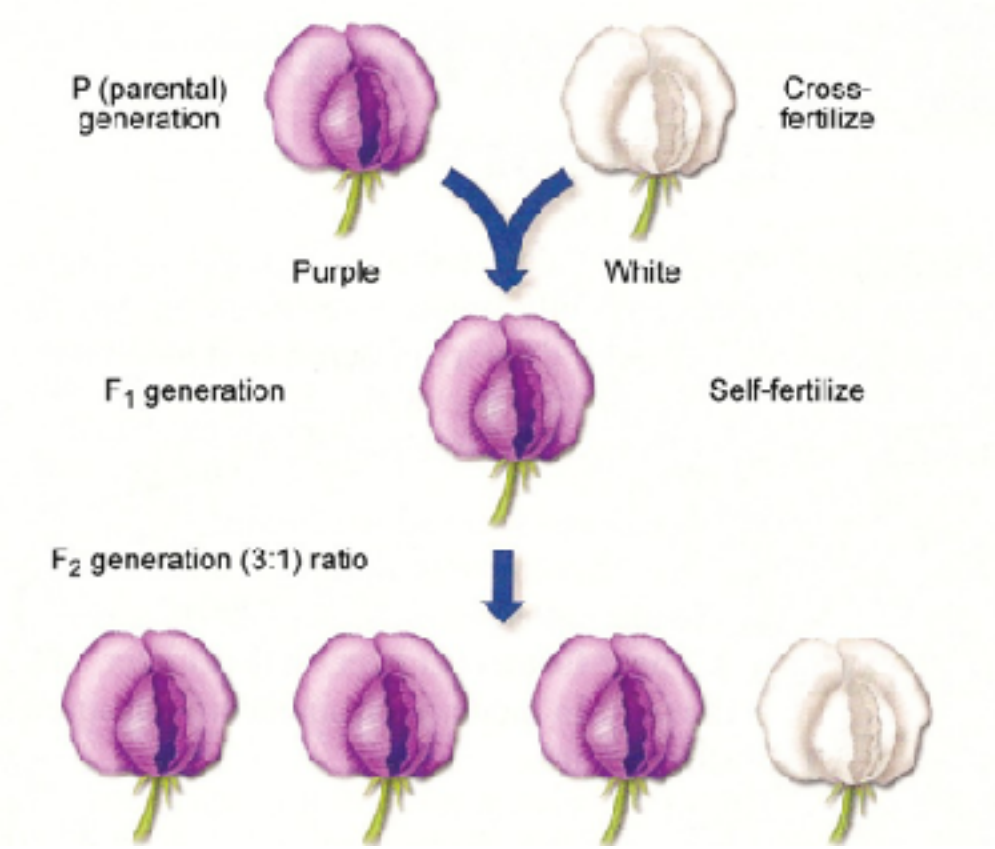
First generation

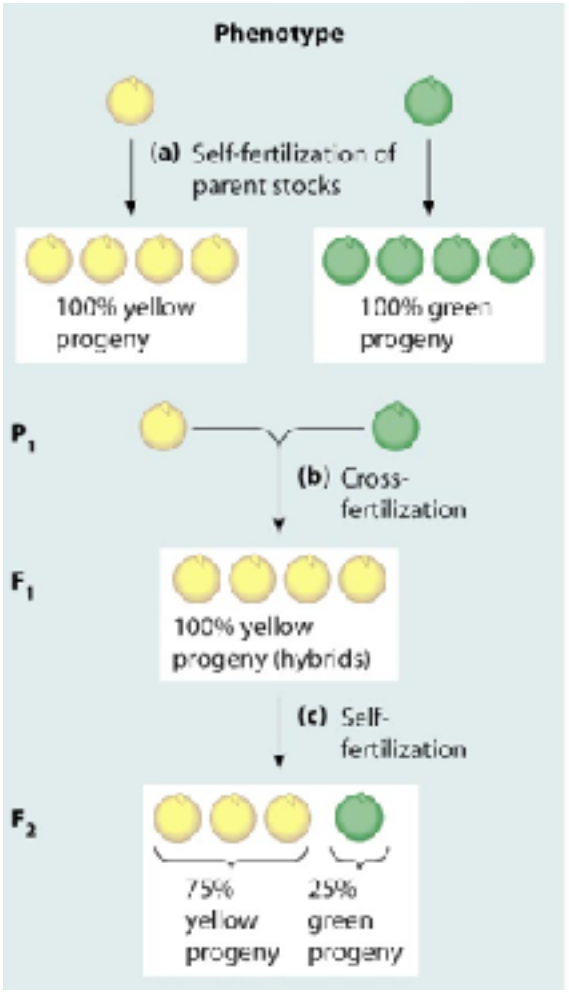
Observations and findings:

- All resulting plants exhibits the phenotype of one of the parents.
- One of the parental phenotypes disappears in the first hybrid generation.

Second generation

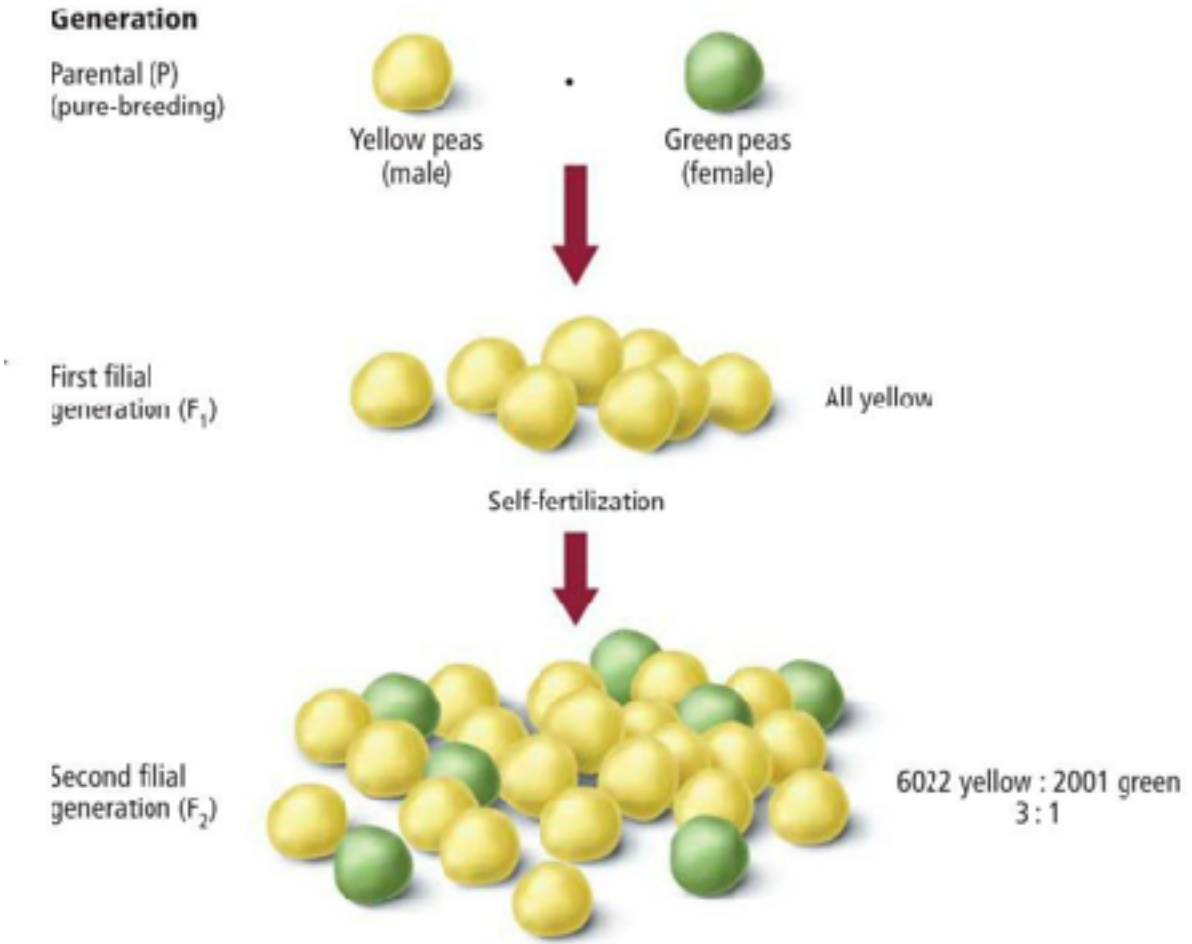
5) Self cross the F1 individuals.
6) Inspect the phenotypes of the resulting F2 generation.



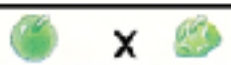
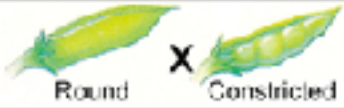
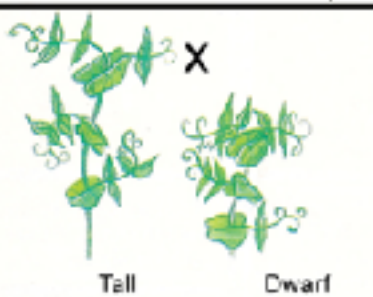


Second generation

How did Mendel inspect the phenotypes of the F2 generation?



Mendel's monohybrid results

Trait	Dominant vs. recessive	F_2 generations Dominant form	Recessive form	Ratio
Flower color	 Purple X White	705	224	3.15:1
Seed color	 Yellow X Green	6022	2001	3.01:1
Seed shape	 Round X Wrinkled	5474	1850	2.96:1
Pod color	 Green X Yellow	428	152	2.82:1
Pod shape	 Round X Constricted	882	299	2.95:1
Flower position	 Axial X Top	651	207	3.14:1
Plant height	 Tall X Dwarf	787	277	2.84:1

Mendel's Monohybrid Experiment

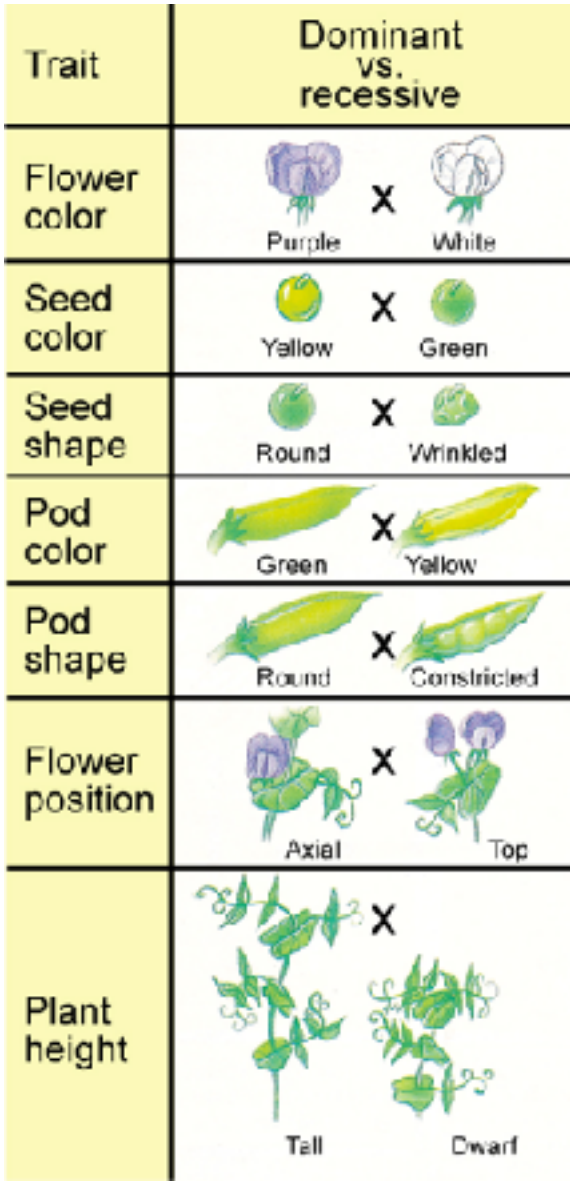
Observations and findings:

- The selfing of the first generation results in the reappearance of one of the parents' characteristics.
- A factor/particle is within the plant that results in the appearance of the plant.
- Both male and female contribute equally to the phenotype.
- The absence or appearance of a specific character depends on the combination of factors.

Factor's type

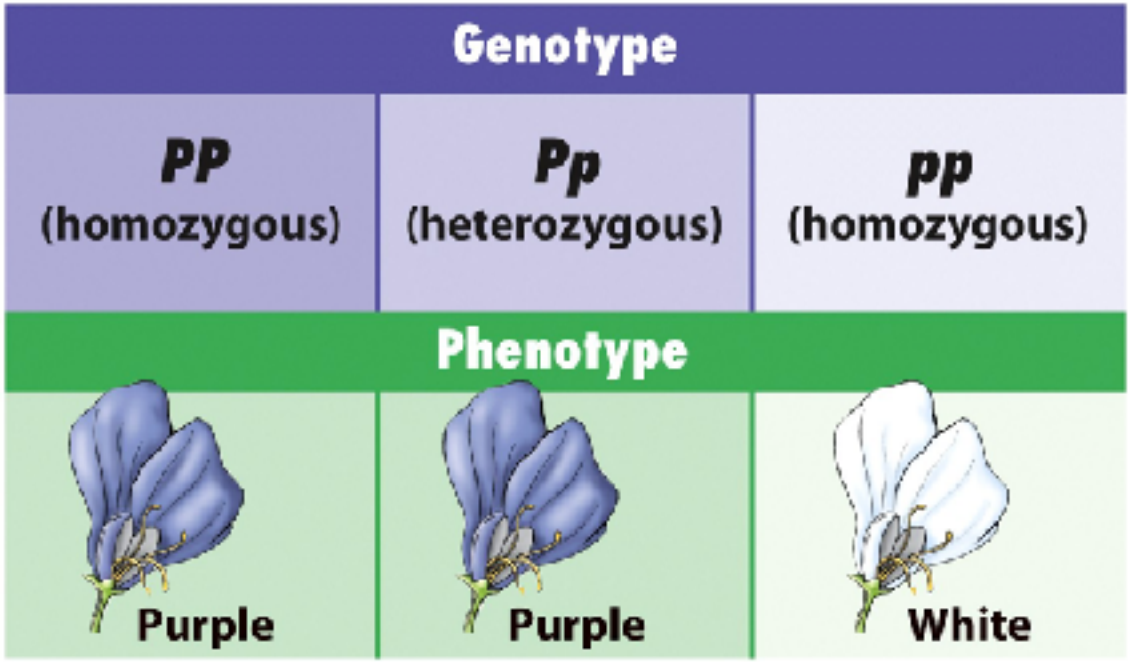
Observations and findings:

- The "factor" that appeared in all individuals of the first generation is the "**dominant**" factor.
- The "factor" that disappeared in the first generation is the "**recessive**" factor.



Genotype

- The P generation is a pure bred contains each with two factors of the same type (homozygous).
- The F1 generation is a hybrid and as a result contains two different “factors” one from each of the parents (heterozygous).



Genotype

What is “dominant” and “recessive” a description of?

What is a genotype?

What is a homozygous?

What is a heterozygous?

Genes and Genotype

It appears as most simple to use the last syllable 'gen' taken from Darwin's well-known word pangene.... Thus, we will say for 'das pangene' and 'die pangene' simply 'Das Gen' and 'Die Gene.

(Wilhelm Ludvig Johannsen)

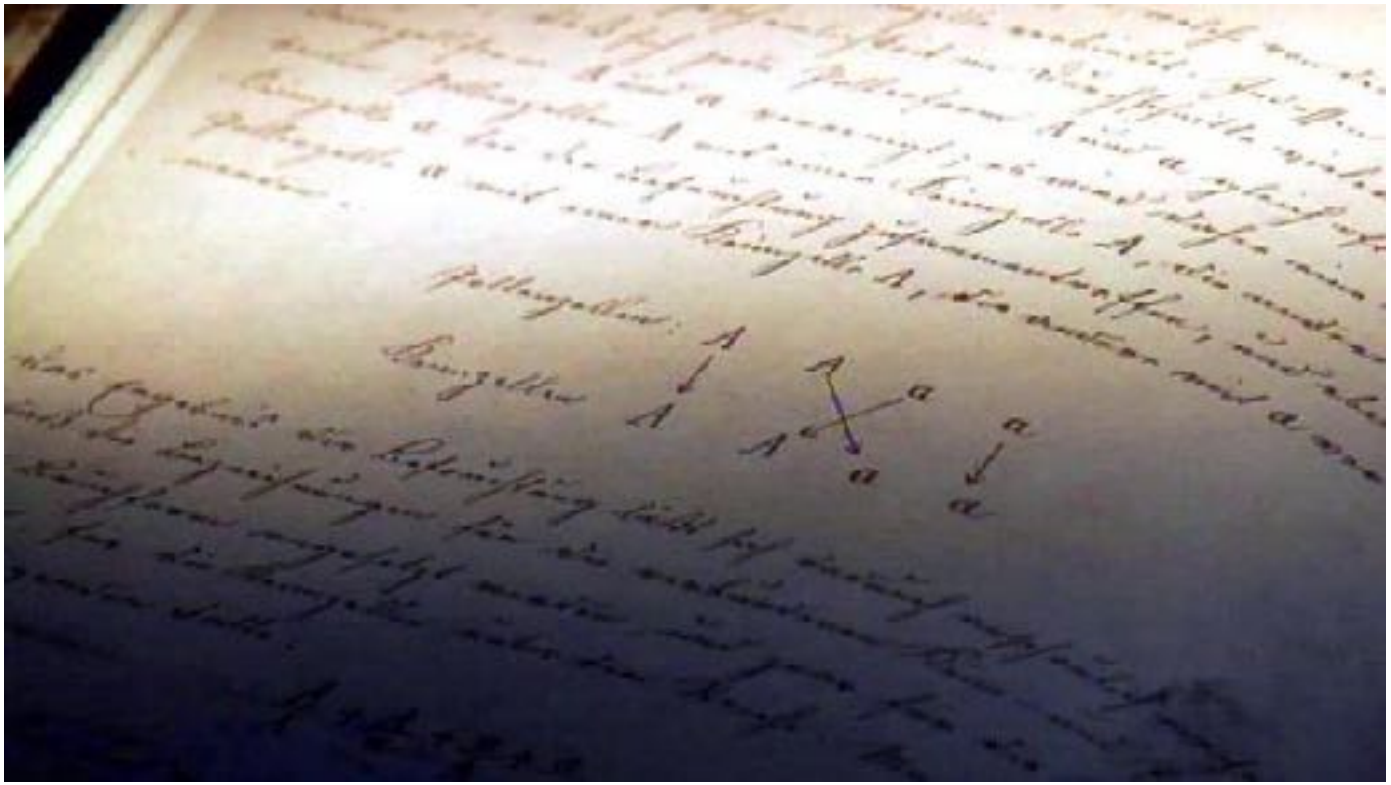
that Johannsen's pure lines were exactly the same as his own 'elementary species'. Shull reviewed Johannsen's claims and concluded that 'if sustained by further research' they would certainly constitute an important new principle.[7]

Johannsen also introduced the term 'gene' and gave genetics two very useful terms: 'genotype', which refers to the full set of genes an organism carries; and 'phenotype' which refers to its external features, everything from size and colour to behaviour. As we saw from Mendel's original pea experiments, a pea plant with yellow peas (the yellow phenotype) might have either two copies of the yellow version of the gene (the yellow allele), or one [illegible] from the phenotype alone, it was impossible

Mendel's work

Important contributions by Mendel to biology:

1. Genotypic notation.
2. Quantitative framework.



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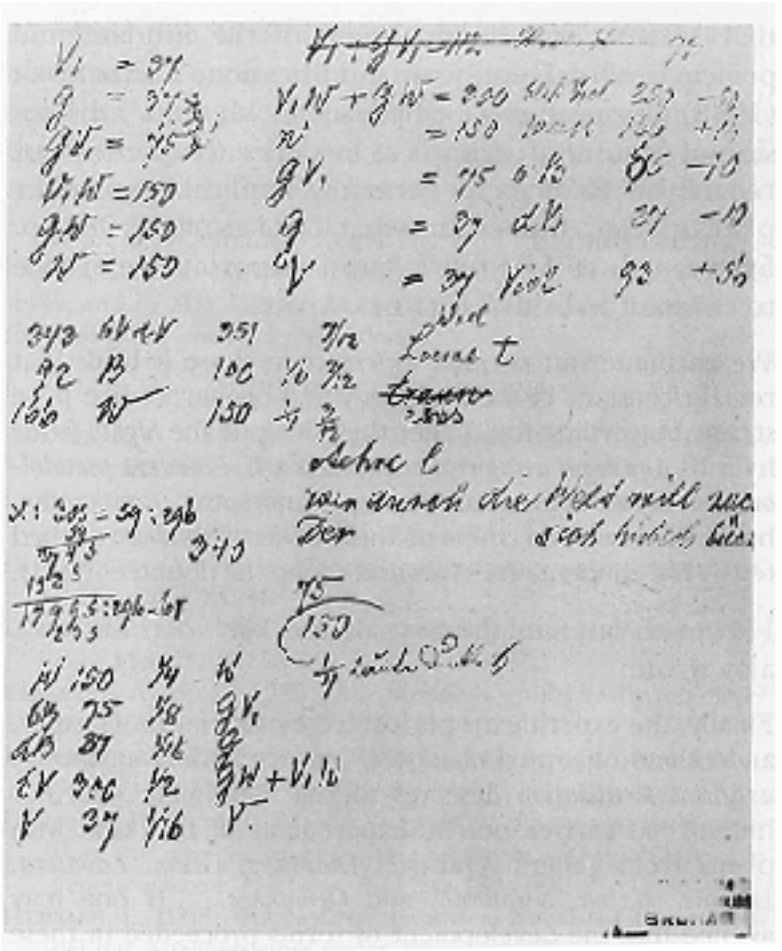
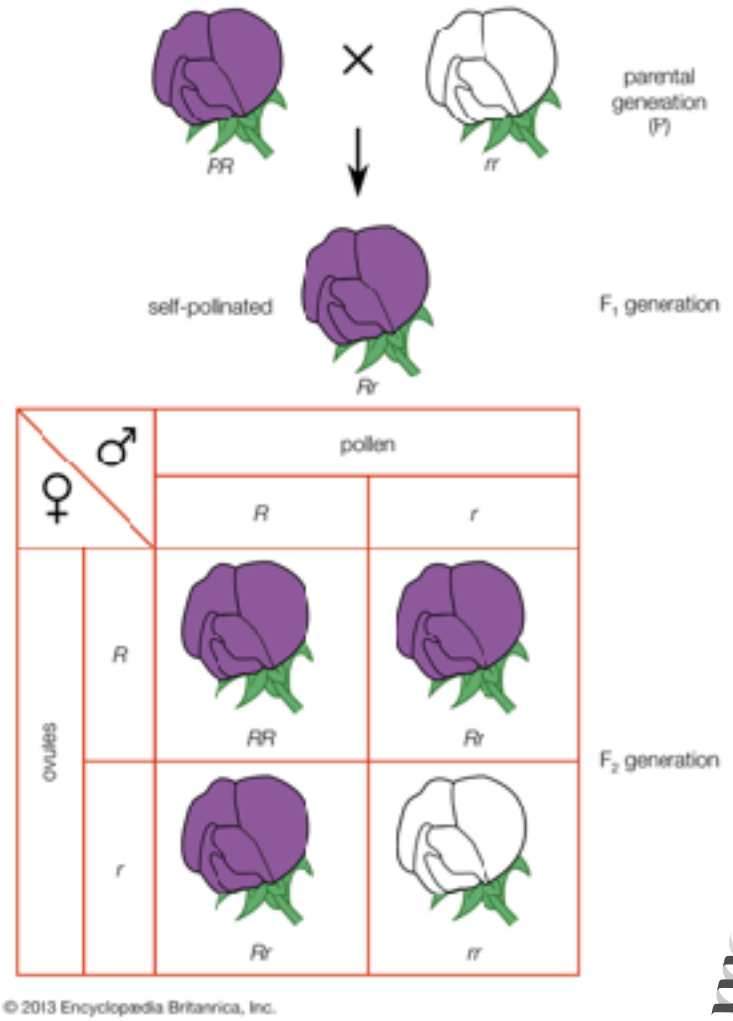


Mendel's First law

Summary and Mendel's first law:

- "Factors" within a plant separate during the formation of gametes.
- "Factors" unite during fertilization randomly.
- The phenotype of resulting union is determined by the combination of factors.

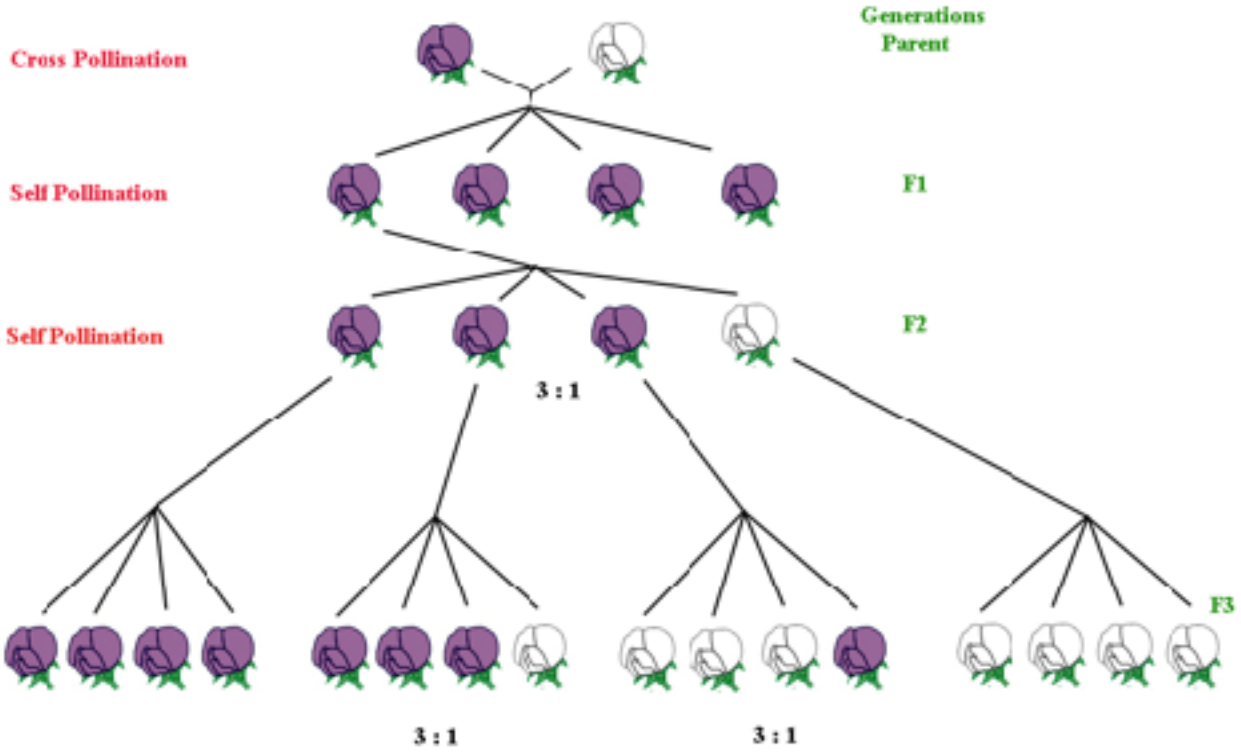
Segregation of factors (alleles)



Homo vs Heterozygous

How can we determine homozygous dominant individuals from heterozygous ones when they have the same phenotype?

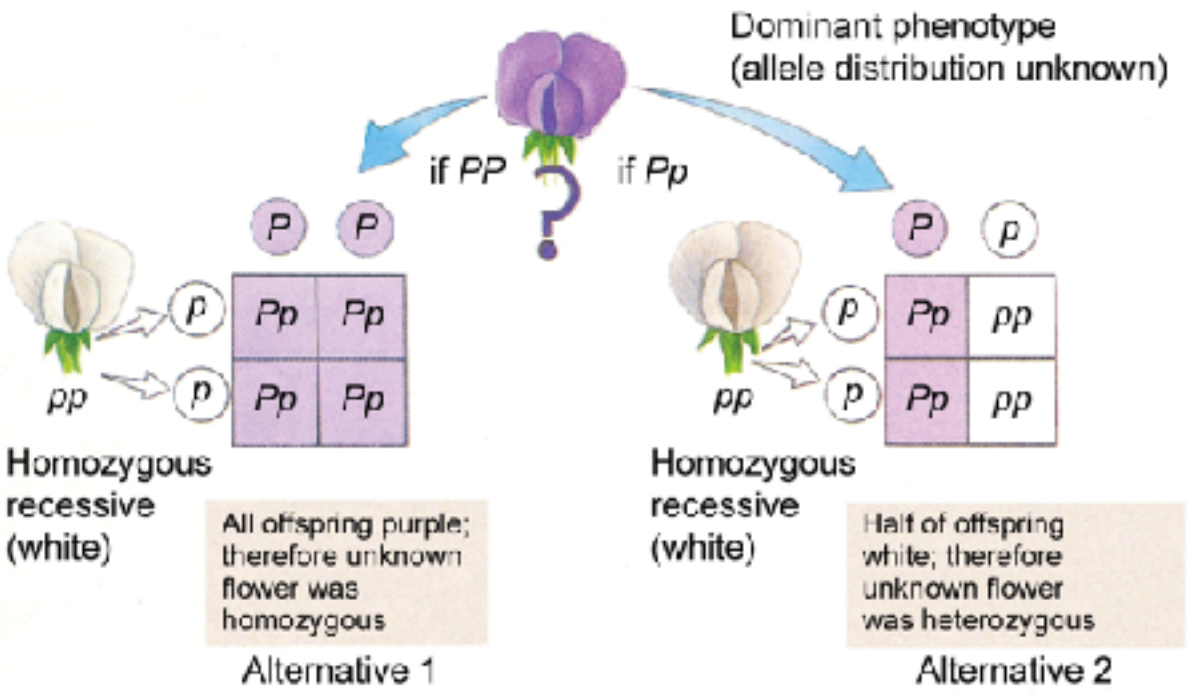
1) By analyzing the ratios of phenotypes in the individuals resulting from self fertilization.



Homo vs Heterozygous

How can we determine homozygous dominant individuals from heterozygous ones when they have the same phenotype?

2) By performing a "**back-cross**".



To study

P

factors

monohybrid experiment

Mendel's first law

F1

F2

dihybrid experiment

back-cross

Heterozygous

Filial generation

Homozygous

Segregation of alleles

Phenotype

Reciprocal cross

F3

Dominant

Genotype

parental generation

Recessive

Expectations

- You understand Mendel's monohybrid experiment and its result and significance.
- Become familiar with the terms associated with Mendel's work.

For a smile