

# CHAPTER 5: Mendelian Genetics

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## Gregor Mendel's work on Inheritance

For centuries, scientists have known that all organisms inherit set of characteristics from their parents. But how?

Gregor Mendel's work in an Austrian monastery in the 1800's revolutionized what would become known as genetics : the study of inheritance.

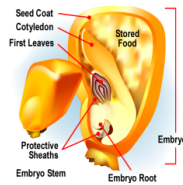


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As a part of his duties, Mendel was in charge of the monastery garden. His work with peas would prove to be revolutionary.

When working with pea plants, Mendel already knew the following:

- pollen contains the male reproductive cell (gametes) and comes from the flower
- egg cells also come from the flower
- fertilization occurs when the male and female gametes come in contact with one another and form a new cell.
- this new cell will develop into an embryo, which is protected inside a seed.



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Mendel also observed that pea plants have self-pollinating flowers:

- flowers contain both female and male parts
- the gametes from these parts fertilize each other within the same flower.
- the resulting offspring has only one parent.



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Mendel knew the plants at the monastery were true-breeding . True breeding plants:

- self-pollinate
- produce offspring that look just like themselves.



So, the tall plant seeds produced only tall plants, the green peas only produced green peas, etc...

With this knowledge, and a large stock of pea plants, he started his experiments.



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Mendel began by cross-pollinating his pea plants.

To do this, he removed the pollen-creating part of the plant, and brushed it against the female part of the flower in another plant.

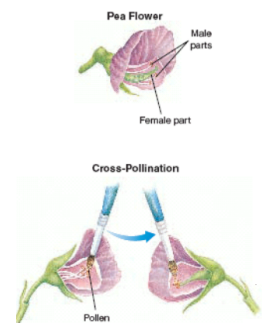
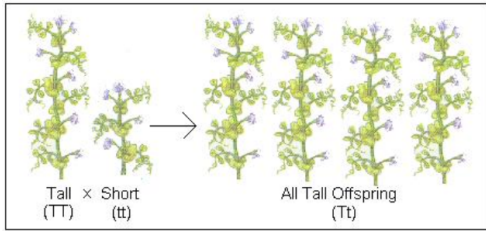


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Cross-pollination allowed Mendel to produce pea plants that had two parents. He could then study the effects of using gametes from two plants with different characteristics.



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Pea plant traits

Mendel studied seven different traits (specific characteristics that vary from organism to organism). (See p. 64 in TB for summary)

- He studied:
- Seed shape (round vs. wrinkled)
  - Seed colour (yellow vs. green)
  - Seed coat colour (grey vs. white)
  - Pod shape (smooth vs. constricted)
  - Pod colour (green vs. yellow)
  - Flower position (axial vs. terminal)
  - Plant Height (tall vs. short)

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Character	Dominant trait	Recessive trait	Character	Dominant trait	Recessive trait
Seed shape	Spherical	Wrinkled	Flower position	Axial	Terminal
Seed color	Yellow	Green	Stem height	Tall	Dwarf
Flower color	Purple	White			
Pod shape	Inflated	Constricted			
Pod color	Green	Yellow			

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In each experiment, he crossed two contrasting characters (ex: tall vs. short plants) and studied the hybrid, or mixed, offspring.

In each case, he found that only one of the characteristics was present.

(In genetics, the original generation is called the parent generation, or P<sub>1</sub>, and the first set of offspring is called the first filial generation, or F<sub>1</sub>).

	Seed Shape	Seed Color	Seed Coat Color	Pod Shape	Pod Color	Flower Position	Plant Height
P	Round × Wrinkled	Yellow × Green	Gray × White	Smooth × Constricted	Green × Yellow	Axial × Terminal	Tall × Short
F <sub>1</sub>	Round	Yellow	Gray	Smooth	Green	Axial	Tall

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Mendel's Conclusions

Mendel first concluded that genes were responsible for passing information from one generation to the next.

The seven traits Mendel studied were the result of 2 contrasting genes called alleles. Alleles are the different forms of the same genes that exist.

ex: A specific part of your DNA on a specific chromosome codes the information for your hair colour. This is a gene.

The alleles of this gene code for brown, blond, and red hair, and each shade in between.

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Mendel also concluded that some alleles were dominant, while others were recessive. This conclusion is now known as the principle of dominance.

An organism with a dominant allele will always show that trait, rather than the recessive one.

ex: In pea plants, the gene for height has two alleles - tall and short.

The allele for tall plants is dominant, the allele for short plants is recessive.

If gametes from a true-breeding tall plant and a short plant are cross-bred, what will be the height of the F<sub>1</sub> offspring?

They will be tall!

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**Segregation**

Mendel was curious about the apparent "disappearance" of certain traits in hybrid plants, so he continued his experiments.

Mendel allowed his F<sub>1</sub> plants, showing only dominant traits, to self-pollinate. The result was an F<sub>2</sub> generation in which three quarters of the plants showed the dominant trait, and one quarter showed the recessive one!

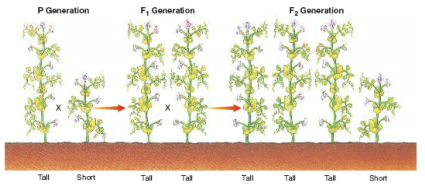


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To explain his results, Mendel assumed that the recessive trait did not disappear in the F<sub>1</sub> generation, but was masked by the dominant trait.

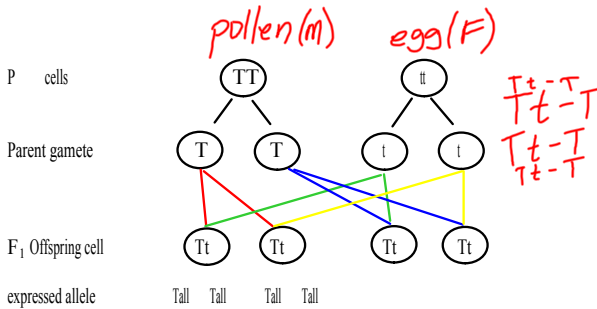
The two alleles must then have separated, or segregated, when producing the F<sub>2</sub> generation.

We know today that each diploid cell carried two sets of homologous chromosomes. During meiosis, these chromosomes are separated and only one allele of a particular gene is passed on to the offspring.

The gametes will fuse and create a cell with two alleles of the same gene (one from each parent). The principle of dominance will determine which one is expressed in the organism.

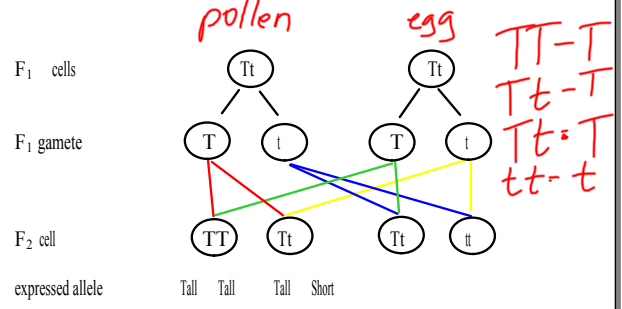
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Visual Representation of F<sub>1</sub> generation



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Visual Representation of F<sub>2</sub> generation



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