

GENETICS

Genetics - the branch of biology dealing with the principles of variation and inheritance in organisms

Heredity - transmission of traits

Many of the general ideas of modern genetics come about as a result of work done by Gregor Mendel, a monk from Austria who lived around the mid-1800s.



Mendel had some background in math and plant studies before he joined the monastery. He was assigned to work in the garden, tending the vegetables used at the monastery. Over an eight-year period he documented experiments involving the passing of traits in garden peas. The publication of his work marked the beginning of the study of genetics.

Mendel was a bit lucky, too. His chosen plant, the pea, was a good plant to study for four reasons:

1. Readily available
2. Easy to grow and mature quickly
3. Mendel could transfer pollen from one plant to another and control their reproduction
4. Different varieties of the plant easily observed from one generation to the next

Mendel studied seven different traits. Each trait had only two possible forms, or variations, like plant height (tall or dwarf) or seed coat colour (either green or yellow).

By controlling their reproduction, he produced plants that he considered **purebred** - always demonstrated the same traits, generation after generation.

He took a group of plants that always bred true for tall height. He bred another group that were all the dwarf variety. Since he was just examining one trait, we call this a **monohybrid cross**.

According to the beliefs at the time, a cross between these two traits should have

produced medium height plants. This was called the **Blend Theory of Inheritance**.

Mendel called the pure tall plants and the pure dwarf plants his **parent generation** or **P generation**. The offspring produced from this first cross were called the **first filial generation** or **F₁ generation**.

When he planted the seeds of the F₁ and watched them grow, they were **all tall**. Mendel concluded the tall trait must somehow dominate the short (dwarf) trait.

A **dominant trait** is a characteristic that is always expressed.

A **recessive trait** is present but inactive and would not be expressed.

Mendel concluded heredity was not a blending of traits, but that one trait was always dominant over the other. He called this the **Principle of Dominance**.

It states that when two contrasting traits are crossed, only the dominant trait will be expressed in the offspring.

Next, Mendel wished to study what would happen if he crossbred the F₁ generation to produce a second filial generation or F₂.

When he crossed the plants of the F₁, the resulting F₂ offspring showed the following ratio - 3 tall plants : 1 short plant (75% were tall and 25% were short). Genetic crosses are expressed in ratios or percentages.

Mendel tested this same experiment on plants that bred true for all the other possible traits of the peas, and every time he got the same 3:1 ratio in the F₂ generation!

Based on these observations he concluded:

- each plant parent has two factors
- the factors separate in each parent and only one factor is passed on to the offspring from each parent
- all plants in the F₁ generation received a dominant factor from the pure tall parent and a recessive factor from the pure dwarf parent
- even though the plants in the F₁ had both types of factors, only the dominant trait would be expressed
- the recessive factor only shows up in the F₂ generation because that is the only time two dwarf factors could come together

He used these deductions to create his first law of heredity : **Law of Segregation**

Inherited traits are determined by pairs of factors . These factors separate in the sex cells, one in each gamete.

Complete Dominance - when one trait is completely dominant. Therefore a homozygous dominant individual and a heterozygous individual would have the same phenotype.

Test Cross - Breeders may want to determine whether an individual is homozygous dominant or heterozygous.

By crossing an individual of unknown genotype with an individual that is homozygous recessive, we can sometimes determine the unknown by examining the offspring. This is called a **test cross**.

If the offspring are all dominant, chances are the unknown individual is homozygous. If any of the offspring show the recessive trait, the individual must have been heterozygous.