

The Origins of Genetics

Heredity – the passing of traits from parents to offspring

Who is Gregor Mendel?

- An Austrian monk
- Carried out experiments where he bred different varieties of the garden pea
- First person to develop rules that accurately predict patterns of heredity
- His discoveries formed the basis of *genetics*

GENETICS – the branch of biology that focuses on heredity

Before Mendel's experiments, people thought offspring were a *blend* of the characteristics of their parents.

- Mendel's experiments disproved this.

Mendel developed four hypotheses that now make up the **Mendelian theory of heredity** – the foundation of genetics:

1. For each inherited trait, an individual has two copies of the gene – one from each parent
 - ⊛ a gene is a segment of DNA that is located in a chromosome and that codes for a protein that determines a specific hereditary trait
2. There are alternate versions of genes. We call these alternate versions alleles – an individual receives one allele from each parent.
 - ⊛ An allele is a specific trait or characteristic like hair color
3. When two different alleles occur together, one of them may be completely expressed, while the other may have no observable effect on the organism's appearance.
 - ⊛ We call the expressed form of a trait **DOMINANT**
 - ⊛ The trait that is not expressed when the dominant form of the trait is present is described as **RECESSIVE**
4. When two gametes combine during fertilization, the offspring have two alleles controlling a specific trait, one from each parent
 - ☑ The LAW OF SEGREGATION states that a pair of alleles is separated during the formation of gametes.

Furthermore, when gametes are formed, the alleles for different hereditary traits in an organism separate independently of one another.

The inheritance of one trait does not influence the inheritance of another trait.

We call this the LAW OF INDEPENDENT ASSORTMENT.

- ⊛ Gametes carry only one allele for each inherited trait

- ⊛ When gametes unite during fertilization, each gamete contributes one allele

Mendel's Findings in Modern Terms

- ☺ Geneticists have developed specific terms for representing a person's genetic makeup
- ☺ Letters are often used to represent alleles
- ☺ Dominant alleles = CAPITAL LETTER
 - An example would be "A"
- ☺ Recessive alleles = lowercase letter
 - An example would be "a"
- ☺ If the two alleles are the same, the organism is said to be **HOMOZYGOUS** for that trait
 - AA = homozygous dominant (dominant trait expressed)
 - aa = homozygous recessive (recessive trait expressed)
- ☺ If the two alleles are different, the organism is said to be **HETEROZYGOUS** for that trait
 - Aa = heterozygous
- ☺ In heterozygous organisms, only the dominant allele is expressed – the recessive allele is present but unexpressed
- ☺ The set of alleles that an organism has is called its **GENOTYPE**
 - The genetic makeup of an organism is its genotype
 - AA, aa, and Aa are all examples of an organisms **GENOTYPE**
- ☺ The physical appearance of a trait is called a **PHENOTYPE**
 - The physical appearance of an organism as a result of its genotype
 - Hair color and eye color are examples of phenotypes

For instance, in pea plants, purple flower color is a dominant trait and written as "P". White flower color is recessive and written as "p". In this example, the possible GENOTYPES are:

PP, Pp and pp

The resulting PHENOTYPES would be as follows:

- ⊛ PP would produce a purple flower, and be homozygous dominant
- ⊛ Pp would produce a purple flower and be heterozygous
- ⊛ pp would produce a white flower and be homozygous recessive

Predicting Results of Traits Inherited by Offspring

Biologists use a diagram called a PUNNET SQUARE to help them predict the probability that certain traits will be inherited by offspring.

☑ Diagram that predicts outcome of genetic cross by considering all possible combinations of gametes

➔ A cross between organisms that involves ONE PAIR of contrasting traits is called a MONOHYBRID CROSS

When one allele is completely dominant over the other, we call this COMPLETE DOMINANCE.

In complete dominance:

➔ heterozygous organisms (Yy) and homozygous dominant organisms (YY) have the SAME phenotype

Incomplete Dominance

- ⊛ Offspring will have a phenotype **IN BETWEEN** that of the parents
- ⊛ Occurs when two or more alleles influence the phenotype

Codominance

- Occurs when both alleles for a gene are expressed in a heterozygous offspring
- Neither allele is dominant or recessive
- The alleles do **NOT** blend in the phenotype
- Genotype is indicated by **TWO** capital letters, followed by an ‘
▪ An example of this is RR’, for a roan color coat on a horse

Predicting Results of DIHYBRID Crosses

A dihybrid cross is a cross between organisms that involves **TWO** pairs of contrasting traits.

- Predicting results is more complicated than monohybrid
- There are more possible combinations of alleles