

Introduction to Genetics

Heredity is the passing of traits from parents to their offspring. In biology, the study of heredity is called **genetics**.

A **characteristic** is any observable quality that can be passed on to future generations. A trait is the specific form the characteristic takes in a specific individual.

Example

In humans, eye-color is a characteristic. Blue eyes, green eyes, and brown eyes are all traits. Since eye-color is passed on genetically, an offspring could inherit the eye-color of either parent.

Heritable traits are known to be passed from one generation to the next via DNA. How this occurs can be explained using gene theory.

Gene Theory

1. Heritable traits are passed from generation to generation by **genes**.
2. A series of some 30 000 genes forms a single molecule of DNA.
3. Each chromosome contains a single molecule of DNA.
4. Every characteristic is represented by a pair of genes, called **alleles**. One gene in each pair comes from each parent (one from the father, one from the mother).
5. Each gene in a pair is either called dominant or recessive.
 - a) A **dominant** gene is always expressed when present in a gene pair.
 - b) A **recessive** gene is only expressed if both genes in a pair are recessive.

When solving genetics problems, we typically use a single letter to represent a specific characteristic. The dominant gene for the characteristic is represented by a capital letter, while the recessive gene is represented by a lower-case letter.

Example

Plant height is a characteristic that has two possible traits: tall plant and short plant. For this particular characteristic, tall is the dominant trait. To represent the genes for plant height, we use

$T = \text{tall gene}$

$t = \text{short gene}$

Since genes occur in pairs, there are three possible combinations of genes for plant height: TT , Tt , and tt .

The pair of genes that an individual has for a specific characteristic, such as the three combinations above, are called the **genotype**. In the example above, TT is one of three possible genotypes. It tells us that this individual inherited a tall gene from both parent plants.

The actual outward appearance of a characteristic is called the **phenotype**. The phenotype for a specific individual is determined by its genotype. If the individual has at least one dominant gene, the dominant trait will be expressed. If the individual has only recessive genes, the recessive trait will be expressed. For example,

Genotype	Phenotype
TT	tall plant
Tt	tall plant
tt	short plant

When an individual has two of the same genes in a given pair (e.g. TT or tt), that individual is said to be **homozygous**, or **purebred**. Thus, an individual with the genotype TT would be referred to as a homozygous tall plant.

When an individual has one dominant and one recessive gene in a given pair (e.g. Tt), that individual is said to be **heterozygous** or **hybrid**. Thus, an individual with the genotype Tt would be referred to as a heterozygous tall plant.

