



The difference between genotype and phenotype

The terms **genotype** and **phenotype** were coined by Wilhelm Johannsen, a Danish botanist and geneticist who became famous for his research on pure lines of the self-fertile common bean. During a series of experiments, he was able to show that even in **homozygous** populations, seed size followed a normal distribution and therefore changed. He concluded that these variations were due to environmental factors and led him to coin the two words. The distinction between phenotype and genotype is fundamental to the understanding of heredity and development of organisms. The **genotype** is the genetic make-up of an individual organism and is determined by the description of the actual physical material made up of DNA that was passed to the organism by its parents at the organism's conception. For sexually reproducing organisms the physical material consists of the DNA contributed to the fertilized egg by the sperm and egg of its two parents. For asexually reproducing organisms, for example bacteria, the inherited material is a direct copy of the DNA of its parent. Our genotype functions as a set of instructions for the growth and development of the body. This word is normally used in association with the **genetics** of a particular trait (such as eye colour). The **phenotype** is the observable

physical or biochemical characteristics of an individual organism – for example, height, weight and skin colour – which are influenced both by its genotype and the environment. Our genes carry the instructions for the growth and development of our body. However, our phenotype is influenced during embryonic development and throughout our life by environmental factors, including diet, climate, illness and stress. Therefore it is essential to distinguish the descriptors of the organism, its genotype and phenotype: the former is the descriptor of the **genome** which is the set of physical DNA molecules inherited from the organism's parents, whereas the latter is the descriptor of the **phenome**, the manifest physical properties of the organism, its physiology, morphology and behaviour. In defining evolution, scientists are concerned with the changes in the genotypes that make up a population from generation to generation. However, since an organism's genotype generally affects its phenotype, the phenotypes that make up the population are also likely to change. At the same time, a change in the environment can affect an organism's phenotype: people believe that flamingoes are pink, however the colour pink is not encoded into their genotype: it is the food they eat that makes their phenotype white or pink.

Homozygous are organisms with identical pairs of genes for any given pair of hereditary characteristics. Heterozygous are organisms with dissimilar pairs of genes for any hereditary characteristic.

The **genome** is an organism's entire hereditary information, which is encoded in DNA or in RNA. The word is a blend of the two words, gene and chromosome. The **phenome** is the set of all phenotypes expressed by a cell, tissue, organ, organism or species.

ACTIVITIES

1 Complete the sentences with information from the text.

- 1 Wilhelm Johannsen coined the two terms
- 2 He discovered that there were variations even
- 3 He attributed these variations to
- 4 The genotype is determined by the description of the
- 5 The word genotype is usually associated with
- 6 The phenotype is the set of physical and biochemical characteristics which are influenced
- 7 When studying evolution, scientists are interested in the genotype changes that
- 8 An example of how an organism's phenotype is affected by the environment is

2 Translate the following words into Italian.

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|-----------------------|--------------------|-------------------|
| 1 Geneticist | 5 Make-up | 9 Growth |
| 2 Line | 6 Fertilized | 10 Set |
| 3 Environmental | 7 Parent | 11 Manifest |
| 4 Seed | 8 Trait | 12 Flamingo |

3 In groups discuss the characteristics of an organism's genotype and phenotype. Which factors influence them? What are their consequences?

4 Why is it the distinction between genotype and phenotype important? Write a short text about this topic.