

## Effect of Environment on Genetics

Genes often interact with the environment, creating different phenotypes depending on where the organism lives.



[Figure1]

### What do these twins have in common?

Almost all their [DNA](#). In fact, all their nuclear DNA. Some of their mitochondrial DNA may have slight variations. So that would mean that genetic studies involving twins can be potentially very rewarding.

## Effects of Environment on Phenotype

Genes play an important part in influencing phenotype, but genes are not the only influence. Environmental conditions, such as [temperature](#) and availability of nutrients can affect phenotypes. For example, temperature affects coat [color](#) in Siamese cats.



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The dark "points" on this Siamese cat are caused by a gene that codes for a temperature-sensitive enzyme. The enzyme, which causes a darkening of the cat's fur, is active only in the cooler parts of the body such as the tail, feet, ears, and area around the nose.[Figure2]

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The pointed pattern is a form of partial albinism, which results from a mutation in an enzyme that is involved in melanin production. The mutated enzyme is [heat](#)-sensitive; it fails to work at

normal body temperatures. However, it is active in cooler areas of the skin. This results in dark coloration in the coolest parts of the cat's body, such as the lower limbs and the face, as shown in **Figure above**. The cat's face is cooled by the passage of air through the nose. Generally adult Siamese cats living in warm climates have lighter coats than those in cooler climates.

Height in humans is a complex phenotype influenced by many genes, but it is also influenced by nutrition. A person who eats a diet poor in nutrients will not grow as tall as they would have had they eaten a more nutritious diet.

## ***Environmental Trigger***

Does everyone who smokes develop lung **cancer**? No, of course not. Is it possible to get lung cancer without smoking? Sadly, yes it is. That's not to say there is no relationship between the two: smoking is still the leading cause of lung cancer. But it does suggest that a person's genetic background has a role in this process. Apart from true single gene disorders, environmental factors, or **environmental triggers**, may determine the development of disease in individuals genetically predisposed to a particular condition. Environmental triggers may include stress, physical and mental abuse, diet, exposure to toxins, **pathogens**, and radiation. Many cancers are thought to have an environmental component. It has been suggested that environmental factors play a role in autism as well. Asthma is obviously triggered under certain environmental conditions.

## ***Twin Studies***

The classical twin design compares the similarity of identical and fraternal twins.

Scientists often study the effects of environment on phenotype by studying identical twins. Identical twins have the same genes, so phenotypic differences between twins often have an environmental cause. **Twin studies** help understand the relative importance of environmental and genetic influences on individual traits and behaviors. Twins are a valuable source of information concerning the relationship between genes and environment. As **monozygotic twins**(identical) share their nuclear **DNA**, their **polymorphisms**, the nucleotide differences that make their **DNA** unique, are common to the two individuals. This means that any phenotypic variation, such as in height, intelligence, or any other measurable trait, is due to the environment. What is different about the experiences of the twins? What unique experiences might one twin have that the other twin did not have? By comparing phenotypes of hundreds of twins, researchers can understand the roles of genetics, shared environment and unique experiences in the formation and development of specific traits.

**Dizygotic twins** (fraternal or non-identical) share only about half of their polymorphisms. These twins are helpful to study as they tend to share many aspects of their environment. As they are born in the same place, usually within a few minutes of each other, they share many environmental conditions. They had the same *in utero* environment, they usually have a similar or the same parenting style during their childhood, and a similar or the same education. Similarities during childhood usually occur with wealth, culture, and their community.

Modern twin studies have shown that almost all human traits are at least partly influenced by genetic differences. Some characteristics, such as height, show a strong genetic influence, while other characteristics have an **intermediate** level of genetic influence, such as with intelligence. Some characteristics have a much more complex genetic relationship, with evidence for different

