

Polygenic Traits and Pleiotropy

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WHAT'S COVERED

In this lesson, you will learn to understand how genes interact with one another and their environment. Specifically, this lesson will cover:

1. Polygenic Traits

Polygenic traits are traits the combined expressions of multiple genes. In other words, these traits are not determined by just one single gene. Most of the traits that are expressed are determined by many genes, with very few traits determined by one single gene.

→ EXAMPLE The color of your eyes, hair, or skin are all polygenic traits.

Polygenic traits can show **continuous variation** within a population. Height is a good example of a polygenic trait because, within a given population, we could have a wide range of continuous differences of that trait. Height is also a **multifactorial trait**, meaning that it is determined by multiple factors such as the combination of a person's genes and environment.

ightarrow EXAMPLE Nutrition is an example of an environmental factor that can influence height.

TERMS TO KNOW

Polygenic Trait

A trait that is determined by several genes.

Continuous Variation

Variation of a trait that shows up in a population of people; body height is an example of continuous variation.

Multifactorial Trait

A gene that is partially controlled by genetics and partially controlled by the environment; for example, body height is influenced by genetics, but nutrition growing up also influences height.

2. Penetrance

Penetrance is the varying degree to which someone expresses a trait that's associated with an allele. Incomplete penetrance means that some people who inherit a disease allele will not manifest the disease in their phenotype. For example, mutations in the BRCA1 gene cause familial breast cancer. 80% of people who inherit one of these mutant alleles will contract breast cancer at some point during their lifetime. That means that the penetrance of these alleles is 80%; just because you have the allele doesn't guarantee the phenotypic outcome.

Cystic fibrosis is an example of a trait that would be completely penetrant. This means that 100% of people who are homozygous recessive will have cystic fibrosis.

Polydactyly would be an example of a trait that would be incompletely penetrant. Polydactyly relates to the number of digits that a person has. Some people who carry the genes for polydactyly might have the normal ten fingers, while some people who have that trait might have more than ten fingers. There are varying degrees to which someone expresses this trait.

TERM TO KNOW

Penetrance

The degree to which an inherited allele is expressed in the phenotype; an example would be familial breast cancer due to mutations in the BRCA1 gene.

3. Pleiotropy

Pleiotropy is the expression of one gene that affects multiple traits. An example of this is the gene that causes **sickle-cell anemia**. This gene produces various effects throughout the body and can affect the way the blood carries oxygen, other internal organs, et cetera.

TERMS TO KNOW

Pleiotropy

When one gene influences multiple phenotypic traits; an example is sickle-cell anemia: A mutation in one of the hemoglobin genes results in phenotypic changes in the blood, the joints, etc.

Sickle-Cell Anemia

An example of pleiotropy, a person who inherits the mutated HBs gene will contract sickle-cell anemia, which damages erythrocytes, the spleen, and many other organs of the body.

🗇 SUMMARY

Polygenic traits are a combined expression of multiple genes. Examples would be the color of your eyes, hair, and skin. These traits can show continuous variation in a population and can also be multifactorial. Penetrance is the varying degree to which a trait associated with an allele is expressed.
Pleiotropy is the expression of multiple traits from one gene, such is the case with the gene for sickle-cell anemia.

Keep up the learning and have a great day!

TERMS TO KNOW

Continuous Variation

Variation of a trait that shows up in a population of people, body height for instance.

Multifactorial Trait

A gene that is partially controlled by genetics and partially controlled by the environment. For example, body height is genetic but nutrition growing up also influences height.

Penetrance

The degree to which an inherited allele is expressed in the phenotype. An example would be familial breast cancer due to mutations in the BRCA1 gene. Of the people who inherit such a mutation, 80% will develop breast cancer over their lifetime. The penetrance of this allele is 80%.

Pleiotropy

When one gene influences multiple phenotypic traits. An example is sickle-cell anemia: a mutation in one of the hemoglobin genes results in phenotypic changes in the blood, the joints, etc.

Polygenic Trait

A trait that is determined by several genes.

Sickle-Cell Anemia

An example of pleiotropy, a person who inherits the mutated HBs gene will contract sickle-cell anemia, which damages erythrocytes, the spleen, and many other organs of the body.