

16-1 Genes and Variation



How Common Is Genetic Variation?

Many genes have at least two forms, or alleles.

All organisms have genetic variation that is “invisible” because it involves small differences in biochemical processes.

An individual organism is heterozygous for many genes.

Variation and Gene Pools

Genetic variation is studied in populations.

A population is a group of individuals of the same species that interbreed.

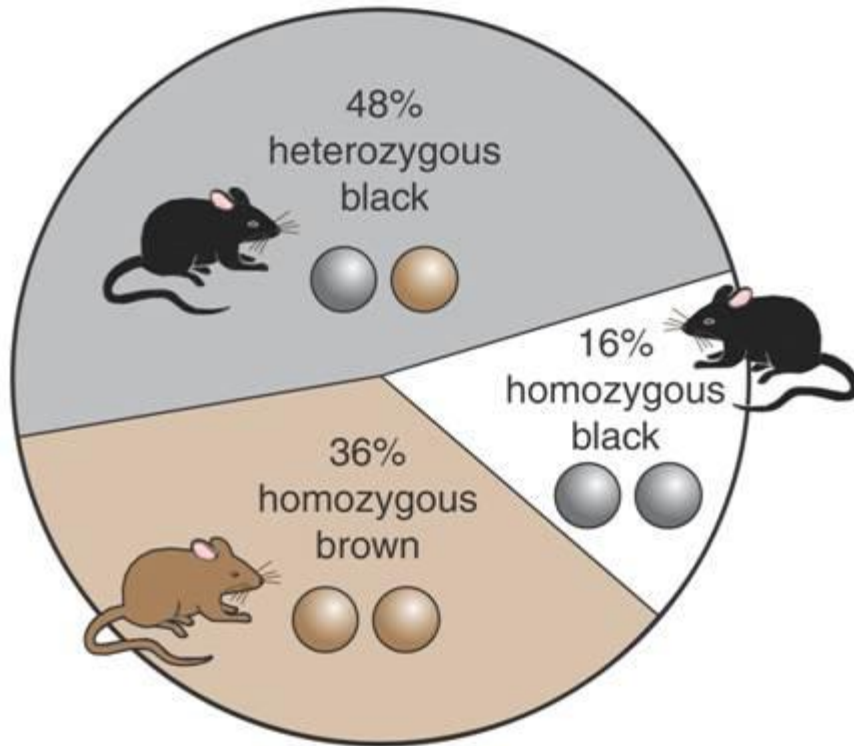
A **gene pool** consists of all genes, including all the different alleles, that are present in a population.

The **relative frequency** of an allele is the number of times the allele occurs in a gene pool, compared with the number of times other alleles for the same gene occur.

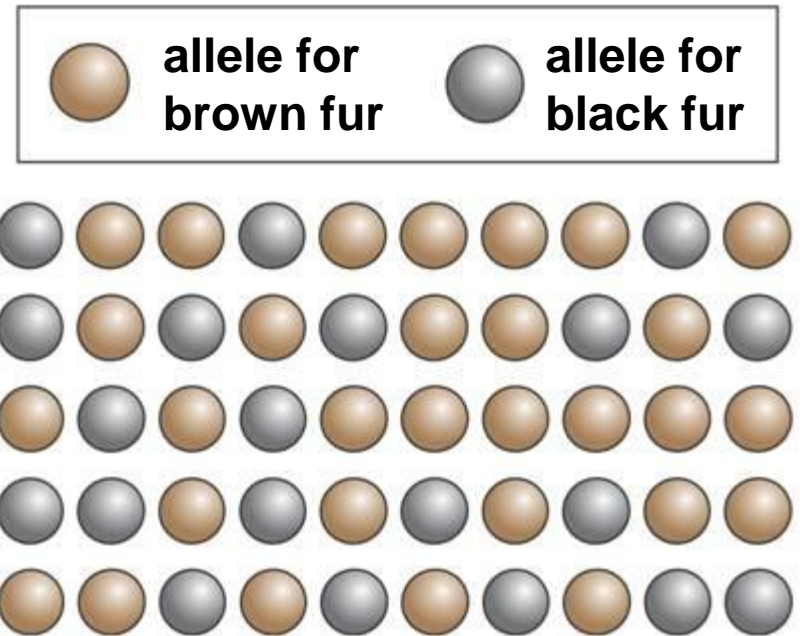
Relative frequency is often expressed as a percentage.

Gene Pool for Fur Color in Mice

Sample Population



Frequency of Alleles





How is evolution defined in genetic terms?



In genetic terms, evolution is any change in the relative frequency of alleles in a population.



What are the main sources of heritable variation in a population?

Sources of Genetic Variation



The two main sources of genetic variation are mutations and the genetic shuffling that results from sexual reproduction.

Mutations

A mutation is any change in a sequence of DNA.

Mutations occur because of mistakes in DNA replication or as a result of radiation or chemicals in the environment.

Mutations do not always affect an organism's phenotype.

Gene Shuffling

Most heritable differences are due to gene shuffling.

Crossing-over increases the number of genotypes that can appear in offspring.

Sexual reproduction produces different phenotypes, but it does not change the relative frequency of alleles in a population.



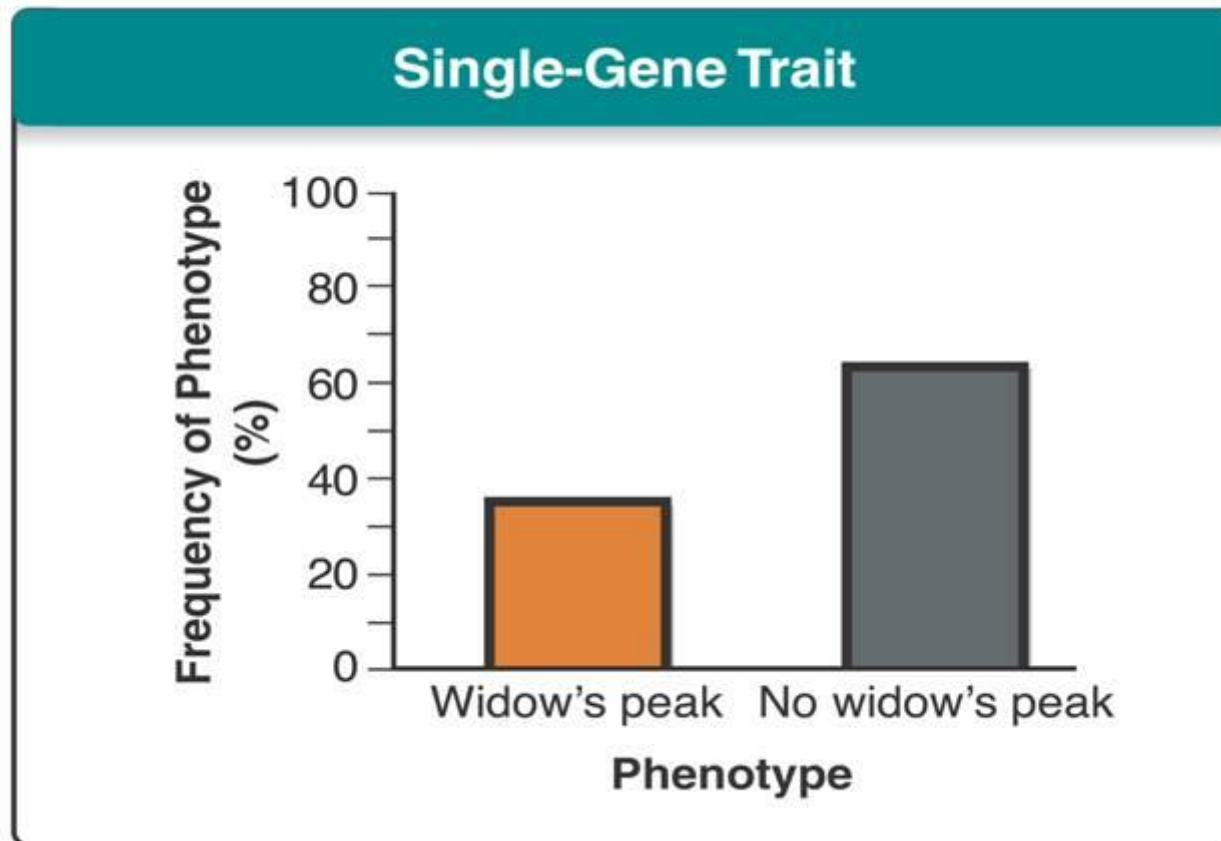
What determines the numbers of phenotypes for a given trait?

Single-Gene and Polygenic Traits



The number of phenotypes produced for a given trait depends on how many genes control the trait.

A **single-gene trait** is controlled by one gene that has two alleles. Variation in this gene leads to only two possible phenotypes.



The allele for a widow's peak is dominant over the allele for a hairline with no peak.

However, the presence of a widow's peak may be less common in a population.

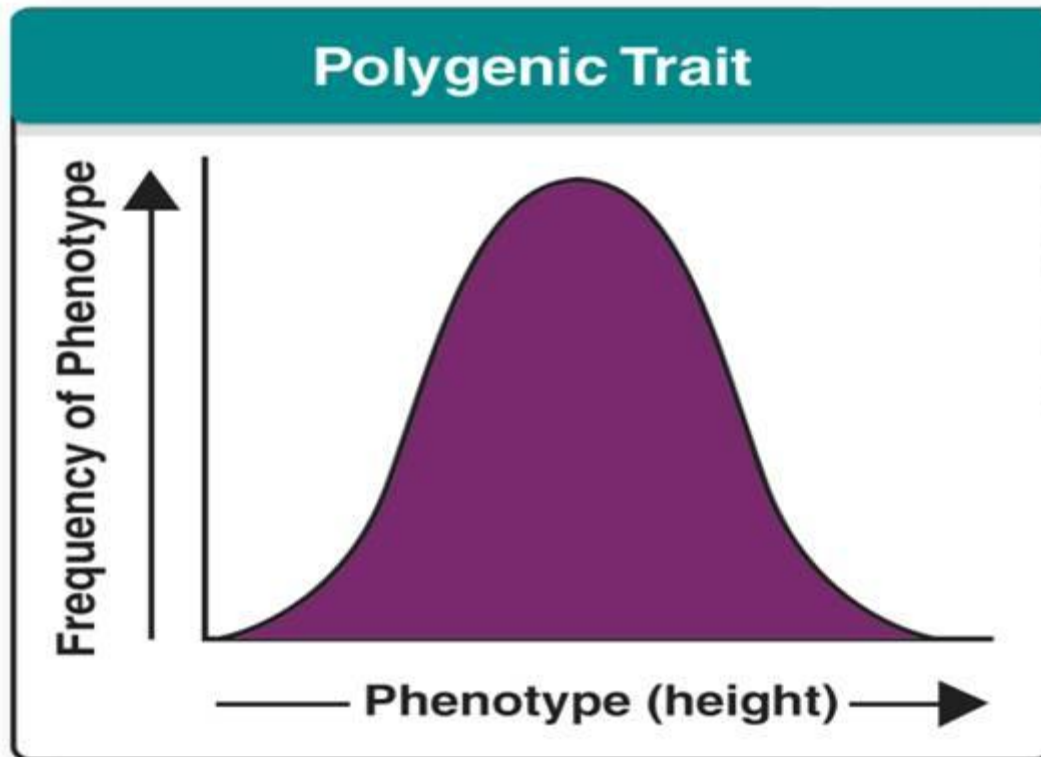
In real populations, phenotypic ratios are determined by the frequency of alleles as well as by whether the alleles are dominant or recessive.

Many traits are controlled by two or more genes and are called **polygenic traits**.

One polygenic trait can have many possible genotypes and phenotypes.

Height in humans is a polygenic trait.

- A bell-shaped curve is typical of polygenic traits.
- A bell-shaped curve is also called normal distribution.



16-1 Section QUIZ

Continue to:

Section QUIZ

- or -

Click to Launch:



16-1 Section QUIZ

1 Which of the following statements is TRUE?

A

- a. The relative frequency of an allele is not related to whether the allele is dominant or recessive.
- b. Mutations always affect an organism's phenotype.
- c. Crossing-over decreases the number of different genotypes that appear in an offspring.
- d. Evolution does not affect the frequency of genes in a gene pool.

16-1 Section QUIZ

2 Most inheritable differences are a result of

A a. gene shuffling.

b. frequency of alleles.

c. mutations.

d. DNA replication.

16-1 Section QUIZ

3 The main sources of inherited variation are

- A**
- a. gene shuffling and mutations.
 - b. gene pools and frequencies.
 - c. single-gene and polygenic traits.
 - d. genotypes and phenotypes.

16-1 Section QUIZ

4 A widow's peak in humans is an example of a(an)

a. invariable trait.

A b. single-gene trait.

c. polygenic trait.

d. mutation.

16-1 Section QUIZ

5 A graph of the length of the little finger on the left hand versus the number of people having fingers of a particular length is a bell-shaped curve. This indicates that finger length is a

a. single-gene trait.

A b. polygenic trait.

c. randomly inherited trait.

d. strongly selected trait.

END OF SECTION