

11.1

Genetic Variation Within Populations

VOCABULARY

gene pool
allele frequency

KEY CONCEPT A population shares a common gene pool.

MAIN IDEAS

- ▶ Genetic variation in a population increases the chance that some individuals will survive.
- ▶ Genetic variation comes from several sources.

Connect to Your World

You may think that if you've seen one penguin, you've seen them all. However, penguins can differ in body size, feather patterns, and many other traits. Just like humans, penguins are genetically different from one another. What is the nature of genetic variation in populations? And how is this variation measured by biologists?

▶ MAIN IDEA

Genetic variation in a population increases the chance that some individuals will survive.

Body size and feather patterns in penguins are each examples of phenotypes. A phenotype is a trait produced by one or more genes. In a population, there may be a wide range of phenotypes. For example, some penguins may be short and rounded. Others could be tall and slim.

Natural selection acts on different phenotypes in a population. However, in order to have different phenotypes, a population must have genetic variation. A population with a lot of genetic variation likely has a wide range of phenotypes. The greater the variation in phenotypes, the more likely it is that some individuals can survive in a changing environment. For example, in an unusually cold winter, short, rounded penguins might be better able to stay warm than tall, slim penguins. But if there is a shortage of food, tall, slim penguins might be better divers, allowing them to catch more fish.

Genetic variation is stored in a population's **gene pool**—the combined alleles of all of the individuals in a population. Different combinations of alleles in a gene pool can be formed when organisms mate and have offspring. Each allele exists at a certain rate, or frequency. An **allele frequency** is a measure of how common a certain allele is in the population. As shown in **FIGURE 1.1**, you can calculate allele frequencies. First count the number of times an allele occurs in a gene pool. Then divide by the total number of alleles for that gene in the gene pool.

Analyze What is the relationship between allele frequencies and a gene pool?

THAT'S
Amazing!

Video Inquiry
HMDSscience.com

PREMIUM CONTENT

Shark Trails

READING TOOLBOX

TAKING NOTES

Use mind maps to show relationships among related terms and concepts.

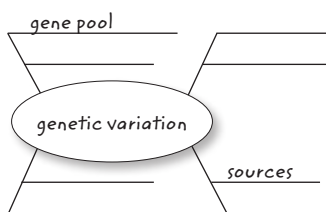
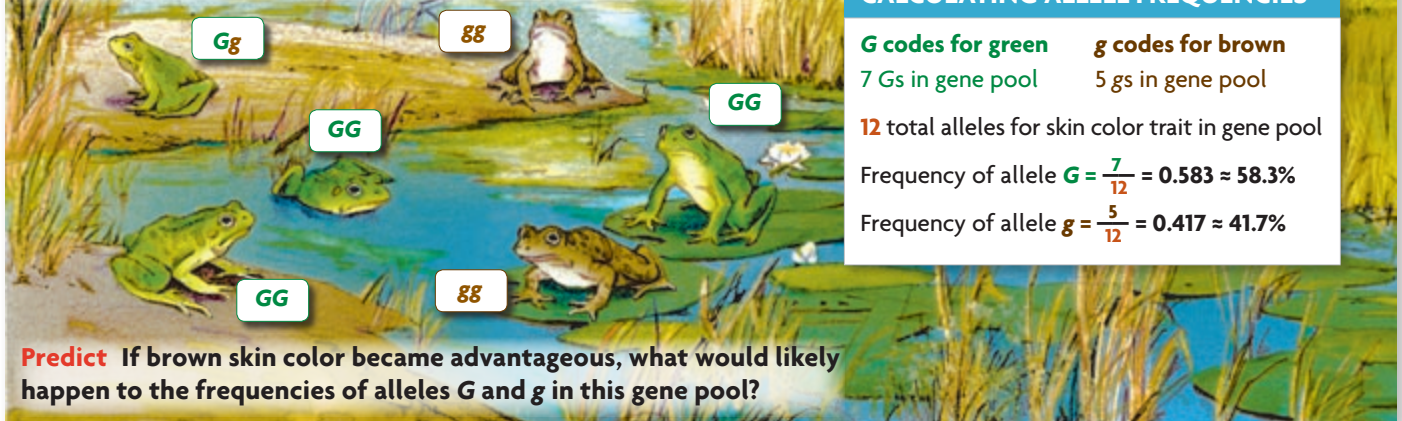


FIGURE 1.1 Allele Frequency

An **allele frequency** is the ratio of one allele to the total number of the alleles for that gene in the gene pool.



▶ MAIN IDEA

Genetic variation comes from several sources.

Genetic variation comes from two main sources: mutation and recombination.

- **Mutation** A mutation is a random change in the DNA of a gene. This change can form a new allele. Mutations in reproductive cells can be passed on to offspring. This increases the genetic variation in the gene pool. Because there are many genes in each individual and many individuals in a population, new mutations form frequently in gene pools.
- **Recombination** New allele combinations form in offspring through a process called recombination. Most recombination occurs during meiosis—the type of cell division needed for sexual reproduction. When gametes are made, each parent’s alleles are arranged in new ways. This shuffling of alleles results in many different genetic combinations.

Some biologists are studying hybridization as another source of genetic variation. Hybridization is the crossing of two different species that share common genes. Research suggests that this process occurs within many groups of animals, including birds and mammals, when similar species live in the same area and individuals cannot easily find mates of their own species.

Infer Why aren’t mutations in nonreproductive cells sources of genetic variation?

CONNECT TO

GENETICS

As you learned in **From DNA to Proteins**, mutations on noncoding regions of DNA do not affect phenotypes. Only mutations on coding regions of DNA can affect an organism’s phenotype.

11.1 Formative Assessment

REVIEWING ▶ MAIN IDEAS

1. Why does genetic variation increase the chance that some individuals in a population will survive?
2. Describe two main sources of genetic variation.

CRITICAL THINKING

3. **Analyze** In what way is a **gene pool** representative of a population?
4. **Apply** If a certain trait’s **allele frequency** is 100 percent, describe the genetic variation for that trait in the population.



SELF-CHECK Online
HMDSscience.com

PREMIUM CONTENT

CONNECT TO

GENETICS

5. How does crossing over during meiosis provide a source of genetic variation? Draw a diagram to show this process.