Chapter 5

DNA and Genes

5.1 What is a Gene?
5.2 Chromosomes
5.3 The Structure of DNA
5.4 How DNA Is Copied
5.5 How Proteins Are Built
5.6 Genetic Mutations

Photo credit: Geoff Gallice

5.1 What is a Gene?

Genes determine many traits in living organisms—the colors of a plant's flowers, the length of a cat's tail, the substances that make up a crab's shell or a bacterium's cell wall. In humans, genes affect our eye color, whether we are tall or short, and whether our hair is straight or curly. Genes even influence our personalities. But what is a gene, and how does a gene determine a trait?

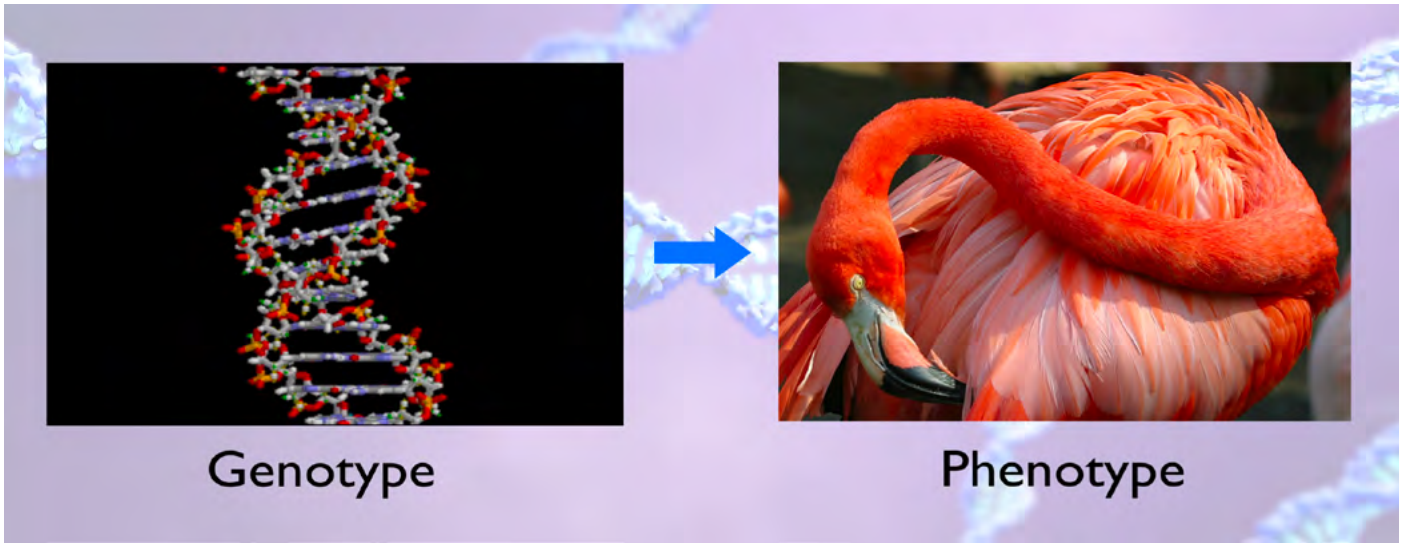

Figure 5.1
An organism's genes, found in its DNA, makes up its genotype. An organism's traits, such as this flamingo's pink feathers, curved beak, and yellow eyes, make up its phenotype.

A **gene** is a section of DNA that contains the instructions for building a protein. An organism's collection of genes makes up the organism's **genotype**. The resulting traits of an organism make up its **phenotype**. Genotype and phenotype are illustrated in Figure 5.1.

Let's look at an example of genotype and phenotype in humans. Consider two genes for eye color, one gene calling for brown eyes and the other for blue eyes. If you have both these genes, then your genotype is one brown-eye gene and one blue-eye gene. But with this genotype, the color of your eyes will be brown. In this case, we say your phenotype is brown eyes. How a genotype generates a particular phenotype—how genes become traits—is one subject of this chapter.

If genes contain instructions for building proteins, you might wonder: Why are proteins so important? Why do so many of our traits depend on proteins? The answer is that proteins do many important jobs in living organisms. Proteins provide structure, act as hormones, transport molecules, function in cell communication, and protect organisms from disease. In addition, enzymes are proteins, and enzymes are needed for practically every chemical reaction that occurs in living things.

READING CHECK

A boy has straight hair. Is that part of his genotype or phenotype?

CHECK YOUR ANSWERS

The traits of an organism—such as the straight hair of a boy—are part of the boy's phenotype.

For more on genes, check out this website at the National Human Genome Research Institute:

https://www.genome.gov/genetics-glossary/Gene