

SECTION 3-4

SECTION SUMMARY

The DNA Connection

Guide for Reading

- ◆ What is meant by the term "genetic code"?
- ◆ How does a cell produce proteins?
- ◆ How do mutations affect an organism?

Today, scientists know that genes control the production of proteins in the cells of an organism. Proteins determine the size, shape, and other traits of organisms. Recall that chromosomes are composed mostly of DNA and contain thousands of genes along their length. A DNA molecule is made up of four nitrogen bases—adenine (A), thymine (T), guanine (G), and cytosine (C). **The order of nitrogen bases along a gene forms a genetic code that specifies what type of protein will be produced.** In the genetic code, a group of three bases codes for a specific amino acid—the building blocks of proteins.

During protein synthesis, the cell uses information from a gene on a chromosome to produce a specific protein. Protein synthesis occurs at the ribosomes in the cytoplasm of the cell. DNA, however, is located in the cell nucleus. Before protein synthesis occurs, a genetic "messenger," called ribonucleic acid or RNA, is made from the DNA. RNA is similar to DNA, except RNA has only one strand and it has uracil in place of thymine.

In the first step of protein synthesis, the DNA molecule "unzips" and directs the production of messenger RNA. **Messenger RNA** copies the coded message from the DNA in the nucleus and carries it into the cytoplasm. When messenger RNA attaches to a ribosome, **transfer RNA** carries amino acids and adds them to the growing protein. The three-letter code in messenger RNA specifies which transfer RNA will drop off its amino acid.

Sometimes mistakes occur in the sequence of bases, and a gene is changed. These changes, called **mutations**, can cause a cell to produce an incorrect protein, which may affect the organism's phenotype. Some mutations are the result of small changes in DNA. Others occur when chromosomes don't separate correctly during meiosis.

If a mutation occurs in a body cell, the mutation affects only the cell that carries it. However, if a mutation occurs in a sex cell, the mutation can be passed on to an offspring and affect the offspring's phenotype. **Some of the changes brought about by mutations are harmful to an organism. Other mutations, however, are helpful, and still others are neither harmful nor helpful.** A mutation is harmful if it reduces an organism's chance for survival and reproduction. Whether or not a mutation is harmful depends partly on the organism's environment. For example, a white buffalo calf may not survive in the wild, but the mutation has no effect on its ability to survive on a farm.