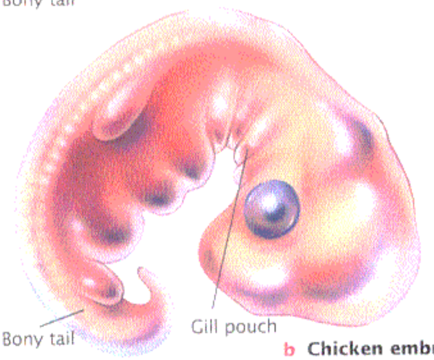
Developmental patterns show evolutionary relationships

Much of our evolutionary history can be seen in the way human embryos develop. Early in development, human embryos and embryos of all other vertebrates are strikingly similar, as shown in **Figure 10-7**. In later stages of development, a human embryo develops a coat of fine fur. The similarity of these early developmental forms strongly suggests that the process of development has evolved. New instructions on how to grow have been added to old instructions inherited from ancestors.

a **Human embryo**



b **Chicken embryo**

Figure 10-7
The five-week-old human embryo (a) and the four-day-old chicken embryo (b) each have a bony tail and gill pouches similar to those of fishes.

DNA and proteins contain evidence of evolution

Although complete fossil histories for living organisms are rare, an organism's history is written in the sequence of nucleotides making up its DNA. If species have changed over time, their genes also should have changed. The theory of evolution predicts that genes will accumulate more alterations in their nucleotide sequences over time. Thus, if we compare the genes of several species, closely related species will show more similarities in nucleotide sequences than will distantly related species. Closely related species also will show more similarities in the amino acid sequences in their proteins. This is because the amino acid sequence in a protein reflects the nucleotide sequence of the gene coding for that protein.

For example, to see how closely related chimpanzees, dogs, and rattlesnakes are to humans, scientists examined the sequence of amino acids in the protein cytochrome *c*, an essential participant in cellular respiration. They found that human cytochrome *c* and chimp cytochrome *c* are identical in all 104 amino acids. This high degree of similarity indicates our very close kinship to chimpanzees. A dog's cytochrome *c* differs from human cytochrome *c* in 13 amino acids, indicating that dogs are fairly distant relatives. But dogs are more closely related to us than are rattlesnakes, whose cytochrome *c* differs from ours in 20 amino acids. In most cases, the evolutionary relationships indicated by DNA or protein sequences confirm those suggested by comparative anatomy and by developmental patterns.

SECTION REVIEW

1. **Why is it unlikely that you will be fossilized?**
2. **Explain why transitional species, such as the ancestors of modern whales, are crucial evidence for evolution.**
3. **How does the whale's vestigial pelvis provide evidence in support of evolution?**
4. **Explain how sequences of amino acids in proteins can be used to reveal relationships among organisms.**

ANSWERS TO SECTION REVIEW

1. To become fossilized, an organism usually must be buried by sediment in slow-moving bodies of water, which is an unlikely situation for most humans.
2. Transitional species act as links that provide evidence of how an ancestral form evolved into a modern species.
3. The whale's vestigial pelvis is a remnant from an earlier life form and is evidence of its evolution from a four-legged, land-dwelling mammalian ancestor.
4. Closely related organisms have more similar DNA sequences and therefore more similar amino acid sequences in their proteins than do distantly related organisms.

Visual Strategy — Videodisc

■ **Recognizing Relationships**

To illustrate the close relationships among primates, use the illustration *Chromosomal Homologies in Primates* shown in Chapter 10 Section 10-2 in ***Holt Biology Videodiscs Teacher's Correlation Guide to Holt Biology: Visualizing Life.*** Point out similarities in chromosome banding patterns among the primates. Have students identify bands that differ among species. Note the many similarities, and ask what these homologous patterns indicate. *(The species share a large portion of their genes.)*

Phase Three

Assessment Options

Closure

● **Organizing Information**

Have students compare and contrast the process of natural selection and the genetic engineering techniques and applications from Chapter 9. Ask them how each process affects a species.

SECTION REVIEW

Assign the *Section Review.*

Reteaching

Show students a photo of the Grand Canyon, and explain that digging for fossils in the canyon is like traveling back in time. The rocks near the top of the canyon contain animal track imprints. If you dug into successively lower layers, you would find plant and reptile fossils, then the bones of primitive fish, then shell fossils, and finally, no fossils. Have students interpret the evolutionary history of the Grand Canyon. *(The Grand Canyon formed as life evolved on Earth.)*

Key to Strategies

- ● Understanding Concepts (Tier I)
- ■ Applying Information (Tier II)
- ▲ Critical Thinking (Tier III)