

Analyzing Amino Acid Sequences

You are a zoologist who specializes in the classification of vertebrates according to their evolutionary relationships. In your research, you examine the amino-acid sequences of a particular protein molecule found in vertebrates to determine similarities between vertebrate species. Your goals are to determine the number of differences in the amino-acid sequences of the molecules and to deduce the evolutionary relationship among the species.

Background Information

A cladogram is a picture depicting patterns of shared characteristics among species. The cladogram labeled Figure 1 shows the relationship of selected animals and their shared physical features.

1. (IOD 301) How many organisms are identified on the cladogram?

- a. 4
- b. 8
- c. 9
- d. 15

2. (IOD 301) How many characteristics are identified on the cladogram?

- a. 4
- b. 8
- c. 9
- d. 15

3. (IOD 301) Which characteristics are found in tuna?

- a. warm blooded and mammary glands
- b. dorsal nerve cord and paired legs
- c. dorsal nerve cord and paired appendages & spinal cord
- d. paired appendages & spinal cord and paired legs

4. (IOD 301) Which characteristics are found in both rabbits and turtles?

- a. warm blooded and mammary glands
- b. warm blooded, mammary glands, opposable thumb, and foramen Magnum forward
- c. opposable thumbs, paired legs, and amnion
- d. dorsal nerve cord, paired appendages & spinal cord, paired legs, and amnion

5. (IOD 301) Which organism possesses the most number of characteristics?

- | | |
|------------|-----------|
| a. lamprey | c. monkey |
| b. chicken | d. human |

Now that you have the necessary background information and skills, you will analyze two proteins to deduce evolutionary relationships. One is cytochrome c, and the other is hemoglobin. Cytochrome c is a protein used in cellular respiration and found in the mitochondria of many organisms. Hemoglobin is the oxygen carrying molecule found in red blood cells. Examine Figure 2a and 2b on the resource page.

For each vertebrate's sequence, count the number of amino acids that differ from the human sequence and record this number in Table 1.

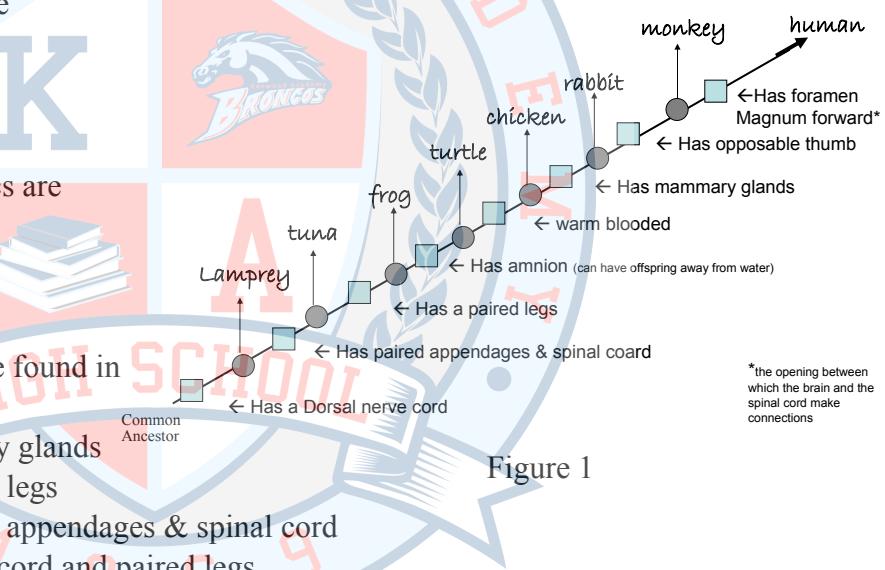


Figure 1

*the opening between
which the brain and the
spinal cord make
connections

Name: _____ Date: _____ Period: _____

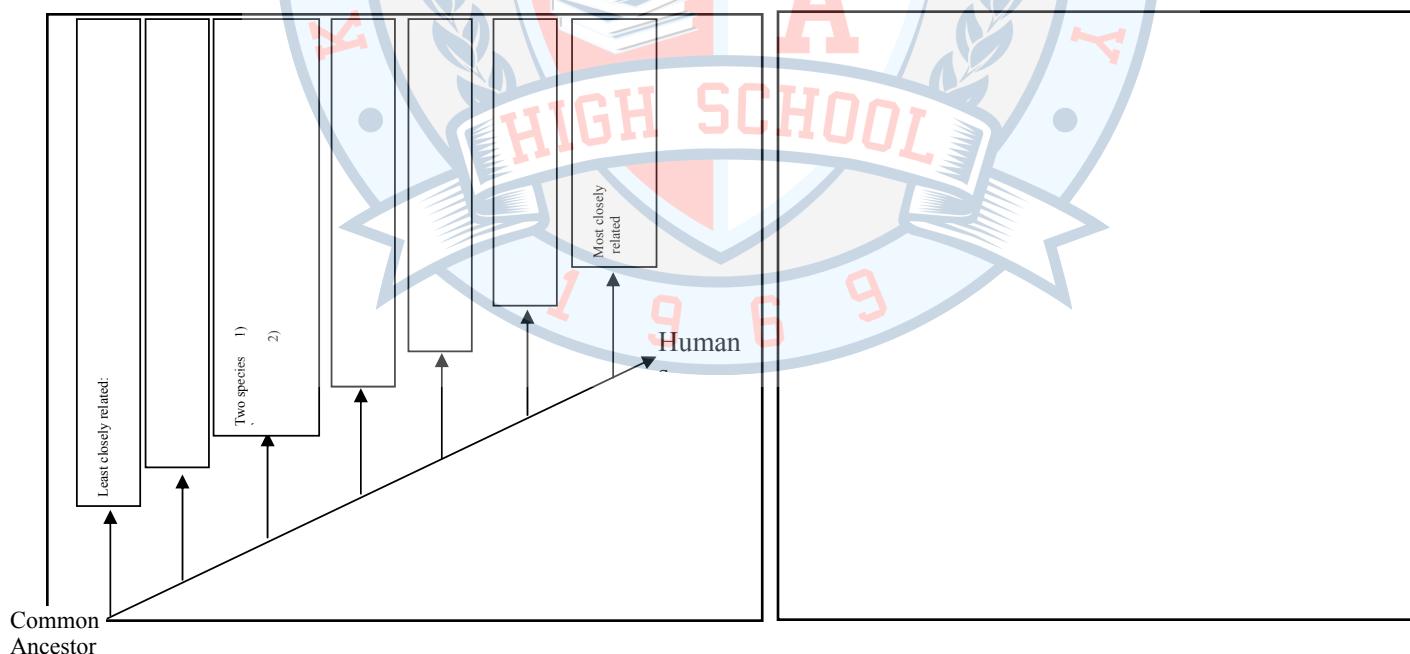
Table 1. Cytochrome c Amino-Acid Sequence Differences Between Humans and Other Vertebrates

	Chicken	Frog	Horse	Monkey	Rabbit	Shark	Tuna	Turtle
# of Differences from Human Cytochrome c								

Table 2. Hemoglobin Amino-Acid Sequence Differences Between Humans and Other Vertebrates

	Chicken	Frog	Horse	Monkey	Rabbit	Shark	Tuna	Turtle
# of Differences from Human Hemoglobin								

Complete the cladogram based on the Cytochrome c amino acid sequence. Then create a cladogram based on the hemoglobin amino acid sequence.



6. (EMI 401) According to this line of evidence, which organism is most closely related to humans? Which is least closely related to humans?

7. (EMI 401) In the study of hemoglobin, which vertebrate is most closely related to humans? Which is least closely related to humans?

8. (EMI 401) Which two organisms have the most recent common ancestor with each other?