evolution

Answer Key-The Molecular Connection

1. Find the human, rhesus monkey, kangaroo, snapping turtle, bullfrog, and tuna on the "Amino Acid Sequences in Cytochrome-C Proteins from 20 Different Species" chart provided and underline their names.

2. Compare the human amino acid sequence with each of these five animals by counting the number of times an amino acid in that animal's cytochrome c is different from the amino acid in that same position of the human sequence. For example, the number of differences between human and dog=10.

   Write that information below:

   Number of amino acid differences between human and

   • Rhesus monkey=1

   • Kangaroo=10

   • Snapping turtle=15

   • Bullfrog=18

   • Tuna=21

3. The cladogram diagram below shows the relationship of selected animals based on their shared anatomical features. For example, out of seven key traits, all of these animals have a dorsal nerve cord, but only humans, monkeys and kangaroos have mammary glands. A complete list of anatomical traits compared is below:

   • Dorsal nerve cord and notochord: in all seven species

   • Paired appendages and spinal column: in all species except lamprey

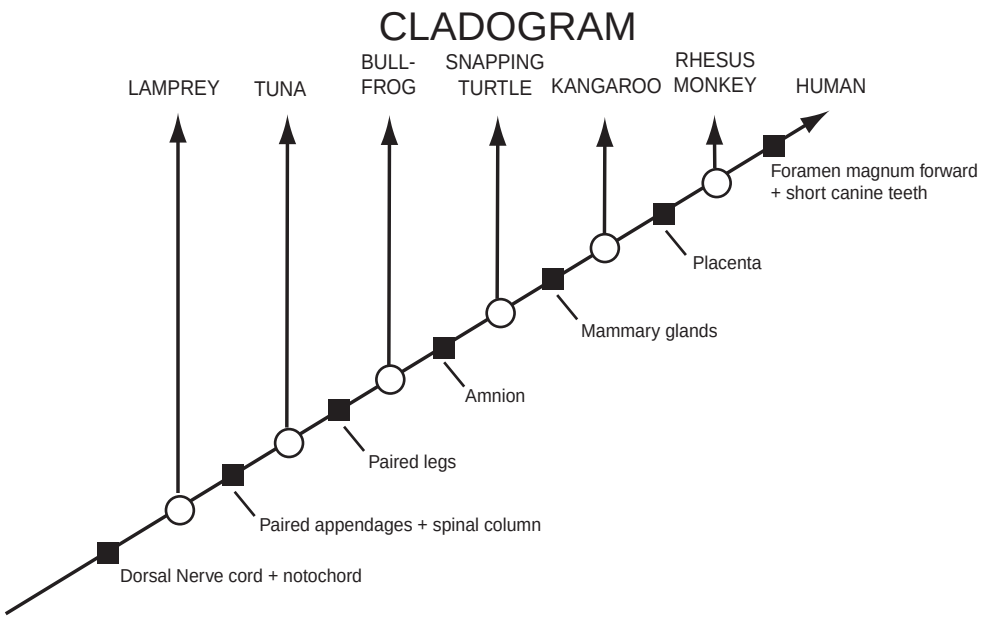
   • Paired legs: in all species except lamprey and tuna

   • Amnion: in all species except lamprey, tuna, and bullfrogs

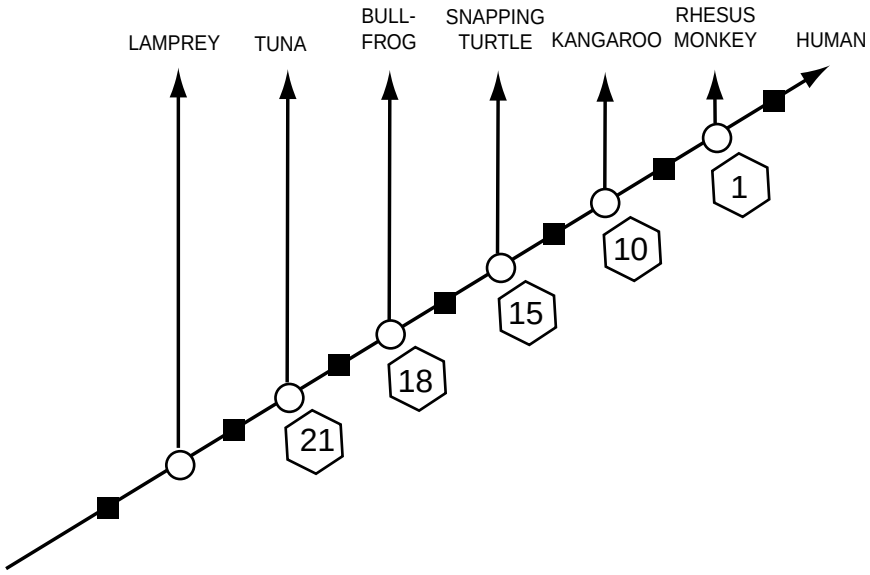
   • Mammary glands: in kangaroo, rhesus monkeys, and humans only

   • Placenta: in rhesus monkeys and humans only

   • Foramen magnum positioned forward (indicating bipedalism): in humans only



Record the total number of amino acid differences between humans and each animal shown below. Write your answer in the hexagon below the arrow pointing to the name of that animal.



4. Does the data from the amino acid sequence generally agree with the anatomical data that was used to make the cladogram?

   Yes.

5. Do organisms with fewer shared anatomical traits also have more amino acid differences?

Yes. The data shows independent confirmation. (when two or more independent types of evidence reveal the same pattern, confidence increases for the interpretation of relatedness.)

6. Based on the molecular data, make a general statement about the "human-monkey" relationship as compared to the "duck-chicken" relationship (which shows three amino acid differences).

   Humans and monkeys are more closely related than ducks and chickens.

7. If the molecular data, the structural similarities, and the fossil record all support the same pattern of relationships, can we be fairly confident that the pattern is accurate? Why?

   Yes. The data shows independent confirmation. (When two or more independent types of evidence reveal the same pattern, confidence increases for the interpretation of relatedness.)

8. Chickens and turkeys are both birds and have the same sequence of amino acids in their cytochrome-c protein. Explain how two species can have identical cytochrome-c and still be different species.

   Chickens and turkeys might have evolved from a common ancestor fairly recently and so have the same amino acid sequences for cytochrome-c. (They might have different sequences for other proteins.) However, because they cannot interbreed and produce fertile offspring, they are considered to be different species.

9. Neurospora (bread mold) and Saccharomycetes (bakers yeast) are both fungi. Chickens and turkeys are both birds. What can you say about the inferred evolutionary relationships between the two birds compared to the relationship between the two fungi? Explain your reasoning.

   Using the number of amino acid differences, it would appear that the two birds are more closely related (had a common ancestor very recently), while the two fungi would have to trace their common ancestry much farther back in time (much more distantly related).

10. Write a short paragraph summarizing the important information can be obtained from clado grams (not the information that was used to make them).

    Cladograms reveal probable relationships and degrees of relationships between groups of organisms, along with the relative times when different lines branched off from a common ancestor (when speciation occurred).