

MOLECULAR EVIDENCE FOR EVOLUTION



Background: Evolution is the process of a species changing over time. As you have learned, fossils are used as tools to prove that evolution has occurred on Earth. But, there is a more advanced tool that can be used thanks to the help of DNA technology. Scientists can look at differences among DNA sequences to see how closely related a species is. For example, the protein Cytochrome-c is commonly looked at in mammal mitochondria. The fewer differences in the molecular evidence, the closer the species is related.

Procedure: Use the DNA evidence provided below to infer evolutionary relationships amongst different species.

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 in the data section:

Data:

Number of amino acid differences between human and

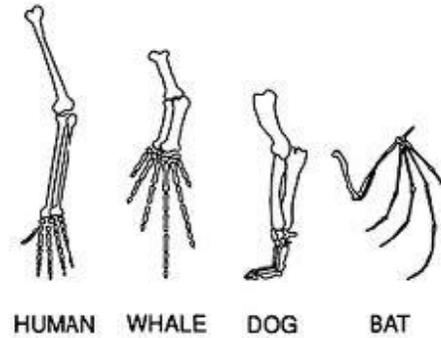
- Rhesus monkey=
- Kangaroo=
- Snapping turtle=
- Bullfrog=
- Tuna=

Analysis: Answer using complete sentences and do not use "it."

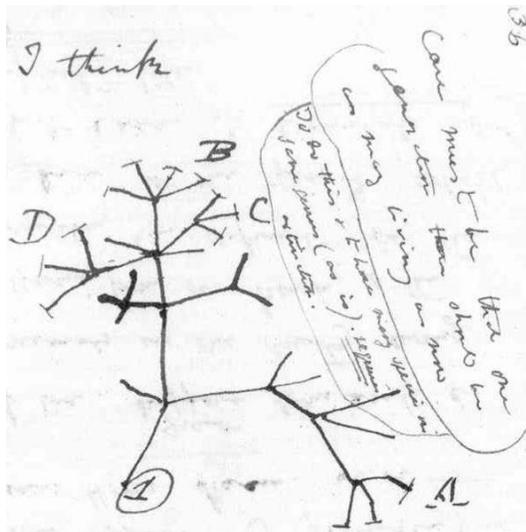
- 1) How many cytochrome-c differences exist between a dog and a monkey? Man and Tuna?
- 2) Scientists often say that humans and monkeys shared a common ancestor many years ago. How does this cytochrome-c data support this statement? Explain.

3) Compare the differences between the Human-Tuna and the Human-Kangaroo. What species is the human most closely related to, evolutionary speaking? Explain your findings.

4) What are some of the structures that a frog and turtle share (both have)?

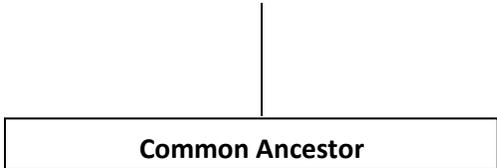


Traits that species share from common ancestors are called **homologous structures. An example is the whale fin and a human hand.



5) Create a "Tree of Life" that shows the evolutionary relationships between all the species listed above: turtle, human, tuna, bullfrog, monkey, kangaroo. The animals must be placed in the order that shows who is closely related. And, they must all branch out from a common ancestor.

Darwin's Tree of Life, 1837



6) 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.

7) Based on the molecular data, how does the "human-monkey" relationship compare to the "duck-chicken" relationship (which shows three amino acid differences)?

8) 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 or why not?

Connection to First Semester's Material:

1) What is the purpose of the mitochondria in a eukaryote?

2) What monomers make up proteins? How many exist?

3) Cytochrome-c is a mitochondrial protein. Salivary amylase is a digestive system protein. Although they are both proteins, how are they different?

4) Draw a piece of DNA in the space below. Identify the 3 components of DNA.