

Name _____

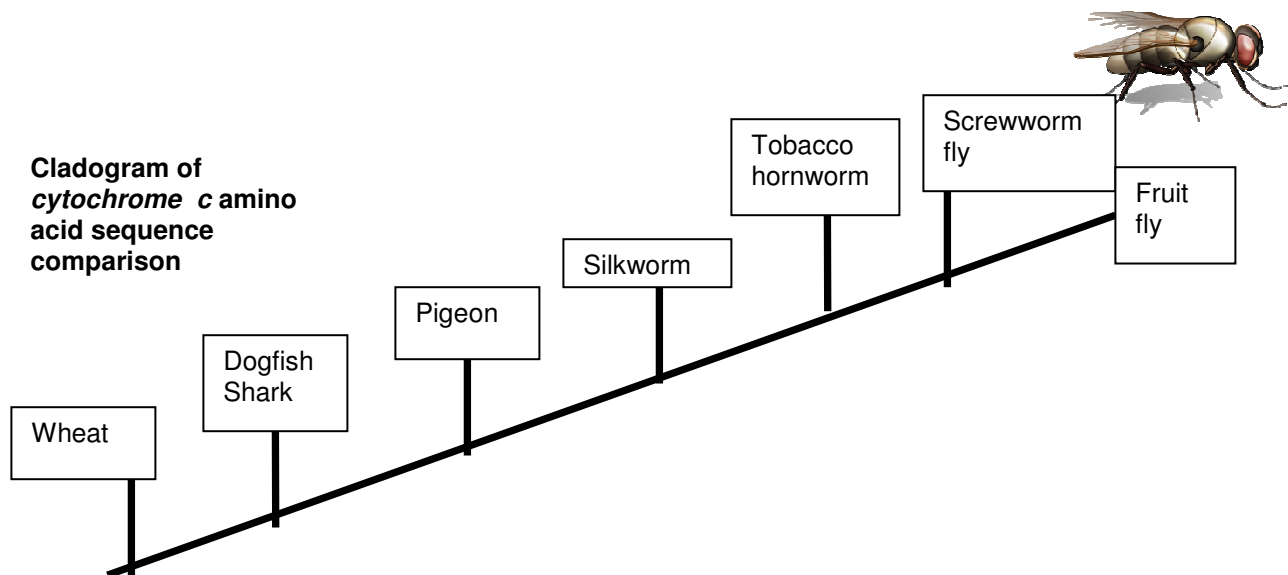
Practicing with Cladograms**Part A. Using Amino Acid Sequences to Show Evolutionary Relationships: Introduction**

With advances in molecular biology, scientists are able to take a closer look at similarities among organisms and to look for evolutionary relationships at the molecular level. The amino acid sequence of a protein can be examined in much the same way as the derived traits shown in the previous sections, and a cladogram can be constructed based on the number of differences in the sequences.

Examine the data table below, which shows the number of differences in the amino acid sequence of a protein called **cytochrome c** between fruit flies and other organisms, and the cladogram made from it (on the next page).

Species	# of amino acid differences from fruit fly
Dogfish shark	26
Pigeon	25
Screwworm fly	2
Silkworm	15
Tobacco hornworm	14
Wheat	47

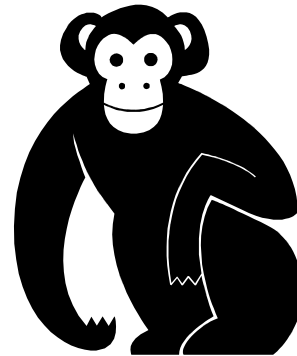
1. As you move from left to right in this cladogram, what happens to the number of difference amino acid sequences?
2. Which species is most closely related to the fruit fly?



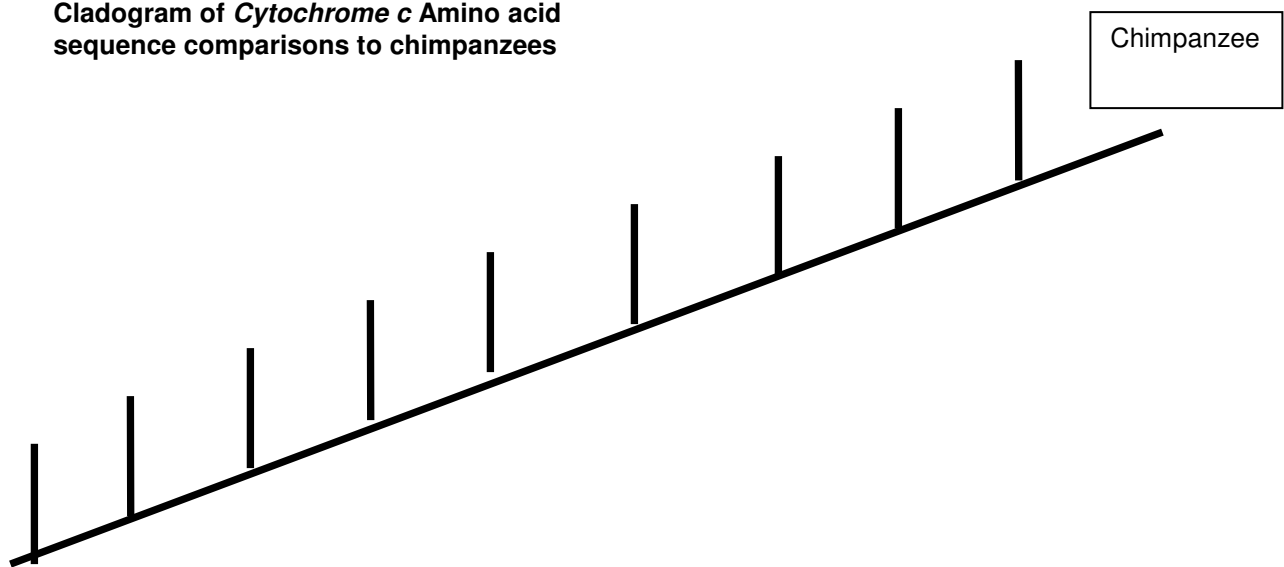
Part B. Practice Amino Acid Cladogram

Now you will practice constructing a cladogram based on the amino acid differences in cytochrome c between chimpanzees and other animals. Use the data table to construct your cladogram. Your cladogram should look similar to the one above when you are finished.

Species	# of amino acid differences from fruit fly
Fruit Fly	29
Horse	12
Rattlesnake	14
Red Bread Mold	48
Rhesus monkey	1
Screwworm fly	27
Snapping Turtle	15
Tuna	21
Wheat	43



Cladogram of *Cytochrome c* Amino acid sequence comparisons to chimpanzees



Part C. On your own!

Now you are ready to construct a cladogram from amino acids. Follow the procedure below.

1. Examine the amino acid relationship for part of the hemoglobin in the table below. You will be comparing the other animals to human beings and determining cladistic relationships between them. Circle any differences in the amino acid sequence between the animals and humans.

Species	AMINO ACID SEQUENCE																													
Human	T	L	S	G	L	H	C	A	L	L	H	V	A	P	G	A	P	A	L	L	G	A	V	L	V	C	V	L	A	H
	H	E	E	L	E	I	Y	S	Y	E	I	A	S	R	L	S	H	R	E	E	L	S	A	L	E	A	L	E	A	I
Gorilla	T	L	S	G	L	H	C	A	L	L	H	V	A	P	G	A	P	L	L	G	A	V	L	V	C	V	L	A	H	
	H	E	E	L	E	I	Y	S	Y	E	I	A	S	R	L	S	H	Y	E	L	L	L	A	L	E	A	L	E	A	I
Horse	A	L	S	G	L	H	C	A	L	L	H	V	A	P	G	A	P	A	L	L	G	A	V	L	A	L	V	V	A	H
	L	E	E	L	E	I	Y	S	Y	E	I	A	S	R	L	S	H	R	E	E	L	S	A	L	E	A	L	A	I	S
Kangaroo	L	L	S	G	L	H	C	A	L	L	H	V	A	P	G	A	P	L	L	G	A	I	I	V	I	C	L	A	G	
	Y	E	E	L	E	I	Y	S	Y	E	I	A	S	R	L	S	H	Y	E	E	L	S	L	L	A	L	E	A	L	
Rhesus Monkey	G	L	S	G	L	H	C	A	L	L	H	V	A	P	G	A	P	L	L	G	A	V	L	V	C	V	L	A	H	
	L	E	E	L	E	I	Y	S	Y	E	I	A	S	R	L	S	H	Y	E	E	L	S	A	L	E	A	L	E	A	I

2. Add up the total differences for each species and complete the table below.

3. Construct a cladogram in the box below

Species	# of amino acid differences from human
Gorilla	
Horse	
Kangaroo	
Rhesus monkey	

4. Based on the hemoglobin data above, which animal is most closely related to humans? Explain your answer.
5. Based on the hemoglobin data above, which animal is least closely related to humans? Explain your answer.
6. Similarities in amino acid sequence between organisms, means that there will also be similarities in DNA sequence. Why?