Molecular Biology

Cytochrome c is a protein found in mitochondria. It is used in the study of evolutionary relationships because most animals have this protein. Cytochrome c is made of 104 amino acids joined together.
Below is a list of the amino acids in part of a cytochrome protein molecule for 9 different animals. Any sequences exactly the same for all animals have been skipped.

For each non-human animal, take a highlighter and mark any amino acids that are different than the human sequence. When you finish, record how many differences you found in the table on the next page.

	42	43	44	46	47	49	50	53	54	55	56	57
Human	Q	A	P	Y	S	T	A	K	N	K	G	I
Chicken	Q	A	E	F	S	T	D	K	N	K	G	I
Horse	Q	A	P	F	S	T	D	K	N	K	G	I
Tuna	Q	A	E	F	S	T	D	K	S	K	G	I
Frog	Q	A	A	F	S	T	D	K	N	K	G	I
Shark	Q	A	Q	F	S	T	D	K	S	K	G	I
Turtle	Q	A	E	F	S	T	E	K	N	K	G	I
Monkey	Q	A	P	Y	S	T	A	K	N	K	G	I
Rabbit	Q	A	V	F	S	T	D	K	N	K	G	I

	58	60	61	62	63	64	65	66	100	101	102	103	104
Human	I	G	E	D	T	L	M	E	K	A	T	N	E
Chicken	T	G	E	D	T	L	M	E	D	A	T	S	K
Horse	T	K	E	E	T	L	M	E	K	A	T	N	E
Tuna	V	N	N	E	T	L	R	E	K	A	T	S	-
Frog	T	G	E	E	T	L	M	E	S	A	C	S	K
Shark	T	Q	Q	E	T	L	R	I	K	T	A	A	S
Turtle	T	G	E	E	T	L	M	E	D	A	T	S	K
Monkey	T	G	E	D	T	L	M	E	K	A	T	N	E
Rabbit	T	G	E	D	T	L	M	E	K	A	T	N	E

Animal	Number of Amino Acid Differences Compared to Human Cytochrome C	Animal	Number of Amino Acid Differences Compared to Human Cytochrome C
Horse		Shark	
Chicken		Turtle	
Tuna		Monkey	
Frog		Rabbit	

LIVEWORKSHEETS

Molecular Biology – Summary Questions

1. Based on the Cytochrome C data, which organism is most closely related to humans?

2. Do any of the organisms have the same number of differences from human Cytochrome C? In situations like this, how would you decide which is more closely related to humans?

Conclusion

1. Charles Darwin published his book *On the Origin of Species* in 1859. Of the different types of evidence that you have examined, which do you think he relied upon the most, and why?

2. Given the amount of research and evidence available on evolution, why is it classified as a theory?