

**Work # \_\_\_\_\_ : Amino Acid Sequences and Evolutionary Relationships**

Name: \_\_\_\_\_  
 Hour: \_\_\_\_\_ Date: \_\_\_\_\_

Introduction

By comparing the amino acid sequences of the same types of proteins in two different organisms, evolutionary relationships can be determined. Organisms who have similar amino acid sequences for the same protein have a closer evolutionary relationship than organisms that have a high number of differences between their sequences.

Part I: Comparing Amino Acid Sequences of Hemoglobin (Protein That Carries Oxygen In Red Blood Cells)

1. In the table below, highlight the abbreviated name of each amino acid in the chimpanzee hemoglobin that is different from that in human hemoglobin. If there are no differences, do not highlight anything. (Note: Hemoglobin contains 146 amino acids. Only amino acids 87-116 are shown.)

2. Repeat step 1 for the other organisms in the table. **NOTE: ALWAYS BE SURE THAT YOU COMPARE THE AMINO ACID SEQUENCE OF EACH ORGANISM WITH THAT OF THE HUMAN AND NOT THE ORGANISM ON THE LINE ABOVE!**

	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116
Human	THR-LEU-SER-GLU-LEU-HIS-CYS-ASP-LYS-LEU-HIS-VAL-ASP-PRO-GLU-ASN-PHE-ARG-LEU-LEU-GLY-ASN-VAL-LEU-VAL-CYS-VAL-LEU-ALA-HIS																													
Chimpanzee	THR-LEU-SER-GLU-LEU-HIS-CYS-ASP-LYS-LEU-HIS-VAL-ASP-PRO-GLU-ASN-PHE-ARG-LEU-LEU-GLY-ASN-VAL-LEU-VAL-CYS-VAL-LEU-ALA-HIS																													
Gorilla	THR-LEU-SER-GLU-LEU-HIS-CYS-ASP-LYS-LEU-HIS-VAL-ASP-PRO-GLU-ASN-PHE-LYS-LEU-LEU-GLY-ASN-VAL-LEU-VAL-CYS-VAL-LEU-ALA-HIS																													
Rhesus Monkey	GLN-LEU-SER-GLU-LEU-HIS-CYS-ASP-LYS-LEU-HIS-VAL-ASP-PRO-GLU-ASN-PHE-LYS-LEU-LEU-GLY-ASN-VAL-LEU-VAL-CYS-VAL-LEU-ALA-HIS																													
Horse	ALA-LEU-SER-GLU-LEU-HIS-CYS-ASP-LYS-LEU-HIS-VAL-ASP-PRO-GLU-ASN-PHE-ARG-LEU-LEU-GLY-ASN-VAL-LEU-ALA-LEU-VAL-VAL-ALA-ARG																													
Kangaroo	LYS-LEU-SER-GLU-LEU-HIS-CYS-ASP-LYS-LEU-HIS-VAL-ASP-PRO-GLU-ASN-PHE-LYS-LEU-LEU-GLY-ASN-ILE-ILE-VAL-ILE-CYS-LEU-ALA-GLU																													

3. Using the information that you highlighted in the table on the front side of this sheet, fill in the missing information below. The first two are done for you as examples.

ORGANISMS COMPARED	# OF AMINO ACID DIFFERENCES	POSITION(S) IN WHICH THEY VARY
Human and Chimpanzee	0	not applicable
Human and Gorilla	1	104
Human and Rhesus Monkey		
Human and Horse		
Human and Kangaroo		

Part I: Analysis and Conclusion Questions

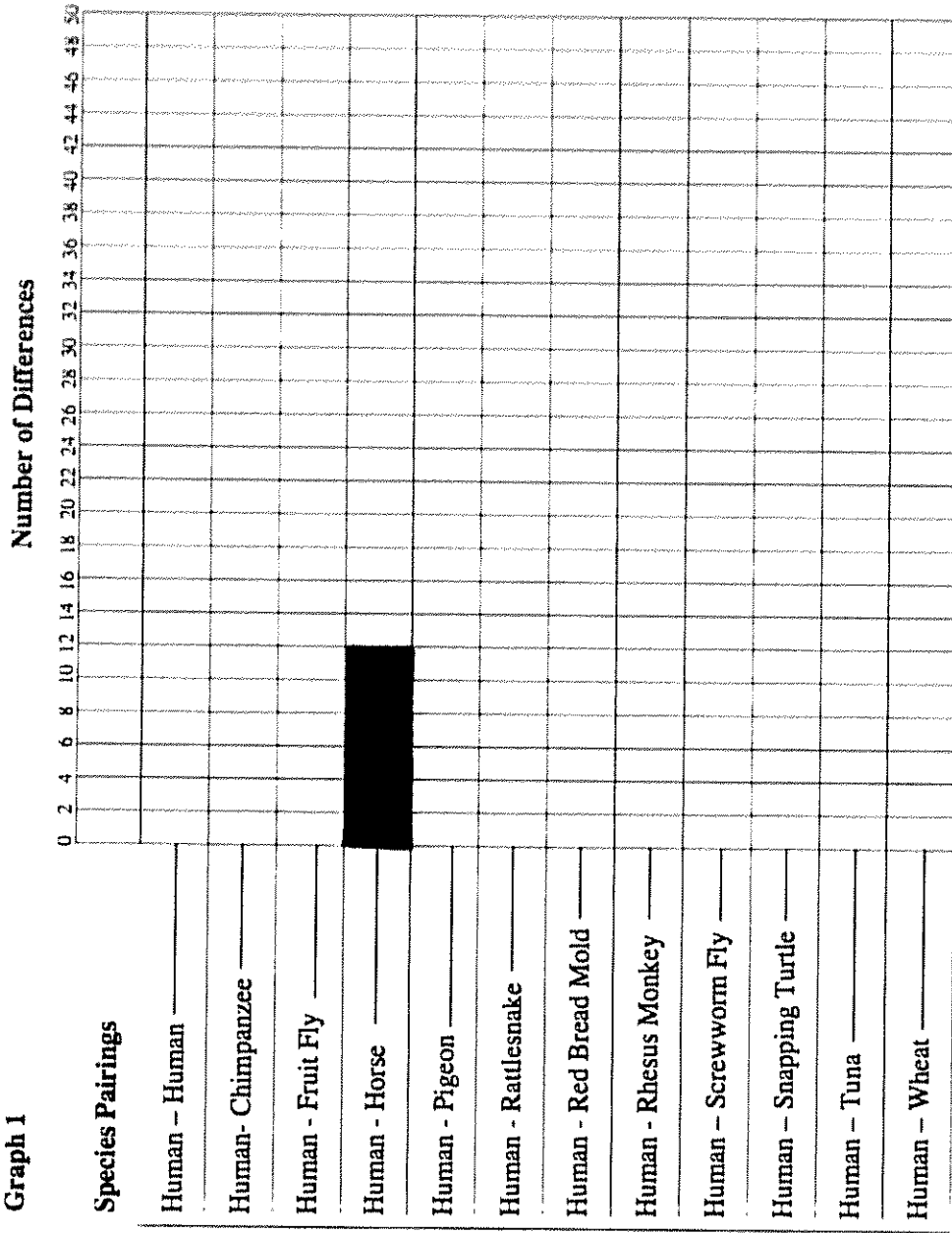
1. On the basis of the hemoglobin data, which two organisms appear to be most closely related to humans? \_\_\_\_\_
2. On the basis of the hemoglobin data, which organism appears to be least closely related to humans? \_\_\_\_\_

**Part II: Differences in Amino Acids Sequences of Cytochrome c (Protein That Functions as a Respiratory Enzyme in Mitochondria)**

The cytochrome c protein consists of 104 amino acids. Using human cytochrome c as a standard, the amino acid differences between humans and a number of other organisms are shown in Table 1 below. Use the information from Table 1 to construct a bar graph on Graph 1 to show the amino acid differences between humans and other organisms for cytochrome c. The human-horse species pairing is already graphed for you as an example.

Species Pairings	# of Differences
Human-Chimpanzee	0
Human-Fruit Fly	29
Human-Horse	12
Human-Pigeon	12
Human-Rattlesnake	14
Human-Red Bread Mold	48
Human-Rhesus Monkey	1
Human-Screwworm Fly	27
Human-Snapping Turtle	15
Human-Tuna	21
Human-Wheat	43

**Graph 1**



**Part II: Analysis and Conclusion Questions**

1. On the basis of the cytochrome c data, which two organisms appear to be most closely related to humans? \_\_\_\_\_
2. On the basis of the cytochrome c data, which two organisms appear to be least closely related to humans? \_\_\_\_\_