Name_____**Bio-**_____**Date**_____

Evidence of Evolution Analysis

Background

Much evidence has been found to indicate that living things have evolved or changed gradually during their natural history. The study of fossils as well as work in embryology, biochemistry and comparative anatomy provides evidence for evolution.

Objective

In this lab you will learn about homologous, analogous and vestigial structures and their significance in evolution theory. You will also compare amino acids sequencing of humans to other vertebrates.

Procedures and Observations

Part I. HOMOLOGOUS STRUCTURES

1. Carefully **examine** the drawings of the bones shown in Figures 1 on the next page. Look for similarities among the various animals.

a. Color each part of the human arm a different color. (All bones of the wrist should be a single color, the bone groups of the hand should be a different single color.) Then color the corresponding bone in each of the other animals the same color as the human bone.

b. Describe the function of each set of bones below:

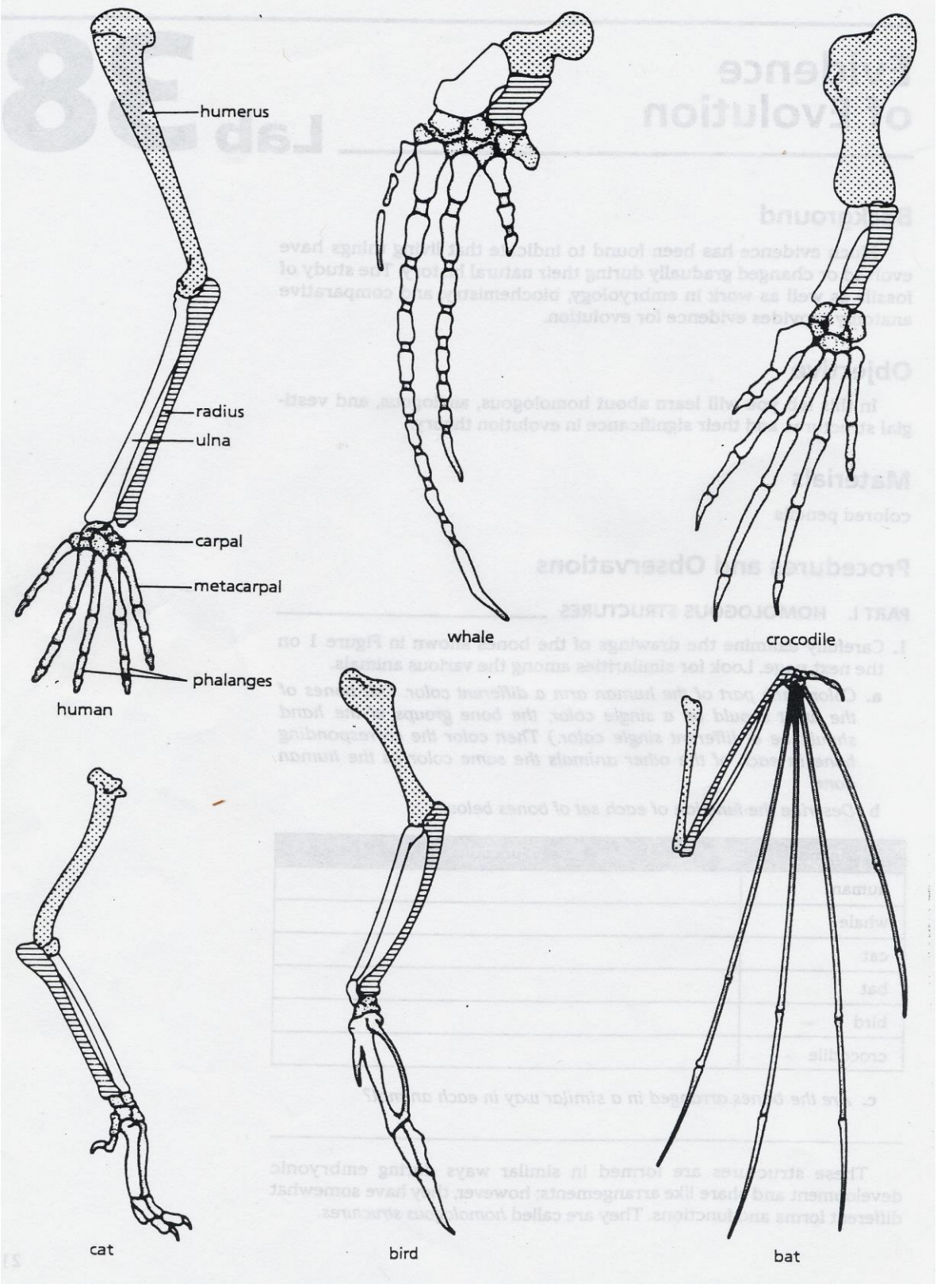
Table 1

Animal	Function
human	
whale	
cat	
bat	
bird	
crocodile	

c. Are the bones arranged in a similar way in each animal? **Yes or No**

These structures are formed in similar ways during embryonic development and share like arrangements; however, they have somewhat different forms and functions. They are called *homologous structures*.

d. Explain why the homologous structures are evidence of evolutionary relationships. **Justify** your answer with one example.


humerus
radius
ulna
carpal
metacarpal
phalanges
human
whale
crocodile
cat
bird
bat

Part II. VESTIGIAL STRUCTURES

Gradual changes have occurred through time that have in some cases reduced or removed the function of some body structures and organs. The penguin's wings and the leg bones of snakes are examples of this phenomenon.

1. The cave fish and minnow show in Figure 3 are related, but the cave fish is blind.

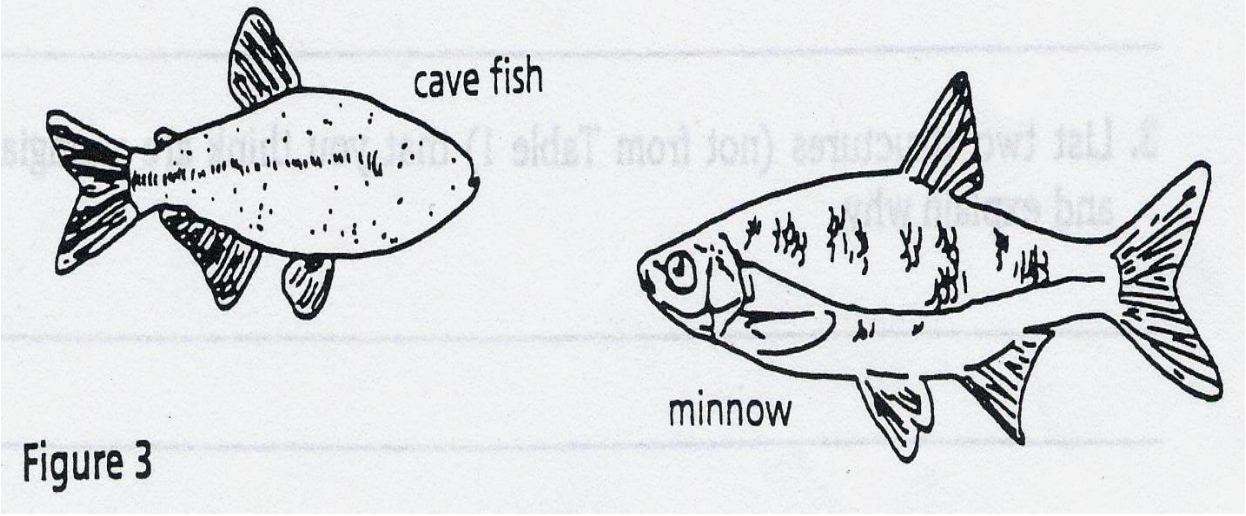


Figure 3

a. Explain why eyesight is not an important adaptation to life in a cave. (Minimum of 3 sentences)

Organs or structures that have lost their function in the organism and become reduced in size (because of efficiency) are called ***vestigial structures.*** Human vestigial organs are well documented.

2. Read the list of human vestigial structures shown in Table 2.

c. Suggest a possible function for each structure after reading why it became vestigial. Record your answers in the table.

Table 2.

Structure	Probable Function	Why Vestigial?
appendix		**Because it could have been used to harbor symbiotic bacteria for digestion of cellulose, which is no longer necessary with the modern diet of humans**
coccyx (tail bone)		**Not needed for walking upright**
muscles that move ears		**Rely more on other senses, especially vision**
muscles that make hair stand up		**Not needed when clothing was adapted**
little toe		**Not needed once humans adapted a ground-dwelling lifestyle instead of an arboreal one**
wisdom teeth		**Diet changed, fire used to cook & soften food**

3. Using your **imagination**, what parts of the human body do you think might become vestigial in the next million years? **Support** your answer with at least one example.

Part III. ANALOGOUS STRUCTURES

1. Examine the butterfly wing and the bird wing shown in Figure 2.

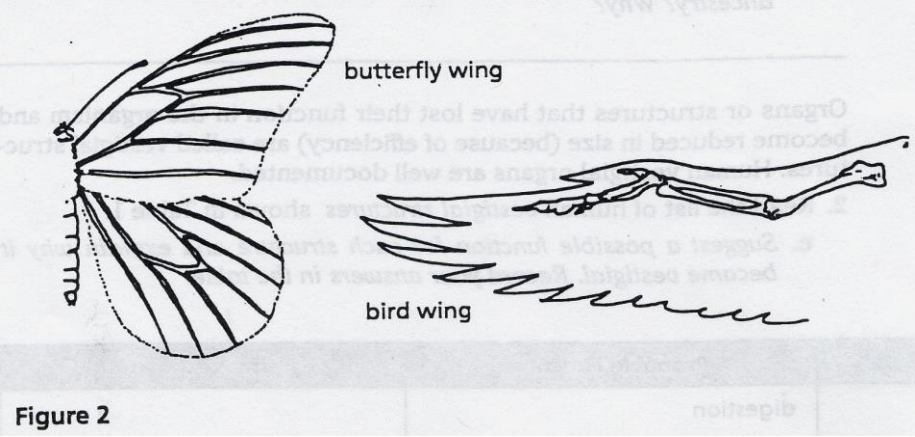


Figure 2

a. What function do these wing structures share?

b. How do the wing structures differ?

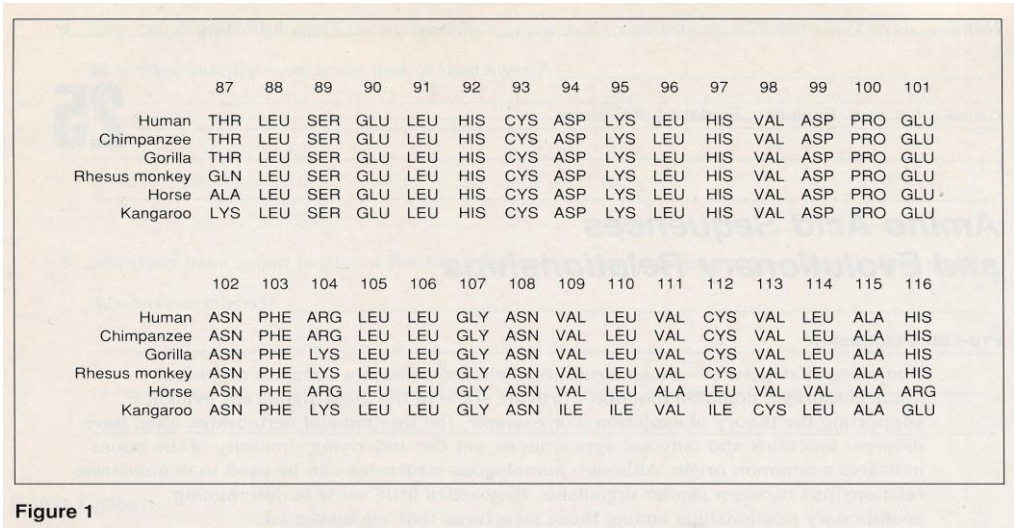
Some apparently unrelated animals have organs with similar functions, yet are very different in structure and form. These structures are called *analogous structures.*

c. Explain why analogous structures occur in nature.

Part IV. COMPARING AMINO ACID SEQUENCES

Biologists believe that the greater the similarity between the amino acid sequences of two organisms, the closer their relationship. Conversely, the greater the differences, the more distant the relationship.

1. Examine Figure 1, which compares corresponding portions of hemoglobin molecules in humans and five other vertebrate animals. Hemoglobin, a protein composed of several long chains of amino acids, is the oxygen-carrying molecule in red blood cells. The sequence shown is only a portion of a chain made up of 146 amino acids. The numbers in Figure 1 indicate the position of a particular amino acid in the chain.



	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101
Human	THR	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU
Chimpanzee	THR	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU
Gorilla	THR	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU
Rhesus monkey	GLN	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU
Horse	ALA	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU
Kangaroo	LYS	LEU	SER	GLU	LEU	HIS	CYS	ASP	LYS	LEU	HIS	VAL	ASP	PRO	GLU

	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116
Human	ASN	PHE	ARG	LEU	LEU	GLY	ASN	VAL	LEU	VAL	CYS	VAL	LEU	ALA	HIS
Chimpanzee	ASN	PHE	ARG	LEU	LEU	GLY	ASN	VAL	LEU	VAL	CYS	VAL	LEU	ALA	HIS
Gorilla	ASN	PHE	LYS	LEU	LEU	GLY	ASN	VAL	LEU	VAL	CYS	VAL	LEU	ALA	HIS
Rhesus monkey	ASN	PHE	LYS	LEU	LEU	GLY	ASN	VAL	LEU	VAL	CYS	VAL	LEU	ALA	HIS
Horse	ASN	PHE	ARG	LEU	LEU	GLY	ASN	VAL	LEU	ALA	LEU	VAL	VAL	ALA	ARG
Kangaroo	ASN	PHE	LYS	LEU	LEU	GLY	ASN	ILE	ILE	VAL	ILE	CYS	LEU	ALA	GLU

Figure 1

Data Table

Use Figure 1, to fill in the follow table analyzing sequences 87-116

Organisms	Number of Amino Acid Differences	Positions in Which They Vary
Human and Chimpanzee		
Human and Gorilla		
Human and Rhesus Monkey		
Human and Horse		
Human and kangaroo		

2. Which animal in this comparison has the least amount of amino acids in common? What does that mean?