Biology **Dry Lab: EVIDENCE OF EVOLUTION**

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

OBJECTIVE: In this lab activity you will learn about homologous, analogous, vestigial structures, fossils, embryology and biochemistry and their significance in evolution theory.

MATERIALS: Map Pencils

PROCEDURES:

I. COMPARATIVE ANATOMY

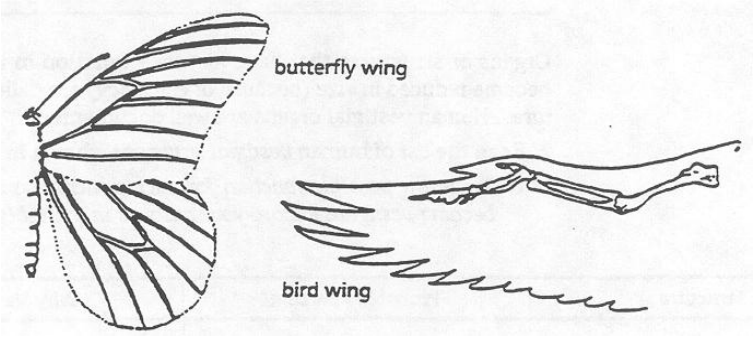
HOMOLOGOUS STRUCTURES

1. Carefully examine the drawings of the bones. 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 the same 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. In Table 1 (question #2 on the *Answer Sheet* describe the **function** of each set of bones and answer the question.)

ANALOGOUS STRUCTURES

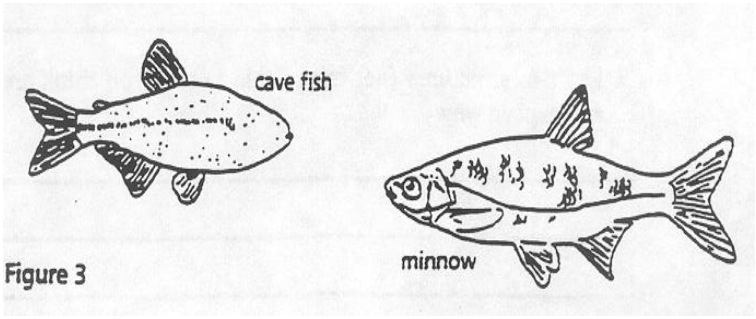
2. Examine the butterfly wing and the bird wing. Answer questions 4 - 6 on the answer sheet.



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.

3. The cave fish and minnow are related, but the cave fish is blind. Answer questions 7-8 on the answer sheet.

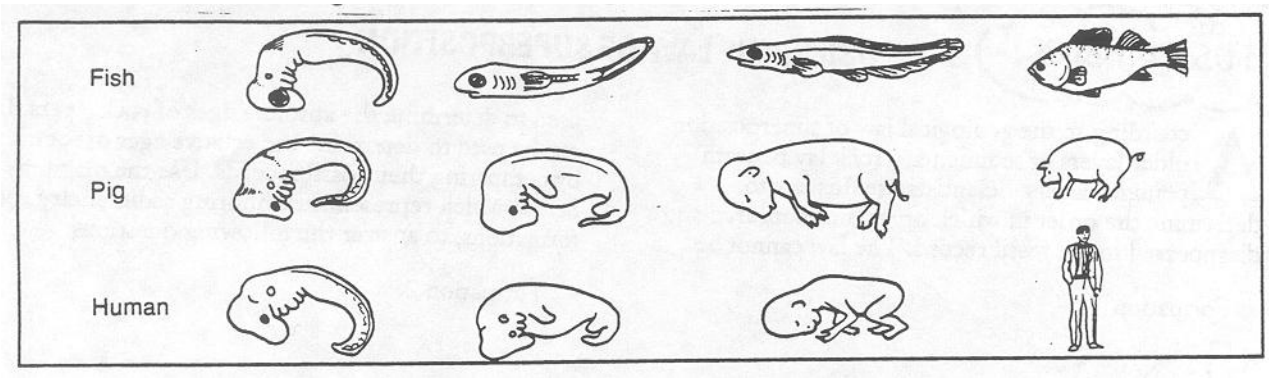


4. Read the list of *human vestigial* structures in Table 2 (question #9). Suggest a ***possible function*** for each structure and explain ***why*** it became vestigial. Then complete questions 10 -12

EVIDENCE FROM EMBRYOLOGY

Evolution occurs slowly. In most cases, it is not possible to observe evolution in progress. However, evidence of evolution can be found by observing the early stages of development in vertebrates. All vertebrate embryos start out similar in appearance. This similarity has led scientists to think that these organisms have a common ancestor. The diagrams below illustrate stages in the embryonic development of a fish, a pig, and a human.

5. Study the diagrams below and answer the questions 13 & 14 on the answer sheet.



EVIDENCE FROM MOLECULAR BIOLOGY

Amino acid sequences of certain proteins can be used to determine how closely related different species are. If the amino acid sequences for a certain protein are very similar in two species, one can assume that those two species had a common ancestor. All 104 amino acids in the protein cytochrome c are identical in humans and chimpanzees.

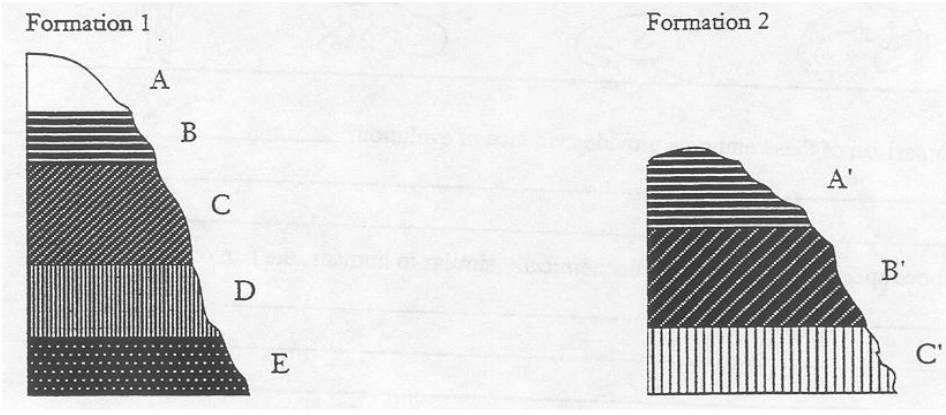
6. Observe the chart in which it shows how many of the amino acids in ***cytochrome c*** in other animals differ from those in humans and chimps. Answer question #15 on the answer sheet.

Animal	Number of Amino Acid Differences in Cytochrome C as COMPARED TO Humans
Dog	8
Dogfish shark	24
Rattlesnake	12
Rhesus monkey	1

FOSSIL RECORD

According to the ***geological law of superposition***, older layers of *sedimentary rock* lay beneath younger layers. Scientists use this law to determine the order in which organisms appeared and disappeared in the fossil record. The law *cannot* be used to determine the absolute ages of rock layers. It *can* be used to determine the relative ages of rock layers by comparing their fossil records.

7. Using the diagrams that represent neighboring sedimentary rock formations, answer questions 16 -19 .

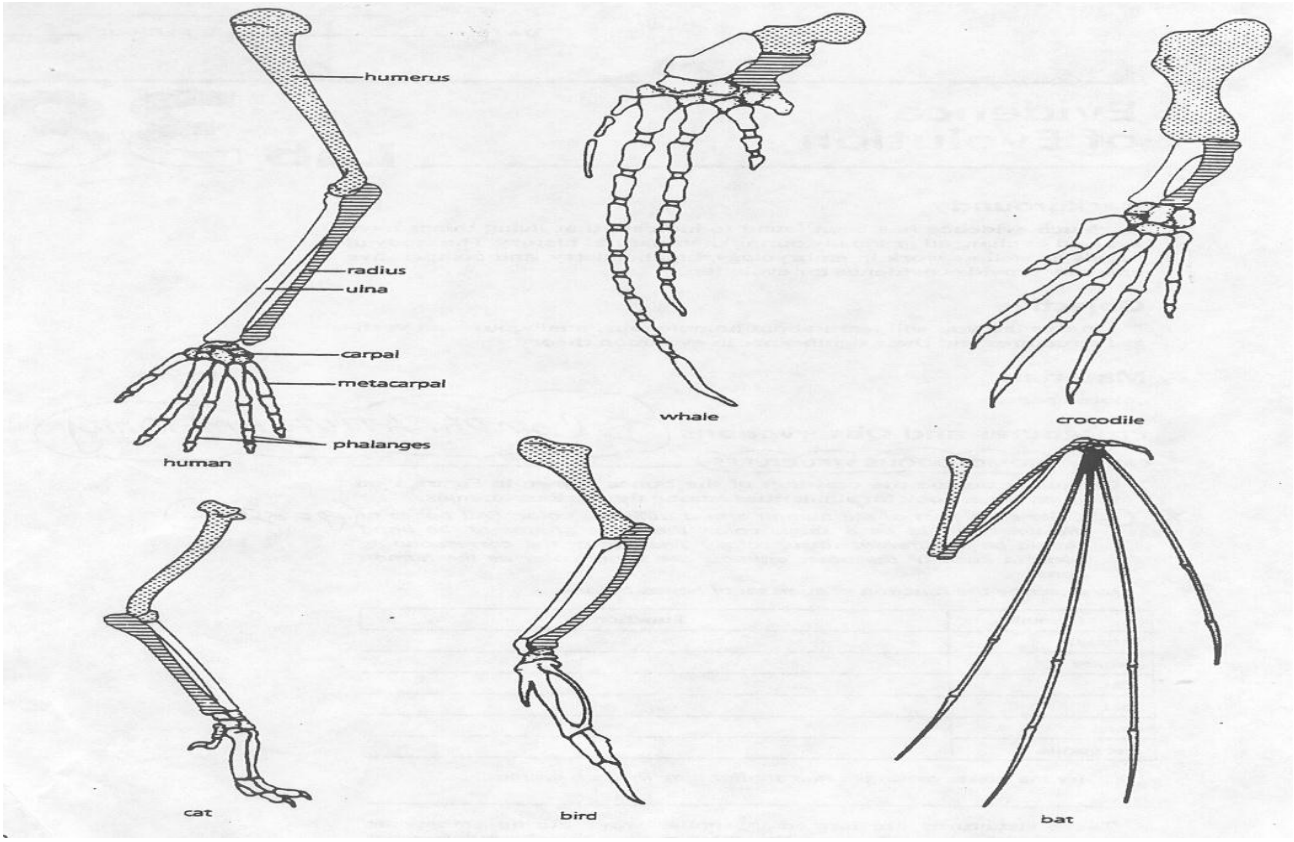


BIOLOGY  **Lab: Evidence for Evolution** Name_____
Date_____Per._____

OBJECTIVE: In this lab activity you will learn about homologous, analogous, vestigial structures; fossils, embryology and biochemistry and their significance in evolution theory.

OBSERVATIONS:

1. COLOR CODE the bones according to instructions.



2. Describe the *function of* each set of bones below:

ANIMAL	FUNCTION
Human	
Whale	
Cat	
Bat	
Bird	
crocodile	

3. Are the bones arranged in a similar way in each animal? _____

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.***

BUTTERFLY WING AND BIRD WING.

4. What function do these structures share? _____

5. How do the structures differ?_____

6. Do birds and insects share any *structural similarities* that would suggest they are closely related?_____

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

VESTIGIAL STRUCTURES (cave fish /minnow)

7. Explain why eyesight is not an important adaptation to life in a cave._____

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8. Does the appearance of the cave fish and minnow suggest common ancestry? _____

Why? _____

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

9. Read the list of human vestigial structures shown below. Suggest a possible function for each structure and explain why it became vestigial.

STRUCTURE	PROBABLE FUNCTION	WHY VESTIGIAL?
Appendix	Possible raw meat digestion	FIRE…. Started cooking meat
Coccyx (tail bones)		
Muscles that move ears		
Muscles that make hair stand up		
Little toe		
Wisdom Teeth		

ANALYSIS AND INTERPRETATIONS

10. Explain why the homologous structures of the bones are evidence of evolutionary relationships.

11. Explain the evolutionary relationship between the fin of a fish and the flipper of a whale.

12. How do you think *vestigial structures* came about?

EVIDENCE FROM EMBRYOLOGY

13. How does a comparison of the embryos provide evidence of evolution?

14. Which of the organisms would be most ***biochemically similar*** to humans: fish or pig? _____

EVIDENCE FROM MOLECULAR BIOLOGY

15. Explain how the chart supports evolutionary theory.

FOSSIL RECORD

16. a. Which layer is the oldest in each formation? _____

    b. Are the two layers the same age? _____

    c. How could you tell?

17. Suppose fossils from layer **C'** of Formation 2 are the same as fossils from layer **D** in Formation 1. What could you say about the age of fossils from Layer **E**?

18. Suppose you also found that layers **C** and **B'** shared similar fossils. Layers **B** and **A'** look very similar, but contain no fossils. What could you say about the relative ages of all layers of both formations?

19. Suggest one or more geological events that might explain why Formation 2 has fewer layers than Formation 1.

COMPLETE THE CHART by *checking* the *kind of evidence* described.

Kind of Evidence

Evidence					
	Homologous Structures	**Analogous Structures**	**Vestigial Structures**	**Embryological Development**	**Genetic Comparisons**
20. A *modified structure* seen among different groups of descendants					
21.In the earliest *stages of development*, a tail and gill slits can be seen in fish, birds, rabbits, and mammals.					
22. Examples of *forelimbs* of bats, penguins, lizards, and monkeys					
The forelimbs of *flightless birds*					
23.*DNA and RNA* comparisons may lead to evolutionary trees					
24.*Bird and butterfly wings* have *same function* but different structures.					
25.A body structure *reduced* in function but may have been used in an ancestor					

CONCLUSION: (What did you learn about homologous, analogous, vestigial, biochemical, and fossils and their significance in evolution theory. Cite example/ Remember; do NOT us I in your conclusion… refer to *Laboratory write up* for a guide)