Name Key

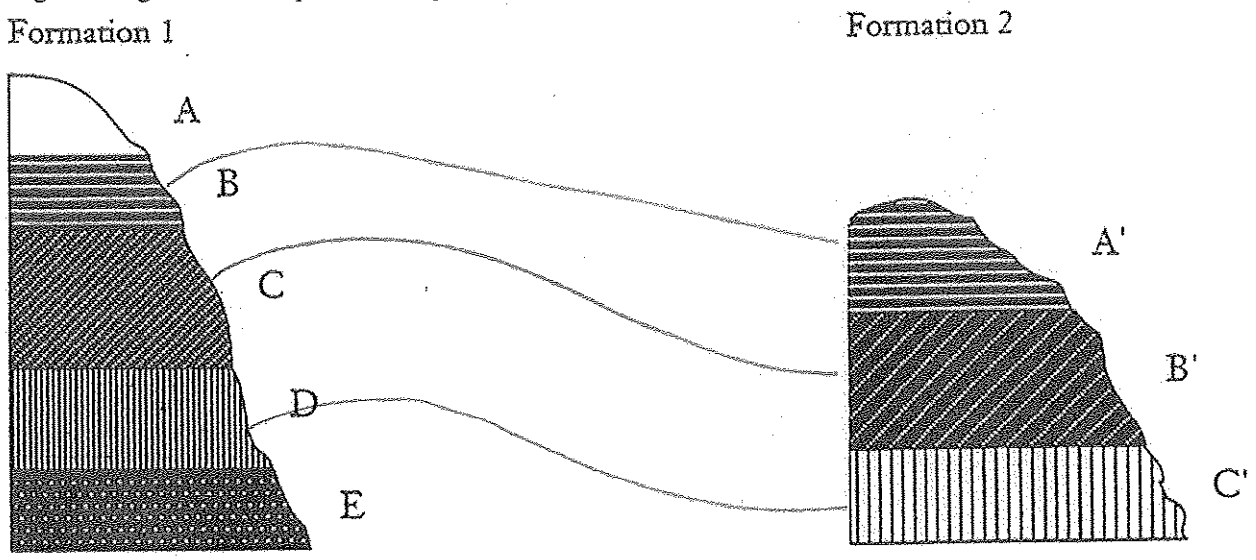
Evidence For Evolution Part 1

A fossil is preserved evidence of an organism that provides evidence of past life.

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.

Using the diagrams that represent neighboring sedimentary rock formations, answer the following questions.



FOSSIL RECORD

1. a. Which layer is the oldest in each formation? E and C'

b. Are the two layers you chose in "a" the same age? No

c. How can you tell? The rock patterns are different

2. 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**? The fossils come from the same era; they are about the same age.

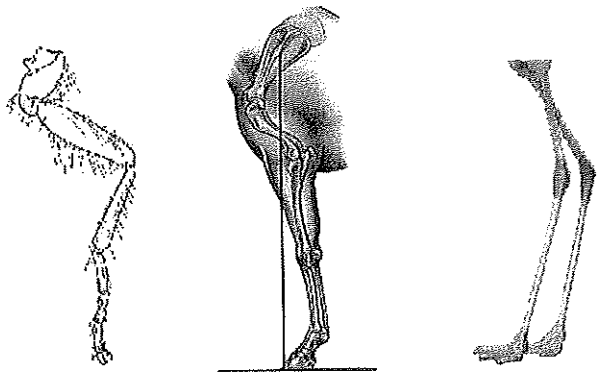
3. Suppose you also found that layers **C** and **B'** shared similar fossils. Layers **B** and **A'** look very similar, but contain no fossils. What could you say about the relative ages of all layers of both formations?

A is the youngest layer
E is the oldest layer
all other layers are the same age.

Comparative Anatomy

Term	Definition	Image
HOMOLOGOUS STRUCTURES	anatomically similar structure inherited from a common ancestor	see guided notes or pg 424 in textbook
ANALOGOUS STRUCTURES	structure that has the same function but different construction and wasn't inherited from a common ancestor	See pg 426 in book or guided notes
VESTIGIAL STRUCTURES	reduced form of a functional structure that indicates shared ancestry.	See pg 425 in book or guided notes

***Directions**: Look at the images below, then identify which type of structures they represent.*

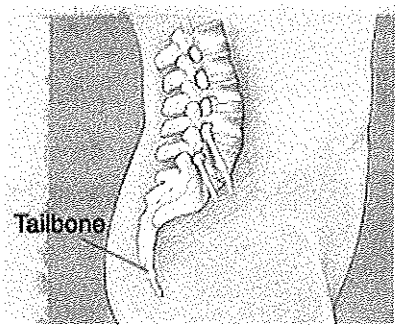


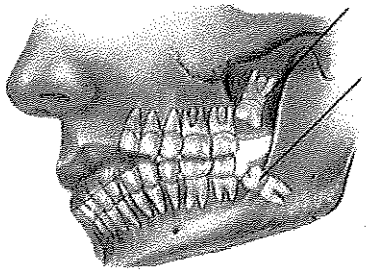
Insect Leg Horse leg Flamingo leg

1. The image above shows analogous structures.

I know this because

The structures have the same function but different construction so the animals don't share a common ancestor

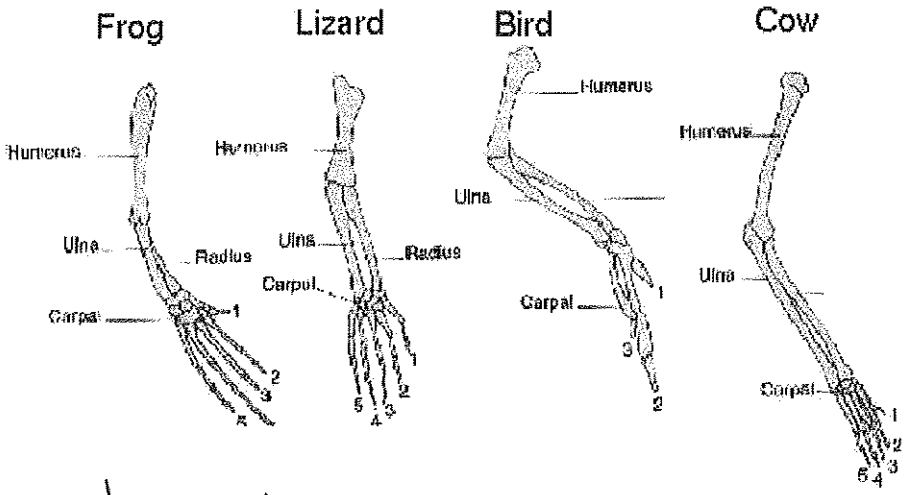




Wisdom Teeth

2. The image above shows Vestigial structures.

I know this because
The structures are a reduced form of structures that once served a purpose for the species.

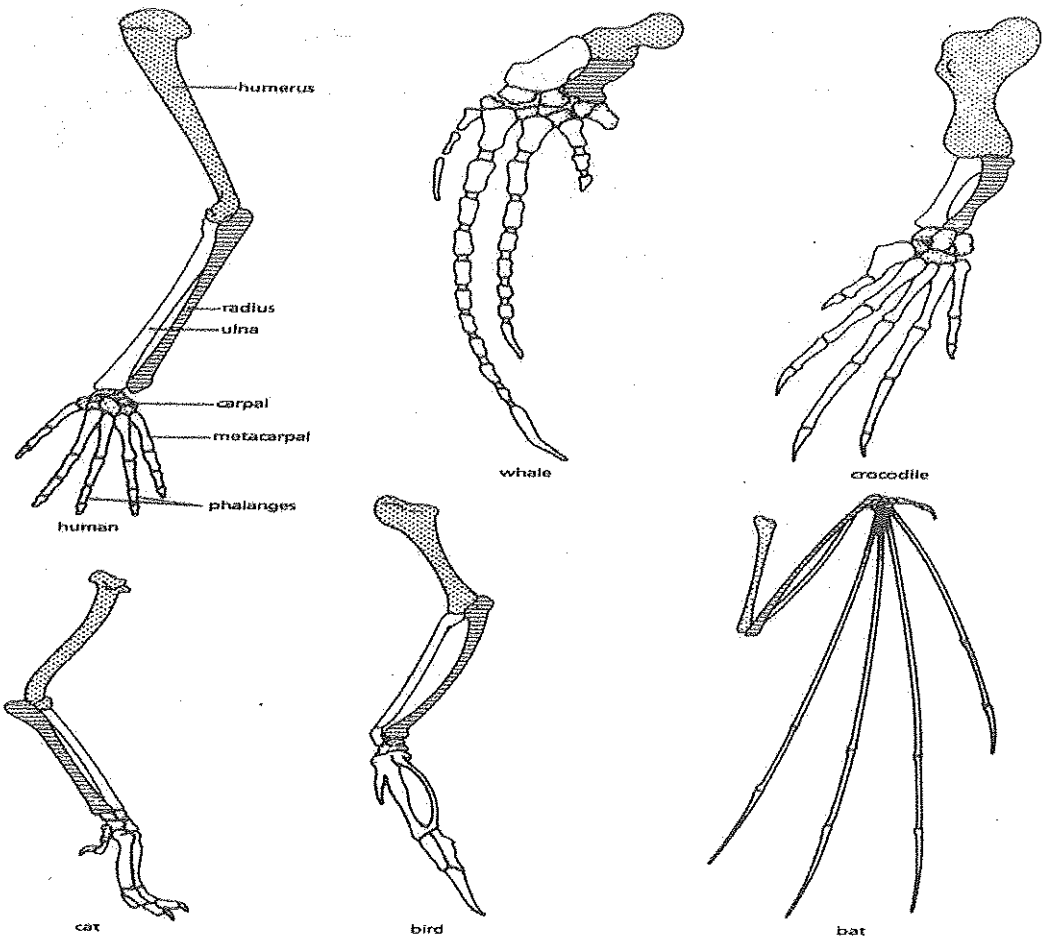


3. The image above shows homologous structures.

I know this because
The structures are anatomically similar so were and all made of muscle tissue and bone derived from a common ancestor

Homologous

1) Carefully examine the drawings of the bones shown in Figure 1 Look for similarities among the various animals.



Describe the function of each set of bones below ***(based on the arrangement of bones, for what purpose is the shown appendage best suited?)***

ANIMAL	FUNCTION
HUMAN	used to aid in mobility of the organism (walking) aids in
WHALE	(swimming)
CAT	(walking)
BAT	(flying)
BIRD	(flying)
CROCODILE	(walking)

Are the bones arranged in a similar way in each animal? yes

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***.

Analogous

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

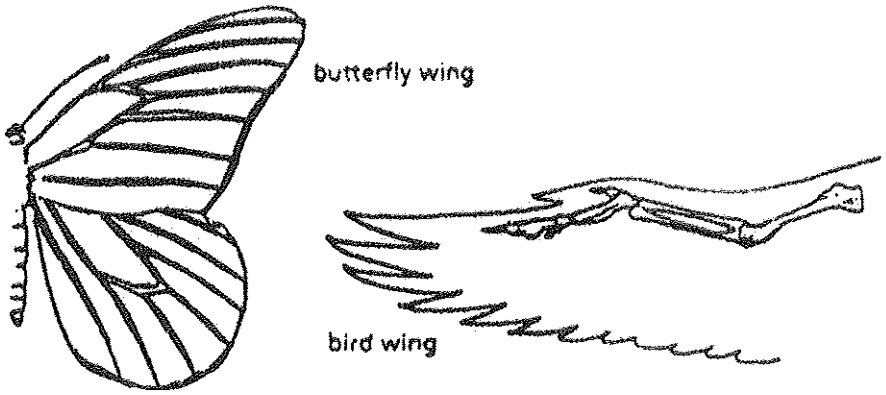


Figure 2.

A) What **FUNCTION** do these structures share? used for flying

B) How are these structures different? Butterfly wing is made of chitin. Bird wing is made of muscle and bone.

C) Do birds and insects share any <u>structural</u> (inside the wing) similarities that would suggest they are closely related taxonomically? Explain.

No

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

VESTIGIAL STRUCTURES

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

1) The cavefish and minnow shown in Figure 3 are related, but the cavefish is blind.

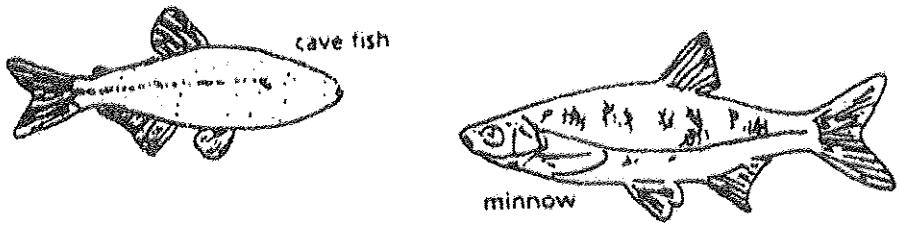


Figure 3.

A) Explain why eyesight is NOT an important adaptation to life in a cave.
Caves are very dark so eyes would not be useful.

B) What about the body plan or structure of the cavefish and minnow suggest common ancestry?
The shape of the body and the location of the fins are very similar.

ANALYSIS AND INTERPRETATIONS

1) Explain why the homologous structures in Part I are evidence of evolutionary relationships.

Because the structures are used for a similar purpose and are made of same material; anatomically similar, too.

2) Explain how fossils provide evidence for evolution.

They are a record of past organisms, they allow scientists to observe and record how species have changed over time.

3) List two structures (not from class) that you think are vestigial and explain why.

1. _____

_____

2. answers will vary

_____

4) Re-define the three different types of evidence for evolution that you have studied in this lab **in your own words**.

1. HOMOLOGOUS STRUCTURES - anatomically similar structures inherited from a common ancestor

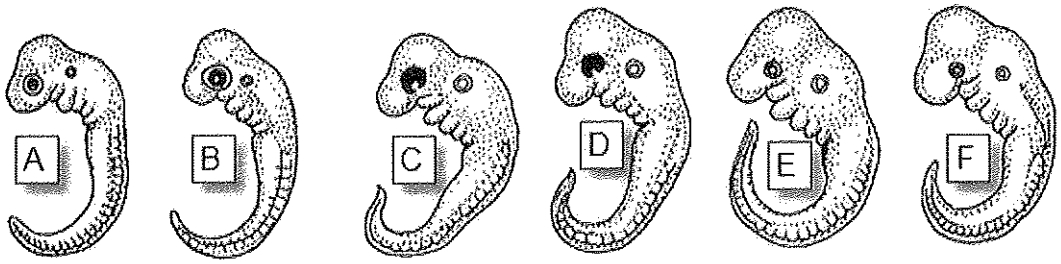
2. ANALOGOUS STRUCTURES - structure that has the same function but different construction and with inherited from a common ancestor.

3. VESTIGIAL ORGANS - reduced form of a functional structure that indicates shared ancestry

Evidence of Evolution part 2

Embryology

Organisms that are closely related may also have physical similarities before they are even born! 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 Take a look at the six different embryos below:



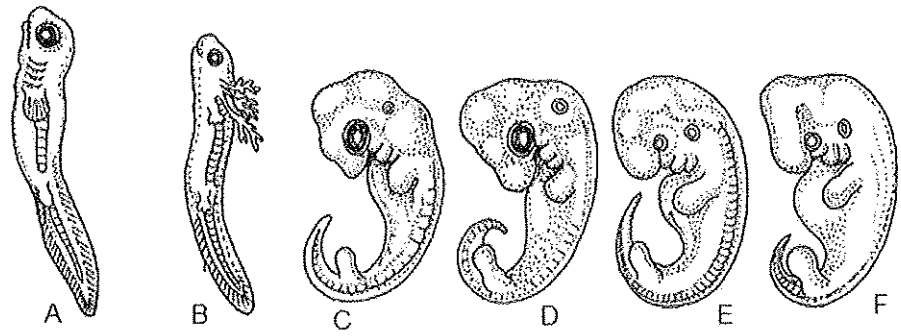
Source: http://www.starlarvae.org

Hypothesize which embryo is from each of the following organisms: ITS OKAY TO BE WRONG!!

Species	Embryo
Human	C
Chicken	A
Rabbit	E
Tortoise	F
Salamander	B
Fish	D

These are NOT correct. The point is that embryos look very similar in the early stages of development.

These are older, more developed embryos from the same organisms.



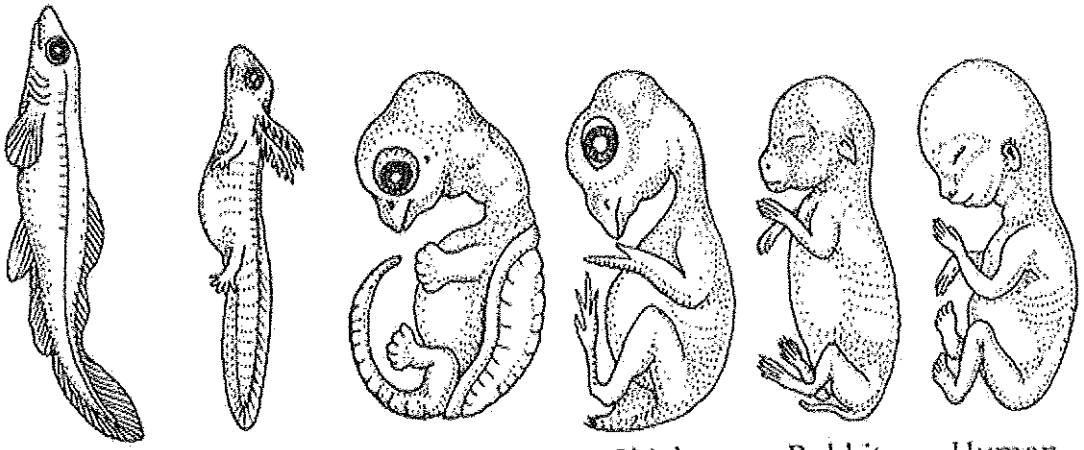
Hypothesize which embryo is from each of the following organisms: ITS OKAY TO BE WRONG!

Species	Embryo
Human	E
Chicken	C
Rabbit	F
Tortoise	D
Salamander	A
Fish	B

Again, these all may not be correct because they look so similar

Name: _____ Class: _____ Date: _____

These are embryos at their most advanced stage, shortly before birth.



Fish Salamander Tortoise Chick Rabbit Human

Describe how the embryos changed for each of these organisms from their earliest to latest stages.

Species	Anatomical Changes From Early to Late Stages
Human	Arms, legs, no tail
Chicken	Beak, wings
Rabbit	Legs
Tortoise	Shell
Salamander	Long body with fins AND Legs
Fish	Gills and fins

1. Look again at the six embryos in their **earliest stages.** Describe the patterns you see. What physical similarities exist between each of the embryos?

Similarities

head
eyes, mouth
extremities used for mobility

2. Does this suggest an evolutionary relationship? Explain how these embryos be used as evidence of a common ancestor between each of these six organisms?

yes. Evolutionary relationships are suggested because in the early stages of development, the embryos look very similar. They begin to differentiate over time and have some of the same features like eyes, tails, extremities.

Name: _____ Class: _____ Date: _____

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 CIRCLE any amino acids that are different than the <u>human</u> 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	T	T	D	K	N	K	G	I
Tuna	Q	A	E	Y	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
Horse	T	K	E	E	T	L	M	E	K	A	T	N	E
Chicken	T	G	E	D	T	L	M	E	D	A	T	S	K
Tuna	V	N	N	D	T	L	M	E	S	A	T	S	-
Frog	T	G	E	D	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	6-7	Shark	14
Chicken	6-7	Turtle	8
Tuna	9	Monkey	1
Frog	8	Rabbit	4

Name: _____ Class: _____ Date: _____

Molecular Biology – Summary Questions

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

Monkey

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?(think what other evidence can you look at?) Yes, you would have to look at comparative anatomy.

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?

Comparative anatomy because he didn't know anything about genes and DNA in 1859. DNA wasn't discovered to be the genetic material until 1950's.

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

Because we have not been able to observe many of the adaptations all of the species on Earth currently have.