

## FROM LAND TO WATER: WHALE EVOLUTION INTERNET ACTIVITY

Go to the following web-site: <http://www.indiana.edu/~ensiweb/lessons/whalekiosk.html>

Click on **Go to site**. Click on **Enter**. Click on **Click Screen**, above find out more. Click on **Start**. Click on **Next**. Click on Cetaceans.

### A. WHALE ANATOMY

1. What does the Latin word “cetus” mean?
2. How would you pronounce the word “cetaceans”?
3. What three groups of organisms are considered cetaceans?
4. What are the two subgroups of cetaceans?
5. What characterizes the subgroup Odontoceti?
6. What characterizes the subgroup Mysticeti?

### Follow the instructions given to compare anatomical parts.

Click on the labels to compare the whale’s anatomy with that of a fish and a cat. Fill out the chart below with **your answers** to each structure, by placing an “X” under the organism whose structure is more similar to the whale’s.

Structure	FISH	CAT
Ears		
Eyes		
Lungs		
Forelimb		
Jaw		
Mammary gland		

7. According to the anatomical evidence, which organism is more closely related to a whale?
8. Draw and label the cladogram that you created for the whale, fish and cat below.
9. What is the relationship between whales and cats?

## **B. FOSSIL RECORD**

1. What is a fossil?
2. What are the most likely parts to become fossilized?
3. What are trace fossils? List some examples.
4. What is a coprolite?
5. What fossilized anatomical structure can be useful to anatomists?
6. Compare the fossil teeth of whales to the other organisms on the website. What sort of organism has fossil teeth most similar to whale teeth?
7. What is a mesonychid? What is an ungulate? What is an ungal?
8. What are some modern day ungulates?
9. To what group did the other skull belong?
10. Which are more closely related to whales...seals or horses?
11. What other organisms belong in the Order Carnivora?
12. Check out the anklebones. List some examples of modern day Artiodactyls.
13. Which anklebone looks more similar to the fossil whalebone?
14. What does this mean for whale's closest relatives?
15. Before we look at molecular evidence, check out more in the fossil record. What environmental shift was responsible for the process of natural selection that led to whales?
16. How is the water different from the air? What does that really mean?
17. What doesn't light travel as straight or far in water as in air?
18. Why don't we have directional hearing under water (click on HUH?)

19. What happens each time a molecule bounces into you?
20. What four parts of the whale have changed over time?
21. Click on the whale forelimb (arm). What is the earliest whale that investigators have found? What does it look like?
22. What were the forelimbs good for in the earliest whale?
23. Compare it to a human arm. How is your arm different from this whale's arm?
24. Which early whale could walk on land and swim in the water? What does it look like? How do its forelimbs compare to the whale's arm?
25. What was the first fully aquatic whale? How does its arm compare to *Ambulocetus* and a modern whale?
26. How are modern whale's arm bones different?
27. Click on games and try "morph a limb". Click on a bone, then use the buttons to change its size or rotate it. How do you think the differences in bone shape relate to how the two animals moved in their environment?
28. Go back and try the game "be a paleontologist". How long did it take you to get the bones in their proper position?

### **C. THE MOLECULAR PICTURE**

1. When finished, click the whale in the bottom left hand corner and return to "Molecules Home". Which molecules help to show how animals are related?
2. What are chromosomes made of? What is DNA made of?
3. What are the steps of the DNA ladder made of?
4. What are the four flavors of nucleotide base pairs? What do they stand for? How do they pair together? What do they do?

5. Compare the patterns of a nucleotide sequence between a whale, a horse, a cow and a seal. Complete the chart:

	Number of differences Horse	Number of differences Cow	Number of differences Seal
Sequence #1			
Sequence #2			
Sequence #3			
Sequence #4			
Sequence #5			
Sequence # 6			
Sequence # 7			
Sequence # 8			
Total Number of Matches			

6. Draw your cladogram of the whale, horse, cow and seal below.

7. To which group does the molecular evidence suggest is most closely related to whales?

8. Click “Find out how DNA changes”. When was the common ancestor to cows and whales?

9. What is a part of the editing process of DNA?

10. What are mutations?

11. What is a point mutation? Record an example.

12. What is a neutral mutation?

13. What are the three other possible changes?

14. How can a change in meaning be helpful? What happens to that mutation in the population?

15. What if the mutation hurts the organism or its chance of having offspring?