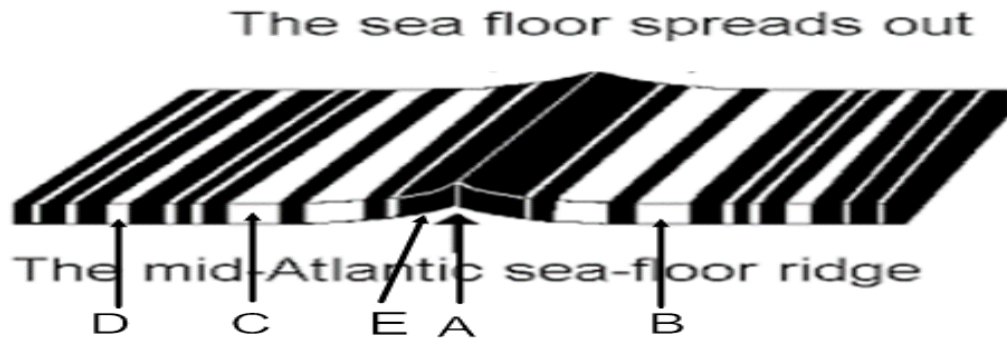


Use the figure below to answer questions 1 & 2.



1. Which letter(s) represent newly formed crust? _____ Explain the science behind your answer.
2. Which two letter represent rock strips that are the same age? _____ & _____
3. In the East African Rift System, also called the Great Rift Valley, explain the age of the rocks in the valley compared to the canyon sides.
4. Explain how alternating magnetic direction in the rocks on the sea floor are evidence for plate tectonics.

5

Using Fossil Evidence to Investigate Whale Evolution

LIVING ORGANISMS SOMETIMES leave behind physical evidence of themselves in rock, ice, tar, amber, or volcanic ash when they die. When this evidence is preserved over geologic time, it creates a **fossil**. In this activity you will use fossil evidence to investigate the evolution of whales.

Challenge

- ▶ How does fossil evidence determine the relationships of whale ancestors and their descendants?



a



b



c

Modern whales include the toothed whales, and the baleen whales. The sperm whale (a) is a toothed whale, and the humpback (b) is a baleen. This whale fossil (c), found in the northern Caucasus, Russia, dates from approximately 10 million years ago.

MATERIALS

FOR EACH PAIR OF STUDENTS

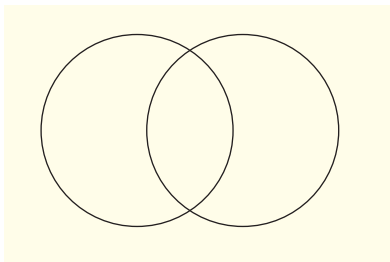
- set of 5 Fossil Skeleton cards, B, K, M, O, and T
- 2 additional Fossil Skeleton cards, A and D

FOR EACH STUDENT

- Student Sheet 5.1, “Whale Fossil Chart”
- Student Sheet 5.2, “Whale Evolutionary Tree”
- Student Sheet 3.2, “Geologic Time and Major Events,” from Activity 3

Procedure

1. Compare the first set of five skeleton cards B, K, M, O, and T. With your partner, based on similarities you observe, group the skeletons into two sets, one with two cards and one with three. Name the set of skeletons containing skeleton M Group 1, and name the other set Group 2.
2. Create a data table in your science notebook for recording the following information:
 - Which skeletons you put into Groups 1 and 2
 - Five similarities and five differences within each group
3. In your science notebook, copy the Venn diagram shown below.



4. Discuss the similarities within each group. Record them on the Venn diagram in the areas where the circles do not overlap.
5. Write down as many similarities as you can between Group 1 and Group 2. Record the similarities between the groups on the Venn diagram in the space where the two circles overlap.
6. From the similarities and differences you noticed among all of the skeletons, arrange the cards vertically in the order you think each first appeared in geologic time, assuming M was found in the deepest rock layers of the earth. Place skeletons either in a single line or in a branched pattern from a common ancestor, depending on your observations.

Hint: If there is a skeleton that doesn't seem to fit into a single-line arrangement, place it off to the side, next to the line.

7. Record your arrangement of the skeletons in your science notebook. Write a brief description of the reasoning behind your placement.
8. Obtain Student Sheet 5.1, “Whale Fossil Chart,” which has more information. With that information rearrange your skeleton cards if necessary. Record any changes in your science notebook.
9. Obtain Student Sheet 5.2, “Whale Evolutionary Tree.” Copy that tree into your science notebook below your arrangement of the skeletons. Record any similarities and differences you notice between the tree you copied and the arrangement you described in Step 7.
10. Obtain the two other cards A and D. With your partner, observe the cards and discuss where to place them on your arrangement. Record your placement of A and D on the tree you drew in your science notebook. Enter the following:
 - A claim: your conclusion about the most logical placement of A and D on the tree
 - Evidence: the evidence you gathered that supports the claim
 - Reasoning: how the evidence you gathered supports the claim
11. Go back to the geologic timeline you constructed in Activity 3, “Geologic Time.” On Student Sheet 3.2, “Geologic Time and Major Events,”
 - record whale evolution at the appropriate time it began.
 - mark the time span in which whale evolution occurred.

Analysis

1. What types of skeletal changes occurred during whale evolution?
2. What change (or transition) in habitat did whales’ ancestors make?
3. Which fossil organism in whale evolution do you think was the first to live mostly in water? Explain your claim with evidence and reasoning.
4. Explain the changes in the skeletons during the transition in habitat, according to the theory of natural selection.
5. **a.** Explain what is happening at the region of the tree where remingtonocetids are observed.
 - b.** What can you infer remingtonocetids looked like based on the other information you have on the tree?

KEY VOCABULARY

evidence	evolutionary tree
evolution	fossil