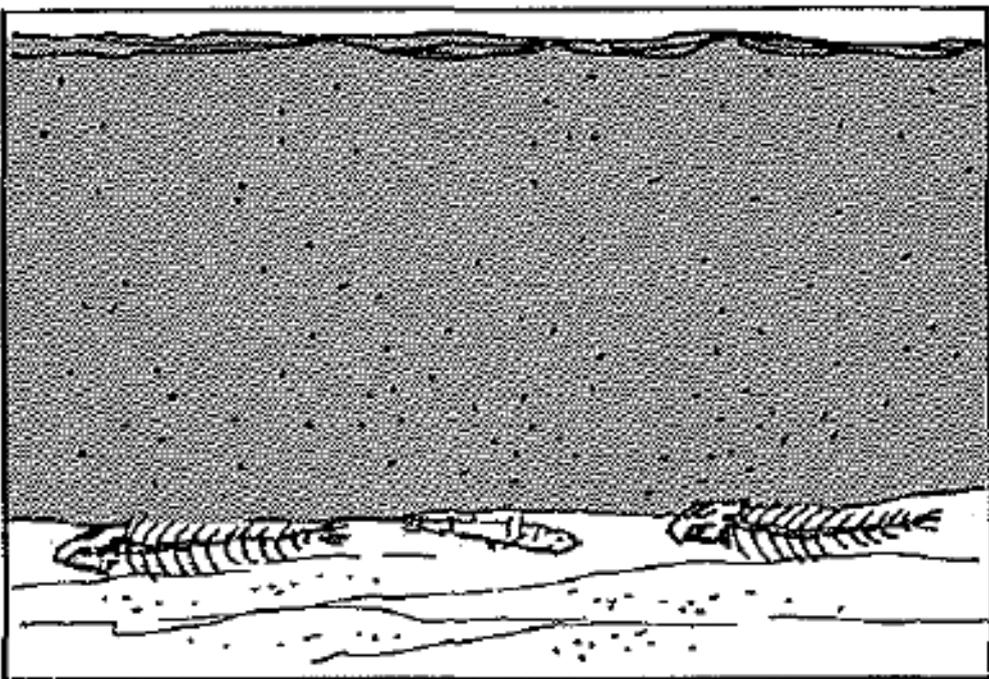
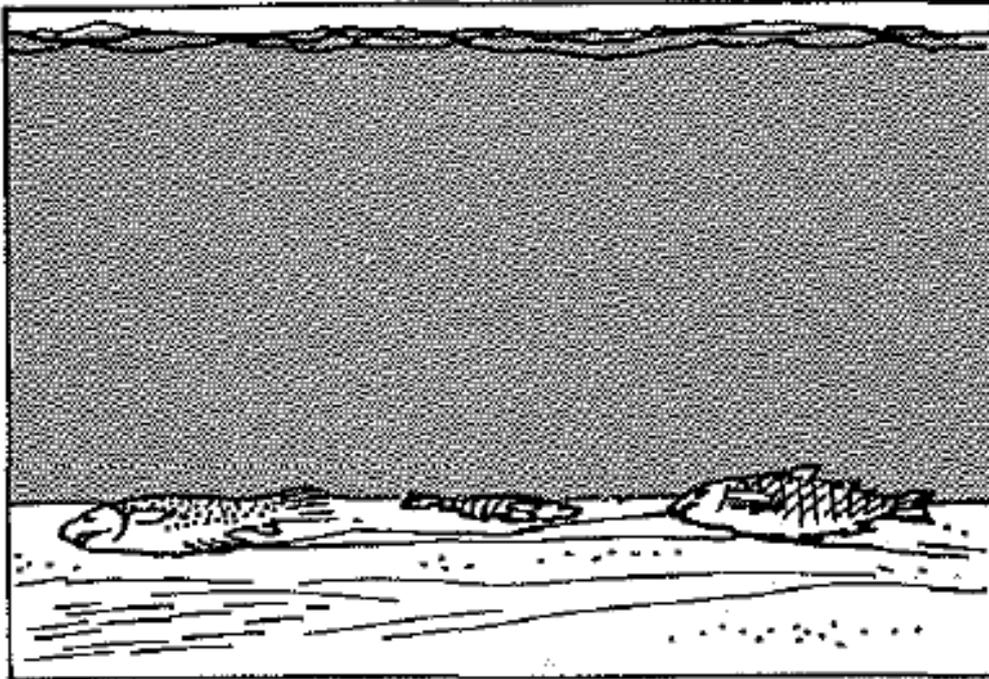


# Fossil Formation

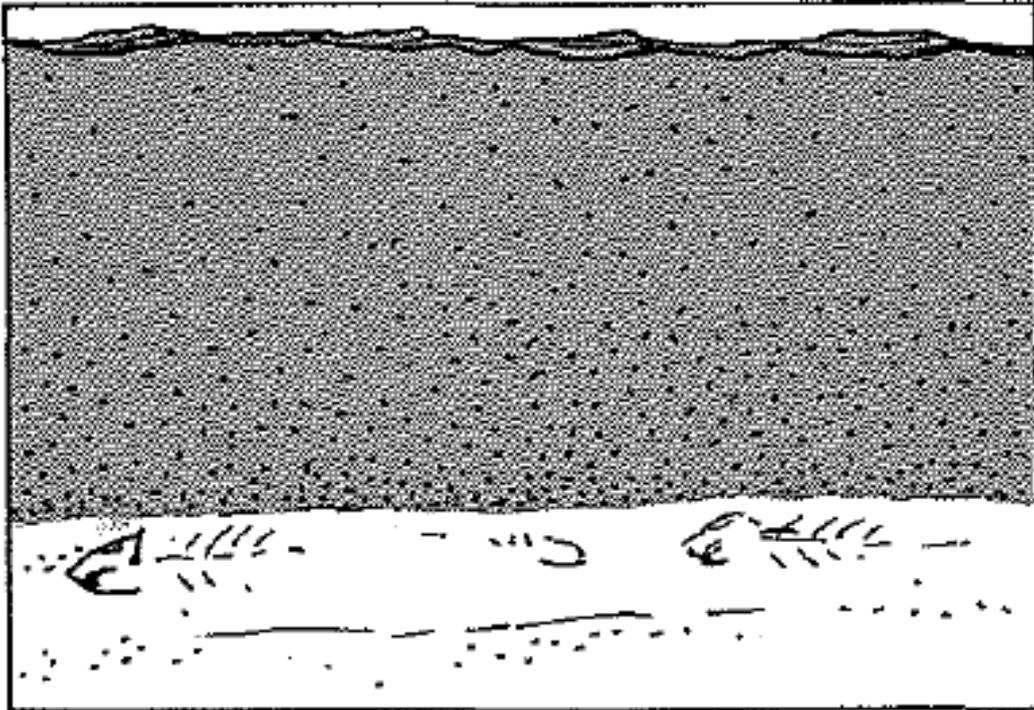
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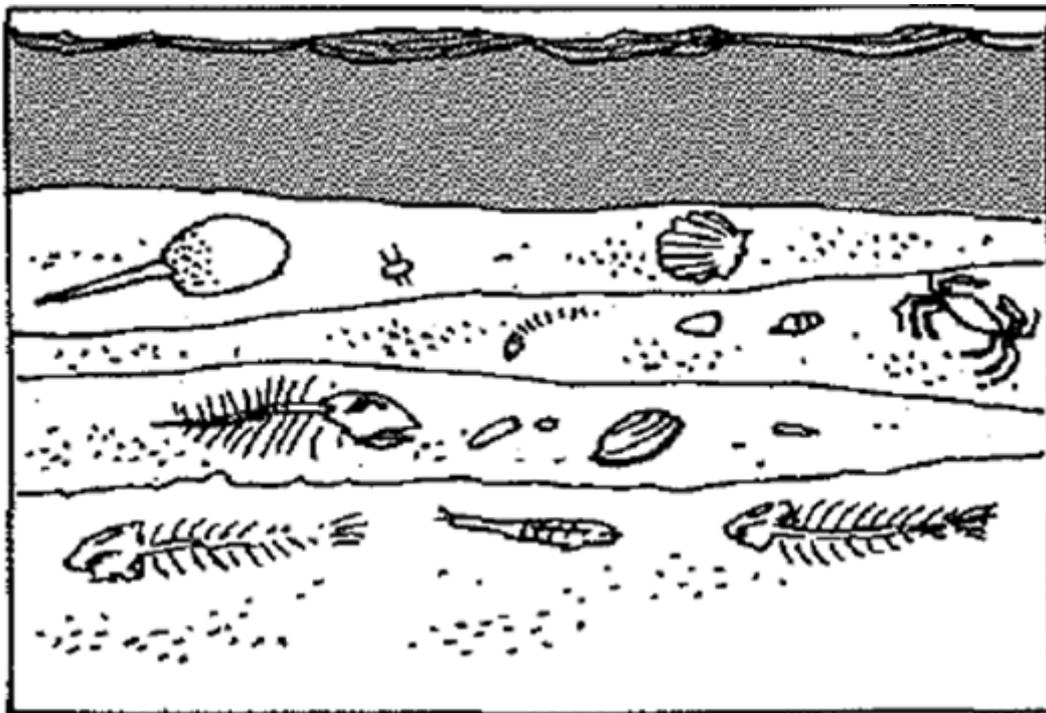
Most fossils are found in sedimentary rocks. They are fossils mainly of marine animals. Marine animals are animals that live in water. This is how marine fossils are formed.



Marine animals die and settle to the bottom.



The sediment now completely covers the remains. This helps keep the hard parts from decaying.



Sediment starts to cover the remains. Usually, the soft parts decay before the covering is finished. The previous steps happen over and over again. More sediment builds more layers. Each layer has fossils.

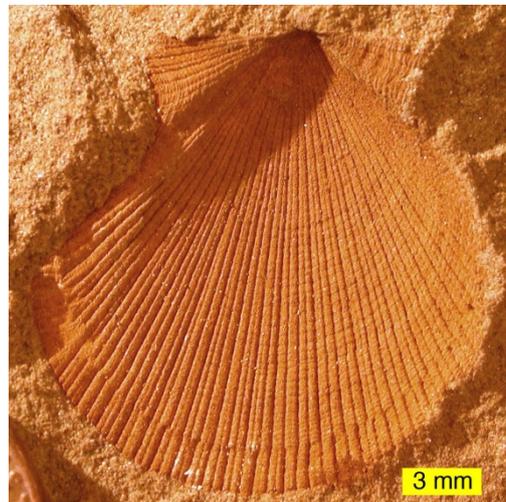
## Different kinds of fossils

There is more than one kind of fossil. Each kind gives special clues to the past. By "reading" the history of fossils we have some idea of what life was like millions-even billions-of years ago.

The most common kinds of fossils are *moulds*, casts, prints, changed hard parts, and *actual* remains.

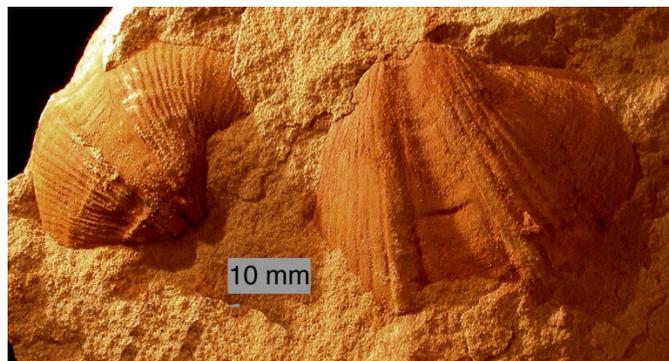
**MOULDS** Many plants and animals were buried in fine sediment. In time, the sediment hardened around them. After a while, the plant or animal rotted. But a space was left in the hardened sediment. The space is the same size and shape as the plant or animal. This space is called a *mould*.

Mould of a fossilised shell



**CASTS** Sometimes material fills a mould and then hardens. The hardened material is the same size and shape as the plant or animal that left the mould. The hardened material formed by the mould is a cast.

Cast of fossilised shells



PRINTS Animals have walked over soft mud and left footprints. Some animals have lain down in mud and left body prints. Prints are outlines that were made on soft mud that later hardened.

Footprints can tell us how an animal walked and how big it was.

Body prints tell us the shape of the body and, sometimes, how skin looked.



A Fossil footprint

A Trilobite fossil in rock



A spider fossilised in amber



Go to pages eleven and twelve and answer the questions.

## Sweet fossils

Amber jewellery is not only beautiful, but can often contain some amazing fossils. Try making these edible versions in your own kitchen.

Safety: This activity involves heating sugar and water, making a sticky mixture that can cause burns.

### You will need

- Sugar
- Water
- Yellow food colouring
- Flavouring (optional)
- Dinosaur lollies (or other jelly lollies)
- Saucepan
- Measuring cups (1/2 and 1/3 cups)
- Wooden spoon
- Paper patty pans
- Baking tray or muffin pan
- **Candy thermometer (optional)**

### What to do

1. Before cooking, set up your patty pans on a baking tray or in a muffin pan. Into each pan, place one dinosaur.
2. Mix 1/2 cup of sugar with 2/3 cup of water in a saucepan for every three fossils you wish to make. Add 3-4 drops of yellow food colouring, along with 3-4 drops of any flavouring you wish to have. Attach a 'candy thermometer' if you have one (it makes it easier to know when the mixture is cooked properly).
3. With an adult helping, bring the mixture to the boil and mix constantly.

## Safety Warning

### Adult supervision

Heat, boiling water, stoves and ovens, hot items (such as baking tins) are used during this activity. Be sure to work safely

- If possible, allow plenty of time for hot objects and materials to cool.
  - Use appropriate equipment, such as tongs or oven mitts, where it's necessary to touch a hot object.
4. If you're using a thermometer, keep cooking until it reaches 138 degrees centigrade. Otherwise, cook the mixture until it is slightly thicker than honey, with large, slow moving bubbles. Remember, it is better to slightly undercook the mixture than slightly overcook.

Carefully pour the mixture into the patty pans, covering the dinosaurs. Wait for at least an hour for it to harden (or you can put it in the fridge or freezer to speed up the process). Make sure people know not to touch and no small children can get at it as it cools.

5. Work out a way to excavate your fossil.



**Now complete the Send-in exercises for Lesson 1 in the Worksheets**

# Lesson 2

## How old is the earth?

The earth's age is estimated by dating its rocks. So far, the oldest rocks that have been found are about 4.5 billion years old. How do we know the age of these rocks?

Two kinds of dating are used—relative dating and absolute dating.

**Relative** dating does not give us an exact age. It just compares the ages of different things. In relative dating, you just say which is older and which is younger.

For example, you are older than a first-grader, but younger than your parents.

**Absolute** dating does give an age in actual number of years. For example: 3 years old, 1,000 years old, 2 million years old.

When we know the age of a rock, we know the age of the fossils in it. A fossil is the same age as the rock it is found in. And a rock is the same age as the fossil found in it. If we know one, we know the other.

Relative dating uses a simple law of science. It says that younger rocks are found on top of older rocks.



Layered rock formation



***Go to page 19 and complete the questions on the remaining pages.***

In 1666, a young doctor named Nicholas Steno was invited to dissect the head of an enormous great white shark that had been caught by local fisherman near Florence, Italy. Steno was struck by the resemblance of the shark's teeth to fossils, known as "tongue stones", recovered from inland mountains and hills (Figure 11.9).



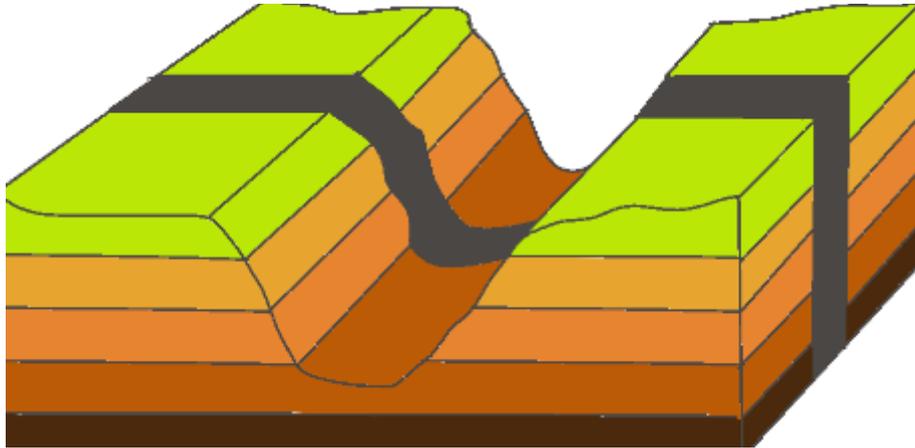
**Figure 11.9:** Fossil shark tooth (left) and modern shark teeth (right).

While it may seem obvious today, most people at the time did not believe that fossils were once part of living creatures. The reason was that the fossils of clams, snails, and other marine animals were found in tall mountains, miles from any ocean.

For Steno, the close resemblance between fossils and modern organisms was impossible to ignore. Instead of invoking supernatural forces to explain fossils, Steno concluded that fossils were once parts of living creatures. He then sought to explain how fossil seashells could be found in rocks far from any ocean.

## Superposition of Rock Layers

Steno first proposed that if a rock contained the fossils of marine animals, the rock was formed from sediments that were deposited on the seafloor. These rocks were then uplifted to become mountains.



**Figure 11.11:** Sedimentary layers that have been deposited horizontally.

Sediments were deposited in continuous sheets that spanned the body of water that they were deposited in. When a valley cuts through sedimentary layers, it can be assumed that the rocks on either side of the valley were originally continuous.

## Superposition

Sedimentary rocks are deposited one on top of another. Therefore, the youngest layers are found at the top, and the oldest layers are found at the bottom of the sequence.

## Cross-Cutting Relationships

A rock formation or surface that cuts across other rock layers is younger than the rock layers it disturbs. For example, if an igneous intrusion goes through a series of metamorphic rocks, the intrusion must be younger than the metamorphic rocks that it cuts through.

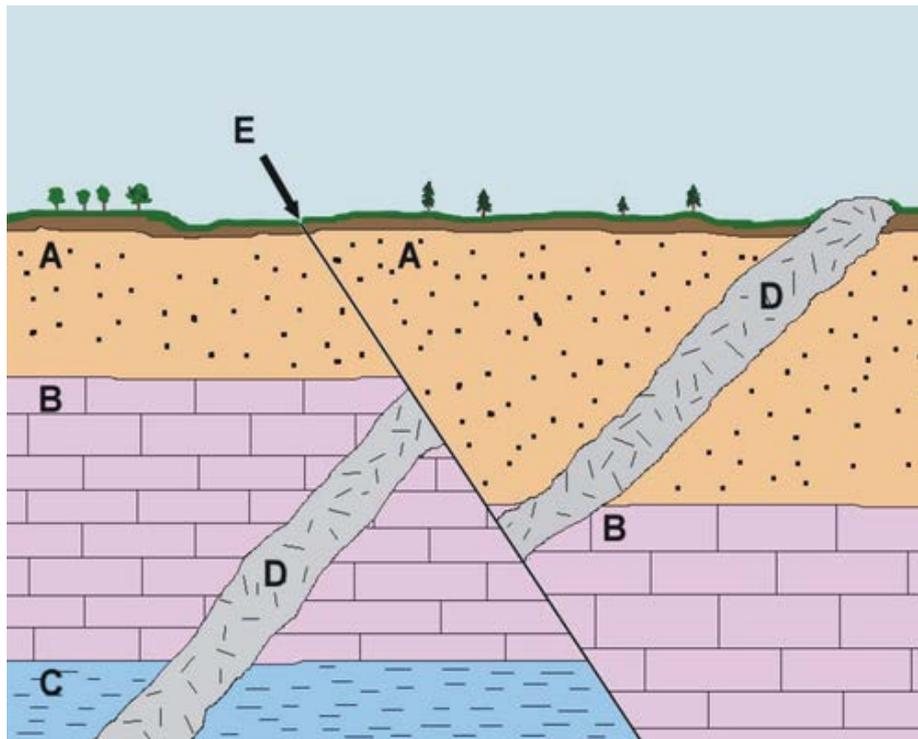
The Grand Canyon provides an excellent illustration of Steno's laws. Figure 11.13 shows the many horizontal layers of sedimentary rock that make up the canyon. This nicely illustrates the principle of original horizontality. The youngest rock layers are at the top of the canyon, while the oldest are at the bottom, which is described by the law of superposition. Distinctive rock layers can be matched across the broad expanse of the canyon. Finally, the Colorado River cuts through all the layers of sedimentary rock to form the canyon. Based on the principle of cross-cutting relationships, the river must be younger than all of the rock layers that it cuts through.



The Grand Canyon

## Determining the Relative Ages of Rocks

The **relative age** of a rock is its age in comparison with other rocks. If you know the relative ages of two rock layers, you know which is older and which is younger, but you do not know how old the layers are in years. In some cases, it is very tricky to determine the sequence of events that leads to a certain formation. Take the example, Figure 11.14:



**Figure 11.14:** Cross-section of sedimentary layers:  
(A-C) igneous intrusion, (D) cross-section, (E) fault.

The principle of cross-cutting relationships states that a fault or intrusion is younger than the rocks that it cuts through. The fault labelled 'E' cuts through all three sedimentary rock layers (A, B, and C) and also cuts through the intrusion (D). So the fault must be the youngest formation that is seen. The intrusion (D) cuts through the three sedimentary rock layers, so it must be younger than those layers.

The principle of superposition states that the oldest sedimentary rock units are at the bottom, and the youngest are at the top. Based on this, layer C is oldest, followed by B and A. So the full sequence of events is as follows:

1. Layer C formed.
2. Layer B formed.
3. Layer A formed.
4. When layers A-B-C were present, intrusion D formed.
5. Intrusion D cut through layers A-C.
6. Fault E formed, shifting rocks A through C and intrusion D.
7. Weathering and erosion occurred, forming a layer of soil on top of layer A.



**Now complete the Send-in exercises for Lesson 2 in the Worksheets**

# Send in exercises

Name: \_\_\_\_\_

## Lesson 1

### Exercise 1.1

Complete the sentences with the choices below. One of these may be used twice.

crush    wood    rot    do not    teeth    muscles    shell    fossils  
bone    hard parts    skin    old    remains    must not be destroyed  
remains    rapid burial

1. Traces or clues of past life are called \_\_\_\_\_ .
2. Most plants and animals \_\_\_\_\_ become fossils.
3. Three good conditions for forming fossils are \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ ,
4. Examples of hard parts are \_\_\_\_\_, \_\_\_\_\_ , \_\_\_\_\_ and \_\_\_\_\_,
5. Examples of soft parts are \_\_\_\_\_ and \_\_\_\_\_ .
6. A dead organism is called the \_\_\_\_\_ of that organism.
7. Air and bacteria help \_\_\_\_\_ remains.
8. Walking animals can \_\_\_\_\_ remains.
9. \_\_\_\_\_ keeps air and bacteria away from dead organisms.
10. A fossil is always \_\_\_\_\_ .

## Exercise 1.2

Look at the questions and the pictures. Then answer the questions.

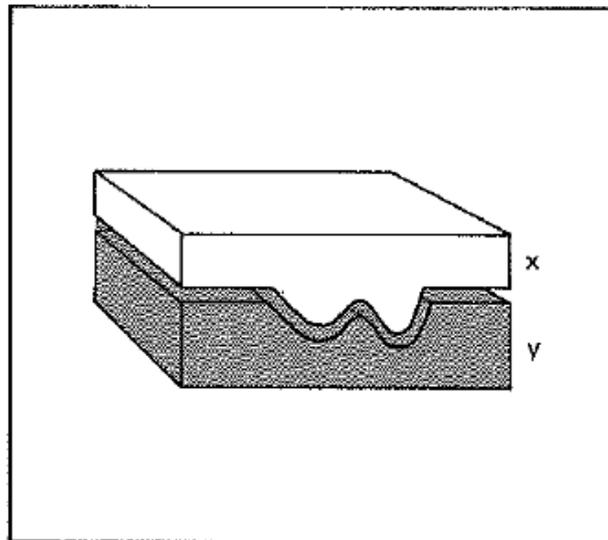
1. The remains or traces of animals or plants that lived long ago are called \_\_\_\_\_
2. Name three forms of fossils. \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_.
3. Look at the opposite figure. It has two parts (x and y). One of these is a mould; the other is a cast.

a) The mould is \_\_\_\_\_

x y

b) The cast is \_\_\_\_\_

x y



4. Which was made first, the mould or the cast? \_\_\_\_\_

5.



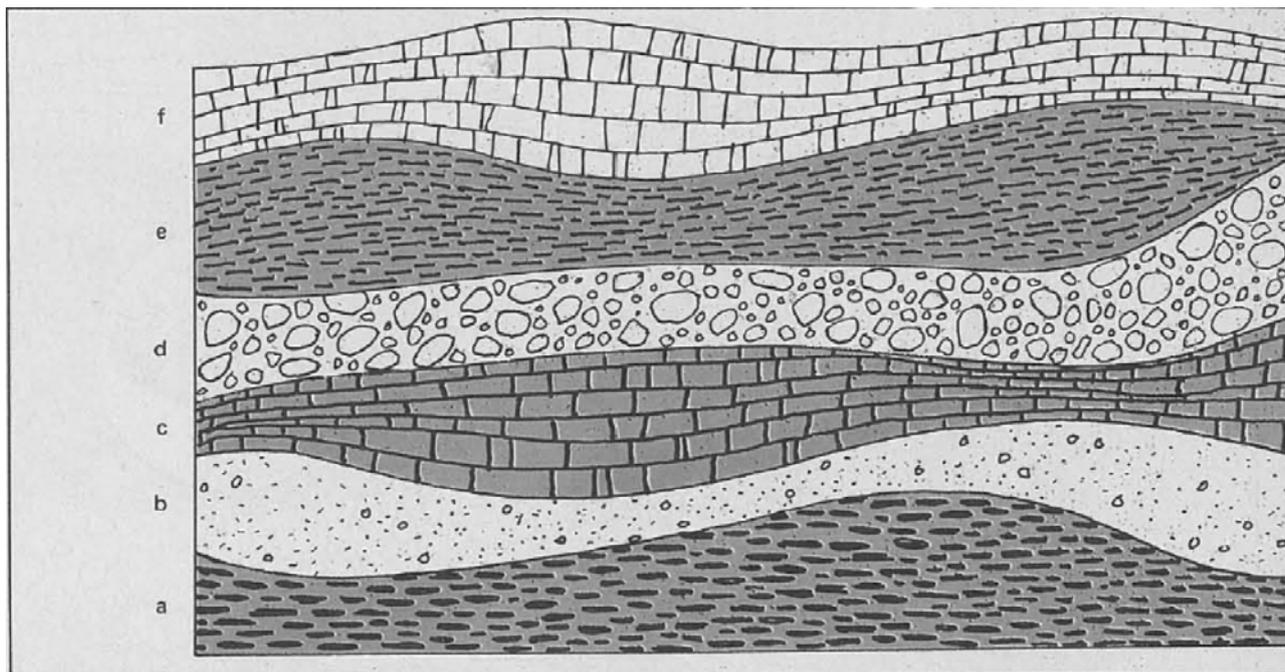
- a) What do we call this kind of fossil? \_\_\_\_\_
- b) On what kind of material was it made? \_\_\_\_\_

6. Write T on the line next to the number if the sentence is true. Write F if the sentence is false.

- a) \_\_\_\_\_ Every organism becomes a fossil.
- b) \_\_\_\_\_ There are more teeth fossils than skin fossils.
- c) \_\_\_\_\_ Most fossils are found in igneous rocks.
- d) \_\_\_\_\_ All fossils were laid down in water.
- e) \_\_\_\_\_ Most fossils were laid down in water.
- f) \_\_\_\_\_ Dinosaurs left footprints wherever they walked.
- g) \_\_\_\_\_ Moulds and casts are actual remains.
- h) \_\_\_\_\_ Moulds were made before casts.
- i) \_\_\_\_\_ Moulds and casts show the actual size of organisms.
- k) \_\_\_\_\_ There are some fossils of every organism that ever lived.

## Lesson 2

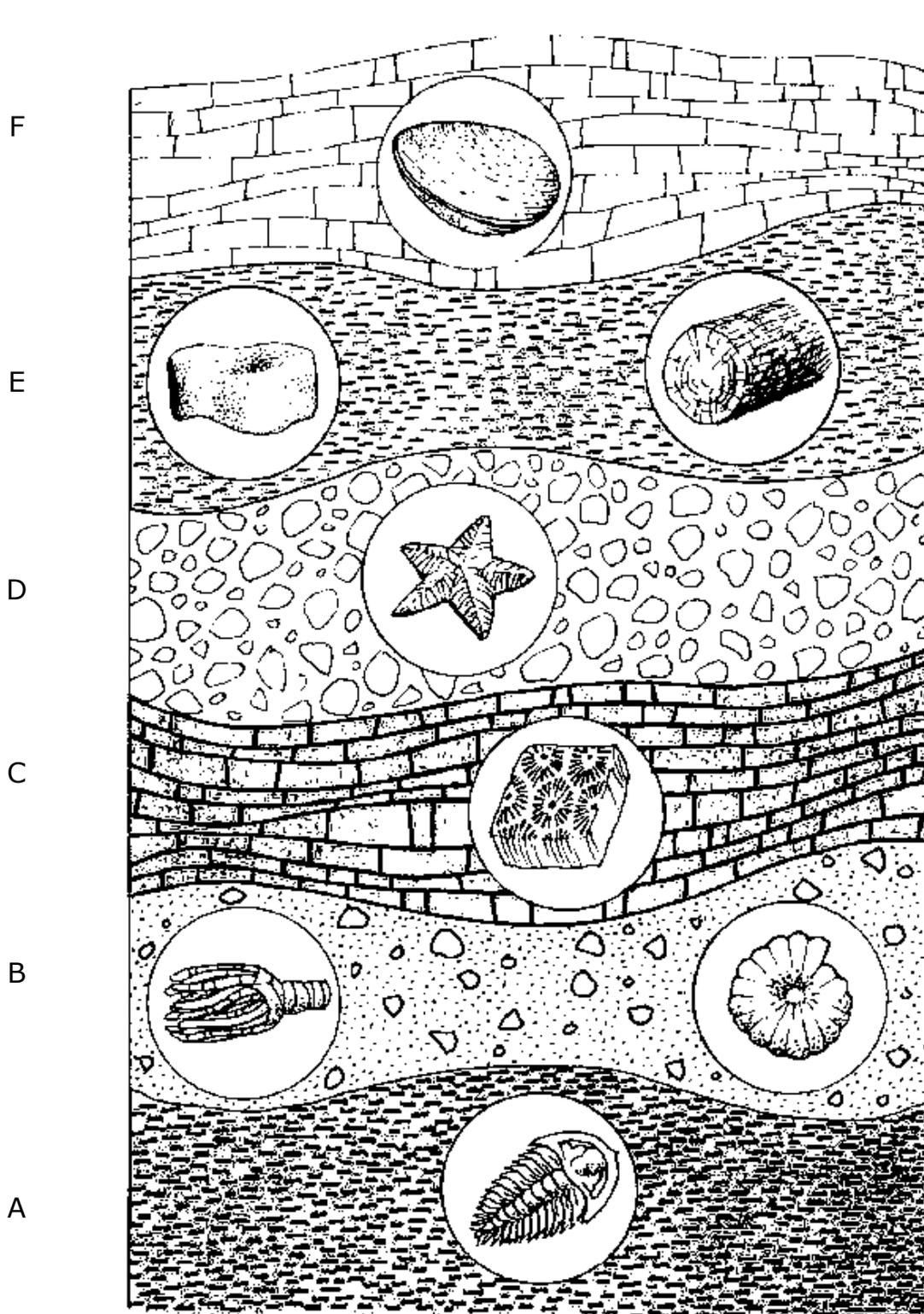
**Exercise 2.1** The diagram below shows six rock layers. Study the layers. Then answer the questions below the diagram.



1. Which is the oldest layer? \_\_\_\_\_
2. Which is the youngest layer? \_\_\_\_\_
3. Which layer was laid down last? \_\_\_\_\_
4. Which layer was laid down first? \_\_\_\_\_
5. Name the layers in order in which they were laid down. \_\_\_\_\_
6. Name the layers that are younger than layer d. \_\_\_\_\_
7. Name the layers that are older than layer d. \_\_\_\_\_
8. A fossil found in a rock layer is; a) younger than b) older than c) the same age as the rock layer found in d).
9. A fossil found in e is:  
a) younger than b) older than c) the same age as a fossil found in d).
10. A fossil found in b is:  
a) older than b) younger than c) the same age as a fossil found in d).
11. This method of dating rocks and fossils is: a) absolute dating b) relative dating.
12. Relative dating \_\_\_\_\_ tell age in "number of years."  
does, does not

## Exercise 2.2

Use the fossil key at the top of the next page to answer the questions about the fossils shown below. Write your answers in the provided spaces.



# FOSSIL KEY

NAME \_\_\_\_\_

NAME \_\_\_\_\_

Trilobite



Starfish



Crinoid



Dinosaur tooth



Snail shell



Petrified wood



Coral



Clam shell



Complete the sentences with the choices below. Two of these may be used twice.

1. Name the *oldest* fossil in this picture. \_\_\_\_\_
2. Name the youngest fossil. \_\_\_\_\_
3. Name the fossils that are *older* than the coral fossil. \_\_\_\_\_
4. Name the fossils that are younger than the coral fossil. \_\_\_\_\_
5. Which fossil is about the same age as the snail? \_\_\_\_\_
6. Which fossil is about the same age as the petrified wood? \_\_\_\_\_
7. The ages given to these fossils are \_\_\_\_\_ ages.  
relative, absolute
8. Which fossil came from a land animal? \_\_\_\_\_

