Resource Disclaimer

This resource was developed to support learning for remote mode students normally enrolled in distance education.

Resources are updated by the teacher to ensure currency and are not designed to be stand alone, but integrated into a blended learning environment where students' learning is supported with a range of peer to peer and teacher to student interactions. These can include interactive and collaborative technologies as well as a range of traditional communication methods such as email, phone and learning management processes.

This resource may contain distance education specific content / instructions and should be adapted and differentiated by the class teacher before distributing to meet the needs of their students and recognise their students' context.

These documents have been harvested from distance education resources on March 12, 2020 to support all teachers in providing a continuity of learning for their students in the event of student absence during this difficult time.

Updated – 12 March 2020

Science Stage 4

Rocks

Part 3 Fossils

Acknowledgments

Distance Education Science Network gratefully acknowledges the following owners of copyright material.

Centre for Learning Innovation

Board of Studies NSW Science K-10 Syllabus 2013

Learning Materials Production, Open Training and Education Network - Distance Education, NSW Department of Education and Training 2002

A Marsupial Lion http://bit.ly/17uLeFM
Diprotodon http://bit.ly/GAjOos/Diprotodon_BW.jpg
Rosen.S 1988 Earth Sci workshop 1
Mould of a fossilised shell http://commons.wikimedia.org/wiki/File:Aviculopecten_subcardiformis01.JPG
Cast of fossilised shells http://commons.wikimedia.org/wiki/File:Syringothyris01.JPG
A Fossil footprint https://commons.wikimedia.org/wiki/File:Trex_footprint.jpg
A Trilobite fossil in rock http://commons.wikimedia.org/wiki/File:Olenellus_fowleri_CRF.jpeg
A spider fossilised in amber http://commons.wikimedia.org/wiki/File:Spider_in_amber_%281%29.jpg
Layered rock formation—http://bit.ly/NBOO3D
Fossil shark tooth http://commons.wikimedia.org/wiki/File:Shark_tooth_-_Haifischzahn.jpg
Modern shark tooth http://commons.wikimedia.org/wiki/File:Maraiche_%28dents%29.jpg
Sedimentary layers that have been deposited horizontally. - http://google/CGiXG
The Grand Canyon- http://google/CGiXG

Writer:	Science Teachers, Sydney Distance Education High School
Editor:	Science Teachers, Sydney Distance Education High School
Illustrators:	Science Teachers, Sydney Distance Education High School
Version date:	September 2014
Produced by:	Sydney Distance Education High School, Locked Bag 5000, Potts Point, NSW, 1335
Telephone:	9383 0200 Fax: 9383 0222
Email:	sydneyh-d.school@det.nsw.edu.au
Website:	sydneyh-d.schools.nsw.edu.au
Original saved in:	\\8587-F01\Officeshare$\DECDATA\Science\DE Network\Stage 4\2014\Rocks Part 3.Docx

Contents

Outcomes

By completing this part you are working towards achieving the following outcomes:

- identify questions and problems that can be tested or researched and make predictions based on scientific knowledge
- collaboratively and individually produce a plan to investigate questions and problems
- follow a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually
- processes and analyse data from a first-hand investigation and secondary sources to identify trends, patterns and relationships, and draw conclusions
- describes the dynamic nature of models, theories and laws in developing scientific understanding of the Earth and solar system
- explain how advances in scientific understanding of processes that occur within and on the Earth, influence the choices people make about resource use and management.

The following are taken from the Board of Studies NSW Syllabus for the Australian Curriculum SCIENCE Years 7 - 10, 2013

Content Statements:

Ws4a, WS5.3a, WS6b. WS7.1a, WS7.1c, ES1f, ES1g

Resources

Here is a list of materials you will need to gather from home to use in Parts 1, 2 and 3.

- **Part 1**
- **Part 2**
- **Part 3**

Icons

Here is an explanation of the icons used in this Part.

Write a response or responses as part of an activity. An answer is provided so that you can check your progress.

Compare your response for an activity with the one in the suggested answers section.

Complete an exercise in the exercises section that will be returned to your teacher.

Think about information or ideas. You need to pause and reflect. You may need to make notes.

Think about a question or problem then work through the answer or solution provided.

Listen to an audiofile.

Access the Internet to complete a task or to look at suggested websites. If you do not have access to the Internet, contact your teacher for advice.

Use research tools to find information. For example, you may need to use a library, an encyclopaedia, the Internet or ask people around you.

Complete a task on your computer.

Perform a practical task or investigation.

Stop and consider the risks to safety for yourself and others.

Glossary

Here is a list of the key terms used in this unit.

Lesson 1

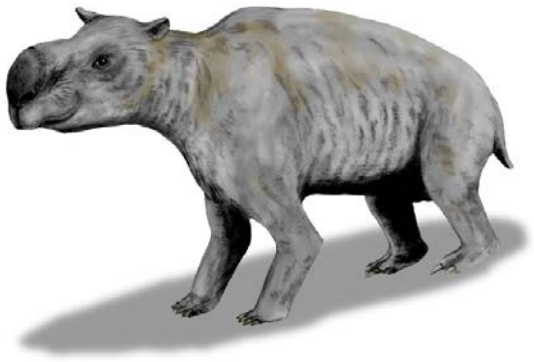
Fossils

Australia has a rich, fossil record, dating from approximately 3.2 billion years ago. Australia has the world's best example of dinosaur tracks. Near Winton, Queensland, it is possible to see where nearly 200 dinosaurs left about 30,000 footprints. The Riversleigh fossil site, near Mount Isa Queensland, is one of the most important fossil sites in the world. Large, now extinct, crocodiles, carnivorous kangaroos and enormous birds are some of the unusual animals that have been identified there.

The Darling Downs region contains fossilised remains of prehistoric megafauna, gigantic creatures such as large goannas, kangaroos and giant horned turtles. The megafauna lived 1.8 million to 11,550 years ago and included Diprotodons that grew as large as a rhinoceros and *Thylacoleo carnifex*, a marsupial lion.

The Nullarbor Plains also has a fossil site in an underground cavern where the skeletons of marsupial lions and other species were discovered, such as giant wombats the size of cars, birds and a kangaroo with horns above its eyes.

A Marsupial Lion



Diprotodon

What are fossils?

There are no living dinosaurs.

No person has ever seen a living dinosaur. Dinosaurs are extinct. That means that all dinosaurs are dead.

How do we know that dinosaurs ever lived?

Dinosaurs and other extinct animals and plants left traces-or clues-behind. These clues tell us that they once lived. The traces of past life are called fossils.

Billions and billions of plants and animals have lived and died. But very few have become fossils.

Conditions had to be right for fossils to form. Usually conditions were not right for fossils.

What are good conditions for fossils to form?

1. Hard parts, like bone, teeth, shell, and wood are most likely to form fossils. Softer parts, like flesh, fur, and petals do not leave many fossils.
2. The remains must be around long enough to form a fossil. What is left when a plant or animal dies is known as "the remains." Usually weather, living animals, and other things destroy the remains quickly. There is no time for a fossil to form.
3. Quick burial keeps away air and other things that can rot dead plants and animals. Quick burial also prevents other animals from eating or crushing the remains.

Not all organisms become fossils. Remains of plants and animals are destroyed in many ways.

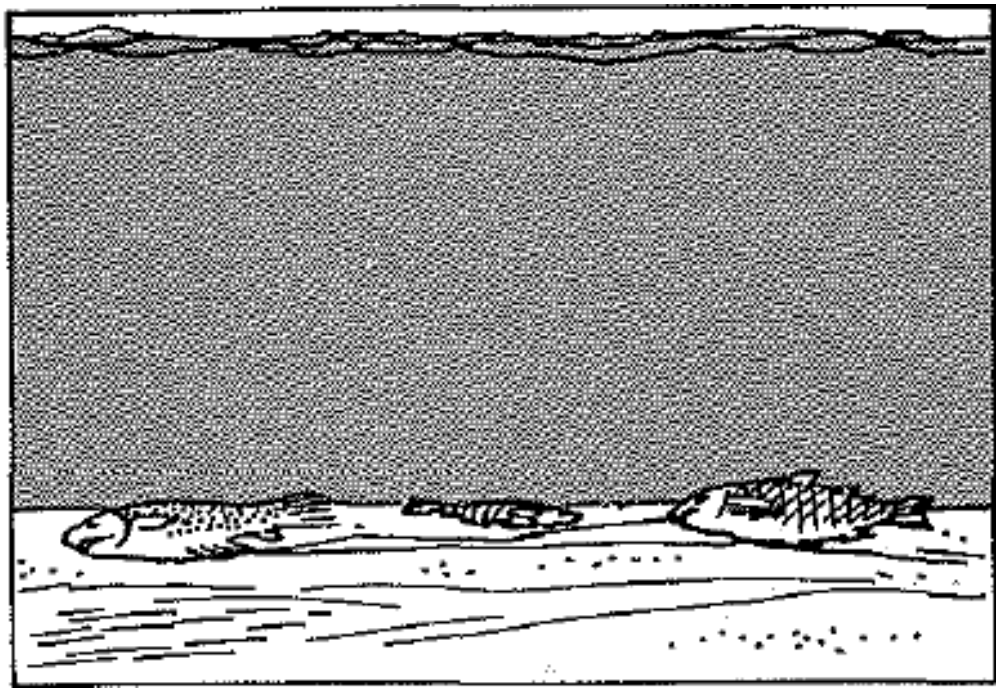
The following internet site has some fun activities examining the conditions needed to make fossils http://www.abc.net.au/beasts/fossilfun/burial/default.htm

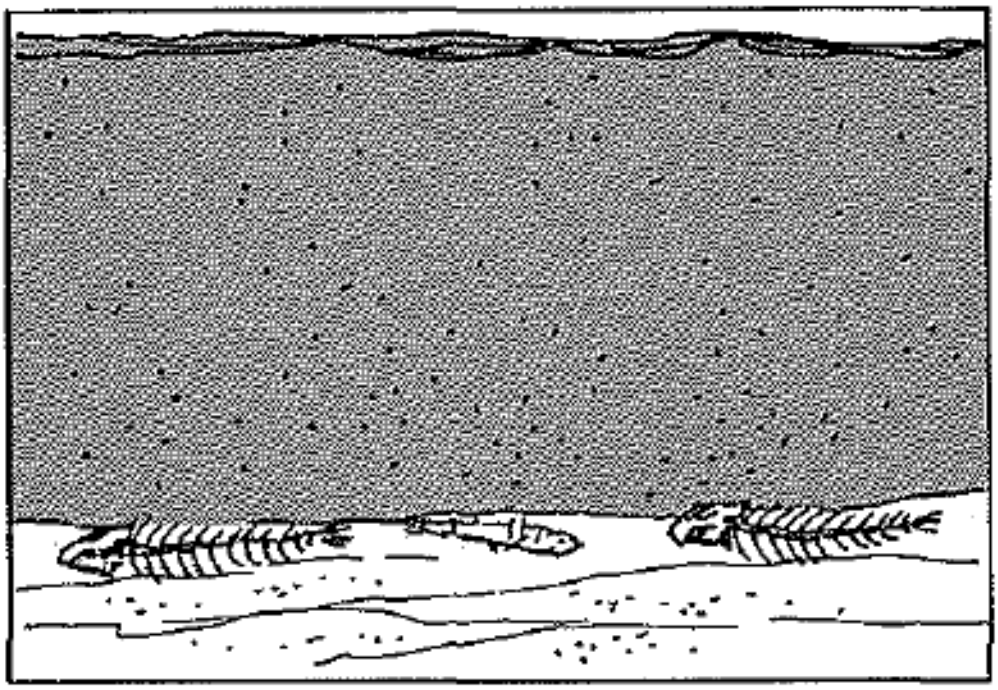
Fossil Formation

Rosen.S 1988

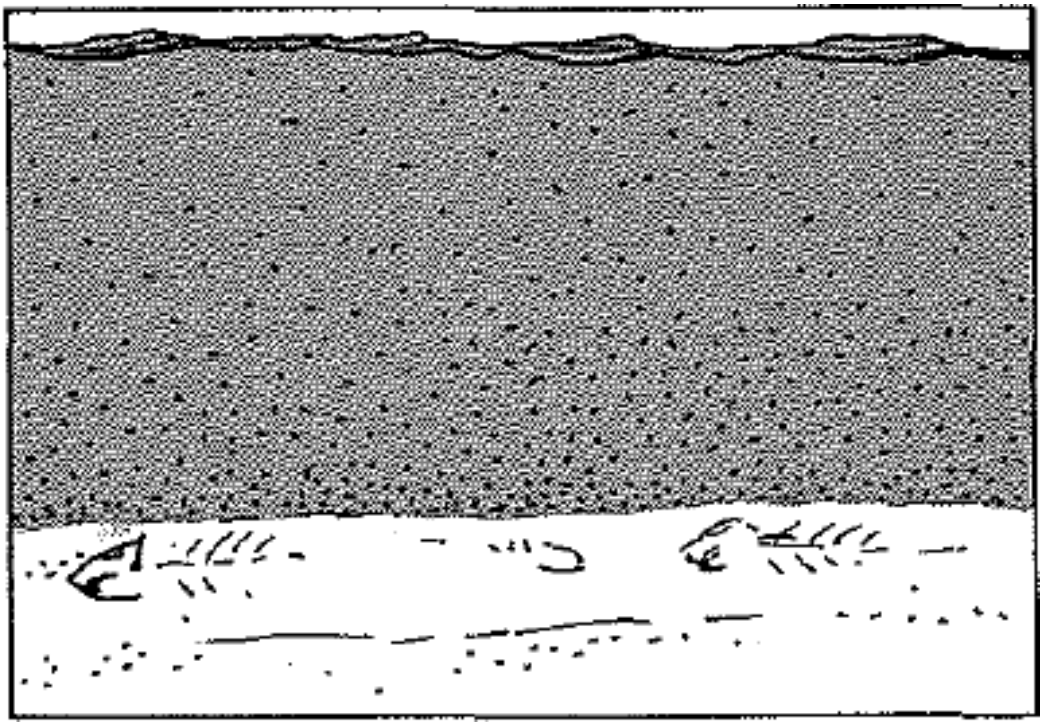
Earth Sci workshop 1

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.

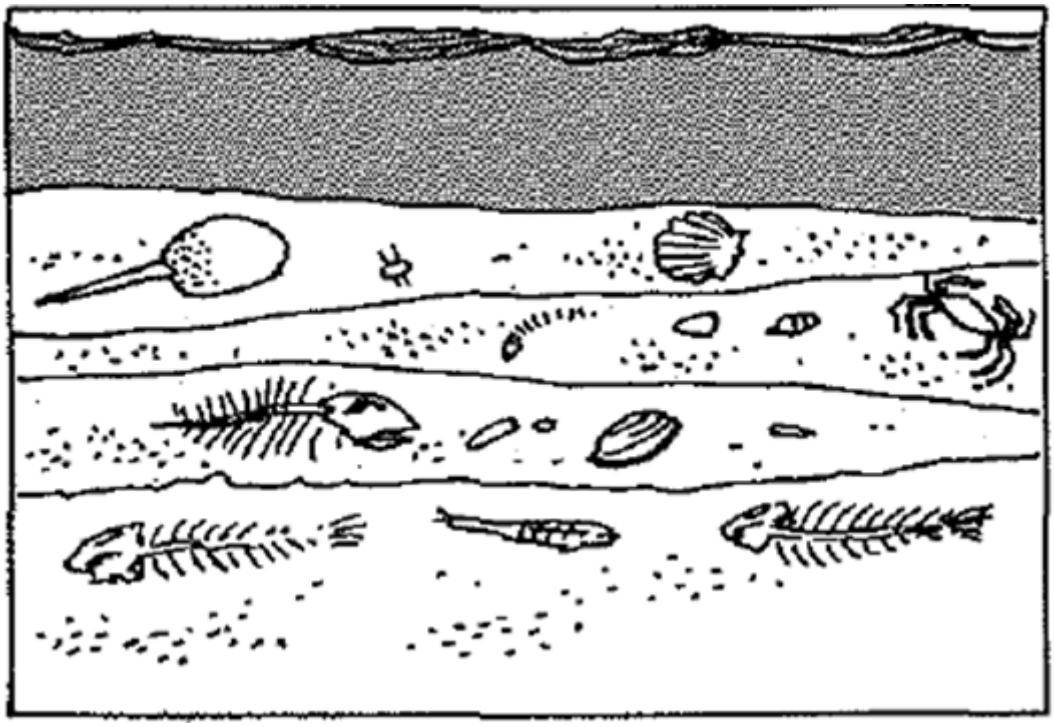




Marine animals die and settle to the bottom.



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.

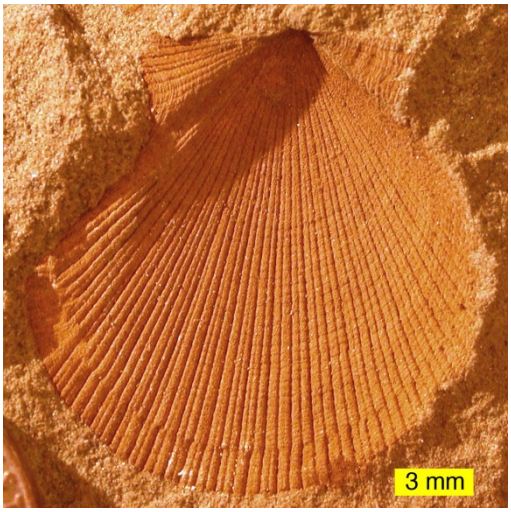
Different kinds of fossils

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.

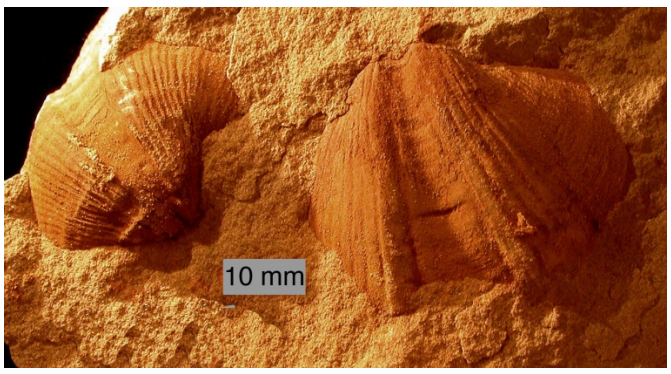
MOULDS Many plants and animals were buried in fine sediment. In time, the sediment hardened around them. After a while, the plant or animal rotted. But a space was left in the hardened sediment. The space is the same size and shape as the plant or animal. This space is called a *mould*.

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 over 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.

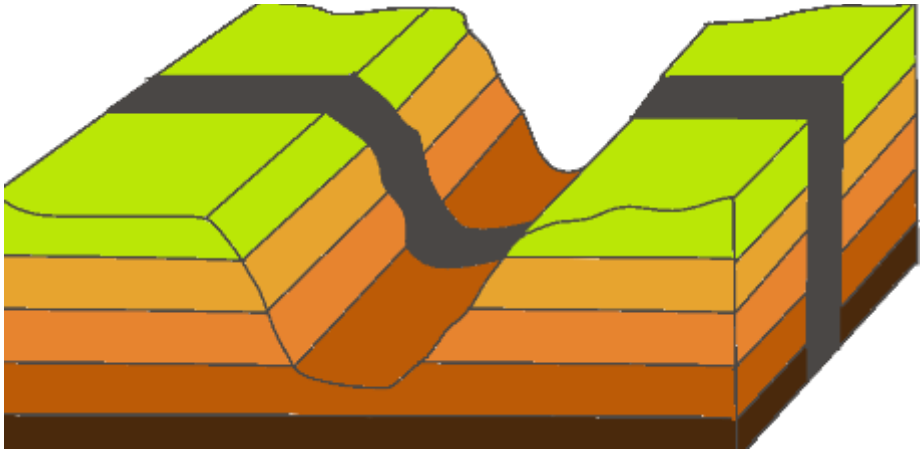


Figure 11.11: Sedimentary layers that have been deposited horizontally.

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:

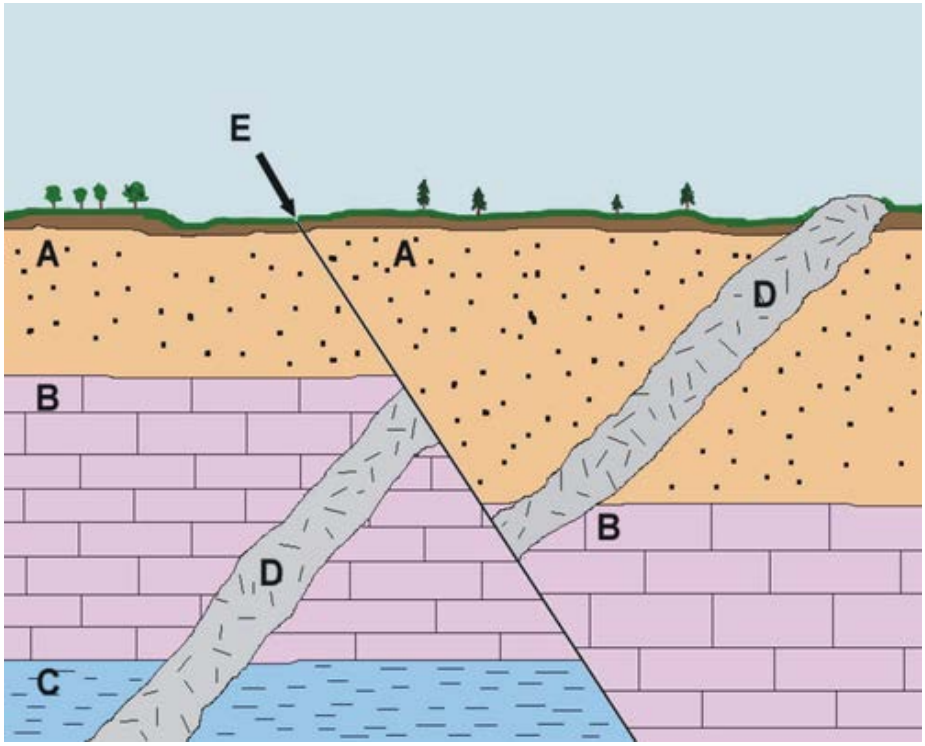


Figure 11.14: Cross-section of sedimentary layers:
(A-C) igneous intrusion, (D) cross-section, (E) fault.

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.

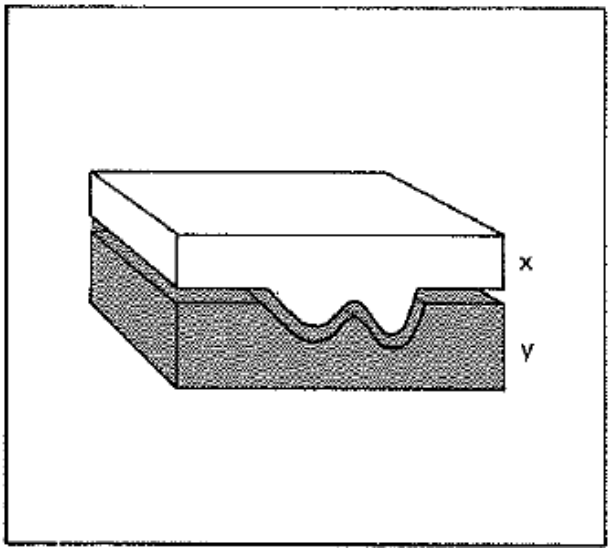
1. The remains or traces of animals or plants that lived long ago are called _____

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.

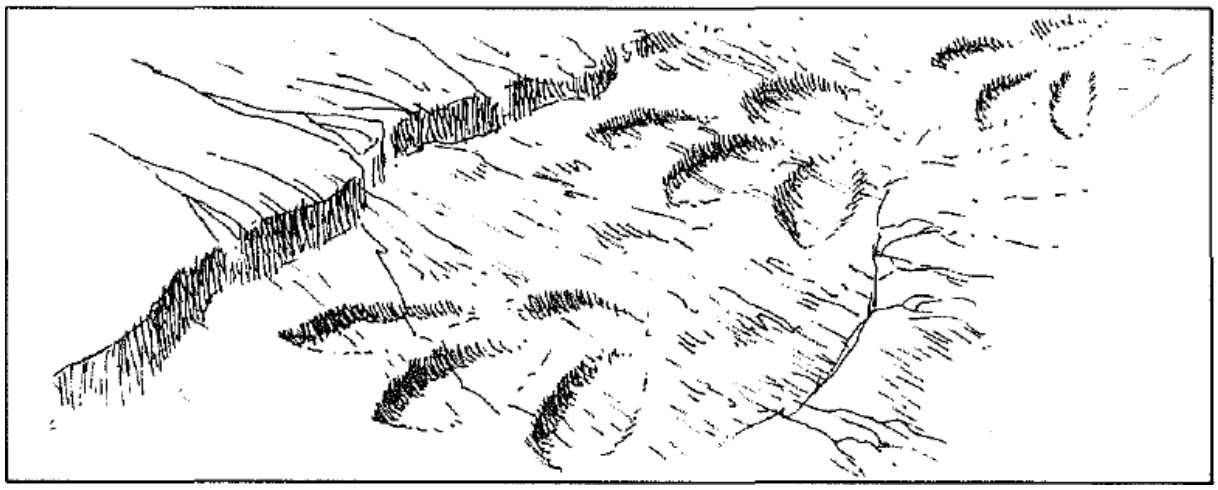
   a) The mould is _____
      x y

   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.

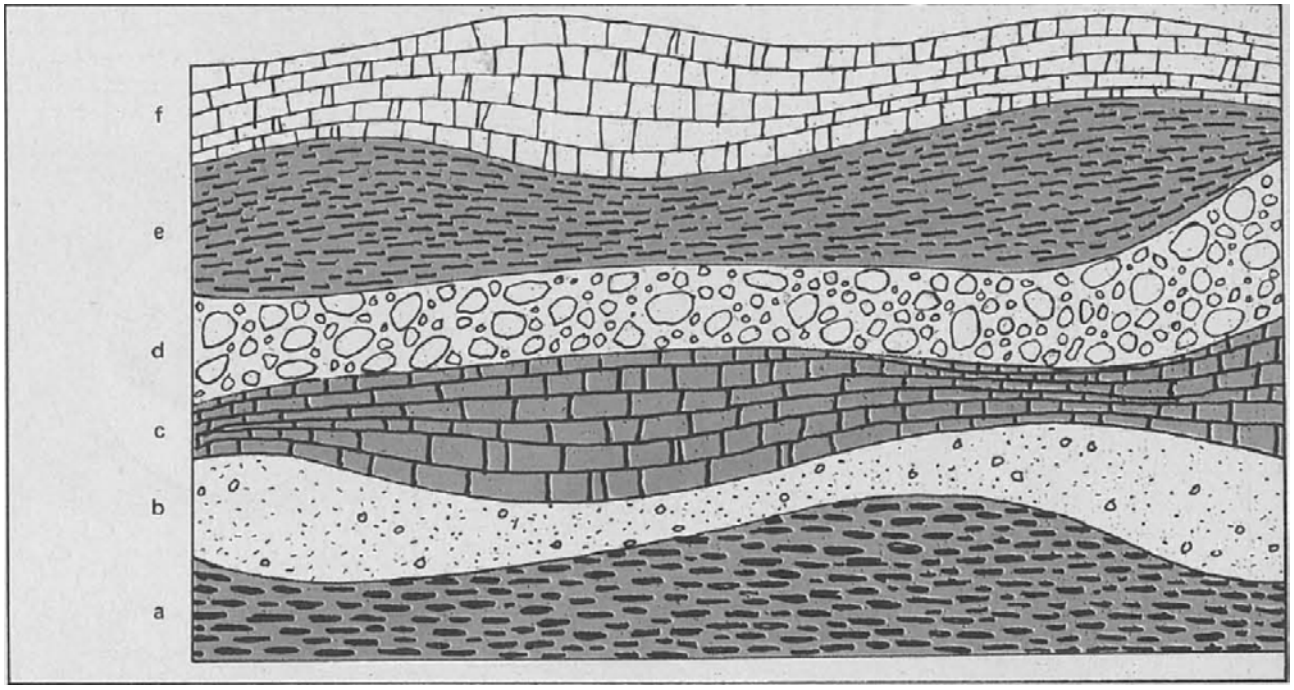
i) _____ Moulds and casts show the actual size of organisms.

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).

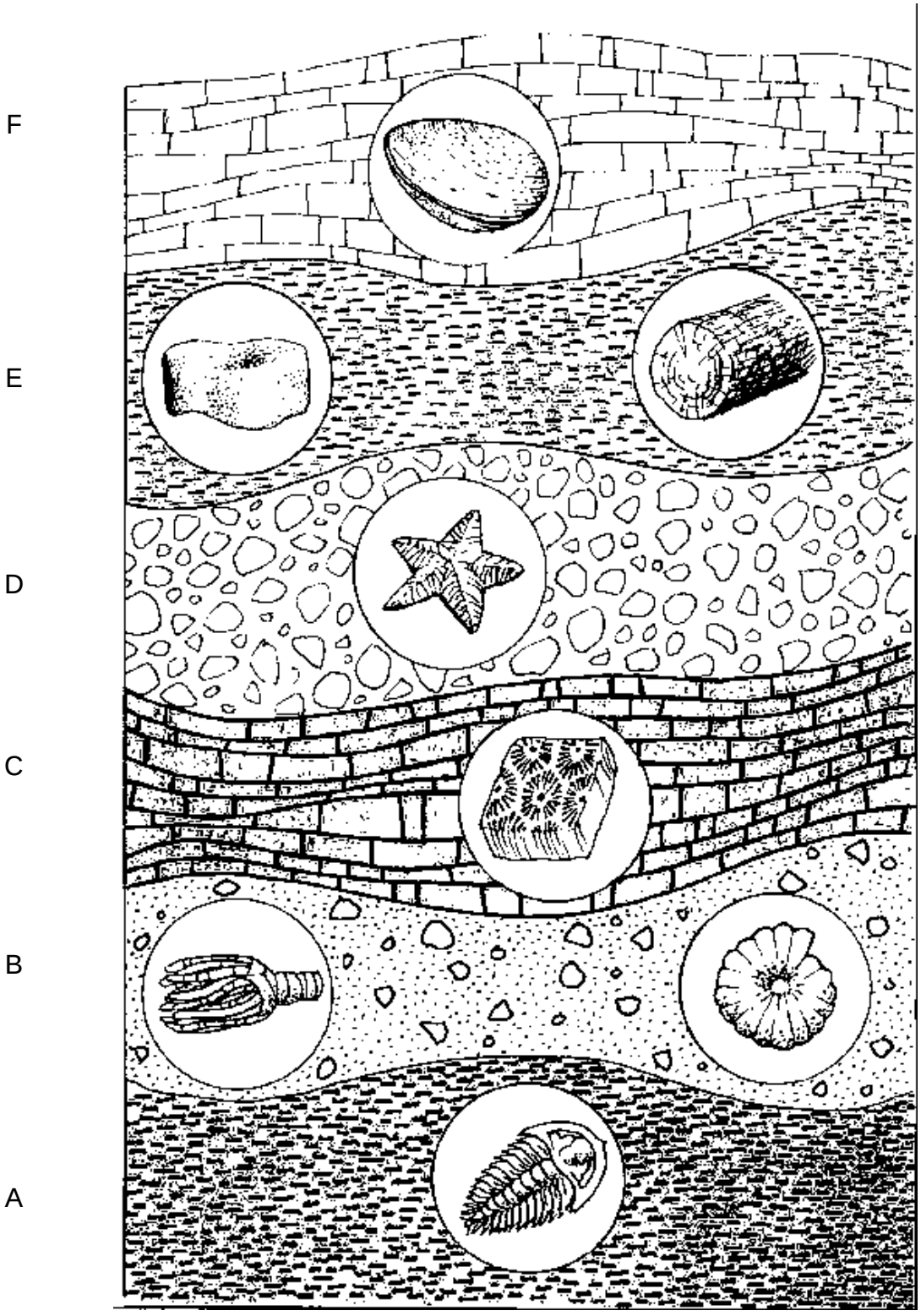
11. This method of dating rocks and fossils is: a) absolute dating b) relative dating.

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.

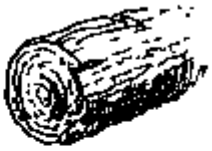


FOSSIL KEY

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? _____