



Fossil Kit Student's Workbook Contents

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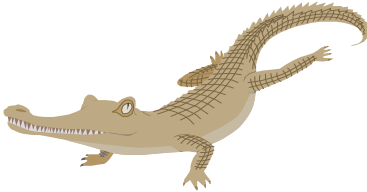


fossils



Why are fossils rare? Predators, scavengers and decomposers

When things die, their remains are broken up by:

Living things

	Your examples	Hint
P _____ S		
S _____ S		
D _____ S		

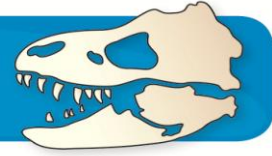
In your own words

A predator is _____

A scavenger is _____

A decomposer is _____

fossils

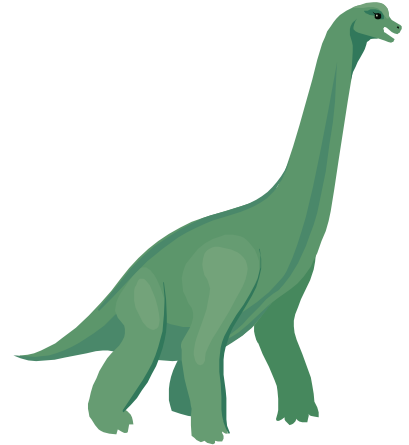


Often only large hard bones and teeth remain on the surface. Weathering and erosion can also break down the remains.

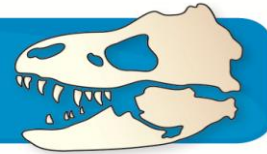
Why are fossils rare?

The dreadful and disgusting decomposition of Denis the dinosaur.

Create a cartoon strip which explains why all that remained of Denis the dinosaur after a year was two leg bones and his skull. Use the blanks below to organize your rough copy



fossils



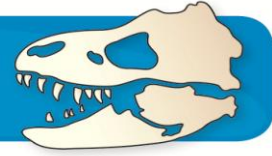
HINT Don't forget weathering and erosion.

Cut up your cartoon, shuffle the images, and see if a friend can reassemble them in the correct order.

OR Create a flicker book

Work due _____

fossils



Why are fossils rare? Microorganisms and water

Dead plants and animals rarely survive to become fossilised because they are broken down by Nature's recyclers. Decomposing microorganisms such as tiny bacteria and fungi in the air are so small that individuals cannot be seen by the naked eye. Luckily, under the right conditions, they multiply and grow into large colonies that are easier to see.

Bread, being made from a living plant, is a good food source for microorganisms. Compare what happens to the two pieces of bread, one moist and one dry, over two weeks to see the effect that moisture has on decomposition.



Petri dishes

You will need:

- Two samples of bread, one of which has been dried
- Two Petri dishes
- Marking pen
- Sticky tape for sealing the dishes

What will we have to do to make this a "FAIR TEST"?

The results of your experiment will be colonies of bacteria and fungi. They can be dangerous to your health. Do not open the Petri dishes after they have been sealed!



Biohazard symbol

You will:

1. Place the moist sample of bread in the Petri dish, mark the dish "MOIST", add the biohazard symbol and seal it properly with sticky tape.
2. Repeat with dry bread, marking the dish "DRY", adding the biohazard symbol and sealing it.
3. Leave the dishes somewhere warm for two weeks observing any changes regularly.
4. Write down your observations.
5. Return your unopened dishes for the teacher to dispose of.

fossils



Prediction

What do you think will happen to the two pieces of bread?



Observations on the effect of moisture on the decomposition of bread

Day	Moist bread	Dry bread

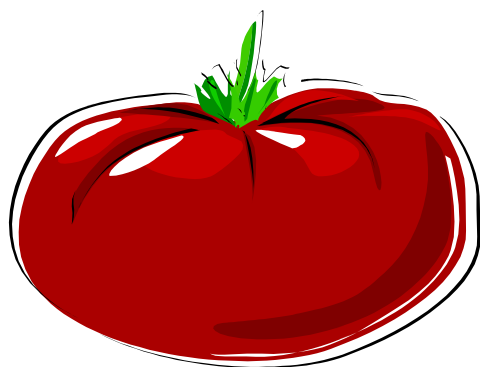
HINT Fungal colonies tend to be furry and bacterial colonies tend to be slimy

Use the information you have learned

What conditions would help a dead plant or animal to be fossilized?

Why are fossils rare? Extension Tomato Body Farm

fossils



Tomato Bodies

The Body Farm at Knoxville Tennessee is a famous laboratory for pathologists studying the effect that weather, scavengers and decomposers have on the rate of decay of human bodies. CSIs use the data to scientifically estimate time of death.

Tomatoes can be used to represent bodies, having a skin which seals softer moist internal parts. Your “Body Farm” is the school yard. Discuss how different areas of your yard would have different factors affecting the exposed (or covered) tomato body.

Each group selects a different location and observes their body over several days. All data is shared and a conclusion (must draw on data and explain any patterns) is written.

Remember:

Scientific data must be observable measurable and repeatable before it is reportable. How can you organize your experiment to reflect this?

The experiment must be a “*fair test*”

What **data** must you collect?

How can you make your observations **accurate and precise**?

How will you **present** all the data collected? (Table, graph, map etc)

What **equipment** do you need?



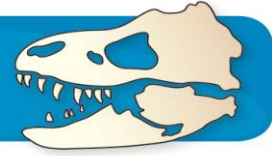
Extension

Would a tomato last longer complete or slashed?

Would a tomato wrapped in plastic last longer than an exposed tomato?

Would a tomato last longer sunk in water?

fossils



Why are fossils rare? Microorganisms and temperature

Have you ever wondered why we cook our food? Extreme heat kills most of Nature's decomposers and makes the food safe to eat. Warm temperatures however can encourage bacteria and fungi to grow and break down the food. To be fossilized, dead plants and animals need to exclude decomposers.

This experiment is similar to the previous one, "Microorganisms and water"



You will need:

1. Two samples of bread
2. Two Petri dishes
3. Marking pen
4. Sticky tape for sealing the dishes
5. A warm place to put one specimen and a cool place to put the other

The results of your experiment will be colonies of bacteria and fungi. They can be dangerous to your health. Do not open the Petri dishes after they have been sealed!



You will:

Biohazard symbol

- Place same sized samples of fresh bread in both Petri dishes and seal them.
- Mark both with the biohazard symbol
- Place one dish on a warm place and the other in a cool place
- Leave the dishes observing any changes regularly.
- Write down your observations.
- Return your unopened dishes for the teacher to dispose of.

Prediction

What do you think will happen to the two pieces of bread?

fossils



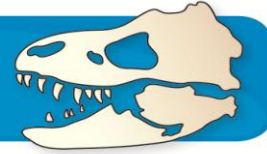
Which variable will we be measuring? (Which is the dependent variable?)

Observations on the effect of moisture on the decomposition of bread

Day	Cool bread	Warm bread

HINT Fungal colonies tend to be furry and bacterial colonies tend to be slimy.

fossils



Use the results of your experiments and your own experience

What conditions would help a dead plant or animal to be fossilized? Add your knowledge from the previous experiment “Microorganisms and water” to make a more complete answer.

Where in Australia would you find conditions which would aid the fossilisation process? Explain your answer.





Why are fossils rare? Groundwater A (Acid groundwater)

Rapid burial in sediments keeps out bacteria and fungi which might decompose plant and animal remains. The layers of sediment keep out oxygen on which some of them depend and also excludes scavengers. Rain penetrates sediments and forms a water table. This contained water will dissolve materials in the sediment. Dead plant material can form humic acid which will preserve flesh but can dissolve bones.

Your teacher may demonstrate this to you or you may do the following experiment.



You will need:

- Two cleaned chicken wing bones.
- Two jam jars or glasses.
- Marking pen.
- Vinegar (acetic acid) or other mild acid.

You will:

1. Place one bone in a jam jar and cover with tap water.
2. Place the other bone in vinegar or another mild acid solution.
3. Observe for one week
4. Take the bones out of the jars and try to bend them.

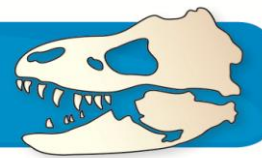
Observations on chicken bones over one week.

Acidic water	Plain water
	

Acid groundwater tends to form in cold wet places like swamps and wetlands.

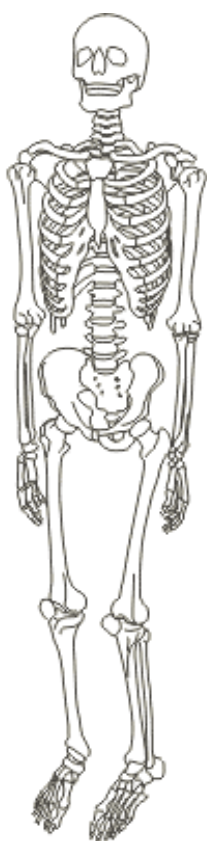
Use the results of your experiment

fossils

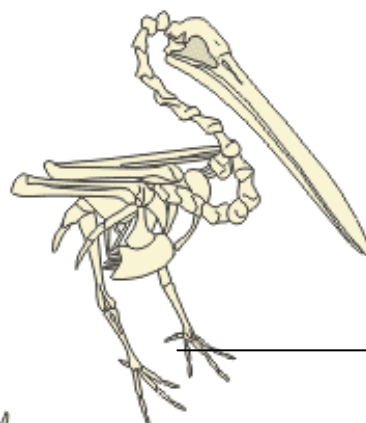


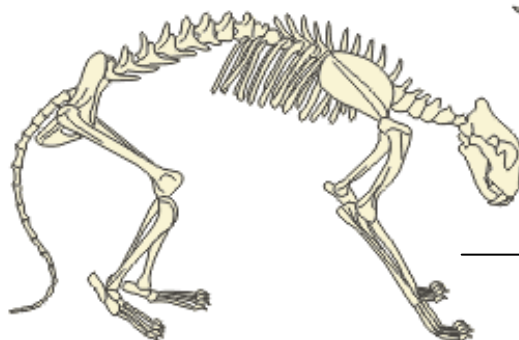
Where in Australia would such conditions be found?

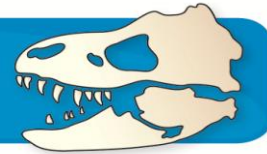
Usually only large strong bones survive natural burial. Name the animals below and colour in which bones you think might survive burial.











Why are fossils rare? Option Food for thought

You may wish to try this experiment at home.
Place a hardboiled egg in a glass of vinegar overnight
and observe what happens.



To make a hard boiled egg

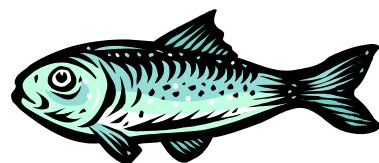
- First check with your parents help.
- Take the egg out of the fridge and allow it to warm to room temperature or it will crack.
- Place egg in saucepan and cover with cold water.
- Place saucepan on stove, bring water to boil and let it boil for about 1 minute.
- Remove saucepan from heat and leave egg in hot water for 4 minutes.
- Lift egg from water with a slotted spoon and allow to cool.

Prediction

What do you think will happen?

What did happen?

Brave students may wish to repeat the experiment with a raw (un-boiled egg).

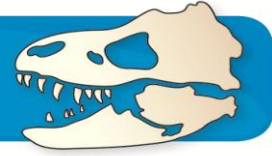


Extra for eggsperts

Give a scientific reason why do people put raw herring in vinegar to make rollmops.

Why are fossils rare? Groundwater B

fossils



Acid water preserves flesh but dissolves bones. Desert water is alkaline. It preserves bone but dissolves flesh.

Water also contains dissolved minerals which will soak into the plant and animal material and permineralise it changing the original materials into stone. Proud parents used to hang their children's first shoes under carbonate rich drips "fossilize" them and turn them to "stone" as mementos.

You will need:

- An empty tea bag
- A beaker, jam jar or glass
- A pencil or pen
- Hot water
- Spoon or spatula for stirring
- Epsom salts or equivalent
- Optional food colouring



You will:

1. Make a super saturated solution of Epsom salts (Magnesium sulphate) by one third filling the container with hot water. Keep stirring in Epsom salts until no more will dissolve. Add food colouring if desired.
2. Hang the tea bag over the pencil and into the container until it just sits into the solution. The tea bag tie can be wrapped round to adjust the height.
3. Leave the equipment for some days adjusting the tie to continue the tea bag to dip into the solution.

Minerals replace the original chemicals in fossils and this process turns them into stone. The fossil below is of an ancient form of the bacterial mats which grow in your swimming pool or pond. It was a stromatolite. Little by little the original silty structure was replaced by minerals and petrified.





Why are fossils rare? Optional Homework “Bodies in Bogs”

Submerged in peat bogs and marshes of Europe, bodies (and part of bodies) up to 6,000 years old have been found in varying states of preservation. Visit <http://www.tollundman.dk/> and view Tollund Man, one of the best preserved examples. Bog water contains humic acid and tannin which is produced from rotting vegetation. Tannin is the chemical which is released by our tea trees in the south west of Western Australia and colours stream water brown. Tannin is also the agent in tea which gives it its brown colour and refreshingly astringent flavour. People have used tannin for staining and for tanning leather since ancient times. Bog water is cold and low in oxygen and this also restricts bacterial decomposition.

Your task Is to tan an egg.

1. Select three white eggs, remove from the fridge and allow them to rise to room temperature. (Light brown eggs can be used but the colour change is less obvious)
2. Place one egg in tap water and heat to boiling. Boil for five minutes. Allow to cool and replace in fridge.
3. This is your **CONTROL**. You will be able to reference any changes against this standard.

Tannin Effect

Create a really strong brew of tea by boiling leaves or tea bags for ten minutes. Sieve out leaves and allow liquid to cool. This is tannin rich water.

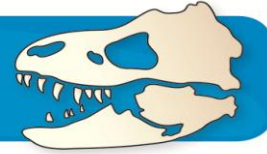
4. Place the two white eggs in the tannin solution and raise to boiling. Boil for five minutes and allow everything to cool. The eggs should look like the picture below.
5. Place one of these eggs into the fridge beside the control egg. This **EXPERIMENTAL** egg can be compared with the control to determine the effect of tannin.
6. Remove all three eggs from the fridge and compare (what is the same?) and contrast (what is different?) the results for your eggs.



Fossils are soaked in mineralized groundwater which turns them into stone. Their colour can also be affected by minerals in solution.

The carbonate shell of this ammonite has been replaced by iron pyrite (Fool's Gold) from groundwater.





Why fossils are rare? Compression and compaction

Fossils also have to survive compaction and cementation processes which turn sediments into rock. You will create sedimentary sandwiches containing replica fossils, compact them and then drill into them to try and intersect a fossil.

You will need:

- Board and knife to cut shapes and to remove bread crusts
- 4 slices of bread with the crusts removed
- Processed cheese slices
- Optional margarine or butter
- Optional jelly lollies
- Cling wrap
- Drinking straws
- Ruler

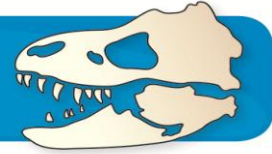


You will:

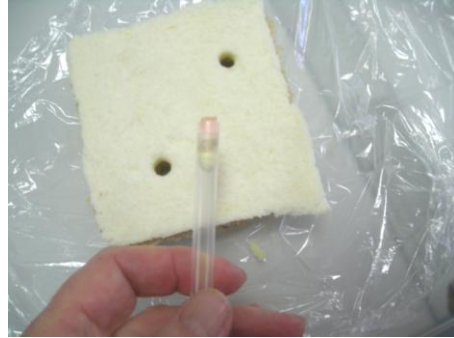
1. Wash your hands before putting down a layer of cling wrap on a clean surface.
2. Place a slice of bread on cling wrap. This is a layer of sediment on the sea bottom.
3. Cut cheese into small shapes and randomly place three of these on the bread. These are the bodies of dead animals which fell to the bottom of the sea and was unaffected by scavengers and microorganisms.
4. Covered with another slice of bread and more fossils .
5. Repeat until a stack of sediments with some fossils is created. At least one fossil free layer should be included. As you stack up the layers of sediments and bodies make a note of what was placed in each layer.
6. When stack is complete, wrap with cling wrap and mark the top of the sandwich pile "T".



fossils



7. Measure the height of the sandwich. _____
8. Remember to measure twice and put in the units).
9. Place these sandwich columns on a flat surface, cover and compress with a heavy weight to represent compaction (crushing) under the weight overlying sediment within the Earth.
10. Estimate the degree of compaction by dividing the compacted height by the original height.



of

Compacted height _____

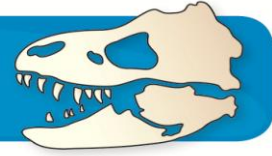
Original height

11. Use the plastic straw to drill down into the sediment and see if you intersect (cut through) a fossil. When you withdraw the straw you will see a sedimentary sequence similar to the rock sequence seen in diamond drill core.
12. Open compacted sandwich, observe the effects of compaction and count the numbers of fossils intersected.



Diamond drill core through rocks

How had your fossils changed because of the forces of compaction applied to them?



Why are fossils rare? Revision and wordsleuth



Fossil crinoid or sea lily from near Geraldton WA

Photograph courtesy of Enza

You have been studying why it is difficult for dead plants and animals to become fossils. Use your notes to answer the following questions.

What is a fossil? _____

What are the three things which attack and destroy plants and animal bodies at the surface of the Earth? Name an example of each.

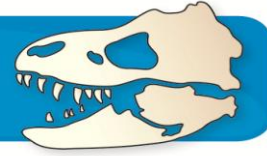
1. P _____ example _____
2. S _____ example _____
3. D _____ example _____

Under which conditions would a dead body last longer? Circle the correct answer.

- | | |
|-----------------|-----------------|
| a. Warm and wet | c. Cold and wet |
| b. Warm and dry | d. Cold and dry |

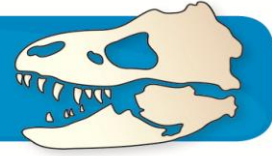
Once the bodies have been buried in sediment, what else can change them?

fossils



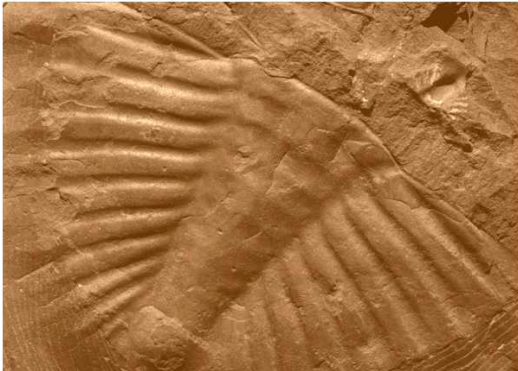
Why are fossils rare?

E L B A T A E P E R L D P S M
R K G R O U N D W A T E R C E
O C A S T X H S I D T C A A A
S O D E E M Y R U R C O L V S
I M E D M M U G I H O M K E U
O P P I P B E F E G M P A N R
N R O M E U I Y T N P O L G A
F E S A R C Q N M I A S I E B
M S I N A G R O O R C I M R L
F S T T T K D L I E T T L S E
B I I A U C I O S H I I I T I
K O O R R O C C T T O O S R G
N N N Y E R A R U A N N S A N
R N C E L B A V R E S B O T U
S T E R I L I S E W K E F A F



Finding Fossils Searching through geological time

Our planet has been without life for a very long time. Early life consisted of simple soft organisms that would be unlikely to form fossils. The first fossil evidence of life in Australia is from Ediacarian times 680 million years ago in what is now South Australia.



Imprint or mould of very early life form in the Burgess shales in Canada

Since life was limited to the oceans for the first 2.7 billion years of this planet, if we are looking for fossils we have to look in areas where these oceans used to be. We also have to avoid areas where volcanos or glaciers would destroy life.

If we are looking for fossils of early land plants we need to find areas of swamps or rivers which would supply them with fresh water.

You will need

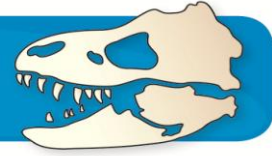
1. Access to internet. Visit the Mining Council of Australia site "Down to Earth"
2. A copy of the "Geological Timescale" for reference (They are in the box).

You will

1. Open "Paleotraveller" and spend about 5 minutes familiarising yourself with the controls.
2. Answer the questions below. We will be starting from Cambrian times and moving to more recent times.

Sketch the fossil sea scorpion, give two important facts about it and suggest where its fossil might be found in Western Australia.

fossils



When did the Cambrian period begin? _____

Which fossil can be found in Western Australia in both Cambrian and Ordovician times?

What happened to Ordovician seas in northern Western Australia during Ordovician times?

(Hint – Look at the landscapes)

The eastern coast of what is now Queensland would not be a good place to collect Devonian fossils.

Explain why.

Glossopteris was a tree. Its fossilised remains form some of Western Australia's economic coal deposits.

Would you expect to find its fossilised remains in Permian rocks in the south of Western Australia?

Explain your answer

Why would it not be a good idea to look for glossopteris fossils in rocks laid down near Geraldton 251 to 245.1 million years ago?

In what age rocks would you look for fossils of Rhoetosaurus, the dinosaur, and where in Western Australia might you find them?

Finding Fossils

Ethical Rules for fossil collection

fossils



People collect fossils because_____

Fossils have been collected for making jewelry, amulets, medicine and for scientific examination. In the process of collection many fossils were destroyed or lost to the world of Science. In 1996 dinosaur footprints were stolen from the beach near Broome in West Australia.

<http://www.dinosauria.com/jdp/stolen/stegfoot.htm>. Not only were these fossils rare but they were also part of the local aboriginal Dreamtime and their loss was sorely felt. In WA fossils cannot be removed from National parks and reserves.

Some paleontologists (people who study fossils) say we should only take photographs of the fossil and leave them in the rock for future generations to enjoy.

Your task is to make simple rules to control fossil collection in Western Australia. These rules should be made into a poster which could be displayed near fossil rich locations such as Coalseam National Park in Western Australia.

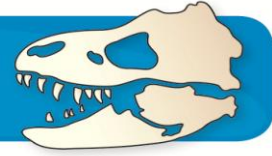
Write down your own five rules for ethical (honourable) fossil collection. The most important should be first. Reduce your rules to a few simple words.

1
2
3
4
5



Collecting ammonite fossil. Picture reproduced courtesy of www.discoveringfossils.co.uk

**People remember ideas when they are presented as simply as possible.
A picture is worth a thousand words.**



KISS - Keep It Simple Stupid!



What does this picture tell us? _____

What features of the poster make it easily understood even though part of it is in a foreign language? _____

Share your five ideas and how you wish to present them with another student. This is called "Peer Review" and ensures that your work is well thought through and will be easily understood by others. Together select the three most important rules to be displayed by each of your posters.

Create your poster and ensure it is simple and eye catching. Consider these points:

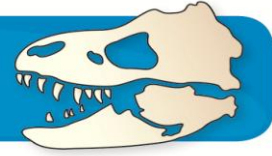
- Title
- Simple bright colours
- Writing that can be read from a distance
- Your name on the back

POSTER DUE ON _____

Where, in Western Australia, could you go to see a good collection of fossils? _____

Finding fossils The Time of the Dinosaurs

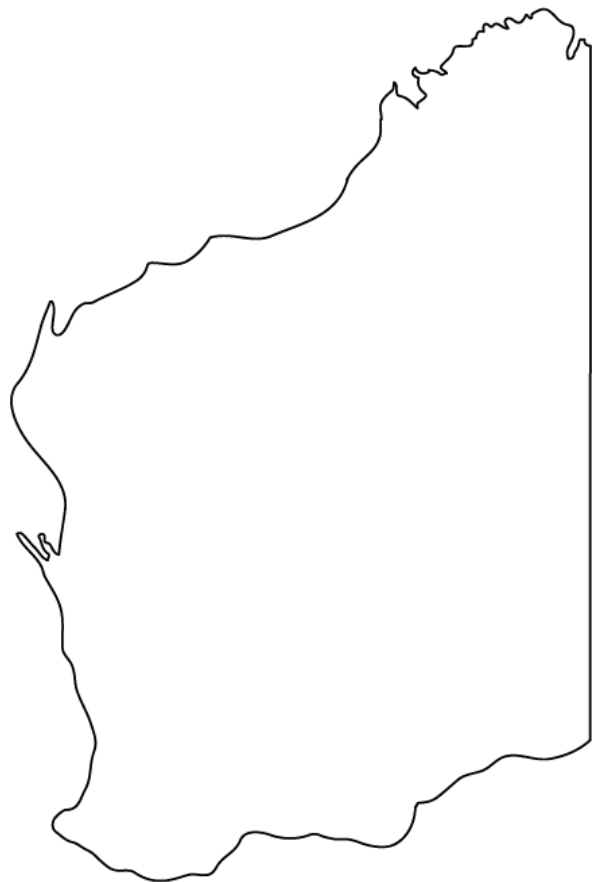
fossils



When we look for dinosaur fossils in Australia, we have to look for rocks of a certain age. Australian dinosaurs appeared during the Triassic (280mya) and most died at the end of Cretaceous times (65mya). They appear to have lasted slightly longer in Australia.

Wonderful dinosaur fossils have been found near Winton in Queensland. What is Dr Scott Hocknull's message in "Australia's answer to T.rex" at <http://www.australianageofdinosaurs.com/video-hub.php?>

Look at the Geological Map of Western Australia provided and find where similar Jurassic and Cretaceous aged rocks outcrop. *HINT* – there is a key down the side of the map. Mark these areas on the blank map of Western Australia provided.

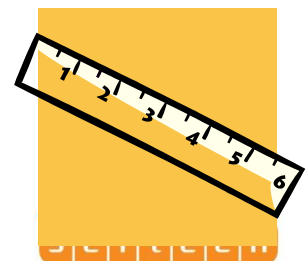


Place the location of your school on the map also.

Where is the nearest place **you** could look for dinosaur fossils? _____

Unlike a timeline, the key on the geological map isn't drawn to scale.

Your task is to draw a geological timeline or time scale



fossils



A simple timeline needs a pencil, ruler and the following data:

- **Cockroach** fossils first appeared about **400my ago**.
- Cockroaches appeared at the same time as the first land plants.
- The first **dinosaurs** were found about **230my ago** and the last ones died out about 65 my ago.
- Australian Dinosaurs lived from **228mya** to perhaps **63my ago**.
- *Humans* and their ancestors have been alive for the last **1.6my**.
- *Sharks* evolved *455 million years ago* and their structure is virtually unchanged.

HINTS Organise your data by age (oldest to youngest).

Select a scale that will allow you to fit the range from oldest to youngest.

Mark time intervals clearly.



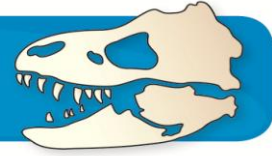
Muttaborrasaurus
An Australian dinosaur

Marking Key for Timeline		Student Marks
Title	1 mark	
Correct choice of scale	1 mark	
Scale started	1 mark	
Clear time markings on line	1 mark	
Labels correctly positioned	1 mark	
Neat presentation	1 mark	

Timeline questions



fossils



1. Could early humans have fought dinosaurs?

2. Explain your answer.

3. Why might dinosaurs have survived longer in Australia than elsewhere?

4. Could sharks have eaten marine dinosaurs?

5. Explain your answer.

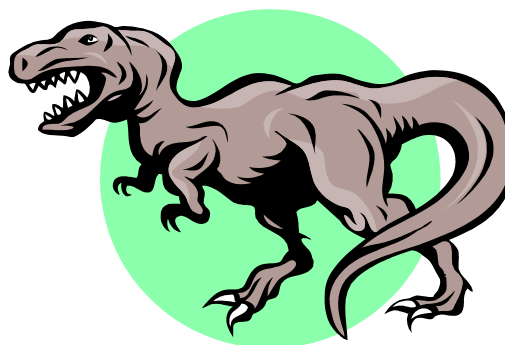
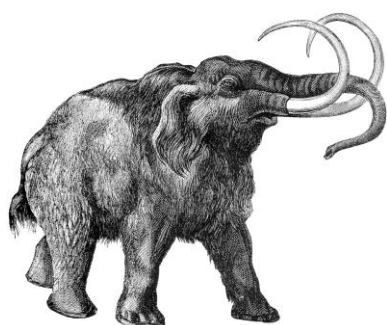
6. Why would dinosaurs NOT have evolved before land plants?

OPTIONAL RESEARCH QUESTION

fossils



Did mammoths and dinosaurs live at the same time? (Explain your answer)



Some Hollywood movies show humans living with dinosaurs and fighting them. Could this be so?

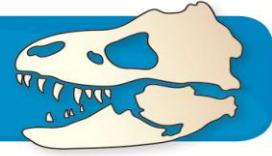
Explain your answer.



Fascinating fact

In 1633, Bishop Ussher tried to estimate the age of the Earth by counting the number of generations mentioned in The Bible and using some of its descriptions of the passage of time. He stated that the first day of creation was on Sunday 23rd October 4004BC. This is the time we now believe that early man first started to settle into agricultural life as estimated by radiocarbon decay methods.

fossils



Finding fossils Dig them out!

Fossils are usually found in rocks which reflect the type of environment organism would have lived in. Fossil oysters are found in sandstone and limestone from near shore sediments, scorpions are found in sandstones from sands rounded by desert winds and ferns which lived in moist muddy environments are found in dark mudstones.

We are going to lay down layers of sediment and hide fossils in them.

Your teacher will discuss with you what materials you can use.



Remember

Fossils have been changed by earth processes to form rock.

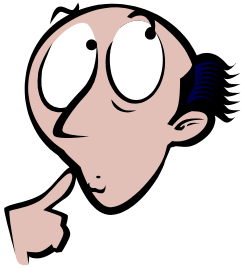
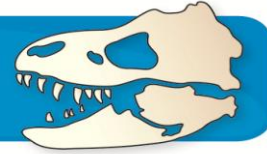
Your “fossils” will be changed by mineralizing groundwater which permeates your sediments.

Plan the sequence of sediments and fossils which will form your rock column. Since the oldest rock and fossils will be the first to be laid down, your rock column will become increasingly younger as it fills upward. James Hutton the Scottish father of modern geology called this “The Principle of Superposition” but it is more commonly called “**Way Up**”.

1. _____
2. _____
3. _____
4. _____

An Hypothesis is a scientific guess or estimate. Since it is impossible to have complete data, scientists hypothesise or “best guess” based on all the data they have and ample “common sense”. This is why we no longer describe ideas as “laws”. Our hypotheses change if new information or new technologies become available.

fossils



Your teacher will explain to you how to turn the loose sediments into a rock.

When the rock has hardened you are going to exchange your with another person.

Hypothesise in which layer fossils are most likely to be found

In your own words, what is meant by the word “HYPOTHESIS”?

You have been given a rock containing different strata (layers). Which beds do you think might contain:

1. fossils of flowers _____

2. beach fossils _____

Write an HYPOTHESIS on which strata **WILL NOT** contain fossils.

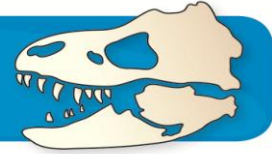
Look for fossils in your rock using the materials provided.

Was your hypothesis supported? _____

Extra for experts

A simple way to make an hypothesis is to use an “**if...then**” statement. E.g. **If** I let go of the book **then** it will fall.OR**If** you use this method **then** you will get good marks in science!

fossils



Finding fossils Using a grid

Once one interesting fossil has been found in an area palaeontologists will search for more. Where rock strata outcrop at the surface, this can merely mean following along the exposed rock. However often there is little to be seen at the surface due to many million years of weathering. In Western Australia some of our weathering is over a hundred meters deep. Weathered rock can also be moved down hill by gravity and general soil creep. Scientists then have to “best guess” where to look as excavation can be difficult and expensive.






A grid is laid over the find area and clues such as colour change in soils, geomorphology or direction of drainage flow are mapped. Where would you expect to find Fossils X and Y?

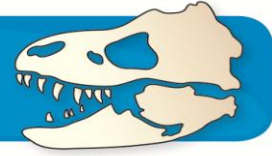
(The pictured fossils are ammonites)



Enter your suggestions on the grid below.

A1	B1	C1	D1	E1	F1 Y
A2	X				
A3					
A4					

fossils



Your teacher will have hidden some “fossils” under sand. The locations of known finds have been marked.

After talking with your group, can you suggest three good ideas for finding the other hidden fossils?

1. _____

2. _____

3. _____

Decide on the dimensions of your grid. Mark out the grid and where the fossils were found

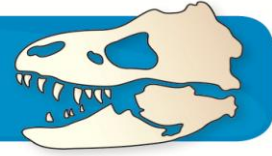


TITLE _____

A1	B1	C1	D1	E1	F1
A2					
A3					
A4					
A5					

Key Fossil 1 _____ Fossil 2 _____ Fossil 3 _____

fossils



Take turns to “best guess” where future fossils might be found. How many tries did it take your group to find all the fossils? _____

Could you have done anything to make it easier to find fossils next time? Suggest some good fossil finding strategies



Fascinating fact

*It is assumed that the large fossilised shell of the ammonites pictured came from a creature similar to the smaller central white Spirula shell or ram’s horn shell of a present day squid which lives in ocean depths. Palaeontologists assume that similar structures develop as adaptations to similar habitats. The structures are sufficiently different to suggest that they are not the same species. The concept was first described by James Hutton (1726-1797). He called it “The Principle of Uniformitarianism” but is more commonly known as “**The present is the key to the past**”.*

What modern creatures resemble dinosaurs? _____



Finding fossils Revision and wordsleuth

Gogo Fish Guessing Game

Western Australia's fossil emblem is the Gogo fish (*Mcnamaraspis kaprios*). They are found at Gogo Station south east of Fitzroy Crossing in shale which was deposited in quiet inter-reef bays 375 million years ago. They had a shark like body with a single dorsal fin and gave birth to live young. They are the best preserved early fishes in the world

**From the information above and what you have discovered about fossils.
Choose the answer you think is most correct.**

1. If you were looking for a Gogo fish elsewhere, you would look:

For rocks of the same age

For rocks of the same type

For rocks which outcrop at the surface

All of the above

2. You can find and collect fossils like the Gogo fish:

A. Anywhere in outback Western Australia

Only on open country where there are no houses

Anywhere except National Parks and Reserves

In mines and quarries

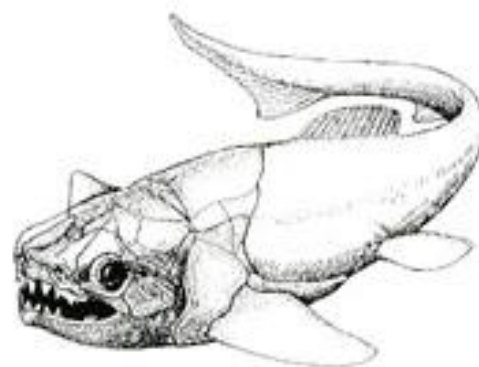
3. The Gogo fish was fossilised because:

A. It lived in a reef environment and had sharp teeth to defend itself against scavengers

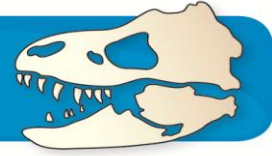
It lived on Gogo Station up in the Kimberley

Its body was deposited in gentle waters and rapidly covered with sediment

It died out before modern fish evolved



fossils



4. We usually find only the head parts of the Gogo fish because:

- A. These were the hard bony parts
- B. Mineralising waters would have hardened bone
- C. Bacteria and scavengers would have eaten the soft parts
- D. All of the above

5. The Gogo fish is extinct. This means:

- A. It smells

It died a long time ago

It can no longer be found on Earth

It was fossilized



Gogo fish bony skull courtesy of DMP

Fascinating fact

In 2008, palaeontologist John Long announced the discovery of a Gogo fish which had inside it the remnants of an umbilical cord and an embryo (baby fish). Most female fish release eggs which are fertilised by males externally. Many millions of eggs are released by females because most are eaten by predators or are not fertilised. Internal fertilisation means fewer eggs and an improved opportunity for baby fish to develop before birth. This is the earliest example of live birth in vertebrates (animals with internal skeletons).

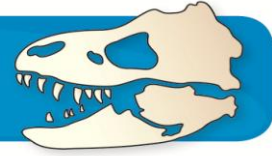
fossils



Find words that are important for this topic.

H X Q C I S S A R U J P C D D
 L F I N D I N G E Y F A H J E
 P A L I S S O F K G R L M T V
 Y Y C C M G W H G B A E I B O
 U W S I R E T P O S S O L G N
 C I L P G C G N O E O N N R I
 D A L A N O I R P Q D T A E A
 O Q M I N F L A I I N O I S N
 I U T B E O C O N D A L C E P
 R X T R R S I O E S I O I R A
 E H O C D I S T K G R G V V R
 P U W N R A A C A C U I O E K
 S I A B U O O N B N L S D D Q
 C L H R L R P U E M I T R T M
 S E D I M E N T S Z S G O G O

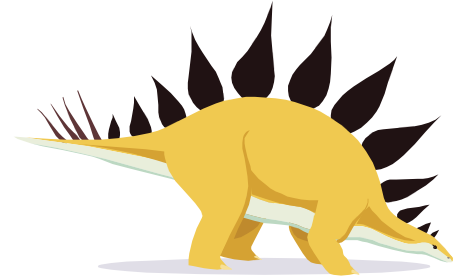




Dinosaurs data and dimensions Dinosaur Trackways

A track way is created when animals move across soft ground. When the mud hardens within the Earth it becomes a fossil track way. The fossilised steps are called “*trace fossils*”

Australia has two particularly famous dinosaur trackways, one near Winton in Queensland and another about 80km long just south of Broome in Western Australia.



Visit

http://www.abc.net.au/dinosaurs/meet_the_dinos/ozdino2.htm

or use the information sheet provided by your teacher to answer the following questions.

1. How long ago did these dinosaurs live?

2. What three things made these footprints exceptional (very special) according to Dr Guiseppe Leonardi?

1.

2.

3.

3. What year was this track way first scientifically studied?

4. Through the internet or a dictionary, find the definition of:

Herbivorous

Carnivorous

5. What is the difference between the tracks of herbivorous and carnivorous dinosaurs?

fossils



6. Is this this footprint from an herbivorous or a carnivorous dinosaur? Explain your answer.

7 .How can we *infer* (good guess) that herbivorous dinosaurs are more common that carnivorous ones?

8. Name the five groups of dinosaurs which roamed south of Broome.

Using books or the internet, draw one dinosaur from one of these four groups and fill in the details about it.

Sketch	Information
	Name _____
	Geological Age _____
	Size _____
	Diet _____

fossils



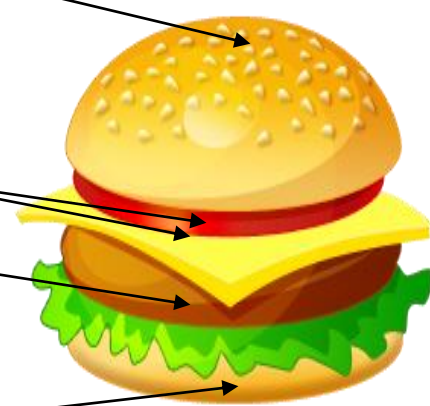
9. What else was discovered during the expedition?

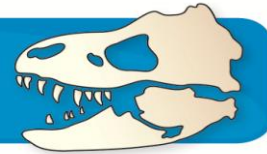
10. Would you like to go on an expedition like this? Explain your answer.

Why should we be upset to find out that the stegosaur footprints were stolen? Surely they are just bits of rock. Describe your feelings on this subject in a short essay.

To help organize this: **Write the important words you will need below. E.g. dinosaur, palaeontologist**

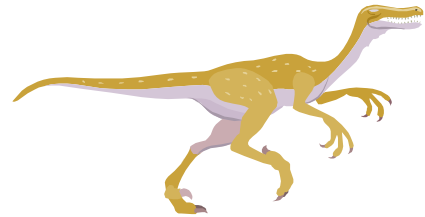
Draft these ideas into an essay:

<p>My introduction</p>  <p>My ideas and explanations</p> <p>My conclusion</p>	<p>DRAFT IDEAS</p>
---	---------------------------



Dinosaurs data and dimensions Dinosaur Dimensions

By studying the relationship between the size of present day animals and their tracks, scientists can better interpret data from fossil track ways. *"The present is the key to the past".*

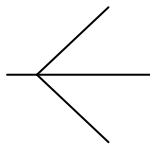


1. The hip height of the animal (dinosaur)

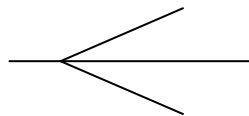
The hip height of a dinosaur can be estimated by multiplying its foot length by four.



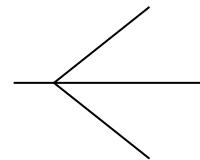
A



B



C



D Scale 1:100

Which of these dinosaurs above is the tallest (at hip)? _____

What is the hip height of the tallest dinosaur? _____

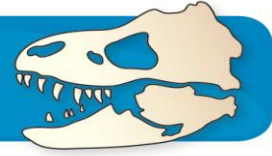
Why can there be problems if we only measure ONE footprint from each group?

2. The hip height of the animal (human)

Create an experiment which will find if there is a direct relationship between a human's total height and their hip height. To help here are some questions:

Which variable/s will you measure? _____

fossils



How can you be sure that each group uses the same points to measure?

What measuring instrument will you use? _____

Which units should they use for measurement? _____

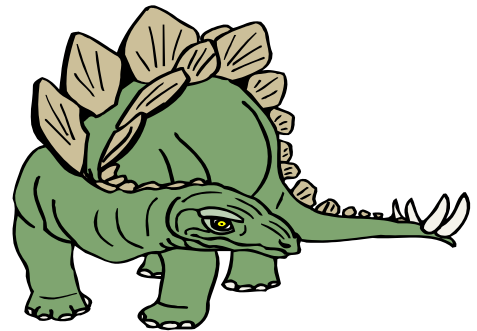
Which variable/s will you control? _____

How many humans should you test? _____

How will you display your results? _____

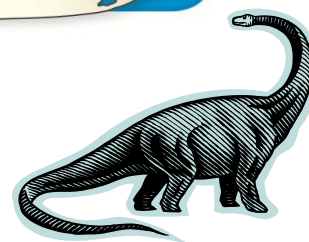
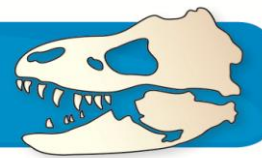
Draw up a table and enter your data from your experiment here.

Results



Conclusion

fossils



3. The length of the dinosaur

The foot length is usually one tenth of the length of the dinosaur.

What is the length of these three dinosaurs?

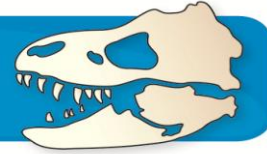
Dinosaur	Foot Length	Length in metres
A. Sauropod from Texas	91.44cm	
B. Tyrannosaurus Rex	114cm	
C. Scutellosaurus	12cm	

Can we estimate the height of a human from length of their feet? Explain your answer.

4. How fast were the dinosaurs travelling?

Visit the school sand pit or long jump pit. Rake the sand flat. Measure the distance of foot imprint between strides when a student walks, ambles and runs across the sand. Is there a direct relationship between the speed and the length of pace?

	Reading 1 (cm)	Reading 2 (cm)	Reading 3 (cm)	Average (cm)
Walk				
Amble				
Run				



Dinosaurs data and dimensions **Quadrupedal and bipedal tracks**

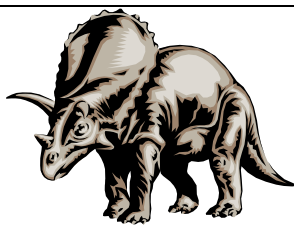
Dinosaurs travelled on two feet (bipedal locomotion) or four feet (quadrupedal locomotion). The earliest dinosaurs were bipedal and had three toes. (See below)

A stride measures the advance from left foot to left foot,

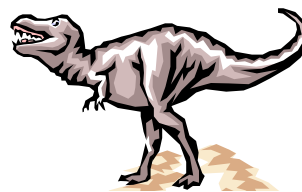
A pace measures the advance from left foot to right foot and vice versa.

Explain to another students the difference between pace and stride by measuring their pace and stride.

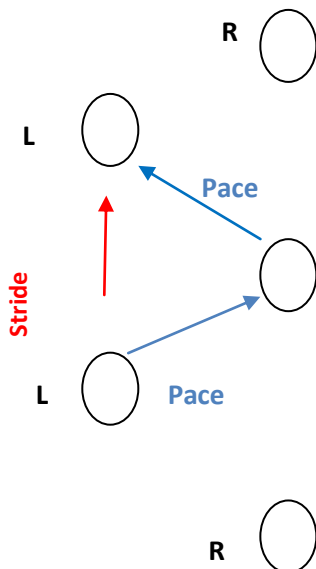
Pace _____ Stride _____



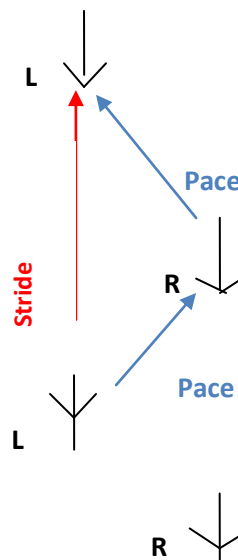
Quadrupedal locomotion Triceratops



Bipedal locomotion Tyrannosaurus



The triangular space created between pace and stride is wide for quadrupedal animals.



The triangular space between pace and stride is narrow for bipedal animals.

fossils




Scientists will only accept ideas if they are backed up by data that is:

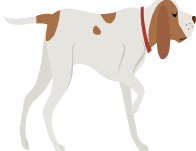
Observable, Measurable and Repeatable.

Bipedal Animal

Walk across soft ground, the school sand pit or clay and make three measurements of stride and pace. The average of these readings will represent a bipedal animal – YOU! (Homo sapiens).

	Observations			
	Reading 1	Reading 2	Reading 3	Average
Pace				
Stride				

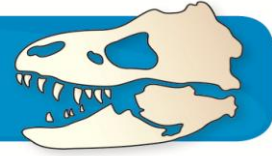
Quadrupedal animal

	Observations			
	Reading 1	Reading 2	Reading 3	Average
Pace				
Stride				

Cows and horses leave deep imprints which are easy to measure. Dogs and cats don't seem to mind water on their paws and they leave obvious wet tracks across concrete and sand. Rats and mice would prefer if their paws are gently dipped in dry flour.

Dinosaur data and dimensions Revision and wordsleuth

fossils



You have been studying data which can tell us more about dinosaurs. What five things can footprints tell us about dinosaurs?

1. _____
2. _____
3. _____
4. _____
5. _____

James Hutton, the “Father of Earth Science” said that the present is the key to the past. Can we use information about the dimensions of present human beings to understand more about dinosaurs? Explain your answer.

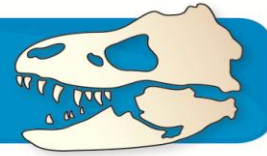
How would the tracks from a quadrupedal dinosaur differ from the tracks of a bipedal dinosaur?

Puzzle for sneaky Scientists

Does your ability to ride a bicycle increase with your shoe size?

Dinosaurs' data and dimensions

fossils



D S C U K Z V P C D M R F Z D
E A R Y R P M E Z O Z O I C U
V U A W A A E R V K O P I H T
R R I I L L U Z K T T U M L G
E I R R E A C D P L I S S O F
S A Y G S E E R O V I B R E H
E N G O S O I S T Y R D O V T
R S N E U N S D T O R A U R R
P I R D T T S D O A D R A M A
D J A I K O Y M X E M C A N C
B N Q R T L E P C D K P N U E
S O T T L O W A E Z N R E R Q
Q F N S F G P P B O O K S D N
K G N E U Y I T S A C I V D E
G K E L S B W A Y S J A N W W



Fossil Fabrication Fun Moulds & Casts

A PALEONTOLOGIST STUDIES FOSSILS. Fossils can be preserved organisms, moulds or casts of the organism or tracks left by the organism. A mould is formed from the material enclosing the fossil. A cast is formed when something else fills the void left by the organism.

Activity To make a fossil leaf mould



Oiled leaf



Plasticine mould

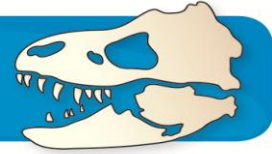


Plaster cast

1. Make a flat disc of plasticine about the size of the palm of your hand.
2. Raise the edges to form a dish.
3. Spray the leaf to be copied with kitchen oil spray.
4. Mould the plasticine firmly onto the leaf. Take care not to puncture the mould.
5. Ease the leaf free from the mould without deforming it.
6. Sketch your mould below indicating any detail lost or deformed from the original leaf.



fossils

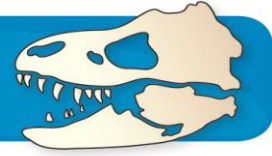


Visit http://en.wikipedia.org/wiki/Ediacaran_biota and copy the photographs of *Dickinsonia costata* into the box below. *D. costata* is one of the earliest complex organisms on Earth and is Australian

What sort of organism/s could the mould of *Dickinsonia costata* be interpreted as? Explain your answer.

Fossil moulds





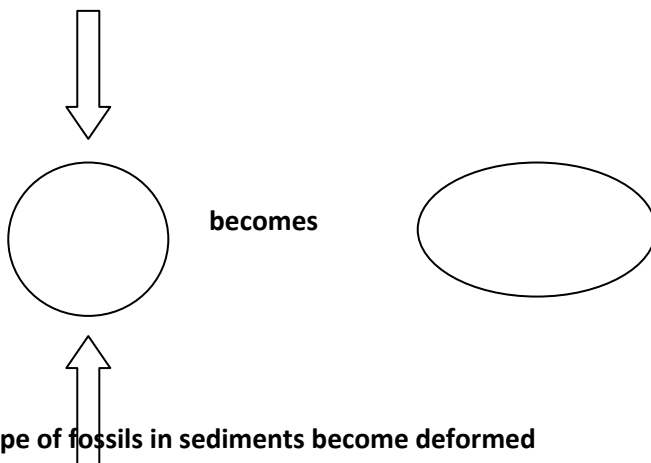
Activity To make a fossil cast

Most creatures which die and fall into the mud and other soft sediments at the bottom of the sea are eaten by scavengers or decay due to the action of fungi and bacteria. All that remains is the mould or imprint where they lay. This shape is filled with later sediments which petrify and form fossil casts.

1. Use the mould you created in the last activity.
2. Your teacher will fill this mould with Plaster of Paris.
3. Gently tap the mould with two fingers for two minutes.
4. After five minutes inscribe your initials in the top of the cast with a pencil or thin stick.
5. Leave until the cast is completely hard.
6. Gently ease the cast from the plasticine mould.
7. Examine the cast. Has any detail been lost forming the cast?

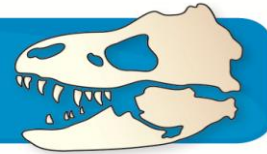
Option Activity Model deformation due to compression.

When sediments are buried they become compressed (squashed) and cemented (stuck together). This process is called tectonic deformation.



1. Create another mould of the original object.
2. Gently deform it to model Earth forces during compression.
3. Fill the mould with Plaster of Paris as you did in the previous activity and leave it to harden.
4. Compare this cast with the original object.

fossils



5. Sketch both below at the same scale.

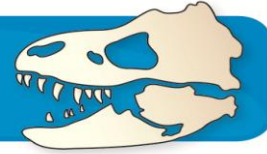
Title _____

<p><i>Original cast</i></p> <p>Scale 1:</p>	<p><i>Deformed cast</i></p> <p>Scale 1:</p>

Comparison with an unaffected fossil can tell us about local deformation forces.

Tectonic deformation can make it difficult to assign a fossil to a particular group.

Differences may be due to deformation or changes in the organism.



Fossil Fabrication Fun Make a replica fossil

THE “Father of Earth Science”, James Hutton , suggested that “The present is the key to the past”. The process which turns dead organisms into fossils nowadays can be used to explain how these things happened in the past. By copying present day Earth processes we can create a replica fossil within in an hour. This activity follows the same steps as “Moulds and casts”.



You will need

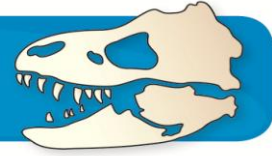
1. A real fossil or a replica fossil. Your teacher may have oiled the fossil first. These fossils are rare and precious. Please treat with respect.
2. A cleared area of bench or table covered with newspaper.
3. A small lump of plasticine or modelling clay.
4. Pre-mixed Plaster of Paris as provided by your teacher.

You will:

1. Warm and soften the plasticine or modelling clay by moving it from hand to hand and by squeezing it gently. When it is pliable, mould it into a flat disc about the size of the palm of your hand. This represents mud at the bottom of the sea.
2. Place the oiled fossil onto the plasticine and mould the plastic round it to form a cup-like mould around the fossil. Take care not to press the fossil too hard into the plasticine to leave a hole. A creature has died and its body has made an impression or mould in the mud.
3. Carefully remove the fossil leaving the mould intact. Since most dead organisms are eaten by scavengers or broken down by decomposers, often all that is left is the mould.
4. Your teacher will fill this mould with mixed Plaster of Paris (magnesium sulphate MgSO_4). A chemical reaction takes place between water and Plaster of Paris and in time it will become hard. Sediments would fill the mould and eventually, under the forces of compaction and concretion,



fossils



harden to form rock.

5. Place the filled mould gently on your newspaper and gently tap the plasticine for two minutes. This will allow any bubbles trapped at the base of the mould to rise up.
6. Leave for about half an hour. During this time the Plaster of Paris will have gone hard.
7. Gently ease the plasticine away from the hardened Plaster of Paris to expose your replica fossil.
8. Paint your replica to make it more realistic. Adding a little sand to paint gives a rock-like texture.

Who wrote "The present is the key to the past"?

What does this statement mean?

Can you think of any ways that you could tell if you were being offered a fake or replica fossil?

Dinosaur skeletons

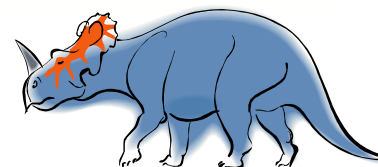
The rarity of fossils has made them precious and collectable. Mary Anning (1799-1847) was a poor fisherman's daughter who lived by the sea at Lyme Regis in England. At low tide fossils including dinosaur bones were exposed. Although the work of recovering fossils was difficult, dangerous and until then exclusively for men, she managed to support her extended family by digging fossils out at low water between tides. She then tried to construct her dinosaurs based on her knowledge of how they were positioned in the rock. She was poorly paid for her work. Fame and fortune went to the rich gentlemen collectors who bought her finds.



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Fossil Fabrication Fun Name your dinosaur



Dinosaurs have descriptive names. Some paleontologists use Latin or Greek to describe the animal.

Stegosaurus	Stego = roof tile Saurus = lizard	A dinosaur with large bony plates which looked like roof tiles
Scotosaurus	Scot = thorn Saurus = lizard	A dinosaur with distinctive spiky skin
Tyrannosaurus	Tyranno = tyrant or king Saurus = lizard	A powerful and frightening dinosaur
Triceratops	Tri = three Ceratops = horns	A three horned dinosaur
Archaeopterix	Archaeo = ancient Opterix = wing	A dinosaur with birdlike "wings"

Other dinosaurs are named after the place they were first found, eg Muttaborrasaurus or the person who found them.

Design your dinosaur, draw it below and give it a descriptive name.

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Dinosaur Names

S D S E A Y M S U C O D O L P I D
 U J H U G T U T S J B N Y G V B J
 R L H T R E T E N U N I B M R G Y
 U Y J I O U T G Y Y B N S R Z Q A
 A B Z N X Z A A N F X P U G R R S
 S N E V Z L B S G A B E H Q C A P
 O M K H A U U A O K O A T H R L O
 N X D Y R S R U M Y D P A D O L T
 N E T Q L I R R T R H E V P T O A
 A M P N Z O A U O X O T Q Q P S R
 R X O W A F S S W P P X H F A A E
 Y X P X Q Q A A T T S R L C R U C
 T P J L E U U E U R U O X I I R I
 J D N W R A R T D R O H B C V U R
 J Y F U X I U R L W U N D E O S T
 J D S G X L S U R U A S O T O C S
 S U L Y T C A D O R E T P B T O B

ALLOSAURUS
 ANKYLOSAURUS
 ARCHAEOPTERIX
 DIPLODOCUS
 HADROSAURUS
 ICHTHYOSAURUS
 MUTTABURRASAUROS

OVIRAPTOR
 PTERODACTYLUS
 SCOTOSAURUS
 STEGASAUROS
 TRICERATOPS
 TYRANNOSAURUS