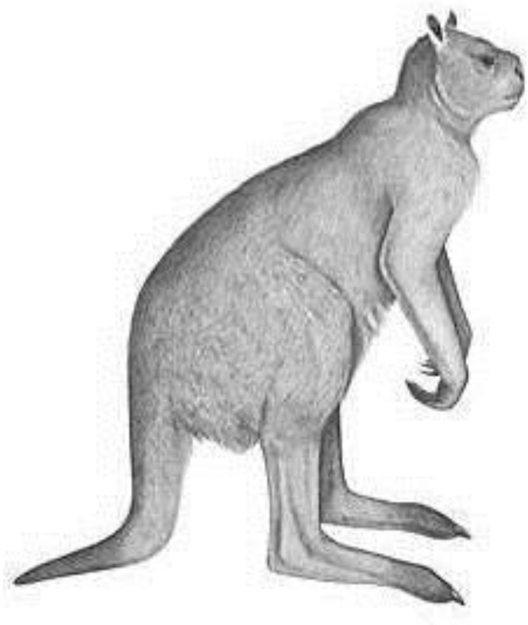
Learning from Fossils

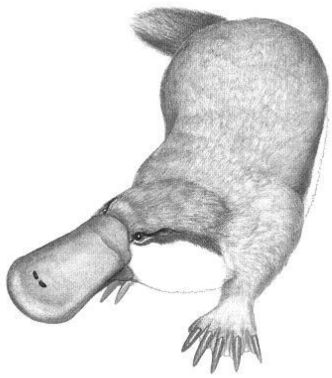
Stage 6 Biology

Educator-led program

Student Activities

Part A – Teacher Notes – see separate document
Part B – Student Activities
Part C – Answers– see separate document





Illustrations: Giant Short-faced Kangaroo and Riversleigh Platypus. Anne Musser, Australian Museum.

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Activity 1: The Diprotodon

Introduction

Diprotodon optatum once roamed much of mainland Australia but was extinct by 30,000 years ago or perhaps 25,000 years ago. It is the largest marsupial that ever lived and was one of Australia's **megafauna**. Many different species of megafauna lived in Australia (and elsewhere around the world) during the Pleistocene Epoch (1.8 million to 12 thousand years ago). Today, Africa still retains many of its megafauna, but in other continents, most megafauna are now extinct.

Illustration: Diprotodon,
Anne Musser, Australian Museum.

The name 'diprotodon' means 'two front teeth' and refers to the two large incisors (front teeth) found in both the upper and lower jaws. *Diprotodon* was a browser (eating the leaves of shrubs) and it used its large incisors to grab and tear off vegetation.

Aim

To become more familiar with the largest of Australia's megafauna and compare *Diprotodon optatum* with one of its closest living relatives, the wombat. Some possible reasons for the extinction of diprotodons will also be considered.

Instructions

Please handle all the specimens gently!

- Specimens labelled 1 to 5 in the Activity box are casts (exact copies) taken from a fossil skeleton of *Diprotodon optatum*.
- The small skull in the bottom layer of the Activity box is a **real** skull of a modern-day wombat – it is very **fragile**!

A. Examining diprotodon fossils

1. How big was *Diprotodon optatum*?

a) Look at **photo A** to get a general impression of the diprotodon's size.

b) Measure the actual length of the diprotodon skull located on the side bench.

____

c) Use your skull measurement and the diprotodon skeleton illustration to estimate the diprotodon's:

i) body length: ________________

ii) body height (to the top of the shoulders): ________________

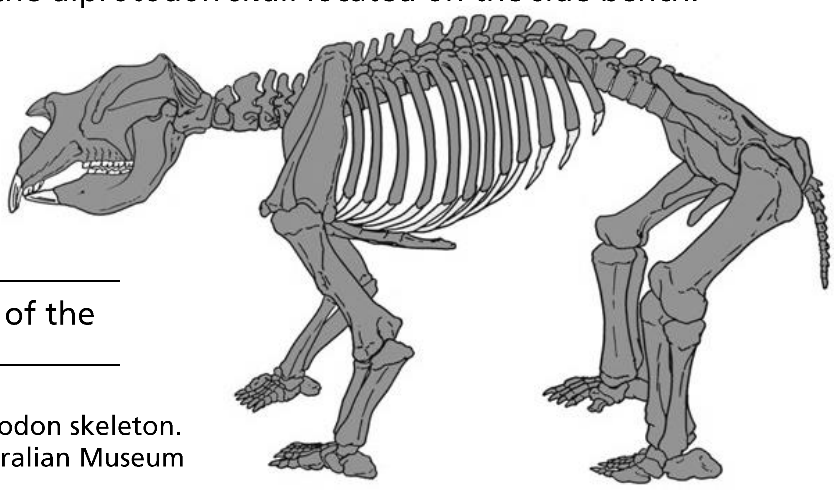

Illustration: Diprotodon skeleton.
Anne Musser, Australian Museum

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2. What are specimens 1 – 5?

a) Examine the specimens 1 - 5 (from the activity box) and match them with structures shown in photos B – H and/or the large skull cast on the side bench.

b) In the table below:

- **i)** complete the missing information in the 'Specimen' column,
- **ii)** match each specimen with the appropriate adaptation by drawing arrows that link the matching pairs.

Specimen

- **1.** rib
- **2.** ___________ foot (front or back foot?)
- **3.** ____________ tooth (what kind of tooth?)
- **4.**
- **5.** pouch bones (epipubic bones)

What is each body part adapted for?

- supports the weight of the pouch – its presence indicates the animal was a marsupial (see photo H.)
- protects vital organs – the heart and lungs
- supports the heavy weight of the animal
- provides body stability rather than flexibility
- allows extensive chewing of tough, fibrous vegetation

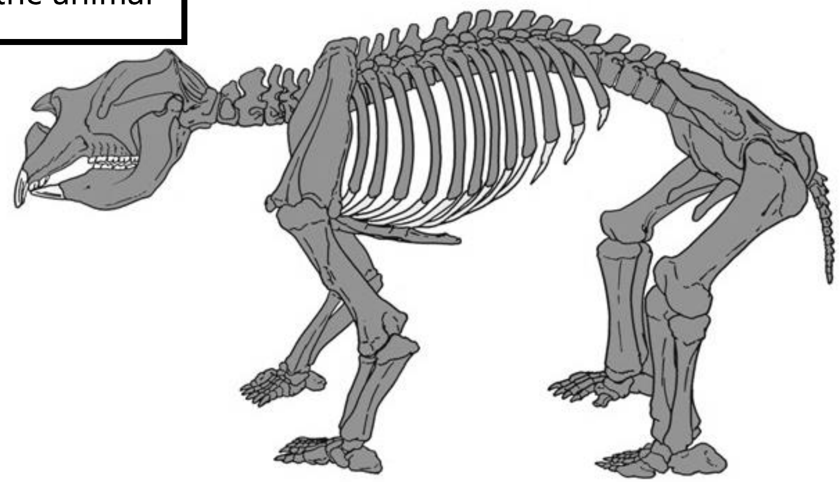


Illustration: Diprotodon skeleton.
Anne Musser, Australian Museum

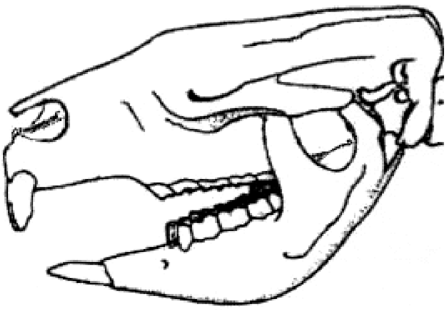
c) Label the skeleton diagram to show the position of each specimen (1 – 5).

B. Comparing the extinct diprotodon to a living relative

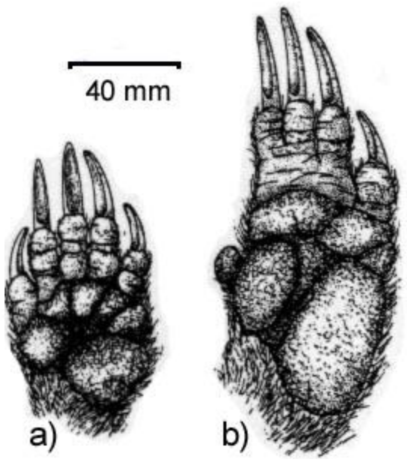
Wombats and koalas are the closest living relatives of the extinct diprotodons. This close relationship is reflected in the many similarities of their skeletons and teeth.
The common ancestor of diprotodons and modern wombats lived about 30 million years ago, so although there are similarities, there are also a number of differences.

3. Examine the following wombat and diprotodon resources and complete the table below.

- **wombat –** the diagrams on this page, the skull in the Activity box and the taxidermied (stuffed) wombat,
- **diprotodon –** the large skull, the photos and the foot and tooth casts in the Activity box.



Wombat skulls:
Left: side view of skull and lower jaw.
Right: base of the skull with the teeth in the upper jaw.
Illustration and photo: Australian Museum.



Wombat feet:
a) is a front left foot,
b) is a back left foot.
The long, broad claws are adapted for digging.
Illustration T. Cochran.

	Comparison of body structures
feet	**Differences:** • relative size of the individual bones within the foot – diprotodon has very bulky foot bones; wombat's are more lightly built to suit a lighter body • claw length / shape – ______ **Similarities:** • toes on front feet (number / size) – ______ • toes on back feet (number / size) – ______
incisors (front teeth)	**Differences:** • the arrangement of the incisors – ______ • number of incisors in upper jaw – ______ **Similarities:** • number of incisors in lower jaw – ______
molars (back teeth)	**Differences:** • height of ridges – ______ • size – ______ **Similarities:** • shape – each molar has 2 lobes (like the number 8) • number of ridges per molar – ______
skull	**Differences:** • degree of flattening at the top of the skull – ______ • complexity of nose area – ______

C. Why did diprotodons become extinct?

4. Look at **photos J and K** – a fossilised *Diprotodon* rib and the close-up of one end showing a mark made by a sharp object. The damage to the rib was made on 'green bone', that is, living bone. Marks made on dead, dry bones look very different. Therefore the mark was made either before the diprotodon's death or very soon afterwards.

a) Examine the mark on the bone. What objects **may** have caused this mark? Complete the following table with additional possible causes due to natural or human-related events (archaeological discoveries show that Aboriginal people lived alongside some of the more recent megafauna including Diprotodons).

Possible cause	My reason for saying this	Problems with this idea
Bullet from a gun	The hole seems the right size for a bullet.	Guns and bullets were not invented at this time.

b) Does the fossilised rib provide evidence of hunting by Indigenous people?

____

c) Is it possible to determine whether the Diprotodon actually died from the rib injury?

____

____

d) Read the information in the box below. There are two main arguments that account for megafauna extinctions. Underline the text that outlines these two arguments.

Megafauna extinctions

By the end of the Pleistocene (11,800 years ago), an incredible 86 per cent of Australia's megafauna had disappeared in extinctions that affected megafauna all over the world. In Australia this included diprotodontids, short-faced kangaroos, marsupial lions, horned turtles and giant goannas.

Arguments about why they died have raged since the first megafauna fossils were discovered. Climate change in the Late Pleistocene is one suggestion. At this time the world cooled and dried. The other suggestion is human impact. It proposes that the extinctions were caused by humans, perhaps through hunting combined with ecological disruption from deliberate burning (which affected the food resources of diprotodons and other megafauna). The range of possibilities also includes various combinations of both climate change and human impact.

e) Examine **photo I**. It compares the onset of megafauna extinctions with human arrival times in Australia, North America and New Zealand (note the white circles on the diagram).
Use the evidence presented in question 4 and decide which argument(s) you support for the cause of megafauna extinctions. Explain your answer.

____

____

____

Activity 2: Short-faced kangaroos

Introduction

Short-faced kangaroos (sthenurines) are a group of kangaroos that were common and widespread across Australia in the last two million years but they are now all extinct.

They short-faced kangaroos were examples of Australia's **megafauna**. Their fossils have revealed about 30 different species in three main genera – *Sthenurus*, *Simosthenurus* and *Procoptodon*.

Illustration: A short-faced kangaroo, *Simosthenurus occidentalis.* Anne Musser, Australian Museum.

Aim

To compare the sizes of short-faced kangaroo fossils with matching bones from a close living relative, the modern Swamp Wallaby. These comparisons will then be used to suggest how many different species of short-faced kangaroos might be represented by the fossils in the Activity.

Instructions

Please handle all the specimens gently – they are all real!

- Inside the small plastic box are a number of specimens in plastic zip-lock bags. These are **real bones** from a **modern-day wallaby**, *Wallabia bicolor*. They are **fragile**. Note: labels inside the bags name the part of the wallaby skeleton that each specimen represents.
- In the base of the large plastic box several specimens are lying in holes made in the protective black foam. These are **real fossils** from extinct **short-faced kangaroos**.

A. Comparing short-faced kangaroos with a modern relative

1. The bodies of short-faced kangaroos show some **differences** when compared with modern kangaroos and wallabies. Examine the following resources:

- the reconstruction of the Giant Short-faced Kangaroo, *Procoptodon goliah*,
- the two photos of short-faced kangaroos,
- the taxidermied (stuffed) modern wallaby.

a) Short-faced kangaroos ate the leaves of shrubs and trees and they could pull down branches to help them reach their food. How do their arms compare with those of modern kangaroos / wallabies (which graze on grasses)?

____

b) Modern kangaroos / wallabies have four toes on their hind feet whereas short-faced kangaroos have: ______________

c) Describe one difference between the face shape of a short-faced kangaroo and a modern kangaroo / wallaby.

____

B. Using a modern wallaby to investigate fossils from short-faced kangaroos

In this section you will focus on the similarities between short-faced kangaroos and their modern relatives to learn more about some short-faced kangaroo fossils. You will use a modern Swamp Wallaby's bones and teeth to:

- identify short-faced kangaroo fossils,
- determine the sizes of the fossil short-faced kangaroos.

2. Complete the table by following the instructions below.

a) Select a **fossil** from the large box (note that one fossil has already been done) and then match it to one of the wallaby skeleton specimens (in the plastic bags).
Hint: Do not match the specimens by their size as the short-faced kangaroos and the modern wallaby may be very different in size. Instead, match the specimens by looking closely at the **shapes** and **structures**.
Read the **label** in the plastic bag to identify the matching fossil. Write the details in the first column of the table. Continue across the table before selecting the next fossil to match.

b) Complete the second column by comparing the **fossil's** size with the matching part of the wallaby skeleton.

c) In the last column, you need to work out exactly how much bigger or smaller the fossil is when compared with the matching part of the wallaby skeleton.
To do this, accurately measure matching parts on **both** the fossil and the wallaby skeleton then use the formula given in the table.
Hint: If the fossil is broken or is missing parts, take care to only compare their sizes by using something **present on both** the fossil and wallaby specimens.

What part of the body is the fossil from?	**Fossil size (compared with the modern wallaby)**	
	Is the **fossil:** smaller / similar / larger?	**fossil's relative size** expressed as a percentage **= (fossil size ÷ wallaby size) × 100**
Example: **1.** partial upper jaw with 3 complete molar teeth	larger	(5.0 ÷ 2.5) × 100 = **200%** (measured along top of 3 teeth)
2.		%
3.		%
4.		%
5.		%

C. Interpreting your results

The **last column** of the data table shows the fossil kangaroo's relative size (compared with a modern-day Swamp Wallaby).
What do these numbers mean?
If you recorded a size of:

- **100%** then the ancient kangaroo bone is the **same size** as the Swamp Wallaby bone that you compared it with.
- **200%** - the ancient kangaroo bone is **twice as big** as the Swamp Wallaby bone.
- **50%** - the ancient kangaroo bone is **half as big** as the Swamp Wallaby bone.

3. Look at the data in the last column of your answer table **including the example**. How many **different sized** short faced kangaroos did you have? (That is, how many **different percentages** were there?) ____________

What do the size differences mean?
An expert has examined these fossils and found that they all came from **adult** kangaroos. The size differences are therefore not due to age (juveniles versus adults).

The different sized kangaroos **could** be:

- **different species** of ancient kangaroo,
- the **same species** of kangaroo with some fossils from larger **male** kangaroos and others from smaller **females**.

4. To investigate whether your fossils are from different species of kangaroos or whether some may be larger males and some smaller females from the same species we can compare modern kangaroo sizes.
Examine the information card, 'Body sizes of modern-day kangaroos'.
The card shows that adult males are larger than adult females by up to ___________ %.

5. List the five fossil kangaroo sizes in your data table so that they are in order (lowest to highest).

_____________%

_____________%

_____________%

_____________%

_____________%

6. Next, start at the top of your list and work down, **grouping** together any sizes within the male/female size range recorded in question **4**. (Note: size range groups may contain only one fossil or two or more fossils.)
How many different **size range groups** do you have?_____________

7. How many different species of short-faced kangaroos do you think the five fossils could represent?

____

____

8. Do you think comparing the fossils of extinct animals with close living relatives is useful. Explain.

____

____

____

____

The short-faced kangaroo fossils used in this Activity are all from **Wellington Caves** – a significant fossil site located near Wellington in central NSW. The caves contain many fossils from animals that slipped and fell into the deep holes that form these caves. The short-faced kangaroo and other megafauna fossils from these caves are from animals that lived in the Pleistocene Epoch (1.8 million to 11,800 years ago).

9. What additional information could help to clarify your answer regarding how many **different** species of short-faced kangaroos the **fossils** might actually represent?

____

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____

Photo: Skeleton of a short-faced kangaroo, *Simosthenurus occidentalis*. Australian Museum.

Activity 3: Mammal teeth

Introduction

Teeth are extremely hard and fossilise more readily than any other part of the body. Teeth also provide a great deal of information about the animal from which they came and scientists can often identify and classify animals using only their teeth.

Teeth can also tell us about the type of food an animal eats and how it obtains that food. This is especially true for mammals (animals that have fur/hair and produce milk for their young).

Unlike other animals, mammals can have a variety of teeth – incisors, canines, premolars and molars. The actual types of teeth and their number, size and shape varies greatly from one type of mammal to another according to their use.

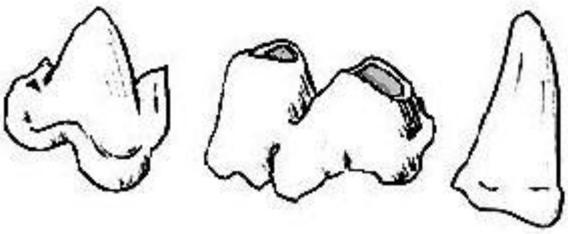

Illustration: Mammal teeth. Australian Museum.

Aim

To examine some modern native Australian mammals to see a variety of mammal teeth, determine the functions of these teeth and relate function to diet. Fossil teeth of two extinct Australian mammals will then be compared with those of modern mammals to help identify the type of mammal and its diet.

Instructions

Please handle all the specimens gently – some of them are very **fragile**!
Refer to the card 'Photo inventory of specimens'. The Activity Box contains the following specimens:

- a cast of a human skull,
- **real** skulls of a modern dingo, kangaroo and koala,
- a cast of a skull from a quoll (marsupial cat),
- two fossils from extinct Australian mammals – one is a **real** fossil of a jaw fragment containing two teeth and the other is a half lower jaw cast. At the end of the Activity your task is to identify the mammals these fossils came from and/or their diets.

Photo: Tasmanian Tiger jaw with teeth. Australian Museum.

A. Mammal tooth types and their functions

The illustration shows the upper jaw of an **adult human**.

The left and right hand sides of a jaw usually contain the same number and types of teeth (provided they have not been damaged or diseased).

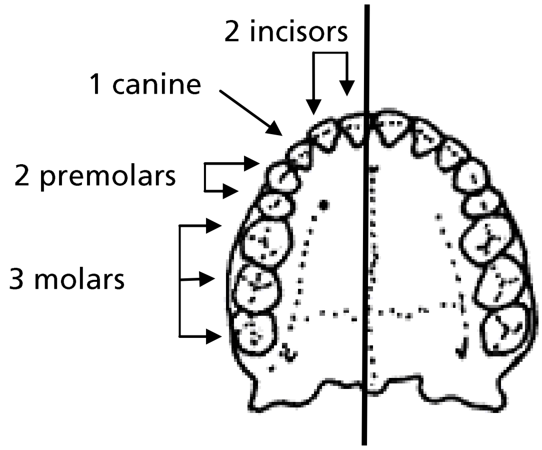

Illustration: Human adult teeth, Australian Museum.

The different types of teeth and how many there are of each type can be abbreviated into a **dental formula**. The dental formula for adult humans is:

$$\frac{2}{2} \quad \frac{1}{1} \quad \frac{2}{2} \quad \frac{3}{3}$$

The numbers above the lines refer to teeth in the **upper** jaw. The number of incisors is given first, then canines, then premolars, then molars.

The numbers below the lines refer to teeth in the **lower** jaw.

That is, each side of an adult human **upper** jaw has 2 incisors, 1 canine, 2 premolars and 3 molar teeth.

In humans, the **lower** jaw also has 2 incisors, 1 canine, 2 premolars and 3 molar teeth.

1. Locate the different types of teeth (outlined above) on the human skull cast in the Activity box.

2. Think about how you use each of your different tooth types to help break down the food you eat. For example, think about eating a carrot, a hamburger and a chicken leg. Refer to the tooth functions listed in the box below and write any relevant function(s) for each type of human tooth in the spaces below. Note: not all functions are relevant for human teeth.

Examples of tooth functions:

cut	hold	crush
shear	tear	chew
slice	pierce	grind

incisors: ________________________________

canines: ________________________________

premolars: ______________________________

molars: _________________________________

B. Tooth types and functions, and the diets of some native Australian mammals

3. Look at the native mammal skulls in the Activity box. Use the **dental formula** information provided in the table (below) to identify each animal's incisors, canines, premolars and molars. (**Note**: the number and type of teeth may differ in the upper and lower jaws, or some tooth types may be absent!)

4. Look closely at the **shapes** of the teeth and also **how the teeth close** against one another when the jaws close (for example, do they close to form a flat, grinding surface or do they shear (close with a scissor-like cutting action). Select relevant tooth functions for each tooth type in each skull using the list in the adjacent box. Write these into each appropriate column of the table.

5. Fill in the final column of the table using the 'Dietary groups' information from the adjacent box.

Examples of tooth functions:

cut	hold	crush
shear	tear	chew
slice	pierce	grind

Dietary groups:
Carnivore (meat / bone)
Omnivore (plants and meat)
Herbivore (plants) which includes:
- Grazer (grass-eating)
- Browser (leaf- eating)

Mammal	Adult dental formula (see previous page for an explanation)	Function(s) of different tooth types:				Diet	Dietary group
		incisors	canines	premolars	molars		
dingo	$\frac{3}{3}\ \frac{1}{1}\ \frac{4}{4}\ \frac{2}{3}$	cut, hold				meat, bones	
kangaroo	$\frac{3}{1}\ \frac{0}{0}\ \frac{1}{1}\ \frac{4}{4}$		no function (as no canines)			grass (often with tough stalks and leaves)	
quoll	$\frac{4}{3}\ \frac{1}{1}\ \frac{2}{2}\ \frac{4}{4}$			shear, cut		meat, bones	
koala	$\frac{3}{1}\ \frac{1}{0}\ \frac{1}{1}\ \frac{4}{4}$				chew, grind	eucalyptus leaves (softer, new growth)	

C. Using fossils to identify mammals and their diets

6. Look at the small fossil in your Activity box. It is a jaw fragment with two complete molar teeth. It is from an extinct relative of one of the native mammals in this activity.

a) Compare the fossil with the various teeth from the native mammal skulls in the box. What kind of mammal do you think the fossil came from? Why?

____

____

b) What do you think this extinct animal ate? ______________________________

c) Did the fossil animal and its modern relative have similar body sizes? Explain.

____

____

7. Now look at the larger fossil jaw in your Activity box. It is half a lower jaw with three unusual teeth – one front **incisor**, one large **premolar** and one smaller **molar** at the back. It is from an extinct Australian mammal.

a) What kind of diet do you think this extinct animal had? Why?

____

b) Do you think the extinct Australian mammal that the larger fossil came from is closely related to any of the modern animals in the Activity box? Explain.

____

____

D. Interpreting fossils

8. Teeth can tell us about an animal's diet and they can also provide information about other characteristics. Name three other characteristics about an animal that we can determine from its **teeth**.

____

____

____

9. A complete fossil skeleton can give additional clues about an animal's lifestyle. Describe ways in which a **skeleton's** features could indicate if an animal was either arboreal (tree-dwelling) or fossorial (ground dwelling).

____

____

____

____

Activity 4: Reconstructing animals from fossils

Introduction

Palaeontologists often reconstruct whole animals from just a few fossilised fragments. To do this, palaeontologists make accurate measurements and compare the fossilised animal with a close living relative.

Body dimensions of the fossil animal can be estimated using the proportions of the living relative until there is confirmation from more complete fossil evidence.

Photo: A vertebra. Australian Museum.

Aim

To identify and reconstruct animals by comparing fossils with bones from modern animals.

Instructions

Please handle all the specimens gently!
The specimens include a variety of vertebrae from the backbones of both extinct and modern-day animals. Many of the specimens are **real** and can be fragile.

A. Identifying fossils

1. Look at the two human vertebrae, the three snake vertebrae and the kangaroo vertebra. Examine them to determine how each one joins to the next vertebra in the backbone. Circle the words below that best describe how they each connect.

Vertebrae	How does each vertebra join to the next one?
human (a mammal)	flat surfaces or ball and socket
snake (a reptile)	flat surfaces or ball and socket
kangaroo (a mammal)	flat surfaces or ball and socket

2. Look at Fossil A (the tiny fossil in the plastic tube) and Fossil B (the three large vertebrae casts). Use the information gathered in question 1 to decide if each fossil is from a **reptile or mammal**. Give **reasons** for your answers.

Fossil A is from a ________________________________

Fossil B is from a ________________________________

3. Look at the vertebrae drawings (in the folder) to narrow down the type of animal that Fossil A and Fossil B have each come from (Hint: look at the shape of the ball).

Fossil A is from a: ________________________________

Fossil B is from a: ________________________________

B. Estimating the size of a snake

It is possible to estimate the size of a snake using a single fossilised vertebra. The calculation uses a simple ratio of body features determined from measurements on modern snakes. An example is shown below.

	Length of one vertebra (cm)	Width of animal (cm)	Length of animal (cm)
Modern snake measurements	2	10	400

The measurements of 2, 10 and 400 centimetres (above) can then be converted into a ratio, written 2 : 10 : 400.
By convention the first number in a ratio is 1, so (after dividing everything by 2 in this case) this ratio becomes:

> **Modern snake ratio = 1 : 5 : 200**
>
> That is, for every 1 centimetre length of vertebra, the width of the snake is 5 times bigger and the length of the snake is 200 times bigger.

4. Follow the steps below to estimate the width and length of the snake from which Fossil A came.

a) Use the **specimen** of Fossil A to obtain a measurement of its length. (Measure the length from the outer edge of the ball to the outer rim of the socket as indicated on the picture.) Write your measurement of Fossil A in the table below.

b) Using the modern snake ratio (1 : 5 : 200), calculate the width and length of the fossil snake by multiplying your Fossil A measurement with each of the ratio numbers. Fill in your width and length answers below.

	Length of vertebra (cm)	Width of animal (cm)	Length of animal (cm)
Modern snake ratio	**1** :	**5** :	**200**
Fossil snake sizes	Fossil A =		

C. Estimating the sizes of animals with more complicated bodies

Snakes have a very simple body shape. For more complicated animals extra ratios need to be calculated that reflect the relevant features of the animal such as where the legs are positioned or perhaps how long the neck is, or how long the tail is.

Here you will estimate the size of the animal that Fossil B came from by making comparisons with a modern-day relative.
Fossil B is from an ancient Australian megafauna lizard called *Megalania*.
You will use a modern relative – a goanna – as a comparison (you'll use a goanna x-ray).

5. Fill in the table below by working through the following steps:

a) Use the **modern goanna x-ray** to:

- **i)** measure the length of **three** vertebrae from the central part of the body.
- **ii)** measure the distance between the goanna's front and back legs (along the backbone).
- **iii)** measure the total length of the goanna from nose to tip of tail.
  Note that the tail curls around the edge of the x-ray and it can be tricky to see the end, so take care to measure the entire length.

b) Calculate the **modern goanna ratio** by using the measurements taken above.
(The ratio is obtained by dividing the three goanna measurements by the smallest goanna measurement and then rounding off to the nearest whole number).

c) Measure the fossils from the **fossil lizard** *Megalania*. That is, measure the total length of the **three** vertebrae of Fossil B.

d) Use the Modern goanna ratio and the fossil measurement collected in c) to calculate the distance between the front and back legs and the total length of the fossil lizard, *Megalania*.

	Length of **3** vertebrae (cm)	Distance between front and back legs (cm)	Total length of animal (cm)
Modern goanna measurements (from the x-ray)			
Modern goanna ratio	**1**	**:**	**:**
Fossil lizard (*Megalania*) **sizes**	Fossil B =		

D. Discussion questions

Palaeontologists often examine modern animals to learn about those from the past.

Comparisons between the fossils of animals from the past and their modern relatives can be very informative. By looking for similarities, we can get clues about the appearance, diet and behaviour of extinct animals and we can also study changes that may have occurred over time.

6. How accurate were the techniques used here? What problems might be encountered in this scientific process? What could you do to avoid or minimise them?

7. In this activity you have identified and reconstructed body dimensions for two different reptiles by using fossils and making comparisons with modern relatives. Do you think the same process could be applied to reconstruct extinct **mammals** from their fossil remains? Why / why not?

Activity 5: Platypus evolution

Introduction

Platypuses are Australia's greatest mammal survivors. Platypus ancestors have lived in Australia for over 110 million years but over this long period, platypuses have changed as they adapted to their environments.

Illustration: Riversleigh Platypus, *Obdurodon dicksoni.* Anne Musser.

Aim

To investigate how platypuses have changed over the last 15 million years and consider how knowledge about ancient platypuses can inform us about the future of the modern Platypus.

Instructions

Please handle the specimens gently!

- The larger specimen in the Activity box is a cast (exact copy) of a fossilised skull of the extinct Riversleigh Platypus, *Obdurodon dicksoni*.
- The smaller specimens in the Activity box are skull and lower jaw casts from the modern-day Platypus, *Ornithorhynchus anatinus*.
- A **real** taxidermied modern-day Platypus is also available for viewing (it may be on a side bench or with another group).

The modern Platypus
Modern Platypus males reach 60 centimetres and three kilograms, and females just 55 centimetres and 1.75 kilograms. They are common in the rivers, streams and lakes of eastern Australia – but you'll rarely see them. They are very shy and most active at night. Platypuses dig burrows with their powerful, clawed feet. They average 11 hours a day in the water and dive about 75 times an hour. They have streamlined bodies and webbed feet to help them swim efficiently.
Platypuses hunt for small aquatic invertebrates including crustaceans (such as yabbies), worms and insects. They close their eyes, nostrils and ears underwater. They find food with bills that have a very well-developed sense of touch and also special electroreceptors that detect the tiny electrical fields produced by animals' bodies.

1. Use the information above and your observations to name three additional features of the modern Platypus that are adaptations to its aquatic environment and explain how / why each is an adaptation.

feature	reason it is an adaptation
close their eyes, ears and nostrils underwater	stops water getting in when hunting or moving about underwater

2. Carefully examine the skulls of the Riversleigh Platypus and the modern Platypus. Compare and contrast the similarities and differences between the two. Record your observations in the following table.

	Riversleigh Platypus *Obdurodon dicksoni*	**Modern Platypus** *Ornithorhynchus anatinus*
Age	15 - 20 million years ago	present-day
Size of skull (larger/smaller/same)		
Relative length of bill (longer/smaller/same)		
Evidence of **deep** sockets to hold the molar (back) teeth? (yes/no)		
Evidence of premolar teeth? (premolars are located just in front of the molars) (yes/no)		
Other observations		

3. What do the differences between the Riversleigh and modern Platypus suggest about the different diets of the two species?

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Photo: Base of *Obdurodon dicksoni* skull showing cranium and bill. Australian Museum.

4. Using the information from questions 2 and 3, describe at least two ways in which the modern Platypus has become very specialised.

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5. What could this specialisation mean for the long term future of the Platypus?

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