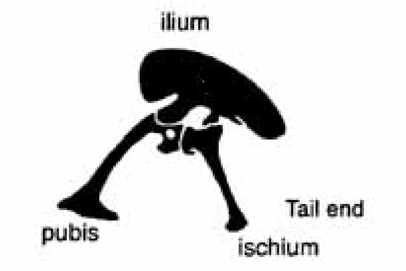
Background information

The dinosaur family tree

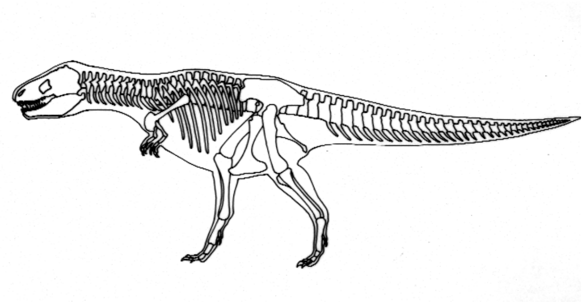
Dinosaurs are distinguished from other ancient reptiles such as crocodiles because of their upright stance. Dinosaur skeletons indicate that they all walked with a straight-legged action, rather than a splayed-legged one. They lived between 200 and 280 million years ago.
All dinosaurs are further grouped according to their particular hip-structure as follows:

Saurischian or 'lizard-hipped' dinosaurs

In the saurischia the hip bones are arranged like those of other reptiles with one of the two bones below the hip joint pointing forwards (the pubis) and the other backwards (the ischium).

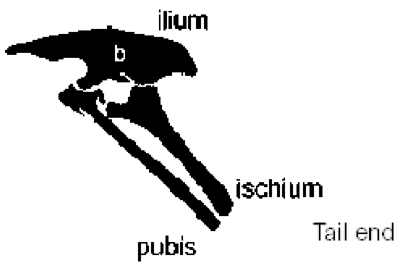


Hip joints of the lizard-hipped *saurischia*

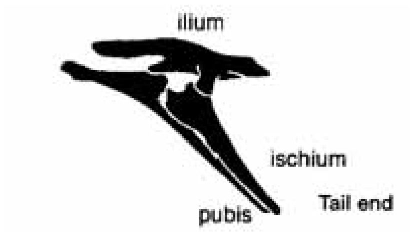


Note the saurischian hip ofAllosaurus

The saurischians included enormous plant-eating sauropods, that walked on all fours such as *Apatosaurus*, and large two-legged carnivorous theropods including *Tyrannosaurus rex* and *Allosaurus*.



Hip joints of an early bird-hipped *ornithiscia*



Hip joint of a late bird-hipped *ornithiscia,* note the extended pubis bone.

Ornithischian or 'bird-hipped' dinosaurs

In the ornithischia both of the pubic bones bones point backwards although in later forms there is a forward projecting part of the pubis.
Ornithischian dinosaurs had a wider pelvis than the saurischians, possibly making them more stable while moving. Other differences in the skeletons of the two groups include the presence in the ornithischians of an extra bone at the front of the lower jaw (predentary bone) and thin bony rods supporting their backbone. The saurischians have neither of these characteristics. Among the ornithischians were the duck-billed hadrosaurs like *Maiasaurus*, and plated stegosaurs such as *Stegosaurus*. All the ornithischians are thought to have been plant-eaters.

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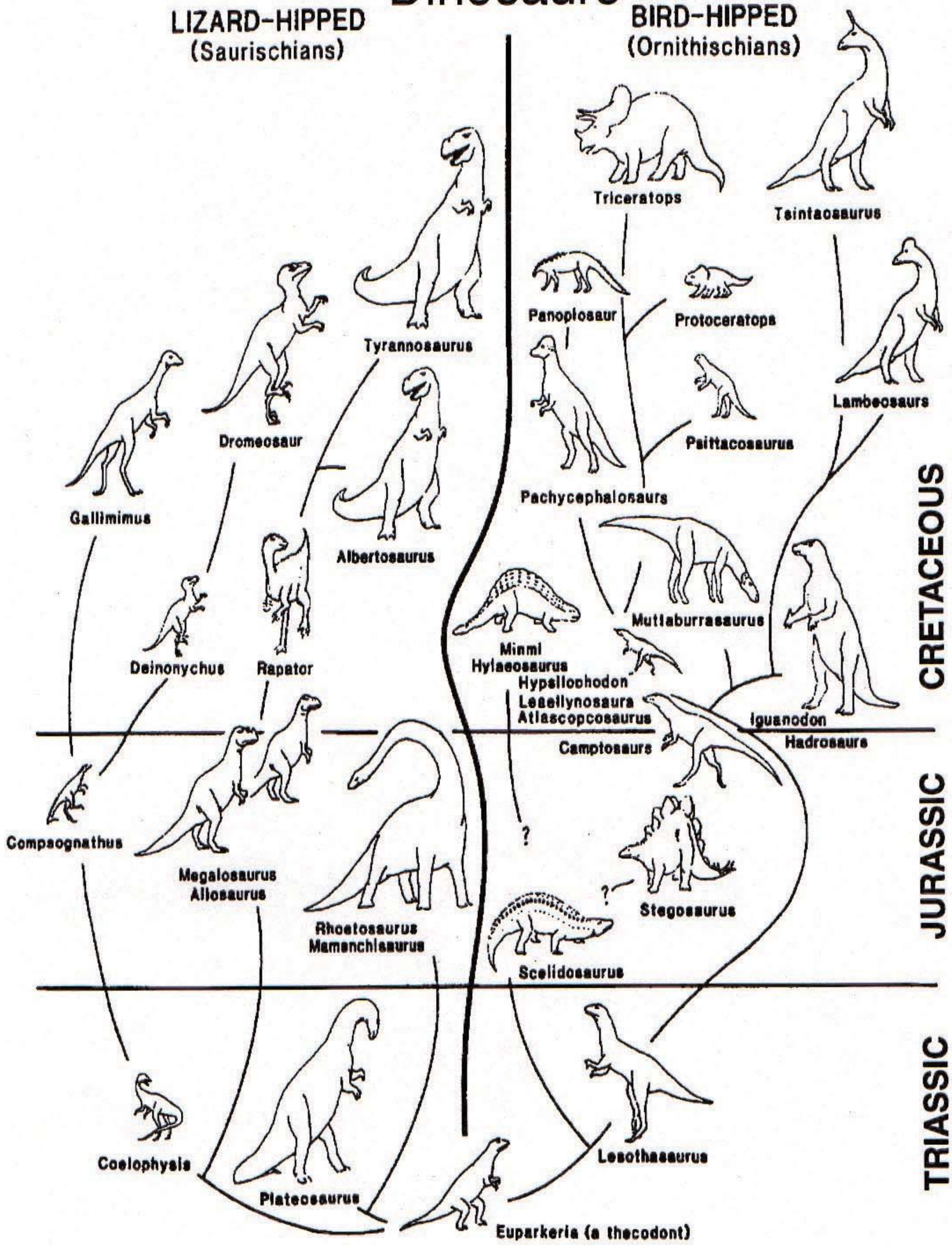
Dinosaurs


LIZARD-HIPPED
(Saurischians)
BIRD-HIPPED
(Ornithischians)
Triceratops
Tsintaosaurus
Panoplosaur
Protoceratops
Tyrannosaurus
Lambeosaurs
Dromeosaur
Psittacosaurus
Pachycephalosaurs
Gallimimus
Albertosaurus
Muttaburrasaurus
Minmi
Hylaeosaurus
Hypsilophodon
Leaellynosaura
Atlascopcosaurus
Deinonychus
Rapator
Iguanodon
Hadrosaurs
Camptosaurs
Compsognathus
Megalosaurus
Allosaurus
Stegosaurus
Rhoetosaurus
Mamenchisaurus
Scelidosaurus
Coelophysis
Lesothosaurus
Plateosaurus
Euparkeria (a thecodont)
CRETACEOUS
JURASSIC
TRIASSIC

Dinosaur controversies

Many 'facts' about the dinosaurs remain controversial.
The*Terrorsaurus* exhibition examines a number of controversial issues such as
- Did parent dinosaurs care for their young?
- What kind of noises did they make?
- What was the colour of their skin?
- How did they move?

It also proposes a number of extinction theories for students to explore, some of which are discussed below.

Why did the dinosaurs become extinct?

Nobody knows for sure. Many explanations have been proposed to account for the mass extinctions which occurred at the end of the Cretaceous. Listed below are a number of reasonable explanations and also a few silly ones.
We've chosen to examine just two of these since they also feature in the exhibition.

Biological causes
- too large to hibernate
- malformations of eggshells
- competition with mammals
- loss of eggs to egg eating mammals
- collapse of the food web
- too many predatory species
- parasites

Terrestrial (non-biological) causes
- climate change (getting wetter, warmer, colder, drier)
- changes in atmospheric pressure
- floods
- earthquakes
- volcanic dust
- break up of super-continents by sea floor spreading
- spillage of frigid Arctic Ocean water into warm southern seas

Extraterrestrial causes
- reversal of terrestrial magnetic field allowing flood of cosmic radiation
- shift of rotational poles
- sunspots
- supernovae
- meteorites and comets

Possible site of the meteorite impact which caused the end of the dinosaurs.

Miscellaneous causes
- entropy
- noah's flood
- God's will

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Volcanoes, floods, earthquakes, disasters

There were a large number of active volcanoes at the end of the Cretaceous, and this might have triggered global warming through the Greenhouse effect. This might have killed many dinosaurs, but probably not all, because dinosaurs occupied a wide variety of ecological niches.

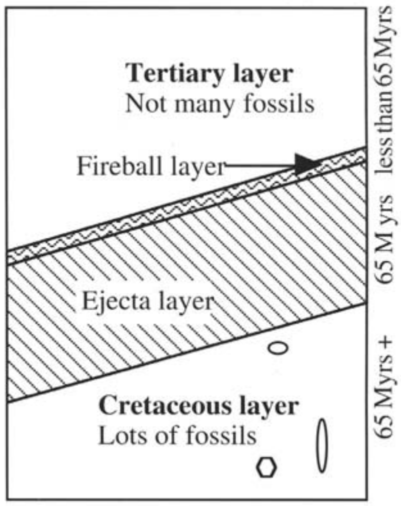
It remains a mystery why some reptile families such as crocodiles and tortoises survived while dinosaurs, pterosaurs and most marine retiles died out.

Bombardment from space

The rock layer that marks the end of the dinosaur era is peppered with a mysterious substance called iridium, a rare metal on Earth but very common in meteorites. This suggests that a huge asteroid, 10 to 15 kilometres across, hit the Earth, sending shock waves across the world and hurling massive dust clouds into the upper atmosphere, blocking out the sun for several months. No sunlight means no plants, which means no food for the plant-eating dinosaurs, and ultimately, no plant-eating dinosaurs for the meat-eating dinosaurs... so just about every-body goes hungry.

Sounds like a crazy idea?

There is a massive crater the size of Tasmania just off the Yucatan Peninsula in Central America, and it is just the right size and the right age to make scientists think it is the best explanation so far. But obviously some life survived because there is life on Earth today.



Cross section of the earth showing Tertiary, Fireball, Ejecta and Cretaceous layers

What can Victorian dinosaurs tell us about extinction theories?

Like any typical Victorian, our local dinosaurs showed that they could tolerate cold weather all year round if necessary Victoria was a sub-Antarctic region in the Mesozoic era, therefore, our dinosaurs would regularly endure up to three months of darkness during winter. This is significant because many theories about the extinction of dinosaurs propose that light from the sun was extinguished, due to either a comet impact or increased levels of volcanic ash. According to these theories, the world got cold and dark, the plants all died and the dinosaurs starved.

How would this kill the Victorian dinosaurs, who were able to survive Antarctic winters? The darkness would have to have lasted much longer than a single winter to have killed off the Victorian dinosaurs. Subsequently, scientists are having to rethink their theories about dinosaur extinction.

In addition to this, our local dinosaurs do not conform to the conventional views about the origins of some of the major dinosaur families, and when and how they died out. Our discoveries suggest that horned dinosaurs and the ostrich-like ornithomimosaurs may have originated in the great southern supercontinent, Gondwana, and only later spread northwards to the rest of the world. Allosaurs, the large predatory carnosaurs may have survived for 20 million years longer in Gondwana than anywhere else in the world. Crocodilian-like labyrinthodont relics found in Victoria suggest these creatures lived for another 85 million years after they were thought to be extinct elsewhere.

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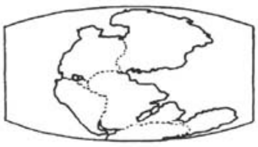
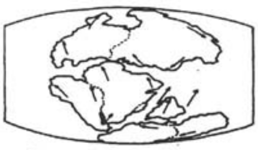
Continental drift

Scientists have discovered that the continents continue to move slowly. They now understand that, in the time of the dinosaurs, Australia was connected to Antarctica. This means that Australia was much further south than it is today and even though temperatures were warmer during that time, the southern parts of Australia would have endured long periods of darkness. Understanding the movement of continents over time, gives us clues about changes in weather and volcanic and earthquake action, both of which might have contributed to dinosaur extinction.

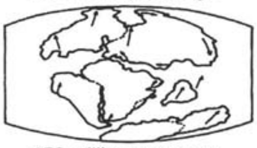
The continents as we know them



240 million years ago



205 million years ago



150 million years ago

135 million years ago

55 million years ago
to the present

The geological and fossil record demonstrates that the crustal plates that make up the exposed surface of the Earth have been colliding and separating since the Earth cooled over 4 billion years ago. 650 million years ago Australia, Antarctica and India, moving south on one side of the planet, collided with Africa and South America moving south on the other side and formed a vast super continent named Gondwana. Two hundred million years later, Gondwana collided with the northern continents forming the super-continent, Pangea. After more than 200 million years, various continental plates that formed Pangea tore apart again. Australia remained joined to Antarctica until 55 million years ago, when it separated and, attached to the southeast edge of the Indian oceanic plate, started its slow progress north. Twenty million years ago, Australia collided with Indonesia, pushing up the New Guinea highlands.

Plate tectonics

In the last thirty or forty years, geologists and oceanographers have amassed a vast body of evidence to support the theory of plate tectonics. It is now universally accepted that the crust of the Earth is in constant motion as 15 continental and ocean floor plates slide past, separate from, and collide with one another.

Why do the plates move?

We don't know with certainty but the most widely held hypothesis is that convection currents drive the plates. Warm fluids, including molten rock, tend to expand and rise as heat lowers their density. Plastic rocks (rocks which have been superheated) within the aesthenosphere appear to rise towards the crust, spreading out and sinking back down as they cool. They are then rewarmed by heat generated by radioactive decay in the Earth's core, which continues the convection cycle. The slow, horizontal movement of the plastic rocks moves the relatively thin crustal rocks like rafts on a sea of hot tar. All the plates of the Earth's crust are joined to one another along their boundaries. When any plate moves it disturbs its neighbours.

This can happen in one of three ways:

- *shear*, where plates slip past each other
- *divergence,* where plates separate
- *convergence,* where plates collide

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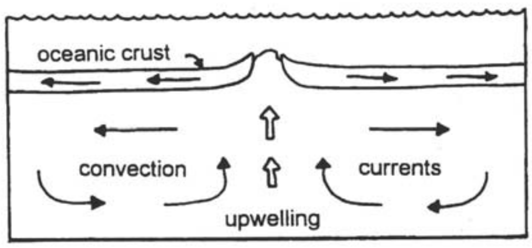
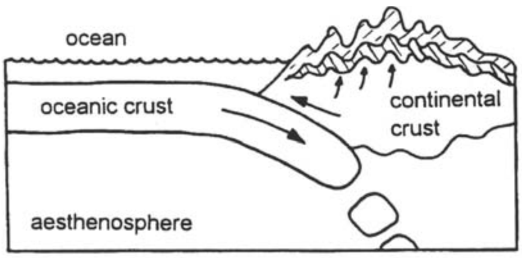
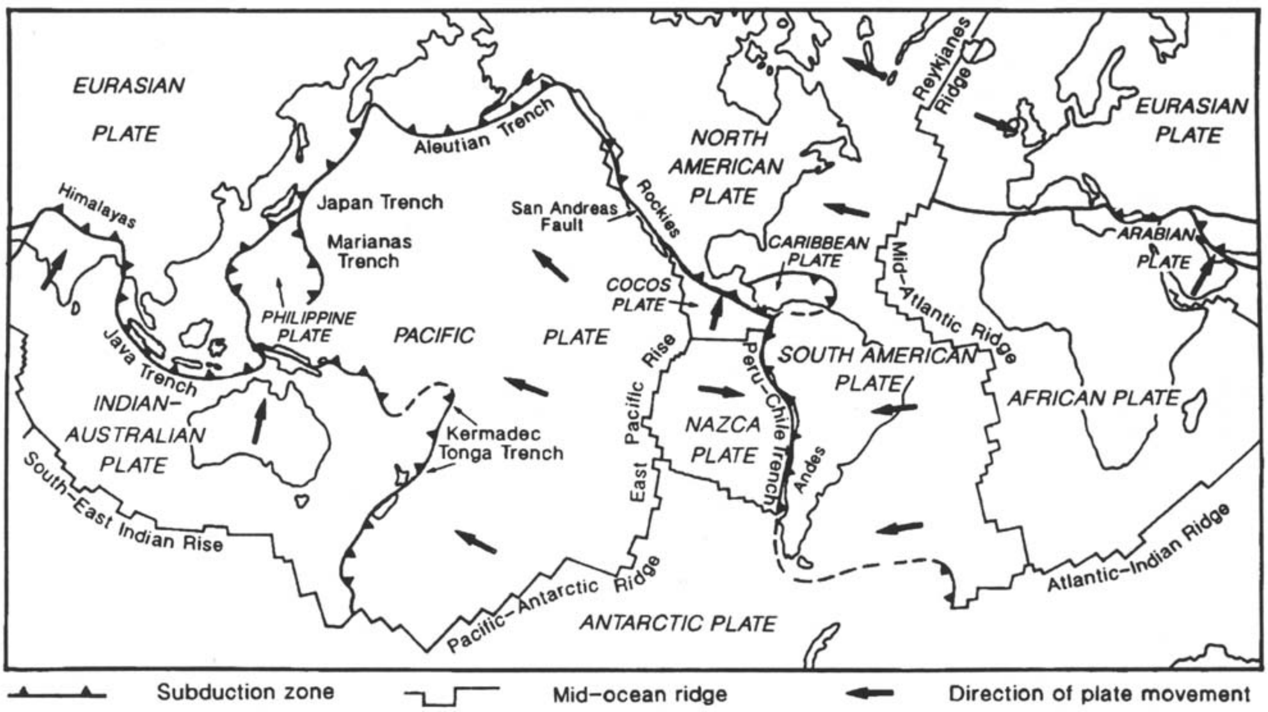
At shear zones a type of crustal break called a transform fault occurs. Here the rocks of two plates slide past each other with many a jerk and lurch, as the plates continually stick to one another and then break apart. Each break causes an earthquake. An example of a transform fault is the San Andreas of California where Baja California and southwestern California are separating from the mainland, and moving north towards Alaska.

Mid-oceanic ridges are plate boundaries where the basaltic ocean floor plates have moved apart. These divergence zones, or gaps, are constantly filled by the intrusion of basaltic lava from below. Sometimes enough lava erupts in these zones to form islands such as Iceland.





The boundaries where plates meet are known as convergence zones. Generally an oceanic plate will plunge under a continental margin at a subduction zone. It is in these zones that the effect of convergence may cause uplifting and the formation of mountain ranges and volcanic island chains. It is also an area where earthquakes are generated.



The Earth's tectonic plates are constantly moving causing earthquakes, tidal waves and new islands to be formed.

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Fossilisation

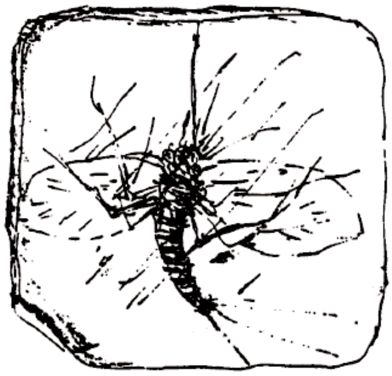
Fossils are the only remaining evidence that dinosaurs ever existed.

What is a fossil?

The word fossil comes from the Latin, *fossilis*, meaning 'dug up'. Fossils are the remains, moulds, or traces of organisms that died a long time ago and were usually preserved in sedimentary rocks such as sandstones, silt stones and shales. Fossils provide evidence of past forms of life including; mosses, ferns, leaves, wood, pollens, shells, corals, crabs, worms, sea urchins, dinosaurs fish, birds and mammals.
About 250,000 different fossil species have been identified.

How are fossils formed?

For millions of years, life was only found in the oceans. The oldest fossils are therefore of marine organisms. When animals died, their remains accumulated on the sea floor where they were buried by mud, sand or silt. When land animals or plants died, the soft parts usually decomposed or were eaten by scavengers. However, if the hard parts (bones, shells, wood) were covered by a sudden flood, or sand, or even volcanic ash, they might be preserved. Teeth are the hardest parts of an animal and were most likely to be preserved. Bone, wood and shell, although hard, have minute air spaces. When buried, water containing dissolved minerals may seep into these spaces and deposit minerals. Often, over millions of years, all the original bone or shell dissolves away leaving a complete mineral replacement embedded in the surrounding rock. The bones, wood and shell are then said to be petrified, or turned to stone.
Rock is not the only medium that contains preserved fossils. Extinct insects have been found in fossil tree sap (amber).
Animals that became trapped in natural tar pits have been beautifully preserved; mammoths and other animals that lived during the ice ages have been incorporated in ice, or frozen ground, so that flesh, hair and even stomach contents have been perfectly preserved. In some locations, scientists have also discovered impressions of skin. Sometimes, the entire animal decayed away but left a 'mould' that was then filled by sediments or minerals making a natural 'cast'. Similarly, footprints made in soft ground created moulds that were later filled, making casts.

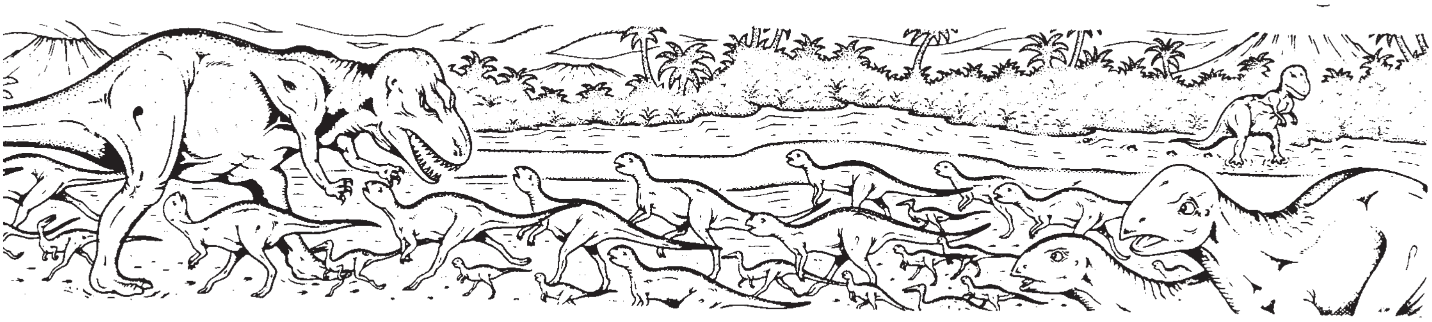


Insect trapped in amber

Where are fossils found?

Fossils can be found in road cuttings, quarries, cliff faces, river valleys and seashores - even in such places as building sites - fossil hunters (palaeontologists) can recognise sedimentary rocks that are likely to contain fossils of a particular period. Background research plays a large part in knowing where to look but luck has a major role as well. When a site has been identified as being a possible site for fossils, and perhaps excavated with some success, similar rock formations may be sought in other localities.

Lark Quarry



The *Terrorsaurus* exhibition features a replica of part of the Lark Quarry trackways found at Lark Quarry in central Queensland. The site contains the preserved footprints of over 150 dinosaurs including one large carnivourous dinosaur from the mid Cretaceous period (about 90 million years ago).
The tracks were formed in soft clay overlying firm sandstone. This is the only trackway in the world in which the dinosaur herd is travelling in one direction (apart from the carnosaur), suggesting these tracks were all made at the same time. Most of the tracks belong to coelurosaurs - light carnivorous bipeds with grasping hands and long necks. The smallest of these was bantam sized, the largest as big as an emu. Some tracks belong to ornithopods - beaked herbivorous bipeds of approximately the same size range as the coelurosaurs. These herds were probably at a waterhole to drink or socialise. The large carnosaur prints indicate it approached the herd with heavy, plodding footsteps that sank way down into the mud. The footprints then change to show us that the carnosaur rose up on to its toes leaving no heel impression. It took nine steps forward and then turned to the right At this time the herd fled in the opposite direction. It is not certain what happened after this point. Whether the herbivores escaped or the carnosaur successfully captured some prey.

Trackways are trace fossils. They provide us with a record of how dinosaurs lived.
Track information may include:
• number of digits
• skin imprints
• pad marks
• presence of webbing or claws.
From this information scientists deduce:
• type and size of dinosaur
• whether the dinosaur is a biped or quadruped
• speed and gait.

Some Victorian Sites

Some of the better known localities in Victoria, where you can fossick for fossils (mainly invertebrates) include:
• Batesford quarry (near Geelong) but permission is required from the owners, Portland Cement.
• Buchan district
• The cliffs at Beaumaris beach but care needs to be taken as these cliffs are unstable.
• Fossil Beach, Mornington
• Wandong district
• Lilydale district
• Kilmore district

Note that before removing fossils from excavation sites, permission must be acquired from the appropriate authorities.

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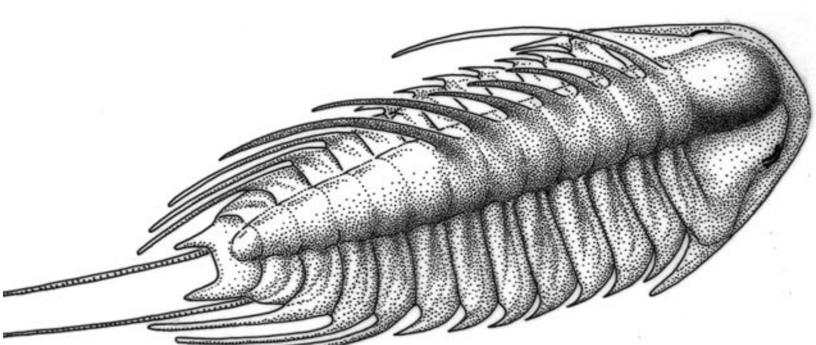
Dinosaurs from DNA

By Dr Les Christidis
Curator, Ornithology, Melbourne Museum

With the release of the movies Jurassic Park and The Lost World, a great deal of interest has focussed on ancient DNA, insects in amber and cloning. The question being asked is ‘can molecular biologists bring the dinosaurs back to life?’ To answer the question I need to first explain a little about the nature of DNA. Most of us are aware that DNA contains the genetic information required for an organism's development. This information is coded by just four nucleic acids or bases, which are abbreviated as A,T, G and C. The message for just one gene can comprise thousands of such bases. To construct an entire organism requires several billion bases of information. Many single base pair errors in the genetic code are lethal. Few people are aware that apart from the DNA contained in the nucleus, there is also DNA in the mitochondria, small organelles in the cell that are involved in energy production.

Mitochondrial DNA consists of only some 17,000 bases but is very abundant as each cell has about 200 mitochondria. Both types of DNA comprise two strands which are held together by hydrogen bonds between complementary bases. The survival of these bonds is all important in the ancient DNA saga. It has now become apparent that under some exceptional circumstances, these hydrogen bonds can survive intact for millions of years. Intact DNA have been obtained from Egyptian mummies, frozen mammoths, 20 million year old plant fossils and insects in amber thought to be 40 million years old, a pretty valuable link with the past. But how long are these fragments of DNA? Unfortunately most are 200 to 500 base pairs long, with the record being 10,000 bases for a bee in amber. The odds of reconstructing the several billion bases from such fragments while avoiding lethal errors are astronomical. Dr Higuchi, one of the pioneers of ancient DNA technology, when asked about the possibility of reconstructing the genetic code of a mammoth, likened it to finding a large encyclopedia ripped into many shreds and written in a language you barely understand. Your mission: to reassemble it in the dark, without using your hands. Depressing enough for would-be dinosaur theme parks operators. Well there is more bad news. The ancient DNA being recovered is mitochondrial, even if one could reconstruct a mammoth mitochondrion and place it in elephant cell, we would still have an elephant, since mitochondria do not influence what the animal looks like. This negative picture for the resurrection of dinosaurs is painted without even mentioning that no one has yet found any surviving DNA and even if some is found, there may never be enough surviving molecules to fully represent an entire genetic code. Also no one has ever "cloned" an extant higher organism using its purified DNA. OK, if we cannot bring back extinct organisms, why the interest in ancient DNA? Well not everything has to centred around the "theme park" mentality. Ancient DNA provides us with an invaluable tool for resolving many evolutionary questions.

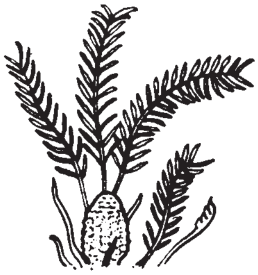


Trilobite

The plants that dinosaurs ate

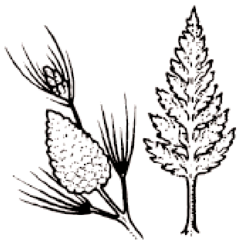
Australia's fossil record shows that during the Jurassic Period the dominant plants were non flowering plants including cycads, ginkgoes, conifers and ferns. In the next large time period, the Cretaceous, flowering plants made their first appearance. The oldest known flower was discovered in 120 million year old rocks at Koonwarra, Victoria, in 1989.

Cycads



Sometimes called 'living fossils' because they reached their peak in the Jurassic (208 to 144 million years ago). They received their name from a resemblance to palms. Unlike palms, however, cycads are cone bearing. They are found along the coastal areas and in isolated patches in central and south west Australia. Seeds of some species were eaten by the Aborigines but are poisonous unless crushed and washed.

Araucarias

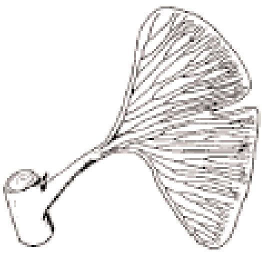


These ancient conifers are found scattered through the forests of eastern Australia. Araucarias appeared in the fossil records before dinosaurs but reached their peak in the Mesozoic. They are named after the South American Indians, Araucanos. The common names of the araucaria grown in parks and large gardens include the Hoop pine, Bunya bunya pine, Norfolk Island pine, Kauri and the South American monkey puzzle tree.

Ferns

Probably the most ancient plant group surviving today. They first appear in the fossil records over 300 million years ago, in the Carboniferous period. While ferns are now never far from wet areas, they once dominated large areas of the Earth's forests and contributed much to the Earth's coal supplies. They can be propagated by vegetative means or sexually from spores.

Ginkgoes

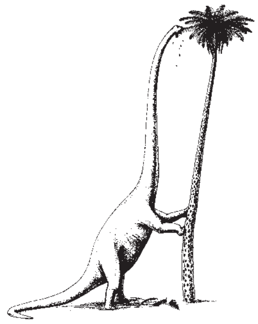


Found in 240 million year old fossils. Curiously, the extensive family of ginkgoes has been reduced to just one member, the species, *Ginkgo biloba.* This species surprised scientists, who had thought it extinct, when it turned up in the gardens of some Chinese monasteries at the turn of the century. Female plants produce a rather quaint smelling orange coloured soft fruit. The fan shaped leaves have led people to refer to it as the maidenhair tree.

Glossary

Geological Periods

Triassic (250 - 200 million years ago [m.y.a.]) so named because the strata that comprise sediments of this age can be divided into three distinct types.
Jurassic (200 - 140 m.y.a.) named after the mountain range between France and Switzerland where rock strata of this age and type were first discovered.
Cretaceous (140 - 65 m.y.a.) from the French word for chalk, cretace, which is found in rock strata of this age.



Geological eras

Proterozoic means 'time of the early animals' (2500 -545 m.y.a.)
Mesozoic means 'time of the middle animals' (251 - 65 m.y.a.)
Cainozoic means 'time of the recent animals' (65 m.y.a. - today)

Anatomical terms

Synapsid means one holed skull.
Diapsid means two holed skull.

Biochemistry

Endothermic - generating internal heat to moderate body temperature e.g. modern birds and mammals (commonly referred to as 'warm-blooded').
Ectothermic - relying on the environment and behaviour to regulate body temperature e.g. typical reptiles (commonly referred to as 'cold-blooded').

Dinosaur classification

Saurischia - lizard-hipped dinosaurs such as *Apatosaurus, Tyrannosaurus rex,* and the ancestors of modern birds.
Ornithiscia - bird-hipped dinosaurs such as *Stegosaurus, Parasaurolophus, Triceratops, Muttaburrasaurus, Maiasaura*

Dinosaur families

Diplodcidae meaning 'of the two-fold beams'.
Hadrosauridae meaning 'of the large reptiles'.
Iguanodontidae meaning 'of the iguana-toothed'.
Stegosauridae meaning 'of the roofed reptiles'.
Tyrannosauridae meaning 'of the tyrant reptiles'.
Ceratopsidae meaning 'of the horned-faces'.
Dromaeosaurid meaning 'running lizard'.

Dinosaur

The word dinosaur was coined in 1841 by Sir Richard Owen in specific reference to the only three known at the time - *Megalosaurus, Iguanodon* and *Hylaeosaurus*. The word derives from the Greek, *deinos* - terrible and *sauros* - lizard.

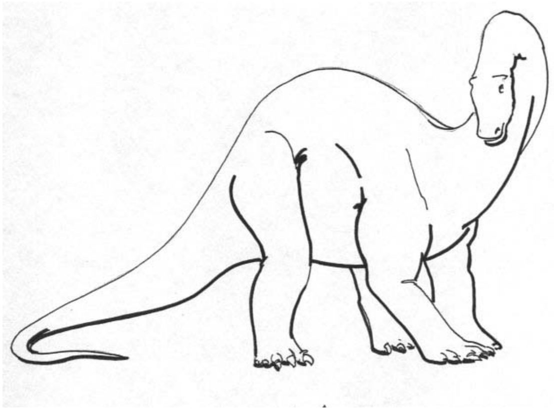
Classification

Kingdom Animalia (animals)
Phylum Chordata (having a hollow nerve chord ending in brain)
Class Archosauria (diapsid reptiles with socket-set teeth etc.)
Subclass Ornithodira (dinosaurs and pterosaurs)
Superorder Dinosauria (dinosaurs)

Dino fact sheets

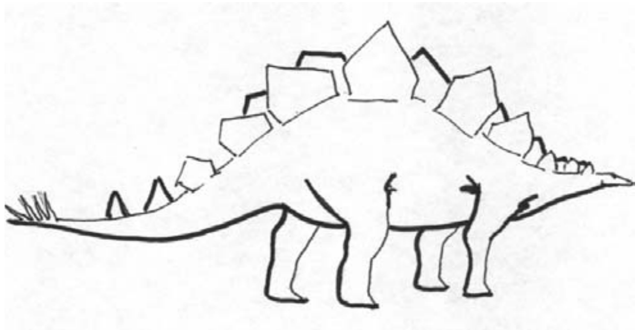
The following dinosaurs are featured in the *Terrosaurus* exhibition

Apatosaurus



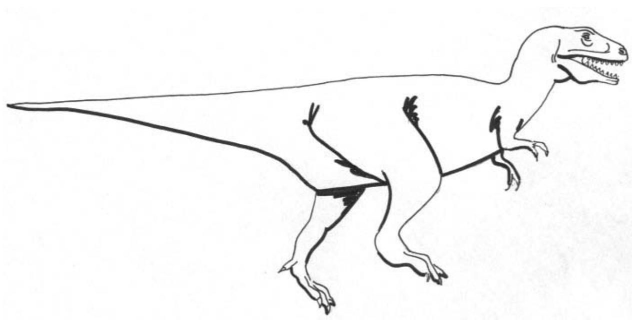
Family: Diplodocidae
Pronounced 'A-pat-o-saw-rus'
Name means 'deceptive reptile'
Found: North America
Lived: Late Jurassic about 160-140 million years ago
Size: 21-27 metres long, 4.6 metres to hip height and 30-35 tonnes
Nearest relatives: *Diplodocus* (formerly known as *Brontosaurus*)

Stegosaurus



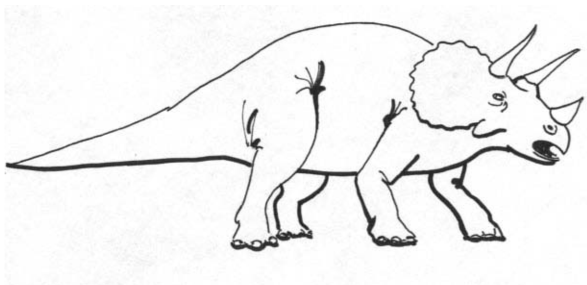
Family: Stegosauridae
Pronounced 'Steg-o-saw-rus'
Name means 'roofed reptile'
Found: western North America, Western Europe, southern India, China, and southern Africa.
Lived: Late Jurassic period about 160-140 million years ago
Size: 8-9 metres long, 2.75 metres tall and about 3100 kg.
Nearest relatives: *Ankylosaurs*

Tyrannosaurus



Family: Tyrannosauridae
Pronounced 'Tie-ran-o-saw-rus'
Name means 'Tyrant lizard king'
Found: North America and Mongolia
Lived: Late Createaceous about 85 to 65 million years ago
Size: 12 metres long, 5 metres tall and weighed about 6 tonnes.
Nearest relatives: *Albertosaurus* and *Tabosaurus bataar.*

Triceratops



Family: Ceratopsidae (Horned Face)
Pronounced 'Try-serra-tops'
Name means 'three horned face'
Found: North America and East Asia
Lived: Late Cretaceous period
Size: 9 metres long, 3 metres tall and weighed from 6-10 tonnes
Nearest relatives: *Styracosaurus* and *Protoceratops*

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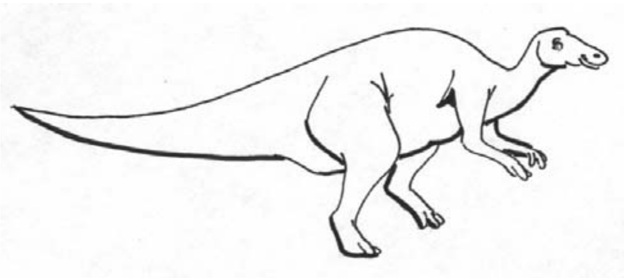
Parasaurolophus

Family: Lambeosaurinae
Pronounced 'Par-a-saw-ro-lo-fus'
Name means 'beside saurolophus (crested lizard)'
Found: North America
Lived: Late Cretaceous, 76-65 million years ago
Size: 10 metres long and 4 metres tall
Nearest relatives: *Bactrosaurus* and *Lambeosaurus*

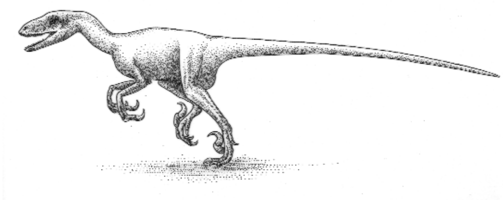
Maiasaura

Family: Hadrosauridae
Pronounced 'May-a-saw-ra'
Name means 'Good mother lizard'
Found: Montana, North America
Lived: Late Cretaceous
Size: 9 metres long, 2.25 metres tall and weighed about 3 tonnes
Nearest relatives: *Hadrosaurus* and *Edmontosaurus*



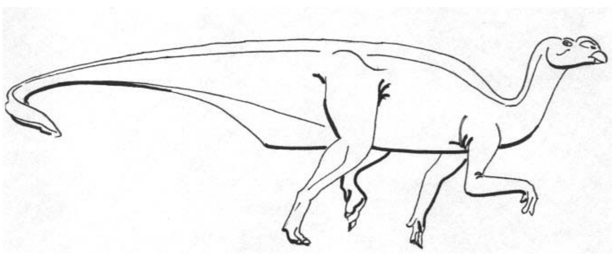
Deinonychus

Family: Dromaeosaurid
Pronounced 'Die-no-nigh-kus'
Name means 'terrible claw'
Found: North America
Lived: Cretaceous period, 110-100 million years ago
Size: 3 metres long, 1.5 metres tall and about 80 kg
Nearest relatives: *Velociraptor* and *Utahraptor*



Muttaburrasaurus

Family: Iguanodontidae (iguana toothed)
Pronounced 'Mut-a-burr-a-saw-rus'
Name means 'Muttaburra lizard'
Found: Central Queensland, Australia
Lived: from Mid Cretaceous about 113 million years ago
Size: 7 metres long, about 1-2 tonnes
Nearest relatives: *Iguanodon* and *Camptosaurus*



Activity 1: Mind mapping

What you need

• *Mind Map* Blackline Master (page 40)

What to do

1 Ask students to think of all the things they know or think about dinosaurs.
2 Ask them to draw or write their ideas on the blackline master.
3 Allow time for students to compare their knowledge with others by sharing their mind maps.
4 Students may then be asked to devise a list of questions about dinosaurs that they would like to research.
5 After visiting the exhibition, ask students to repeat the activity.
6 Compare the pre and post visit mind maps in order to assess any new learning that may have taken place.

Student questions

Are all mind maps the same?
Where did you learn your information?

Activity 2: Dinosaur interview

What you need

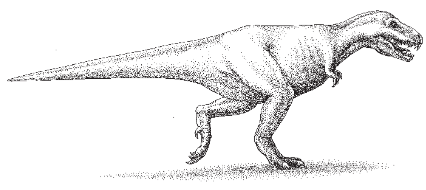
• reference materials including encyclopedias, internet and factual science texts
• multiple copies of the *Dino fact sheets* (pages 23-24)

What to do

1 Ask students to choose a dinosaur with which they are familiar or one from the list supplied.
2 Students are required to read and become well informed about their dinosaur.
3 Ask students to imagine they are news reporters assigned to interview their chosen dinosaur.
4 Brainstorm a list of questions they might want to ask.
5 Depending on availability of multimedia resources, students may be invited to record their interviews on audio or videotape or to present the interview as a written document.
6 Make a time during each day to hold a 'Current Affairs' program where students are given the opportunity to share their interviews with the class.

Student questions

What made you choose your dinosaur?
How easy/difficult was it to find the information you needed?
What else would you like to find out about your dinosaur?



Activity 3: Dinosaur definitions

What you need

- *Terrorsaurus* background information (pages 12-22)
- science text books
- dictionaries
- multiple copies of the *Dino fact sheets* (pages 23-24)
- *What's in a name* blackline masters (pages 41-42)

What to do

1. Explain to students that many dinosaur names are derived from Ancient Greek or Latin, and may incorporate the name of the place where they were first discovered (e.g. Muttaburrasaurus found at Muttaburra in Queensland).
2. Distribute the *What's in a name?* blackline masters to students and ask them to choose at least five dinosaurs to complete the first column of the table.
3. Provide students with fact sheets, dictionaries and science texts and ask them to complete the grid.

Options

Older students may be asked to use the last column of the grid to classify each dinosaur according to its features and characteristics, according to the 5-Kingdom classification system.

Useful references

A very thorough taxonomic cladogram may be found at:
www.dinosauria.com/dml/dmlf.htm

Activity 4: Dinosaur dictionary

What you need

- reference materials including encyclopedias, internet and dictionaries
- student notebooks

What to do

1. Ask students to alphabetise 26 pages or half-pages of their notebooks in preparation for creating their own dinosaur dictionaries.
2. As students come across new words in their study of dinosaurs, ask them to insert the words on to the correct page of their own dictionary and to find the meanings or definitions of these words.
3. When students have completed their unit of work, they should have a useful reference guide that they may keep or present to younger students.

Options

You might ask students to find just one topic-relevant word for each letter of the alphabet, which may be illustrated to create an effective alphabet picture book. Similarly, students might be asked to write a short verse or sentence using alliteration to define the words they have chosen.

Activity 5: Australian dinosaurs

What you need

- *Australian Dinosaurs* blackline master (page 43)
- *Terrorsaurus* background notes (pages 12-22)
- atlases
- reference materials including encyclopedias, internet and factual science texts

What to do

1. Ask students to decide upon a key for the location of dinosaur fossil discoveries on their maps. e.g. bone = bone find, dinosaur = skeleton, footprint = footprint
2. As they work through their dinosaur unit, students are asked to locate and mark in, Australian or Victorian dinosaur fossils and footprint finds on their maps, using the key they have chosen.
3. Make sure that students clearly label locations and the names of dinosaurs found at these locations.
4. Encourage students to pursue their own investigations and report back to the class when they find out about new Australian finds.

Options

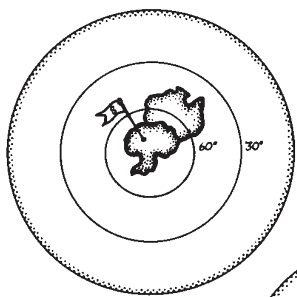
Use maps of other countries to encourage investigations of dinosaur fossil finds in other parts of the world.

Student questions

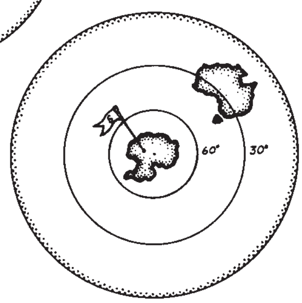
Why are most Australian fossil discoveries limited to small, particular areas of the country?

Extension activities

Victorian dinosaurs lived within the Antarctic Circle, above 70 degrees latitude. At the time Australia was joined to the Antarctic continent and experienced long periods of darkness during the Antarctic winter. Find out what particular adaptations Victorian dinosaurs made to cope with the cold and dark. Students may need to research why an Antarctic winter is dark.



Position of Australia in the late Cretaceous period, just inside the Antarctic circle.

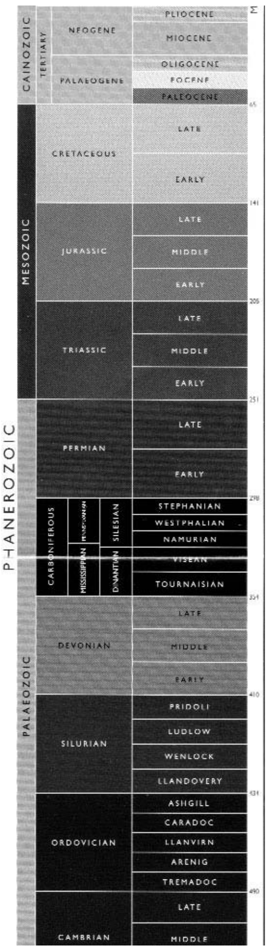


The present position of Australia in relation to Antarctica.

Activity 6: Identify when dinosaurs lived timeline

What you need

- *Timeline* blackline masters (page 44)
- *Terrorsaurus* background notes (pages 12-22)
- AGSO bookmark enclosed in this kit
- piece of chalk



What to do

1. Draw a line 4.5 metres long on the ground to represent the life of our planet Earth (approximately 4 500 million years). The scale is 1 cm = 10 million years
2. Explain to students that on this scale, human life (Homo erectus) has only existed for about 5mm or 5 million years. (The thickness of the chalk line equals about 5mm)
3. Identify the last 5 millimetres on the timeline and ask one student to stand there to represent human life.
4. Count back 6.5 cm from this end of the timeline and mark the spot with chalk or ask another student to stand at this point. Explain to students that this is when dinosaurs became extinct. (65 million years ago)
5. From this point, count back another 18 cm and mark the spot with chalk or another student. This is when dinosaurs first appeared on earth. (245 million years ago)
6. Hand out the *Timeline* blackline masters and ask students to read the information about the Mesozoic Era.
7. Ask students to cut out the six dinosaur illustrations and paste them correctly on the timeline according to the information given in the table.

Options

This activity may be performed inside the classroom using butcher's paper.

Student questions

What was the Earth like before dinosaurs lived?
What other life forms existed in the Mesozoic era?

Extension Activity

Geological timespans are divided up into Eons, Eras, Periods, Epochs and Ages. Find out which timespan lasted the longest? Which lasted the shortest time?

Activity 7: Using a scale to make your own timeline

What you need
- calculators
- toilet paper roll
- butcher's paper
- drawing materials
- *Terrorsaurus* background notes (pages 12-22)
- reference materials including encyclopedias, internet and factual science texts

What to do
1. Ask students to create their own timeline to represent the last 245 million years using materials and a scale of their choice.
2. Students should label the major periods of Earth history on their timeline and sketch or draw appropriate illustrations for each period.
3. Display these timelines around the classroom.

Teacher notes
A 500 sheet toilet roll can be used to represent geological time. If each sheet is the equivalent of 10 million years, the whole roll will equal 5 billion years, the total history of the Earth.

Activity 8: Collect and display plants

What you need
- plant specimens of conifers, cycads, ginkgoes and tree ferns
- reference materials including encyclopedias, internet and factual science texts

What to do
1. Point out to students that flowering plants only appeared a little over 100 million years ago. Therefore, for much of the Mesozoic era, the herbivorous dinosaurs would have lived on plants like conifers, ginkgoes, cycads and tree ferns.
2. Show students examples of these four plants and discuss their features. What do they all have in common?
3. Ask students to collect and press examples of these species and to display them on a poster or in a book.
4. Ask students to include a brief description of each example including its features, distribution and fossil history.
5. Draw a landscape without modern plants. Include plants known to exist from the Mesozoic Era or earlier.

Student questions
What kinds of animals eat cycads, ginkgoes, conifers or tree ferns today?
Why are so many cycads in danger of extinction?

Activity 9: Your own diorama

What you need
• plastic dinosaur models
• plasticine
• cardboard boxes
• coloured paper
• natural materials

What to do
1 Invite students to make their own dinosaur dioramas using natural materials, coloured paper and small plastic dinosaur models.
2 Encourage students to look at pictures and read about the Mesozoic era in order to make the diorama look as realistic as possible.
3 Remind them to consider the scale of the animals and plants and to try to keep the scale as accurate as possible.
4 Display your dioramas in the classroom or in a public viewing area for others to learn and enjoy.

Student questions
What other life forms existed during this period?
Is it possible to talk about the world's climate during the Mesozoic Era?
What was Australia's climate like during the period it was part of Gondwanaland?

Activity 10: Create your own tracks

What you need
• plasticine
• plastic model dinosaurs (just legs and feet if possible)
• rolling pin

What to do
1 Knead the plasticine until it is soft enough to roll with the rolling pin.
2 Use the rolling pin to make a trackway that is one centimetre thick and about 20 cm long x 10 cm wide.
3 Use the plastic dinosaur models to create a trackway story that others can interpret.
4 Ask students to show their trackways to others encouraging them to interpret what happened.
5 Students confirm these interpretations.

Student questions
Did your dinosaurs have two or four legs?
Were they walking or running? Why?

Options
Instead of model legs and plasticine, use potato prints on newsprint.

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Activity 11: How do you read tracks?

What you need

• a sand pit or other soft surface

What to do

1 Choose one student to be the 'trackmaker' while the other students will be the investigators.

2 Ask the trackmaker to move about in the sandpit either hopping, running, jumping or walking while the other students have their backs turned.

3 When the desired amount of tracks have been made, ask the investigators to turn around and view the tracks.

4 Ask them guess how the tracks have been made by observing the distance between steps, frequency of tracks, depth and so on.

5 Confirm these predictions with the trackmaker.

Student Questions

What would the prints look like if the trackmaker was trying to sneak up on someone?
What would the tracks look like if the trackmaker was carrying weights?
How would these be different to normal walking prints?
Which professions regularly take plaster casts of footprints or tracks?

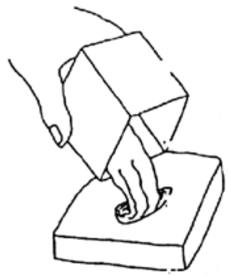
Extension activity

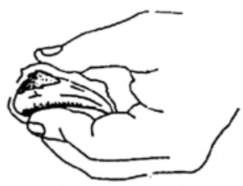
Go for a walk around the school or home and look for impressions left in concrete footpaths. What stories can the students generate from these marks? Some marks are simply graffiti, while animals or pedestrians may inadvertently leave other marks. What stories can the children create from these marks?
e.g. What modern animal left this footprint? What other evidence did it leave behind?

Activity 12: Make a fossil cast

What you need
- potters clay
- piece of bone (chicken bone) or shell
- petroleum jelly or castor oil
- a small brush
- dental plaster/ plaster of Paris

What to do
1 Press clay flat until it is approximately 2 cm thick.
2 Brush the bone or shell with petroleum jelly or castor oil, then push it into the clay.
3 Remove the bone or shell carefully leaving an imprint in the clay.
4 Mix the plaster of paris according to the instructions on the box.
5 Pour the plaster into the mould. You may find it useful to enclose the imprint with a cardboard ring to avoid spills.
6 When the plaster is solid, remove it from the mould.





Student Questions
Why do scientists make casts of fossils in this manner?

Teacher notes
The cast is a replica of the original bone. Fossil casts allow us to see what the original fossil looked like. Fossils were made when dinosaurs, plants, shells and insects were covered in mud. The living organism eventually decayed, leaving only the imprint behind.

Options
Bury some bones in a tub of dirt or sand and ask students to excavate the tub. When they have found the bones, ask them to identify the animals they came from and to explain how they came to their decisions.

Activity 13: Finding the right rocks

What you need

- *Map of Victoria* blackline master (page 45)
- atlases
- *Terrorsaurus* teacher background notes (pages 12-22)
- sedimentary rock samples
- photos or posters showing coastal sedimentary rock formations

What to do

1. If possible, allow students to view a sedimentary rock formation, otherwise display a variety of sedimentary rock samples.
2. Allow students to feel and describe these rocks.
3. On the map of Victoria, ask students to observe the places where fossil finds have occurred and to compare this map with a topographical one of the same area.
4. Encourage students to share their ideas about why fossils are found in the areas located on the map.

Student questions

Why do these areas yield fossils and other areas do not?
What do these areas have in common?

Extension activities

Students may like to research where other fossils are found in their local area. Victoria has an extensive range of fossil sites which can sometimes be visited and even fossicked with permission from the appropriate authorities. Sites with a range of non-dinosaur fossils include Bullengarook, Kinglake, Beaumaris, Lilydale, Geelong and Kilmore.

Collecting fossils at a roadside cutting where sedimentary rock has been exposed.

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Activity 14: Increase the scale by using a grid

What you need

- a photocopied drawing of a dinosaur
- ruler
- greylead pencil
- eraser
- A3 paper for the enlargement

What to do

1 Instruct students to draw a ten by ten grid over the dinosaur (grid scale may vary depending on the size of the drawing).
2 Explain to students how to decide on the ratio of enlargement for the dinosaur. e.g. Would you like to scale the drawing up by a factor of two, four or ten?
3 On the larger paper, ask students to construct the next ten by ten grid according to the ratio they have chosen.
4 Students then transfer the elements of each square in the original photocopy to the larger grid, square by square.

Teacher notes

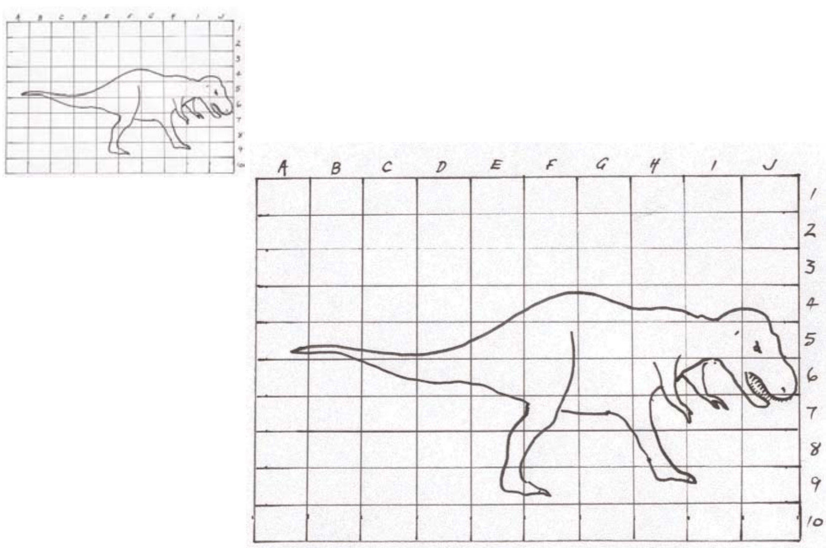
This is a standard method used by artists and designers to enlarge or compress the size of things they want to draw.

Student questions

1 Why does the surface area of an animal increase at the square of the enlargement but the mass of the animal increase at the cube of the enlargement?
2 Palaeontologists have observed that the length of a dinosaur is often about 5 times the length of its femur or thighbone. What is the relationship to human height and femur length?

Extension activity

Palaeontologists have also connected foot length to height and stride length.
Try graphing the foot length and the heights of students in your class. Was there a strong connection between the length of student's feet and their height?



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Activity 15: What happens to weight when size doubles?

What you need
- *A question of scale* blackline master (page 40)
- plastic dinosaur models
- plasticine
- set of kitchen scales

What to do
1. Make a small plasticine model of a dinosaur. For convenience sake try to round off its height and length to a whole number of centimetres.
2. Estimate the weight of your model.
3. Weigh the plasticine model using the kitchen scales and record your findings on the photocopied master.
4. Make another model, twice the size of the original. (To double the size of the original plasticene model, all components must be twice as big.)
5. Record your estimate of the weight of the second model.
6. Weigh the larger plasticine model and record your findings.

Teacher notes
When dinosaurs grew in size their weight increased at an exponential rate. This means that if the dinosaur doubled its size or dimensions, the weight increased at a cube rate, that is 2 x 2 x 2 or by a factor of 8.
e.g. Based on an original model that weighs 140 gm, a reasonable estimate of the weight of a model twice this size might be 280 gm. In fact the correct answer is:

140 x 2 x 2 x 2 = 1120 gm.

Student questions
Was the larger model's weight double the weight of the original model? Why?

Activity 16: Calculating the weight of a dinosaur

What you need

• plastic model dinosaurs
• large jug of water
• cotton thread
• a tray to catch the water that overflows from the bucket
• a one-litre, graduated jug

What to do

1 Identify the scale of the model dinosaur compared to the original.
2 Place the large jug in the tray.
3 Fill the bucket of water to the very brim. This is important as you are going to immerse the model dinosaur and calculate the volume of the model dinosaur.
4 Suspend the model dinosaur from the cotton thread.
5 Immerse the model into the full bucket, ensuring you catch all the water, that over flows.
6 Measure, in millilitres, the volume of the water displaced by the model by pouring it into the graduated jug.
7 Calculate the weight of the displaced water. (The millilitres of water displaced equals the weight of the water in grams.)
8 To calculate the weight of the original dinosaur, multiply the weight of the displaced water, by the scale of the model cubed. For example, if the model is one tenth scale and the water displaced was 400 grams or 0.4 kg, the approximate weight of the original dinosaur would be 0.4 x 10 x 10 x 10 kilograms = 400 kg.

Student questions

Do you think this might be an accurate scientific method for calculating dinosaur weight? Why?

Activity 17: Making a larger model dinosaur with papier mache

What you need
- recycled paper
- chicken wire
- pine blocks
- staples
- papier-mache glue
- a big plastic drop sheet
- overhead transparency
- overhead projector

What to do
Note: When ‘scaling up’ a dinosaur, make an overhead transparency of a photocopied image, preferably of the skeleton. The OHT will enable you to project the image on the wall and make an appropriate choice of the right size for the dinosaur.
1 Measure all the limbs and key features from the projected image.
2 Record all measurements on to the original photocopied image.
3 Build the wire and pine skeleton, based on these measurements.
4 Wrap chicken wire around the armature and stuff with rolled up newspaper.
5 Cover the stuffed chicken wire model with masking tape in preparation for pasting the papier-mache.
6 Add one layer of paper-mache, ensuring each successive layer is well dried. Adding more than one layer a day will not allow enough time for the model to dry. Each strip of paper mache should be stripped of excess glue also to ensure satisfactory drying time.

Additional tips for the papier-mache
1 Sculpt the head separately, perhaps using polystyrene, as this is easily shaped with sandpaper.
2 Claws and teeth can be made from Das, self-hardening clay.
3 Use acrylic based paints, as brushes (and messes!) wash up more easily.
4 When using the chicken wire be mindful of the sharp edges that will be exposed.

Stages of the papier mache process

Activity 18: What was a dinosaur?

What you need
- *What was a dinosaur* blackline master (page 48)
- two cardboard cylinders per student
- 8 x 15 cm lengths of stiff wire
- pliers
- scissors
- adhesive tape
- one stop-watch between two students

What to do
This activity examines the skeletal differences between dinosaurs and most living reptiles.

1 Direct students to make their models as shown on the instruction sheet and discuss the questions posed on the sheet.
2 Mark off a flat running area fifteen metres long.
3 Instruct students to pair up in order to demonstrate the difference between splayed-leg movement and straight-legged movement along this straight.
4 Instruct students to follow the directions on the sheet for timing the two movements.
5 Ask students to compare times and discuss what this suggests about splayed-leg and straight-legged movement.

Student questions
What leg arrangements do you think dinosaurs had?
Have scientists always thought dinosaurs looked like this?

Activity 19: Compare and label skeletons

What you need
- a frozen chicken from the supermarket
- a large pot to boil the chicken
- a poster or 3D model of a human skeleton
- *Just dinosaur bones* blackline master (page 47)

What to do
1 Boil the chicken carcass until the flesh leaves the bones.
2 Extract the chicken bones. (The remaining broth may be made into chicken soup).
3 Dry the bones on newspaper overnight and then lay them out or glue them in place to a suitable piece of thick cardboard.
4 Ask students to label the parts of the chicken using the names of bones with which they are familiar.
5 Compare the chicken bones with known human bones and locate on the human skeleton.
6 Distribute the *Just dinosaur bones* blackline master and locate the corresponding dinosaur bones e.g. femur/thigh, tibia and fibula etc.

Extension activities
Purchase some larger animal bones at the butcher shop to illustrate the similarities between all femurs. Find out why dinosaur femurs had a hook half way along their length.

Activity 20: Why are they now extinct?

What you need
• written articles proposing different extinction theories (refer reference section)

What to do
1 Read to students or have them read about possible extinction events from *New Scientist, Scientific American* or other scientific journals.
2 Ask students to summarise the possible events or combination of events, which may have led to the dinosaurs' extinction. (This may be organised as a 'jigsaw' reading and reporting activity)

Teacher notes
'Jigsaw' reading involves either groups or individual students receiving only part of the total information that is required to be shared amongst the whole group. In this way, individuals or groups are encouraged to accurately report about what they have read in order that the total information is understood by the whole group.

Student questions
1 What other animals became extinct at the same time as the dinosaurs?
2 What animals living at the same time as the dinosaurs survived to the present day?

Extension activities
1 Why is it difficult to find old meteorite craters on a map of Australia? Why is the Moon covered in meteorite craters and the Earth relatively free of craters?
2 Research what the likely effects of a large meteorite impact might be.
3 Extinction is normal. Choose one animal species and research its average longevity .
4 What are some of the characteristics of animals and plants that have survived extinction events?

Activity 21: A Cretaceous game of survival

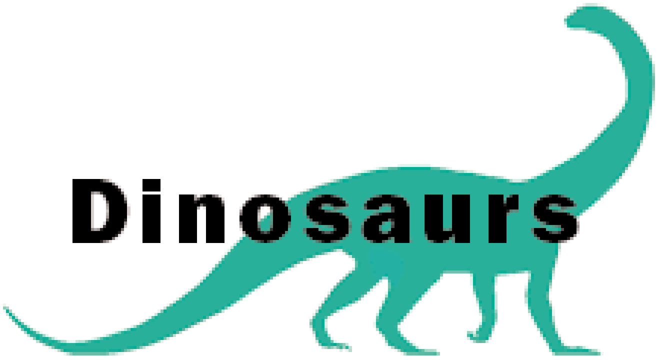
What you need
• survival game photocopy masters:
• *Instructions* one per student (page 49)
• *Island grid* one per student (page 50)
• *Hunting tally sheet* one per pair of students (page 51)

What to do
1 Divide students into pairs.
2 Distribute one *Instruction sheet* per student and read through instructions slowly with students.
3 Instruct students to choose to be either Deinonychus (predator) or Maiasaura (prey).
4 Distribute one *Island grid* per student and one *Hunting tally* sheet to each Deinonychus.
5 Allow students to follow the game instructions to play the game for 20 rounds.
6 After students have finished the game, compare each pair's results.

Teacher notes
This survival game is designed to demonstrate the inter-dependence of carnivores and herbivores in any given environment.

Mind mapping

What do you know?



What do you want to find out?

What's in a name? (1)

Dinosaur Name	Break it down	Language Origin	What does it mean?	Classification
e.g. Muttaburrasaurus	Muttaburra saurus	Place in Queensland Lizard (Ancient Greek)	lizard found at Muttaburra	
Leaellynosaurus	Leaellyn saurus	Leaellyn is a girl's name Lizard (Ancient Greek)	Leaellyn's reptile	
Minmi	Minmi	Minmi Crossing is a place in Queensland	Minmi is the place the fossils were found	
Protoceratops	Proto Cera tops	First Horned face	The first dinosaur to have any sort of horns projecting from its face	
Triceratops	Tri Cera tops	Three Horned face	Three horned dinosaur	
Pentaceratops	Penta Cera tops	Five Horned face	Five horned dinosaur	
Tyrannosaurus rex	Tyranno Saurus rex	Tyrant Lizard king	The tyrant king of all dinosaurs	

What's in a name? (2)

A list of Latin and Greek root words for understanding dinosaur names

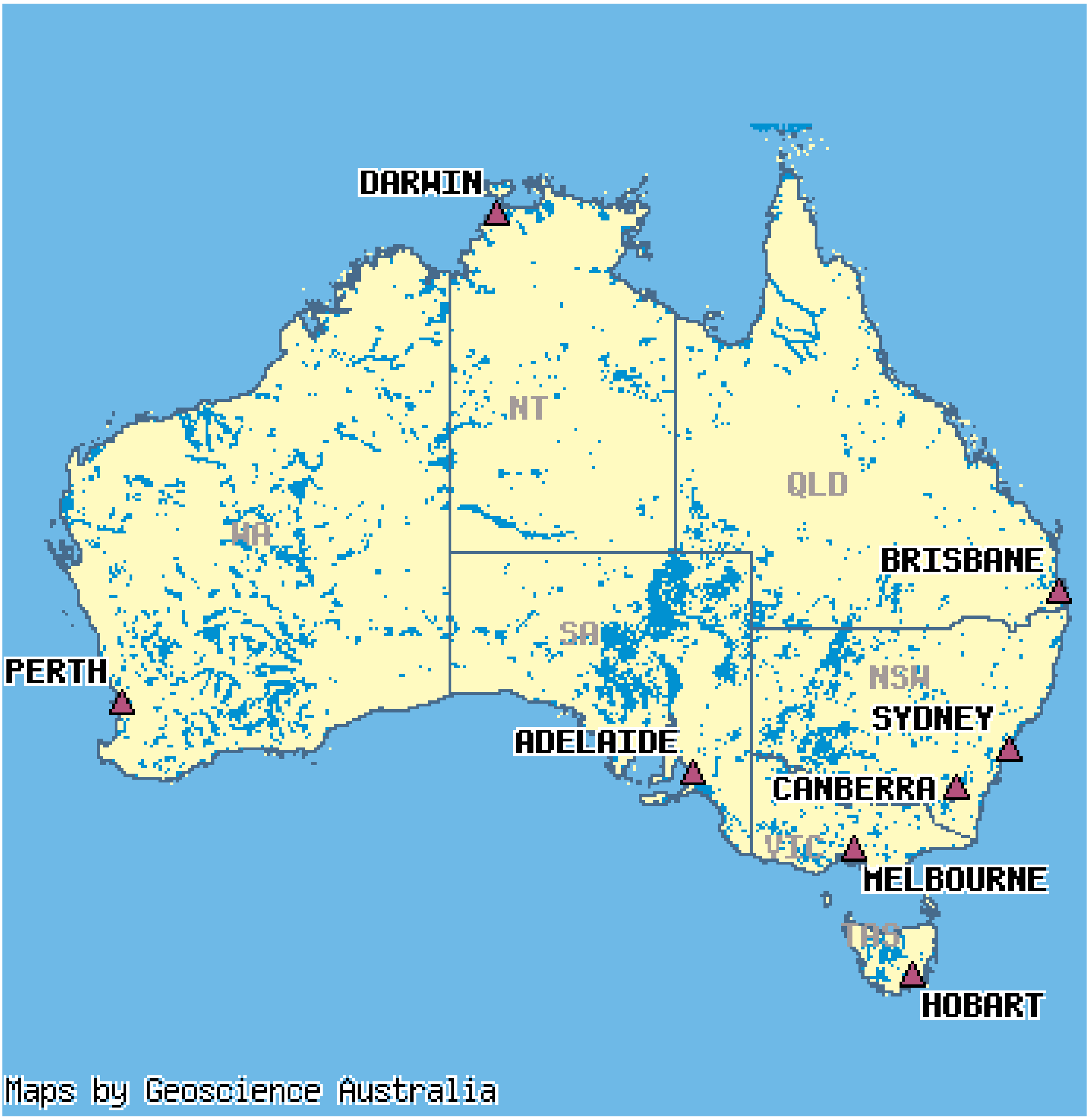
Root word	meaning	Root word	meaning
anklo	crooked	mega	large
anuro	tail	micro	small
apato	deceptive	nycho, nychus	claw
avi, avis	bird	ops	face
bary	heavy	ornitho	bird
brachio	arm	pachy	thick
bronto	thunder	plateo	flat
caudia	tail	proto	first
cephalo	head	pteryx	wing
cerat, cero	horn	raptor	plunderer
compso	elegant	rex	king
di, diplo	two	saur, sauro, saurus	lizard
dino, deino	terrible	segno	slow
don, dont	tooth	tri	three
gnathus	jaw	ultra	extreme
hadro	large	urus	tail
hypselo	high	velocci	speedy
masso	bulk, body		

Invent your own dinosaur and name it according to its physical characteristics.

My dinosaur is called ___________________
It looks like this...

Australian dinosaurs

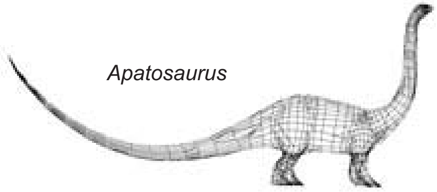
Locate and mark in, significant Victorian and Australian dinosaur fossil finds.



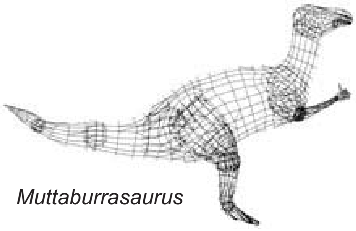
Timeline

Dinosaurs lived during the Mesozoic Era, 245 to 65 million years ago. Scientists have named three periods during this Era

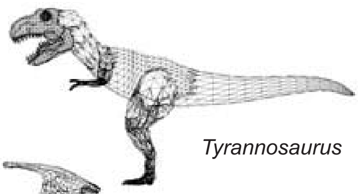
Triassic Period	245 - 205 million years ago
Jurassic Period	205 - 130 million years ago
Cretaceous Period	130 - 65 million years ago



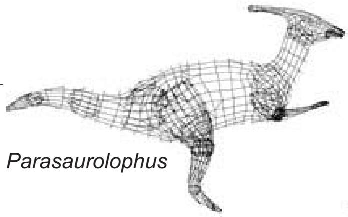
Apatosaurus



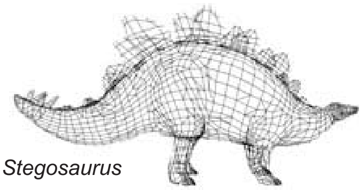
Muttaburrasaurus



Tyrannosaurus



Parasaurolophus

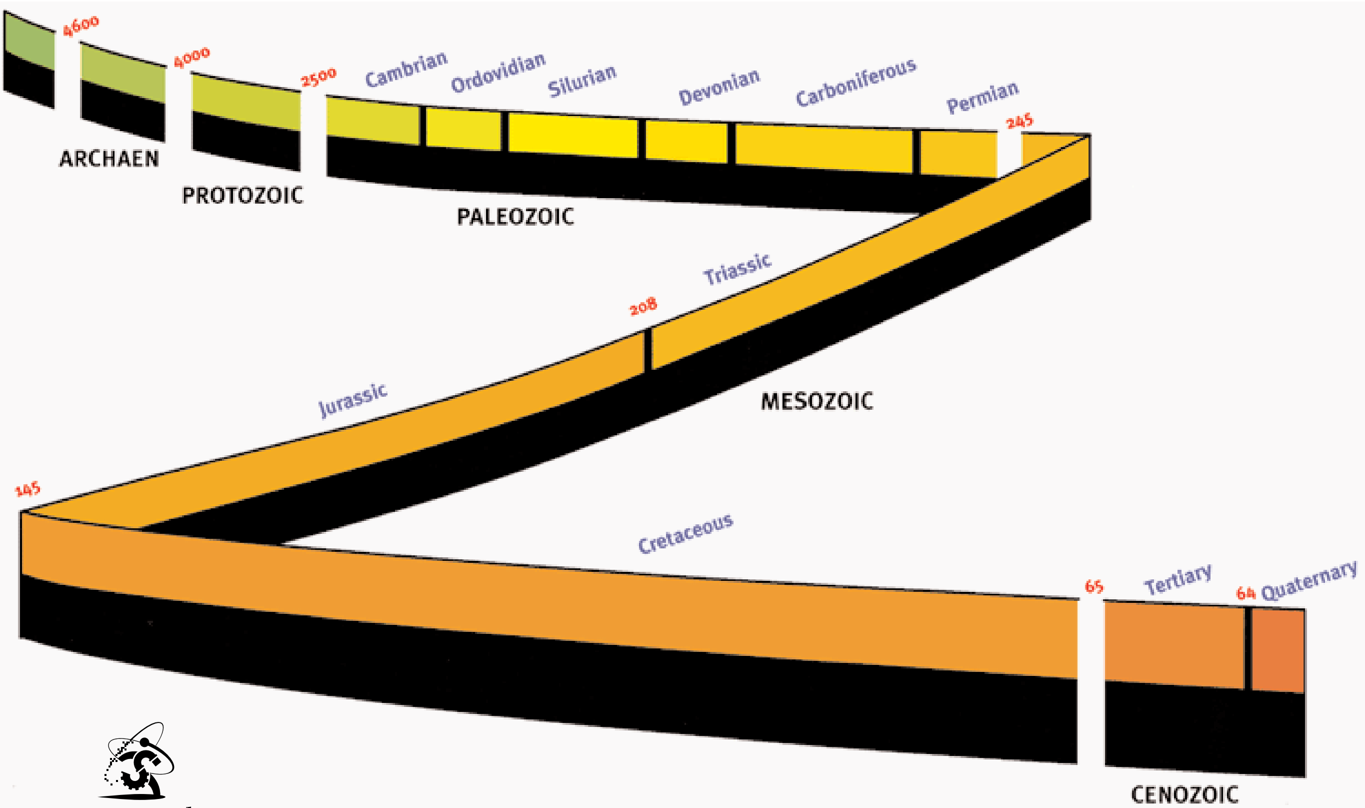


Stegosaurus

What does each Period represent?

Identify which Period each of the following dinosaurs belonged to, then cut out the pictures on the right and match each dinosaur to its correct Period on the timeline below.

Dinosaur	Geological time Period (millions of years ago)
Apatosaurus	148 - 138
Muttaburrasaurus	110 - 100
Parasaurolophus	80 - 65
Stegosaurus	152 - 140
Tyrannosaurus	72 - 65



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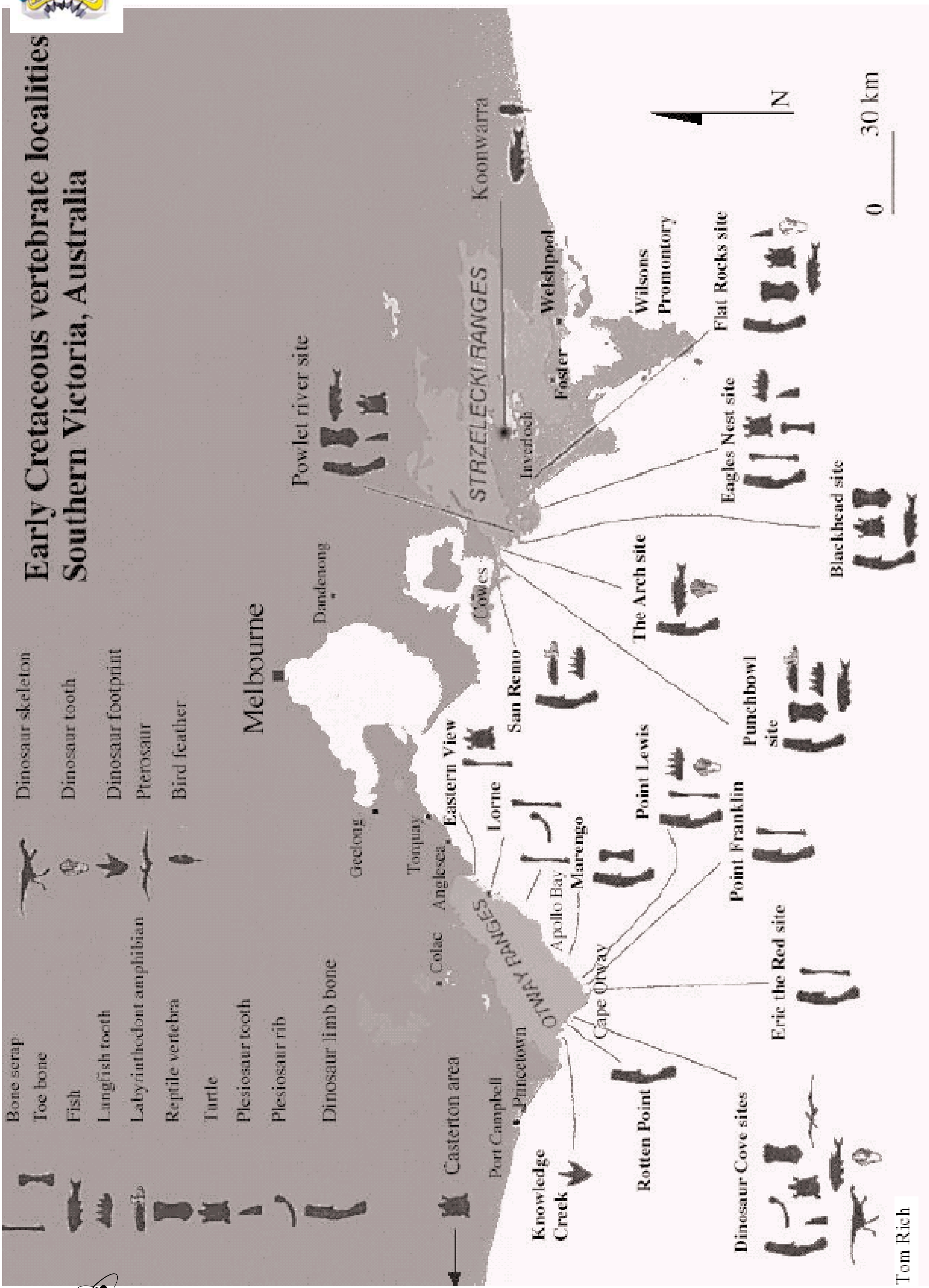
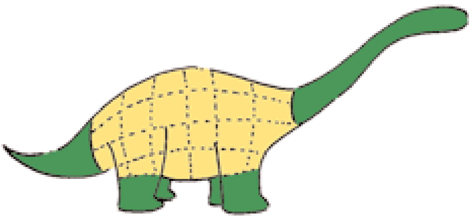
Map of Victoria



A question of scale

What to do

1. Make a small plasticine model of a dinosaur. For convenience sake try to round off its height and length to a whole number of centimetres.
2. Estimate the weight of your model and record on the grid below.
3. Weigh the plasticine model using the kitchen scales and record your findings on the photocopied master.
4. Make another model, twice the size of the original. (To double the size of the original plasticine model, all components must be twice as big.)
5. Record your estimate of the weight of the second model
6. Weigh the larger plasticine model and record your findings.



Dinosaur	Size	Weight estimate	Actual weight
1	g		
2	Twice dino #1		
3	Three times dino #1		

Questions for you to explore

As the models double their size, does their weight also double? Why?

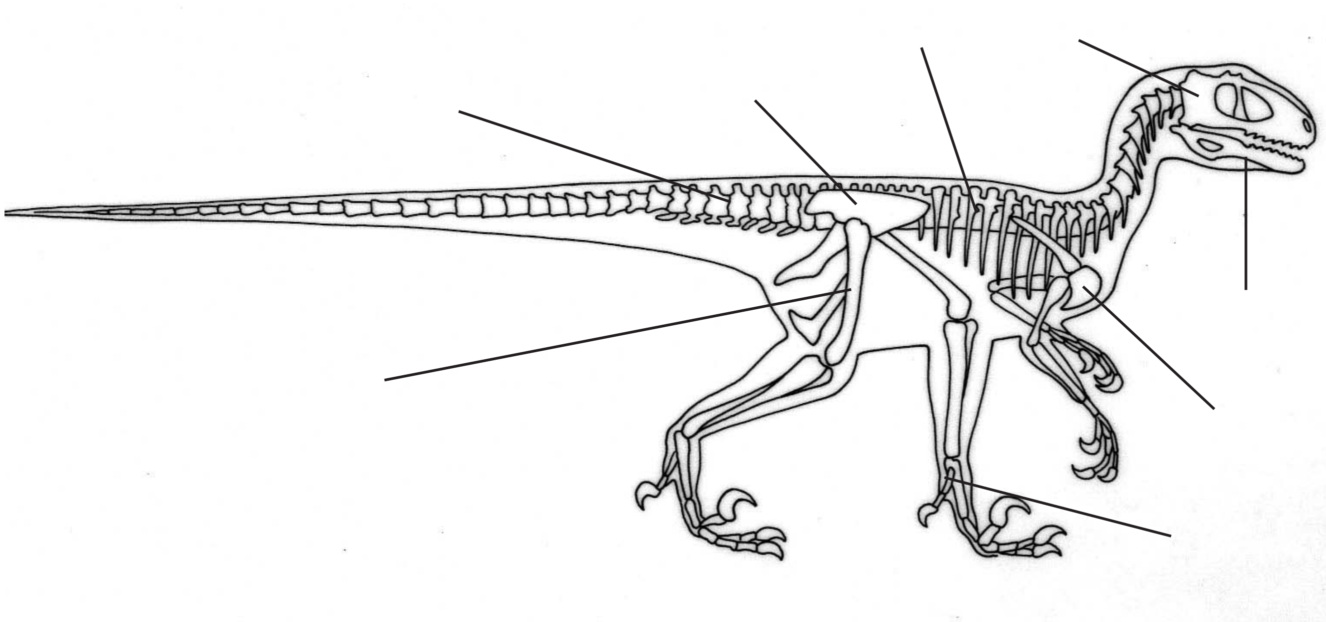
What do you think will be the weight of a model that is three times the size of the first model? Test your theory!

Just dinosaur bones

This is an artists impression of a Deinonychus skeleton.

Can you label the following bones?

femur, jaw, ribs, spine, hip, ankle, skull, clavicle



What was a dinosaur?

Part 1 Build model dinosaurs and other reptiles

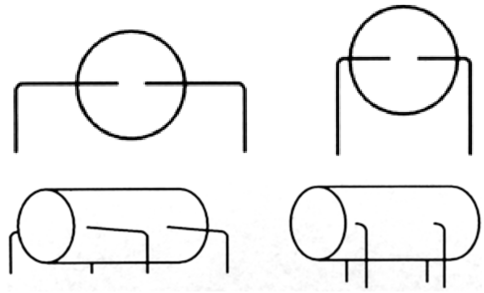
You need

2 cardboard cylinders
8 x 15 cm lengths of stiff wire
Pliers, scissors, adhesive tape

What to do

1 Bend the wires into legs for model animals as shown.

2 Secure the legs to the cylinders with adhesive tape.



splayed legs   straight legs

Dinosaurs were reptiles but not all reptiles look the same or move in the same way. Dinosaurs had straight legs tucked underneath their bodies.

Questions for you to think about and discuss

1 Which model looks most like a living reptile (e.g. lizard, crocodile)?
2 Which one supports pressure best when you press down on its back?

Part 2 Make yourself into a splayed-legged animal and see how fast you can move

You need

A friend   A stop-watch   A 15 metre, flat piece of ground

What to do

1 One partner makes themselves into a splayed-legged animal while the other partners times how long it takes them to move the 15 metres in this position. (That is, in a push-up position with arms and legs spread as wide as possible)
2 Record this time on a piece of paper.
3 The partner doing the moving makes themselves into a straight-legged animal by getting into a squat position and placing his/her hands on the ground with knees under the hips.
4 Try moving the 15 metres once more and record the time it takes using a straight-legged movement.

Questions for you to think about and discuss

1 Did you crawl faster and further in the straight-legged position?
2 Which arrangement seems best for active animals?

Research tasks

1 What leg arrangements do scientists think dinosaurs had?
2 Have scientists always thought dinosaurs looked like this?

A Cretaceous game of survival (1)

Instructions

This is a game involving a series of hunts made by the fierce carnivore, Deinonychus, upon a herd of herbivorous, Maiasaurs. The setting is the late Cretaceous.

How to play

1 Divide into pairs. One person takes the part of Deinonychus and the other person takes the part of Maiasaurus.

2 Each player must have a copy of the island square grid.

3 Maiasaurs start with a population of 30. They hide in the squares of the Island. Show where they are hiding on the island by marking 30 squares lightly, with a pencil. Do not let Deinonychus see where they are.

4 Deinonychuses begin with a pack of three Deinonychuses.

5 Deinonychuses hunt by naming a number from 1 to 49. If there is a Maiasaurus in the chosen square, it is rubbed out because the hunt is successful. If there is no Maiasaurus in the square, the hunt is unsuccessful. Deinonychuses must keep a written record on a separate piece of paper of successful and unsuccessful hunts.

6 One round of hunting means that each Deinonychus has one guess at where a Maiasaurus is hiding on the island. (Remember, you represent three Deinonychus to begin with).

7 After each round of hunting, the number of successful and unsuccessful hunts is added up and the populations are changed like this:
• for every one successful hunt, one extra Deinonychus is added to the pack,
• for every two unsuccessful hunts, one Deinonychus is removed from the pack due to starvation,
• two extra Maiasaurs are added after every round because of reproduction. (Remember to mark these on your plan of the Island.)

8 The results must be recorded after every round in a table like this:

Round of Hunting	Number of Deinonychuses	Number of Maiasaurs
Start 1	3	30

Example

Imagine a game where, after 3 rounds there are 7 Deinonychuses and 22 Maiasaurs. In the next round there are 4 successful and 3 unsuccessful hunts. Because of the successful hunts, 4 extra Deinonychuses are added but one Deinonychus is removed because of the unsuccessful hunts.

The new deinonychus population is 7 + 4 - 1 = 10

9 Continue for up to 20 rounds of hunting.

This game is a modifeid version of ‘Dingos and Wallabies’, a game published by DEET in its Science Extended PD, Biological Science Module.

A Cretaceous game of survival (2)

Island grid

- To begin, place 30 crosses at random throughout the grid.
- Use a grey lead pencil and press lightly.
- DO NOT SHOW DEINONYCHUS!

1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	32	33	34	35
36	37	38	39	40	41	42
43	44	45	46	47	48	49

A Cretaceous game of survival (3)

Hunting tally sheet

At the end of each round of hunting calculate results

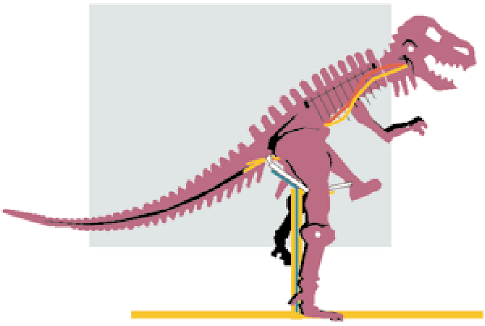
- In each round each Deinonychus has one guess to find a Maiasaurus.
- For every successful hunt, one extra Deinonychus is added to the pack.
- For every 2 unsuccessful hunts one Deinonychus is removed from the pack due to starvation.
- 2 extra Maiasaurs are added after every round because of reproduction.

Round of hunting	Number of Deinonychuses	Number of Maiasaurs
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		

There are three zones in Terrorsaurus. Your teacher may instruct you to begin in one particular zone but you may complete the activities in any order you choose.

Robosaurus

- Move the handles to make the dinosaur move.
- Draw a line from the words to the correct body part on the model below.



• jaws • arm • hip • ankle
• claws • tail • spine • knee

Maiasaura nest

- Draw a picture of the Maiasaura nest.
- How many eggs are in the nest?

Answer ______

- Talk to a friend about how the mother and her young are the same or different.

Quizasaurus

- Write three new things you have learnt about dinosaurs from this quiz.

1
2
3

Long-gone-a-saurus

- Draw a line from the scientist to their theory

Gradual extinction

Meteorite impact

Volcanic eruption

- Discuss each theory with a friend, then circle the extinction theory you think is most likely.

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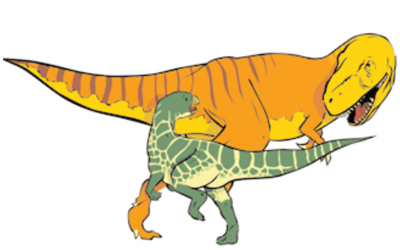
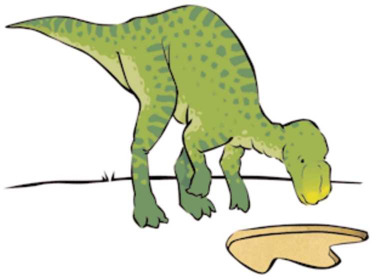
Trackasaurus

- Press the green button and watch the tracks appear.
- Count how many large dinosaur footprints appear. Answer ______
- Circle the picture that you think tells the story of the tracks.



A great escape



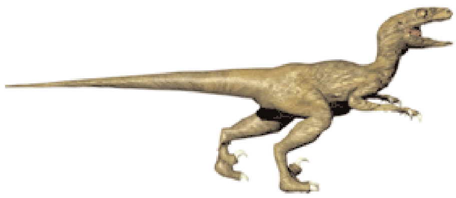
Old prints and new prints

A family stroll

Jigarasaurus

- Choose one dinosaur to rebuild then circle your chosen dinosaur.

It is a ...leaf eater twig eater meat eater



How is your dinosaur different to the other two?

Answer: ______________________________

Deinonychus Dash

Scientists use fossil tracks and leg bones to estimate how fast dinosaurs moved. How fast can you run?

- Measure and record your hip height, stride length and potential running speed at the Deinonychus Dash.
- Compare these with your friend's measurements.

Name	Hip height	Stride length	Predicted speed (from graph)	Actual speed (racing Deinonychus)

Can you run faster than Deinonychus? Yes or No

There are three zones in Terrorsaurus. Your teacher may instruct you to begin in one particular zone but you may complete the activities in any order you choose.

Trackasaurus

Tracks were made by dinosaurs when they were alive. Fossil bones are the remains of dead dinosaurs.

- What sort of information are scientists able to deduce from footprints?

1

2

3

A trip to the waterhole

- Press the green button and watch the tracks appear.
- What do you think the tracks show?

- Do you agree with the answer given?

- What do you think might have happened after the escape?

- List three other animals that lived during the Jurassic Period that were not dinosaurs:

1

2

3

- What living animals are they similar to?

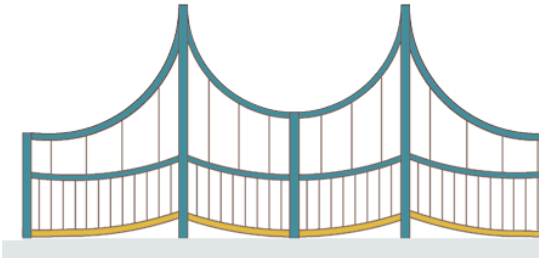
1

2

3

Backs and bridges

Nature often presents solutions for engineering problems.



- Explain how the bridge above is similar to Apatosaurus.

Long-gone-a-saurus

Did dinosaurs die out 65 million years ago?

- Label the three main extinction theories shown in the exhibition.

- Explore each theory by placing evidence in the evidence tray.
- Which theory do you think most likely and why?

Meteorite Impact

- Drop the disc into the dust and describe the effect?

Dust and darkness

- Turn the knob to move the screen. Explain the difference in temerature as you move the screen.

- What would be the effects of a large meteorite hitting earth and how might this have led to the extinction of dinosaurs?

Deinonychus Dash

Scientists use fossil tracks and leg bones to estimate how fast dinosaurs moved.

- Measure and record your hip height, stride length and potential running speed at the Deinonychus Dash.
- Compare these with your friend's measurements.

Name	Hip height	Stride length	Predicted speed (from graph)	Actual speed (racing Deinonychus)

Can you run faster than Deinonychus? Yes or No

Flesh on bones

- Use the computer to find out morea bout *Tyrannosaurus rex.*
- What did you discover about...

T rex's skeleton and posture? T rex was a bipedal dinosaur. What does this mean?

T rex's eyes? Why would forward facing eyes allow *Tyrannosaurus rex* to be an effective predator?

T rex's arms? What do you think *Tyrannosaurus rex's* arms could have been used for?

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Resources

Education kits

- *Dinosaurs in Time*, Teacher Resource Package, Melbourne Museum, 2001
- *Rex Surfs the Net,* Museum Victoria,
- *Terrorsaurus, Resources for teachers and students,* Questacon, National Museum of Science and Technology, 1997
- *Terrorsaurus Explainer Notes*, Questacon, National Museum of Science and Technology, 1997

Student resources

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- Macdonald, J. Reid, Macdonald, Mary Lee, Vicker-Rich, Patricia, Rich, Leaellyn S.V. and Rich, Thomas H., *Fossil Collector's Guide,* Kangaroo Press, East Roseville, NSW, 1997.
- McClish, B., *Time Traveller's Guide to Ancient Australia*, Gould League of Victoria, 1991.
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Websites

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  http://www.sidwell.edu/us/science/vlb/class/index.html
- **Dinosaurnews Webzine**
  http://www.dinosaurnews.org/
- **Discover Current Issue**
  http://www.discover.com/may_01/gthere.html
- **Enchanted Learning Dinosaur Site**
  http://www.enchantedlearning.com/subjects/dinosaurs/
- **Melbourne Museum Education Resources - Dinosaurs**
  http://www.museum.vic.gov.au/dinosaurs/dinosactivs.stm
- **Polar Dinosaurs in Australia**
  http://pubs.usgs.gov/publications/text/polar.html#anchor9568806
- **Queensland Museum - Dinosaurs of Australia**
  http://www.qmuseum.qld.gov.au/features/dinosaurs/dino.asp
- **Scientific American**
  http://www.sciam.com/index.cfm
- **Terrorsaurus Homepage (Questacon site)**
  http://www.questacon.edu.au/html/terrorsaurus.html
- **The Dinosauria**
  http://www.ucmp.berkeley.edu/diapsids/dinosaur.html
- **Walking with Dinosaurs**
  http://www.abc.net.au/dinosaurs/default.htm