PRIMARY + STEM

Teaching Resource

ACTIVITY: Dinosaur Footprints

ACTIVITY OVERVIEW

Dinosaurs are fascinating creatures from the past that don't always find a place within the Australian curriculum. But who doesn't love dinosaurs? With a little background information, we can add dinosaurs into several areas of the primary education curriculum, including English, Mathematics and Science.

Palaeontologists have found evidence of many different types of dinosaurs across Australia, through the discovery of fossils and traces such as footprints. Use this Australian dinosaur-themed maths activity to engage your students in measurement and multiplication.

Students will draw and measure footprints of dinosaurs found along the coast of Western Australia, as well as use multiplication (at an age-appropriate level) to determine the hip height of the dinosaurs, based on scientific theory.

SYNOPSIS

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Foundation – Year 2

- F: Use direct and indirect comparisons to decide which is longer, heavier or holds more, and explain reasoning in everyday language.(VCMMG078)
- Y1: Measure and compare the lengths, masses, and capacities of pairs of objects using uniform informal units. (VCMMG095)
- Y2: Compare and order several shapes and objects, based on length, area, volume and capacity, using appropriate uniform informal units.(VCMMG115)
- Y2: Recognise and represent multiplication as repeated addition, groups and arrays.(VCMNA108)

Years three - four

- Y3: Measure, order and compare objects, using familiar metric units of length, area, mass and capacity.(VCMMG140)
- Y4: Use scaled instruments to measure and compare lengths, masses, capacities and temperatures.(VCMMG165)
- Y3: Recall multiplication facts of two, three, five and ten and related division facts. (VCMNA134)
- Y3: Represent and solve problems involving multiplication, using efficient mental and written strategies and appropriate digital technologies.(VCMNA135)
- Y4: Investigate number sequences involving multiples of 3, 4, 6, 7, 8, and 9.(VCMNA154)
- Y4: Recall multiplication facts up to 10 × 10 and related division facts.(VCMNA155)
- Y4: Develop efficient mental and written strategies and use appropriate digital technologies for multiplication and for division where there is no remainder. (VCMNA156)

Years five - six

- Y5: Choose appropriate units of measurement for length, area, volume, capacity and mass.(VCMMG195)
- Y6: Connect decimal representations to the metric system.(VCMMG222)
- Y6: Convert between common metric units of length, mass and capacity. (VCMMG223)
- Y6: Solve problems involving the comparison of lengths and areas, using appropriate units.(VCMMG224)
- Y5: Use efficient mental and written strategies and apply appropriate digital technologies to solve problems.(VCMNA185)
- Y6: Multiply decimals by whole numbers and perform divisions by non-zero whole numbers, where the results are terminating decimals, with and without digital technologies.(VCMNA215)

ACTIVITY, MATERIALS AND INSTRUCTIONS

Activity

Use footprint measurements from Australia's Jurassic dinosaurs - found along the coast of Western Australia - to estimate the height of these amazing creatures from the past.

Materials needed (for class of 30 students working in pairs)

- Table of dinosaur names and footprints (see below)
- Paper
- Pencils
- Chalk OR masking tape (to mark measurements on the ground/wall)
- Rulers
- Tape measures / trundle wheel

Instructions

Dinosaur footprints have been found in several locations across Australia. Some of the most significant footprints were found along the coast of Western Australia, near Broome.

There are four types of footprint shapes made by different dinosaur groups.

- Sauropods (e.g. *Apatosaurus, Oobardjidama*): big and blobby
- Therapod (e.g. *Tyrannosaurus, Australovenator*): three toes, look like bird feet
- Ornithopod (e.g. *Iguanadon, Wintonopus*): three toes, wider than therapod feet
- Thyreophoran (armoured dinosaur) (e.g. *Stegasaurus, Ankylosaurus*): more than three toes (sometimes number of toes differs on front and back feet)

1. Make a footprint: Student pairs choose one dinosaur footprint to draw and cut out from paper, making sure that the footprint measurements match those given. Students can use the footprint shape descriptions to help work out how many toes their dinosaur has. Some footprints can be drawn on A4 paper, while others are much too large. For larger footprints, either stick together sheets of paper, use butcher's paper, or draw with chalk on the ground.

2. Dinosaur hip height: Scientists have studied dinosaurs that have known footprint and leg bones sizes. Using this information, we can estimate the hip height (or leg length) of a dinosaur, based on its footprint length.

   Dinosaur hip height = 4 x footprint length

   Multiply the footprint length by four to estimate the height of the dinosaur's hip.

3. Using your cut out dinosaur footprint, estimate the height of your dinosaur's hip. Draw this on the ground or a brick wall outside, using chalk.

4. Dinosaur length: It is difficult to estimate a dinosaur's length (from head to tail) from footprint length, as dinosaurs have a wide range of neck and tail lengths that don't all match up with their hip height. Using your dinosaur hip height and knowing your dinosaur body shape (use Australian Age of Dinosaurs to see similar dinosaurs), try drawing the head and tail of your dinosaur, to estimate the size of its whole body.

   You will need plenty of space on the ground to do this with the largest sauropod footprints (as their hip height is seven metres).

HOW TO USE THIS ACTIVITY WITH YOUR STUDENTS

Foundation - Year 2

Each pair of students draws and cuts out one dinosaur footprint.

Alternatively, teacher may provide students with footprint shapes at correct sizes, by doing a rough sketch of one three-toed therapod, one sauropod round blobby print, one wider three-toed print and one armoured dinosaur print.

You may like to cut out shapes from cardboard (e.g. side of a box), so that students can trace around them on the ground. Lay out footprints on the ground to estimate hip height.

Working together, students add four footprints together to show the hip height of the dinosaur. These can be laid on the ground in the classroom, hall, or outside space. When you have four footprints laid down, draw a leg shape around these.

Have you measured any dinosaurs that are smaller than you? Remember that some dinosaurs stand much taller than the height of their hips.

To extend students use of measurement and multiplication with animal bodies, draw around the shape your own foot and cut it out. Lie on the ground/carpet. Your partner uses your cut out foot to work out how many times your foot length fits into your body length (your height).

Optional – use tape measures to measure the actual lengths of feet and bodies in centimetres (or metres).

Years 3/4

Working together, students add four footprints together to show the hip height of the dinosaur. These can be laid on the ground in the classroom, hall, or outside space. When you have four footprints laid down, draw a leg shape around these. Measure the actual hip height of dinosaurs using a tape measure or trundle wheel.

What unit of measurement is best for dinosaur size? Millimetres, centimetres, metres? Extend your class learning by asking the question - Does it work on people? Is your leg length four times your foot length? Can we estimate your height based on the length of your foot? Measure your foot length and your height, then work out what number we need to multiply your foot length by to estimate your height. Students may like to cut out their own foot size and work out how many times it fits into their body length (height) or use multiplication or division to work out the answer mathematically. Work out a rule that can be used with your class. Test it out on another class.

Years 5/6

Measure the footprints to the nearest millimetre. Is this a good unit of measurement for the size of these dinosaurs? No! You will need to convert to metres. Extend your class learning by transferring these dinosaur skills into measurements of people. Plot a class graph of foot length vs. height (scatterplot). Display this on the whiteboard and draw a trend line through dots. Use this graph to estimate the height of students from another class, by only measuring their foot lengths. Measure foot lengths, then go back to your classroom to check on your graph. Create a list in height order of the other class. Does it match up? How accurate is your estimate?

Some students may like to create a mathematical rule for working out human height from foot length.

DISCUSSION SECTION AND KEY THEMES

KEY THEMES

What is a dinosaur?

Dinosaurs were reptiles that laid eggs and had their four limbs positioned under their bodies. The word dinosaur comes from Greek words meaning 'terrible' and 'lizard'. Dinosaurs lived on Earth from around 245 to 66 million years ago.

Today, birds are the living descendants of dinosaurs.

Many museums have easy to read dinosaur information including the Australian Age of Dinosaurs, Australian Museum, and international Natural History Museums.

Ichnology

Ichnology is the study of fossilised tracks, trails, burrows and excavations made by animals. Ichnology provides evidence about the behaviour of extinct animals and is a specific area of palaeontology.

Scientific names

When you see the name of a plant or animal written in italics, this is the scientific name.

Scientific names are made up of two words, the genus, and the species of the living thing, with this system called binomial nomenclature.

When we write scientific names, we always write them in italics. The first word, the genus, always has a capital letter. The second word, the species, always has a lower-case letter.

The genus may be the same between many living things and shows us something about how one living thing is related to others.

For example, *Wintonopus latomorum* and *Wintonopus middletonae* are similar, but different enough that they are considered different species.

The species name often tells us something about the living thing or maybe someone involved in its discovery.

Scientific names mean that people all over the world studying different living things can easily communicate with each other and share their research.

If you see a dinosaur genus name ending in 'pus' this means that we only have evidence of this animal from its footprints (e.g. Winotonpus, Tyrannosauropus).

Dinosaur footprints in Australia

Dinosaur footprints have been found in several locations around Australia.

These include:

- near Broome, Western Australia
- Lark Quarry Conservation Park, Queensland (https://www.dinosaurtrackways.com.au/)
- near Skenes Creek, Victoria (https://www.abc.net.au/news/2022-06-07/dinosaur-therapod-footprints-skenes-creek-great-ocean-road/101121278)

Units of measurement

Students can measure dinosaur sizes using:

- Rulers – millimetres, centimetres
- Tape measures – centimetres, metres
- Measuring/trundle wheel – centimetres, metres

Ratios

A ratio compares one thing to another using numbers. For example, when I make oobleck (cornflour slime) I use a ratio of one cup of water for every two cups of cornflour. I can write this ratio as 1:2. This helps me to work out exactly how much cornflour and water I will need to make small or large bowls of oobleck.

When we use dinosaur footprint to hip height calculations, we use the ratio 1:4, meaning that for every one cm of footprint, we must multiply this by four to find the dinosaur hip height (leg length).

Multiplication

During primary school, students are working towards being able to recall the times tables from 0 to 10 by the end of Year 4.

To achieve this, they are led through a progression from adding and grouping, sharing equally, skip counting, and displaying information in arrays until they reach the times tables.

Following on from this, students explore multiplication by one and two digit numbers, and the use of digital technology to assist in multiplication (e.g. calculators, computers).

Throughout this mathematical journey, students also encounter division, the opposite of multiplication.

QUESTIONS AND ANSWERS

Why are there no dinosaurs alive today?

Dinosaurs lived on Earth between about 245 to 66 million years ago, during the Mesozoic Era. We know about the dinosaurs because of fossils and traces they have left behind in rocks. The period that dinosaurs lived is divided into three periods:

- Triassic: 252 – 201 million years ago
- Jurassic: 201 – 145 million years ago
- Cretaceous: 145 – 66 million years ago

At the end of the Cretaceous period there was a mass extinction, with around 75 per cent of animals disappearing from the fossil record at this point in time. Scientific evidence suggests that an asteroid hit Earth, off the coast of present-day Mexico. The impact site is known as the Chicxulub crater and is about 150km wide. As well as damage in the immediate area of the impact, the asteroid caused a massive amount of soot and debris to enter the atmosphere and travel around the world. Less light was able to reach the surface of Earth, causing a decrease in plant growth. This meant less plants for animals to eat, then less animals for other animals to eat, as this change amplified up the food chain. Around the same time as the asteroid impact, there was an increased amount of volcanic activity on Earth, as well as continents moving further apart, changing ocean currents and overall climate change. Following this event, flowering plants, mammals, and birds were able to take over the new environment.

Did Tyrannosaurus rex live in Australia?

No, we do not have any fossil record of Tyrannosaurus rex living in Australia. At present, T.rex fossils have only been found in North America. However, Australia was home to our own therapod (carnivorous dinosaur that walked on two legs), Australovenator wintonensis, found in Queensland. Australovenator was approximately 1.6 metres tall at the hips and five - six metres long, from head to tail.

Did dinosaurs have feathers or scales?

Both! Palaeontologists have found evidence of scales and feathers in different dinosaur fossils. The more fossils of dinosaur skin that are found, the more we learn about the body coverings of these creatures.

Could Jurassic Park actually happen? Could scientists bring dinosaurs back to life?

Sorry, it is unlikely that scientists could create a Jurassic Park in the future. In the movies, scientists use DNA (genetic material) found inside mosquitos from the time dinosaurs are alive. DNA molecules will break down over time and are unlikely to survive millions of years. If scientists did get lucky and find a small fragment of dinosaur DNA they would need to add in extra genetic material from present-day animals to make a complete sequence.

Although we won't be visiting Jurassic Park any time soon, we may be able to visit Thylacine Park, as scientists from the University of Melbourne are currently working on bringing the Tasmanian Tiger (Thylacine) back to life using preserved DNA. These animals were still alive 100 years ago, so it is much easier to find intact DNA to use for this research.

Are there more dinosaur fossils and tracks still to find when I grow up?

YES! All over Australia there are fossil sites that have not been fully explored. Palaeontologists require more sets of eyes, more time, and more money to find more Australian fossils. Some fossil sites rely on volunteers walking along stretches of beach, or farmers heading out to their remote paddocks to spot a glimpse of a new fossil that has been uncovered by weathering from wind and rain. There are still plenty of fossils out there for us to find!

Have we always measured things using centimetres and metres?

In Australia before we used the metric system (that includes centimetres and metres) the British Imperial System was used. This meant that the size of objects was measured in inches, feet, yards and miles. In the USA, these measurements are still used today.

Before people travelled widely around the world and traded between countries, local units of measurement were used. Some of these continue to be used today. Students may like to research traditional units of measurement from around the world, including Egypt, China, and India.

What size were the biggest and smallest dinosaurs that we know about?

Biggest, smallest, longest, tallest are tricky things to determine when we only have some parts of dinosaur skeletons, and we can't always tell the difference between babies and adults.

Here are some interesting dinosaur statistics, based on current information from The Dinosaur Museum, in Dorchester, UK.

- Longest dinosaur – Argentinosaurus, over 40 m
- Heaviest dinosaur – Argentinosaurus, 77 tonnes
- Smallest adult dinosaur – Lesothosaurus (chicken sized)
- Tallest dinosaur – Sauroposeidon (a Brachiosaurid), 18 m tall
- Oldest dinosaur – Saltopus, from Scotland, 245 million years ago

Can we predict the height that a child will grow to as an adult?

There are several formulas that will provide a reasonable guess at what height children will grow, just like the dinosaur footprint lengths can provide a reasonable guess at the hip height of dinosaurs.

Try:

- Double a girl's height at age 18 months
- Double a boy's height at age two years
- Add the height of the mother and father together. Girls – subtract 13 cm, then divide by two. Boys – add 13 cm, then divide by two.

Children may like to try these calculations at home later.

What are some jobs that involve a lot of measuring?

There are many jobs that require people to use specific instruments to take measurements as part of their work.

These include carpenters and builders measuring length, height, width and angles of materials and spaces. Doctors and nurses measure heart rates, weights, and blood pressure.

- Athletes measure their personal best times and distances.
- Police measure the speed of moving vehicles.
- Water companies measure the chemicals found in our drinking water.
- Musicians measure the time between beats of the music, the length of notes and the volume that they are playing.

Why do I need to learn my times tables?

Learning the times tables (or multiplication tables) is an important step in your maths education.

No, not everyone is going to be a mathematician when they grow up, but the ability to recall these sets of facts can assist us in many aspects of our ordinary lives.

We use multiplication and division in cooking (e.g. how many potatoes will I need when the whole family comes over for dinner), gardening (e.g. if I expect to grow 10 capsicum on each plant, how many should I put in my garden), shopping (e.g. how many packs of Easter eggs do I need to share with my class), calculating materials needed for home renovations (e.g. tiles to cover a bathroom floor).

In secondary school, students will need these times tables to help them discover the world of algebra and how this can be used for more complex calculations.

OUTSIDE OR SUPPLEMENTARY READING

Australian Age of Dinosaurs Museum (easy to use Australian dinosaur information)

https://www.australianageofdinosaurs.com/

Largest Dinosaur Footprint Found in Australia (National Geographic)

https://blog.education.nationalgeographic.org/2017/03/28/largest-dinosaur-footprint-found-in-australia/

The Dinosaurian Ichnofauna of the Lower Cretaceous (Valanginian–Barremian) Broome Sandstone of the Walmadany Area (James Price Point), Dampier Peninsula, Western Australia (scientific paper written by palaeontologists)

https://www.tandfonline.com/doi/pdf/10.1080/02724634.2016.1269539?needAccess=true

Saving Australia's Jurassic Park

https://shorthand.uq.edu.au/changemakers/issue3/saving-australias-jurassic-park/

Natural History Museum – Dinosaurs

https://www.nhm.ac.uk/discover/dinosaurs.html

Australian Museum – Dinosaurs and their relatives

https://australian.museum/learn/dinosaurs/

TOPIC WORDS

- Dinosaur
- Fossil
- Footprint
- Ichnology
- Track
- Size
- Scale
- Measurement
- Multiply
- Hip
- Length
- Width
- Height
- Metres
- Centimetres

Western Australian dinosaur footprints

Length = measurement from tip of middle toe to back of heel

Width = measurement across the foot, from left toe to right toe

To see pictures of the footprints and dinosaurs, refer to Australian Age of Dinosaurs website https://www.australianageofdinosaurs.com/

DINOSAUR NAME	FOOTPRINT SHAPE	FOOTPRINT SIZE (LARGEST FOUND)
Megalosauropus broomensis (therapod)	3 toes	60 cm long
Yangtzepus clarkei (therapod)	3 toes (with long middle toe)	33 cm long
Broome unnamed therapod	3 toes	47 cm long
Oobardjidama foulkei (sauropod)	Big and blobby	77 cm long, 68 cm wide
Broome unnamed sauropod	Big and blobby	175 cm long, 140 cm wide
Wintonopus latomorum (ornithopod)	3 toes, wider	44.6 cm long
Wintonopus middletonae (ornithopod)	3 toes, wider	25 cm long

Walmadanyichnus hunter (ornithopod)	3 toes, wider	80 cm long
Amblydactylus (ornithopod)	3 toes, wider	44.6 cm long
Garbina roeorum (thought to be from a stegosaur)	4 toes front feet 3 toes back feet	20 cm long, 21 cm wide 35 cm long, 52 cm wide
Luluichnus muecki (thought to be from a stegosaur)	4 toes	14 cm long, 22 cm wide
Broome unnamed armoured dinosaur (thyreophoran)	5 toes	14 cm long, 29 cm wide

Source: The Dinosaurian Ichnofauna of the Lower Cretaceous (Valanginian–Barremian) Broome Sandstone of the Walmadany Area (James Price Point), Dampier Peninsula, Western Australia (scientific paper written by palaeontologists).

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