# STEM Stage 2 learning sequence: Native animals

**Driving question**

How can I design a product or system to monitor and protect a small Australian native animal?

**Learning sequence description**

Students will:

* design a solution to an authentic problem by creating a system that monitors or protects a small Australian native animal
* identify the characteristics of systems and apply their knowledge of measurement, forces and properties of materials in the design solution.

## Syllabus outcomes and content

### Science and technology

**ST2-1WS-S** – questions, plans and conducts scientific investigations, collects and summarises data and communicates using scientific representations. Students:

* **conduct scientific investigations to find answers to questions**

**ST2-2DP-T** – selects and uses materials, tools and equipment develops solutions to an identified need. Students:

* **define a need or opportunity according to functional and aesthetic criteria**
* **consider potential resources in defining design needs and opportunities**
* **develop, record and communicate design ideas and decisions using appropriate technical terms**
* **produce labelled and annotated drawings including digital graphic representations.**

**ST2-7MW-T** – investigates the suitability of natural and processed materials for a range of purposes. Students:

* investigate how the properties of natural and processed materials influence their suitability and use in products, services and/or environments
* develop a design solution for an identified need or opportunity, using a variety of tools and materials that considers factors such as sustainability and time.

**ST2-9PW-ST** – describes how contact and non-contact forces affect an object's motion. Students:

* identify that both pushes and pulls can be classified as contact and non-contact forces
* observe how contact and non-contact forces cause changes in the motion of objects
* investigate how forces and materials interact in a product or system to perform a function.

### Mathematics

**MA2-1WM** – uses appropriate terminology to describe, and symbols to represent mathematical ideas

**MA2-2WM** – selects and uses appropriate mental or written strategies, or technology, to solve problems

**MA2-3WM** – checks the accuracy of a statement and explains the reasoning used

**MA2-9MG** – measures, records, compares and estimates lengths, distances and perimeters in metres, centimetres and millimetres, and measures, compares and records temperatures. Students:

* **estimate lengths and distances using metres and centimetres and check by measuring**
* **measure lengths and distances using metres and centimetres**
* **record lengths and distances using metres (m) and centimetres (cm), for example 1 m 25 cm**

**MA2-12MG** – measures, records, compares and estimates the masses of objects using kilograms and grams. Students:

* use hefting to identify objects that have a mass of ‘more than’, ‘less than’ and ‘about the same as’ one kilogram.
* recognise that there are 1000 grams in one kilogram, 1000 grams = 1 kilogram
* record masses using the abbreviation for kilograms (kg) and grams (g), for example 1 kg 200g.

[Science and Technology K-6 Syllabus](https://educationstandards.nsw.edu.au/wps/portal/nesa/k-10/learning-areas/science)  © NSW Education Standards Authority (NESA) for and on behalf of the Crown in right of the State of New South Wales, 2017.

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### Resource considerations

This lesson sequence allows for continuity of student learning and could be adapted to fit in with your existing teaching and learning program. Students will be supported to meet outcomes from different key learning areas. Most tasks have a duration of approximately 45 minutes and could be used in conjunction with your existing frameworks. The tasks provide options for students with and without technology. They can be used with any online platform. Suggestions about how your school will plan students’ learning from home and ways to communicate with students can be found through the [Learning at home](https://education.nsw.gov.au/teaching-and-learning/learning-from-home) space on our website. Assessment strategies linked to the success criteria are included to ensure evidence of learning is monitored and collected.

### Teacher notes

This learning sequence models an integrated approach to learning where the student solves an authentic problem by employing [design thinking skills.](https://schoolsequella.det.nsw.edu.au/file/ba43743b-baca-4dd2-9689-2da09ad2ffc7/1/design-thinking-across-the-curriculum.zip/index.html#/)



This learning sequence models an integrated approach to learning where the student solves an authentic problem by employing [design thinking skills](https://schoolsequella.det.nsw.edu.au/file/ba43743b-baca-4dd2-9689-2da09ad2ffc7/1/design-thinking-across-the-curriculum.zip/index.html#/).

When initially introducing the model to learners, the flow is sequential; that is from Identify and define to Research and plan to Produce and implement to Test and evaluate. As students and teachers become more familiar with the approach, regular and rapid movement backwards and forwards between the stages is to be expected and encouraged. In practice, students may move from Test back to Identify and define or Research and plan; they may then jump forward to Produce and implement. The fluid movement between the stages frequently results in a more comprehensive outcome.

1. **Empathise**: build the empathy of the student to focus on the problem: human and natural events impact on the environment and cause a threat to small Australian native animals.
2. **Identify and define** the task: consider all stakeholders, understand the terminology, research and discover ways that small Australian native animals move and/or are moved to places of safety.
3. **Ideate**: develop the skills of generating rapid ideas: imagine, create and express new and innovative ideas.
4. **Prototype**: allow students to plan and develop their idea, experimenting with solutions.
5. **Test** the validity of the solution and allow for modification and refinement.
6. **Share** and interrogate the solution with lots of praise and support.

## Learning experiences

### Activity 1 (30 minutes)

Students are learning to:

* identify why animals need protection
* appreciate Aboriginal and Torres Strait Islander knowledge on the interconnectedness and care for the land and living things.

#### Activity 1.1 Stimulus – Why should we protect animals?

Read a story or picture book about how animals need protection (you may be able to create a video read-through for students who are learning remotely). Some examples are:

* ‘Where the Forest Meets the Sea’ by Jeannie Baker – environment
* ‘Fox’ by Margaret Wild and Ron Brooks - predation
* Hunwick’s Egg’ by Mem Fox – Australian native animals

Ask students to imagine that they are a character in the story. Use a ‘5 senses’ online graphic organiser to collaboratively describe what students ‘see’, ‘hear’, ‘feel’, ‘smell’ and ‘taste’, or students can record their ideas in the STEM S2 student workbook.

Brainstorm how the animals in the story protect themselves. Students can record their ideas in the student workbook. Discuss why we need to protect small Australian native animals from threats such as loss of their environment (food and shelter) and predators (foxes and cats).

##### Aboriginal perspective

Discuss the way Aboriginal and Torres Strait Islander Peoples have shown respect and care for living things in Australian environments over many millennia. In their role as custodians of the land they recognise that people, animals and the natural environment are all deeply connected. Aboriginal and Torres Strait Islander Peoples have deep knowledge of this interconnection, integrating sustainable management practices in their daily lives to support this connection. For example, over millennia Aboriginal people only hunt what is needed to provide for their daily needs. Their sustainable management of the land ensures certain areas are protected from hunting and other activities to provide safe places for Australian native animals and plants to survive and thrive.

Have students create an ‘I wonder...’ question about the survival and protection of these animals and write it in their student workbook. They will return to this question in Activity 3.1.

#### Resources

* Resource 1 – story/picture book; digital sharing platform such as YouTube (video/book)
* Resource 2 – student workbook
* Resource 3 – Video about [bushfire and wildlife](https://www.youtube.com/watch?v=JD6s29dMQY8) (Behind the News, 3:07min)

### Activity 2 (30 minutes)

Students are learning to:

* appreciate that others may have experiences that affect their viewpoint
* identify key stakeholders as part of the design process
* define a need for solving a problem.

#### Activity 2.1 STEM: Design thinking – Empathise

Introduce or review the design thinking model (as above in Teacher notes). You could complete [Design thinking](https://schoolsequella.det.nsw.edu.au/file/ba43743b-baca-4dd2-9689-2da09ad2ffc7/1/design-thinking-across-the-curriculum.zip/index.html#/) online (resource 1) to build knowledge of the design thinking process.

In the student workbook, students complete an empathy map about caring for small Australian native animals and their environments. They plan for and conduct four interviews about caring for small Australian native animals and their environments. Students can include the following questions in their interviews:

* **Who is responsible for protecting small, native Australian animals?**
* **Why do we need to protect small, native Australian animals?**

Students create additional questions (in the student workbook), conduct the interviews and add additional or new information they discover to the empathy map they created in their student workbook.

#### Resources

* Resource 1 – [Design thinking](https://schoolsequella.det.nsw.edu.au/file/ba43743b-baca-4dd2-9689-2da09ad2ffc7/1/design-thinking-across-the-curriculum.zip/index.html#/) [Online resource – NSW Department of Education website]
* Resource 2 – Student workbook

### Activity 3 (60 minutes)

Students learn to:

* actively apply the language of the driving question when considering the concepts and stakeholders
* consider the role of a driving question in solving a problem
* work mathematically to measure and record length, mass and temperature.

#### Activity 3.1 STEM: Design thinking – Define

Revise students’ ‘I wonder...’ questions from Activity 1 and explain that students will be working to answer the driving question:

* How can I design a product or system to monitor and protect a small Australian native animal?

Discuss role of driving question:

* to focus the task/s
* to challenge thinking
* to provide direction.

Students use a dictionary to define key words and note them in their student workbook.

**Discuss with students questions to help define the situation and the problem, or provide time for students to develop their own questions such as:**

* **what is different about caring for something and protecting something?**
* **how you might decide if an animal is a small or large Australian native animal (we will be working on this in the next task)?**
* **name some small Australian native animals in your local area or school.**
* **are there any dangers or threats to the animals that you know about?**
* **who might be involved in caring for or protecting these animals in your area?**

**Students could watch a BTN video such as** [BTN video about feral animal threats to native animals](https://www.abc.net.au/btn/classroom/protecting-desert-animals/10522828). (3:16min)

**Ask students to summarise their ideas in their student workbook.**

#### Activity 3.2 Mathematics: How big is a small Australian animal?

##### Opportunity for monitoring student learning: Practical activities

**What to look for:**

* measure lengths using metres and centimetres
* record lengths using metres (m) and centimetres (cm)
* use hefting to identify objects that have a mass of ‘more than’, ‘less than’ and ‘about the same as’ one kilogram
* record masses using the abbreviation for kilograms (kg) and grams (g).

Students measure length and mass of found objects using informal measures by comparing length to a piece of string and mass to measured pantry items.

Students estimate and order the objects.

Students confirm estimates using formal measures of a ruler and scales and record their measurements in the student workbook.

##### Let’s consider the size of Australian native animals

Ask students to brainstorm some problems they might encounter in measuring small Australian native animals. The list could include:

* remote area
* difficult terrain
* animal is hard to catch (for example, a koala up a tree)
* animal doesn’t stay still long enough to measure accurately (for example a living, swimming fish)
* animal is poisonous or too dangerous to measure directly.

Students use [Australian animal fact-sheets](https://australianmuseum.net.au/learn/animals/mammals/eastern-pygmy-possum/) (resource 2) to create a table of 10 Australian animals showing the size and weight for each animal. Identify which ones they think are small animals.

Discuss how students decided that an animal is ‘small’ and develop parameters for classification based on length and mass. Considering parameters for being a ‘small’ animal, ask students to think about how they could measure this.

##### Focus on an Australian animal

Students choose one small Australian native animal from the following list and read about it in the factsheet provided. Note: Teachers can print these factsheets and attach them to the student workbook if required.

* [Brown antechinus](https://australianmuseum.net.au/learn/animals/mammals/brown-antechinus/)
* [Eastern pigmy possum](https://australianmuseum.net.au/learn/animals/mammals/eastern-pygmy-possum/)
* [Black flying fox](https://australianmuseum.net.au/learn/animals/mammals/black-flying-fox/)
* [Feather-tail glider](https://australianmuseum.net.au/learn/animals/mammals/feathertail-glider/)

#### Resources

* Resource 1 – Student workbook
* Resource 2 – [Australian Museum animal factsheets](https://australianmuseum.net.au/learn/animals/)
* Resource 3 – Fact sheets
	+ [Brown antechinus](https://australianmuseum.net.au/learn/animals/mammals/brown-antechinus/)
	+ [Eastern pigmy possum](https://australianmuseum.net.au/learn/animals/mammals/eastern-pygmy-possum/)
	+ [Black flying fox](https://australianmuseum.net.au/learn/animals/mammals/black-flying-fox/)
	+ [Feather-tail glider](https://australianmuseum.net.au/learn/animals/mammals/feathertail-glider/)

### Activity 4 (2 hours)

Students are learning to:

* generate rapid ideas to imagine, create and express innovative ideas
* work scientifically to conduct investigations.

#### Activity 4.1 STEM: Design thinking – Ideate

Ask guiding questions:

* How can we help the people who help the animals?
* What new ideas do you have that will help protect or monitor your small Australian animal?
* What are the existing ways that people help to monitor or protect small Australian animals?

Students then develop rapid design ideas using the ideation strategy of a moonshot: big picture ideas with no financial or building constraints. Students ideate 4 crazy, innovative, and creative ideas in their workbook, quickly drawing the ideas that could be used to help protect their chosen small Australian native animal using a time limit for each idea.

Discuss student ideas. Have students add to their ideas following the group discussion. Students then select their best idea for prototyping. Ask students to think about these questions and summarise their ideas in the student workbook.

* What will it be made from?
* What tools will I need?
* How will it be powered?
* Does it have any moving parts?
* How will the parts move?

##### Resources

* Resource 1 – Student workbook

#### Activity 4.2 Science and technology: What will I need to make my design?

Students list the materials that they will need to build their best moonshot idea. They will enter the object and material in the table in their student workbook and then compile a matching list of the properties using a hints table

* rubber (rubber band) – elastic/stretchy
* plastic (raincoat) – waterproof, smooth, often shiny
* fabric (wash cloth) – absorbent
* ceramic (plate) – rigid/not bendable, fragile
* glass (window) – transparent, smooth
* clay (brick) – rough, tough, strong
* plastic (drinking straw) – flexible/bendable, non-absorbent

##### Aboriginal perspective

Discuss how Aboriginal and Torres Strait Islander Peoples use their understanding of the properties of natural materials found in Australia to construct items, such as tools. For example, digging tools need to be made from a hard, heavy material. Dense wood has these properties, so it is the material chosen to make digging tools. On the other hand, fishing spears need to be made from a material with different properties. This material needs to be buoyant and light. Aboriginal and Torres Strait Islander Peoples also change materials to strengthen specific properties making it more suited for its purpose. For example, steam is used to reduce brittleness and increase flexibility of wood making it easier to shape. More information from [Australian Curriculum: Science Aboriginal and Torres Strait Islander Histories and Cultures cross-curriculum priority](https://www.australiancurriculum.edu.au/f-10-curriculum/cross-curriculum-priorities/aboriginal-and-torres-strait-islander-histories-and-cultures/) (Content elaborations and teacher background information for Foundation to Year 6, 2019, pp. 174-181).

#### Activity 4.3 Science and technology: How will my design work?

##### Opportunity for monitoring student learning

Label action pictures using the words ‘push’ or ‘pull’ (student workbook).

Draw an annotated diagram of a vehicle or activity that involves both push and pull forces.

**What is a contact force?**

Discuss the term ‘contact’. Use familiar examples such as netball or basketball. Using instructions in the student workbook, students develop a game that uses contact forces: Ping Pong Soccer (use a straw, or a paper fan, to blow a ping-pong ball across a table) Students could investigate other examples of contact forces that act by pushing or pulling. Examples could include: a wind-up toy, a fan or hairdryer to blow a polystyrene ball across a table, the pattern formed by sand on a drum when it is struck.

Discuss student ideas about ‘contact’ in games. Review misconception that air is non-contact, since they cannot see any physical contact. Discuss how each game involves push and pull. Ask students to draw a diagram in their student workbook showing their understanding of push and pull forces in different games. They use arrows to represent the direction of each force.

Explain that contact forces are forces which act directly on objects.

**What is a non-contact force?**

Discuss the term ‘non-contact’. Use familiar examples like netball or basketball. Using instructions in the student workbook, students make Confetti Rain using electrostatic force and make a compass using magnetic force; in addition they will investigate which materials will attract a magnet. Students may also explore some activities including magnet car races (use a magnet to push another magnet across a table) and throwing a ball into the air and observing how gravity makes it fall.

Discuss student ideas about “non-contact” in each game. Discuss how each game involves push and pull. Ask students to draw a diagram to show the push and pull forces in different games. They could use arrows to represent the direction of each force. Identify the name of the non-contact force in each example above such as gravitational, electrostatic, magnetic forces.

Review that non-contact forces act on objects from a distance. (They do not physically touch).

**Investigating non-contact forces**

Provide opportunities for students to investigate non-contact forces in more detail based on the context of your school and students.

**Electrostatic force**

1. Investigate the effect of rubbing a plastic rod with different materials such as: cotton, nylon, paper
2. Find out whether a balloon can make water move.
3. Find out if there are other materials that can make water move.
4. Find out if there are other materials that can pick up confetti.
5. Cut out a small shape from a piece of tissue and use a balloon to make it “magically” hover.

**Magnetic force**

Investigate how the ends of a bar magnet can attract or repel each other.

#### Activity 4.4 Science and technology: How do I develop a product or system?

##### Opportunity for monitoring student learning

**What to look for:**

* Correct terminology to describe technology as tools and machines that may be used to solve real world problems.
* Correctly labelled annotated drawing or diagram.
* Correct terminology to describe a system as a collection of interconnected products that work together to perform a single function.

In this learning sequence, students are investigating how technology can be used in a system or product to help protect small Australian native animals. Explain that technology refers to tools and machines that may be used to solve real world problems.

Students will view an image of a possum crossing over a highway as an example of a product as part of a transport system, noting that this idea uses technology to solve an environmental problem by helping possums get to and from their nests more safely.

Students draw an annotated diagram of a product which is part of a system that helps a local animal move around more safely. Students will draw the product with labels to explain its function. **Hint**: think about signs or tunnels.

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#### Resources

Resource 1 – 'I wonder...’ questions from Activity 1

Resource 2 – List of Australian animals

Resource 2 – [BTN video about feral animal threats to native animals](https://www.abc.net.au/btn/classroom/protecting-desert-animals/10522828); Video

Resource 3 – [Corroboree frogs;](https://youtu.be/cB2j5lVG_Bg) Video

Resource 4 – [Koala;](https://youtu.be/oI3ADcDH0Uc) Video

Resource 5 – [Penguins](https://education.abc.net.au/home#!/media/2428256/penguins-conservation-and-tourism-on-phillip-island); Video

Resource 6 – [Northern hairy-nosed wombat](https://education.abc.net.au/home#!/media/155058/saving-the-northern-hairy-nosed-wombat); Video

Resource 7 – Materials to investigate different properties such as foil, glass, plastic, paper, foam, cardboard, bubble wrap, paint and aluminium cans, a thermometer and ice cubes.

Resource 8 – Objects to demonstrate contact and non-contact forces such as marbles, ping-pong balls, toy cars, paper planes, dominoes, play-dough, elastic bands, toy boats, fan/hair dryer, tubs of water, musical drums, magnets, balloons, confetti, wind-up toys, bar magnets or magnet chariots/cars, compasses, paper clips, polystyrene or cork, tennis balls.

Resource 10 – Student workbook

### Activity 5 (60 minutes)

Students are learning to identify, develop, plan and model a complex solution to a problem.

#### Activity 5.1 STEM Design thinking – Prototype

Provide time for students to construct (engineer) their best ideas to monitor or protect the small Australian native animal they chose in Activity 3.2. Use materials found at home or school (a making box) such as cardboard boxes, cylinders, tape, glue, pipe cleaners, materials, empty PET bottles, or any other resources that are needed.

Students reflect on the process of building their prototype and record their thoughts in their student workbook by drawing a labelled diagram of their idea, listing the materials that they are using for their prototype and identifying the tools and equipment that they are using for their prototype.

Students will take a photograph of their final prototype and attach it to their workbook.

Ask students to reflect on the process and write two actions that they are most proud of, two actions that could have been done better and any things that they would do better next time.

#### Resources

* Resource 1 – Student workbook

## Activity 6 (60 minutes)

Students are learning to:

* demonstrate and test the validity of their best idea
* reflect on their design
* refine their ideas based on feedback.

#### Activity 6.1 STEM – Test

Students identify 4 possible ways of testing their product or system – perhaps through feedback, perhaps by setting it up in different environments. Students then test their prototype to see how well, it works.

At this point, students may wish to modify their design to improve it and make it work better. Allow time for students to revisit the design phase, then make and test modifications to their design solution. They could ask for feedback from a family member.

#### Resources

* Resource 1 – Student workbook

### Activity 7 (30 minutes)

Students are learning to:

* showcase their solution
* review and refine their solution based on feedback
* reflect on their design journey.

#### Activity 7.1 STEM – Share

Organise a showcase display of the design solutions in your outside exercise space (perhaps you might like to make invitations and set up a special STEM display space).

Students use the claim-evidence-reason strategy (student workbook) to explain their learning, making sure to include learning about the design process as well as their learning about science and technology, engineering and mathematics. Photos could be added to their student workbook and a sentence written about the success of their design solution.

Students share their design solution with their teacher in the classroom or online.

Student reflect on the design process used throughout this STEM learning sequence.

#### Resources

* Resource 1 – Student workbook