Taxonomy-specimen collection, classification, scientific nomenclature and ethics in science

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Number of lessons: 11 (5 topics)

Year level(s): Year 4-5

Australian Curriculum content descriptions:

1. Collecting and pressing plants

Living things have life cycles (ACSSU072)

Living things have structural features and adaptations that help them to survive in their environment (ACSSU043)

Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena and reflects historical and cultural contributions (ACSHE081)

Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate (ACSIS090)

2. Pushes, Pulls & Pooter Prototypes

Forces can be exerted by one object on another through direct contact or from a distance (ACSSU076

Natural and processed materials have a range of physical properties that can influence their use (ACSSU074)

Reflect on and suggest improvements to scientific investigations (ACSIS09)

3. Categorising Living Things

Living things have structural features and adaptations that help them to survive in their environment (ACSSU043)

Science involves making predictions and describing patterns and relationships (ACSHE061)

Use a range of methods including tables and simple column graphs to represent data and to identify patterns and trends (ACSIS068)

Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS071)

4. Codebreaking Binomial Nomenclature

Science involves making predictions and describing patterns and relationships (ACSHE061)

Represent and communicate observations, ideas and findings using formal and informal representations (ACSIS071)

5. Ethics in Science

Science knowledge helps people to understand the effect of their actions (ACSHE062).

Scientific knowledge is used to solve problems and inform personal and community decisions (ACSHE083)

Reflect on and suggest improvements to scientific investigations (ACSIS091)

Achievement standard:

1. Collecting and pressing plants

By the end of Year 4, students … describe relationships that assist the survival of living things and sequence key stages in the life cycle of a plant or animal. They identify when science is used to understand the effect of their actions.

Students follow instructions to … conduct investigations and safely use equipment to make and record observations with accuracy… Students suggest explanations for observations and compare their findings with their predictions… They use formal and informal ways to communicate their observations and findings.

2. Pushes, Pulls & Pooter Prototypes

By the end of Year 4 students… describe how contact and non-contact forces affect interactions between objects… Students follow instructions to identify investigable questions about familiar contexts and make predictions based on prior knowledge. They describe ways to conduct investigations and safely use equipment to make and record observations with accuracy…

3. Categorising Living Things

By the end of Year 5, students… analyse how the form of living things enables them to function in their environments. Students discuss how … scientific knowledge develops from many people's contributions.

Students … use equipment in ways that are safe and improve the accuracy of their observations. Students construct tables and graphs to organise data and identify patterns in the data. They … communicate their ideas and findings using multimodal texts.

4. Codebreaking Binomial Nomenclature

By the end of Year 5, students… analyse how the form of living things enables them to function in their environments. Students discuss how scientific developments have affected people's lives, help us solve problems and how science knowledge develops from many people's contributions… They communicate their ideas and findings using multimodal texts.

4. Ethics in Science

By the end of Year 4, students … identify when science is used to understand the effect of their actions. They use formal and informal ways to communicate their observations and findings.

By the end of Year 5, students … discuss how scientific developments have affected people's lives, help us solve problems and how science knowledge develops from many people's contributions.

Lesson 1, 2 – Collecting & Pressing Plants

Context

This series of lessons provides students the chance to collect, preserve and store samples in a scientific way. They then try and identify the species they have collected and label them as such.

Materials and equipment

Old newspaper or phone books, cardboard, boards or frames, belts, ropes, tie down straps or weights (or alternatively, specifically made/purchased plant presses)
Samples of plants, collected by students from school ground, own homes or a field trip site.

Safety Advice

Remind students of general outside safety rules (hats, sunglasses, sunscreen, long sleeves, closed shoes etc are preferential), may need to plan for potential snake encounters.
Also need to consider that plant sap, berries, leaves etc can be toxic (or sharp) and so need to be handled with care.

Objectives

To learn how to take samples. To practice how to present information. To include and use diagnostic features to aid with identification.

Introduction

1. Run through the history of plant collecting. Then watch a basic 'how to' clip, such as:
How to Press a plant by Brilliant Botany- https://www.youtube.com/watch?v=qInacetx_II

2. If you have time and the kind of students who would find it interesting, watching the following art/commercial focused way of pressing plants, then comparing the two, may be worthwhile: https://www.youtube.com/watch?v=YBORgUKIfdo

Core

Discuss key ideas with students. Ask 'Why' this is done, 'what' certain steps in the process achieve, 'how' this is science etc.

Give students 5 minutes to go and collect an acceptable sample from the school yard and return.

As a class, practice the process of collecting, recording, labelling then arranging and pressing the sample. Ask students to explain what they have done.

Once you have observed all students doing this/helped adjust methods, correct misconceptions etc, then students can go and collect a few more and repeat the process.

Offer assistance & supervision throughout.

Conclusion

Bring students back together. Remind them of the 'why are we doing this?' answers & the long history of this as a scientific activity & human endeavor. Ask for feedback, student noticings etc. Introduce the idea that you (may) be expecting more samples from home, or alternatively that you may undertake a field trip to collect more.

Let them know that the assessable piece of work at the end of this (once the samples are properly dried of course) will be a display, including labels and ID's, and that upcoming lessons will involve collecting and processing, but also identifying where possible.

Resources

Digital: Youtube video clips
How to Press a plant by Brilliant Botany- https://www.youtube.com/watch?v=qInacetx_II
I Turn Old Flowers Into Art For A Living- https://www.youtube.com/watch?v=YBORgUKIfdo

Lesson 3, 4: Pushes, Pulls & Pooter Prototypes

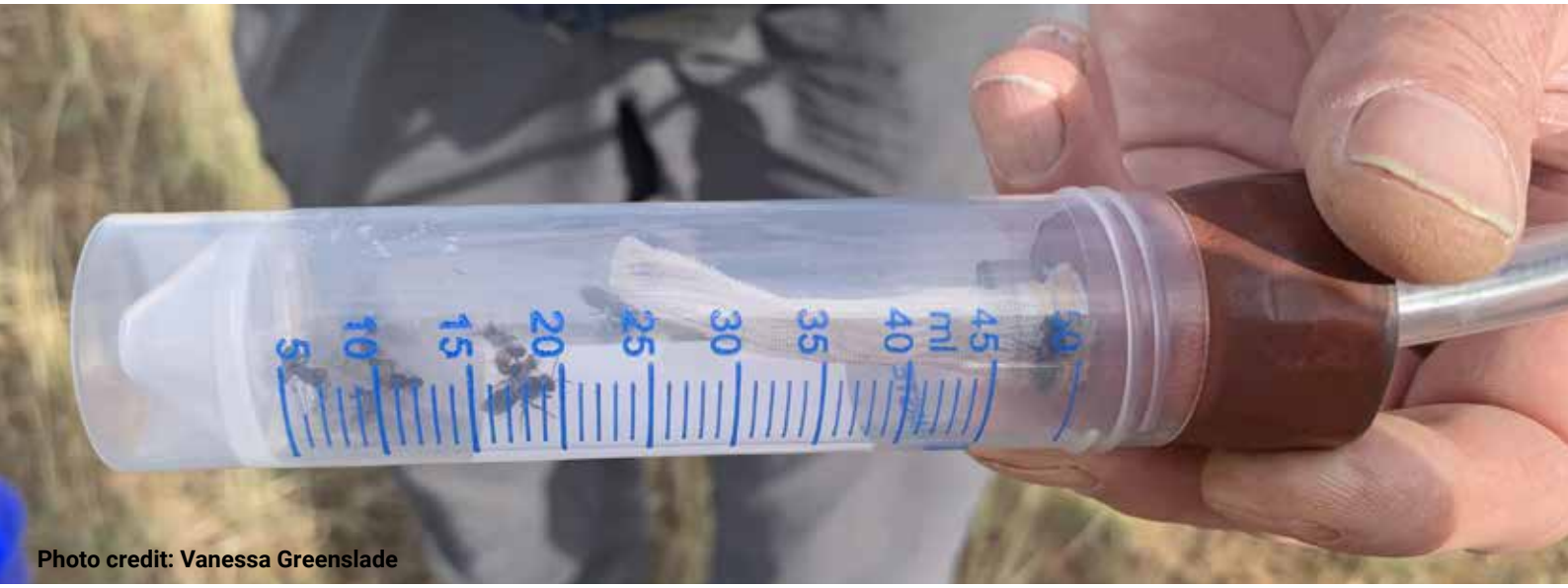

Photo credit: Vanessa Greenslade

Context

'Pooters', more formally known as 'Aspirators' are a tool some entomologists (aka Bug Scientists) use to safely collect small insects and spiders. Imagine a mini vacuum cleaner powered by your own mouth, and you are getting close to what a Pooter is. Our job this lesson is to work out what forces are operating them, how they work, whether we can make a practice one – a 'Prototype' – out of random classroom materials, and what we might need in the future to improve on our first designs.

Materials and equipment

Before the lesson source the following items: thin plastic bottles/containers, drinking straws, plasticine/blue tac/glue guns+glue sticks, old nylon stocking or similar thin material, rubber bands, hole punch, scissors, dry rice (optional).

Students will need an A4 piece of paper (or their science exercise book page) and pens/pencils/markers.

Safety Advice

- Use scissors and glue guns sensibly.
- Follow instructions closely to avoid bugs in your mouth!
- If going outside, follow school hat/sunscreen/weather/outdoor policies.

Objectives

Students observe video footage of pooters in action and use their science knowledge to propose how they work, including what physical forces are at play.
They then draw a labelled diagram of a pooter/aspirator, using arrows to show the direction of movement and text boxes to name the locations of forces, key events, features etc.
After this, students use the materials to make and test a pooter/aspirator of their own, following the instructions provided in the Youtube clips.

Introduction

Introduce the topic and, if applicable, the lesson 'Intention' and 'Success Criteria'.

For example, the **topic** is '**Physical Forces in relation to a piece of Science Equipment'**; the **intention** of the lesson is for students to 'learn about a piece of scientific equipment, consider the forces that operate it, and use their STEM skills to build one'; and the **success criteria** will be 'students watch the clips for instructions/ key information, complete a labelled diagram and then work to build a useable prototype'.

Then watch at least one of these clips and discuss as a class:

https://www.youtube.com/watch?v=VzGnLbEDegs
https://www.youtube.com/watch?v=CAkFC-vjTA4

Both these links take us to examples of science educators making simple 'Pooters' with easily found, everyday materials. The first one is shorter and from England, while the second, longer one is from Canada & begins with the presenter introducing some insects that definitely would not fit into a pooter tube!
Watch at least one of them to get the instructions, or both to enable some discussion of which design is best.

This link is a video of the English presenter using her pooter in a real life setting:
https://www.youtube.com/watch?v=yyk6rHMnXzg

If students need reminding of/introducing to the idea that forces can be broken down to either '**pushes' or 'pulls',** the following link is worth viewing: https://www.youtube.com/watch?v=-lOyW3pEUl0

Core

Students use the first part of the lesson to draw a diagram of a pooter & label the components/features, the points where forces are operating, and the direction in which captured organisms will travel. Remember they need to decide if this is a 'push' or a 'pull' and label it appropriately.

The diagram should also have a title & you could possibly get students to consider attempting 'scale' as well.

Once this is done, students can begin to make their own prototype pooters using the material provided. Teacher to provide tips, assistance, ask clarifying questions etc as needed. Finished students can test their designs, optionally initially with dried rice as shown in the video resources, or simply out in the school yard.

Conclusion

Finally (and this could be turned into an extended activity in the following lesson), students evaluate their design, consider limitations and possible improvements (strength of materials, sustainability, function, ease of use, observation only vs sample collection, target size limits, what kind of organisms may be harder to catch than others due to their lifestyles/adaptations/behaviours, safety/usage considerations etc) and suggest ways they could make a second design better.

Resources

Digital: Access to Internet/Youtube
Useful links: Included in the above notes.

Lesson 5-7: Categorising Living Things

Context

Students practice 'sorting' things into categories based on observable characteristics and features

Materials and equipment

1. Optional lesson 5 materials:

$5 worth of mixed lollies/assorted chocolates etc

Paper/exercise books; Pens/pencils

2. Optional lesson 6 materials:

Buckets, scrapers/nets, thick gloves

3. Lesson 7 materials:

Trays or containers,

Lights

Magnifying glasses/microscopes

Guidebooks, identification charts, ICT access & suggested websites etc

Paper/exercise books and pens or pencils

Safety Advice

Lesson 5 - may need to consider student allergies
Lesson 6 - if taking students to beach, will need to follow all departmental & site specific excursion rules
Lesson 7 - general lab/wet area reminders & expectations

Objectives

The purpose of this set of lessons is to give students practice categorizing, following scientific principles.

Introduction

Explain what categorizing is, why & how scientists do it, what they look at etc.
In the optional first lesson, students get to practice using familiar, non-living objects (ie lollies/chocolates).
Teacher gives students various categories eg size, shape, colour, ingredients, form etc and students sort their lollies as such.
Record data.
Give students the chance to create their own categories and then sort into those.
Record data.
Students are allowed to eat their supplies at the end of the activity.

Core

Second lesson (optional) - class excursion to nearby accessible human structure/marine environment (jetty,

marina, breakwall, pontoon etc)

Students use necessary equipment to safely scrape growth from structure into buckets for collection. Students add enough salt water to keep collection alive and return to school. Document what they have done, predict what they will find etc. (alternatively, teacher to collect this material in own time ASAP before the lesson, including extra salt water).

Third lesson – students use their knowledge of categorization to sort out the organisms they found on the marine structure into scientific groups.

E.g. Algae > 'red', 'green' or 'brown'

Worms

Shells/Molluscs > 'gastropods' or 'bivalves'

Crustaceans > 'barnacles', 'shrimp', 'isopods' or 'crabs'

Students observe, sort, research, ask questions, suggest/predict/hypothesise as they go through the sample, physically moving individual specimens into similar/related groups (ie, one tray for each specific group they create).

Students look closely, record results (inc opportunity for scientific drawing or photographing, plus potentially put into tables, charts, graphs or infographics).

They use Identification resources to try and work out which species they are looking at & verbally explain why to teacher when asked.

Once done, teacher to return all samples to location taken ASAP. Possible follow up lesson on ethics.

Conclusion

Class sharing of learning/results. Discussion.

Possible test or quiz based on this activity to test their learning.

Resources

Useful links:

Marine Life Society of SA Inc. - http://mlssa.org.au/

I-Naturalist - www.inaturalist.org

Identification Factsheets of the Marine Benthic Flora of SA- http://flora.sa.gov.au/algae_revealed/index.shtml

Atlas of Living Australia- https://www.ala.org.au/

Lesson 8: Codebreaking Binomial Nomenclature (or the hows, whys and whos of understanding the 'scientific names' of living things)

Context

When it comes to reading scientific texts, many of my students seem to get freaked out by unfamiliar, technical or 'Tier 3' vocabulary words, of which binomial 'Latin' or 'Scientific' names are a particularly challenging example. This task is designed to get students more familiar with how to read these words aloud and then extend this into understanding that they make sense, have meaning and can be read to find this information.

Materials and equipment

- Youtube videos:

Binomial names explained well for younger students. https://www.youtube.com/watch?v=b9YRjUEJKE4

Detailed but dry/long. Suitable for older/more advanced students https://www.youtube.com/watch?v=dG-MP4qZ_K8Y

- Students will need their science exercise books, pens/pencils and ICT access with internet access.
- A list of some selected species (eg from a recent Bush Blitz, from around your local area, previously compiled/nominated by your class etc.)

Safety Advice

N/A

Objectives

For students to develop familiarity with, understanding of, and confidence in, what scientific names are and why they are important.

Introduction

Introduce the topic. Explain learning intention "to better understand how scientific names work" and success criteria "to accurately read, say and write some scientific names" and "to investigate the meaning of some scientific names".

Explain the following:
Scientific names are more accurate, and therefore more useful, in a way that common names are not. For example, while some 'Wasps' are pest species that can ruin picnics and worsen our back yards, other kinds are important pollinators and agricultural pest controllers that help humans grow food. Obviously, knowing which kind is which is valuable knowledge for scientists, farmers, gardeners, councils, pest controllers, vets and others.

It can also be important for human safety. While "Brown Snakes" in Australia are a highly venomous family, "Brown Snakes" in the US are non-venomous and suitable as pets. Obviously scientists, pet shop owners, vets, zookeepers and tourists need to know that they are not the same animals! Also, in both countries, snakes from different families can still be brown in colour while snakes from the Australian "Brown" family can be grey, black, yellowy orange and even pale blue and can also have spots, bands and freckles... or not. That's why it is important (for some people at least) to use the scientific names *Storeria* for the American genus and *Pseudonaja* for the Australian one instead of the common name.

Core

Watch the linked Youtube clips as a class, pause when needed for discussion, questioning, note taking etc.

Using the binomial name examples given in the clips to practice reading and speaking. Remind students that no matter how 'weird' the words look, they follow the same syllable and sound patterns as everyday English.

As a class, read them aloud, with hands on chins to work out syllables.

Hydrurga leptonyx, Felis catus, Canis lupus familiaris, Acynonyx jubatus, Scaptia beyonceae, Hylocirtus princecharlesi

No doubt students will notice that one of these has 3 names not 2. So extension of the system into subspecies, and mentioning *Canis lupus lupus (*Eurasian Wolf) and *Canis lupus dingo (*Dingo) will be needed.

Then give students an A4 sheet of paper with a list of at least a dozen binomial names of your choosing. In pairs or tables, students break them into syllables and practice saying them aloud to each other. Can then share back to the class, compare, correct in some way.

Finally, introduce the idea that these names all mean something – usually relating to appearance, location,

behaviour, 'discoverer' (I always add that this itself is often a contested notion) or patron, cultural reference or a unique feature.

Many of these names are based on either Latin or Greek but increasingly use other languages, including Indigenous languages as well.

Then challenge students to find out what this 'secret language' is telling us. With the provided list, students use online translators, dictionaries, science websites, judicious use of Wikipedia (cross reference with other sources afterwards) etc to try and codebreak the names.

Success in this may vary considerably, so teacher assistance & demonstration may be required.

Conclusion

Students record what they found and report back to class, explaining how they reached their translation, what they did etc.

Resources

Digital: ICT with internet capabilities

Worksheet: Species list on next page (optional)

Useful links: Youtube clips hyperlinked above

A selection of species likely to occur in the Fowler's Bay-Yalata region

Acacia papyrocarpa	*Nerita atramentosa*
Anilios bituberculatus	*Neosparrassus caligaster*
Bembix kunanurra	*Ocrisiona leucocomis*
Bossiaea walker	*Ozius truncatus*
Cacatua leadbeateri	*Pogona minor*
Cercartetus concinnus	*Phyllopteryx taeniolatus*
Diplodactylus calcicolus	*Quinetia urvillei*
Drosera macrantha	*Questopogon affinis*
Eremophila glabra	*Rhagodia parabolica*
Eucalyptus gracilis	*Rytidosperma fulvum*
Ferreola handschini	*Scolopendra morsitans*
Ficinia nodosa	*Sminthopsis crassicaudata*
Geijera parviflora	*Taeniopygia guttata*
Gymnothorax prasinus	*Thysanotus baueri*
Haliaeetus leucogaster	*Underwoodisaurus milii*
Hormosira banksia	*Uniophora granifera*
Ibla quadrivalvis	*Venatrix pictiventris*
Ischnochiton cariosus	*Velarifictorus woomera*
Jania verrucose	*Wahlenbergia aridicola*
Juncus bufonius	*Wittrockiella salina*
Kallymenia rubra	*Xanthoparmelia semiviridis*
Kyphosus sydneyanus	*Xerochrysum bracteatum*
Lasiorhinus latifrons	*Yakirra australiensis*
Lycium austral	*Yiiinthi kakadu*
Macropus fuliginosus	*Zonioploca medilinea*
Megachile aurifrons	*Zostera mucronata*

Lesson 9-11 – Ethics in Science

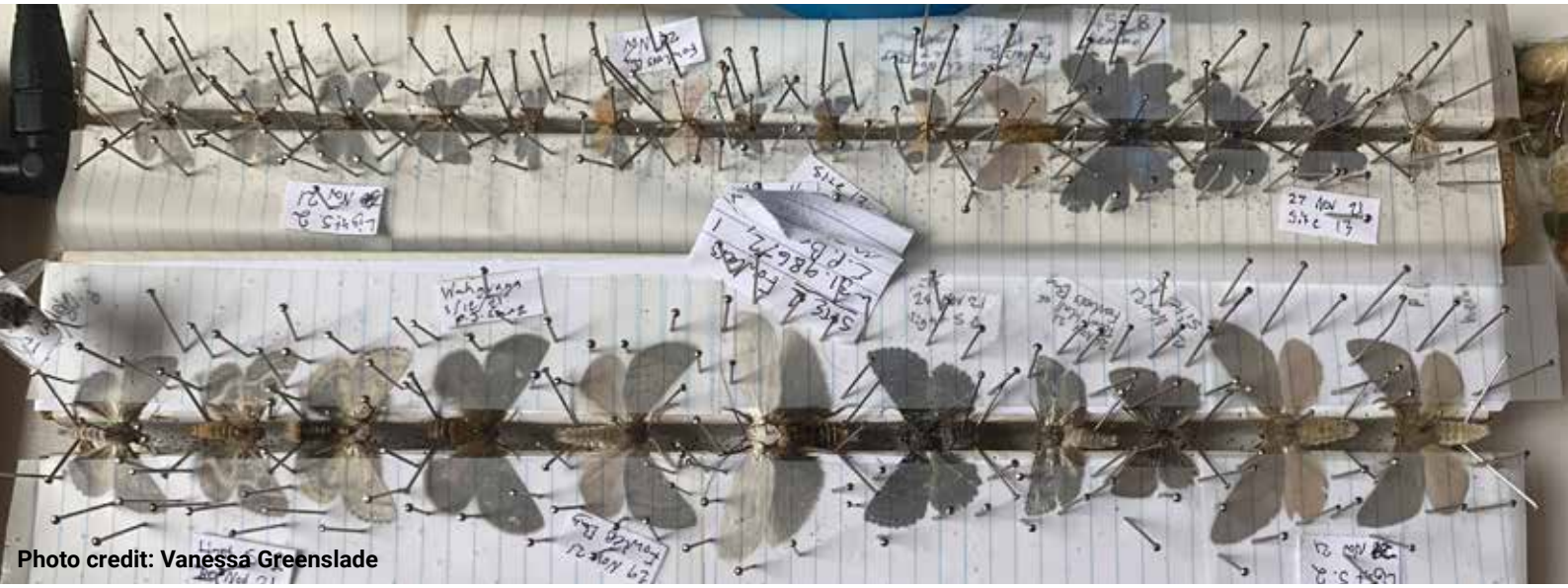

Photo credit: Vanessa Greenslade

Context

Our school currently has a focus on developing formal writing further, including persuasive texts. Giving students the opportunity to consider ethics will then provide them with a topic to write personally and persuasively about.

Materials and equipment

General stationery, eg workbooks or pad paper, pens/pencils. Optional ICT use instead.
Various websites, youtube videos etc. (some examples provided in links below; teachers should search for the best ones for them/their class context). Materials may be printed out as needed.
Teacher may also choose to

Safety Advice

N/A

Objectives

The purpose of this 3 lesson block is for students to consider a 'big idea', access & read information relating to it, and then practice writing their own thoughts and opinions in response.

Introduction

Teacher talk time – introduce topic by pointing out that sometimes scientists choose to kill animals they are researching, even uncommon or poorly known ones. Examples from Bushblitz include lots of different invertebrates in 'kill jars', fish being caught, even some reptiles & mammals collected.

Briefly outline why.

Ask for, collect, discuss student thoughts and responses. They may also suggest alternatives, research examples and other sources etc during this time.

Core

Lesson 1 – watch/read/discuss/note-take relevant teacher provided resources. Teacher to ask class leading questions

Lesson 2 & 3 – students have this class time to plan, write and edit a 1 page persuasive text addressing the question; **"Is it okay for scientists to kill some animals in the pursuit of knowledge?"**

Students should be practicing using evidence, examples and reasons to back up their opinions.

Conclusion

Brief discussion at the end of the lesson re content. Eg, do an 'exit pass' activity where students need to share their main/key point (or favourite sentence etc) before leaving.

Resources

1. Suggested Youtube videos:

What is ethics? By The Ethics Centre
https://www.youtube.com/watch?v=u399XmkjeXo

Animal testing Pros and Cons. By thatswhytv
https://www.youtube.com/watch?v=QwzofzcsaVw

2. BushBlitz teacher blog:
Nets, Trowels, Traps & Tracks on the Maps | Earthwatch Institute
https://www.earthwatch.org.au/blog/nets-trowels-traps-tracks-on-the-maps

3. Article: What it feels like to kill 563 mice for science (cnet.com)
https://www.cnet.com/science/i-killed-563-mice-for-science/