Coastal Custodians, Citizens and Scientists

Teacher Guide



Coastcare Victoria School Kit

Coastcare Victoria

VICTORIA State Government | Energy, Environment and Climate Action

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Acknowledgment

We acknowledge and respect Victorian Traditional Owners as the original custodians of Victoria's land and waters, their unique ability to care for Country and deep spiritual connection to it. We honour Elders past and present whose knowledge and wisdom has ensured the continuation of culture and traditional practices.

We are committed to genuinely partner, and meaningfully engage, with Victoria's Traditional Owners and Aboriginal communities to support the protection of Country, the maintenance of spiritual and cultural practices and their broader aspirations in the 21st century and beyond.



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Curriculum links

Year 5 and 6 curriculum	Curriculum code	Content description	Topic covered – link to Learning Intentions
Science – Science as a Human Endeavour – Use and influence of science	VC2S6H01	Scientific knowledge changes over time, often resulting from collaboration or by building on the work of others, and leads to advances in science	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Science – Science Inquiry – Processing, modelling and analysing	VC2S6I04	Data and information can be organised and processed to show patterns, trends and relationships by constructing representations including tables, graphs and visual or physical needs	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses. Research and organise information into the structure of a scientific poster to engage a specific audience.
Science – Science Inquiry – Evaluating	VC2S6I05	Methods and findings can be compared with those of others to identify sources of error, to select evidence in support of reasoned explanations and conclusions, and to develop further questions for investigation	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Humanities – Geography – Geographical Knowledge and Understanding – Management of places	VC2HG6K01	How places and environmental are changed and managed by people	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.

Humanities – Geography – Geographical Skills – Geographical inquiry	VC2HG6S02	Locate, collect and organise information and data from primary and secondary sources, including from fieldwork	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Humanities – Geography – Geographical Skills – Geographical inquiry	VC2HG6S03	Represent information and data collected using maps that conform to cartographic conventions, graphs, tables, sketches and other formats	Research and organise information into the structure of a scientific poster to engage a specific audience.
English – Literacy – Phonic and word knowledge	VC2E5LY03	Use phonological, morphological and vocabulary knowledge to read and spell words that share common letter patterns but have different pronunciations	Deconstruct everyday words to understand their scientific meaning.
English – Literacy – Phonic and word knowledge	VC2E5LY04	Build and spell new words from knowledge of known words, prefixes and suffixes, word origins (etymology), letter patterns and spelling generalisations	Deconstruct everyday words to understand their scientific meaning.
English – Literacy – Phonic and word knowledge	VC2E6LY03	Use combined phonological, morphological and vocabulary knowledge to read and write increasingly complex words	Deconstruct everyday words to understand their scientific meaning.
English – Literacy – Phonic and word knowledge	VC2E6LY04	Use their knowledge of know words, base words, prefixes, letter patterns, spelling generalisations and word origins (etymology), including some Latin and Greek roots, to spell new words, including technical words	Deconstruct everyday words to understand their scientific meaning. Identify features of sea slugs. Compare and contrast scientific illustrations with scientific diagrams.

Mathematics – Number	VC2M5N09	Use mathematical modelling to solve practical problems involving additive and multiplicative situations, including simple financial planning contexts; formulate the problems, choosing operations and efficient mental and written calculation strategies, and using digital tools where appropriate; interpret and communicate solutions in terms of the situation	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Mathematics – Number	VC2M6N09	Use mathematical modelling to solve practical problems involving rational numbers and percentages, including in financial contexts; formulate the problems, choosing operations and using efficient mental and written calculation strategies, and using digital tools where appropriate; interpret and communicate solutions in terms of the situation, justifying the choices made	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Mathematics – Statistics	VC2M5ST03	Plan and conduct statistical investigations by posing questions or identifying a problem and collecting relevant data; choose appropriate displays and interpret the data; communicate findings within the context of the investigation	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Mathematics – Statistics	VC2M6ST03	Plan and conduct statistical investigations by posing and refining questions to collect categorical or numerical data by observation or survey, or identifying a problem and collecting relevant data;	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.

		analyse and interpret the data and communicate findings within the context of the investigation	
The Arts – Visual Arts – Presenting	VC2AVA6P01	Select, present and display artworks and visual arts practice in informal and formal settings	Compare and contrast scientific illustrations with scientific diagrams.
Critical and Creative Thinking – Reasoning	VC2CC6R01	Ways to identify, structure and communicate a conclusion justified by a range of reasons	Research and organise information into the structure of a scientific poster to engage a specific audience.
Critical and Creative Thinking – Reasoning	VC2CC6R04	The use of criteria to support analysis and evaluation when reasoning	Research and organise information into the structure of a scientific poster to engage a specific audience.
Ethical Capability – Decision-making and Actions	VC2CE6D02	The meaning of an ethical framework, and how the consequences framework, duties framework and virtues framework can each guide decision-making in response to an ethical issue	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Intercultural Capability – Cultural Diversity	VC2CI6D02	Community and government initiatives to promote harmony and respect among people with diverse worldviews	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses. Deconstruct everyday words to understand their scientific meanings.

Year 7 and 8 curriculum	Curriculum code	Content description	Topic covered – link to Learning Intentions
Science – Science as a Human Endeavour – Nature and development of science	VC2S8H02	Multidisciplinary endeavours to advance scientific knowledge make use of people's different perspectives	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses. Deconstruct everyday words to understand their scientific meanings.
Science – Science as a Human Endeavour – Use and influence of science	VC2S8H03	Proposed scientific responses to socio-scientific issues impact on society and may involve ethical, environmental, social and economic considerations	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses. Deconstruct everyday words to understand their scientific meanings.
Science – Science as a Human Endeavour – Use and influence of science	VC2S8H04	Communication of scientific knowledge has a role in informing individual viewpoints, and community policies and regulations	Research and organise information into the structure of a scientific poster to engage a specific audience.
Science – Science Understanding – Biological sciences	VC2S8U01	There are similarities and differences within and between groups of organisms living on Earth; the development and use of classification tools, including dichotomous keys, help order and organise human understanding of the diversity of life	Identify features of sea slugs. Compare and contrast scientific illustrations with scientific diagrams. Deconstruct everyday words to understand their scientific meaning.
Science – Science Understanding – Biological sciences	VC2S8U04	Matter and energy flow through ecosystems and can be represented using models, including food webs and food pyramids; populations will be affected by changing biotic and abiotic factors in	Research and organise information into the structure of a scientific poster to engage a specific audience.

		an ecosystem including habitat loss, climate change, seasonal migration and introduction or removal of species	
Science – Science Inquiry – Processing, modelling and analysing	VC2S8I04	Data and information can be organised and processed by selecting and constructing representations including tables, graphs, keys, models and mathematical relationships	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Science – Science Inquiry – Processing, modelling and analysing	VC2S8I05	Information and processed data can be analysed to show patterns, trends and relationships, and to identify anomalies	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Science – Science Inquiry – Evaluating	VC2S8I06	Scientific methods, conclusions and claims can be analysed to identify assumptions, possible sources of error, conflicting evidence and unanswered questions	Research and organise information into the structure of a scientific poster to engage a specific audience. Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Humanities – Geography – Geographical Knowledge and Understanding – Landforms and landscapes	VC2HG8K14	The spiritual, aesthetic and cultural value of landscapes and landforms for people, including Aboriginal and Torres Strait Islander Peoples	Deconstruct everyday words to understand their scientific meanings.

Humanities – Geography – Geographical Skills – Geographical inquiry	VC2HG8S02	Collect, organise and process information and data from primary and secondary sources, including fieldwork, and using geospatial technologies and digital tools as appropriate	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Humanities – Geography – Geographical Skills – Geographical inquiry	VC2HG8S03	Represent and describe information and data using a range of formats, including maps constructed with geospatial technologies	Research and organise information into the structure of a scientific poster to engage a specific audience.
English – Literacy – Word knowledge	VC2E7LY03	Understand how to use spelling rules, base words, suffixes, prefixes, spelling patterns and word origins (etymology), including Green and Latin roots, to learn new words and how to spell them	Deconstruct everyday words to understand their scientific meaning. Identify features of sea slugs. Compare and contrast scientific illustrations with scientific diagrams.
English – Literacy – Word knowledge	VC2E8LY03	Explore and use learnt knowledge to spell technical and academic words consistently and accurately	Deconstruct everyday words to understand their scientific meaning. Identify features of sea slugs. Compare and contrast scientific illustrations with scientific diagrams.
Mathematics – Number	VC2M7N10	Use mathematical modelling to solve practical problems involving rational numbers and percentages, including financial contexts such as 'best buys'; formulate problems, choosing representations and efficient calculation strategies, designing algorithms and using digital tools as appropriate; interpret and communicate	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.

		solutions in terms of the situation, justifying choices made about the representation	
Mathematics – Number	VC2M8N06	Use mathematical modelling to solve practical problems involving rational numbers and percentages, including financial contexts involving profit and loss; formulate problems, choosing efficient mental and written calculation strategies and using digital tools where appropriate; interpret and communicate solutions in terms of the context, reviewing the appropriateness of the model	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Mathematics - Statistics	VC2M7ST03	Plan and conduct statistical investigations for issues involving discrete and continuous numerical data, and data collected from primary and secondary sources; analyse and interpret distributions of data and report findings in terms of shape and summary statistics	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
Mathematics - Statistics	VC2M8ST02	Analyse and report on the distribution of data from primary and secondary sources using random and non-random sampling techniques	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
The Arts – Visual Arts – Presenting	VC2AVA8P01	Curate and present examples of visual arts practice and/or artworks to communicate ideas, perspectives and/or meaning to audiences	Compare and contrast scientific illustrations with scientific diagrams.

Critical and Creative Thinking – Reasoning	VC2CC8R01	Ways to identify, structure and communicate a conclusion and its justification where competing claims, and grounds for claims, are analysed and evaluated	Research and organise information into the structure of a scientific poster to engage a specific audience.
Ethical Capability – Decision-making and Actions	VC2CE8D02	Strengths and limitations of the consequences framework, duties framework and virtues framework, and how these and alternative frameworks can guide decision-making in response to an ethical issue	Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.

Key themes

Scientific illustration and identification, data collection, scientific practices, citizen science, the connection of Traditional language with country, language for science communication, and the design of different science communication tools.

Lessons overview

Activity	Time	Difficulty	Topic & Skills
1: Quiz	5 min video 15 min quiz	**Simple**	Barwon Heads Bluff, intertidal habitats, marine organisms, conservation, Friends of the Bluff, citizen science projects, watching changes in the reef over time, community engagement and safety in tidal areas. • Listening comprehension and understanding.
2: Sea slug census	30 min	**Simple**	Sea slugs (nudibranchs) anatomy and body types, importance of scientific diagrams vs colour illustrations, using scale bars and labels in diagrams, identifying species by patterns and colours, citizen science, science communication and careers, and collecting and presenting scientific work. • Observing and recording anatomical details, scientific diagrams, adding colour to scientific illustrations, using online citizen science databases, comparing and evaluating science communication tools, species identification methods, and organising and presenting scientific work collaboratively.
3: Scientific Sampling - Survey	60 min	**Moderate**: Multiple step activity.	Biodiversity and species abundance, intertidal rockpool ecosystems, population estimation using surveys, citizen science databases, random sampling to reduce bias, and interpreting survey data for ecosystem health. • Counting and recording species, using quadrats to estimate populations, data analysis, understanding survey bias and random sampling, applying citizen science tools, and interpreting results to assess ecosystem health.
Investigation 1: The Language of Science	60 min+	**Complex**: Using external resources. Independent learning.	Scientific literacy through everyday language, meaning of species and plant names, connection between words and concepts, infographic design and communication, using online resources for research, and Traditional Language. • Research and information gathering, identifying relationships between words, designing clear and creative infographics, translating complex information into visual format, and critical thinking.
Investigation 2: Scientific poster	60 min+	**Complex**: Using external resources. Multi-step	Community and citizen science, Coastcare groups and their environmental work, science communication methods, scientific

	instructions. Independent learning.	poster format and design, researching and summarising information. • Independent research, data collection, organising information logically, visual communication, explaining scientific work to an audience, and critical thinking.

Learning intentions

Students will:

- Identify features of sea slugs.
- Compare and contrast scientific illustrations with scientific diagrams.
- Understand that data can be collected by scientists and citizen scientists, and each have strengths and weaknesses.
- Deconstruct everyday words to understand their scientific meanings.
- Research and organise information into the structure of a scientific poster to engage a specific audience.

Success criteria

Students are able to:

- Choose and design the most appropriate science communication tool for a variety of purposes.
- Identify the two groups of nudibranchs and illustrate their anatomical differences.
- Use sampling techniques to calculate population estimates.
- Learn Wadawurrung words and understand the connection between people, places and names.
- Understand the scientific meaning behind common words.
- Use graphic design to show the connections between related words and concepts.
- Create a scientific poster to summarize the impact of a Coastcare community group.

Background

This module is focused on Custodianship. A custodian is a person who feels compelled to care for a place they feel connected to. This connection may be due to loving a place, living there, or having ancestors who have lived there for many generations. Care is explored through community actions, like maintaining language, and scientific actions, like monitoring for ecosystem health.

The video features Jon Duthie and the Friends of the Bluff (FoB) - a group of committed community members providing support, education, awareness and publicity for the physical regeneration of the natural habitat of the Barwon Bluff area. The group works in association with scientific and management staff of the Barwon Coast Committee of Management and Parks Victoria. They also collaborate and communicate with environmental organisations like Coastcare Victoria.

To achieve these aims, FoB members are actively involved in sustainable management strategies, such as weed eradication programs, planting indigenous species, surveying bird and animal life, and providing community interpretation and education sessions. Friends of the Bluff are committed to

developing programs to promote conservation and preservation of the Bluff and to encourage others to recognise and appreciate this unique coastal landmark. Through these actions, FoB members are acting as custodians, citizen scientists and science communicators.

In this curriculum resource, students will be introduced to citizen science projects; the Melbourne Sea Slug Census and BioBlitz. Students are educated throughout the resource by different citizen and custodial science communicators. Kitty Turner is an artist whose colourful book pages will teach your students about sea slugs. Uncle Bryon Powell is a Wadawurrung elder who uses educational videos to share the Wadawurrung language.

Students will also learn how to create different science communication tools like diagrams, illustrations, data tables, infographics and scientific posters. In learning why these tools suit different stories and audiences, your students are gaining the skills necessary to participate in their community as custodians, citizen scientists and communicators.

Resources

- Coastal Custodians video
- Video transcript
- Presentation slides
- Supplementary presentation slides: Citizen scientist profiles
- Answers
- Quiz
- Sea Slug Census worksheet
- Scientific sampling – survey worksheet
- Wadawurrung Language game worksheet
- Investigation: The science of language worksheet
- Investigation: Scientific poster worksheet
- Barwon Bluff rockpool print out
- Wadawurrung word cards
- Review questions
- Glossary

Other useful links

- iNaturalist: Melbourne Sea Slug Census
- Girls that Scuba: 11 facts about nudibranchs
- Kitty Turner: The Weird and Wonderful World of Nudibranchs
- Gigacalculator: Random Number Generator
- This Place - Wadawurrung language series: There are 4 A's in Balaraat
- Friends of the Bluff: Wadawurrung Language Games
- Wathawurrung: The Language Of The Geelong-Ballarat Area Barry J. Blake, Ian D. Clark & Sharnthi H. Krishna-Pillay
- Piktochart: Why Use Infographics?
- Friends of the Bluff: Explore life on the Bluff
- Coastcare Victoria: Environmental Volunteer Opportunities Map

  Wadawurrung Language App: Wadawurrung Language - Intro App - App Store

- **Youtube: ABC Indigenous - There are four A's in Ballaarat – This Place**
  https://www.youtube.com/watch?v=cF0dkvNRtJs
  "Bryon Powell takes us on a journey across Wadawurrung country, sharing some of the stories behind its place names. His country stretches from the mountains to the sea. It includes hills, rivers and grassy plains, creeks and coasts and includes modern towns such as Werribee, Geelong and Ballarat in Victoria."

- **Youtube: ABC Indigenous - Wadawurrung language: Wurdi Youang**
  https://www.youtube.com/watch?v=PGEJOsaeCJQ&list=PLmWe-V9tacwHqIfIBPvZMThlaYH6gH2u0&index=51
  "This video is set in Wurdi Youang, which means big hill in the middle of a plain. It is located about 60km south-west of Melbourne and is now known as the You Yangs. Here we explain the story behind how this impressive series of granite ridges, was formed and why it is part of an ancient song line."

Lesson plan

Activity 1: Quiz

Use this 10-question quiz to assess comprehension and understanding of the video. This could be run as a Kahoot quiz, online form or worksheet.

1. Where does the Barwon River flow from and to?

a) Geelong to Barwon Heads

b) Queenscliff to Barwon Heads

c) The Otway ranges to Bass Strait

d) Bass Strait to the Otway Ranges

2. Who are the Traditional Owners of the area known as Barwon Bluff?

a) Wadawurrung

b) Wiradjuri (Wagga Wagga to Dubbo)

3. What type of rocks support the intertidal habitat in the Barwon Bluff Marine Sanctuary?

a) Boulders and rock-pools

b) Reefs and cliffs

c) Smooth and rough

d) Basalt and limestone

4. What do Friends of the Bluff group do to help protect and maintain the Barwon Bluff?

a) Provide education, fundraising and putting up signs

b) Weeding, collect litter and provide education

c) Take tours, collect litter and lobby the government

d) Count animals, collect litter and fundraising

5. Which of these is a citizen science program that people can join at the Barwon Bluff?

a) Sea Search
b) Sea Slug Census
c) Bio Blitz
d) All of the above

6. What kind of rockpool creature did Isabelle get to learn about and touch?

a) Elephant seal
b) Elephant snail
c) Barnacle
d) Chiton

7. Who is allowed to use iNaturalist to record biodiversity at the Barwon Heads?

a) Scientists
b) Friends of the Bluff members
c) Citizen scientists
d) Park rangers

8. What are some dangers of exploring the Barwon Bluff Marine Sanctuary?

a) Blue ringed octopus and big waves
b) Leaving litter and damaging the rocks
c) Blue ringed octopus and elephant snails
d) Big waves and sunburn

9. What is the primary ecosystem protected by the Barwon Bluff Marine Sanctuary?

a) Intertidal reef ecosystem
b) Beach ecosystem
c) Cliffs ecosystem
d) Marine ecosystem

10. Which statement is most true?

a) There are dangerous creatures in rockpools, you must not explore them
b) There are no dangerous creatures in rockpools, you can touch anything you find
c) Some creatures are dangerous, and some are not, you need to know the difference to explore
d) Some creatures are dangerous, but you can touch them if you are counting them in a survey

Activity 2: Sea Slug Census

This activity helps students learn about nudibranch anatomy and species identification through scientific diagrams and coloured illustrations. Students develop observation, drawing, and labelling skills by creating accurate scientific diagrams, then adding colour to capture species-specific patterns.

This activity also encourages understanding of science communication, showing how diagrams and illustrations serve different purposes – diagrams for anatomy, colour illustrations for species identification. Students gain an insight into careers in science communication and citizen science, while creating a collaborative nudibranch reference book.

Scientific diagrams are simple but accurate line drawings which show the shape and dimensions of an organism very clearly. They do not include any colour, shading or texture which might make the essential details harder to see or understand. Diagrams also include a scale bar to show the real size of the animal and labels for important body parts, linked by carefully ruled lines.

However, colours and patterns are often essential in correctly identifying an organism. This is particularly true for nudibranchs which have a few simple body plans, covered with incredible colours which can be specific to species. This means a diagram is the best way to learn and understand the basic anatomy of nudibranchs, but a colour illustration is essential to properly depict each species.

1. Use Slides 5-12 to teach your students about nudibranchs.
    - Slides 6-12 are designed by UK artist Kitty Turner.
    - Older students can independently learn 11 facts about nudibranchs from the Girls that Scuba website.
    - Supplementary Presentation Slides: Citizen Scientist Profiles are available to facilitate a conversation about science communication careers.
2. Students use iNaturalist, and the Melbourne Sea Slug Census to answer the questions on the *Sea Slug Census worksheet* [slide 13]. There are multiple dates and years to choose from. Examples in the answer document are based on March 2024.
3. Students choose a nudibranch species from the Sea Slug Census and create a scientific diagram [slide 14]. They will highlight the anatomy of either sea slug; Dorid (gills in a tuft on its back) or Aeolid (gills running the length of its back) [slide 8 and 14].
4. Photocopy student diagrams so that they can add colour to match their nudibranch species [slide 15].
5. Gather the student diagrams and illustrations in a binder to create your own nudibranch book like Kitty Turner.

Talking points: Diagrams are simplified so that basic anatomy is clear to see and easy to learn. Without colour, a diagram can never properly represent a nudibranch species, because they are identified using their patterns as well as their anatomy. Therefore, a scientific illustration is essential to convey species level information about nudibranchs. These are two different science communication tools, designed to meet different communication needs.

Kitty Turner is an artist who was inspired by nudibranch patterns and colours. She designed her own book to share her love of nudibranchs. Her book is a science communication tool, therefore, Kitty is both an artist and a citizen scientist.

Please share your nudibranch illustrations with us! Email Kitty and Coastcare Victoria, or tag Coastcare Victoria online.

Worksheet answers:

Answers based on Melbourne Sea Slug Census April 2026 project page.
(https://www.inaturalist.org/projects/melbourne-sea-slug-census-xxviii-april-2026?tab=species)

1. How many citizen scientists (OBSERVERS) helped record sea slugs?

   41 observers

2. How many SPECIES of sea slugs were recorded in this census?

   64 species

3. How many OBSERVATIONS (sightings of sea slugs) were recorded in this census?

   255 observations

4. Why are those two numbers different?

   Common species are observed many times. The number of observations is the sum of all of the times each species is seen, so it is higher than the number of species.

Click into SPECIES tab to answer the following questions:

5. What was the most commonly observed sea slug around Victoria?

   Record the common name and the scientific name.

   Short-tailed Ceratosoma, *Ceratosoma brevicaudatum*

6. How many species were observed only once during the whole census?

   27 species were observed only once

7. In the introduction slides we saw that there are two main groups of sea slugs, Dorid and Aeolid. Which group does the most common Melbourne sea slug belong to? How can you tell?

   Dorid. The Short-tailed Ceratosoma has gills in a tuft on its back, and not as row along its back (cerata).

Activity 3: Scientific sampling - survey

This activity enables students to practice scientific data collection and population estimates by sampling species in a simulated rockpool environment. They learn how to use quadrats to count a subset of organisms, apply random sampling to reduce bias, and calculate estimates for total populations. Students also interpret variations in their results, understanding how species distribution and abundance affect accuracy. Through this task, they develop skills in observation, data analysis, and critical thinking, while appreciating the role of citizen science in supporting real-world biodiversity research.

BioBlitz is a citizen science program facilitated by the iNaturalist website. Assisted by AI image recognition, anyone can help to count biodiversity by taking photos of species and adding them to the BioBlitz project page. Biodiversity surveys help scientists and land managers understand how many of which species are present in an ecosystem. Community composition says a lot about the health of an ecosystem [slide 16].

On the rockpool print out, your students will be counting five common intertidal species. Use slide 17 to learn about these species as a class. Knowing the expected species abundance will assist students to interpret their survey data.

This is what the student worksheet looks like, with answers included.

STEP 1: Count every species you can see on the rockpool print out and enter the data into the TOTAL COUNT row in your RESULTS table.

Neptune's necklace seaweed has been counted for you. It is recorded as the number of 25cm x 25cm grid squares the seaweed covers on your rockpool print out.

It would be very hard to count every species on a real life rockpool platform. Instead, scientists count a subset of the rockpool area (called a survey) and then multiply their answer to estimate the total number of species. A 1m x 1m survey square called a quadrat, is used to count the subset.

If we choose where to put our survey squares, we might pick the 'best looking' locations. This will bias the data and create inaccurate results. It is impossible not to be biased, it's just how the human brain works. Therefore, we use an unbiased method to help us choose, which is a random number generator.

To select the coordinates of their ten quadrats, students will use a random number generator https://www.gigacalculator.com [slide 18]

STEP 2: Use a random number generator to create coordinates for each of your ten quadrats and record them here.

Quadrat coordinates 1-8 x A-F: Teacher example coordinates									
1:	**8C**	**2:**	**4C**	**3:**	**4D**	**4:**	**3A**	**5:**	**6A**
6:	**1F**	**7:**	**5D**	**8:**	**3F**	**9:**	**7E**	**10:**	**8F**

STEP 3: Outline a 1m x 1m quadrat at each of your ten coordinates, and label them 1-10 [slide 19]. This slide also shows the example coordinates, and highlights in red that the number generator might produce duplicate coordinates, and you will need to skip them].

STEP 4: Count each animal or grid square with seaweed in it, and record in your RESULTS table.

RESULTS: These example results match the quadrats shown on slide 19.

Species	**Shore Crab** 	**Eight-armed Sea Star** 	**Nudibranchs** 	**Elephant Snail** 	**Neptune's Necklace Seaweed** 
TOTAL COUNT	**35**	**30**	**10**	**15**	**420 grid squares**
Quadrat 1	**1**	**1**	**-**	**1**	**7**
Quadrat 2	**1**	**1**	**-**	**-**	**5**
Quadrat 3	**-**	**-**	**-**	**-**	**14**
Quadrat 4	**1**	**1**	**-**	**-**	**5**
Quadrat 5	**1**	**1**	**-**	**1**	**5**
Quadrat 6	**-**	**1**	**-**	**1**	**12**
Quadrat 7	**2**	**-**	**-**	**1**	**9**
Quadrat 8	**-**	**1**	**-**	**-**	**5**
Quadrat 9	**-**	**1**	**1**	**-**	**-**

Quadrat 10	1	1	-	-	11

Use your results to estimate the total population of organisms in the rockpools.

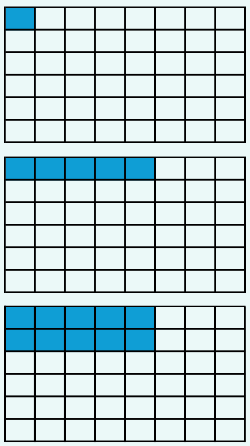
The rockpool platform is 8m across x 6m down.

How many 1m square quadrats would it take to survey the whole reef? 48 x 1m squares

Now that we have completed our survey, we have ten subsets of the total population. Through multiplication these counts can be used to estimate the total population. You will investigate how the estimate changes when you use counts from 1, 5 and 10 quadrats, [slide 20 - worked example].

STEP 5: Add together each organism you counted in 1, 5 and 10 quadrats. Enter the answers into the corresponding rows of the ESTIMATE table.

Try visualising!



STEP 6: Calculate your multipliers.

How much of the total rockpool area is 1 quadrat? **48 ÷ 1 = [_48 _] A**

Multiply the number of species from quadrat 1 by answer **A**

How much of the total rockpool area is 5 quadrats? **48 ÷ 5 = [_9.6_] B**

Multiply the number of species from 5 quadrats by answer **B**

How much of the total rockpool area is 10 quadrats? **48 ÷ 10 = [_4.8_] C**

Multiply the number of species from 10 quadrats by answer **C**

ESTIMATE: [Q = quadrat]

Species	Shore Crab 	Eight-armed Sea Star 	Nudibranchs 	Elephant Snail 	Neptune's Necklace Seaweed
TOTAL COUNT	35	30	10	15	420 grid squares
Number in Q1	1	1	-	1	7
Multiply x A 48	48	48	0	48	336
Number in Q1+2+3+4+5	4	4	0	2	36
Multiply x B 9.6	38	38	0	19	345
Number in Q1+2+3…+9+10	7	8	1	4	73
Multiply x C 4.8	33	38	4	19	350

Discuss: What happens to your estimate as you add more data?

They become more accurate, which means they become closer to the total population number. Inaccuracies occur from low count numbers because the multiplier is so large, and because many organisms are absent from some quadrats. As you can see, abundant organisms, like the seaweed, can be estimated more accurately than rare ones.

Answers in your class should improve with more data but may not. Animals and plants clump together in their environment, so some quadrats will have more and some less. Once multiplied, these patchy results can give false positive or false negative counts of species in an environment. Learning about species biology and distribution tells scientists what to expect and how to recognise a faulty answer.

There are less scientists in the world than regular people. Inviting regular people to collect data as citizen scientists, is one way for scientists to gather more data and hopefully get better estimates of species populations.

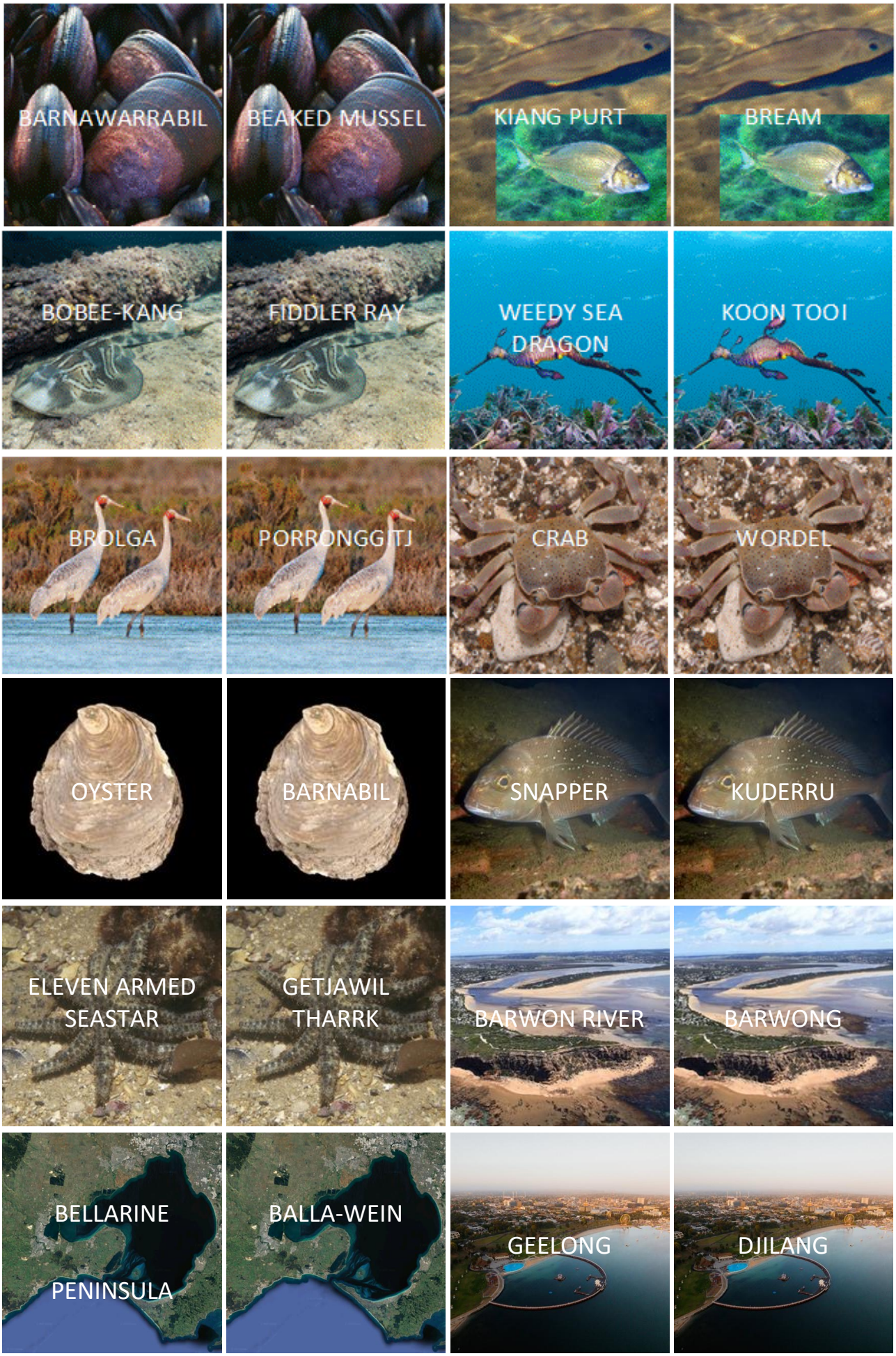
Activity 4: Wadawurrung language game

This activity enables students to explore the connection between language and place by learning Wadawurrung words tied to the local landscape. Students practice memory, matching, and communication skills through flashcards and interactive games, while developing cultural awareness and respect for Indigenous knowledge. This supports both language learning and understanding of how language reflects and preserves connection to Country.

Today, language is quite universal, because people share words over large distances through travel and technology. However, hundreds, and thousands of years ago, languages were localised. Mountains and lakes and places like the Barwon Bluff were only known and named by the people who lived close by. In this way, traditional languages are connected to a specific place. Learning specific place names depends on having access to those specific places.

Watch a video and hear from Bryon Powell about the development of Wadawurrung words into Australian English words. [There are 4 A's in Balaraat – This Place]

1. Students fill in the blank spaces in their word list worksheet using the Wadawurrung language memory puzzles, and crossword answers on the Friends of the Barwon Bluff website. https://www.barwonbluff.com.au/wadawurrung-language/
2. Hand out print outs of the Wadawurrung Word Cards and have your students cut them out. Each pair of cards has an identical image.
3. Have students label one card with the English language name, and the corresponding Wadawurrung name on the other card.
4. The memory cards now also function as Wadawurrung language flash cards. Give students time to play the memory game and begin learning the new words.
5. Working in pairs (or as a class), have students design their own activity to use the cards and practice Wadawurrung language, e.g. snap, call and response, Guess Who, Pictionary…


BARNAWARRABIL
BEAKED MUSSEL
KIANG PURT
BREAM
BOBEE-KANG
FIDDLER RAY
WEEDY SEA DRAGON
KOON TOOI
BROLGA
PORRONGGITJ
CRAB
WORDEL
OYSTER
BARNABIL
SNAPPER
KUDERRU
ELEVEN ARMED SEASTAR
GETJAWIL THARRK
BARWON RIVER
BARWONG
BELLARINE PENINSULA
BALLA-WEIN
GEELONG
DJILANG

Worksheet answers:

Word	Location: Play the Memory Puzzles
Bream	*kiang purt*
Fiddler ray	*bobee-kang*
Beaked mussel	*barnawarrabil*
Weedy sea dragon	*koon tooi*
Brolga	*porronggitj*
Word	**Location: Crossword (click: *show solution*)**
Crab	*wordel*
Snapper	*kuderru*
Oyster	*barnabil*
Eleven-armed sea star	*getjawil tharrk*
Barwon river	*barwong*
Geelong	*djilang*
Bellarine peninsula	*balla-wein*

A profile of Bryon Powell is available in the supplementary slides.

Investigation 1: The language of science

This activity enables students to visually communicate complex information by combining facts, definitions, and illustrations into an infographic. Students develop research skills by gathering accurate information, practice critical thinking by defining and connecting interrelated terms, and enhance creativity through the design and layout of their infographic. They also improve their ability to summarise and interpret scientific or ecological concepts in a clear and engaging way, making the information accessible and memorable for others.

Infographics illustrate the old adage, *'a picture paints a thousand words'*. An infographic combines facts and pictures to help break down long, wordy, explanations into smaller parts which are easier to understand, more fun to look at and are more memorable to a reader [slide 22].

Further reading: piktochart.com/blog/why-use-infographics/

1. Using slide 23, students will brainstorm examples of infographics. For example, an interpretative sign at a national park, a poster on a complex subject like climate change, a weather map on the nightly news, instructions which include a diagram, graphs and maps.
2. Using slide 24 as an example, students will design an infographic which investigates the meaning behind three interrelated words. Use *Investigation 1: The language of science worksheet.*
   - Define these words and illustrate their connections in a clear and creative way.
   - Use search engines to gather definitions, illustrations and facts which help to explain the words and their connections.
3. Go to the Friends of the Barwon Bluff 'Living on the Edge' website. Under the LIFE tab, students can see many species names and descriptions to spark ideas for their own infographic.

Examples of interrelated words from 'Explore Life on the Bluff' website Underlined words are clickable links.		
Simple		
Pacific Black Duck	Pacific Gull	Silver Gull
Coast Saltbush	Seaberry Saltbush	Google: table salt
Coast Beard-heath	Sea Heath	Google: common heath
Austral Salt-grass	Austral Sea Blite	Google: Australia
Intermediate		
Sooty Oystercatcher Pied Oystercatcher	Pied Currawong Little Pied Cormorant	Australian Magpie Magpie Lark
Shared concept: beads/segments Beaded Glasswort	Neptune's Necklace	Google: necklace
Shared concept: shape words Coast Spear Grass	Coast Twin-leaf	Coast Fan-flower

Investigation 2: Scientific poster

This activity enables students to practice communicating scientific information clearly and effectively to a real audience. Students learn to organise their research using logical headings, summarise complex information and combine visuals with text to make their work engaging and easy to understand. They also develop skills in collaboration, digital or physical design, and connecting science to real-world contexts, such as community projects or citizen science initiatives.

Science communication is the essential task of 'spreading' the word about new scientific discoveries, and there are many ways of doing it. Many modern scientists have social media where they share their work with followers.

Academic publications are a traditional way for researchers (not just scientists) to share their findings with the world. The format is a written document like a thesis, a journal article or a governmental report. Your students will write science reports to document experiments in their high school science class. These documents use specific language, technical diagrams, highly detailed descriptions, and they are very boring to read.

Scientific posters are another science communication tool used by real scientists to share their research. Posters follow the logical order of the 'scientific method' while also incorporating graphic design to make the display of results or research much more engaging.

The format is up to you. Students might work alone or in groups. This could be a digital design task, or you could create A3 poster boards and hold a class science fair where your students present their research to an audience or display the digital posters on a social media platform.

1. Introduce your class to scientific posters and help them to understand the terms used as subheadings [slide 25-26].
2. Slide 28 shows how Coastcare community group activities can be fitted into the scientific poster format – with a little creative thinking. Students have a copy of this in their worksheets.

You might rewatch the Citizen Science at the Bluff video from the beginning of this unit and have students tick off information on their example poster as they hear it mentioned in the video.

3. Students have a blank *scientific poster worksheet* to help organise their research notes.
4. Students can choose a community group from the Coastcare Victoria: Environmental Volunteer Opportunities Map – it's interactive!
    - Or they could choose videos from the Coastcare Schools Kit: Lesson 3, 4 and 7 which features community actions.
    - Advanced students might use iNaturalist and present the findings of a citizen science data collection project.
    - Or research the caring for country practices of the traditional custodians of your area.

Review questions

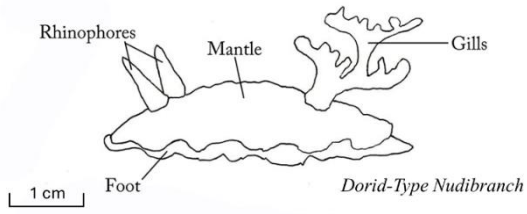
1. What is the main difference between a scientific diagram and a scientific colour illustration? (2 marks)

Diagrams are black and white line drawings, which do not show any colour, shading or texture.

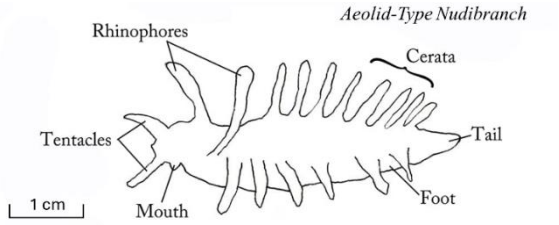
An illustration includes colour which can help with species level representation.

2. What are some differences between the two main groups of nudibranchs, Dorid & Aeolid? (3 marks)

   Use sketches if you like.



Gills in a plume towards the tail
No tentacles



Gills arranged in cerata: a mohawk along the back

Tentacles on the front

3. Why do scientists count a subset and not the total number of organisms in an environment? (4 marks)

It is impossible to count all of the organisms in an environment, because they are hidden, and because there are too many to count. Counting a subset of organisms through a survey allows for accurate population estimates – if enough counts are gathered.

4. What are some reasons you would choose to use an infographic to communicate a subject? (4 mark)

When the subject is complex and can be broken down into several parts.

When some parts can be better explained with an illustration or a diagram.

When some words can be replaced with graphic design elements.

Glossary

Abundance: The number or amount of something in a particular area or environment. In ecology, it often refers to how many organisms of a species are present.

Accurate: In statistics, refers to how close a measured or calculated value is to the true or actual value, indicating the level of correctness of the data.

Bias: A tendency to favour one thing over another in an unfair or unbalanced way.

Citizen: A member of a community who actively participates in and contributes to the well-being, decision-making, and social life of that community, with shared rights and responsibilities.

Citizen scientist: A regular person who volunteers to help with scientific research, often by collecting data or observing nature.

Community composition (In ecosystem terms): the different types of species that live together in a particular environment and how many of each are there.

Custodian: A person responsible for taking care of or protecting something, like a building or the environment.

> **Traditional custodian**: A member of an Indigenous community who has ancestral ties and responsibilities to care for and protect their land, waters, and cultural heritage.

Diagrams: Simple drawings or plans that show how something works or how parts of something are arranged.

Illustration: A drawing or picture used to explain or decorate something.

Infographic: A visual image, like a chart or diagram, that presents information or data in an easy-to-understand way.

Intertidal: The area of the shore that is underwater at high tide and exposed to air at low tide.

Nudibranch (also known as a sea slug): A colourful, soft-bodied marine mollusc belonging to the subclass *Nudibranchia*. Named for their lack of a protective shell in adulthood, leaving their gills-naked (nudi-branch). These gastropods are found in oceans worldwide, with diverse species displaying bright colours and striking patterns, often as a form of defence or camouflage.

Organism: Any living thing, like a plant, animal, or microorganism.

Quadrat: A frame, usually a square, used by scientists to mark off a small area to study the number of organisms in that space.

Sea slug: See nudibranch.

Science communicator: Someone who explains scientific ideas in a way that regular people can easily understand.

Scientist: A person who studies or works in science to understand how things in the world or universe work.

Survey: A method used by scientists to observe and record the types and numbers of organisms in an ecosystem, usually to understand the health or composition of that environment.