National Parks and Wildlife Service South Australia

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DEFINITION FILMS

BASED ON THE FILM
'SEA LIONS: LIFE BY A WHISKER'

AUSTRALIAN SEA LIONS AND THEIR HABITATS

AN EDUCATION RESOURCE

CONTENTS

Acknowledgements

This online curriculum-linked resource was produced by Angela Colliver Consulting Services. The curriculum-linked resource is designed to introduce young people to the production of foods and fibres in Australia.

FOUNDATION YEAR 1 YEAR 2

ACTIVITY ONE

Australian Sea Lions and their Habitats

Overview

Explain to the class that their task is to design and make a model of an Australian sea lion's sustainable habitat! They can create a safe and fun place for one of Australia's sea lions to enjoy, play within and source their food.

Background Science for Students: Habitats

Every organism, plant or animal lives in a habitat. A habitat is another name for their local environment. A habitat is a place where a collection of organisms, plants and animals live and which provides them with food and shelter. Cracks in a path, seashores, gardens and ponds are all examples of habitats. Habitats can be big (a forest, for example) or small (a leaf, for example).

Survival of individual species of animals and plants depends on the health of the habitat in which they live. The main cause of species extinction is loss of their habitat. If there isn't a place to live, life cannot occur. Everyone can take action for habitats.

The Essential Question

What might Australian sea lions need to be safe and healthy?

The Scenario

You are invited to create a safe and fun place for an Australian sea lion to live.

Sea lions need to have space to rest, socialise and breed, they also require shelter for young pups as well as food to eat, and good clean water to swim in.

Your task is to imagine what their ultimate sustainable habitat might look like!

Your group can either write and draw, record and video, or design and make a model of the ultimate sustainable Australian sea lion's habitat, accompanied by a text about what an Australian sea lion might need, now and in the future, to grow, and survive in nature.

Suggested Learning Process

DEFINE

Share the essential question with the class and talk about what they need to be safe and healthy.

Present the scenario, assign teams if appropriate, and ask students to define the task they have been set.

DISCOVER

Go outside, visit a home garden, reserve or park and observe any animals. Brainstorm what these animals might need to remain safe and healthy.

Connect with nature and explore habitats in the school grounds. Every part of the school grounds is a habitat. Observe what might live in the cracks of a path or the crown of a tree. Find out what lives in a tussock of native grass, dry creek bed, pond, under rocks or shrubs.
Be with nature and discover what something eats, where it lives, how it moves, and where it shelters.

View the YouTube movie trailer 'Sea Lions. Life By A Whisker' (1:31 mins) or "a Line in the Sand" (12:37 mins) and look at photographs of sea lions in books or online and explore what an Australian sea lion needs to be safe and healthy.

Share stories and view photographs about sea lions, their habitats and needs. For example:

- 'Australian Sea Lions' by Carmel Reilly (2009 Oxford University Press)
- 'Australian Sea Lions' by Claire Saxby and Graham Byrne (2020 Macmillan Books)
- 'Fur Seals and Sea Lions' by Roger Kirkwood and Simon Goldsworthy (2013 CSIRO Publications)

Identify their specific habitat needs – food, water, shelter, and places to raise their young. Talk about where the suggested elements might be located. For example, sea lions need shelter that might be found in rock crevices, beneath cliffs, under boulders along coastlines, or they can utilise a particular species of plant. They need fish and seafood to eat that are found in the ocean. They need places to raise their pups. They need protection...

FOUNDATION YEAR 1 YEAR 2

DREAM

Ask students to visualise their chosen sea lion's habitat and what it might look, sound, and feel like.

Ask students to imagine the steps involved in creating their sea lion's ultimate habitat. Challenge students to think about the materials, tools, and equipment they will need to make or draw their healthy, and safe habitat.

Ask students to imagine how they are going to create a text about what an Australian sea lion might need, now and in the future, to grow and survive in nature.

DESIGN

Invite students to design its safe, and healthy habitat.

Ask students to write/scribe a text about what their Australian sea lion might need, now and in the future, to grow, and survive in nature.

Talk about the importance of a good title and ask students to decide on a title for the text.

Ask students to draft the steps involved in making their chosen habitat for an Australian sea lion.

Ask students to gather the materials, tools, and equipment needed and then make the safe and healthy habitat for their chosen Australian Sea Lion. Photograph students at work.

DELIVER

Share student work samples showing what animals need to be safe and healthy and read aloud texts about what Australian sea lion might need, now and in the future, to grow and survive in nature.

Create a display of student's work and enjoy a day of learning about healthy and safe habitats for Australian sea lion.

Share students' work samples and showcase their learning.

DEBRIEF

Ask students to:

- Reflect on what things outside their local place might affect the habitat they created.
- Draw something new they discovered regarding what Australian Sea Lions need to be safe and healthy.
- Describe their favourite memory of creating their work samples.
- Discuss what they learned about what Australian sea lions might need, now and in the future, to grow and survive in nature.

FOUNDATION YEAR 1 YEAR 2

CURRICULUM CONNECTIONS

Australian Curriculum

SCIENCE (ACARA, 2015a)

Foundation & Year 1
Science Understanding – Biological sciences

Living things have basic needs, including food and water ACSSU002

Living things live in different places where their needs are met ACSSU211

Foundation
Science Inquiry Skills

Respond to questions about familiar objects and events ACSIS014

Participate in guided investigations and make observations using the senses ACSIS011

Engage in discussions about observations and represent ideas ACSIS233

Share observations and ideas ACSIS012

Year 1
Science Inquiry Skills

Respond to and pose questions, and make predictions about familiar objects and events ACSIS024

Participate in guided investigations to explore and answer questions ACSIS025

Use informal measurements to collect and record observations, using digital technologies as appropriate ACSIS026

Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions ACSIS027

Compare observations with those of others ACSIS213

Represent and communicate observations and ideas in a variety of ways ACSIS029

FOUNDATION YEAR 1 YEAR 2

Year 2
Science Inquiry Skills

Pose and respond to questions, and make predictions about familiar objects and events ACSIS037

Participate in different types of guided investigations to explore and answer questions, such as manipulating materials, testing ideas, and accessing information sources ACSIS038

Use informal measurements in the collection and recording of observations, with the assistance of digital technologies as appropriate ACSIS039

Use a range of methods to sort information, including drawings and provided tables ACSIS040

Through discussion, compare observations with predictions ACSIS21

Compare observations with those of others ACSIS041

Represent and communicate observations and ideas in a variety of ways such as oral and written language, drawing and role play ACSIS042

Science as a Human Endeavour – Nature and development of science

Science involves exploring and observing the world using the senses ACSHE013

Science involves observing, asking questions about, and describing changes in, objects and events ACSHE013 ACSHE021 ACSHE034

Science as a Human Endeavour – Use and influence of science

People use science in their daily lives, including when caring for their environment and living things ACSHE022

TECHNOLOGIES (ACARA, 2015b)

Foundation , Year 1 & Year 2
Design and Technologies Processes and Production Skills

Explore needs or opportunities for designing, and the technologies needed to realise designed solutions ACTDEP005

Generate, develop and record design ideas through describing, drawing and modelling ACTDEP006

Use materials, components, tools, equipment and techniques to safely make designed solutions ACTDEP007

Use personal preferences to evaluate the success of design ideas, processes and solutions including their care for environment ACTDEP008

Sequence steps for making designed solutions and working collaboratively ACTDEP009

FOUNDATION YEAR 1 YEAR 2

NSW Syllabus (NESA, 2018)

Early Stage 1

Science and Technology

STe-3LW-ST explores the characteristics, needs and uses of living things

STe-1WS-S observes, questions and collects data to communicate ideas

STe-2DP-T develops solutions to an identified need

Stage 1

Science and Technology

ST1-4LW-S describes observable features of living things and their environments

ST1-1WS-S observes, questions and collects data to communicate and compare ideas

ST1-2DP-T uses materials, tools and equipment to develop solutions for a need or opportunity

ST1-3DP-T describes, follows and represents algorithms to solve problems

VIC Syllabus (VCAA, 2018)

Foundation - Year 2

Science

Science Understanding- Biological Sciences

Living things have a variety of external features and live in different places where their basic needs, including food, water and shelter, are met.

Science Inquiry Skills

Respond to and pose questions, and make predictions about familiar objects and events

Participate in guided investigations, including making observations using the senses, to explore and answer questions Use a range of methods, including drawings and provided tables, to sort information

Compare observations and predictions with those of others

Represent and communicate observations and ideas about changes in objects and events in a variety of ways

continued...

FOUNDATION YEAR 1 YEAR 2

Science as a human endeavor

People use science in their daily lives

Design and Technologies

Explore needs or opportunities for designing, and the technologies needed to realise designed solutions

Visualise, generate, and communicate design ideas through describing, drawing and modelling

Use materials, components, tools, equipment and techniques to produce designed solutions safely

Use personal preferences to evaluate the success of design ideas, processes and solutions including their care for environment

Sequence steps for making designed solutions

WA Syllabus (SCSA, 2017)

Pre-Primary
Science - Biological Sciences

Living things have basic needs, including food and water

Year 1
Science - Biological Sciences

Living things live in different places where their needs are met

Pre-Primary
Science Inquiry Skills

Pose and respond to questions about familiar objects and events

Participate in guided investigations and make observations using the senses

Engage in discussions about observations and represent ideas

Share observations and ideas

Year 1 & Year 2
Science Inquiry Skills

Pose and respond to questions, and make predictions about familiar objects and events

Participate in guided investigations to explore and answer questions

Use a range of methods to sort information, including drawings and provided tables through discussion, compare observations with predictions

continued...

FOUNDATION YEAR 1 YEAR 2

Compare observations with those of others
Represent and communicate observations and ideas in a variety of ways

Pre-Primary
Science as a human endeavour

Science involves observing, asking questions about, and describing changes in, objects and events

Year 1 & Year 2
Science as a human endeavour

Science involves observing, asking questions about, and describing changes in, objects and events

People use science in their daily lives, including when caring for their environment and living things

Pre-Primary
Design and Technology

People produce familiar products to meet personal and community needs

Explore needs for design

Generate and record design ideas through describing, drawing, modelling and/or a sequence of written or spoken steps

Use given components and equipment to safely make simple solutions

Use personal preferences to evaluate the success of simple solutions

Work independently, or with others when required, for solutions

Year 1
Design and Technology

People produce familiar products and services to meet personal and community needs

Explore opportunities for design

Develop and communicate design ideas through describing, drawing, modelling and/or a sequence of written or spoken steps

Use given components and equipment to safely make solutions

Use personal preferences to evaluate the success of design processes

Work independently, or with others when required, to safely create and share sequenced steps for solutions

continued...

FOUNDATION YEAR 1 YEAR 2

Year 2
Design and Technology

People design and produce familiar products, services and environments to meet local and community needs
Explore design to meet needs or opportunities

Develop, communicate and discuss design ideas through describing, drawing, modelling and/or a sequence of steps

Use components and given equipment to safely make solutions

Use simple criteria to evaluate the success of design processes and solutions

Work independently or collaboratively when required, to organise information and ideas to safely create and share sequenced steps for solutions

General Capabilities

Literacy; Critical and creative thinking, Personal capability, ICT's capabilities.

Cross-Curriculum Priority

Sustainability

Organising Ideas

OI 2: All life forms, including human life, are connected through ecosystems on which they depend for their wellbeing and survival.

OI.7: Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments.

OI.8: Designing action for sustainability requires an evaluation of past practices, the assessment of scientific and technological developments, and balanced judgments based on projected future economic, social and environmental impacts.

FOUNDATION YEAR 1 YEAR 2

ACTIVITY TWO

A Sustainable Future

Overview

Explain to the class that their task will be to explore Australian sea lions and view the movie 'Sea Lions. Life by a Whisker" and then create a book to educate others about what sea lions need for a sustainable future.

Background Science for Students: Scientists

A scientist is someone who uses a systematic approach to acquire new knowledge. A scientist can also be defined as someone who uses the 'scientific method' and performs research work.

A scientist may be an expert in one or more areas of science, such as biology, or agriculture, space, food, nutrition or plants! Some scientists think about how all of these fit together to make up our whole 'life support system'.

Being a scientist begins by thinking like a scientist. Scientists are curious about how the world works. They have many questions and go about answering those questions using the scientific methods.

If you are fascinated by how things work and why they work a certain way, you too could become a scientist!

To work as a scientist, a person usually needs a degree in science. A degree is obtained by attending university and getting a Bachelor of Science or Engineering degree.

The Essential Question

What happens when we understand that science involves observing, asking questions about, and describing changes in, objects and events?

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FOUNDATION YEAR 1 YEAR 2

The Scenario

Discover what a sustainable natural environment might look like, sound like and feel like through the development of short, illustrated books.

We are calling on your school because we have heard about the wonderful sustainability and science program at your school. Your school is well known for its food garden, composting program, worm farm and the ability for all children to be involved in the 'magic of sustainability'.

Your challenge is to produce a short, illustrated book for a pre-school or kindergarten that explains how science involves solving problems and how it could help create a sustainable natural environment for Australian sea lions.
I wonder how your school could promote a 'sustainable natural environment for Australian sea lions through a short, illustrated book. Does anyone have any thoughts?

Are you up for the challenge? If so, then we would like you to create a short illustrated book that explains:

- How anyone could help create a sustainable natural environment for Australian sea lions.
- A description of a sustainable natural environment.

I wonder will you create a paperback or an e-Book?

FOUNDATION YEAR 1 YEAR 2

Suggested Learning Process

DEFINE

Capture students' interest and share information about the movie Sea Lions. Life by a Whisker. See Home | SEA LIONS MOVIE (sealionsfilm.com)
Choose different features on the top toolbar, and discover the more about the movie, its characters, settings, problem, and solution. Record ideas in Resource 1.1.

Talk about what a sustainability scientist might need to observe, and what information they might need to collect.

As a class, talk about all stories having an illustrated cover, an inside front cover, a title page, a sizzling start and the other pages available for the story, including the back cover.

Talk about stories needing an action starting point where something exciting happens and the characters are introduced to the reader. Talk about the place or 'setting' in which the story happens, and how the story then unfolds around a problem moves to a really strong ending.

Ask students what they might need to know more about, in order to undertake the challenge set by the Roots & Shoots program. Might they need to know something about science, what scientists do, and sustainability?

DISCOVER

Watch the video 'Growing in the Garden at Plunkett Street Public School', Filmpond (4:07 min).

Talk about whether the students 'green' quest might be a great idea for a sustainable natural environment.

Consider whether growing a garden, raising chooks, watering plants, collecting seed, adding veggie scraps to worm farms, creating soil, planting seeds, controlling bugs, making compost, using compost on the garden, and harvesting fresh food, cooking and eating it might be the way to sustain life on our planet.

Check out how Pennant Hills Public School in NSW has created a solution...a 'bird haven'. Watch 'Small Bird Haven at Pennant Hills Primary School', Filmpond (5:33 min).

continued...

FOUNDATION YEAR 1 YEAR 2

Talk about the value of a 'bird haven' that provide nests, food and shelter in both built and natural environments.

View a 'Planting Lilly Pillies to Improve Air Quality at Belmore South PS', Filmpond (6:33 min) and discover how Belmore South Public School has created a range of outdoor spaces, environmental assets, in particular, how lilly pilly plants are protecting them from more than 39 000 cars that pass by each day and the pollution and noise created by that volume of traffic.

Hear about the problem solving activities and thinking the students have used and developed while creating their native garden.

Talk about the importance of working together to create solutions.

Discover what solutions are being created at Cambridge Gardens Public School. Watch 'Cambridge Gardens Gardening Club', Filmpond (3:01 min).

Brainstorm the science in all the things that happen in their gardening club.

Go outside and connect with nature in the school grounds. As a class, sit under trees, lie on the grass, visit the school veggie patch and look for signs of life. Watch, listen, and take in what is happening in these places.

Where possible visit a local beach or stretch of coastline and imagine life beneath the water.

View the photographs that provide clues about Australian sea lions and their homes here. Then, ask students a range of geographical questions, such as:

- What is this place?
- What is this place like?
- What are natural features in it?
- What are built features in it?
- How is it being used?
- What is happening at this place at this time?

Collate and list the common natural and built features found by the students.

Encourage students to complete the following matrix, by naming or listing what they have seen.

FEATURES	COAST (shoreline)	SAMPHIRE FLATS (intertidal region)	NEARBY CATCHMENT AREA
Animals			
Plants			
Natural features			
Human made features			
Caring for the place			
Why this place is important			

FOUNDATION YEAR 1 YEAR 2

Go outside and investigate places in the school grounds. As a class or in small groups, discuss actions you could take to improve or care for part of the school or its grounds and look after it. Ask students to reflect on the places investigated and ask students to suggest ways that people could improve, care for or look after them.

Record the students' ideas.

In class meetings put forward suggestions, vote and make decisions regarding actions classes could take to care of special places in the school, e.g., start a litter team or a compost heap, recycle paper, plastics, cans and bottles, mulch garden areas. Talk about how such actions might help sea lions have a more sustainable future.

Explain to the class that we all live in a catchment that is connected to the sea. Explore gutters in and around the school and discuss how with wing and water the litter, leaf litter and soil all end up in the ocean via our stormwater system.

Discuss about how our coasts and oceans receive large amounts of waste be it by deliberate dumping or by natural run-off from the land.

Talk with students about what we do at home and school and how these actions affect the coast.

Talk about where water goes down the drain, in the classroom area. Describe the types of water that goes down the drain. e.g., water used for washing hands, paint brushes, glue pots.

Brainstorm ways the class might show more care when disposing of solutions down the drain, e.g., scrape left over paint into paint pots, clean paint palettes using newspaper, not using too much detergent or soap, etc.

Identify areas in the school and home that involve water and chart these, e.g. drains, gutters, downpipes, sprinklers, tap, showers, laundries, rainwater tanks, toilets, drinking fountains.

Discuss any environmental issues connected with these areas. Draw cause and effect flow charts to show the issue and its effect on coastal area.

For example:

drains ⟶ blocked with leaves and litter ⟶ mini flooding in school grounds and after draining away pollutes coastal area

continued...

FOUNDATION YEAR 1 YEAR 2

Talk with students about leaf litter and both urban and agricultural run-off that is washed into watercourses or drains. Follow its path to the sea.

Brainstorm ways the class could get involved in activities for the protection of our waterways and the sea.

Choose an area of the school grounds to adopt and care for. As a class decide, who will do what, when and how? Gather ideas by role playing to show ways individuals and groups can care for the school grounds.

Create a 'How we can care for our coast and the sea' space in the classroom. Display pictures, photographs and information about your class actions. Promote these at school assemblies.

Focus on the task of writing a story. Brainstorm six ideas for the story. Ask students to select the idea that really 'grabs' the class, and draft a story sequence. Ask questions like; 'And then what happens?' Encourage students to think deeply about how the story might reveal the way anyone can create a sustainable natural environment in a funny, exciting and creative way. Talk about the ending as well, asking 'what will happen at the end of the story?'

Ask students to create a short illustrated book that explains:

- How anyone could help create a sustainable natural environment for Australian sea lions.
- A description of a sustainable environment.

DREAM

Ask students to visualise an illustrated cover for their book as well as an inside front cover and a title page.

Ask students to imagine what their short illustrated story book might look like. Will it be a paperback or an e-Book? Will it include photographs, pop-ups, pull-tabs, textures or other features to increase a reader's interaction with the book?

DESIGN

Ask students to design their draft story for their book.

Ask students to gather the materials, tools, and equipment needed and then design their book.

continued...

FOUNDATION YEAR 1 YEAR 2

Invite a peer class group to the class and to find out more about how a short illustrated book can explains:

- How anyone could help create a sustainable natural environment for Australian sea lions.
- A description of a sustainable natural environment.

DELIVER

Create the stories about a sustainable natural environment.

Prepare a display of students' stories about how sustainability science could help create a sustainable natural environment for Australian sea lions.to enjoy.

Visit the local pre-school, kindergarten, Foundation class or day-care centre and share and discuss the stories with younger children.

Share photos and students' stories via the school's online community. The public loves to see pictures of children in the classroom learning, and to share photos via email at (insert email address) or share what has been created via Facebook or Instagram. Please ensure that you have parental permission prior to posting any images of students.

DEBRIEF

Ask students to recall what they learned.

Talk about what they might still like to find out.

Ask students to describe their favourite part of creating a story and sharing it with others to learn more about for Australian sea lions.

FOUNDATION YEAR 1 YEAR 2

CURRICULUM CONNECTIONS

Australian Curriculum

SCIENCE (ACARA, 2015a)

Foundation & Year 1
Science as a Human Endeavour - Nature and Development of Science

Science involves observing, asking questions about, and describing changes in, objects and events ACSHE013 ACSHE021 ACSHE034

Science as a Human Endeavour – Use and Influence of Science

People use science in their daily lives, including when caring for their environment and living things ACSHE022 ACSHE035

TECHNOLOGIES (ACARA, 2015b)

Foundation, Year 1 and Year 2
Design and Technologies - Processes and Production Skills

Explore needs or opportunities for designing, and the technologies needed to realise designed solutions ACTDEP005

Generate, develop and record design ideas through describing, drawing and modelling ACTDEP006

Use materials, components, tools, equipment and techniques to safely make designed solutions ACTDEP007
Use personal preferences to evaluate the success of design ideas, processes and solutions including their care for environment ACTDEP008

Sequence steps for making designed solutions and working collaboratively ACTDEP009

FOUNDATION YEAR 1 YEAR 2

NSW Syllabus (NESA, 2018)

Early Stage 1

Science and Technology

STe-3LW-ST explores the characteristics, needs and uses of living things

STe-1WS-S observes, questions and collects data to communicate ideas

STe-2DP-T develops solutions to an identified need

Stage 1

Science and Technology

ST1-4LW-S describes observable features of living things and their environments

ST1-1WS-S observes, questions and collects data to communicate and compare ideas

ST1-2DP-T uses materials, tools and equipment to develop solutions for a need or opportunity

ST1-3DP-T describes, follows and represents algorithms to solve problems

VIC Syllabus (VCAA, 2018)

Foundation - Year 2

Science as a Human Endeavour

People use science in their daily lives

Design and Technologies

Explore needs or opportunities for designing, and the technologies needed to realise designed solutions

Visualise, generate, and communicate design ideas through describing, drawing and modelling

Use materials, components, tools, equipment and techniques to produce designed solutions safely

Use personal preferences to evaluate the success of design ideas, processes and solutions including their care for environment

Sequence steps for making designed solutions

WA Syllabus (SCSA, 2017)

Pre-Primary
Science as a Human Endeavour

Science involves observing, asking questions about, and describing changes in, objects and events

Year 1 & Year 2
Science as a Human Endeavour

Science involves observing, asking questions about, and describing changes in, objects and events

People use science in their daily lives, including when caring for their environment and living things

Pre-Primary
Design and Technologies

People produce familiar products to meet personal and community needs

Explore needs for design

Generate and record design ideas through describing, drawing, modelling and/or a sequence of written or spoken steps

Use given components and equipment to safely make simple solutions
Use personal preferences to evaluate the success of simple solutions

Work independently, or with others when required, for solutions

Year 1
Design and Technologies

People produce familiar products and services to meet personal and community needs

Explore opportunities for design

Develop and communicate design ideas through describing, drawing, modelling and/or a sequence of written or spoken steps

Use given components and equipment to safely make solutions
Use personal preferences to evaluate the success of design processes

Work independently, or with others when required, to safely create and share sequenced steps for solutions

continued...

FOUNDATION YEAR 1 YEAR 2

Year 2
Design and Technologies

People design and produce familiar products, services and environments to meet local and community needs

Explore design to meet needs or opportunities

Develop, communicate and discuss design ideas through describing, drawing, modelling and/or a sequence of steps

Use components and given equipment to safely make solutions

Use simple criteria to evaluate the success of design processes and solutions

Work independently or collaboratively when required, to organise information and ideas to safely create and share sequenced steps for solutions

General Capabilities

Literacy; Critical and creative thinking, Personal capability, ICT's capabilities.

Cross-Curriculum Priority

Sustainability

Organising Ideas

OI 2: All life forms, including human life, are connected through ecosystems on which they depend for their wellbeing and survival.

OI.7: Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments.

OI.8: Designing action for sustainability requires an evaluation of past practices, the assessment of scientific and technological developments, and balanced judgments based on projected future economic, social and environmental impacts.

YEAR 3

YEAR 4

ACTIVITY THREE

Cleaning up the Oceans

Overview

Explain to the class that their task is to help others understand the effects of pollution and waste in our oceans, and on Australian sea lions, and empower them to know what they can do to help the oceans.

Background Science for Students: Water Pollution

Pollution is the introduction of harmful materials into the environment. Water pollution is when waste, chemicals, or other particles cause a body of water (ie. oceans, rivers, lakes, wetlands, etc) to become harmful to the fish, animals, reefs, and plants that need the water to survive. Water pollution can also have damaging and disruptive impacts on the natural water cycle.

Most people are affected in some way by water pollution in oceans and beaches. However, fewer people are aware of the many sources of water pollution.

Human causes of water pollution

A lot of water pollution comes from human activity. Some human causes include that which is washed into stormwater drains that lead to rivers and the sea. Other causes include pesticides, insecticides, herbicides and fertilisers from farms, wastewater and poisonous chemicals from factories, schools and offices, silt from construction sites, and rubbish from people littering which gets washed into dams, rivers and the sea after rain.

In the oceans, a lot of pollution comes from things that are thrown overboard from boats and by rubbish that washes into the ocean from the land and from rivers. Plastics, fishing line, fishing nets, waste from aquaculture (plastic, rubber, biological & chemical) and other wastes can affect the creatures living in our oceans.

Plastic pollution is considered in the top three dangers to a continuing healthy ocean.

continued...

YEAR 3

YEAR 4

The thoughtless disposal of manures, fertilisers, and toxic or hazardous waste is a serious problem because these chemicals can cause pollution, even if they are in small quantities in waterways or stormwater drains that feed into our oceans.

Industry is not permitted by law to discharge materials or chemicals directly into waterways, the stormwater system, or the oceans. However, many industries are allowed to dispose of materials or chemicals into the wastewater system. They must do so under strict guidelines.

Natural causes of water pollution

Sometimes water pollution can occur through natural causes, like volcanoes, algal blooms, animal waste, and silt from storms and floods.

The Essential Question

What happens when we understand that are our oceans are under stress from pollution?

The Scenario

Our Marine Park Rangers are looking for innovative ideas to help others understand the effects of pollution and waste in our oceans, and on Australian sea lions, and empower them to know what they can do to counter those effects.

What science investigations can assist you in your mission to leave our ocean waters in a better condition than we find them today?

Your challenge is to help others understand the effects of pollution and waste in our oceans and empower them to know what they can do to help. Will you design an experiment, animation, or digital science presentation? Are you up for the challenge?

Suggested Learning Process

DEFINE

Share the essential question with the class and talk about the need to have clean, healthy water in our oceans.
Present the scenario, assign pairs or small groups if appropriate, and ask students to define the task they have been set.

DISCOVER

Capture student's interest and read 'Alba the One Hundred Year Old Fish' by Libby Hawthorne. It tells the story of a beautiful coral reef that becomes a littered graveyard. Alba the fish becomes stuck in a plastic bottle and is saved by a little girl who recruits her community to clean up the ocean and release Alba.

View the movie trailer for 'Sea Lions. Life By A Whisker' (1:31 mins) and look for evidence of pollution in the ocean.

Locate where water can be found in the classroom area. Talk about what it is used for, e.g., washing hands, cleaning paint brushes and paint containers, making glue, cooking, watering plants, watering classroom animals, etc. Talk about how water is used outdoors e.g., washing cars, watering lawns and gardens, washing windows, etc.

Go on a drain hunt. Find drains that take water into the stormwater system and out to the ocean. Talk about the water that goes down the drain in and around the school grounds and local area. Discuss how water pollution here affects others downstream, and how pollution upstream affects you.

In pairs or small groups, talk about the ways the class can be more careful of what can be washed down outside drains and care for their oceans. Encourage pairs or small groups to report back their ideas.

Collate ideas. For example:

Ways we can care for the ocean and Australian sea lions include:

- *Scraping left-over paint back into paint pots and not wash paint brushes near drains.*
- *Washing cars on lawns.*
- *Sweeping leaves away from gutters and use them as mulch.*
- *Putting litter in a bin.*
- *Picking up after our dogs and compost doggy poo.*
- *Reusing plastics.*
- *Stop releasing balloons.*
- *Stop using plastic drinking straws*
- *Never dispose of oil or chemicals down the gutter or into a drain.*

continued...

YEAR 3

YEAR 4

Identify areas in and around the school and children's homes where water is found.

Discuss any environmental issues connected with those areas.

Draw cause and effect charts to show the issue and the problem. For example: drains → blocked with leaves and litter → polluted water that can flow to the ocean.

Download the AUSMEPA PowerPoint presentation about pollution in the ocean and discover more about stormwater discharges with litter, plastics, oil, chemicals, fertilisers and dog poo and their effects on marine animals and birds. Ask students to imagine the effects of these pollutants on Australian sea lions.

Talk with students about what happens to leaves, plastics, and other types of litter that are washed into drains. Follow their path to the ocean. Simulate what happens and immerse leaves, plastics, paper, aluminium, bread, fruit peel and litter in buckets of water. Leave them outside in the sun and overnight for a week or so and observe what happens. Download the AUSMEPA 'My Stinking Experiment' file and record observations and findings.

Brainstorm ways the class could get involved in activities for the protection of the ocean environment and Australian sea lions, e.g., sweep gutters and asphalt, collect leaf litter, compost leaf litter, collect litter and recycle.

Set up teams of Gutter-Guardians and Litter-Busters to ensure all street gutters near the school and drains in the school grounds are cleared and litter is collected, sorted, and disposed of wisely during and after play periods.
Think of ways to refuse using plastics at school, for example, plastic free lunches.

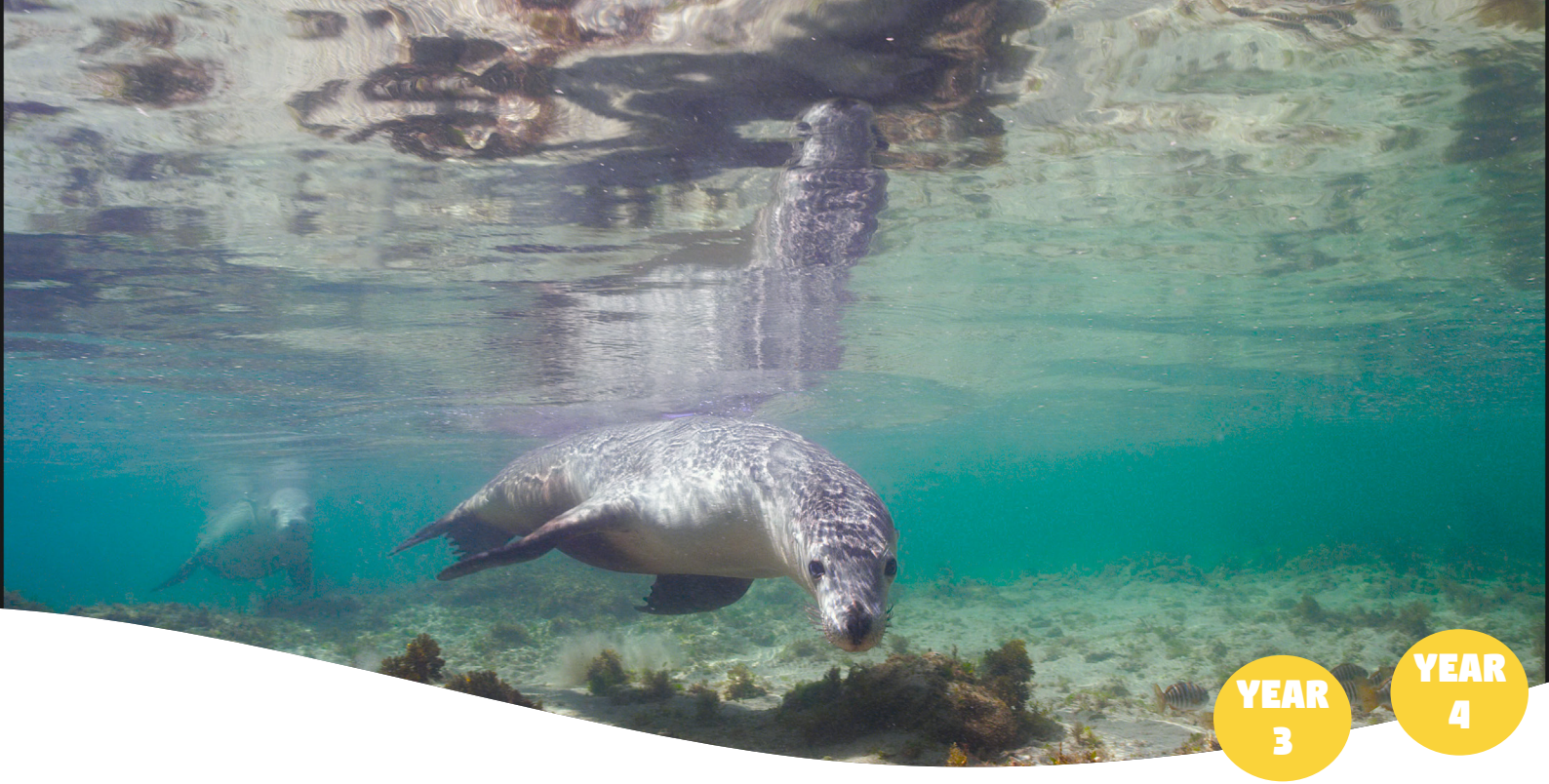
Discuss the environmental issues affecting the ocean and possible ways to solve the problems.

Talk more about how plastics are affecting the oceans and Australian sea lions.

Introduce students to Molly Steer, a Year 4 student from Cairns in North Queensland who has started a campaign called 'Molly's Straws No More'. It all began when Molly and her mother saw a film Plastic Ocean (1.05 mins).

View a video on YouTube (1.26 mins) and discover nine ways we can all help reduce plastic pollution.

continued...



YEAR 3

YEAR 4

Introduce a range of innovations that are currently helping to clean up our oceans and make them more sustainable. Introduce the Seabin Project, where two Australian surfers have designed and engineered a floating bin that can capture thousands of pieces of floating debris and plastics.

Introduce Boyan Slat, a young innovator, and discover his Ocean Cleanup prototype that promises to clean up the ocean.

Learn about what we can all do to reduce micro-plastics from the ocean. Watch a video (3:10 mins) and hear from high school students who won the 2019 Eureka prize.

Introduce Jane Goodall's "Roots and Shoots" youth-led campaign called Thumbs up for Turtles that aims to raise awareness about the impact of our waste footprint and promote solutions to minimise our impact on the oceans. Read about the things we can do to reduce plastic and protect our oceans here.

DREAM

In pairs or small groups, envision or dream about the many possible solutions to pollution problems in our oceans and its harmful effects on Australian sea lions.

Further develop ideas for possible solutions using sketches and labels.
Ask students to visualise their most creative solution.

Invite students to think about what materials, tools, equipment, and ingredients they will need to make their solution a reality.

Remind students that their solution needs to explain the effects of pollution and waste in our oceans and on Australian sea lions, as well as empower others to know what they can do to help them.

Record a video, sing a song, or read an announcement to explain this.

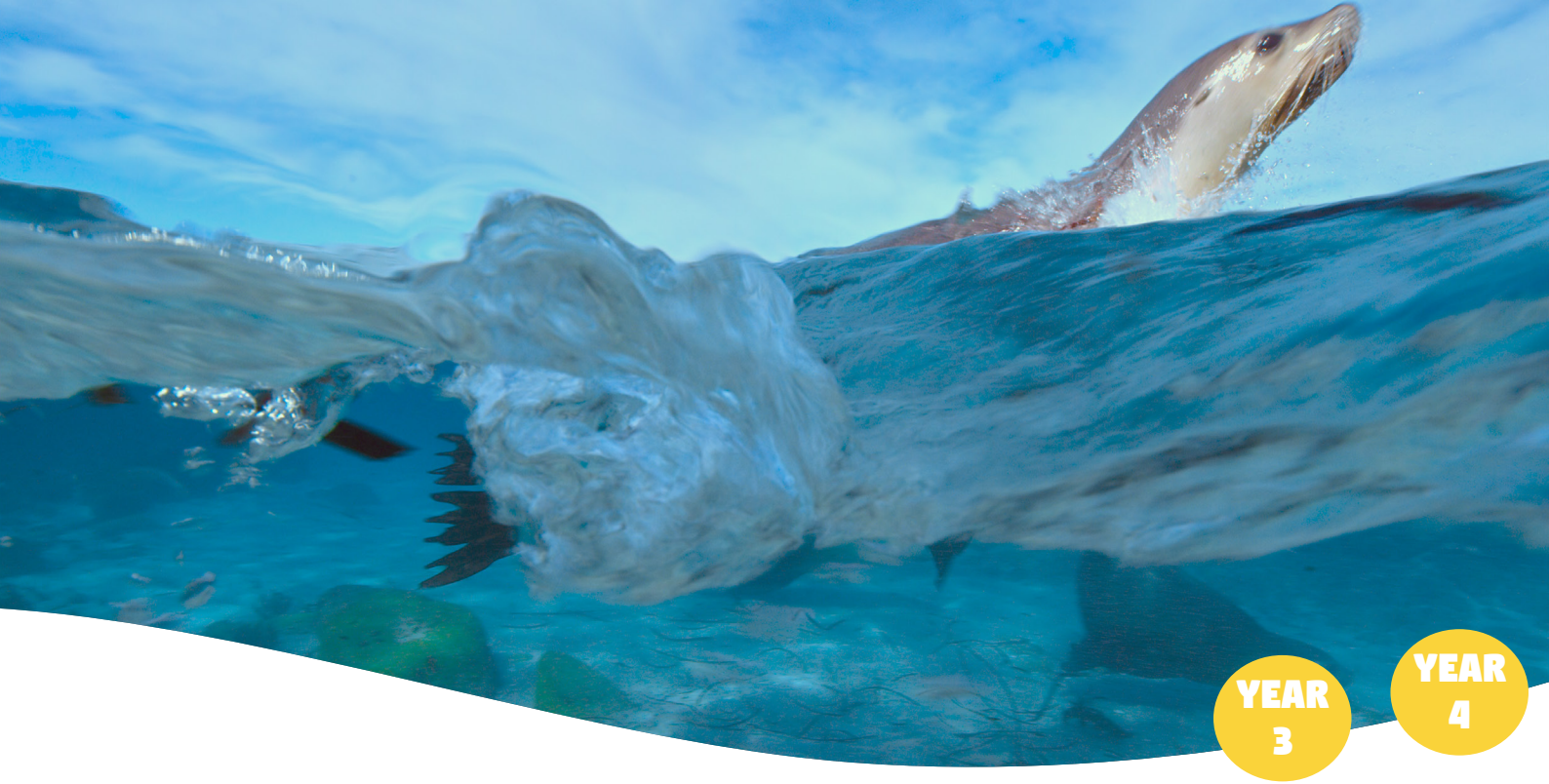
DESIGN

Invite students, in pairs or small groups, to begin drafting their designs for their solutions.

Ask students to draft the steps involved in making their design item.

Ask students to gather the materials, tools, and equipment needed and then design and create the solution.

Invite a peer class group to the class to find out more about the effects of pollution and waste in our oceans, and on Australian sea lions, and know what they can do.



YEAR 3

YEAR 4

DELIVER

In pairs or small groups, showcase the creations and associated messages explaining the effects of pollution and waste in our oceans, on Australian sea lions, and what others can do to ensure clean and sustainable oceans.

DEBRIEF

Ask students to reflect on their learning and something they learnt that was new.

Ask students to describe what worked well and not so well in their efforts to create a solution to pollution problems in our oceans which also affect Australian sea lions.

YEAR 3

YEAR 4

CURRICULUM CONNECTIONS

Australian Curriculum

SCIENCE (ACARA, 2015a)

Year 3 & Year 4

Science Understandings - Biological Understandings

Living things depend on each other and the environment to survive ACSSU073

Science as a Human Endeavour - Nature and Development of Science

Science involves making predictions and describing patterns and relationships ACSHE050 ACSHE061

Science as a Human Endeavour - Use and Influence of Science

Science knowledge helps people to understand the effect of their actions ACSHE051 ACSHE062

TECHNOLOGIES (ACARA, 2015b)

Year 3 & Year 4

Design and Technologies - Processes and Production Skills

Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques ACTDEP015 Select and use materials, components, tools and equipment using safe work practices to make designed solutions ACTDEP016

Evaluate design ideas, processes and solutions based on criteria for success developed with guidance and including care for the environment ACTDEP017

Plan a sequence of production steps when making designed solutions individually and collaborativelyACTDEP018

YEAR 3

YEAR 4

NSW Syllabus (NESA, 2018)

Stage 2
Science and Technology K-6

ST2-2DP-T selects and uses materials, tools and equipment to develop solutions for a need or opportunity

ST2-3DP-T defines problems, describes and follows algorithms to develop solutions

VIC Syllabus (VCAA, 2018)

Levels 3 - 4
Design and Technologies - Creating Designed Solutions

Critique needs or opportunities for designing and explore and test a variety of materials, components, tools and equipment and the techniques needed to create designed solutions

Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques

Select and use materials, components, tools and equipment using safe work practices to produce designed solutions

Evaluate design ideas, processes and solutions based on criteria for success developed with guidance and including care for the environment and communities

Plan a sequence of production steps when making designed solutions

Levels 3 - 4
Science - Science as a Human Endeavour

Science knowledge helps people to understand the effects of their actions (VCSSU056)

Science - Biological Sciences

Different living things have different life cycles and depend on each other and the environment to survive (VCSSU058)

Science Inquiry Skills

With guidance, identify questions in familiar contexts that can be investigated scientifically and predict what might happen based on prior knowledge (VCSIS065)

Safely use appropriate materials, tools, equipment and technologies (VCSIS067)

continued...

YEAR 3

YEAR 4

Use formal measurements in the collection and recording of observations (VCSIS068)

Represent and communicate observations, ideas and findings to show patterns and relationships using formal and informal scientific language (VCSIS072)

WA Syllabus (SCSA, 2017)

Years 3-4
Science - Biological Sciences

Living things have life cycles. Living things depend on each other and the environment to survive

Science as a Human Endeavour

Science involves making predictions and describing patterns and relationships

Science knowledge helps people to understand the effect of their actions

Science Inquiry Skills

With guidance, identify questions in familiar contexts that can be investigated scientifically and make predictions based on prior knowledge

With guidance, plan and conduct scientific investigations to find answers to questions, considering the safe use of appropriate materials and equipment

Compare results with predictions, suggesting possible reasons for findings

Represent and communicate observations, ideas and findings using formal and informal representations

Year 3
Design & Technologies - Processes and Production Skills

Creating solutions by...

Create a sequence of steps to solve a given task

Develop and communicate ideas using labelled drawings and appropriate technical terms

Select, and safely use, appropriate components with given equipment to make a solution

Use criteria to evaluate design processes and solutions developed

Work independently, or collaboratively when required, to plan, safely create and communicate sequenced steps

continued...

YEAR 3

YEAR 4

Year 4

Design & Technologies - Processes and Production Skills

Creating solutions by...

Define a sequence of steps to design a solution for a given task

Identify and choose the appropriate resources from a given set

Develop and communicate design ideas and decisions using annotated drawings and appropriate technical terms

Select, and safely use, appropriate components and equipment to make solutions

Use criteria to evaluate and justify simple design processes and solutions

Work independently, or collaboratively when required, to plan, safely create and communicate ideas and information for solutions

General Capabilities

Literacy; ICT Capability, Critical and Creative thinking, Ethical Understanding and Personal and Social Capability.

Cross-Curriculum Priority

Sustainability

Organising Ideas

OI. 2: All life forms, including human life, are connected through ecosystems on which they depend for their wellbeing and survival.

OI.7: Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments.

OI.8: Designing action for sustainability requires an evaluation of past practices, the assessment of scientific and technological developments, and balanced judgments based on projected future economic, social and environmental impacts.

YEAR 5

YEAR 6

ACTIVITY FOUR

Let's Help Monitor Australian Sea Lions

Overview

Explain to the class that their task is to learn from engineers and design and build a boat with an attached submersible that can be used to help monitor Australian sea lions and assist rangers and scientists explore, collect, and retrieve samples from the ocean.

Background Science for Students: Scientists

Engineers do an amazing job designing and building different types of boats that can take us across the ocean and submarines or submersibles that take us below the ocean's surface.

Did you know that there are many types of engineers?

1. Marine engineers design, build, and maintain ships, from aircraft carriers to submarines and from sailboats to tankers. They are responsible for the internal systems of a ship, such as the propulsion, electrical, refrigeration, and steering systems.
2. Aerospace engineers design and build satellites that are used to monitor the oceans.
3. Chemical engineers discover and manufacture plastics, paints, fuels, fibres, medicines, fertilisers, and paper.
4. Structural engineers oversee the construction of boats, submersibles, buildings and structures.
5. Civil engineers design roads, bridges and unique structures.
6. Electrical engineers develop the electrical parts of most things we use.
7. Mechanical engineers design and make all sorts of equipment.
8. Industrial engineers design efficient systems that integrate workers, machines, materials, information, and energy to make a product or provide a service.

Engineers use a design process. It helps them stay on track when developing a technology used on or under the ocean or a solution to a problem

continued...

The Essential Question

What happens when we understand how boats and submersibles are engineered and designed with systems to monitor Australian sea lions and explore, collect, and retrieve items from the ocean?

The Scenario

Given that the ocean is the largest living space on our planet and covers 71 percent of Earth's surface, it seems that perhaps we ought to know a bit more about the planet we call home.

However, we have only explored five percent of the world's oceans. That means that 95 percent of our ocean is unknown. Source: NOAA

Your design team's challenge is to design and build a boat with an attached, remotely operated submersible vehicle (ROV) that can be used to help monitor Australian sea lions and explore, collect, and retrieve samples found at a depth of 30cm in the ocean.

Imagine you are a team of expert engineers and design and build your design solution that can monitor Australian sea lions, explore the ocean, and make scientific contributions to our understandings of how it is changing and its resources.

What investigations can assist you to develop your engineering skills? How might you design and build a boat with an attached unmanned submersible that can be used to help monitor Australian sea lions, and explore and collect samples in the ocean? How might you test it and demonstrate that it can safely grip, retrieve, and collect samples? What samples will you be looking for and why?

YEAR 5

YEAR 6

Suggested Learning Process

DEFINE

Learn about the Educational Passages program where schools can launch an unmanned mini-sailing boat that is tracked by satellite. When the vessel eventually makes landfall in another country, the nearest school can refurbish it, contact the original school, and send it back out to sea.

Share the essential question and scenario with the class and talk about different tools that are used to grip, collect, and retrieve items.

Imagine a crane that grips and collects building materials, a robot that can grip and retrieve objects, or a prosthetic hand that can grip and pick up items.

View a video on YouTube (2:47 mins) that features Ocean One, a robot that goes underwater and retrieves objects. Talk about its functions.

Imagine a dragline with a bucket that can scoop, retrieve, and collect ocean samples.

View images of draglines and talk about how they work.

Discuss other ways marine park rangers, like Dirk, and scientists monitor Australian sea lions, and explore the ocean. Explain to the students that many scientific discoveries are being made with the assistance of buoys, drones, satellites, and underwater probes.

Talk about how the work of an engineer always begins with a 'brief'. Explain how the brief they will be given as engineers is a set of requirements written by the people with whom they will be building the boat with, an attached unmanned submersible that can be used to help monitor Australian sea lions and explore and collect samples in the ocean.

Present the scenario again, assign pairs or small groups if appropriate, and ask students to define the task they have been set.

DISCOVER

Locate where different kinds of grippers or draglines can be found. Talk about what they are used for and the types of people who design and build them.

continued...

YEAR 5

YEAR 6

Ask students to bring to class, barbecue tongs, pegs, and grippers (that might be used by elderly people to reach distances to pick things up) and investigate their shapes and properties. Talk about their ability to grip and retrieve objects.

As a class, view the movie trailer 'Sea Lions. Life by a Whisker' and identify the engineered solutions and technologies used by Dirk and others to monitor Australian Sea Lions and explore he ocean.

As a class, talk about the Ocean One robot. Use Google Images to source photos of the robot designed by Stanford University. Discuss how it collects samples.

Ask students to look at its shape and design features and describe what they see.

Ask students to view the robot, other mini-submarines, and submersibles used to explore and collect samples in the ocean and, in design teams, brainstorm ways to use similar ideas in their designs and determine the materials they might use.

In design teams, discuss whether the proposed submersible might retrieve objects magnetically/mechanically. Talk about the weight and size of the team's proposed boat and submersible. What might the optimum weight and size be?

Invite design teams to use these ideas as a springboard to help them consider ways they can design and produce their own boat with an attached unmanned submersible that can be used to help monitor Australian sea lions and explore and collect samples found at a depth of 30 cms in the ocean.

Ask students to consider manipulating materials, developing prototypes, testing ideas, and accessing information sources to use in subsequent phases of their designs.

Talk about using high-tech solutions, like Minecraft, to scope their design. Low-tech solutions, like LEGO®, or no-tech solutions, like recycled materials for the boat that will float and similar recycled materials that can sink the submersible. Challenge students to design their tool that can retrieve and collect samples and attach it to the submersible.

View student-built ROV models and competitions at Woodbridge School Marine Discovery Centre, Re-Engineering Australia Foundation Subs in Schools program, Hallett Cover Robotics Club and SeaPerch.

continued...

YEAR 5

YEAR 6

DREAM

In pairs or small groups, envision or dream about the many possible design solutions to build a boat with an attached unmanned submersible that can be used to help monitor Australian sea lions and explore and collect samples in the ocean.

Further develop ideas for possible solutions using sketches and labels.
Ask students to visualise their most creative solution.

Invite students to think about what materials, tools, equipment, and ingredients they will need to make their solution a reality.

Remind students that their solution needs to float on water as well as be able to sink a submersible. Its attachment needs to retrieve and collect samples found in the ocean.

DESIGN

Invite students, in pairs or small groups, to begin drafting their designs for their solutions.

Ask students to draft the steps involved in designing and building their boat, submersible, and attachment.

Ask students to gather the materials, tools and equipment needed and then design and build the solution.

Invite students to prototype and test their model, evaluate its ability to float on a test surface, sink its submersible, monitor Australian sea lions, collect an ocean sample, and where necessary redesign their solution.

Encourage students in their design teams to demonstrate their models operating on a test surface.

Ask groups to talk about how they solved any problems that emerged as they designed, built, tested, and adjusted their models. Ask students what samples they decided to collect and why.

Talk about the forces that may have affected the models as they floated, sank, and were dragged and moved.

Invite a peer group to the class to hear the engineers in the class describe the type of boat, submersible, and sample collector they designed and built and see them demonstrate how they work and how they might monitor Australian sea lions.

YEAR 5

YEAR 6

DELIVER

In pairs or small groups, showcase the models they designed and built as well as demonstrate how the prototypes of their boat and submersible that can monitor Australian sea lions and collect ocean samples to a depth of 30 cms.

Host a 'Sea Lions Monitoring Day' and invite students, teachers and parents to discover what students can do.

DEBRIEF

Ask students to reflect on their learning and answer the following questions.

- What worked and what didn't?
- How could you improve on what you have done?
- What are three things you learned that you didn't know before?
- What are three things that surprised you?
- What was your most inspiring moment in the challenge?
- How can you apply what you have learned to other challenges, now and in the future?

YEAR 5

YEAR 6

CURRICULUM CONNECTIONS

Australian Curriculum

SCIENCE (ACARA, 2015a)

Year 5 & Year 6

Science as a Human Endeavour - Nature and Development of Science

Science involves testing predictions by gathering data and using evidence to develop explanations of events and phenomena and reflects historical and cultural contributions ACSHE08 ACSHE098

Science as a Human Endeavour – Use and Influence of Science

Scientific knowledge is used to solve problems and inform personal and community decisions ACSHE083 ACSHE100

Science Understandings - Biological Sciences

The growth and survival of living things are affected by the physical conditions of their environment ACSSU094

Science Inquiry Skills

With guidance, pose clarifying questions and make predictions about scientific investigations ACSIS231 ACSIS232

Identify, plan, and apply the elements of scientific investigations to answer questions and solve problems using equipment and materials safely and identifying potential risks ACSIS086 ACSIS103

Compare data with predictions and use as evidence in developing explanations ACSIS218 ACSIS221

Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts ACSIS093 ACSIS110

TECHNOLOGIES (ACARA, 2015b)

Year 5 and Year 6

Design and Technologies - Knowledge and Understandings

Examine how people in design and technologies occupations address competing considerations, including sustainability in the design of products, services, and environments for current and future use ACTDEK019

Investigate characteristics and properties of a range of materials, systems, components, tools and equipment and evaluate the impact of their use ACTDEK023

Design and Technologies - Processes and Production Skills

Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions ACTDEP024

Generate, develop, and communicate design ideas and processes for audiences using appropriate technical terms and graphical representation techniques ACTDEP025

Select appropriate materials, components, tools, equipment and techniques and apply safe procedures to make designed solutions ACTDEP024-6

Develop project plans that include consideration of resources when making designed solutions, individually and collaboratively ACTDEP028

NSW Syllabus (NESA, 2018)

Stage 3
Science and Technology - Living World

ST3-4LW-S examines how the environment affects the growth, survival and adaptation of living things

Stage 3
Design and Production

ST3-2DP-T plans and uses materials, tools and equipment to develop solutions for a need or opportunity

ST3-3DP-T defines problems, and designs, modifies and follows algorithms to develop solutions

VIC Syllabus (VCAA, 2018)

Year 5 & 6
Science Understandings - Biological Sciences

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

The growth and survival of living things are affected by the physical conditions of their environment

Year 5 & 6
Design and Technologies - Technologies and Society

Investigate how people in design and technologies occupations address competing considerations, including sustainability, in the design of solutions for current and future use

Design and Technologies - Creating Designed Solutions

Critique needs or opportunities for designing, and investigate materials, components, tools, equipment and processes to achieve intended designed solutions

Generate, develop, communicate and document design ideas and processes for audiences using appropriate technical terms and graphical representation techniques

Apply safe procedures when using a variety of materials, components, tools, equipment and techniques to produce designed solutions

continued...

Negotiate criteria for success that include consideration of environmental and social sustainability to evaluate design ideas, processes and solutions

Develop project plans that include consideration of resources when making designed solutions

WA Syllabus (SCSA, 2017)

Year 5
Science Understandings - Biological Sciences

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

Science as a Human Endeavour - Nature and Development of Science

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

Science as a Human Endeavour - Use and Influence of Science

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

Year 6
Science Understandings - Biological Sciences

The growth and survival of living things are affected by physical conditions of their environment ACSSU098

Science as a Human Endeavour - Nature and Development of Science

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

Science as a Human Endeavour - Use and Influence of Science

Scientific knowledge is used to solve problems and inform personal and community decisions ACSHE100

Year 5
Design and Technologies - Technologies and Societies

How people address competing considerations when designing products, services and environments

continued...

YEAR 5

YEAR 6

Design and Technologies - Processes and Production Skills

Define a problem, and set of sequenced steps, with users making a decision to create a solution for a given task
Identify available resources

Develop and communicate alternative solutions, and follow design ideas, using annotated diagrams, storyboards and appropriate technical terms

Select, and apply, safe procedures when using components and equipment to make solutions

Develop negotiated criteria to evaluate and justify design processes and solutions

Work independently, or collaboratively when required, to plan, safely develop and communicate ideas and information for solutions

Year 6

Design and Technologies - Technologies and Societies

How people address competing considerations, including sustainability when designing products, services and environments for current and future use

Design and Technologies - Processes and Production Skills

Creating solutions by:

Define a problem, and set of sequenced steps, with users making decisions to create a solution for a given task

Identify available resources

Design, modify, follow and represent both diagrammatically, and in written text, alternative solutions using a range of techniques, appropriate technical terms and technology

Select, and apply, safe procedures when using a variety of components and equipment to make solutions

Develop collaborative criteria to evaluate and justify design processes and solutions

Work independently, or collaboratively when required, considering resources and safety, to plan, develop and communicate ideas and information for solutions

YEAR 5

YEAR 6

General Capabilities

Literacy; ICT capability, Critical and creative thinking, Ethical Understanding and Personal and Social Capability.

Cross-Curriculum Priority

Sustainability

Organising Ideas

OI 2: All life forms, including human life, are connected through ecosystems on which they depend for their wellbeing and survival.

OI.3: Sustainable patterns of living rely on the interdependence of healthy social, economic and ecological systems.

OI.4: World views that recognise the dependence of living things on healthy ecosystems, and value diversity and social justice are essential for achieving sustainability.

OI.5: World views are formed by experiences at personal, local, national and global levels, and are linked to individual and community actions for sustainability.

OI.6: The sustainability of ecological, social and economic systems is achieved through informed individual and community action that values local and global equity and fairness across generations into the future.

OI.7: Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments.

OI.8: Designing action for sustainability requires an evaluation of past practices, the assessment of scientific and technological developments, and balanced judgments based on projected future economic, social and environmental impacts.

YEAR 7 YEAR 8 YEAR 9 YEAR 10

ACTIVITY FIVE

Sea Lions, Oceans and Climate Change

Overview

Explain to the class that their task is to educate others to understand how climate change is impacting Australian sea lions and altering the nature of the ocean now, and consider future impacts.

Background Science for Students: Pinnipeds

Australian sea lions are a type of marine mammal known as pinnipeds. Australian sea lions are endemic to Australia, meaning they aren't found anywhere else in the world. They live in the ocean in colonies, and eat things like schooling fish, octopus, penguins, sharks, fish, and squid. They are incredibly smart and have some unique feeding strategies. They feed almost exclusively on the ocean floor (benthos) in the sand, and around rocks, seagrass, and reef systems. Because of this trait, they are referred to as "benthic foragers". Sea lions have a set foraging range around their colonies which is taught socially either from mother to pup (vertical learning), or between pups (horizontal learning). Any disruptions to the marine environment locally will cause sea lions to have to spend longer at sea and return with less energy (food consumed) not only for their own health, but also, in the case of pregnant or nursing mothers, less energy for their offspring.

Background Science for Teachers and Students: Climate Science

Climate science looks at past, present and future climate systems, and seeks to understand the impact of these on physical, biological, and human environments.

Climate science focuses on the longer term (for example, seasonal variability and climate change) whereas meteorology (the study of weather) focuses on the short-term day to day changes.

continued...

YEAR 7 YEAR 8 YEAR 9 YEAR 10

Climate scientists aim to develop a coherent and systematic understanding of linked processes using a vast range of measurements (e.g., from the deep oceans to satellites), and sophisticated computer modeling approaches to test our understanding of the factors that affect climate (such as greenhouse gas emissions), and the things climate affects (such as food security and weather). Climate scientists would usually have a strong background in mathematics, physics, biology, and environmental systems.

Source: Professor Mark Howden, Director Climate Institute, Australian National University, Canberra.

Background Science for Teachers and Students: Weather vs Climate

Weather is the daily and hourly changes we experience in temperature, humidity, air pressure, rain, snow, etc. Fluctuations in weather in some regions can be small from day to day while other regions changes can be dramatic.

Climate is the average of all the weather over many years. Climate in a region is influenced by latitude, altitude, prevailing winds, proximity to mountains and large bodies of water, etc. While climate changes from place to place, across regions climate can be relativity stable, meaning that fluctuations in weather are predictable and occur in cycles.

Background Science for Teachers and Students: What is Climate Change?

It is difficult for students as well as adults to get their heads around climate when the weather fluctuates wildly each day and between seasons.

Why would a 2-degree Celsius change in climate worry us when the temperature changes by at least 10 degrees each day?

The climate has been changing for ever. It is easily observed in the geological fossils over hundreds of millions of years and ice cores over many thousands of years. It usually changes at slower than snail pace over tens of thousands of years. We can see when there have been major sudden changes in climate because these changes are recorded as geological difference in fossils, rocks and ice. To understand climate change you need to understand two elements of climate: long term averages of normal daily, yearly and inter annual weather cycles and the impact changes in the amount of atmospheric gases has on Earth's regulatory systems - the atmosphere. Also consider the changing chemistry of the oceans, and how increased absorption of gases in the ocean are affecting marine organisms.

continued...

YEAR 7 YEAR 8 YEAR 9 YEAR 10

Whilst the changing seasons mean that daily, weekly and even yearly weather is constantly variable, these changes are generally predictable and stable and are part of the normal cycles of short-term changes in climate, Climate change, however, is a reflection of longer term changes in temperature and rainfall (tens to thousands of years) and refers to changes in long term averages of changes in temperate and rainfall. A change in the average of long-term climate change can result from either warmer (or colder) than usual days (e.g. a 40 degree day rather than a 35 degree day) or from more (or less) warm or colder days throughout the year (e.g. 10 days warmer than 35 degrees rather than 6 days warmer than 35 degrees).

These changes in the long-term averages of climate are influenced by the mix of gases in the atmosphere. Some gases which include carbon dioxide and methane can hang on to heat better than oxygen and nitrogen which makes up most of the atmosphere.

The sun warms the Earth and a lot of that heat is reflected back into space which cools the Earth at night. The balance between the Sun's direct heat and the cooling of the Earth is the major influence determining our climate. When less heat is reflected into space the Earth warms up. The extra gasses in the atmosphere work just like putting on an extra blanket at night.

One or two degrees hotter may not sound like a big deal. However, what it means is that the entire atmosphere, the top layer of the ocean and the Earth's surface have all on average increased the amount of heat being stored. This is a mind-boggling amount of energy.

Background Science for Teachers and Students: Effects of Climate Change

The long-term climate record has been increasingly changing for the past few decades with record high temperatures occurring around the world. Some aspects of these changes have been more obvious. The ice caps on the North Pole are shrinking and glaciers are retreating. In Australia, the sea life of warmer waters along the east coast are moving south as the sea temperature in that region increases.

continued...

YEAR 7 YEAR 8 YEAR 9 YEAR 10

It is likely the biggest impact of climate change for all Australian people is changes to our normal weather cycles, with hotter drier temperatures in southern Australia and more intense rainstorms and cyclone events in the northern Australia. This will result in more frequent and intense fires in the southern and more frequent and intense flooding in the north. Other issues include rising sea levels, droughts, strong winds, and more heatwaves, less rain in some regions and drier conditions over winter.

Whilst scientists and farmers have done many studies on the impact of climate change on water resources and agriculture, we know less about the effects of changes in climate on Australia's plants and animals. Some of these effects may be obvious and dramatic, such as the loss of alpine swamps (through drying) on the endangered Corroboree frog. Others may be more subtle, but equally devastating such as the mismatch in timing of when an insect emerges and a flower needs pollinating, or the inability of hard-shelled marine organisms (crustaceans, molluscs, gastropods) to build and maintain their exoskeleton through ocean acidification.

Background Science for Teachers and Students: How Citizen Science can Help?

We have no idea what most of the impacts of climate change will be. Which animals and plants can migrate to more suitable homes? Which can adapt? How will it play out? What are the knock on effects? How can we help?

More scientists are needed to gather important data on how our plants and animals are coping with changes in climate. Yet scientists can't be everywhere and sending out teams of researchers can be costly. Luckily, in many cases, untrained volunteers can make the same accurate observations as trained scientists when they are provided with proper tuition and the right tools. Using volunteers to assist scientists allows for many more sets of eyes, ears and minds to help understand and solve many of today's environmental issues. When volunteers partner with professional scientists to conduct meaningful research, we call this 'citizen science'. A 'citizen scientist' can work alone, in groups or as part of an international network, but what separates them apart from other types of volunteers is that they are following the principles and rules of authentic scientific research and are working to solve a real-world problem.

continued...

YEAR 7 YEAR 8 YEAR 9 YEAR 10

The field of citizen science has been around for centuries and citizen scientists have made many important contributions to the field of science (some have discovered new stars and galaxies, found new species, or made medical breakthroughs).

Some of our most famous scientists started off as citizen scientists (Charles Darwin, for instance, was acting as a citizen scientist when on the Beagle). More recently the explosion of different mobile technologies has made it easier for people to collect, identify, analyse, and report information to scientists and so there are now thousands of different citizen science research projects across the world.

Citizen scientists can help researchers in all stages of the scientific process: from question selection (e.g., which creeks are most polluted in my area?), to data collection (recording monthly water quality), data analysis (crowd sourcing of photo analysis – see "Sealspotter" & "Sea lion spotter"), communication and interpretation (reporting in local newsletters or through Facebook) and even in restoration or mitigation. Without the help of many thousands of citizen scientists, professional scientists would not be able to solve many of world's problems.

Background Science for Teachers and Students: ClimateWatch

ClimateWatch has produced an app for collecting data on animals and plants. The app automatically records location and time and after the user has recorded information; the app sends the data to a central database. ClimateWatch provides a range of indicator species for land and marine ecosystems. To input data, it is essential that the user can accurately identify species to avoid mistakes being placed into the database.

The Essential Question

What happens when we understand that climate change is affecting Australian sea lions and is altering the nature of the ocean, its circulation, temperature, and chemistry?

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The Scenario

Arguably, there has never been a time in history when knowledge of global environmental change has been greater than it is today. Climate scientists, atmospheric scientists, oceanographers, geochemists, agronomists, and biologists have all researched and published their specialist knowledge and findings about the planet, its atmosphere, oceans, plants, and animals as they are today and were in the recent past.

Climate change education is covered under Article 12 of the Paris Agreement, to which Australia is a signatory. Under the Paris Agreement Work Programme, countries have agreed to develop extensive education programs about the changing climate. A number have national education programs addressing climate change. Currently, Australia is not one of them.

Your task is to research how climate change is impacting Australian sea lions and altering the nature of the ocean, its circulation, temperature, and chemistry. Then learn about some of the programs that are active around Australia and internationally, attempting to understand the effects of a changing climate on the ocean.

Finally, design and produce a photo-essay to tell the story of Australian sea lions, and the ocean living with climate change.

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Suggested Learning Process

DEFINE

Capture students' interest and share the video on YouTube (2:03 mins) "Nature is Speaking" (Harrison Ford speaks as the ocean). Talk about the messages conveyed in the video.

View a video (4:05 mins) that explains climate change and its effects on one part of the ocean.

Present the scenario, assign pairs or small groups if appropriate, and ask students to define the task they have been set.

DISCOVER

Read about climate change.

Ask students to investigate how climate change is altering the nature of the ocean.

View a TED talk, 'The astonishing hidden world of the deep ocean' by Robert Ballard.

Support students with a range of credible scientific sources. Some examples can include:

- CSIRO Oceans and Coasts
- CSIRO and frequently asked questions about climate change
- National Climate Change Adaptation Research Facility (NCCARF)
- Bureau of Meteorology (BoM)
- Australian Institute of Marine Science – Climate Change (AIMS)
- Great Barrier Reef Marine Park Authority – Climate Change (GBRMPA)
- Australian National University – Climate Change (ANU)

Gather data about sea surface temperatures in Australia using the BoM website and plot a graph of a locality near you. Compare the data with the sea surface temperatures experienced on the waters of the Great Barrier Reef and Ningaloo Reef.

Delve deeper into ocean acidification, read about what it is, its effects on crustaceans, how it affects food webs, and some strategies to reduce its effects on oceans.

Learn about the Antarctic Division and their research into ocean acidification.

Ask students to read a Marine Report Card and learn about Australian research teams involved in investigating climate change and the ocean, including ocean acidification, ocean temperatures, ocean oxidization, sea level, and ocean currents. Look at some of the island sea lion colonies and consider how they will be affected by sea level rise.

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Delve deeper and read about CSIRO scientists who have contributed their scientific understandings to the October 2019 Intergovernmental Panel on Climate Change (IPCC) report that flags risks and response options for polar and ocean environments.

Delve into the Integrated Marine Observing System (IMOS) website and learn about the innovative probes, systems, and technologies used to monitor and observe changes in the ocean.

Discover how Argo floats and takes readings of the ocean's temperature and salinity.

Learn about Deep Water Arrays that observe deep ocean currents and the contribution they make to understanding the role of the ocean on climate and its variability.

Learn about the Jason-2 satellite designed to make observations of ocean topography for investigations into sea-level rise, and the relationship between ocean circulation and climate change. The satellite also provides data on the forces behind such large-scale climate phenomena as El Niño and La Niña.

Learn about the Grace and Grace Follow-On satellites that can track the ocean's water movement across the planet.

Collate ideas about the innovative ways that scientists are monitoring changes in the ocean using a mind mapping app or mapping ideas using a concept mapping technique.

Go further and investigate how climate change impacts Australian sea lions and affects coastal habitats that may include corals, mangroves, seagrass, and seaweeds.

Read a CSIRO blog for information.

Talk about blue carbon that is defined by Wikipedia as 'carbon that is captured and stored by the world's coastal ocean ecosystems. Discuss how at the UN's Climate Change Conference in Paris (2015), Australia committed to accelerating action in the use of coastal blue carbon for climate change action. Find out about the steps that have been taken to set up a blue carbon market and allow Australians to capitalise from this nature-based approach to offset carbon emissions.

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Delve deeper into information about the effects of a changing climate in sea lions. Talk about how sea lions have a set foraging range around their colonies which is taught socially either from mother to pup (vertical learning), or between pups (horizontal learning). Explain that any disruptions, including climate change, to the marine environment locally will cause sea lions to have to spend longer at sea and return with less energy (food consumed) not only for their own health, but also, in the case of pregnant or nursing mothers, less energy for their offspring.

Research the effects of a changing climate on sea lions and record information for use later in the essay.

Be inspired by citizens who are taking action and harvesting coral spawn, restoring mangroves, and re-planting seaweed forests.

Introduce a SWOT analysis. Talk about 'SWOT' being an acronym for **S**trengths, **W**eaknesses, **O**pportunities and **T**hreats.

Model the use of a SWOT analysis using the example of seaweed farming for capturing CO_2 as a climate change solution for the ocean, and identify:

- strengths of the concepts
- weaknesses of the concepts
- real opportunities that the concepts offer the ocean; and
- threats that might adversely impact on the ocean environment.

Ask students to clarify ideas and explanations and summarise these in written form.

Many entrepreneurs, companies, individuals, and communities have also devised climate solutions. Investigate the Spanish company that has developed a concrete that can breathe in carbon dioxide from the air and recycle it.

Read about thirteen ocean-based solutions for climate change here.

Scientists tell us that if we are to avoid the worst effects of climate change and safeguard wildlife, we need to protect at least 30% of our oceans by 2030. In 2020, at the UN negotiations, world leaders are coming together to discuss a Global Ocean Treaty, an agreement that would make it possible to protect oceans outside national borders from human exploitation by making them ocean sanctuaries. Research and find information about the Global Ocean Treaty.

Ask students how they might communicate the ways their ideas or photo-essay might present their findings about the effects of climate change on Australian sea lions and the ocean.

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DREAM

In pairs or small groups, students envision or dream about the many possible ways they might design their photo-essay.

Further develop ideas for possible solutions using sketches and labels.
Ask students to visualise their most creative solution.

Invite students to think about what materials, tools, equipment, and ingredients they will need to make their solution a reality.

DESIGN

Invite students, in their pairs or small groups, to begin drafting their designs for their photo-essay to share with others.

Ask students to draft the steps involved in making their photo-essay.

Ask students to gather the materials, tools and equipment needed and then design and create the photo-essay.

DELIVER

Pairs or small groups showcase their ideas about how climate change is impacting Australian sea lions and altering the nature of the ocean, its circulation, temperature, and chemistry, and some of the programs that are active around Australia and internationally, attempting to understand the effects of a changing climate on the ocean.

Classes host an 'Investigating Sea Lions, Oceans and Climate Change Day' and invite students, teachers, and parents to discover more about the issues.

DEBRIEF

Ask students to reflect on their learning and something new they learned.

Ask students to describe what worked well, and not so well, in their efforts to engage others in thinking about what is socially and ethically responsible about mining asteroids.

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CURRICULUM CONNECTIONS

Australian Curriculum

SCIENCE (ACARA, 2015a)

Year 7, Year 8, Year 9 and Year 10
Science as a Human Endeavour - Use and Influence of Science

Solutions to contemporary issues that are found using science and technology may impact other areas of society and may involve ethical considerations ACSHE120 ACSHE135

People use science understanding and skills in their occupations and these have influenced the development of practices in areas of human activity ACSHE121 ACSHE136

People use scientific knowledge to evaluate whether they accept claims, explanations or predictions, and advances in science to affect people's lives, including generating new career opportunities ACSHE160 ACSHE194

Values and needs of contemporary society can influence the focus of scientific research ACSHE228 ACSHE230

Science as a Human Endeavour - Nature and Use of Science

Science knowledge can develop through collaboration across the disciplines of science and the contributions of people from a range of cultures ACSHE223

Year 10
Earth and Space Sciences

Global systems, including the carbon cycle, rely on interactions involving the biosphere, lithosphere, hydrosphere, and atmosphere ACSSU189

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TECHNOLOGIES (ACARA, 2015b)

Year 9 & Year 10
Design and Technologies - Knowledge and Understanding

Critically analyse factors, including social, ethical and sustainability considerations, that impact designed solutions for global preferred futures and the complex design and production processes involved ACTDEK040

Explain how products, services and environments evolve with consideration of preferred futures and the impact of emerging technologies on design decisions ACTDEK041

Investigate and make judgments, within a range of technologies specialisations, on how technologies can be combined to create designed solutions ACTDEK047

Design and Technologies - Processes and Production Skills

Apply design thinking, creativity, innovation and enterprise skills to develop, modify, and communicate design ideas of increasing sophistication ACTDEP049

General Capabilities

Literacy; ICT Capability, Critical and Creative thinking, Ethical Understanding and Personal and Social Capability.

Cross-Curriculum Priority

Sustainability

Organising Ideas

OI. 2: All life forms, including human life, are connected through ecosystems on which they depend for their wellbeing and survival.

OI.7: Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments.

OI.8: Designing action for sustainability requires an evaluation of past practices, the assessment of scientific and technological developments, and balanced judgments based on projected future economic, social and environmental impacts.

DESIGN FOLIO

YOUR DESIGN FOLIO

RESOURCE 1.1

NAME:

MOVIE TITLE:

SETTINGS

CHARACTERS

PROBLEM

SOLUTION