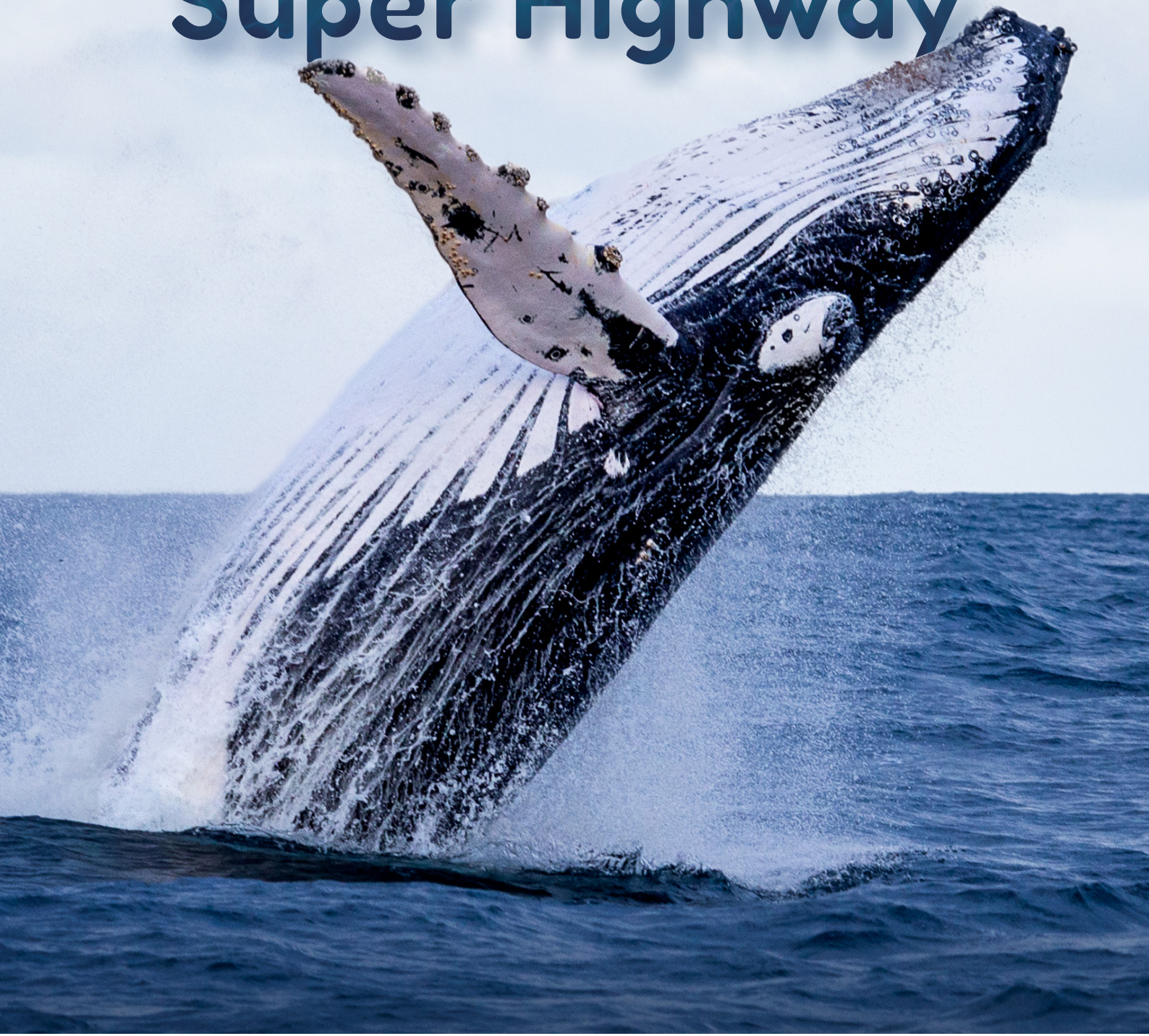


# WHALE

## Super Highway



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© ATOM 2019 ISBN: 978-1-76061-294-8



A STUDY GUIDE BY  
DAVE CREWE



Humpback  
whale

## » SYNOPSIS

### Whale Super Highway

A breathtaking journey down the west coast of Australia following two majestic whale species, the humpback whale, and the endangered pygmy blue whale. These majestic mammals travel one of the longest animal migrations on the planet from the top of Australia's North West to the feeding grounds of Antarctica.

As they make the long journey south, a team of experts track them. Their goal is to discover why one of the whale species that travels this route has made one of the greatest comebacks ever. Today, Western Australia is home to the largest population of migratory humpbacks in the world. But for the blue whales, it's a very different story - their numbers are struggling. If the experts can discover why the humpbacks are so successful here, it may help in the fight to save the blues.

In the warm waters of the Kimberley coast, the humpbacks give birth. Rare images reveal a newly born calf, only minutes old. It is already four metres long and weighs over a tonne! Now begins an extraordinary journey for the mother and baby on the Whale Super Highway. For the calf, its first journey will be the toughest of them all.

In the two-person submarine, *Odyssey*, young marine mammal scientist Bec Wellard enters the whales' domain like she's never done before. But first, in a deep-water graveyard, she discovers a relic from the whaling past, the whaler, *Kos VII* that in its day killed hundreds of whales.

Nearer the surface Bec begins her work of listening and learning about whale song crucial to the whales' survival.

Little is known about the elusive blue whale, but what scientists do know is that they are snack feeders and their

survival is dependent on one of the smallest creatures in the ocean – krill. We follow these magnificent giants of the sea as they feast on vast quantities of their tiny pink prey and discover how their waste is vital not just to the health of the ocean, but to the entire planet's survival.

Further down the highway, our mother and baby humpback find themselves in a humpback nursery - the Exmouth Gulf. There, the baby can continue to feed and grow. It will suckle a massive 250 litres of milk a day while the mother will barely eat at all, losing over a third of her body weight.

Further down the highway, just off the coast from a bustling metropolis, lies a marine hot spot. One that is vital to the survival of the blue whales. In the two-person submarine, *Odyssey*, Mich Jenner, from the Centre for Whale Research, dives into the depths of an underwater canyon. At 5 kilometres deep and 15 kilometres wide, Perth Canyon is bigger than the Grand Canyon. Here blue whales feast on krill. Mich warns that if we lose the krill then we lose the Blues.

Finally, the humpback whales' epic 90-day journey comes to an end. They arrive at the remote, plankton rich waters of Antarctica. Now the mother can feast.

Meanwhile the blues continue on to the waters off Victoria and Tasmania. Where they're going is less remote and more at affect from humans. Forcing the blues to keep moving... keep searching. Their constant need to feed making life on the super highway that much tougher.

For the humpback whales, their cycle of fasting and feasting seems to be a key to their success on the Whale Super Highway.

Climate change, pollution and overfishing are all changing our ocean in dramatic ways. The more we can learn, the more we can discover, and the more power we have in choosing the world we want to live in and what we want to share it with. Bec hopes she gets to share it with more whales.

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Humpback whale and calf

## The Whale Super Highway

Stretching 3000km along the western coast of Australia is a 'whale super highway'. Internationally considered to have the world's largest annual migration of humpback whales, this coastline sees more than 35,000 humpbacks travel between their Antarctic feeding grounds and their breeding sites in the warm waters of the Kimberley. With numbers booming, their population bounce-back from the devastation of industrial whaling is in stark contrast to that of another species that comes to feed off this coast every year.

A relative of the largest animal ever known to have existed and with a gigantic appetite, the pygmy blue whale, measuring a whopping twenty-four metres, is a 'smaller' subspecies of the Antarctic blue whale. They enter this highway at the same time each year to feed on the vast abundance of krill that swarms in the deep waters of the Perth Canyon. Despite the same protective measures applied to these leviathans, pygmy blue whale numbers remain very low. *Whale Super Highway* sets out to share the journey of these extraordinary creatures to try and help understand how marine scientists and the world alike can continue to preserve this essential ocean route.

## The Narrator – Marta Dusseldorp

Award-winning actress Marta Dusseldorp has worked extensively in theatre, film and television and is one of Australia's most recognised actresses.

She received an AACTA Award for Best Lead Actress in a TV Drama for ABC's *Janet King* in which she plays the title role and is also an Associate Producer. She stars in the popular series, *A Place to Call Home* for Foxtel and in the *Jack Irish* series opposite Guy Pearce. Her numerous other television credits include the six-part *Blackjack* telemovies opposite Colin Friels, *Devil's Dust*, and the award-winning mini-series *After the Deluge*.

Marta has a wealth of experience on stage including being a member of Sydney Theatre Company's Actor's Company where she received a Helpmann Award for her role in Shakespeare's *War of the Roses*. Other STC highlights include *Victory*, *The Lost Echo*, *Serpent's Teeth*, *Mother Courage*, *The Crucible* and *Never Did Me Any Harm* (STC/Force Majeure), Malthouse Theatre's *Journal of the Plague Year/Ham Funeral*, *Three Sisters* and *The Balcony*, Company B's international tour of *Cloudstreet* and *Like a Fishbone* for the Sydney Theatre Company/Griffin Theatre. Most recently she starred to huge acclaim in Melbourne Theatre Company's *A Doll's House: Part 2*, *Gloria* for the Griffin Theatre and *Scenes from a Marriage* at Queensland Theatre.

## Odyssea

*Odyssea* is Prospero Productions' specialist design submersible that enables a pilot and one passenger to descend below the ocean's surface to the maximum depth of 200 metres. Its length is five metres, height two and a half metres, and weight three. two tonnes. *Odyssea* offers a unique opportunity to view from a 250-degree perspective and capture the marine world with its 200-degree, 4k cameras as rarely seen before. The thick, acrylic domed cabin creates a safe, 1 atmosphere environment and the cabin opens as a clamshell and allows for easy entry and exit for the occupants. *Odyssea* has a maximum mission dive time of eight hours and a life support system of up to seventy-two hours.



Ed Punchard & Bec Wellard prepare to descend

## The Marine Biologist – Bec Wellard

Born on the coast of Victoria, thirty-six-year old Bec Wellard has been studying cetaceans for the past fifteen years and is a passionate conservation scientist, cetacean ‘nerd’ and ocean adventurer. After four years at Curtin University, Bec graduated in 2019 with a PhD investigating the vocal repertoire, social structure and feeding preferences of Australian and Antarctic killer whales.

Already holding a Bachelor of Science in Zoology from the University of Melbourne, and an honours year at Monash University studying the impacts of man-made noise on dolphin communication in Port Phillip Bay, Bec has an extensive marine research background.

Before moving to Perth in 2015 to take up her PhD position, Bec was based in Hong Kong for three years to conduct specialist research on the cognitive abilities of bottlenose dolphins. Following this, Bec was part of a large team of marine mammal scientists investigating the impact of man-made noise on the behaviour and communication of humpback whales off the coast of Australia for four years. Sitting in an acoustic lab all day, Bec would listen to and analyse humpback whale song for hours on end. Now recognised as an international whale expert, Bec came on board mini-submersible, *Odyssea* in 2019 as the marine scientist for Prospero Productions’ voyage of discovery into the world of whale song along the whale super highway.



Bec Wellard on the bow of *Talasea II*

## The Director – Julia Redwood

Julia Redwood co-established Prospero Productions in 1991. Prospero has now become one of the leading independent documentary production companies in Australia. In addition to being joint managing director, Julia is a multi award-winning producer, director and writer.

In 1998, Julia’s highly acclaimed directorial debut, *Paying for the Piper* was nominated for two AFI awards and won the Golden Spire Award at the 2000 San Francisco Film Festival.

She is regarded as one of the leading factual producers in Australia.

Julia is currently a member of the Screen Producers Association of Australia (SPAA), the

Western Australian IAG and Deputy Chair of Screen Voice. Coupled with her extensive creative talents and many years of experience in the marketplace, this makes Julia one of the leading figures in the Australian factual screen industry.

Her credits include: *Paying for the Piper* (San Francisco Golden Spire Award for Best Television in Current Events), *Hutan - Wildlife of the Malaysian Rainforest* (Silver Medal - New York Festivals), *Diving School* (Western Australian Screen Awards, Outstanding Achievement), *Selling Australia* (2001 Chicago International Television Competition, Certificate of Merit), *SAS – The Search for Warriors*, (AACTA award for Best Documentary Series) and recent series, *Life on the Edge*, *Wild Survivor* and *Outback Truckers*.

## » CURRICULUM LINKS

*Whale Super Highway* is suitable for students undertaking:

- **YEAR 6-10 SCIENCE** (with applications in **UNIT 1 OF SENIOR BIOLOGY**)
- **YEAR 9-10 HISTORY**
- **YEAR 7-10 MEDIA ARTS**

with further links to Year 7–10 English and the Cross-curricular priority of Sustainability.

As a curriculum resource in Science, *Whale Super Highway* is primarily relevant to the Biological Sciences strand of Science Understanding, with applications in Earth and Space Science. Investigations and observations suggested by the program allow students to develop their Science Inquiry skills, while connections to questions of sustainability and conservation ensures that this resource is also applicable to the Science as a Human Endeavour criterion.

As a curriculum resource in History, *Whale Super Highway* is primarily relevant to topics associated with the Industrial Revolution and modern Australian history. These descriptors are primarily found in the sub-activities under the Whales and the Environment heading.

As a curriculum resource in Design and Technologies, *Whale Super Highway* is relevant to the Knowledge and Understanding strand. In Media Arts, the program provides the opportunity for students to explore technical and symbolic elements in the context of a Fulldome documentary.

Teachers are advised to consult the Australian Curriculum online at <https://www.australiancurriculum.edu.au/> and curriculum outlines relevant to their state or territory for further information.

## Relevant Content Descriptors for English

CONTENT DESCRIPTIONS – LITERACY		
Year 7	<p><b>Creating texts:</b></p> <ul style="list-style-type: none"> <li>• Plan, draft and publish imaginative, informative and persuasive texts, selecting aspects of subject matter and particular language, visual, and audio features to convey information and ideas</li> <li>• Edit for meaning by removing repetition, refining ideas, reordering sentences and adding or substituting words for impact</li> <li>• Use a range of software, including word processing programs, to confidently create, edit and publish written and multimodal texts</li> </ul>	<p>ACELY1725</p> <p>ACELY1726</p> <p>ACELY1728</p>
Year 8	<p><b>Creating texts:</b></p> <ul style="list-style-type: none"> <li>• Create imaginative, informative and persuasive texts that raise issues, report events and advance opinions, using deliberate language and textual choices, and including digital elements as appropriate</li> <li>• Experiment with text structures and language features to refine and clarify ideas to improve the effectiveness of students' own texts</li> <li>• Use a range of software, including word processing programs, to create, edit and publish texts imaginatively</li> </ul>	<p>ACELY1736</p> <p>ACELY1810</p> <p>ACELY1738</p>
Year 9	<p><b>Creating texts:</b></p> <ul style="list-style-type: none"> <li>• Create imaginative, informative and persuasive texts that present a point of view and advance or illustrate arguments, including texts that integrate visual, print and/or audio features</li> <li>• Review and edit students' own and others' texts to improve clarity and control over content, organisation, paragraphing, sentence structure, vocabulary and audio/visual features</li> <li>• Use a range of software, including word processing programs, flexibly and imaginatively to publish texts</li> </ul>	<p>ACELY1746</p> <p>ACELY1747</p> <p>ACELY1748</p>
Year 10	<p><b>Creating texts:</b></p> <ul style="list-style-type: none"> <li>• Create sustained texts, including texts that combine specific digital or media content, for imaginative, informative, or persuasive purposes that reflect upon challenging and complex issues</li> <li>• Review, edit and refine students' own and others' texts for control of content, organisation, sentence structure, vocabulary, and/or visual features to achieve particular purposes and effects</li> <li>• Use a range of software, including word processing programs, confidently, flexibly and imaginatively to create, edit and publish texts, considering the identified purpose and the characteristics of the user</li> </ul>	<p>ACELY1756</p> <p>ACELY1757</p> <p>ACELY1776</p>

## Relevant Content Descriptors for Senior Biology

SCIENCE UNDERSTANDING		
Unit 1	Biodiversity includes the diversity of species and ecosystems; measures of biodiversity rely on classification and are used to make comparisons across spatial and temporal scales	ACSBL015
	Ecosystems are diverse, composed of varied habitats and can be described in terms of their component species, species interactions and the abiotic factors that make up the environment	ACSBL019
	Human activities (for example, over-exploitation, habitat destruction, monocultures, pollution) can reduce biodiversity and can impact on the magnitude, duration and speed of ecosystem change	ACSBL028
	Models of ecosystem interactions (for example, food webs, successional models) can be used to predict the impact of change and are based on interpretation of and extrapolation from sample data (for example, data derived from ecosystem surveying techniques); the reliability of the model is determined by the representativeness of the sampling	ACSBL029

SCIENCE AS A HUMAN ENDEAVOUR		
Unit 1	The use of scientific knowledge is influenced by social, economic, cultural and ethical considerations	ACSBL011
	Scientific knowledge can be used to develop and evaluate projected economic, social and environmental impacts and to design action for sustainability	ACSBL014

SCIENCE INQUIRY SKILLS		
Unit 1	Interpret a range of scientific and media texts, and evaluate processes, claims and conclusions by considering the quality of available evidence; and use reasoning to construct scientific arguments	ACSBL005
	Select, construct and use appropriate representations, including classification keys, food webs and biomass pyramids, to communicate conceptual understanding, solve problems and make predictions	ACSBL006
	Communicate to specific audiences and for specific purposes using appropriate language, nomenclature, genres and modes, including scientific reports	ACSBL007

## Relevant Content Descriptors for Media Arts

CONTENT DESCRIPTIONS		
Year 7–8	Experiment with the organisation of ideas to structure stories through media conventions and genres to create points of view in images, sounds and text	ACAMAM066
	Analyse how technical and symbolic elements are used in media artworks to create representations influenced by story, genre, values and points of view of particular audiences	ACAMAR071
	Identify specific features and purposes of media artworks from contemporary and past times to explore viewpoints and enrich their media arts making, starting with Australian media artworks including of Aboriginal and Torres Strait Islander media artworks	ACAMAR072
Year 9–10	Experiment with ideas and stories that manipulate media conventions and genres to construct new and alternative points of view through images, sounds and text	ACAMAM073
	Evaluate how technical and symbolic elements are manipulated in media artworks to create and challenge representations framed by media conventions, social beliefs and values for a range of audiences	ACAMAR078
	Analyse a range of media artworks from contemporary and past times to explore differing viewpoints and enrich their media arts making, starting with Australian media artworks, including media artworks of Aboriginal and Torres Strait Islander Peoples, and international media artworks	ACAMAR079

## Relevant Content Descriptors for Science

SCIENCE UNDERSTANDING		
Year 6	<b>Biological sciences:</b> The growth and survival of living things are affected by physical conditions of their environment	ACSSU094
	<b>Earth and space science:</b> Sudden geological changes and extreme weather events can affect Earth's surface	ACSSU096
Year 7	<b>Biological sciences:</b> Interactions between organisms, including the effects of human activities can be represented by food chains and food webs	ACSSU112
	<b>Earth and space science:</b> Some of Earth's resources are renewable, including water that cycles through the environment, but others are non-renewable	ACSSU116
Year 9	<b>Biological sciences:</b> Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems	ACSSU176
Year 10	<b>Earth and space sciences:</b> Global systems, including the carbon cycle, rely on interactions involving the biosphere, lithosphere, hydrosphere and atmosphere	ACSSU189

SCIENCE AS A HUMAN ENDEAVOUR		
Year 6	<b>Use and influence of science:</b> Scientific knowledge is used to solve problems and inform personal and community decisions	ACSHE100
Year 7	<b>Use and influence of science:</b> Solutions to contemporary issues that are found using science and technology, may impact on other areas of society and may involve ethical considerations	ACSHE120
Year 9	<b>Use and influence of science:</b> Values and needs of contemporary society can influence the focus of scientific research	ACSHE228
Year 10	<b>Use and influence of science:</b> Values and needs of contemporary society can influence the focus of scientific research	ACSHE230

SCIENCE INQUIRY SKILLS		
Year 6	<b>Communicating:</b> Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts	AC SIS110
Year 7	<b>Communicating:</b> Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate	AC SIS133
Year 9	<b>Evaluating:</b> Critically analyse the validity of information in primary and secondary sources and evaluate the approaches used to solve problems	AC SIS172
	<b>Communicating:</b> Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations	AC SIS174
Year 10	<b>Evaluating:</b> Critically analyse the validity of information in primary and secondary sources and evaluate the approaches used to solve problems	AC SIS206
	<b>Communicating:</b> Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations	AC SIS208

## Relevant Content Descriptors for History

HISTORICAL KNOWLEDGE AND UNDERSTANDING		
Year 9	The nature and significance of the Industrial Revolution and how it affected living and working conditions, including within Australia	ACOKFH016
	The emergence and nature of significant economic, social and political ideas in the period, including nationalism	ACOKFH019
	The technological innovations that led to the Industrial Revolution, and other conditions that influenced the industrialisation of Britain	ACDSEH017
	The short and long-term impacts of the Industrial Revolution, including global changes in landscapes, transport and communication	ACDSEH082
	Living and working conditions in Australia around the turn of the twentieth century (that is 1900)	ACDSEH090
Year 10	Developments in technology, public health, longevity and standard of living during the twentieth century, and concern for the environment and sustainability	ACOKFH024
	Continuity and change in beliefs and values that have influenced the Australian way of life	ACDSEH149
	The background to environmental awareness, including the nineteenth century National Parks movement in America and Australia	ACDSEH028
	The growth and influence of the environment movement within Australia and overseas, and developments in ideas about the environment including the concept of 'sustainability'	ACDSEH126
	Responses of governments, including the Australian Government, and international organisations to environmental threats since the 1960s, including deforestation and climate change	ACDSEH128

HISTORICAL SKILLS		YEAR 9 / YEAR 10
Year 9 and Year 10	<b>Historical questions and research:</b> <ul style="list-style-type: none"> <li>Identify and select different kinds of questions about the past to inform historical inquiry</li> <li>Evaluate and enhance these questions</li> <li>Identify and locate relevant sources, using ICT and other methods</li> </ul>	ACHHS166 / ACHHS184 ACHHS167 / ACHHS185 ACHHS168 / ACHHS186
	<b>Analysis and use of sources:</b> <ul style="list-style-type: none"> <li>Process and synthesise information from a range of sources for use as evidence in an historical argument</li> <li>Evaluate the reliability and usefulness of primary and secondary sources</li> </ul>	ACHHS170 / ACHHS188 ACHHS171 / ACHHS189
	<b>Explanation and communication:</b> <ul style="list-style-type: none"> <li>Select and use a range of communication forms (oral, graphic, written) and digital technologies</li> </ul>	ACHHS175 / ACHHS193

## Cross-Curricular Priorities under the Sustainability heading

- The biosphere is a dynamic system providing conditions that sustain life on Earth.
- All life forms, including human life, are connected through ecosystems on which they depend for their wellbeing and survival.
- Sustainable patterns of living rely on the interdependence of healthy social, economic and ecological systems.
- World views that recognise the dependence of living things on healthy ecosystems, and value diversity and social justice, are essential for achieving sustainability.
- World views are formed by experiences at personal, local, national and global levels, and are linked to individual and community actions for sustainability.
- 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.
- Actions for a more sustainable future reflect values of care, respect and responsibility, and require us to explore and understand environments.
- Designing action for sustainability requires an evaluation of past practices, the assessment of scientific and technological developments, and balanced judgements based on projected future economic, social and environmental impacts.
- Sustainable futures result from actions designed to preserve and/or restore the quality and uniqueness of environments.





## » WHALE MIGRATION

### The Whale Super Highway

According to *Whale Super Highway*, the migratory pattern of whales around Australia is ‘one of the longest animal migrations on the planet. A marathon 13,000 kilometre round trip.’ According to the narration, the reasons for this lengthy trip are straightforward: ‘up to breed’ (to the warmer waters around Australia and New Zealand) ‘and down to feed’ (to the chillier climates in the vicinity of Antarctica.)

#### MAPPING THE SUPER HIGHWAY

Use the map above of the Australian and Antarctic regions to annotate the migratory patterns of whales to and from Antarctica.

Include on your map labels to indicate **timing**, the different whale **species** and the **properties** of each region that draws these species to these areas. These properties should consider ocean temperature, tidal patterns and the

optimum conditions for whale breeding.

Useful links:

- <https://www.environment.gov.au/marine/publications/humpback-whales-eastern-australia>
- <https://www.wildaboutwhales.com.au/whale-facts/about-whales/whale-migration>



L-R: Humpback whale fluke; Jon Shaw (DOP) films humpback whale



*Humpback whale and calf*

## WHALE WATCHING

Whale watching plays an important role in Australia's tourism industry. But as with any tourism activity structured around wild animals, reliability is key. Customers tend to expect to see whales on a service advertised as 'whale watching', so providers must do their research to ensure that the locations and times chosen are likely to be populated by whales.

- Identify three regions where you would expect to find a high density of whales.
- What time of the year would you be mostly likely to find whales at these destinations?
- What sort of whales could tourists expect to see at your chosen regions?
- Consider your regions and their distance from the nearest ports. Identify the region that would be the best choice to run a whale watching trip for tourists, explaining your justification.
- Produce a brochure or promotional website advertising your whale watching service. This should explain the time of year when tourists would be most likely to see whales, and ensure that customers are given accurate information about the likelihood of a successful whale watching trip.

- **EXTENSION:** contextualise this with information about the scientific particulars of whale migration, explained in a way that a layperson would understand.

Exemplar whale watching website:

- <https://www.reefmagiccruises.com/whale-watching/>

*L-R: Humpback whale and calf; Bec Wellard on the bow of Talasea II*



## » WHALES ARE FAMILY

### Classifying Whales

'Whale' is an informal categorisation of a number of mammals in the infraorder Cetacea.

From a taxonomic perspective, they can be grouped into two parvorders:

- **Mysticeti** (which includes four families: Balaenidae, Balaenopteridae, Cetotheriidae and Eschrichtiidae)
- **Odontoceti** (which includes four whale families – Kogiidae, Monodontidae, Physeteridae and Ziphiidae – along with dolphin and porpoise families)

In the first sub-activity, *Whale Families – Taxonomy* that follows, you'll explore how whales are categorised by biologists; in the second and third sub-activities (*Humpbacks and Blue Whales* and *The Biggest Animal*), you will specifically investigate the features of the humpback and blue whales featured in *Whale Super Highway*.



*Humpback whale breaching*



*Humpback whale and calf*

#### WHALE FAMILIES – TAXONOMY

- What are the meanings of the following taxonomic categories?
  - **KINGDOM**
  - **PHYLUM**
  - **CLASS**
  - **ORDER**
  - **SUBORDER**
  - **INFRAORDER**
  - **PARVORDER**
  - **FAMILY**
- What purpose do each of these categories serve in Biology?

Produce a poster representing the eight whale families under the Mysticeti and Odontoceti parvorders (identified above). For each family, include a clear representation of the distinguishing features of that family and a picture of a whale found within that family.

*You may wish to make a physical poster or a digital representation, but the structure of the families in the context of the parvorders should be clear.*

Indicate clearly on your poster in which family the humpback whales and blue whales seen in *Whale Super Highway* would be found.

- **EXTENSION:** expand upon your poster by including adjacent non-whale families (eg dolphins and porpoises), a link to the kingdom, phylum, branch and order connections above these families, or more detail of your own choosing.

#### THE BIGGEST ANIMAL

Blue whales are famously the largest animals on Earth – not just living animals, but the largest animals ever known to have lived. Produce an infographic that contrasts the size of a typical blue whale to other animal species. Your infographic should be to scale.

## KNOW

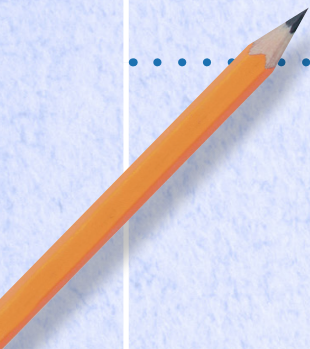
What did you learn about humpbacks and blue whales from the program?  
List facts and observations below.

## NEW AND INTERESTING

Choose one interesting fact about each of humpbacks and blue whales that you learned from the program.

## WANT TO KNOW

After watching *Whale Super Highway*, what's a question you have about humpbacks and/or blue whales?



### HUMPBACKS AND BLUE WHALES

During and after watching *Whale Super Highway*, complete the above table with notes and observations on the two whale species featured, humpbacks and blue whales.

After completing this table, gather into a small group (with two or three other students) and compare your **KNOW** and **NEW AND INTERESTING** columns, collating your information into a fact sheet on the two whale species.

Then choose one **WANT TO KNOW** question from your group – try to select the most challenging and interesting question! – and research the answer to this question as a group.

Useful links:

- <https://www.livescience.com/58464-humpback-whale-facts.html>
- <https://marinebio.org/species/blue-whales/balaenoptera-musculus/>

## Whale Family Structures and Communication

Much of *Whale Super Highway* is spent following a humpback whale mother and her calf on their migration. The pair cling closely together along their incredible journey, with the calf relying on its parent for food and protection. This tight duo is just one example of the various family structures found across whale species; while humpback whales are comparatively solitary, many whales travel in 'pods' with diverse social structures.

Such diversity is reflected in the variety found in different species' whale songs. *Whale Super Highway* showcases how song is used as flirtation, with only male humpbacks singing. Dr Bec Wellard explains that for marine biologists 'It's like a singing competition. Whoever sings the best, gets the girl.' But other whales sing songs that not only sound different to humpbacks' songs – they achieve very different purposes.

### SOCIAL STRUCTURES

Select one of the following articles on whale (and cetacean) social structures (*Your teacher may assign you a specific article*):

- Eric Wagner, 'The social lives of whales', *Science News for Students*, Mar 13 2015  
URL: <https://www.sciencenewsforstudents.org/article/social-lives-whales>
- Kerry Lotzof, 'Life in the pod: the social lives of whales', *Natural History Museum*, 21 June 2017  
URL: <https://www.nhm.ac.uk/discover/social-lives-of-whales.html>



Humpback whale and calf

- Susanne Shultz, 'Whale brains can teach us about our own social structures', *World Economic Forum* in collaboration with *The Conversation*, 20 October 2017  
URL: <https://www.weforum.org/agenda/2017/10/what-whale-brains-can-teach-us-about-our-own-social-structures>
- **EXTENSION** (and requires database subscription):  
Kieran Fox, Michael Muthukrishna and Susanne Shultz, 'The social and cultural roots of whale and dolphin brains', *Nature Ecology & Evolution*, October 2017,  
[https://www.researchgate.net/publication/320428073\\_The\\_social\\_and\\_cultural\\_roots\\_of\\_whale\\_and\\_dolphin\\_brains](https://www.researchgate.net/publication/320428073_The_social_and_cultural_roots_of_whale_and_dolphin_brains)

Read and annotate this article, then summarise the important findings and observations in your own words. Answer the following questions (as appropriate):

- Why are whale social structures so diverse?
- Why is it important to study cetacean social structures?
- What role does whale song play in whale society?
- What differences and similarities can you identify between different whale species? Between whale social structures and human social structures?



Humpback whale breaching

### FAMILY FRIENDLY

Produce a picture book or similar publication for young primary-age or preschool-age children exploring the journey of a humpback pod from Antarctica to Australia (or vice versa). This should be accessible, understandable and entertaining – but also grounded in scientific fact.



L-R: Mich Jenner onboard *Whale Song II*; Curt Jenner swabs whale blow; Humpback whale fluke

## » WHALE OF A MEAL

### Eat or Be Eaten

*Whale Super Highway* explores the fascinating diet of the blue whale which despite its size, sustains itself on mouthfuls of tiny krill. The ocean is filled with similarly intriguing relationships amongst its predators and prey, with sea animals often falling into both categories. Biologists group these interactions into representations such as food chains, food webs and even food pyramids.

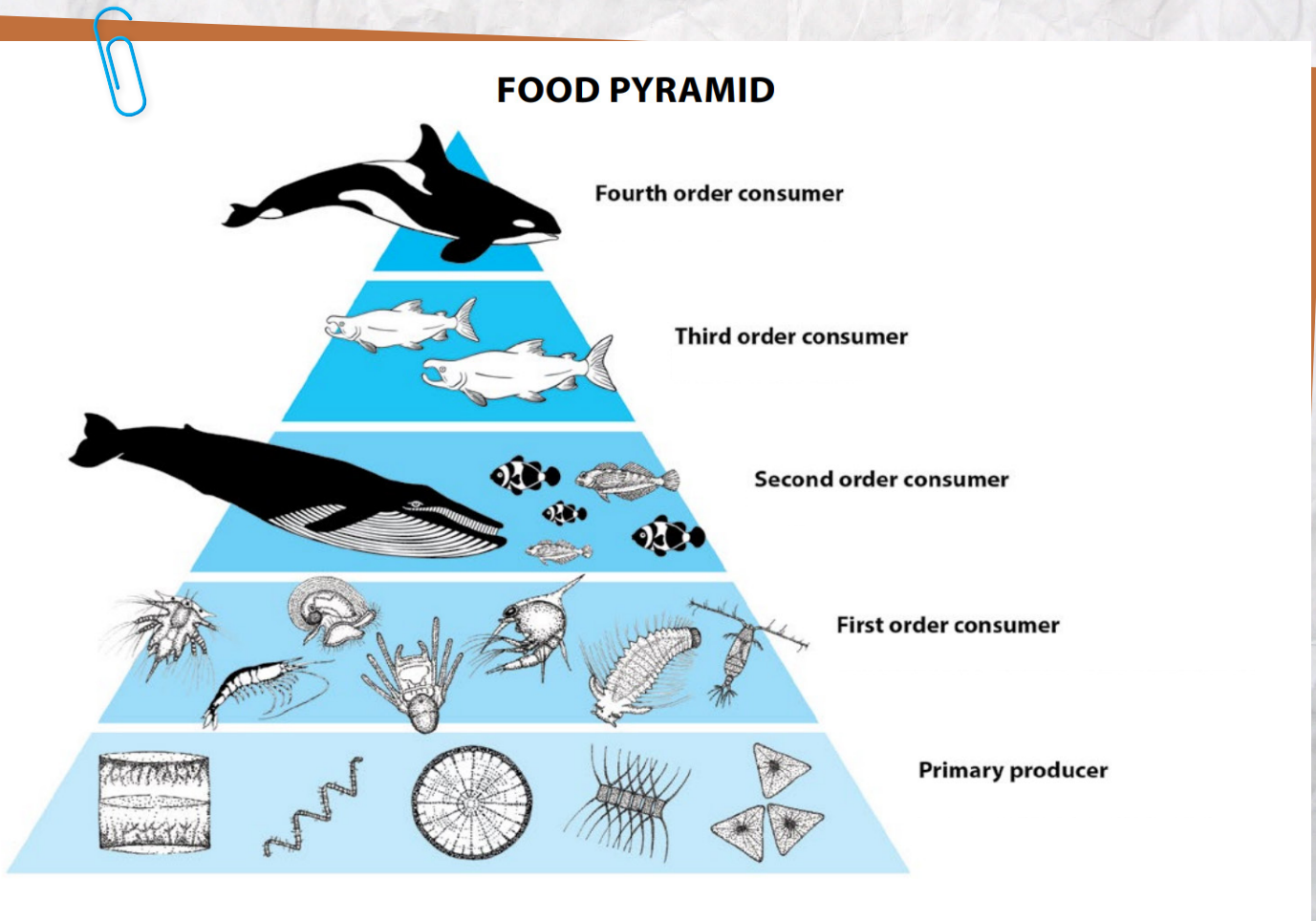
#### FOOD WEBS AND PYRAMIDS

Below is a diagram of a **food pyramid**, excerpted from a Seattle Aquarium activity (<https://www.seattleaquarium.org/sites/default/files/files/Whale%20Food%20Pyramid%202017-R1.pdf>).

- What do the terms first, second, third and fourth order consumer mean here?
- What is a primary producer? How is phytoplankton a primary producer?

- What information in *Whale Super Highway* complicates our understanding of this food pyramid?
- Draw a food web of your own including a blue whale and/or humpback whale.

Useful link: <https://www.rnz.co.nz/national/programmes/ourchangingworld/audio/20170633/krill-to-blue-whales-food-webs-in-the-southern-ocean>



# » WHALES AND THE ENVIRONMENT

## Whaling

'For hundreds of years,' narrator Marta Dusseldorp intones, 'whales were hunted across the oceans. Their blubber a rich source of valuable oil. By the 1950s, hunting was on an industrial scale.' The program goes on to explain how the whaling industry had a huge effect on whale populations across the globe, leaving many whale species precariously endangered until whaling was curbed and, eventually, concluded entirely.

### THE HISTORY OF WHALING

- Produce a timeline of the whaling industry in Australia, identifying key moments and figures in the industry.

Write a research essay arguing for or against one of the following statements:

- The oil produced from whaling greased the gears of the industrial revolution.
- Whaling was an economic pillar of the Australian federation in the early twentieth century.
- Early whaling practices were sustainable; it was only with the advance of science and technology that it began to endanger whaling populations.
- The decline of whaling in Australia was driven more by its dwindling economic importance than the nascent environmentalist movement.
- The rise of whaling in Australia is tied to the improvement of living standards in Australia.

### WHALING TODAY

As observed in *Whale Super Highway*, 'commercial whaling was finally banned in Australia' in 1979, leading to the restoration of whale populations like humpbacks. Internationally, the contemporary status of whaling is more controversial. Though an international moratorium on commercial whaling was agreed upon in 1986 – and enforced by the International Whaling Commission

– scientific whaling, largely by Japan, has continued in the years since. In July 2019, Japan withdrew from the IWC and resumed its commercial whaling, arguing that they could harvest whale meat sustainably.

Further details on contemporary conservation efforts related to whales can be found at the Australian Government's Department of Environment and Energy website: <https://www.environment.gov.au/marine/marine-species/cetaceans/whale-conservation>

What is Japan's argument in favour of continuing commercial whaling? How does this stack up against Australia's environmental concerns?

- Write an opinion piece for a newspaper (or analogous online publication) arguing for the abolition of Japanese commercial whaling, considering the lenses of culture, economics and environment.
- Then write a letter-to-the-editor response to your own essay, posing an argument as for why Japanese whaling should be permitted to continue at sustainable levels.

Curt & Mich Jenner  
onboard *Whale Song II*



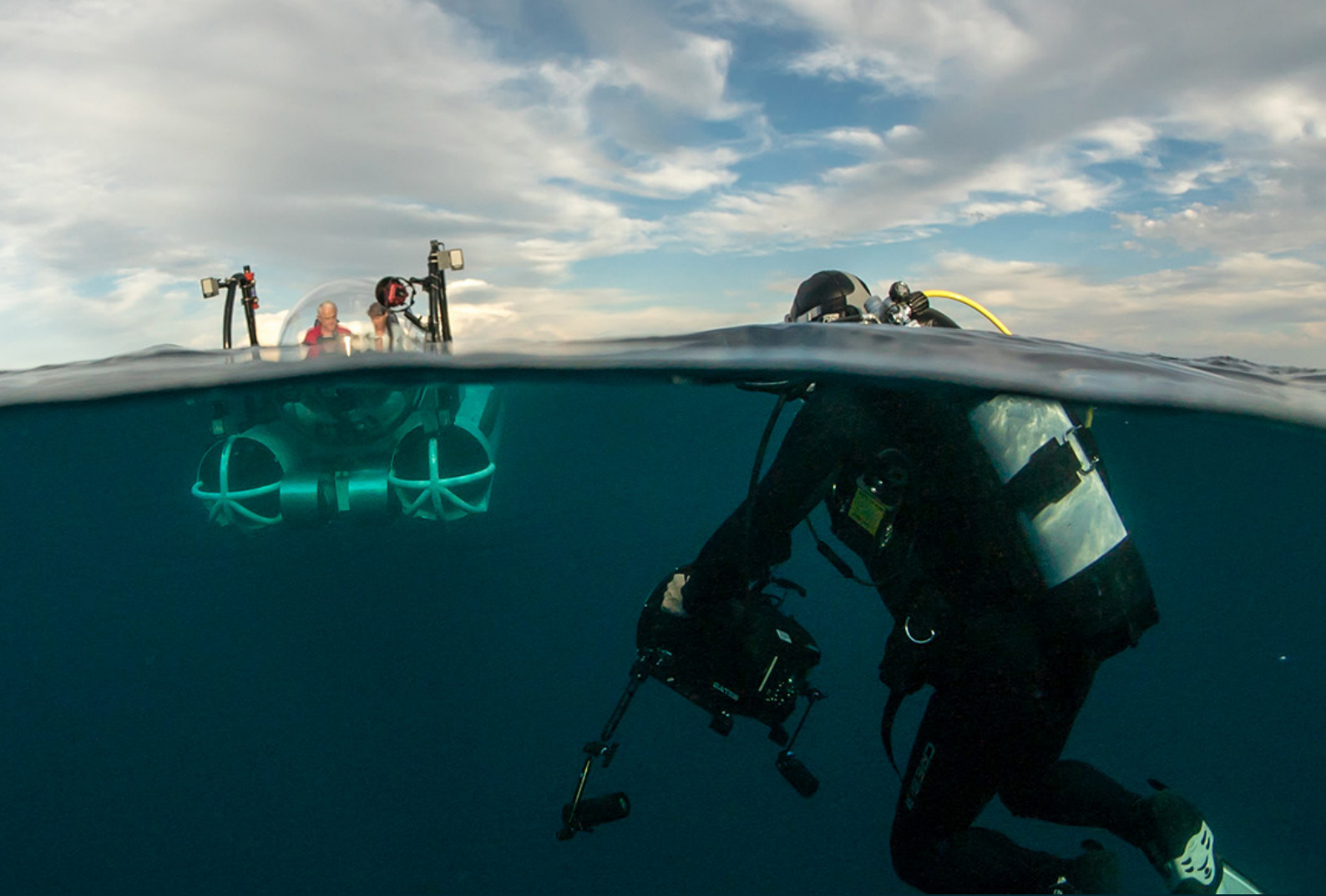
### CLIMATE CHANGE

The program presents two perspectives on climate change. On one hand, scientists and enthusiasts like Curt Jenner study the effect of the changing planet on whales. As Jenner says, 'By collecting the [whale] snot, we can learn not only about the health of the whales, but also about the effects of climate change and stress.'

But whales also play a critical, if secondary, part in the global climate. As *Whale Super Highway* explains, blue whale waste feeds phytoplankton, which in turn absorbs carbon dioxide: 'Over a quarter of all manmade carbon released as CO<sub>2</sub> is absorbed by the ocean.'

Research the science associated with the ocean's absorption of carbon dioxide.

- Is the above quote accurate?
- How important is phytoplankton to the ocean's absorption of carbon?
- If whales were to become extinct, what impact would this have on our climate?



Jon Shaw (DOP) films  
*Odyssea* preparing to  
descend

## » **FILMING UNDERWATER**

### **Odyssea**

*Odyssea* enables the entire running time of *Whale Super Highway*. A modern, innovative submersible, it provides a 250-degree view of its marine environment – allowing for careful study of the surrounds by marine biologists like Bec – and can dive as deep as 200 metres under the sea.

The specifications for *Odyssea* can be found in this Study Guide in the **About** section ([page 3](#)). Use these specifications and the vision of the submersible in *Whale Super Highway* to produce a labelled diagram of the ship and its key features.

- The *Odyssea* boasts a ‘safe, 1 atmosphere environment’. What does 1 atmosphere mean, and why is this considered safe?
- What water pressure would you expect to encounter 200 metres beneath the surface of the sea?
- Approximate the kind of force the *Odyssea* would need to sustain at this depth.
- What are the design challenges associated with creating a submersible with such a wide view of its surrounds?
- Could you redesign *Odyssea* to safely travel deeper into the ocean? What changes would need to be made?





Ed Punchard & Bec Wellard prepare to descend

## Build Your Own Sub

There are numerous options open to the enterprising inventor wishing to make a miniature submarine for their own household. *Make Magazine* have shared easily-understandable instructions for developing a self-propelled soft drink bottle submarine at <https://makezine.com/projects/soda-bottle-submarine/>, while more enterprising design students might want to create their own RC – remote-control – with the assistance of resources such as this ThoughtCo website: <https://www.thoughtco.com/what-do-you-need-to-build-an-rc-submarine-2863059>

### DESIGNING YOUR OWN SUBMARINE

For this activity, we'll be focusing on designing our own simple film-cannister submarine, using an activity adapted from <https://www.nsta.org/publications/news/story.aspx?id=40867>.

**Aim:** Make your own miniature submarine. Your submarine should rise to the bottom of the provided water container, then rise back to the surface.

#### APPARATUS:

- Film canister with hole in lid (or similar sealed, water-tight container)
- two litre soft drink bottle, top removed
- Coins
- Baking powder
- Baking soda
- Citric acid
- Effervescent antacid tablets

**PROCEDURE:** Working in a group, design and construct different submarines using different materials. Record the process used to build each submarine, then decide upon your most effective submarine based on your observations.

**DATA:** Record the mass and volume of chosen submarine after it rises to the top, along with any other observations.

- Describe what causes your sub to sink, then float.
- What was the density of your sub after it rose to the top?
- How much buoyant force was required to make the sub rise?
- How much mass must the sub initially have to sink?  
**EXTENSION:** what **weight** must the sub have to sink?
- What is the mass of the sub while floating?  
**EXTENSION:** what **weight** does the sub have while floating?

- Explain which three substances or combinations of substances were successful.
- Link the results of this experiment to the operation of real submarines.

Further teacher notes to contextualise the science associated with this experiment can be found at the above link from which this activity is adapted.



*Odyssea on the deck of Talasea II*

## Optics

*Whale Super Highway* is not only a showcase for the wonders of the natural world; it also showcases modern camera technology through its immersive Fulldome photography.

### FULLDOME PHOTOGRAPHY

Fulldome is a video-projection format that, as suggested by its name, is displayed in a dome format. It is an excellent showcase for non-narrative films that allow the viewer to explore and be immersed by their environment, whether expansive wilderness, infinite space or – as in *Whale Super Highway* – the dark depths of the ocean.

Research the history and technical qualities of Fulldome photography to answer the following questions:

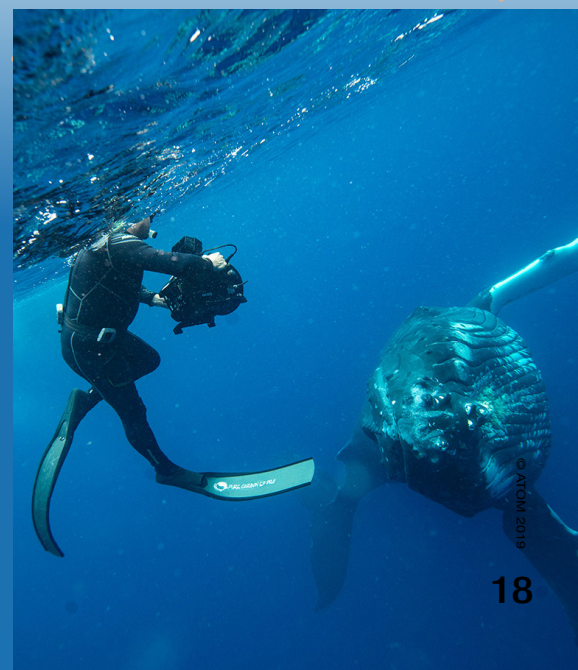
- When and where did Fulldome photography first originate?

- What sort of Fulldome films are shown at the venue where you viewed *Whale Super Highway*?
- How does Fulldome projection operate?
- What are the advantages of single-projector Fulldome systems as opposed to multiple-projector Fulldome systems?

This program was filmed using the 200-degree, 4K digital camera installed in the *Odyssea* submersible.

- What are the challenges associated with designing, producing and filming with such a wide lens?
- How do the laws of reflection apply to a 200-degree lens? Where would its focal centre be located?

*This panel: Jon Shaw (DOP) films humpback whales and Odyssea*





Humpback whale and calf

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This study guide was produced by **ATOM**. (© ATOM 2019)  
ISBN: 978-1-76061-294-8 [editor@atom.org.au](mailto:editor@atom.org.au)

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