Prehistoric marine life in Australia's inland sea

Teaching Guide and Worksheets

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Summary of the teaching guide and worksheets

Prehistoric marine life in Australia's inland sea connects with many aspects of the Australian curriculum, particularly English and the Biological Sciences. It can also be used in an interdisciplinary way to support other subjects including earth sciences, mathematics, art and technology. The underlying theme of climate change, ecological change and extinction underpins the cross-curricular theme of sustainability. The study of Australian bioregions also supports a discussion of Australia's biological engagement with Asia.

The book is divided into two main elements:

- Understanding the context of the palaeontological record for the middle Cretaceous (the first and final chapters)
- The species details (the central sections of the book). These are constructed in a 'field guide' format to emphasise reconstructions of the living animals and their ecosystems.

This teacher's guide provides a few examples of the way in which *Prehistoric marine life in Australia's inland sea* can be used to support curriculum priorities from Foundation to Year 10. The book is suitable for use across a wide age-range. Prehistoric animals are very popular in junior primary and the book makes strong use of visual elements to support this younger age group. The text also supports high level analysis and information suitable for young adults and upper secondary, but structural elements and accessible language have been used to allow middle readers to use the book as a research source.

Primarily, this teacher guide focuses on the Biological Sciences and English curriculum but cross-curriculum links are also discussed. A selection of worksheets are provided.

Find out more:

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Author Biography

Dr Danielle Clode is an award-winning science writer and interdisciplinary scholar. Her doctorate is in zoology, but she also teaches academic and creative writing. Her previous books have covered topics as diverse as killer whales (*Killers in Eden*), natural history collections (*Continents of Curiosities*) and bushfires (*A Future in Flames*). She was awarded the Victorian Premiers Literary Award for Nonfiction in 2007 for *Voyages to the South Seas*, a narrative non-fiction about Australian French exploration history. Her previous book in Museum Victoria's Nature Series, *Prehistoric Giants: The Megafauna of Australia*, was shortlisted for the CBCA Information Book of the Year in 2010 and won the Junior Judges award.

Cross curriculum priorities

Sustainability

The sustainability priority has a strong focus on human action and future mediation of environmental concerns. Understanding world views around sustainability and envisaging sustainable futures requires an understanding of past environments, natural environmental change, and the consequences of dramatic climate change. Environmental change and extinction in the Australian inland sea can be used to discuss more complex issues of climate change, human-induced modification of the environment and action for sustainability. Many of the worksheets in Biological Sciences for this topic will support the theme of sustainability.

Relevant organising ideas

Systems	
OI.1	The biosphere is a dynamic system providing conditions that sustain life on Earth.
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.

Asia and Australia's engagement with Asia

This priority has a strong focus on cultural and economic factors related to human society. Nonetheless, part of the Australian identity is tied to the sense of uniqueness about our fauna and landscape. Although we often think of kangaroos and gum trees (for example) as uniquely Australian, in fact they are features of the Australasia landmass that includes parts of south-east Asia and the first European contact with these species took place in Asia, not Australia. The bioregional connections between Asia and Australia's fauna and flora feature throughout prehistory. *Prehistoric marine life of Australia's inland sea* discusses which species were endemic (only found in Australia), which were regional (to Australasia, the Pacific or Antarctic) and which were cosmopolitan or worldwide in their distribution.

Asia-Australia engagement	
OI.6	Australia is part of the Asia region and our histories from ancient times to the present are linked.

Biological Sciences curriculum links

Year Level	Science Scape and Sequence	Activity Links
Foundation Year	Living things have basic needs, including food and water	What do we eat?
Year 1	Living things have a variety of external features Living things live in different places where their needs are met	What do we eat?
Year 2	Living things grow, change and have offspring similar to themselves	Life cycles
Year 3	Living things can be grouped on the basis of observable features and can be distinguished from non-living things	What do we eat? Convergent evolution
Year 4	Living things have life cycles Living things, including plants and animals, depend on each other and the environment to survive	Food webs Life cycles
Year 5	Living things have structural features and adaptations that help them to survive in their environment	What do we eat? Convergent evolution
Year 6	The growth and survival of living things are affected by the physical conditions of their environment	Extinction
Year 7	There are differences within and between groups of organisms; classification helps organise this diversity Interactions between organisms can be described in terms of food chains and food webs; human activity can affect these interactions	Convergent evolution Food webs
Year 8	Cells are the basic units of living things and have specialised structures and functions Multi-cellular organisms contain systems of organs that carry out specialised functions that enable them to survive and reproduce	
Year 9	Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems	Food webs Extinction
Year 10	The transmission of heritable characteristics from one generation to the next involves DNA and genes The theory of evolution by natural selection explains the diversity of living things and is supported by a range of scientific evidence	Convergent evolution Extinction

English curriculum links

Relevant curriculum strands—Early primary (Foundation-3)

Strand	Foundation Year	Year 1	Year 2	Year 3
GENERAL				
Text structure and organisation				
Purpose audience and structures of different types of texts—How texts serve different purposes and how the structures of types of texts vary according to the text purpose	Understand that texts can take many forms, can be very short (for example an exit sign) or quite long (for example an information book or a film) and that stories and informative texts have different purposes	Understand that the purposes texts serve shape their structure in predictable ways	Understand that different types of texts have identifiable text structures and language features that help the text serve its purpose	Understand how different types of texts vary in use of language choices, depending on their purpose and context (for example, tense and types of sentences)
Expressing and developing ideas				
Visual language—How images work in texts to communicate meanings, especially in conjunction with other elements such as print and sound	Explore the different contribution of words and images to meaning in stories and informative texts	Compare different kinds of images in narrative and informative texts and discuss how they contribute to meaning	Identify visual representations of characters' actions, reactions, speech and thought processes in narratives, and consider how these images add to or contradict or multiply the meaning of accompanying words	Identify the effect on audiences of techniques, for example shot size, vertical camera angle and layout in picture books, advertisements and film segments
Vocabulary—The meanings of words including everyday and specialist meanings and how words take their meanings from the context of the text	Understand the use of vocabulary in familiar contexts related to everyday experiences, personal interests and topics being taught at school	Understand the use of vocabulary in everyday contexts as well as a growing number of school contexts, including appropriate use of formal and informal terms of address in different contexts	Understand the use of vocabulary about familiar and new topics and experiment with and begin to make conscious choices of vocabulary to suit audience and purpose	Learn extended and technical vocabulary and ways of expressing opinion including modal verbs and adverbs
LITERACY				
Texts in context				
Texts and the contexts in which they are used—How texts relate to their contexts and reflect the society and culture in which they were created	Identify some familiar texts and the contexts in which they are used	Respond to texts drawn from a range of cultures and experiences	Discuss different texts on a similar topic, identifying similarities and differences between the texts	Compare texts including media texts that represent ideas and events in different ways, explaining the effects of the different approaches
Interacting with others				
Oral presentations—The formal oral presentations that students engage in including presenting recounts and information, and presenting and arguing a point of view	Deliver short oral presentations to peers	Make short presentations using some introduced text structures and language, for example opening statements	Rehearse and deliver short presentations on familiar and new topics	Plan, rehearse and deliver presentations selecting and sequencing appropriate content and multimodal elements for defined audiences and purposes, making appropriate choices for modality and emphasis
Interpreting, analysing, evaluating				
Purpose and audience Recognising and analysing differences between different types of texts	Identify some differences between imaginative and informative texts	Describe some differences between imaginative informative and persuasive texts	Identify the audience of imaginative, informative and persuasive texts	Identify the audience and purpose of imaginative, informative and persuasive texts
Creating texts				
Creating texts—Creating different types of spoken, written and multimodal texts using knowledge of text structures and language features	Create short texts to explore, record and report ideas and events using familiar words and phrases and beginning writing knowledge	Create short imaginative and information texts that show emerging use of appropriate text structure, sentence- level grammar, word choice, spelling, punctuation and appropriate multimodal elements, for example illustrations and diagrams	Create short imaginative, informative and persuasive texts using growing knowledge of text structures and language features for familiar and some less familiar audiences, selecting print and multimodal elements appropriate to the audience and purpose	Plan, draft and publish imaginative, informative and persuasive texts demonstrating increasing control over text structures and language features and selecting print, and multimodal elements appropriate to the audience and purpose

Relevant curriculum strands—Middle-late primary (4-7)

Sub Strand	Year 4	Year 5	Year 6	Year 7
GENERAL				
Text structure and organisation				
Purpose audience and structures of different types of texts—How texts serve different purposes and how the structures of types of texts vary according to the text purpose	Understand how texts vary in complexity and technicality depending on the approach to the topic, the purpose and the intended audience	Understand how texts vary in purpose, structure and topic as well as the degree of formality	Understand how authors often innovate on text structures and play with language features to achieve particular aesthetic, humorous and persuasive purposes and effects	Understand and explain how the text structures and language features of texts become more complex in informative and persuasive texts and identify underlying structures such as taxonomies, cause and effect, and extended metaphors
Expressing and developing ideas				
Visual language—How images work in texts to communicate meanings, especially in conjunction with other elements such as print and sound	Explore the effect of choices when framing an image, placement of elements in the image, and salience on composition of still and moving images in a range of types of texts	Explain sequences of images in print texts and compare these to the ways hyperlinked digital texts are organised, explaining their effect on viewers' interpretations	Identify and explain how analytical images like figures, tables, diagrams, maps and graphs contribute to our understanding of verbal information in factual and persuasive texts	Investigate vocabulary typical of extended and more academic texts and the role of abstract nouns, classification, description and generalisation in building specialised knowledge through language
Vocabulary—The meanings of words including everyday and specialist meanings and how words take their meanings from the context of the text	Incorporate new vocabulary from a range of sources into students' own texts including vocabulary encountered in research	Understand the use of vocabulary to express greater precision of meaning, and know that words can have different meanings in different contexts	Investigate how vocabulary choices, including evaluative language, can express shades of meaning, feeling and opinion	Understand how to use spelling rules and word origins, for example Greek and Latin roots, base words, suffixes, prefixes, spelling patterns and generalisations to learn new words and how to spell them
LITERACY				
Texts in context				
Texts and the contexts in which they are used. How texts relate to their contexts and reflect the society and culture in which they were created	Identify and explain language features of texts from earlier times and compare with the vocabulary, images, layout and content of contemporary texts	Show how ideas and points of view in texts are conveyed through the use of vocabulary, including idiomatic expressions, objective and subjective language, and that these can change according to context	Compare texts including media texts that represent ideas and events in different ways, explaining the effects of the different approaches	Analyse and explain the effect of technological innovations on texts, particularly media texts
Interacting with others				
Oral presentations The formal oral presentations that students engage in including presenting recounts and information, and presenting and arguing a point of view	Plan, rehearse and deliver presentations incorporating learned content and taking into account the particular purposes and audiences	Plan, rehearse and deliver presentations for defined audiences and purposes incorporating accurate and sequenced content and multimodal elements	Plan, rehearse and deliver presentations selecting and sequencing appropriate content and multimodal elements for defined audiences and purposes, making appropriate choices for modality and emphasis	Plan, rehearse and deliver presentations, selecting and sequencing appropriate content and multimodal elements to promote a point of view or enable a new way of seeing
Interpreting, analysing, evaluating				
Purpose and audience Recognising and analysing differences between different types of texts	Identify characteristic features used in imaginative, informative and persuasive texts to meet the purpose of the text	Identify and explain characteristic text structures and language features used in imaginative, informative and persuasive texts to meet the purpose of the text	Analyse how text structures and language features work together to meet the purpose of a text	Analyse and explain the ways text structures and language features shape meaning and vary according to audience and purpose
Creating texts				
Creating texts—Creating different types of spoken, written and multimodal texts using knowledge of text structures and language features	Plan, draft and publish imaginative, informative and persuasive texts containing key information and supporting details for a widening range of audiences, demonstrating increasing control over text structures and language features	Plan, draft and publish imaginative, informative and persuasive print and multimodal texts, choosing text structures, language features, images and sound appropriate to purpose and audience	Plan, draft and publish imaginative, informative and persuasive texts, choosing and experimenting with text structures, language features, images and digital resources appropriate to purpose and audience	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

Relevant curriculum strands—Early-middle secondary (7-10)

Sub Strand	Year 7	Year 8	Year 9	Year 10
GENERAL				
Text structure and organisation				
Purpose audience and structures of different types of texts— How texts serve different purposes and how the structures of types of texts vary according to the text purpose	Understand and explain how the text structures and language features of texts become more complex in informative and persuasive texts and identify underlying structures such as taxonomies, cause and effect, and extended metaphors	Analyse how the text structures and language features of persuasive texts, including media texts, vary according to the medium and mode of communication	Understand that authors innovate with text structures and language for specific purposes and effects	Compare the purposes, text structures and language features of traditional and contemporary texts in different media
Expressing and developing ideas				
Visual language—How images work in texts to communicate meanings, especially in conjunction with other elements such as print and sound	Analyse how point of view is generated in visual texts by means of choices, for example gaze, angle and social distance	Investigate how visual and multimodal texts allude to or draw on other texts or images to enhance and layer meaning	Analyse and explain the use of symbols, icons and myth in still and moving images and how these augment meaning	Evaluate the impact on audiences of different choices in the representation of still and moving images
Vocabulary—The meanings of words including everyday and specialist meanings and how words take their meanings from the context of the text	Investigate vocabulary typical of extended and more academic texts and the role of abstract nouns, classification, description and generalisation in building specialised knowledge through language	Recognise that vocabulary choices contribute to the specificity, abstraction and style of texts	Identify how vocabulary choices contribute to specificity, abstraction and stylistic effectiveness	Refine vocabulary choices to discriminate between shades of meaning, with deliberate attention to the effect on audiences
LITERACY				
Texts in context				
Texts and the contexts in which they are used— How texts relate to their contexts and reflect the society and culture in which they were created	Analyse and explain the effect of technological innovations on texts, particularly media texts	Analyse and explain how language has evolved over time and how technology and the media have influenced language use and forms of communication	Analyse how the construction and interpretation of texts, including media texts, can be influenced by cultural perspectives and other texts	Analyse and evaluate how people, cultures, places, events, objects and concepts are represented in texts, including media texts, through language, structural and/or visual choices
Interacting with others				
Oral presentations— The formal oral presentations that students engage in including presenting recounts and information, and presenting and arguing a point of view	Plan, rehearse and deliver presentations, selecting and sequencing appropriate content and multimodal elements to promote a point of view or enable a new way of seeing	Plan, rehearse and deliver presentations, selecting and sequencing appropriate content, including multimodal elements, to reflect a diversity of viewpoints	Plan, rehearse and deliver presentations, selecting and sequencing appropriate content and multimodal elements for aesthetic and playful purposes	Plan, rehearse and deliver presentations selecting and sequencing appropriate content and multimodal elements to influence a course of action
Interpreting, analysing, evaluating				
Purpose and audience— Recognising and analysing differences between different types of texts	Analyse and explain the ways text structures and language features shape meaning and vary according to audience and purpose	Analyse and evaluate the ways that text structures and language features vary according to the purpose of the text and the ways that referenced sources add authority to a text	Interpret, analyse and evaluate how different perspectives of an issue, event, situation, individuals or groups are constructed to serve specific purposes in texts	Identify and analyse implicit or explicit values, beliefs and assumptions in texts and how these are influenced by purposes and likely audiences
Reading processes— Strategies for using and combining contextual, semantic, grammatical and phonic knowledge to decode texts including predicting, monitoring, cross-checking, self-correcting, skimming and scanning	Use prior knowledge and text processing strategies to interpret a range of types of texts.	Apply increasing knowledge of vocabulary, text structures and language features to understand the content of texts	Apply an expanding vocabulary to read increasingly complex texts with fluency and comprehension	Choose a reading technique and reading path appropriate for the type of text, to retrieve and connect ideas within and between texts
Creating texts				
Creating texts Creating different types of spoken, written and multimodal texts using knowledge of text structures and language features	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	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	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	Create sustained texts, including texts that combine specific digital or media content, for imaginative, informative, or persuasive purposes, and that reflect upon challenging and complex issues

Overview of the book

Prehistoric marine life in Australia's inland sea (Museum Victoria Nature Series, 2015) is an illustrated non-fiction book about the fauna that lived in and around Australia's Eromanga Sea 100 million years ago in the age of the dinosaurs. At this time, sea levels were much higher than today and the centre of Australia was flooded by a vast shallow inland sea filled with a great diversity of species, including:

PLESIOSAURS

Large marine reptile predators (on which the mythical Loch Ness monster is based)

ICHTHYOSAURS

Marine reptiles which shared many superficial similarities with modern dolphins but were much larger

TURTLES

Modern turtles evolved and diversified in the cretaceous period and many of their modern features date back to the past pressures they faced

CROCODILES

The earliest modern crocodiles date from this period in Australia

AMPHIBIANS

The last of the great amphibious predators could still be found in Australian waters, long after they had gone extinct elsewhere

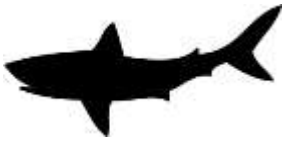
PTEROSAURS

The skies over the inland sea were dominated by the pterosaurs, a highly diverse family of flying reptiles

BIRDS

The first of the birds began emerging in the Cretaceous and a few could be found in the coastal forests surrounding the inland sea

SHARKS



Sharks were just as abundant in the inland sea as they are in modern waters and many species are almost unchanged from those times

FISH

The diverse and abundant fish fauna of the Eromanga Sea comprises both modern and ancient forms with a few species, like the Queensland Lungfish, almost unchanged since the Cretaceous

SHELLFISH

Many of the shellfish of the Eromanga Sea were similar to those found in the Australasian region today and provide important indicators of climate change

CEPHALOPODS

Cephalopods included squids and nautilus, but also long-extinct branches like the highly variable and diverse species of ammonites and belemnites

Biological Sciences Activities and Worksheets

What do we eat?

Some of the creatures of the inland sea are very similar to species we have today, like some of the sharks, turtles, fish and shellfish. But other species are extinct and are no longer found alive today. How do we know what they looked like and what they ate? Palaeontologists, who study extinct life forms, have to imagine what they looked like from just a few bones, and sometimes just from a few teeth. What can we tell about animals from their bones and teeth?

1. What can you tell about these animals from their teeth?
2. What sort of food do you think they ate?
3. Are these teeth for cutting, stabbing, grinding or snipping?

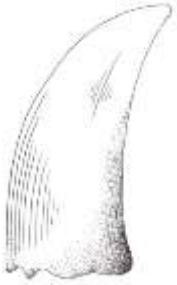
			
Shark tooth	**Sperm whale tooth**	**Elephant tooth**	**Horse teeth**
This is a slicing tooth. It has a sharp serrated edge for cutting through meat.	This is a stabbing tooth. It is for holding on to prey that moves.	This is a grinding tooth. It is wide and flat for grinding up plants.	This is a snipping or chewing tooth. It is for biting off or chewing on plants like grass, wood or fruits.

1. What sort of teeth do you have?
2. Do you have sharp slicing teeth or stabbing pointy teeth?

Humans have snipping teeth at the front for biting off food and grinding teeth at the back for grinding up plant matter. Our teeth are for eating plants, not for catching prey.

1. What sort of teeth do these animals have? What do you think they ate?
2. Can you draw a picture of what you think this animal might have looked like?

Resource sheet: What do we eat?

What kind of animal has these teeth?	What kind of food does it eat?
 _____	
 _____	
 _____	
 _____	

Food webs

The tropic levels of the inland sea are similar to those of many modern marine environments with production largely being generated by microscopic plant life or phytoplankton. With most production occurring at a microscopic level, the system appears to be dominated by animals, which occupy many different consumption roles (including filter feeders, top level predators and detrivores).

Changes to the sea levels and water circulation of the inland sea made significant changes to the oxygen levels on the sea floor between the Aptian and the Albian periods. These changes dramatically altered the species found on the seafloor in particular – reducing the diversity of molluscs for example. Changes in temperature and inflow of marine currents may also have changed the composition of other species.

Questions

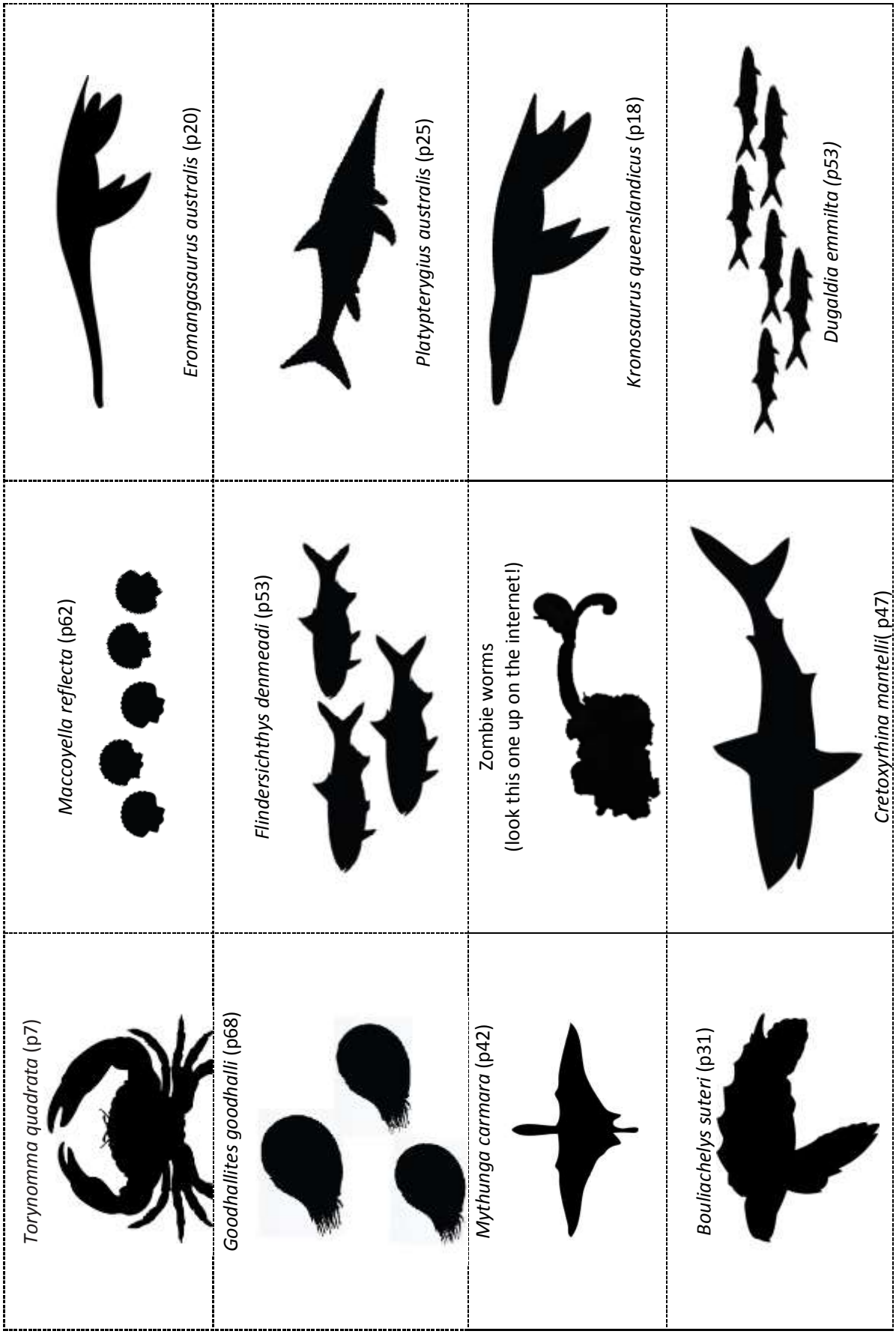
- Who ate whom in the Eromanga Sea?
- Can you identify the primary producers and consumers, top level predators, detrivores , filter feeders in this ecosystem?
- What are the modern parallels of these species and groups in today's oceans? Are they the same or different?
- One of the elasmosaurs is thought to have been a filter feeder – what large animals fill this role in today's oceans?
- How many species can you use to connect the kronosaurus with the phytoplankton?
- What evidence do palaeontologists use to learn what different animals ate in the past? (Physiology and remains)
- How did the food web change as conditions in the Eromanga Sea changed from the Aptian to the Albian?

Activities

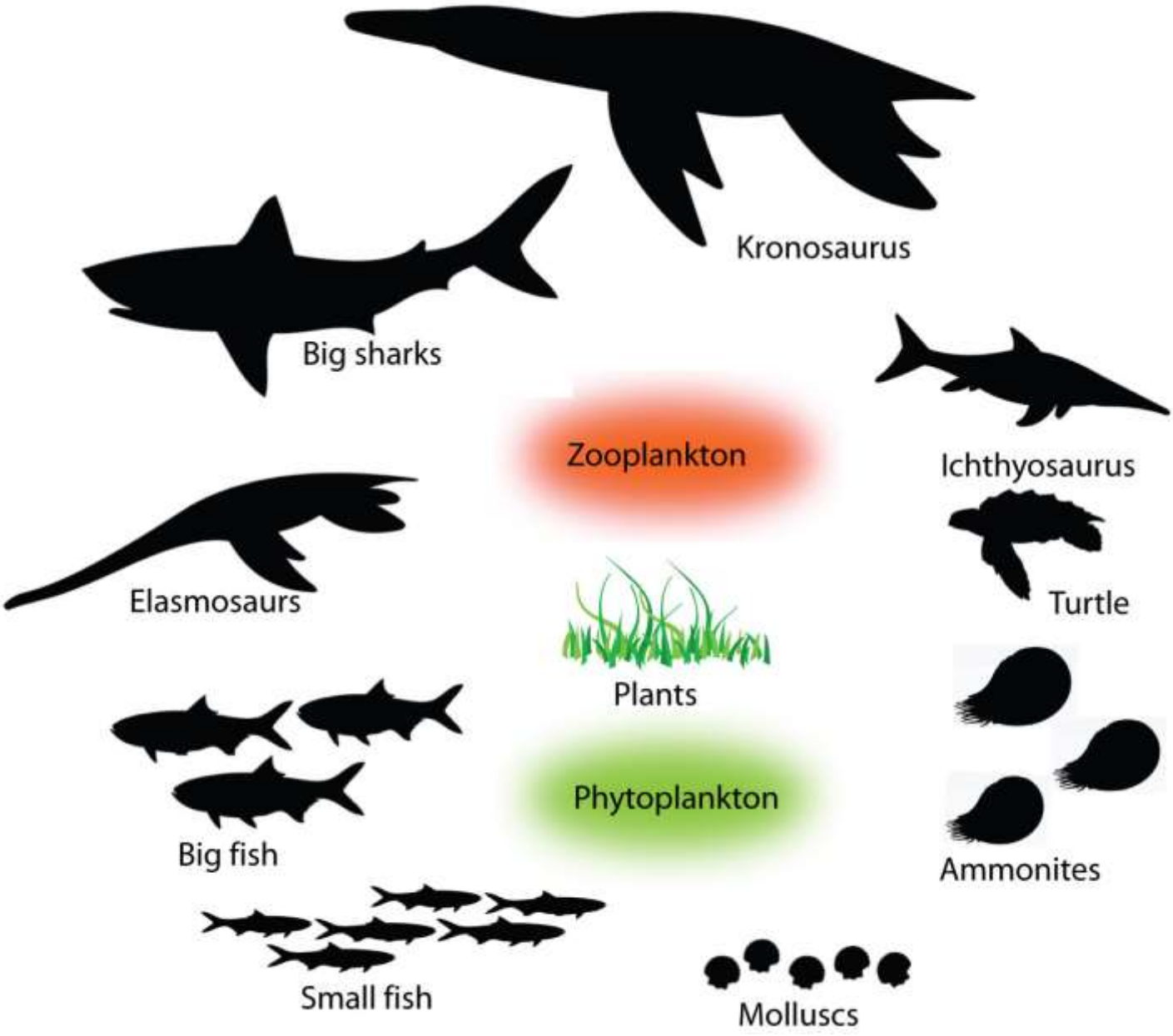
- Label primary producers, consumers, top level predators (resource sheet)
- Connect the different species in terms of what they ate and what ate them to create a food web (resource sheet)
- Make a food chain mobile of the Eromanga sea species
- Draw a trophic triangle, identify the different levels and fill in the species from the inland sea. Compare this with modern species.
- Allocate one animal from the book to each student. Is their animal:
    - Vertebrate or invertebrate
    - Omnivore, carnivore, herbivore, or detrivore
    - Pelagic, bottom dwelling, marine, freshwater, terrestrial
    - Microscopic, small, medium, large or very large?
      (Play a game based on who can eat whom – make sure to include detrivores like crabs to make the game circular)
- Use the text to research the paleontological evidence for prey types (teeth marks, stomach contents etc) to construct an evidence-based food web.

Resources: Tasmania Parks and Wildlife Marine Food Web worksheets (under games and puzzles) http://www.parks.tas.gov.au/index.aspx?base=2016#5
http://www.coolaustralia.org/activity/food-chains-12/
http://www.tesaustralia.com/article.aspx?storyCode=6071621

Resource Sheet: Food webs



Resource Sheet: Food webs



Life cycles

Reptiles have a wide variety of life cycles. Many reptiles lay eggs (like turtles and crocodiles). Other species give birth to live young (like some snakes and lizards). Unlike birds, which usually sit on their eggs to incubate them, reptiles usually bury their eggs and rely on the warmth of the sun to hatch them.

Some look after their young, while others leave them to fend for themselves after hatching. Crocodiles defend their nests and carry their newly hatched young to the water in their mouths. Turtles lay their eggs on the same beaches they hatched on, often travelling many hundreds of miles to reach them, but they never see their young hatch.

The marine reptiles of the inland sea showed a similar diversity of life cycles. The pterosaurs lay eggs like birds, but probably did not look after their young. At least some plesiosaurs gave birth to live young and may well have cared for their young for an extended time, teaching them to hunt and find food.

Questions

- What evidence do palaeontologists use to find out an animal's life cycle?
- What are the advantages and disadvantages of egg-laying and live birth?
- Why do some reptiles lay eggs but others give birth to live young?
- Why do some animals have only a few young and look after them for a long time while others have a lot of young but don't look after them? (Discuss k and r life history strategies). What type of strategy do humans have? (What about stick insects, goldfish, dogs, horses etc).

Activities

Chose an animal from the book and draw a life cycle. Does it lay eggs or have live young? Does it look after its eggs or young? How big are the babies compared to the adult?

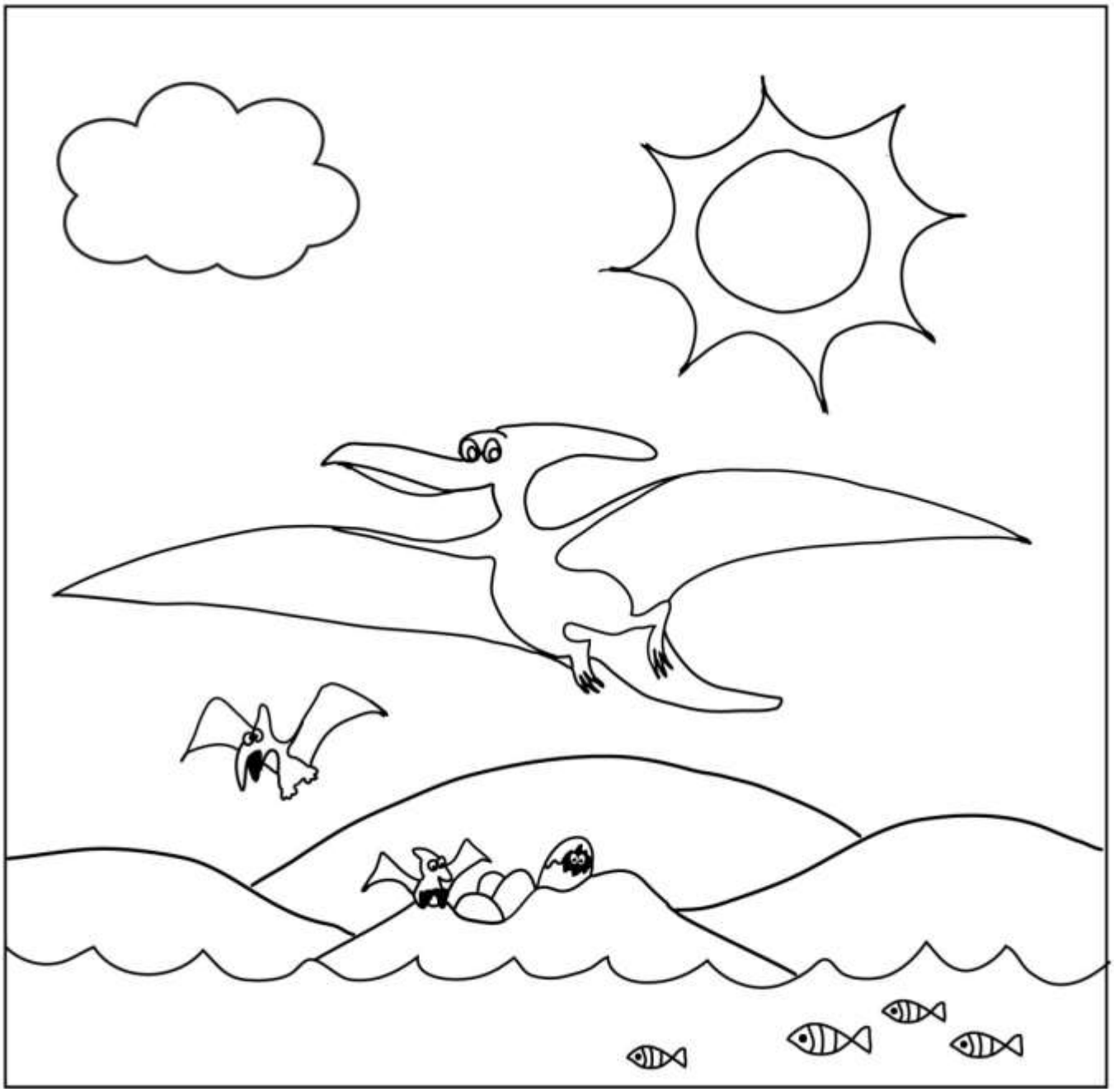
Colour in sheets of different animal life cycles. What colours do you think pterosaurs would be? Why did you choose those colours?

Resources: Turtle life cycle colour in sheet
http://www.education.com/worksheet/article/color-life-cycle-19/

http://museumvictoria.com.au/melbournemuseum/discoverycentre/dinosaur-walk/prehistoric-fun/egg-hatching-game/

http://museumvictoria.com.au/bugs/life/cycles.aspx

Resource Sheet: Pterosaur life cycle



Understanding convergent evolution

Some animals share a similar ancestor, but become different over time. Darwin's finches are an example of this, with different species on each island of the Galapagos specialising in different types of food – seed-eating, insect eating and even blood sucking. Although different environmental pressures create differences (speciation), similar environments can also make different types of animals appear similar. This is convergent evolution and it provides a compelling illustration of ecological pressures in evolution.

For example, gliding has evolved in several unrelated species: Sugar gliders (Mammalia: Marsupalia), Gliding lizards (Reptilia: Squamata: Iguania) and Flying frogs (Amphibia: Anura). Big cat-like carnivores have also evolved independently several times: Thylacoleo (Mammalia: Marsupialia: Diprotodontia) from Australia, Sabre toothed cats (Mammalia Carnivora: Felidae) from North America and tigers and lions (Mammalia: Carnivora: Felidae) from Africa and Asia. There are other examples for each of these groups.

Australia's inland sea also provides classic examples of convergent evolution, including:

- Swimming adaptations in ichthyosaurs, sharks and dolphins
- Flying adaptations in pterosaurs, bats and birds

Questions

- What common characteristics do you see between these animals? Why do you think they evolved that way?
- In what way are these animals different? (Feathers/fur, mammal/bird/reptile, egg-laying/live young) How are their wings different? How else did they move?
- What does this tell us about how evolution works? What does it tell us about classifying animals by their external features?

Activities

- Draw a shark and ichthyosaur or a bird and pterosaur and label similar body parts.
- Create a Venn diagram that shows three convergent (shared) traits and three divergent traits that are not shared, by each animal.
- Feel the shape of your arm and hand bones and compare them to the pictures on the worksheet of a bird, bat and pterosaur.
- Act out the differences in how a fish swims, a dolphin swims and an ichthyosaur swam (paying attention to their tails).
- Create a chart that outlines three convergent features between a dolphin and an ichythosaur and three characteristics shared by common ancestry
- Research other examples of convergent evolution. How does this differ from mimicry?
- What can we deduce about pterosaur behaviour based on shared ancestry, and what can we deduce from convergent evolution? Discuss the influences of phylogeny and ontogeny.

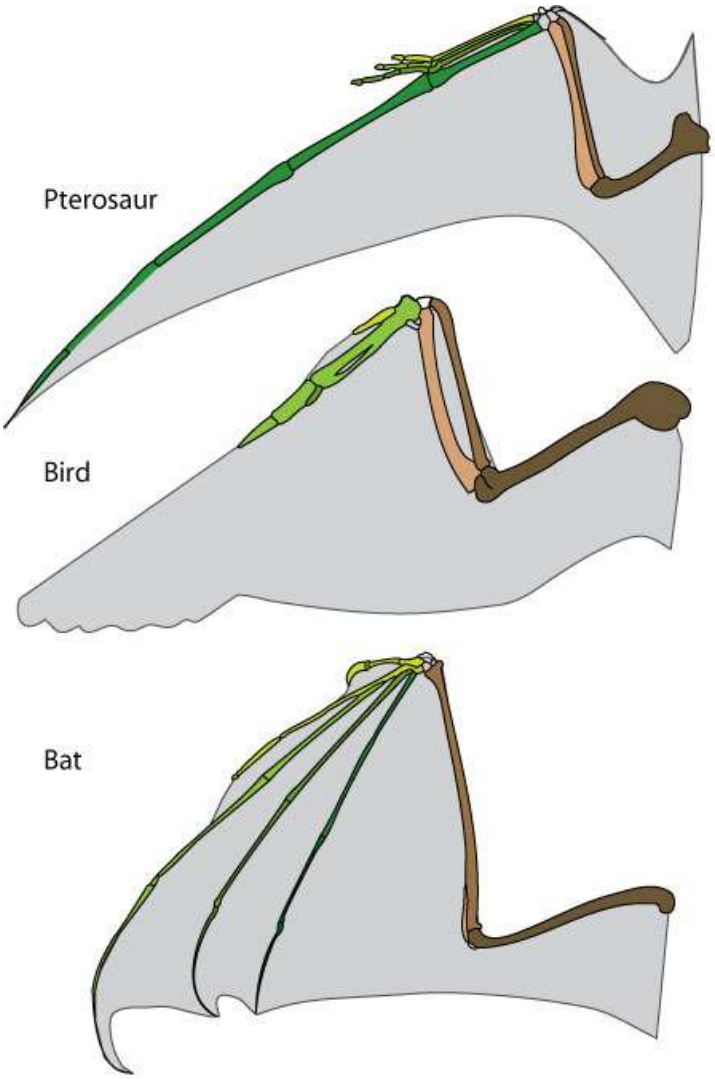
Resources:

http://education.nationalgeographic.com.au/education/activity/examining-convergent-evolution/?ar_a=1

http://naturalhistory.ku.edu/sites/all/themes/bootstrap/bootstrap_biotheme/img/public_html/sites/all/themes/bootstrap/bootstrap_biotheme/img/photos/schools/pdfs/Convergent_Evolution.pdf

http://museumvictoria.com.au/melbournemuseum/discoverycentre/600-million-years/videos/finding-fossils/

Resource Sheet: Wing Comparison for pterosaur, bird and bat



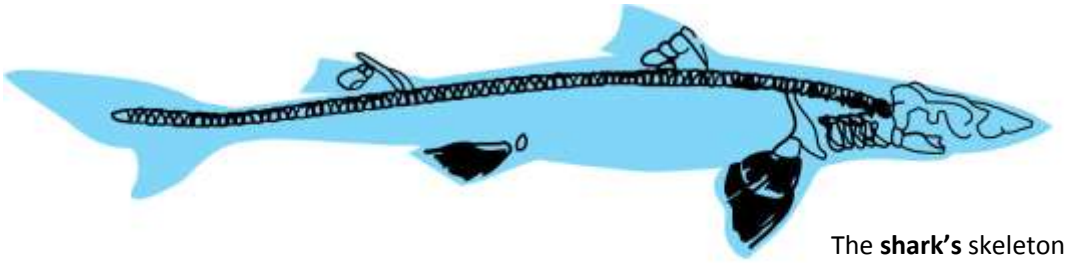
A pterosaur's wing is a membrane attached to one elongated finger.

A bird's wing consists of feathers attached to one residual finger.

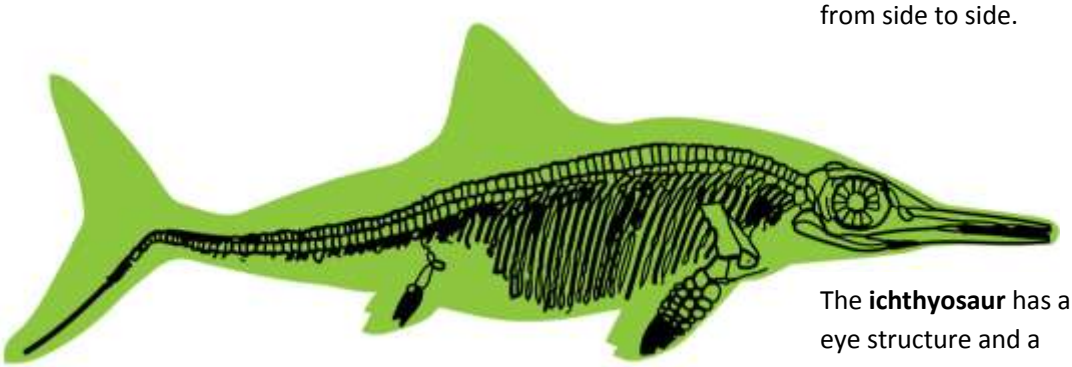
A bat's wing is a membrane stretched between several fingers.

Redrawn and adapted from M. Hildebrand, *Analysis of Vertebrate Structure*, 3rd Ed, John Wiley and Sons, New York, p577.

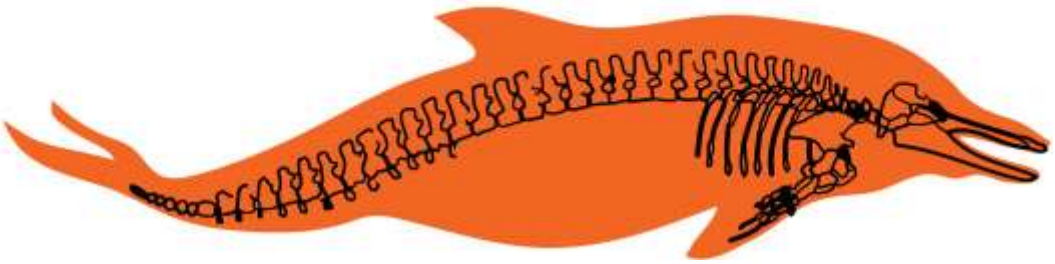
Resource Sheet: Shark, ichthyosaur and dolphin comparison



The **shark's** skeleton is made of cartilage not bone. Its tail moves from side to side.



The **ichthyosaur** has a large bony eye structure and a characteristically 'kinked' tail. Its tail moves from side to side.



The **dolphin's** skeleton is still characteristically mammalian although it has lost its hind limbs and pelvis. Its tail moves up and down.

Source: Redrawn and adapted from S.J. Gould, 1993, *Book of Life,* Random House, Sydney, p32.

Extinction

Understanding both the natural and human processes of extinction is an important factor in living sustainably. Extinction is both a natural and recurring process in natural systems, but current extinction rates are predominantly human-induced and exceed baseline extinction rates. Human-induced environmental change and consequent extinctions represent the sixth mass extinction event in Earth's long history.

Much of the fauna of Australia's inland sea went extinct locally due to changing environmental conditions, particularly falling sea levels and the drying out of the continent. This event was part of the worldwide Cretaceous mass extinction, most famous for the death of the dinosaurs. An estimated 50-75% of species were lost over the course of millions years either side of the K-T boundary, particularly in marine ecosystems. Factors implicated in this extinction event include meteor strikes (both local and global in impact), sea level changes and climate change.

Questions

- What do the words threatened, endangered and extinct mean?
- Which of the groups of animals in the book are extinct and which have living representatives today?
- Which species are 'living fossils'?
- What changes have occurred in Australia's climate since the middle Cretaceous period (discuss sea-levels, continental drift, ocean currents and the impact of meteors)
- How long did the Cretaceous mass extinction take? How does this compare with extinction caused by humans?

Activities

- Explore concepts of deep time by drawing a timeline outside on a basketball court or footpath. Identify major events in Earth's biological history – origins of multicellular life, the Cambrian explosion, the mass extinctions, the evolution of humans. Identify the Aptian-Albian period on this time scale.
- Research two threatened or extinct species that are biologically or ecologically similar – one from the Eromanga Sea and one from today. What factors contributed to their decline? What environmental conditions were they dependent on?
- Research a living fossil – what factors may have contributed to their longevity? Does anything threaten their survival today?

English Activities and Worksheets

Information and imagination

Different types of books are used for different purposes, created in different cultural contexts and are intended for different audiences. *Prehistoric marine life in Australia's inland sea* is a non-fiction or information book. It contains many features common to information books including a high level of internal structure and strong use of visual information. Compare this book with other types of books on a similar theme (e.g. *Amazing Facts about Australian Dinosaurs* by Scott Hucknull, *I'm a dirty dinosaur* by Janeen Brian or *Draw Aussie Dinosaurs and other Monsters* by Marion and Steve Isham).

Questions

- How does this book differ from the other books? Who is the intended audience?
- What are the differences between an illustrated information book, a non-fiction picture book, an instruction book and a story book?
- What's the difference between a fiction and a non-fiction book? How can we tell the difference?
- Identify the different structural components of the text and how they work.
- Where did the information in this book come from? Discuss scientific information.
- How do the animals get their names? What do they mean? How are they created?
- What is technical language and why is it used? Discuss the glossary.
- How do the pictures tell the story? What can you find out from the pictures?

Activities

- Choose one of the animals in the book and tell the class a story about them. Is it an information story or an imaginative story?
- Draw a story about your animal. How does your story use pictures and words?
- Write a story about a day in the life of an animal. How did you use imagination and information to create your story?
- Write a description of one of the animals in the book. How big is it, what kind of skin does it have, how does it move? What colour do you think it might have been (and why?)
- Make up a name for an imaginary animal that tells us something about it – where it came from, what it looks like or who found it?

The structure of non-fiction

Information books often need to cater for a wide range of readers – from young children to adults. Design, language and structure play an important role in providing accessibility to a wide range of readers. Use the book to discuss the structural elements of non-fiction and how they are used.

Nonfiction texts often contain a wider variety of structural features than fiction texts. *Prehistoric marine life in Australia's inland sea* can be used to identify many of these features.

1. What are some of the different elements of a non-fiction book?
2. Can you find examples of the following in this book?
    a. Table of contents
    b. Pictures
    c. Maps
    d. Diagrams
    e. Glossary
    f. References
    g. Headings and subheadings
    h. Further reading
3. Why do they have these elements? What do they help the reader to do?
4. How quickly can you find this information in the book? How did you find it and where?
    a. How long was Kronosaurus?
    b. What does Umoonasaurus mean?
    c. How big was the biggest ammonite?
5. Research another prehistoric animal using the following structure. Put each heading on a different piece of paper. Add a picture to each page, illustrating the topic. Add a title page and a table of contents and staple your book together. Don't forget to include your references.
    a. Description: What type of animal is it (reptile, mammal, insect)? What does it look like?
    b. Size: How big was it?
    c. Diet: What does it eat?
    d. Habitat: Where did it live? Which country, what type of environment (ocean, forest, desert etc.)?
    e. Reproduction: Did it lay eggs? Did it have lots of young or one at a time? Did it look after its young?

Resource Sheet: Analysing structural elements in non-fiction texts

Find the following elements:	**What page is it on?**	**What is it (describe or explain)?**
Title		
Contents Page		
Tables		
Pictures or photographs		
Diagrams		
Caption		
Index		
Maps		
Glossary		
References		
Further reading		

What did you like about this book?_____

_____

What is the book about?_____

_____

What is your favourite part of the book?_____

_____

Resource Sheet: Elements of non-fiction text

Label these elements on the page: main text, caption, picture, heading, table, diagram, page number, running title

The Australian leptocleidians are best represented by a beautifully opalised young adult *Umoonasaurus* known as 'Eric', which is now on display at the Australian Museum. In life, leptocleidians carried their own ornamentation. *Umoonasaurus* appears to have had a crest on its head, which may have been used for display.

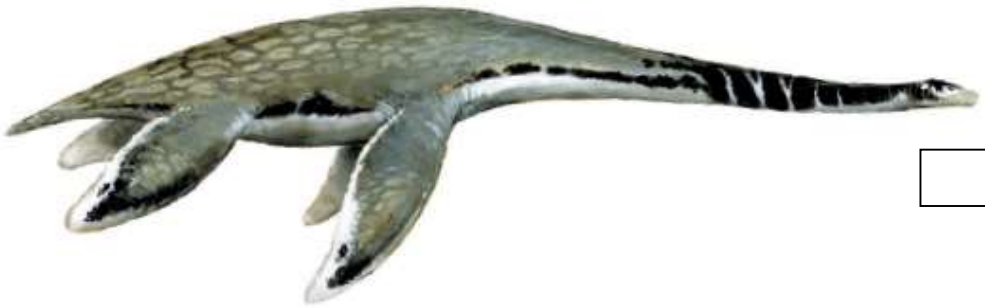
Elasmosaurs

FAMILY: Elasmosauridae

— ribbon lizard

SPECIES	ETYMOLOGY	LENGTH
Eromangasaurus australis	Southern Eromanga lizard	9–10 m

Elasmosaurs were once assumed to be cosmopolitan and found around the world. Closer inspection, however, has revealed that the Australian elasmosaur species were quite distinct from their overseas cousins. Much of the elasmosaur fossil record is too fragmentary to assign to a species, with the exception of *Eromangasaurus australis*. This particular species has been identified on the basis of a skull that is notable because it was crushed by a large predator, presumably *Kronosaurus*.



Eromangasaurus australis
Artist: Josh Lee, Adelaide. From *Dinosaurs in Australia, Mesozoic life from the Southern continent*, by Benjamin P. Kear & Robert J. Hamilton-Bruce

Telling stories with words and pictures

Illustrated books require the images, design and text to work seamlessly together to create tone and convey information. Investigate the way in which these three elements work together.

Text

- Is the text clear and coherent?
- Is the text easy to read, clear and not obscured by images?
- Is the language clear and simple?
- Is it factually accurate?
- Is it fair and balanced?
- Is the message or meaning or argument clear?

Design

- Is there variety in the pages (number of frames, portrait and landscape boxes)?
- Are the panels varied?
- Are the illustrations clear or cluttered?
- Is it physically well-produced and effective?
- How is colour used to convey tone?
- What 'feel' does the design convey? (Fun, engaging, exciting, reliable, light-hearted, serious, authoritative?)
- Where is the eye drawn on the page?

Illustrations

- What is the art style (realistic, stylised)?
- Are the illustrations clear?
- Do the illustrations echo the words or add more ideas and meanings by themselves?
- Are there good maps where needed?
- Why has the author used reconstructions of extinct animals, rather than images of fossils. How different would the book be if it only contained images of fossils?

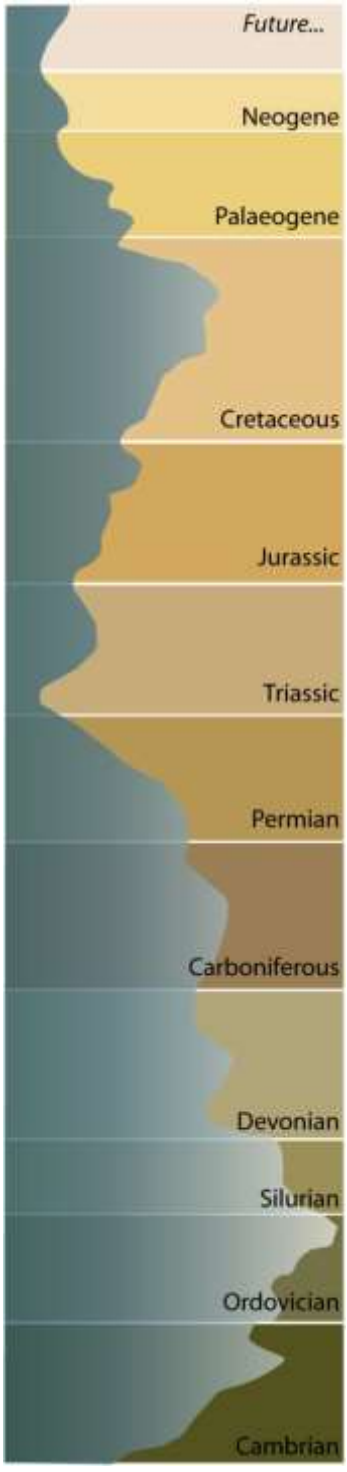
Activities

- Chose an image or diagram that conveys information more effectively than written information could. Discuss how it interacts with the text. What does the text provide that the image cannot?
- Research one of the animals described in the book. Prepare an A3 poster to display in class. Consider the flow of information, balance of images, reading ease, tone and aesthetics in your design.

Resource Sheet: Visual text

The following graphics are designed to illustrate changing sea levels in different ways. Discuss elements of each.

- Which one more effectively conveys the scale of past sea level changes?
- What visual messages is the illustrator including in the use of colour and imagery?
- How much information is being included in these images?



From me to you: author and audience

Different texts use different tones depending upon the message the author is trying to convey and the intended audience to which the author is communicating. They can be seen as a conversation between the author and the intended audience.

Questions about the author

- Does it matter who wrote this book?
- Does the author biography influence how you read the text?
- Does the author have authority?
- How does this author compare with other authors in this field (e.g. Steve Parish or Scott Hucknull). Are they more or less authoritative?
- What techniques does the author use to reassure the reader that the text is reliable and trustworthy? (references, publisher, acknowledgements, tone, design).
- What voice does the author use? (formal, informal, engaging, objective etc.)
- What literary techniques does the author use in the first and final chapters? (see resource sheet)

Questions about the audience

- Who is the intended audience for this book? What makes you think this?
- Who would be most interested in this kind of topic? If you had to give this book as a gift, who would you give it to?
- What is the relationship between the author and the audience in this book? How does that differ from other types of books (picture books, young adult fiction)?
- How would you change the book to make it suit a different audience? (pre-school children vs palaeontologists).

Activities

- Establish a debate over whether it is more important that an author writes well, or knows their subject.
- Locate the full reference list used for researching this book from the publisher or author website). Discuss the depth of information required to construct a non-fiction book. Is this depth necessary? Is it important to be accurate? Why would the author investigate the subject matter to this level of detail?

Resource sheet: Techniques used in literary nonfiction

The following techniques are often used in literary non-fiction, such as personal essays, memoir, creative non-fiction, nature writing and science writing. Identify examples of some of these techniques in the text you are working with and describe how they are used by the author and to what effect.

Structural elements	Use of language
• **Crisis** – turning point, *peripeteia* (reversal) of tragedy • **Dialectic** – defines someone or something in relation to its opposite • **Digression** – a departure, slippage of human thought • **Double vantage point** – use of two timelines (then and now) • **Purataxis** – juxtaposition without links, jumpcuts, non sequitors • **Texture** – density and complexity, the weaving of multiple threads	• **Imagistic repetition** – rhythmic repetition of an image for effect • **Incarnations** – embodiment of an idea in one of the actors e.g. Orwell's elephant • **Jouissance** – bliss of reading a text with so much meaning for the reader they are intimately connected to it. • **Lyricism** – poetry or musical elements for effect • **Scene** – a place-specific stage • **Trope** – use of figurative language such as metaphor, simile, hyperbole, alliteration, personification, metonymy and imagery.
Promoting authenticity	**Authorial**
• **Recognition** – insight of significance, to "know again" • **Rigor** – mental toughness, thoroughness, tenacity • **Truth function** – truth relative to the text, apparent truth • **Uncanny** – odd blend of familiar with unfamiliar • **Vertical Drop** – moment of deepened intimacy, not an epiphany, but 'spreading depth' (Virginia Woolf), unmasking of self.	• **Conceit of humility** – self-deprecation, self-effacing (but not altogether truthful) • **Persona** – the performative 'I' – sounds authentic but is a fabrication • **Personality effect** – boosting the whimsical or idiosyncracy in 'I' • **Self-implication** – author incriminates themselves for the sake of a larger point. Self-revelatory. Moment of truth. • **Voice** – style that evokes the narrator's state of mind

Adapted from Patricia Foster and Jeff Porter, 2012 *Understanding the Essay*, Broadview Press, Ontario.