A Pain in the Guts: Analysing Gut Contents

YEAR 6-9
BIOLOGICAL SCIENCES

QGC | FUTUREMAKERS | QUEENSLAND MUSEUM NETWORK | Queensland Government

Future Makers

Future Makers is an innovative partnership between Queensland Museum Network and Shell's QGC business aiming to increase awareness and understanding of the value of science, technology, engineering and maths (STEM) education and skills in Queensland.

This partnership aims to engage and inspire people with the wonder of science, and increase the participation and performance of students in STEM-related subjects and careers — creating a highly capable workforce for the future.

Cover image: Replicated gut contents of a Flesh-footed Shearwater, Ardenna carneipes. © QM, Gary Cranitch

QUEENSLAND MUSEUM NETWORK

Queensland Government

THE UNIVERSITY OF QUEENSLAND AUSTRALIA

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EXPLORE - EXPLAIN - ELABORATE

A Pain in the Guts: Analysing Gut Contents

Teacher Resource

In 2018, the Department of the Environment and Energy released findings from the 2017-18 Australian Plastics Recycling Survey. Key findings from this survey indicated:

- A total of 3.4 million tonnes of plastics were consumed in Australia.
- A total of 320,000 tonnes of plastics were recycled.

Of the 3,080,000 tonnes of plastics that were not recycled, most were sent to landfill or ended up in the environment. Many plastics are not biodegradable; instead they break up into smaller and smaller pieces over time. As a result, most plastics never fully disappear and can exist in landfill and the environment for hundreds of years.

This plastic waste can cause a number of different problems for living things and can significantly affect their growth and survival. The ingestion of plastics, for example, can result in death through the perforation or impaction of the digestive system, false satiety and exposure to chemicals leaching from plastic[2]. To investigate the impact of plastic on the digestive system, you may wish to model the digestive system with your class (for example, the Making Poo experiment). Students can then add a hard piece of plastic and assess how it impacts the digestive system model.

Scientists from Queensland Museum are constantly analysing evidence from animals to learn more about them. The gut content of animals allows scientists to analyse feeding relationships; it can also show us the impact that human waste, particularly plastics, can have on these animals. This can be seen from the plastics found in the Flesh-footed Shearwater and Green Turtles, shown in the gut content photo plates. Floating litter is hazardous to many marine animals. The stomach of a rare Bryde's Whale (*Balaenoptera edeni*) that washed ashore in 2000 contained a mass of plastic sheets, bait bags, zip-lock bags, fertiliser bags, frayed rope, shopping bags and several metres worth of plastic strips. Some of this material may have been accidentally ingested, mistaken for food[3].

In this activity, students investigate the impact of plastics on living things as they explore and analyse replicated gut contents of five animals.

The See-Scan-Analyse strategy has been used to structure this activity. Detailed step-by-step instructions can be seen below. It is recommended that you use these instructions to guide your students through the activity.

[2] Schuyler, Q., Hardesty, D.B., Wilcox, C., & Townsend, K. (2012). To eat or not to eat? Debris selectivity by marine turtles. *PLoS ONE 7*(10), 1-9. doi: 10.1371/annotation/0215f07d-0265-485c-966f-aee192a18313

[3] Czechura, G. (2013). The Great Barrier Reef: A Queensland Museum Discovery Guide. South Brisbane, Queensland: Queensland Museum

1. Present the following information to students:

   - In 2018, the Department of the Environment and Energy released findings from the 2017-18 Australian Plastics Recycling Survey.
   - Key findings from this survey indicated:
     – A total of 3.4 million tonnes of plastics were consumed in Australia.
     – A total of 320,000 tonnes of plastics were recycled.

2. Ask students to calculate approximately how many tonnes weren't recycled.

3. Discuss the following questions with the class group. You may wish to use the Think-Pair-Share strategy during this time.

   - Where did these plastics go?
   - Why is this problematic?

4. Introduce the ingestion of plastics by animals as a problem associated with plastic waste, if not already discussed by students. State that some living things are more vulnerable to ingesting plastics than others, and the ingestion of plastics can significantly affect the growth and survival of these organisms.

5. Introduce the activity. Students will:

   - Use gut content analysis to explore plastics ingested by varied animals.
   - Use information gathered during the gut content analysis to identify which animals are likely to have ingested observed materials.

6. Divide students into groups of two or three and distribute the gut content photo plates. Students use the See-Scan-Analyse strategy to engage with the photo plates. Distribute the animal cards to students after they have completed the Scan questions. Ask students to identify which animal is likely to have ingested the material shown in each photo plate. Students then complete the Analyse questions. Answers can be revealed after students have finished this activity. It is important to note with students that the animal cards used in this activity also show the gastrointestinal tract, and each of the animals have digestive accessory organs, including the liver, pancreas and gall bladder.

   - See: View the gut content photo plates.
     List the ingested material seen for each photo plate.
   - Scan: Use a magnifying glass to look closer at the gut contents.
     What do you notice about the ingested items?
     What do the images make you wonder?
   - Analyse: What type of animal ingested these items?
     How do you know?
     Why might this animal have ingested these items?
     How might these ingested items affect the animal?

7. After the completion of the activity, facilitate a whole-class discussion. You may like to pose the following questions during the discussion:

    - Which animals did you match to which gut content plates?
      What informed your decisions?
    - How might the ingested items affect the growth and survival of each animal?
    - How and why do the digestive systems differ between animals?
    - Compare each animal's diet and their digestive systems. Use this comparison to explain differences between the digestive system of each animal, and justify the purpose of these differences.
    - How might plastic in the digestive system impact the organism's access to the requirements for life (for example oxygen, nutrients, water and removal of waste) and the function of other body systems?
    - How might ingested plastics affect feeding relationships in varied habitats?
    - How might plastic waste affect food webs and food chains?
    - What does the gut content of each animal tell us about the influence of people on natural environments?
    - Could plastic waste create health problems for other animals living within these habitats? Which ones? What about humans?
    - Should we care about this issue? Why or why not?
    - How could we use this information to inform community action?
    - What further questions do we have about this issue? How might we find the answers to these questions?

The *Wild State* exhibition at Queensland Museum in South Brisbane highlights the extreme beauty, yet fragile state of each environment. It explores how we, the human race, need to protect and preserve our precious natural world for future generations. The *Death by plastic* display in this exhibition shows the plastics that have been found in five different species of seabird.

Curriculum Links

Science

YEAR 5

Science as a Human Endeavour

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

Science Inquiry Skills

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

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

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

YEAR 6

Science Understanding

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

Science as a Human Endeavour

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

Science Inquiry Skills

Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships in data using digital technologies as appropriate (ACSIS107)

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

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

YEAR 7

Science Understanding

Interactions between organisms, including the effects of human activities can be represented by food chains and food webs (ACSSU112)

Science Inquiry Skills

Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate (ACSIS129)

Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence (ACSIS130)

Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate (ACSIS133)

YEAR 8

Science Understanding

Multi-cellular organisms contain systems of organs carrying out specialised functions that enable them to survive and reproduce (ACSSU150)

Science Inquiry Skills

Construct and use a range of representations, including graphs, keys and models to represent and analyse patterns or relationships in data using digital technologies as appropriate (ACSIS144)

Summarise data, from students' own investigations and secondary sources, and use scientific understanding to identify relationships and draw conclusions based on evidence (ACSIS145)

Communicate ideas, findings and evidence based solutions to problems using scientific language, and representations, using digital technologies as appropriate (ACSIS148)

YEAR 9

Science Understanding

Multi-cellular organisms rely on coordinated and interdependent internal systems to respond to changes to their environment (ACSSU175)

Ecosystems consist of communities of interdependent organisms and abiotic components of the environment; matter and energy flow through these systems (ACSSU176)

Science Inquiry Skills

Use knowledge of scientific concepts to draw conclusions that are consistent with evidence (ACSIS170)

Communicate scientific ideas and information for a particular purpose, including constructing evidence-based arguments and using appropriate scientific language, conventions and representations (ACSIS174)

Humanities and Social Sciences

YEAR 5

Knowledge and Understanding: Geography

The influence of people, including Aboriginal and Torres Strait Islander Peoples, on the environmental characteristics of Australian places (ACHASSK112)

The environmental and human influences on the location and characteristics of a place and the management of spaces within them (ACHASSK113)

Inquiry and Skills

Locate and collect relevant information and data from primary sources and secondary sources (ACHASSI095)

Evaluate evidence to draw conclusions (ACHASSI101)

Work in groups to generate responses to issues and challenges (ACHASSI102)

Use criteria to make decisions and judgements and consider advantages and disadvantages of preferring one decision over others (ACHASSI103)

Reflect on learning to propose personal and/or collective action in response to an issue or challenge, and predict the probable effects (ACHASSI104)

Present ideas, findings, viewpoints and conclusions in a range of texts and modes that incorporate source materials, digital and non-digital representations and discipline-specific terms and conventions (ACHASSI105)

General Capabilities

Literacy

Comprehending texts through listening, reading and viewing

Composing texts through speaking, writing and creating

Numeracy

Estimating and calculating with whole numbers

Critical and Creative Thinking

Inquiring – identifying, exploring and organising information and ideas

Reflecting on thinking and processes

Analysing, synthesising and evaluating reasoning and procedures

Personal and Social Capability

Social awareness

Social management

Intercultural Understanding

Interacting and empathising with others

Cross-Curriculum Priorities

Sustainability

All life forms, including human life, are connected through ecosystems on which they depend for their wellbeing and survival. (O1.2)

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Student Activity

	SEE	SCAN
	List the ingested material seen in each photo plate.	What do you notice about the ingested items? What do you wonder about each image?
Photo Plate 1		
Photo Plate 2		
Photo Plate 3		
Photo Plate 4		
Photo Plate 5		

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Student Activity

	ANALYSE		
	What type of animal ingested these items? How do you know?	**Why might this animal have ingested these items?**	**How might these ingested items affect the animal?**
Photo Plate 1			
Photo Plate 2			
Photo Plate 3			
Photo Plate 4			
Photo Plate 5			

Gut Content Analysis: Student Photo Plates

Photo Plate 1

Gut Content Analysis: Student Photo Plates

Photo Plate 2

Gut Content Analysis: Student Photo Plates

Photo Plate 3

Gut Content Analysis: Student Photo Plates

Photo Plate 4

Gut Content Analysis: Student Photo Plates

Photo Plate 5

Gut Content Analysis: Teacher Photo Plates

Photo Plate 1 – Flesh-footed Shearwater

Gut Content Analysis: Teacher Photo Plates

Photo Plate 2 – Green Turtle

Gut Content Analysis: Teacher Photo Plates

Photo Plate 3 – Dingo

Gut Content Analysis: Teacher Photo Plates

Photo Plate 4 – Southern Cassowary

Gut Content Analysis: Teacher Photo Plates

Photo Plate 5 – Eastern Grey Kangaroo

Flesh-footed Shearwater

Ardenna carneipes

Habitat

Coastal, Marine

Interesting facts

The Flesh-footed Shearwater can dive to a depth of 4 metres to catch prey.

Adult shearwaters regularly regurgitate indigestible parts of their food. Chicks do not tend to regurgitate until they are almost fully developed and ready to leave the nest.

The Flesh-footed Shearwater is a trans-equatorial migrator, flying from the southern to the northern hemisphere after the breeding season.

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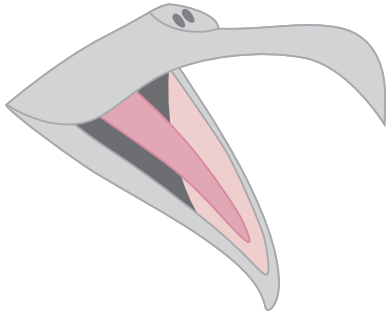
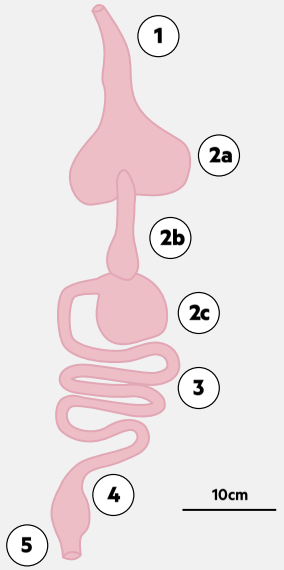
Mouth



Gastrointestinal tract

1. Lower oesophagus
2. Stomach
   - a. Crop
   - b. Proventriculus
   - c. Gizzard
3. Small intestine
4. Large intestine
5. Cloaca



Green Turtle

Chelonioidea mydas

Habitat

Marine

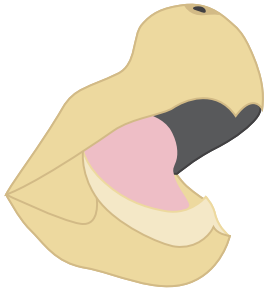
Interesting facts

The Green Turtle's name comes from the green colour of its fat, rather than the colour of its shell (carapace).

Adult Green Turtles feed mainly on seagrasses and algae, and occasionally jellyfish. Juvenile Green Turtles are carnivorous.

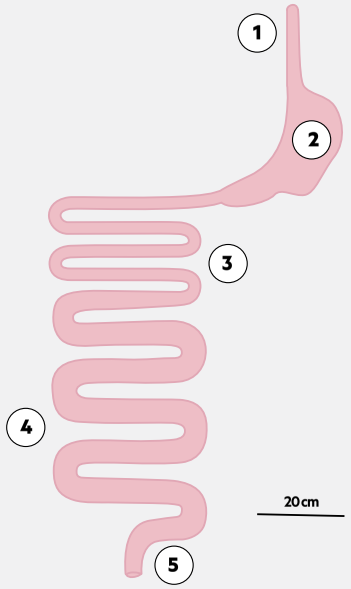
The oesophagus and mouth of sea turtles is lined with papillae, sharp prongs that point toward the stomach. Papillae help them hold onto and digest food.

Mouth



Gastrointestinal tract

1. Oesophagus
2. Stomach
3. Small intestine
4. Large intestine
5. Cloaca



Dingo

Canis lupus dingo

Distribution

Habitat

Arid outback, Open forest, Rainforest, Coastal

Interesting facts

The Dingo is thought to have been introduced to Australia by Asian seafarers over 4000 years ago.

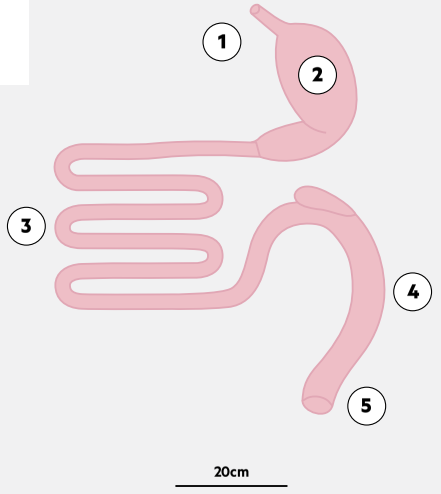
The colour of a Dingo's coat is largely determined by its environment.

Dingo saliva does not contain enzymes; it only lubricates food to aid in swallowing.

Mouth

Gastrointestinal tract

1. Lower oesophagus
2. Stomach
3. Small intestine
4. Large intestine
5. Rectum



Southern Cassowary

Casuarius casuarius

Habitat

Rainforest

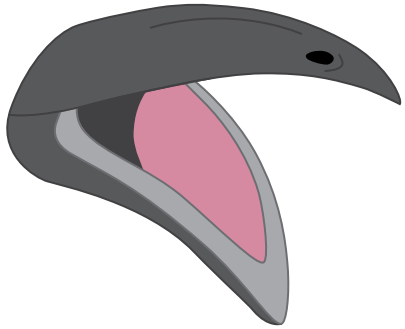
Interesting facts

The cassowary's digestive system is adapted to process many species of fallen fruits and fungi which are poisonous to humans.

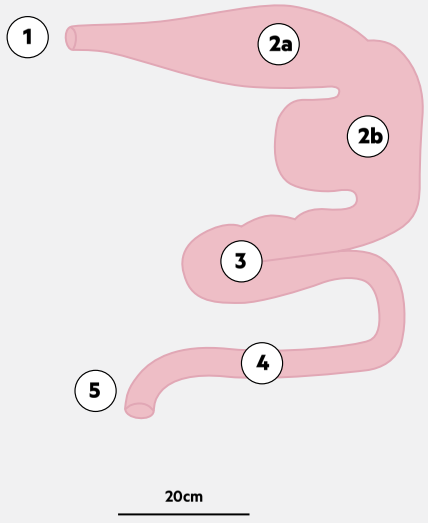
Cassowaries are keystone species due to their important role in seed dispersal. They have a short digestive system preventing the complete digestion of plant material. Due to this and their large size, they are the sole animal responsible for the distribution of over 100 species of plants.

The casque, or helmet, found on top of the cassowary's head is made of a foam-like material that is covered with a thick layer of keratin.

Mouth



Gastrointestinal tract



1. Lower oesophagus
2. Stomach
   - a. Proventriculus
   - b. Gizzard
3. Small intestine
4. Large intestine
5. Cloaca

Eastern Grey Kangaroo

Macropus giganteus

Distribution

Habitat

Open forest

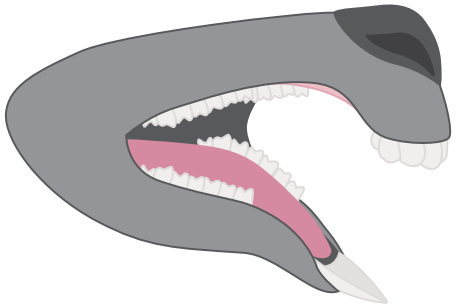
Interesting facts

The word kangaroo derives from 'Gangurru', the name given to Eastern Grey Kangaroos by the Guuga Yimithirr people of Far North Queensland.

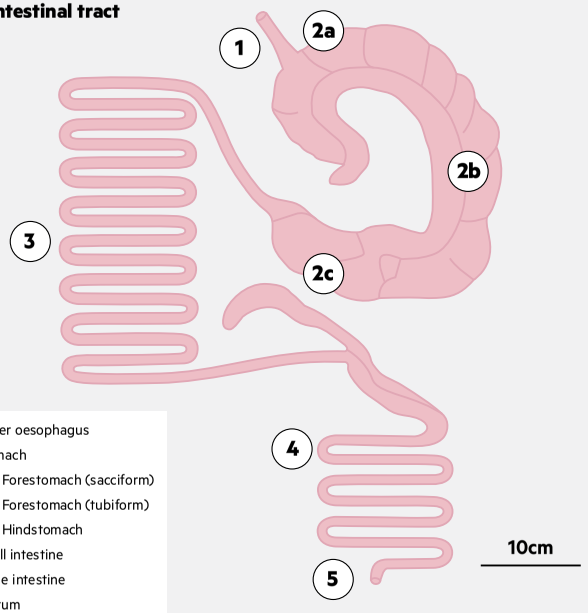
When full, a kangaroo's stomach can be up to 15% of its body mass.

Kangaroos can pause embryonic development during unfavourable conditions (embryonic diapause).

Mouth



Gastrointestinal tract



1. Lower oesophagus
2. Stomach
   - a. Forestomach (sacciform)
   - b. Forestomach (tubiform)
   - c. Hindstomach
3. Small intestine
4. Large intestine
5. Rectum

Human

Homo sapiens

Habitat

All

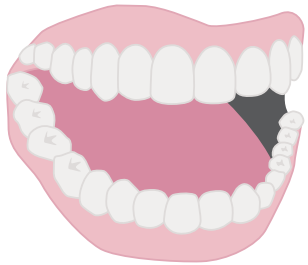
Interesting facts

Homo sapiens evolved in Africa around 200,000 years ago.

Scientific studies suggest the rate of human evolution increased with the advent of agriculture and cities.

A healthy person produces an average of 500 mL to 1.5 L of saliva a day!

Mouth



Gastrointestinal tract

1. Oesophagus
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5. Rectum