Who's Eating Who?

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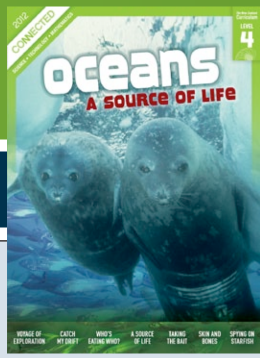
CONNECTED
SCIENCE • TECHNOLOGY • MATHEMATICS
2012 LEVEL 4



Overview

"Who's Eating Who?" introduces students to some of the creatures in the Antarctic food web. Students learn about some of the adaptations that enable these animals to survive in the harsh Antarctic environment.

Curriculum context

SCIENCE

NATURE OF SCIENCE

Participating and contributing

Achievement objective(s)

L4: Students will use their growing science knowledge when considering issues of concern to them.

L4: Students will explore various aspects of an issue and make decisions about possible actions.

LIVING WORLD

Ecology

Achievement objective(s)

L4: Students will explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human-induced.

Life Processes

Achievement objective(s)

L4: Students will recognise that there are life processes common to all living things and that these occur in different ways.

Key ideas

- All living things have adaptations that help them to survive in their habitat.
- Living things can alter their behaviour in response to a change in their environment.
- All living things are part of a balanced network of predators and prey. Consumers are dependent on other organisms.
- The surface area of a living thing directly influences its ability to conserve heat.

ENGLISH

READING

Ideas

Achievement objective(s)

L4: Students will show an increasing understanding of ideas within, across, and beyond texts.

Indicators

- Makes meaning of increasingly complex texts by identifying and understanding main and subsidiary ideas and the links between them.
- Makes connections by thinking about underlying ideas within and between texts from a range of contexts.
- Makes and supports inferences from texts with increasing independence.

The Literacy Learning Progressions

The literacy knowledge, skills, and attitudes that students need to draw on by the end of year 8 are described in *The Literacy Learning Progressions*.

MATHEMATICS AND STATISTICS

STATISTICS

Statistical investigation

Achievement objective(s)

L4: Students will plan and conduct investigations using the statistical enquiry cycle:

- … sort … data to detect patterns, variations, relationships and trends.

GEOMETRY AND MEASUREMENT

Measurement

Achievement objective(s)

L4: Students will use side or edge lengths to find the perimeters and areas of rectangles … and the volumes of cuboids.

Key idea

- Organising data can reveal trends.

Meeting the literacy challenges

The following strategies will support students as they engage with the information and ideas in the text. Once they understand what the article is about ("the story"), they will be able to explore the key science ideas outlined in the following pages.

The *Connected* series includes a range of texts that provide opportunities for students to locate, evaluate, integrate, and synthesise information and ideas.

It is expected that students will read across the range of texts in this *Connected* to develop their literacy skills and their understanding of the topic.

Text characteristics

- Explanatory text that covers a broad range of information
- Competing information
- A diagram that requires interpretation and text boxes that challenge the reader to solve numerical problems.

1. FINDING THE MAIN IDEAS

"Who's Eating Who?" introduces some of the animals that are part of the Antarctic food web. Although the text focuses on the food web, the article includes many other details about the animals' adaptations.

The main ideas in the text include:

- The living things that survive in the Antarctic are all part of a marine food web.
- Animals have adapted in different ways to the Antarctic environment.
- The Antarctic food web is a delicate system that could be disrupted by changes in climate.

IDENTIFY aspects of the structure such as the title, headings, diagrams, and photographs that help students navigate the article and locate the main ideas.

ASK QUESTIONS to support students to identify the main ideas.

What does the title suggest this article is about? Why?

How do the visual features on pages 14–21 support your predictions about the content?

MODEL the process of thinking aloud to show how predictions about the text can be tested and revised during reading.

I was expecting the article to be about animals eating animals, so I was surprised that the first sentence is about the size of Earth and the fourth discusses the harsh environment in Antarctica. However, reading the end of the paragraph, I can see that it's now mentioned the Antarctic food web.

2. MAKING CONNECTIONS

There is a range of competing information in the article. **PROMPT** the students to **MAKE CONNECTIONS** between the information in the text by **ASKING QUESTIONS**.

How does the information in the section headed "Amazing Feats" link back to the first paragraph?

What part of this section links to the diagram of the marine web?

Name three things that all the animals discussed in this article have in common.

At the end of the reading, students could complete a mind map in the form of a web, showing the links between the information.

3. INTERPRETING THE DIAGRAM TO CLARIFY THE TEXT

EXPLAIN that the diagram illustrates the interdependence of the creatures that are part of the food web.

PROMPT the students to review what they know about diagrams and the use of arrows to show connections. Have them share their ideas with a partner. Ask them to view the diagram together to work out what it shows.

The direction of the arrows can seem counter-intuitive. A food web shows how "energy" (food) moves through the web, which is why the arrow points away from the creature that is eaten towards the creature that eats it.

Note that the circles and arrows are only coloured differently to make it easier to trace the path of each arrow.

ASK QUESTIONS to clarify the information.

What do the arrows show? Why do the arrows point outwards from the creature being eaten rather than towards it?

Why are phytoplankton at the bottom of the web?

Why are whales at the top?

Why are the relationships between the organisms described as a "web"?

4. READING THE TEXT BOXES

IDENTIFY the text boxes on pages 18 and 19 and **EXPLAIN** that text boxes often include additional information.

ASK QUESTIONS to determine why the writer has included boxed text. Students can think, pair, share to answer these questions.

Why didn't the writer add the material in the text boxes as additional paragraphs?

How is the writing in the text boxes different from the writing in the main sections? (Questions directed to the reader and numerical content) *How do these help you as you read?*

Why does the writer address the reader and give them problems to solve? (To actively engage the reader) *How does this engage you in the information?*

Why wouldn't you get all the important information if you didn't read the boxed text?

What other section includes material written in the same style as in the text boxes?

Exploring the science

The following activities and suggestions are designed to support students to develop scientific understanding as they explore the concepts of adaptations, food webs, and the transfer of energy within a food web.

Key ideas

- All living things have adaptations that help them to survive in their habitat.
- Living things can alter their behaviour in response to a change in their environment.
- All living things are part of a balanced network of predators and prey. Consumers are dependent on other organisms.
- The surface area of a living thing directly influences its ability to conserve heat.

Begin by reading "Who's Eating Who?" This article describes the relationships between predators and prey in Antarctica and outlines some of the adaptations these living things have to help them survive. To find out more about Antarctic animals and their adaptations, visit: www.sciencelearn.org.nz/Contexts/Icy-Ecosystems

Activity 1: *Design an item of clothing*

In this activity, students learn about the adaptations of living things in Antarctica. They use this knowledge to design an outfit suitable for a visit to this icy continent.

Have students read the article and tell them to find examples of adaptations. Encourage students to focus on the structural rather than behavioural adaptations. (Structural adaptations are physical features that help the animal to survive; behavioural adaptations are things that animals do to survive.)

Ask the students to consider the following situation:

"You have been invited to join a research expedition to Antarctica. Use your knowledge of the adaptations of living things in Antarctica to design an outfit to wear while you are there."

Encourage the students to conduct further research. Useful links include:

www.sciencelearn.org.nz/Contexts/Icy-Ecosystems

www.sciencelearn.org.nz/Science-Stories/Research-Voyage-to-Antarctica

www.anta.canterbury.ac.nz/resources/adapt.html

Tell students to draw their design and then label the features that make it appropriate for Antarctica. Ask students to present their design to the class and to explain which Antarctic adaptations they based their design on.

Activity 2: *The impact of relative surface area*

In this experiment, students investigate the rate at which different forms of sugar dissolve. They then relate their findings to the relationship between relative surface area and heat loss.

Have students read "Big Works Better" on page 21. Note down any questions that the students have.

Arrange the class into groups. Each group will need icing sugar, white sugar, raw sugar, hot water, three teaspoons, three glasses, a stopwatch, and a measuring spoon.

Explain to the students that they will be conducting an experiment to compare the rates at which the three forms of sugar dissolve in hot water. Explain that a comparison can be made between the rate at which the sugar dissolves and the rate at which animals lose heat because both are influenced by relative surface area.

Talk the students through the POE (Predict, Observe, Explain) process. Have them predict and record which of the three types of sugar will dissolve the fastest and ask them to record their reasons.

Experiment

Students fill the three glasses with the same amount of hot water. Three students are allocated a different form of sugar:

- one teaspoon of icing sugar
- one teaspoon of white sugar granules
- one teaspoon of raw sugar granules.

Discuss the relative surface area of the three forms of sugar.

At a set time, the three students each place their teaspoon of sugar in a glass. Another student starts the stopwatch as soon as the sugar is added.

The students stir the water at the same rate. (They will need to watch each other to do this.) Record how long it takes until no sugar granules are visible in the bottom of the glasses.

To make the test fair, students could repeat the experiment. Students could also use different types of sugar, for example, a sugar cube or brown sugar.

Encourage students to discuss why some forms of sugar dissolved faster than others.

Discuss how the results relate to relative surface area. In the experiment, each glass had the same volume of sugar (one teaspoon), but the surface area of each unit was different. The icing sugar granules have a smaller volume and therefore a larger relative surface area. These granules dissolved first. Compare this concept to the relative surface area of living things in Antarctica.

Activity 3: *Thinking ethically*

Scientists consider many different perspectives and need to think ethically about possible actions. In this activity, students are guided through an ethical-thinking process much like the one scientists use.

Discuss and record the features of the toothfish that are described.

Arrange the class into groups and give them the following scenario:

"Scientists have discovered that the toothfish has an extremely slow heart beat – one beat every six seconds. This information could help scientists to find new ways to help people whose hearts slow down during operations or who have hypothermia. The scientists want to remove some toothfish from their natural environment so they can investigate how this species could help humans. This may cause harm to some toothfish, and some may die as a result."

Tell the students that they will now go through an ethical decision-making process to help them decide.

Use the Science Learning Hub Ethics thinking tool (http://www.sciencelearn.org.nz/Thinking-Tools/Ethics-thinking-tool/Teaching-Ethics) to guide small groups of students through the "Rights and Responsibilities" pathway of ethical thinking. Teachers will need to log in to the tool in advance to register their class and set up the toothfish scenario. If Internet access is limited, the different steps in the ethical-thinking approach can be recorded and presented to students.

Firstly, the students consider the following questions. These questions are from the Science Learning Hub website:

1. Who/what is affected by this issue?

2. What groups have rights associated with this issue? What are their rights?

3. Do these groups also have responsibilities? What are their responsibilities?

4. Do we value some rights more than others? Whose rights do we want to protect?

5. Do any codes, declarations, and/or conventions relate to this issue?

Next, students consider their answers to the questions above and come up with five possible responses. These responses can be ranked from 1 (most important) to 5 (least important).

Using all of the information, students then make a final decision about what the scientists should do.

To conclude the exercise, discuss these questions:

What did you find challenging about this task?

Did the thinking tool help you to make a decision? Why or why not?

In what types of situations might you use an ethical-thinking approach?

In what ways are ethical-thinking approaches useful?

MINISTRY OF EDUCATION RESOURCES

- Building Science Concepts: Book 4: *Animal Life Histories: Reproduction, Growth, and Change*
- *Making Better Sense of the Living World*, pages 11–12
- Constructing diagrams of food chains: http://scienceonline.tki.org.nz/Nature-of-science/Nature-of-Science-Teaching-Activities/Constructing-diagrams-of-food-chains
- www.sciencelearn.org.nz/Contexts/Icy-Ecosystems
- www.sciencelearn.org.nz/Science-Stories/Research-Voyage-to-Antarctica
- www.sciencelearn.org.nz/Thinking-Tools/Ethics-thinking-tool/Teaching-Ethics

FURTHER RESOURCES

- www.anta.canterbury.ac.nz/resources/adapt.html

Exploring the mathematics

In "Who's Eating Who?", students are presented with a rate (heart beats per minute) and a ratio (surface-area:volume ratio of cubes). They use this rate and ratio to make comparisons.

Key ideas

- Organising data can reveal trends.
- If two shapes are similar (that is, same in proportion if not in size), the larger shape will have a smaller surface-area:volume ratio than the smaller shape.

Activity 1: *Heart rate comparisons*

When students compare their heart rate to that of the Antarctic toothfish, they are using proportional reasoning. Proportion involves comparing one aspect of an object with another aspect. The emphasis is on the relationship between aspects, not the aspects themselves.

Students can work out how many times an Antarctic toothfish's heart beats per minute and compare it with their pulse. Alternatively, they can count the number of times their own hearts beat in 6 seconds.

Here are the average heart rates of some mammals. Show the table to the students and ask them whether they can identify a trend.

Animal	Average rate
Human	70
Cat	120
Cow	65
Dog	115
Guinea pig	280
Hamster	450
Horse	44
Rabbit	205
Rat	328

The animal with the fastest heart rate is the hamster. The slowest is the horse. This suggests that there may be a relationship between size and heart rate.

Have students work in groups to order the animals by size.

Is it true that larger mammals tend to have a slower heart rate?

The Antarctic toothfish is a very large fish. Discuss whether other types of fish are likely to have such a slow heart rate.

Activity 2: *Big is better*

On page 21, students explore the surface-area:volume ratio of two cubes in order to see why larger animals have a smaller relative surface area than smaller animals.

The relationship between surface area and volume can be surprising. If you take a cube and double the length of each side, the surface area of the enlarged cube will be four times that of the original and the volume will be eight times greater. This relationship is true for any geometric shape.

In the same way, if you could enlarge a penguin without changing its proportions, the enlarged penguin would have a larger surface-area:volume ratio than the small penguin. This is because surface area increases at a slower rate than volume.

The large size of emperor penguins is a structural adaptation. To conserve heat in the extreme Antarctic environment, emperor penguins use a behavioural adaptation: huddling.

By huddling in a big group, penguins make themselves into an even larger mass, further reducing the surface area exposed to the air and wind. The huddle continually reorganises itself so that penguins take turns on the edge of the huddle.

You can watch a time-lapse video of Emperor penguins huddling here: http://video.nationalgeographic.com/video/news/animals-news/antarctica-emperor-penguins-huddle-vin/

Give each student nine multilink cubes. Each cube represents a penguin. Have the students calculate the surface area of the following:

a. nine separate cubes (9 x 6 = 54 cm^2)

b. nine cubes joined in a row (9 x 4 + 2 = 38 cm^2)

c. nine cubes joined as a square (4 x 4 + 9 x 2 = 34 cm^2)

Penguins can't stand on top of each other, but if they could, what would be the most efficient way for them to huddle? Have the students find the smallest possible surface area when their nine cubes are combined.

MINISTRY OF EDUCATION RESOURCES

- http://nzmaths.co.nz/resource/volumes-cubes
- http://nzmaths.co.nz/resource/hot-dogs

FURTHER RESOURCES

- www.hhmi.org/biointeractive/heart_size/frames.html

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