Teacher Notes

Themes

- Ocean ecology
- Sustainability of plastic waste
- Marine research and conservation

Key learning outcomes

- Marine ecosystems provide vital resources we rely on for survival
- Discarded plastics spread and break up slowly in the environment
- Plastic waste is a growing health concern for humans and other organisms
- Scientists and the community are working together on solutions to plastic waste dispersal

Key curriculum areas

- **Science:** Science Understanding (Biological sciences; Chemical sciences; Earth and space sciences), Science as a Human Endeavour
- **English:** Language
- **Mathematics:** Statistics and Probability
- **Cross Curriculum Priority: Sustainability**

Publication details

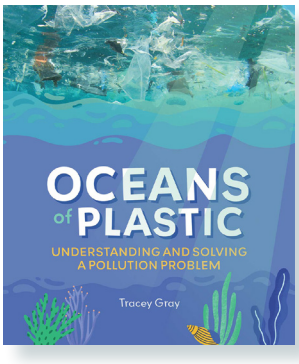
Oceans of Plastic: Understanding and Solving a Pollution Problem

ISBN: 9781486312573

Teacher notes prepared by Mike McRae.

CSIRO Publishing
Private Bag 10
Clayton South, VIC 3169, Australia

Website: www.publish.csiro.au
Tel: 1300 788 000 (local call in Australia)
Email: publishing.sales@csiro.au



Oceans of Plastic

Understanding and Solving a Pollution Problem

Tracey Gray

About the book

Our oceans are amazing! They are filled with wonderful sea creatures and are essential for a healthy planet. But it's now estimated that there are more pieces of plastic in the ocean than visible stars in the Milky Way. So how can we stop plastic from our homes and cities from ending up floating in oceans far away? By becoming ocean change-makers!

Oceans of Plastic explores how ocean systems and swirling currents bring plastics together into massive ocean garbage patches. It also uncovers the floating world of the 'plastisphere' – a mini community of microbes living on ocean plastics – and explains how plastic breaks up, not down, and can even end up on your dinner plate!

Oceans of Plastic is packed with great ideas and simple changes that you can make to help our oceans. Become an ocean change-maker in your home, school or community, and inspire others to join you in protecting the future of our oceans.

Recommended for

Readers aged 9 to 12 (Years 4 to 6)

CSIRO PUBLISHING

Teacher Notes

About the author

Tracey Gray is an aquatic scientist and environmental science teacher, who provides education programs for schools and educators. She cares deeply about the ocean, beaches and living creatures, and inspires everyday actions to create positive environmental change.

Pre-reading questions or activities

Plastics are a ubiquitous material we use in just about every facet of our lives. Ask students to identify objects in the room that are made of plastic, and to describe each item's properties. Is it malleable or hard? Is it colourful or transparent? Why might it be made of plastic and not wood or metal?

Discuss the life cycle of each item. How long might it be used for before it is discarded? Where might it end up one day?

Share with the students your expectations of some of the items, in how they break up and end up in waterways and eventually the ocean.

Discussion questions

Science

1. Read the quote 'Without oceans, there would be no life on Earth' on page 9 of *Oceans of Plastic*. Ask students their thoughts on the claim. Read through Chapter 1 and ask students to keep a list of all the ways oceans impact other parts of our planet, far and wide.
2. Ocean currents are like winds for the water. Ask students to consider a world without wind. What might happen to smoke and pollution? How might it affect transport? Temperatures? Read through Chapter 2 and encourage students to compare currents in the atmosphere with those in the ocean.
3. Plastics can get a bad rap thanks to their impact on the environment. Ask students to imagine a world without plastic at all. How might things change? What objects should remain plastic?
4. Large plastic items fragment into much smaller pieces called 'microplastics'. These do take a long time to break up, though. Read pages 44 to 46 and discuss with students how tiny pieces of plastic could potentially harm organisms, including ourselves.

5. Read the statistic on plastic bottles on page 47. Discuss with students ways they can reduce reliance on single-use bottles for carrying beverages. Expand this to include other materials, from coffee cups to cutlery and plastic bags. How much can they replace in their everyday lives with non-plastic items?
6. While most students will know it's important to recycle plastics, it can be confusing knowing precisely which plastic items can't be put into recycling bins. Ask students to share what they know about plastic recycling. Read page 52 and discuss how PET and other recyclable plastics can be identified.
7. Read pages 68 and 69 and discuss with students the way Persistent Organic Pollutants (POPs) can concentrate in predators. Discuss what this means for humans – as top-level feeders – eating large fish from the ocean.

English

1. Explain to the class how 'evaluative language' describes how we express judgement of something as good or bad, either using words like 'great' or 'terrible', or by implying something's value such as 'plastic is destroying our oceans'. Ask students their thoughts on the author's judgements of plastic waste. Invite them to use examples of language from the book that they would describe as evaluative.

Mathematics

1. Show students the pie-graph on page 38 and ask them to describe its meaning. Why might a pie-graph be a good way to show the information in simple terms? Could different colours be used? Compare the graph with the illustrations on page 59 and ask the students how they're similar.
2. The scale of the Great Pacific Garbage Patch can be difficult to imagine. Ask students to read 'How big is the Great Pacific Garbage Patch?' on page 40. Use a large box to represent 250 pieces of plastic of various sizes, from tiny flakes to large plastic bottles. Take students out to a basketball court and have three volunteers space themselves evenly around the court, explaining this is roughly the concentration of plastic in the garbage patch. Ask them to imagine everybody on the planet standing in a similar space with their own box. Discuss with the class whether this makes the huge size easier to comprehend.

Sustainability

1. Explain to students how a large amount of ocean plastic waste is from marine activities such as fishing. Read pages 73 to 74 and ask students about the pros and cons of using large nets to catch seafood. Invite them to share their experiences of beachcombing and finding plastic waste on the shore.
2. There are many things students can do to 'break up with plastics'. Read page 101 with the class and discuss the ways they might be able to reduce the amount of plastic they use each day. Ask them how they might encourage others in their school and home to do the same.

Activities

Science

Marine mimicry mobile

Sustainability: Only use existing plastic waste materials for the activity. Share the limited materials you have, even if it means doing this activity as a single class demonstration or reusing materials in multiple classes. Please dispose of the waste responsibly, recycling or reusing what you can.

Safety: This activity requires the use of sharp objects to cut materials. Some plastics might have sharp edges when cut or broken. Please assist students and be aware of their level of risk.

You will need

- Different examples of plastic waste materials (single-use containers, bags, bottles etc.)
- String
- Scissors
- Glue
- Sticky tape
- Sticks
- Small bits of card
- Pens

What to do

1. Spread out the different plastic materials on a desk.
2. Read page 57 together as a class and discuss how animals might perceive plastic waste as food items.
3. Work together in teams or as a class to transform different waste materials into items that resemble prey in the oceans, such as fish, jellyfish or eggs.
4. Use string to arrange the plastic marine animals so they balance on sticks like a mobile. Suspend the mobile somewhere in the classroom.
5. Write on a card the name of an animal that might eat the items, explaining what they could mistake the plastic for.

What's happening?

Predators use a range of clues to discern what is edible and what isn't. In the oceans, eyesight isn't always as handy as smell or touch, so a plastic bag could very easily appear like a jellyfish to a turtle through murky seawater. An algae-coated lid could smell like a string of delicious eggs to a fish.

Once eaten, the plastic can prove hard to digest, causing a range of problems for the predator. In the worst situations it could even prove fatal.

Current affairs

This activity works best as a demonstration using volunteers.

Safety: This activity uses hot, boiled water. Take care around students when transferring and using the water.

You will need

- A fish tank
- Room temperature water (enough to fill the fish tank)
- 2 × plastic containers
- Hot water (from a kettle or tap)
- Fridge
- Blue and red food colouring
- 2 × pipettes or eye droppers

What to do

1. Fill half a plastic container with water and add several drops of blue food colouring.
2. Place this blue-coloured water in the fridge at least one hour before the activity.
3. Place the fish tank in a prominent position where the class can see it easily and fill it three-quarters full with room temperature water.
4. Pre-boil water in a jug (or use hot water from a tap) and half-fill a plastic container with the hot water just before the activity is to be conducted. (Note: if a student is to be assisting, allow the water to cool slightly or mix with some cool tap water to avoid risk of scalding.)
5. Add several drops of red food colouring to the hot water.
6. Place the jug with hot water next to one side of the tank, and the jug with cold water next to the opposite side.
7. Fill one pipette with hot water and one with cold water. Squeeze one pipette into the right side of the tank, into a spot halfway down towards the bottom. Squeeze the other pipette into a similar spot on the left side of the tank, so that it's parallel with the first pipette on the opposite side for easy comparison (this step can be performed by yourself, or responsible students).
8. Watch how each colour spreads, noting whether one is rising more and the other is falling more.

What's happening?

Though it's hard to feel, a pipette full of hot water doesn't quite weigh the same as the same volume of cold water. As a fluid, like water, heats up, its particles jostle a little faster, taking up more room.

That means a drop of hot water will be a little less dense than a drop of cold water. When you place both of them in a tank of water with a temperature that's in between, the three liquids will form layers. The heated water will rise towards the top, the cold water will spread towards the bottom.

As ocean water warmed by the Sun mixes with waters chilled towards the planet's poles, the same thing happens on a much, much larger scale. This layering effect plays an essential role in helping currents form, mixing the ocean's waters and ensuring nutrients and gases reach all corners of the planet.

Milk to plastic

Safety: This activity uses heated milk. Take care around students when transferring and using the milk.

You will need

- Measuring cup
- Thermos
- Stove or microwave
- Teaspoons
- White vinegar
- Heat-resistant cup or mug
- Fabric (cheesecloth or old t-shirts)
- Paper towels (or coffee filters)
- Milk (1 cup per group)
- Optional: Food colouring, glitter, cookie cutters

What to do

1. The milk used in this activity needs to be heated to at least 50 degrees Celsius (hot enough for a good cup of tea). To avoid heating milk with students present, heat up enough to fill a thermos and take this into the classroom.
2. Break the class into a suitable number of groups, depending on availability of materials.
3. Provide each group of students with one heat-resistant cup (or mug) and a teaspoon.
4. Add 4 to 5 teaspoons of vinegar to each cup.
5. Add around 1 cup of hot milk to each cup. (Optional: students can also add a drop or two of food colouring at this point.)
6. Instruct students to stir the mixture carefully and observe closely.
7. Place a square of fabric on the table. Layer 3 squares of paper towel on top.
8. Instruct students to carefully scoop out the lumpy bits of milk, called curds, and place them onto the paper towel.
9. Ask students to then fold the cloth over the curds and lift it over the cup. They can then gently squeeze the curds to remove more of the liquid, called whey.
10. The students can then open the cloth and remove the ball of curds. They can now mould the ball into shapes, add glitter or add impressions. Once done, they can leave it on a piece of paper towel to dry and harden.

What's happening?

Milk is made of a variety of sugars, fats, proteins, minerals and vitamins – and a lot of water.

Most of the protein in milk is called casein. Adding vinegar forces the casein to unwind and change into a shape that tangles with other casein molecules easily. This turns it into a material that can be moulded, making it a form of plastic.

Unlike plastics we make from the long chains of hydrocarbon in oil, casein plastic will break down pretty easily in the environment and be consumed by bacteria before very long. This makes it biodegradable. Unfortunately, its properties don't make it a very useful plastic for making cups, cutlery or bags.

Scientists are exploring other materials from living sources that break down easily and can make plastics that are useful in many parts of everyday life.

Mathematics

Sort it out, Part 1

Plastic comes in a wide variety of forms, from hard and tough, to rubbery and bendable, to films that can be stretched and pulled tight. It can be clear or coloured, heavy or light, suiting many needs. This is one reason why plastic is literally everywhere.

Discuss with the class ways plastic waste might be sorted. Set up a plastic collection service in the school, inviting other classes to bring in plastic items they wish to throw out.

Invite students to come up with ways to categorise the plastic and count it. Discuss how it might be by mass, by item or by some other characteristic. Suggest how they might decide which items are recyclable. Once they have sorted the waste, discuss how they might represent these statistics using charts and graphs.

Have a conversation about ways they might be able to dispose of the waste. Where might they recycle it? Can anything be reused? How can the amount of landfill be reduced?

Instruct students to come up with a list of questions they could ask others in their school about their use and disposal of plastics. What do they find most confusing about recycling, for example? Explain what a survey is, and set aside time for the class to use their questions to collect data from their peers.

Sustainability

Sort it out, Part 2

Discuss the results of the survey in *Sort it out, Part 1* with the class, asking them how the data might be combined to form opinions on how to best encourage their peers to recycle plastic accurately. Help them turn these views into a strategy for promoting plastic recycling in the school.

Provide art materials, bins or other resources that could be used to market and encourage recycling and reusing plastic items.

Australian curriculum links

Year level	Learning area: Science	Other learning areas
Year 4	**Science Understanding: Chemical sciences** • Natural and processed materials have a range of physical properties that can influence their use (ACSSU074) **Science Understanding: Earth and space sciences** • Earth's surface changes over time as a result of natural processes and human activity (ACSSU075) **Science as a Human Endeavour** • Science knowledge helps people to understand the effect of their actions (ACSHE062)	**English** • Incorporate new vocabulary from a range of sources into students' own texts including vocabulary encountered in research (ACELA1498) **Mathematics** • Select and trial methods for data collection, including survey questions and recording sheets (ACMSP095) • Evaluate the effectiveness of different displays in illustrating data features including variability (ACMSP097)
Year 5	**Science Understanding: Chemical sciences** • Solids, liquids and gases have different observable properties and behave in different ways (ACSSU077) **Science as a Human Endeavour** • Scientific knowledge is used to solve problems and inform personal and community decisions (ACSHE083)	**Mathematics** • Pose questions and collect categorical or numerical data by observation or survey (ACMSP118) • Construct displays, including column graphs, dot plots and tables, appropriate for data type, with and without the use of digital technologies (ACMSP119)
Year 6	**Science Understanding: Biological sciences** • 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)	**English** • Investigate how vocabulary choices, including evaluative language can express shades of meaning, feeling and opinion (ACELA1525)
All	**Cross Curriculum Priority: Sustainability** • OI.1 The biosphere is a dynamic system providing conditions that sustain life on Earth.	

Related books from CSIRO Publishing

For younger readers:

- *Hold On! Saving the Spotted Handfish* (https://www.publish.csiro.au/book/7903)
- *The Great Southern Reef* (https://www.publish.csiro.au/book/8042)
- *The Way of the Weedy Seadragon* (https://www.publish.csiro.au/book/7982)

For older readers:

- *Ocean Animals: The Weirdest, Smartest and Sneakiest Sea Creatures* (https://www.publish.csiro.au/book/7881)

Other CSIRO resources

CSIRO has developed and delivered a broad range of high-quality STEM education programs and initiatives for nearly 40 years. Our programs aim to inspire the pursuit of further STEM education among students and the community, to equip the emerging workforce with tomorrow's skill sets, and to strengthen collaboration between industry and classrooms across Australia. For more information visit: https://www.csiro.au/en/Education