



Common
Seas

OCEAN PLASTICS

X-CURRIC | AGES 7-11



A resource by Common Seas

Gate House
2 High Street
Totnes TQ9 5RZ

Text © Common Seas CIC 2019

These resources may be reproduced for educational purposes only.

Written by Maddy Street and Jamie Buchanan-Dunlop
Edited by Megan Folan
Layout and design by Daniel Metson



Common Seas

Common Seas is a not-for-profit enterprise that researches, designs and implements practical project-based solutions to our global plastic pollution crisis. Our mission is to quickly and significantly reduce the amount of plastic waste produced and stop it polluting rivers and seas.

With thanks to

Association for Science Education
Design and Technology Association
Geographical Association

Contents

Foreword	page 4
Overview	page 5
Ocean Plastics learning objectives	page 6
Scheme of work	page 7
Resource guidance	page 14

Lessons

Lesson 1: What are plastics? Part one	page 15
Lesson 2: What are plastics? Part two	page 19
Lesson 3: Where are plastics? Part one	page 23
Lesson 4: Where are plastics? Part two	page 29
Lesson 5: What impact can plastic have? Part one	page 35
Lesson 6: What impact can plastic have? Part two	page 43
Lesson 7: What can I do? Part one	page 53
Lesson 8: What can I do? Part two	page 59
Lesson 9: Plastics - a design problem	page 63
Lesson 10: Plastics - a design solution	page 69

Welcome to Common Seas Education



Marine plastic pollution is a visible and pervasive environmental issue affecting all oceans. Recent media coverage has raised awareness of the topic, encouraging politicians, businesses and the general public to take much-needed action.

Common Seas believes that education can be an important part of the solution to addressing marine plastic pollution. The recent popularity of the topic of marine plastics has meant that there is a wealth of information and ideas for action scattered across the internet and other media.

Common Seas uniquely provides teachers with a full suite of resources across science, geography, and design and technology across Key Stages 1 to 3, that are designed to fulfil the English National Curriculum teaching requirements. Providing teachers with off the shelf lesson plans, presentations and activities they can choose to deliver in their entirety or use sections as appropriate.

Supporting a more sustainable relationship with the environment is not a quick fix, but a multi-generational endeavour. This is why Common Seas works with a range of partners to move marine plastics education from an important side issue into the mainstream.

Jo Royle
Managing Director
Common Seas

OVERVIEW

About Common Seas Education



We believe children and young people should be equipped with the skills, knowledge and experience that allow them to thrive in a world affected by climate change, while helping to create a greener, fairer and more sustainable future.

Common Seas Education provides knowledge-rich, hands-on learning experiences about plastic – including its growing role in the climate crisis. In this way, our resources exist to give every child a deeper understanding of sustainability and climate change, while helping them create tangible, positive changes in their homes, schools and wider communities.

How to use Common Seas Education

Common Seas Education provides fully resourced lesson plans and activities that enable you to teach sustainability, within the curriculum and through project-based learning. These resources have been designed to be an off-the-shelf teaching tool for your classroom. Of course, you know your students better than anyone and may want to adapt and change them to suit your needs.

Developed in collaboration with a broad coalition of educators, scientists and industry experts, we provide learning packages for geography, science, design & technology, citizenship and enrichment in primary and secondary schools.

The curriculum and beyond

The resources are aligned with the national curriculum and the DfE Strategy on Sustainability and Climate Change.

Common Seas has used the UNESCO Learning Objectives for the ocean¹ as a basis for creating a set of Ocean Plastics Learning Objectives to support educators in designing an appropriate set of learning opportunities for students. These learning objectives are listed in following section.

¹ UNESCO Ocean literacy for all: a toolkit <https://unesdoc.unesco.org/ark:/48223/pf000026072> (see page 24)

Learning objectives

Common Seas has worked with partners to create a set of universal Ocean Plastics Learning Objectives, utilising the frameworks developed by UNESCO and those working for Ocean Literacy. These learning objectives are listed below and are subscribed to by Common Seas Education partners. We hope that these overarching learning objectives are useful to other individuals and organisations planning their own education programming to help a plastic waste free future.

Ocean Plastics learning objective	Lessons									
	1	2	3	4	5	6	7	8	9	10
Cognitive learning objectives										
• The learner understands the fundamental properties of plastics, including the use of additives.	✓	✓								
• The learner understands the scope and geographical scale of plastic use and plastic pollution historically as well as current predictions.	✓		✓	✓						
• The learner understands the pathways through which plastics enter the ocean and marine life.			✓			✓				
• The learner understands the social, environmental and economic cost of plastics across its entire life cycle.			✓		✓	✓	✓			
• The learner can identify and evaluate ways to improve the sustainability of plastics at different stages of the product life cycle ¹ .		✓				✓	✓		✓	✓
Socio-emotional learning objectives										
• The learner can reflect on their own use of plastics, and how this use might affect the marine environment.	✓						✓			
• The learner actively seeks alternative designs, behaviours and practices that reduce their contribution to plastic pollution.							✓		✓	
• The learner can communicate the societal and environmental impacts of plastic use, referring to the scientific evidence base.										
• The learner is able to influence the behaviours and practices of others in their community in terms of plastic use and management.										
• The learner can collaborate at a range of scales to campaign for the reduction of plastic pollution.							✓	✓		
Behavioural learning objectives										
• The learner is able to access and improve waste management systems in their local area.										
• The learner can plan and implement campaigns that lead to a reduction in plastic pollution at a range of scales.										
• The learner is able to evaluate media narratives about plastic pollution and present a balanced judgement to their peers.										
• The learner is able to make informed decisions as a consumer to reduce plastic pollution.							✓			
• The learner is able to research different approaches to design, including circularity and biomimicry.										

¹ Including improved design, alternative materials, waste management and individual behaviour.

Applicable standards

National Curriculum for England Key Stage 2

KS2 Science	Lessons									
	1	2	3	4	5	6	7	8	9	10
Element of the Science Programme of Study										
Properties and changes of materials										
<ul style="list-style-type: none"> Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal), and response to magnets 	✓	✓	✓	✓						
<ul style="list-style-type: none"> Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic 	✓	✓	✓	✓						
<ul style="list-style-type: none"> Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda 		✓	✓							
Animals including humans										
<ul style="list-style-type: none"> Identify that animals, including humans, need the right types and amount of nutrition, and that they cannot make their own food; they get nutrition from what they eat 					✓					
<ul style="list-style-type: none"> Construct and interpret a variety of food chains, identifying producers, predators and prey 					✓					
Living things and their habitats										
<ul style="list-style-type: none"> Recognise that environments can change and that this can sometimes pose dangers to living things 					✓	✓	✓	✓		
Working Scientifically										
<ul style="list-style-type: none"> Plan different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary 	✓	✓					✓	✓		
<ul style="list-style-type: none"> Take measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate 	✓	✓					✓	✓		
<ul style="list-style-type: none"> Record data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, bar and line graphs 	✓			✓			✓	✓		
<ul style="list-style-type: none"> Use test results to make predictions to set up further comparative and fair tests 	✓									
<ul style="list-style-type: none"> Report and present findings from enquiries, including conclusions, causal relationships and explanations of and a degree of trust in results, in oral and written forms such as displays and other presentations 	✓	✓		✓			✓	✓		

Applicable standards

National Curriculum for England Key Stage 2

KS2 Geography		Lessons									
Element of the Geography Programme of Study		1	2	3	4	5	6	7	8	9	10
Human and physical geography											
<ul style="list-style-type: none"> Describe and understand key aspects of physical geography, including: climate zones, biomes and vegetation belts, rivers, mountains, volcanoes and earthquakes, and the water cycle 				✓	✓		✓	✓	✓		
<ul style="list-style-type: none"> Human geography, including: types of settlement and land use, economic activity including trade links, and the distribution of natural resources including energy, food, minerals and water 				✓	✓		✓	✓	✓		
Geographical skills and fieldwork											
<ul style="list-style-type: none"> Use maps, atlases, globes and digital/computer mapping to locate countries and describe features studied 				✓							
<ul style="list-style-type: none"> Use fieldwork to observe, measure, record and present the human and physical features in the local area using a range of methods, including sketch maps, plans and graphs, and digital technologies. 					✓						

KS2 English		Lessons									
Element of the English Programme of Study		1	2	3	4	5	6	7	8	9	10
Spoken language											
<ul style="list-style-type: none"> Listen and respond appropriately to adults and their peers 		✓	✓	✓	✓	✓	✓	✓	✓		
<ul style="list-style-type: none"> Ask relevant questions to extend their understanding and knowledge 		✓	✓	✓	✓	✓	✓	✓	✓		
<ul style="list-style-type: none"> Articulate and justify answers, arguments and opinions 		✓	✓	✓	✓	✓	✓	✓	✓		
<ul style="list-style-type: none"> Give well-structured descriptions, explanations and narratives 		✓	✓	✓	✓	✓	✓	✓	✓		
<ul style="list-style-type: none"> Maintain attention and participate actively in collaborative conversations 		✓	✓	✓	✓	✓	✓	✓	✓		
<ul style="list-style-type: none"> Use spoken language to develop understanding through speculating, hypothesising, imagining and exploring ideas 		✓	✓	✓	✓	✓	✓	✓	✓		
<ul style="list-style-type: none"> Participate in discussions, presentations, performances, role play, improvisations and debates 		✓	✓	✓	✓	✓	✓	✓	✓		
<ul style="list-style-type: none"> Consider and evaluate different viewpoints, attending to and building on the contributions of others 		✓	✓	✓	✓	✓	✓	✓	✓		
Writing - composition:											
<ul style="list-style-type: none"> composing and rehearsing sentences orally 		✓		✓							
<ul style="list-style-type: none"> organizing paragraphs around a theme 		✓	✓								
Reading - word reading:											
<ul style="list-style-type: none"> apply their growing knowledge of root words, prefixes and suffixes to read aloud and understand the meaning of new words that they meet. 			✓								

Applicable standards

National Curriculum for England Key Stage 2

KS2 Mathematics

Element of the Mathematics Programme of Study

Statistics

- Interpret and present discrete and continuous data using appropriate graphical methods, including bar charts and time graphs

Lessons									
1	2	3	4	5	6	7	8	9	10
			✓						

KS2 Design and technology

Element of the Design and Technology Programme of Study

Design

- Use research and develop design criteria to inform the design of innovative, functional, appealing products that are fit for purpose, aimed at particular individuals or groups
- Generate, develop, model and communicate ideas through discussion, annotated sketches, cross-sectional and exploded diagrams, prototypes, pattern pieces and computer-aided design

Lessons									
1	2	3	4	5	6	7	8	9	10
								✓	✓
								✓	✓

Make

- Select from and use a wider range of tools and equipment to perform practical tasks [for example, cutting, shaping, joining and finishing], accurately
- Select from and use a wider range of materials and components, including construction materials, textiles and ingredients, according to their functional properties and aesthetic qualities

								✓	
								✓	✓

Evaluate

- Investigate and analyse a range of existing products
- Evaluate ideas and products against design criteria and consider the views of others to improve work
- Understand how key events and individuals in design and technology have helped shape the world

								✓	✓
								✓	✓
									✓

Lesson 1: What are plastics? Part one

Overview

In this lesson students investigate the properties of materials and develop an understanding of why plastic is so widely used due to its versatility. They learn how plastic is produced and then go on to investigate which material is most effective for the purpose of insulation. The lesson concludes with an overview of the historical development of plastics where students identify significant events on a timeline.

Learning outcomes

- Match materials to their properties
- Understand the process of plastic production
- Describe why plastic is chosen over other materials
- Investigate which materials are the best insulators
- Review the historical development of plastics
- Reflect on why plastic is a versatile material

Resources



Slideshow 1:
What are plastics? Part one



Activity Overview 1a:
Insulation investigation



Student Sheet 1a:
Insulation investigation



Gallery:
How are plastic bottles made?



Thinglink:
Global plastics production

Lesson 2: What are plastics? Part two

Overview

In this lesson students continue to investigate different types of plastics, so that by the end of these first two lessons they are familiar with the seven types of plastic and what they are used for. Students identify why each type of plastic is well suited to its use. They go on to complete a practical to create their own plastic slime using borax and PVA glue (creating a polymer) and reflect on the variety of uses for plastics.

Learning outcomes

- Understand how to identify the seven types of plastic
- Describe the plastic production process
- Describe the recycling production process
- Create a polymer
- Reflect on sustainable alternatives to plastic

Resources



Slideshow 2:
What are plastics? Part two



Activity Overview 2a:
Making plastic



Student Sheet:
Innovation Diary



Gallery:
Where does plastic come from?

Gallery:
How is plastic recycled?



Thinglink:
Seven Types of plastic

Lesson 3: Where are plastics? Part one

Overview

In this lesson students follow the life cycle of a PET bottle. Using Google Maps, students track the journey a plastic bottle goes on during its lifetime and map the possible outcomes of where it could end up. Students will go on to discover some of the incredible uses for plastic (e.g. medical science and space exploration) and reflect on why single-use plastics continue to be used today and why they have become unpopular.

Learning outcomes

- Explore what happens to a plastic bottle after its first and only use
- Map the journey of a plastic bottle from production to recycling or litter
- Explore important uses of plastic
- Debate the pros and cons of plastics
- Reflect on the pros and cons of plastics

Resources



Slideshow 3:
Where are plastics? Part one



Activity Overview 3a:
Google maps



Student Sheet 3a:
Life cycle of a plastic bottle

Student Sheet:
Innovation Diary



Gallery:
Plastic recycling
Fantastic plastic



Thinglink:
Life cycle of a PET bottle

Lesson 4: Where are plastics? Part two

Overview

In this lesson students will explore what happens to plastic that is not recycled. They will discover what happens to plastic that ends up in the ocean and examine data from a sample of litter collected on Henderson Island. They go on to consider where the plastic litter could have come from and create a bar graph representing this data. After this, they will think about how they could recreate the Henderson Island data collection in their local area. They will plan and conduct fieldwork, after which they will analyse their own data collections. You may need more than one session to complete this lesson in order to conduct the fieldwork.

Learning outcomes

- Examine data from a beach clean up
- Create a bar graph demonstrating the amount of plastic litter collected
- Plan and conduct fieldwork to research the levels of plastic pollution in the local area.
- Create a bar graph demonstrating the amount of plastic litter collected
- Explore alternative uses for a range of discarded plastics

Resources



Slideshow 4:
Where are plastics? Part two



Student Sheet 4a:
Henderson Island

Student Sheet 4b:
Plastic fieldwork
record sheet.

Student Sheet:
Innovation Diary

Lesson 5: What impact can plastic have? Part one

Overview

In this lesson students are introduced to microplastics and ocean plastic pollution and begin to understand how and why it occurs through investigating one of three case studies. They go on to discover some of the dangers plastic pollution and microplastics can pose to marine life and consider how entire food webs are impacted.

Learning outcomes

- Contextualise and understand ocean plastic pollution statistics
- Investigate different ways plastic pollution affects marine life
- Explore three case studies related to ocean plastic pollution
- Understand the impact of microplastics on food webs
- Reflect on how plastic pollution impacts the wider food web

Resources



Slideshow 5:
What impact can plastic have? Part one



Activity Overview 5a:
Food webs



Student Sheet 5a:
Plastic pollution case studies



Gallery:
Marine plastic pollution

Gallery:
Coral life (advanced)

Lesson 6: What impact can plastic have? Part two

Overview

This lesson sees students investigate how plastics get into the oceans and affect marine life. Students discover how plastic pollution doesn't start when plastic enters the ocean. They go on to consider economic, political and social elements of human geography that impact ocean plastic pollution. Students examine case studies relating to plastic pollution at home and abroad to consider the social and economic impacts.

Learning outcomes

- Describe three ways in which ocean plastic pollution can occur
- Discover some of the ethical and societal issues related to ocean plastic pollution
- Discuss and describe how plastic pollution is linked to economics, human rights and sustainability
- Reflect on the sustainable development goals

Resources



Slideshow 6:
What impact can plastic have? Part two



Student Sheet 6a:
Case Studies

Student Sheet 6b:
Plastic profiles

Student Sheet:
Innovation Diary



Gallery:
Marine plastic pollution

Lesson 7: What can I do? Part one

Overview

The last two lessons in this unit challenge students to work collaboratively to create a campaign based on the 6 Rs. First students find out about innovation, development and policy changes that have recently occurred. They are then briefed on their mission – to reduce the amount of plastic consumption in their school community. In groups students then design and implement their campaign, planning and launching it over the following week.

Learning outcomes

- Name the 6 Rs and explain what each one means
- Understand developments in technology and innovation regarding plastics pollution
- Discover how recent policy has been proposed and enacted relating to plastics pollution
- Reflect on how they can make a difference
- Work collaboratively to plan a plastics pollution campaign

Resources



Slideshow 7:
What can I do? Part one



Student Sheet 7a:
Our plastics project

Student Sheet:
Innovation Diary

An interim lesson can follow this lesson for students to continue to work on their campaigns, measure progress, make changes and / or work on promoting their cause. They might wish to conduct surveys during this time, analyse their data and make promotional materials.

Lesson 8: What can I do? Part two

Overview

In the last lesson students review the success of their campaign and the impact it had on plastic consumption. They review their targets, reflect on what went well and decide what they would do differently. They then share their results and discuss what they could do going forward. The unit of work could end with an assembly for students to share their findings and continue to spread their message.

Learning outcomes

- Review the impact of their campaign
- Reflect on achievements and challenges
- Share findings and results with a wider audience
- Reflect on how they can make a difference
- Discuss what they plan to do next

Resources



Slideshow 8:
What can I do? Part two



Student Sheet:
Innovation Diary

Lesson 9: Design Technology - The plastics problem

Overview

In this lesson students are posed with a problem; they need to design a product which can carry a number of items from one location to another. They should attempt to design a new product and consider its features including strength, usability and materials. Students go on to evaluate existing solutions to this product in terms of strength, cost, aesthetics, usability and sustainability. Finally, they conclude by evaluating whether a new product is required or whether there are already suitable alternatives.

Learning outcomes

- Understand design criteria
- Develop and communicate ideas
- Discuss purpose, function and appeal of products
- Investigate and analyse a range of existing products
- Evaluate ideas and products

Resources



Slideshow 9:
The plastics problem



Student Sheet 9a:
Solutions sheet

Student Sheet 9b:
Product analysis



Thinglink:
What's your bag?

Lesson 10: Design Technology - The plastics solution

Overview

Students explore a range of products which have been redesigned with sustainability in mind. They then consider some of the other single-use plastics they know of and choose one to redesign focussing on sustainability. Students then develop their designs considering the materials they will use and how it will be manufactured, pitching their idea to the class and reflecting on feedback. At the end of these two lessons students can produce a prototype.

Learning outcomes

- Understand key events which have shaped the redesign of plastic products
- Research and develop an idea
- Model and communicate designs in a variety of forms
- Evaluate ideas against criteria and consider the views of others
- Select a range of tools and materials to develop a product

Resources



Slideshow 10:
The plastics solution



Student Sheet 10a:
Product design

Teacher guidance

The Teacher Guidance for each lesson uses a set of icons as seen below to provide visual clues to support teachers:

Lesson activities

**Explain**

teacher exposition using slides or script to support

**Demonstration / watch**

students watch a demonstration or video

**Student activity**

activity for students to complete individually such as questions on a Student Sheet

**Pair activity**

activity for students to complete in pairs

**Group work**

activity for students to complete in groups

**Whole class discussion**

teacher conducts a whole class discussion on a topic or as a plenary review

**Home learning**

home learning exercise for after school or alternatively, a lesson extension

Teacher ideas and guidance

**Assessment and feedback**

guidance to get the most from AfL (Assessment for Learning)

**Guidance**

further information on how to run an activity or learning step

**Idea**

optional idea to extend or differentiate an activity or learning step

**Information**

background or further information to guide an activity or explanation

**Technical**

specific ICT or practical hints and tips

**Health and safety**

health and safety information on a specific activity

What are plastics?

Part one



Age 7-11



60 minutes

Curriculum links

- Compare and describe the properties of materials
- Predict and draw conclusions on the uses of materials based on fair tests

Writing - composition:

- Composing and rehearsing sentences orally
- Organizing paragraphs around a theme

Resources



Slideshow 1:

What are plastics? Part one



Activity Overview 1a:

Insulation investigation



Student Sheet 1a:

Insulation investigation



Gallery:

How are plastic bottles made?



Thinglink:

Global plastics production

Lesson overview

How did plastic become so commonplace? In this lesson students explore the properties of different materials to see what makes plastic stand out. They learn how plastic is produced and then go on to investigate which material is most effective for the purpose of insulation. The lesson concludes with an overview of the historical development of plastics with students locating significant events on a timeline.

Lesson steps

Learning outcomes

1. Properties of materials (10 mins)

To recap prior knowledge students match material cards to their properties and uses.

- Match materials to their properties

2. How is plastic produced? (10 mins)

Students look at Gallery: PET bottle production illustrating how a plastic bottle is produced and then order the events chronologically.

- Understand the process of plastic production

3. Why plastic? (5 mins)

Discuss why plastic has become so popular, due to its versatility and low cost. Take feedback on what students know about the uses of plastics.

- Describe why plastic is chosen over other materials

4. Investigation (20 mins)

Students conduct an experiment to find out which material is the best insulator. Using a hot drink, they make predictions, measurements and draw conclusions.

- Investigate which materials are the best insulators

5. Plastic timeline (5 mins)

Students discover how recently plastic was developed through studying a timeline of significant plastic events.

- Review the historical development of plastics

6. Innovation Diary (10 mins)

In the final stage of the lesson, students will be shown how to create their own Innovation Diary. They will then complete the first entry in them, reflecting on the various uses of plastic, its versatility and development.

- Reflect on why plastic is a versatile material

Extension or home learning

Take the '**Plastic Quiz**' to put your family's knowledge to the test!

<https://encounteredu.com/steam-activities/plastic-quiz>

Make a list of items around the home that are made from plastic, that in the past were made from a different material. For example, UPVC window frames; window frames were traditionally made from wood. They can then share their findings with the class.

Step Guidance

Resources

1
10
mins



Step 1 recaps students' prior knowledge of materials and their properties.

- Explain that today students will be discussing the properties of materials.
- Use slides 1-6 to look at a variety of materials, pointing out the properties of each one.
- Slide 7 explains that children should match the 4 images of materials to the descriptions of their properties that are all on the slide. Ask students if they can think of any objects at home or here in the classroom that are made of the materials up on the board.

Slideshow 1:
Slides 1-7

2
10
mins



Next students discover how PET bottles are produced. PET stands for polyethylene terephthalate and is most commonly used to make single-use plastic drinks bottles. Around 13 billion of these bottles are produced in the UK each year and recent government statistics suggest only around 7.5 billion are recycled.

- Look at the Gallery which illustrates the process of manufacturing a PET bottle.
- Look at slide 9 and ask students to discuss in pairs which order the events go in.
- Reveal the correct order on the following slide.
- Allow students an opportunity to ask questions and share reactions.

Slideshow 1:
Slides 8-10

Gallery:
How are plastic bottles made?

3
5
mins



In this step students discuss why plastic is so popular as a material choice.

- Using slide 11 discuss with students how versatile plastic is and how its low production costs have made it a popular choice for manufacturers.
- Ask students to share what they know about the uses of plastic, what products they know to be made from plastic and why they think plastic was chosen for that particular product.

Slideshow 1:
Slide 11

Step Guidance

Resources

4
20
mins



Step 4 sees students investigate which materials are the most effective insulators.

- Using slide 12 explain that students will be testing a range of materials to find out which is the most effective insulator.
- Recap vocabulary with students and demonstrate which materials are available for testing, ensuring products such as foam are understood to be types of plastic.
- Using Activity Overview 1a: Insulation investigation facilitate students running their own investigation.
- On Student Sheet 1b students record their predictions, method and conclusions during the investigation.
- Record student's findings on a flip-chart or white-board and as a class identify the most effective insulator.
- Explain that the versatility of plastic, for purposes such as insulation is one of the reasons it is so popular.
- Discuss how this test could be made fairer.

Slideshow 1:
Slide 12-13

Activity Overview 1a:
Insulation investigation

Student Sheet 1b:
Insulation investigation

5
10
mins



Next students find out how recently plastic has become a commonplace material.

- Using Thinglink: Global plastics production review the significant developments in the history of plastic. Explain how plastic surged in popularity during the 20th century but has only been around for a relatively short period of time.
- Ask students to think about how plastic influences their lives and what they think the most important use of plastic is.

Slideshow 1:
Slide 14

Thinglink:
Global plastics production

6
10
mins



Students will now use scrap paper to create their own Innovation Diary, which they will use at the end of every lesson throughout this unit.

- Follow the instructions on slide 15 for how to fold a sheet of paper to create the diary. You may wish to model this first so that students can see how to do it for themselves.
- Once they have finished creating their diaries, move on to slide 16 and give students the opportunity to make their first entries.

Slideshow 1:
Slides 15-16

Scrap paper

Insulation investigation



Name of material:

Things we will change

Things we will keep the same

Prediction

Method

Conclusion

Results

Time (minutes)	Temperature
0:00	
2:00	
4:00	
6:00	
8:00	
10:00	

What are plastics?

Part two



Age 7-11



60 minutes

Curriculum links

- Investigate and understand how plastic is produced and recycled
- Investigate how to produce a polymer
- Reflect on sustainable alternatives to plastics

Reading - word reading:

- apply their growing knowledge of root words, prefixes and suffixes to read aloud and understand the meaning of new words that they meet.

Resources



Slideshow 2:

What are plastics? Part two



Activity Overview 2a:

Making plastic slime



Student Sheet:

Innovation Diary



Gallery:

Where does plastic come from?



Gallery:

How is plastic recycled?

Thinglink:

Seven types of plastic

Lesson overview

Plastic is not just one product but comes in many different forms. In this lesson, students will learn about the different types of plastic and why each type might be useful. Students will then complete a practical activity creating their own plastic slime using PVA and borax (which makes a polymer) and reflect on the variety of uses for plastics.

Lesson steps

Learning outcomes

1. Plastic production (10 mins)

Re-cap from Lesson 1. Students look at Gallery: Plastic production and discuss how plastics are produced (from crude oil to injection moulding). Students order the significant events in this process and then find out what is meant by monomer and polymer.

- Understand how to identify the seven types of plastic

2. Plastic identification (10 mins)

Students understand that plastic comes in seven different forms and can be identified by looking for a number, usually on the underside of a product. Students examine different plastics and group them accordingly.

- Describe the plastic production process

3. Plastic recycling (10 mins)

Students look at Gallery: Plastic recycling which demonstrates how plastic is sorted, washed, shredded and reused in a down-cycling process.

- Describe the recycling production process

4. Making plastic slime (20 mins)

Students complete Activity Overview 2a: Making plastic slime, in which they create a polymer using borax and PVA glue.

- Create a polymer

5. Innovation Diary (10 mins)

Students consider alternatives for plastic bottles and discuss whether they are sustainable or not.

- Reflect on sustainable alternatives to plastic

Extension or home learning

Fantastic Plastic:

<https://encounteredu.com/steam-activities/fantastic-plastic>

In this activity, students will build a really strong bridge, one with plastic and one with paper. They will investigate how strong each material is.

Step Guidance

Resources

1
10
mins



Students should re-cap what they learned about where plastic comes from in Lesson.

- Look at Gallery: Plastic production. Discuss with students the process of plastic production from drilling for crude oil, through to injection moulding plastic bottles. Encourage students to make notes.
- Ask students to order the process of plastic production. This can be done as a mini-whiteboard activity using the boxes on Slide 5.
- Explain what is meant by monomer and polymer. Link this to their Greek roots (mono and poly) to consolidate their understanding of the words.

Slideshow 2:
Slides 3-5

Gallery:
Plastic production

2
10
mins



In step 2 students discover the different forms plastic takes.

- Explain that every plastic product can be identified by locating a number, usually on the underside of the product.
- Using Thinglink 7 Types of plastic by clicking 'View Gallery' on slide 7. Talk through each type of plastic and where it is commonly found.
- Give students a range of plastic products and ask them to identify the type of plastic they are made from.

Slideshow 2:
Slides 6

Thinglink:
7 Types of plastic

3
10
mins



In step 3 students find out about the recycling process.

- Look at Gallery: Plastic recycling, which demonstrates how plastics are sorted, washed, shredded and then reformed into other products.
- Explain that the plastic that is reclaimed from the recycling process is down-cycled and does not create new PET bottles but is used in products such as polyester clothing and loft insulation.
- Ask students to list with a partner some of the items that are made from recycled PET bottles, based on what they saw in the gallery.
- Students feedback whether they are surprised by what they found out about plastic recycling.
- Using slide 10 explain that this type of plastic cannot be reused over and over due to the way that heat and light effect the structure of the plastic, causing it to leach harmful chemicals.

Slideshow 2:
Slides 15-17

Gallery:
How is plastic recycled?

Step	Guidance	Resources
4 20 mins	 <p>Step 4 sees students complete a practical activity to create a polymer and make plastic slime by mixing PVA glue and borax.</p> <ul style="list-style-type: none"> · Activity Overview 2a will give you guidance on how to organise the activity, the resources that the students will need and the method to follow. · Explain how mixing the two ingredients creates a polymer and can take the form of both a liquid and a solid. · Use slide 13 to discuss reversible and irreversible changes in plastics. 	<p>Slideshow 2: Slides 18-19</p> <p>Activity Overview 2a: Making plastic slime</p>
5 10 mins	 <p>Finally, students reflect on their learning in their Innovation Diaries.</p> <ul style="list-style-type: none"> · Ask students to reflect on what they now know about recycling plastic. · They should consider the alternatives to PET bottles and say whether they are sustainable. 	<p>Slideshow 2: Slides 20-21</p> <p>Student Sheet: Innovation Diary</p>
+ 10 mins	 <p>Students conduct a brief survey of their friends and family investigating how many of them use a keep-cup or reusable water bottle. They can then share their findings with the class.</p>	

Making plastic slime



Age 7+
(adult supervision)



20 minutes

Details

What you need

- PVA glue
- Cups / containers
- Food colouring
- Water
- Borax powder (available at most large grocery stores near the laundry detergent)
- Table spoon (for stirring and measuring)

Safety and Guidance



Precautions

Care should be taken to avoid spills. Do not ingest any of the ingredients.

- Remind students and demonstrate how to conduct the investigation safely.

Overview

Students combine borax and PVA glue to make a slime-like plastic which is a type of polymer and takes the form of both a liquid and a solid. Slime should be kept in a sealed bag when not in use as it can become quite messy.

Preparation

It may be preferable to run this activity in small groups with an adult as extra support may be required.

Running the Activity

Briefing

1. Fill one small cup with water and add a spoonful of the borax powder and stir it together. Set it aside.
2. Fill the other small cup with about 2.5 cm of glue.
3. Add three tablespoons (20 ml) of water to the glue and stir.
4. Add a few drops of the food colouring and stir it until mixed.
5. Add one tablespoon of the Borax solution you made earlier and stir well. Watch the slime form.
6. After the slime forms let it sit for about 30 seconds and then pull it off the spoon and play with it!

Expected results

- In this activity students create a polymer that has the properties of both a liquid and a solid. Solid molecules are close together, liquid molecules are spread out, and polymer molecules chain themselves together. Polymer molecules are found in things like rubber bands, trainer soles, plastic water bottles and even chewing gum. The slime should take the form of a liquid when placed in a beaker, yet has the properties of a solid when handled, stretched and squeezed.

Where are plastics?

Part one



Age 7-11



60 minutes

Curriculum links

- Investigate and understand how plastic bottles are recycled
- Create a new product by reusing a single-use bottle
- Reflect on sustainable alternatives to single-use plastics

Geographical skills and fieldwork

- Use maps, atlases, globes and digital/computer mapping to locate countries and describe features studied

Writing - composition:

- composing and rehearsing sentences orally

Resources



Slideshow 3:
Where are plastics?
Part one



Activity Overview 3a:
Google maps



Student Sheet 3a:
Life-cycle of a plastic bottle

Student Sheet:
Innovation Diary



Gallery:
Plastic recycling
Fantastic plastic



Thinglink:
Life cycle of a PET bottle

Lesson overview

In this lesson students follow the life cycle of a PET bottle. Using Google Maps, students track the journey a plastic bottle goes on during its lifetime and map the possible outcomes of where it could end up. Students will go on to discover some of the incredible uses for plastic (e.g. medical science and space exploration) and reflect on why single-use plastics continue to be used today and why they have become unpopular.

Lesson steps

Learning outcomes

1. The PET bottle (5 mins)

Students discuss what they think happens to plastic bottles once they've finished with them and explore some statistics about plastic use, recycling and litter.

- Explore what happens to a plastic bottle after its first and only use

2. The plastic journey (15 mins)

Using Google Maps students plot the journey of a PET bottle from the drilling of oil to the retailer, right through to its arrival at a recycling centre. Note: A Google account is needed to complete this activity.

- Map the journey of a plastic bottle from production to recycling or litter

3. Fantastic plastic! (10 mins)

Students look at Gallery: Fantastic plastic to discover some of the fascinating ways plastic is used to improve our health, life and scientific endeavours.

- Explore important uses of plastic

4. Pros and cons (20 mins)

Students will have a debate about the pros and cons of plastic use. They will be encouraged to engage with a debate question and be given some time to formulate their response before having a short, whole class, debate.

- Debate the pros and cons of plastics

5. Who needs plastic? (10 mins)

Students write an entry in their Innovation Diary, summarising how they feel about the different uses for plastics, which are important and which are unnecessary.

- Reflect on the pros and cons of plastics

Extension or home learning

Students can complete a practical activity which demonstrates one way in which plastic bottles could be re-used.

TEACHER GUIDANCE 3

Step Guidance

Resources

1
5
mins



- In step 1 students develop their understanding of what happens to a PET bottle after its one and only use.
- Re-cap what they learned in the last lesson about the recycling of plastic. Ask students what they think happens to PET bottles once they have been discarded.
- Draw out answers related to landfill, recycling, litter etc.

Slideshow 3:
Slides 1-6

Gallery:
Plastic recycling

2
15
mins



Step 2 sees students use Google maps to track the journey of a PET bottle during its life. This can be done as a whole class activity or as a partner/group activity if time allows.

- Remind students that PET bottles are not recycled into new bottles but are down-cycled by reminding them of what they learned about the recycling of plastic.
- Students then plot on a map a possible journey a PET bottle might go on during its life time using the information on Student Sheet 3a.
- Using Activity Overview 3a: Google maps students can either plot the stages provided or can research local amenities to plot. If Google maps is not available then a printed map of northern Europe will work for this activity.
- Using slides 8-12 discuss and contextualise some of the statistics around plastic use and recycling, using relatable examples.

Slideshow 3:
Slides 7-12

Activity Overview 3a:
Google maps

Student Sheet 3a:
Life-cycle of a plastic bottle

Thinglink:
Life cycle of a plastic bottle

3
10
mins



The next step reminds students that not all plastic is bad, some of it is incredible and we rely on it for all sorts of fascinating reasons.

- Look at Gallery: Fantastic plastic to discover some of the incredible uses of plastic.
- Using the Fantastic Plastic gallery, explain that without plastics we would not have developed as many medical, technological and innovative procedures that are of huge scientific importance. Explain that making things in plastic is cheaper so it makes many of these innovations accessible to more people.

Slideshow 3:
Slides 13

Gallery:
Fantastic plastic

Step Guidance

Resources

4
20
mins



In step 4 students reflect on the pros and cons of plastics by having a debate.

- Ask students to decide whether they agree or disagree with the debate question: 'Is plastic fantastic?'
- Give them 5 minutes make some notes that they can then use to help them during the debate. Make it clear to them that they must use evidence (from the lesson) to justify their opinions.
- Have the students decide on the rules for a good debate: how will they ensure that everyone gets a chance to speak, and how will they ensure that everyone's opinions are respected? Once they have agreed upon these rules, they can begin.

Slideshow 3:
Slide 14

5
10
mins



The last step in today's lesson is for students to reflect on the pros and cons of plastics.

- Ask students to write in their Innovation Diaries reflecting on how they currently feel about plastic as a material, where it is vital and where it is unnecessary.

Slideshow 4:
Slides 16

Student Sheet:
Innovation Diary

+
20
mins



Students will complete a practical activity which demonstrates two ways plastic bottles can be re-used.

- Using Activity Overview 3b and 3c students make either a bird feeder or snack box, re-using a discarded plastic cola or milk bottle. These can be handed out, or students can follow the links to use the instructions online.
- Encourage students to evaluate their new product and give feedback to the class.

encounteredu.com/steam-activities/make-your-own-snack-box

encounteredu.com/steam-activities/make-your-own-plastic-bird-feeder

Activity Overview 3b and 3c

Google maps



Age 7+
(adult supervision)



15 minutes

Details

What you need

- Laptops or computers
- Google account

Find out more

The stages provided are based on the following facts. The UK imports most of its crude oil from Norway. Fawley Oil refinery is the largest in the UK. Hemswell in Lincolnshire is home to the largest PET bottled manufacturer in the UK. Nestle's new £35 million water bottling plant is located in Buxton, Derbyshire. Plastic recycling can be shipped as far away as China.

Find out more



www.encounteredu.com/cpd/subject-updates/learn-more-alternatives-to-plastic

Overview

This activity allows students to map the journey of a single-use plastic bottle from source to retailer and on to the recycling centre, or out to sea as litter.

Preparation

This activity works best on laptops or PCs so ensuring access in advance may be necessary. It would be advantageous if students are already familiar with Google maps, so you may wish to incorporate this into an ICT lesson. Students can work in pairs to support one another. A paper map of the area with place names has been provided on the following page. This can be used by students if IT is an issue.

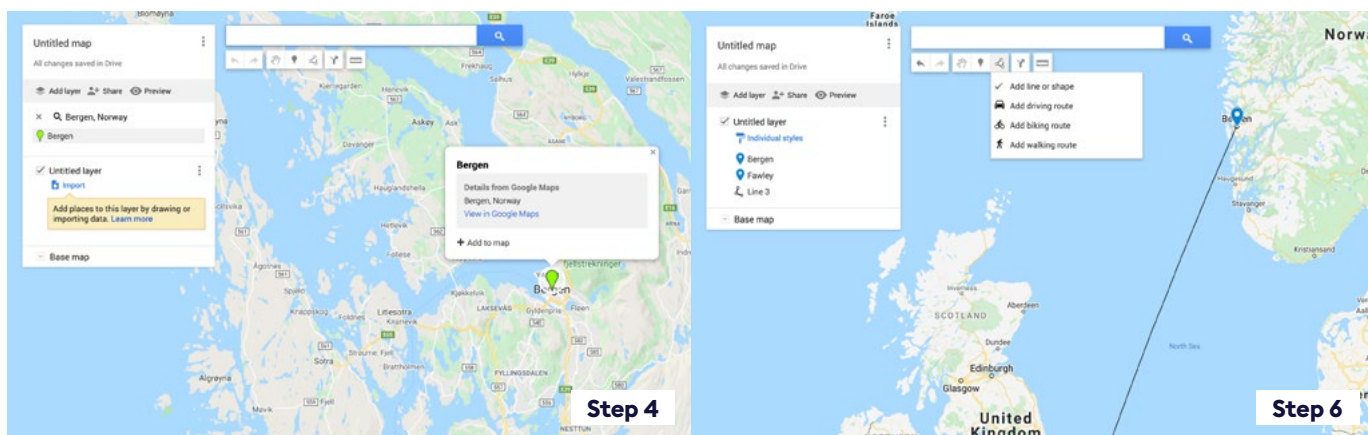
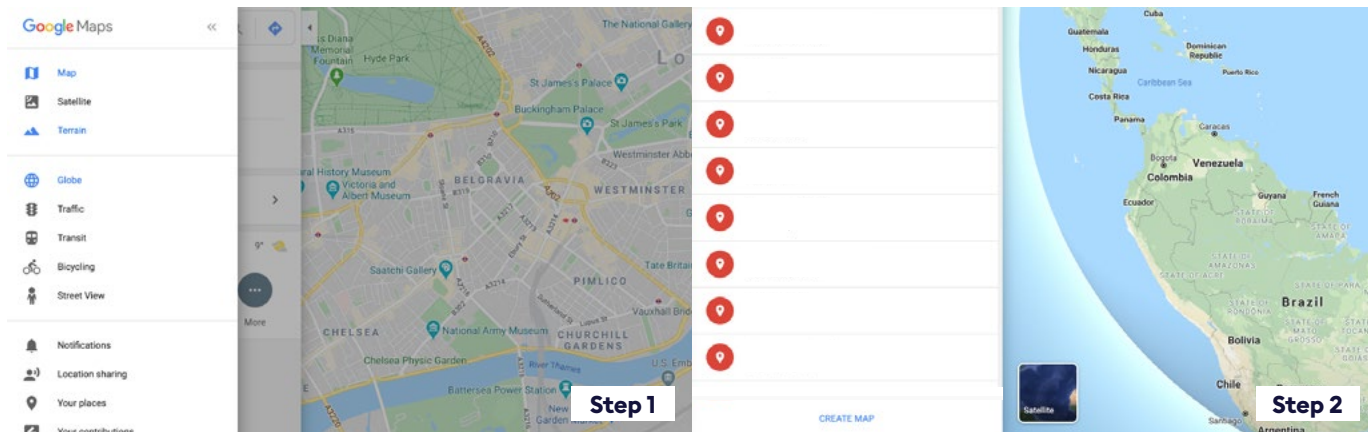
Running the Activity

Briefing

1. Go to www.google.com/maps.
2. Log into your Google account.
3. Go to the side bar menu and select 'your places', then 'maps' and click on 'create map'.
4. In the search bar add the first location i.e. Bergen, Norway and click 'add' to the map. You can now change the icon and the colour etc.
5. Add the next location as above and repeat until you have added all your locations.
6. Click the 'Draw a line' icon under the search bar and link all the locations together. You can change the style or colour of the line by choosing the 'Select items' icon.
7. Edit the title and description of the map and choose which 'Base map' you wish to use.
8. You can then share it or print it.

Expected results

- Students will see how far a single-use plastic bottle travels, only to be used briefly before being discarded.

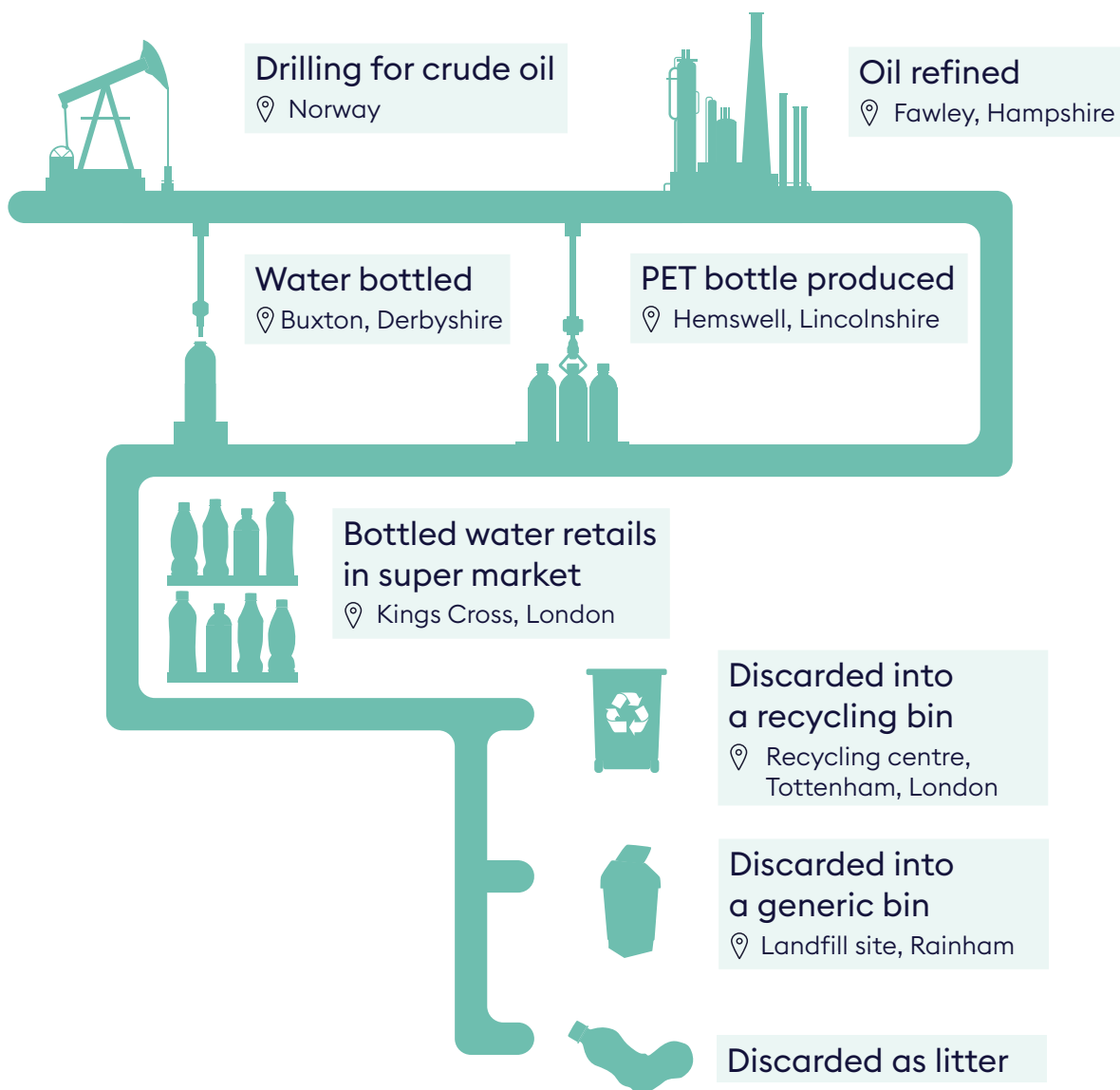


Life-cycle of a plastic bottle



Using Google Maps plot the journey a single-use PET bottle might take during its life.

Below is an example route you can use, or you might wish to research a possible journey for a bottle distributed in your local area.



Can you suggest a possible route the bottle might take, to end up in the ocean?

Where are the plastics? Part two



Age 7-11



1 hour 40 minutes

Curriculum links

- Present and interpret data
- Weigh up the pros and cons of a variety of plastics
- Reflect on the impact of plastics on society

Geographical skills and fieldwork:

- Use fieldwork to observe, measure, record and present the human and physical features in the local area using a range of methods, including sketch maps, plans and graphs, and digital technologies.

Resources



Slideshow 4:
Where are plastics?
Part two



Student Sheet 4a:
Henderson Island

Student Sheet 4b:
Plastic fieldwork
record sheet.

Student Sheet:
Innovation Diary

Extension or home learning

Students will become a plastic investigator around their own house. They will have to try to find as many different types of plastic as possible.

Lesson overview

Students will discover what happens to plastic that ends up in the ocean and examine secondary data from a sample of litter collected on Henderson Island. They will then plan and conduct fieldwork to collect and analyse primary data from their own local environment. You may need more than one session to complete this lesson.

Lesson steps

1. Beach litter survey (10 mins)

Students will explore what happens to plastic that is not recycled. They will discover what can happen to plastic that ends up in the ocean and how far it can travel.

2. Data analysis (20 mins)

Students examine the data from the beach survey at Henderson Island in the Pacific and discuss how various items could have arrived there. Using this data students create a bar graph demonstrating what percentage of the pollution is plastic and draw conclusions about its origin.

3. Plan fieldwork (10 mins)

Students look at Gallery: Fantastic plastic to discover some of the fascinating ways plastic is used to improve our health, life and scientific endeavours.

4. Conduct fieldwork (30 mins)

Students choose two uses of plastic that they feel represent the pros and cons of plastics and create a poster illustrating these uses and their impacts.

5. Data analysis (20 mins)

Students examine the data from their fieldwork study and discuss what they found. They will share their thoughts and feelings about what they found. They will then go on to use this data in order to create a bar graph to represent the data they recorded.

6. Alternative thinking (10 mins)

Students mind map ideas of alternative uses for single-use plastics.

Learning outcomes

- Examine data from a beach clean up.

- Create a bar graph demonstrating the amount of plastic litter collected.

- Plan and conduct fieldwork to research the levels of plastic pollution in the local area.

- Create a bar graph demonstrating the amount of plastic litter collected.

- Explore alternative uses for a range of discarded plastics.

Step	Guidance	Resources
1 10 mins	<p>In step 1 students will re-cap what they learned about PET plastic bottles. They will discover what can happen when plastic ends up in the ocean. They will then be introduced to Henderson Island, where a 2017 study collected and analysed over 55,000 pieces of litter.</p> <ul style="list-style-type: none"> Use slide 6 to explain what happens to plastic that ends up in the oceans, how the currents move it and how it can collect in gyres. Using slides 7-8 introduce students to the location of Henderson Island and ask them to locate it on maps or globes. Explain that researchers collected over 55,000 pieces of plastic to analyse their composition and origin. Ask students to discuss how some of the plastic pieces of litter might have ended up there. 	<p>Slideshow 4: Slides 1-10</p> <p>Atlas/maps</p>
2 20 mins	<p>Step 2 sees students use this data to create a bar graph representing a portion of the data. This can be done as a whole class activity or as a partner activity using the student sheet.</p> <ul style="list-style-type: none"> Using Student Sheet 4a, students select the items they would like to represent on their bar graph. Ask students to think about the most appropriate increments to use, for example students could label the x axis with the types of rubbish and the y axis with increments of 20. They then answer questions on Student Sheet 4a. 	<p>Slideshow 4: Slides 8-10</p> <p>Student Sheet 4a: Henderson Island</p>
3 10 mins	<p>Step 3 has students planning their own fieldwork to conduct a plastic pollution survey of their school grounds. They will need to think about the areas of the school that would be best, and most sensible, for them to conduct their research.</p> <ul style="list-style-type: none"> Using a map of the school grounds, students will be encouraged to think about where they will be looking, what they will be looking for, and how they will record their findings. Ask students to think about potential risks they might face while conducting their fieldwork (i.e. what could go wrong) and how they will best avoid these risks. 	<p>Slideshow 4: Slides 11-13</p> <p>Student Sheet 4b: Plastic fieldwork record sheet</p>

TEACHER GUIDANCE 4 (page 2 of 2)

Step	Guidance	Resources
4 30 mins	<p>In step 4, students will conduct their fieldwork. They will use the plastic fieldwork sheet to record the plastic pollution that they find around the school grounds.</p> <ul style="list-style-type: none">Teachers will need to consider their own school policies for adult to student ratios when carrying out fieldwork on the school grounds and carry out their own risk assessments before taking their students out.	Student Sheet 4b: Plastic fieldwork record sheet
5 20 mins	<p>Step 5 sees students use their fieldwork data to create a bar graph representing a portion of the data.</p> <ul style="list-style-type: none">Students will use their data to discuss what they found on the school grounds, which areas had to most/least litter, how they think the problem could be improved/solved.Ask students to create a bar graph for their own data collected during their fieldwork. Have them think about the most appropriate increments to use, for example students could label the x axis with the types of rubbish and the y axis with increments of 20.As an extension task, ask students to write a paragraph explaining how they conducted their fieldwork and what they discovered. How do they feel about the level of plastic pollution in their school and what do they think could be done about it?	Slideshow 4: Slides 15-16 Student Sheet: Innovation Diary
6 10 mins	<p>The last step in today's lesson is for students to think about other alternatives can you think of for single-use plastic bottles?</p> <p>Get students to record their ideas in their innovation diary.</p>	Slideshow 4: Slide 18 Student Sheet: Innovation Diary
+ 30 mins	<p>Students will become a plastic investigator around their own house. In this activity, they will have to try to find as many different types of plastic as possible.</p>	https://encounteredu.com/steam-activities/plastic-investigator

Henderson Island trash survey



Henderson Island lies halfway between New Zealand and Chile in the South Pacific. No one lives there, yet in 2017 researchers collected nearly 55,000 pieces of trash from the beach to analyse their composition and origin. Plastic fragments were found to have come from Russia, the United States, Europe, South America, Japan, and China.

The table below details the frequency of each item collected on Henderson Island. Choose ten items and create a bar chart which represents the data.

2 pieces of plastic cutlery	486 plastic bottle tops and lids	3,336 plastic fishing cords / ropes	16 pieces of polystyrene
10 plastic drinking straws	43 pieces of melted plastic	220 plastic fishing line	48,121 plastic fragments
3 plastic tiling spacers	24 plastic lollipop sticks	16 plastic glow sticks	642 plastic strapping
2 plastic tooth brushes	60 plastic bags	50 plastic buoys	207 plastic netting
6,774 plastic pellets	27 plastic pipes	25 plastic buckets	121 plastic fencing
115 plastic bottles	5 pieces of metal	4 shoes	245 plastic crates
10 plastic pen caps	3 plastic lighters	4 plastic razors	4 foam buoys
16 aluminium buoys	10 lightbulbs	8 glass bottles	67 glass fragments

STUDENT SHEET 4a

Title

Number of items collected on the island in 2017

Plastic Item

How do you think items such as fishing line and netting end up on the island?

How might items such as toothbrushes and plastic cutlery end up here?

Which items do you think are easiest to reduce?

How could this be achieved?

Plastic fieldwork record sheet

Type of plastic	Quantity

What impact can plastic have? Part one



Age 7-11



60 minutes

Curriculum links

- Understand the impact of plastic pollution on marine life
- Reflect on how plastic pollution impacts food webs

Resources



Slideshow 5:
What impact can plastic have? Part one



Activity Overview 5a:
Food web



Student Sheet 5a:
Plastic pollution case studies



Gallery:
Marine plastic pollution

Gallery:
Coral life (advanced)

Extension or home learning

Create an ocean diorama to learn more about the impact of plastic waste on marine life.

<https://encounteredu.com/steam-activities/plastic-threats>

Lesson overview

In this lesson students are introduced to microplastics and ocean plastic pollution and begin to understand how and why it occurs through investigating three case studies. They go on to discuss some of the dangers ocean plastic pollution and microplastics can pose to marine life and consider how entire food webs are affected.

Lesson steps

1. Plastic stats (10 mins)

Students explore some of the recent statistics relating to ocean plastics pollution and begin to understand the scale of the problem.

2. The plastic pollution problem (10 mins)

Using Gallery: Marine plastic pollution students are introduced to some of the ways in which marine life can be adversely affected by plastics.

3. Case study (15 mins)

Students examine one of three case studies outlining how the albatross, turtle and zooplankton have been found to be threatened by different types of plastic pollution.

4. Food webs (15 mins)

Students explore how species are interdependent through creating an ocean food web. This illustrates that when one species is threatened, it has an impact on the wider ecosystem.

5. Innovation Diary (10 mins)



Students summarise what they learnt and reflect on what had the most impact.

Learning outcomes

- Contextualise and understand ocean plastic pollution statistics
- Investigate different ways plastic pollution affects marine life
- Explore three case studies related to ocean plastic pollution
- Understand the impact of microplastics on food webs
- Reflect on how plastic pollution impacts the wider food web

Step	Guidance	Resources
1 10 mins	 <p>Step 1 presents and contextualises some statistics about plastic pollution.</p> <ul style="list-style-type: none"> Go through slide 3 discussing each statistic and encouraging students to feedback and share their thoughts and reactions. 	Slideshow 5: Slides 1-3
2 10 mins	 <p>In step 2 students see some of the devastating affects plastic pollution has on marine life.</p> <ul style="list-style-type: none"> Look at Gallery: Marine plastic pollution. Using slides 5-7 talk through the effects of plastic pollution on marine life. Some of the images are upsetting, so check the images first and use your discretion as to whether appropriate for your class. 	Slideshow 5: Slides 4-7 Gallery: Marine plastic pollution
3 15 mins	 <p>Next students investigate one of three case studies.</p> <ul style="list-style-type: none"> Using slide 8, explain that students will be allocated either the Albatross, Galapagos Turtle or Zooplankton case studies to investigate. In groups students read the information and then explain to other groups what they've discovered. Encourage students to share their thoughts and feelings while completing this step. 	Slideshow 5: Slide 8 Student Sheet 5a: Plastic pollution case studies
4 15 mins	 <p>In step 4 students discover how species are interdependent through constructing a food web. They go on to consider how threats to any of the creatures in the food web have wider implications for other marine animals.</p> <ul style="list-style-type: none"> Look at Gallery: Coral life (advanced) to demonstrate the interdependence of organisms within an ecosystem. Using slides 10-12 look at a variety of food chains. Students can order the species on mini white-boards. Ask students to reflect on what happens to the food chain if one creature is threatened. Use Activity Overview 5a: Food web to demonstrate species interdependence. 	Slideshow 5: Slides 9-13 Activity Overview 5a: Food web Gallery: Coral life (advanced)

TEACHER GUIDANCE 5 (page 2 of 2)

Step	Guidance	Resources
5 10 mins	 <p>Students reflect on what they've learnt today.</p> <ul style="list-style-type: none">· In their Innovation Diaries, students write an entry outlining how they felt about the three case studies.· They should then write a sentence which explains how threats to one species can impact a whole food web.	<p>Slideshow 5: Slides 14-15</p> <p>Student Sheet: Innovation Diary</p>
+ 45+ mins	 <p>Plastic in the ocean is having a devastating effect on marine life. In this activity, students will learn about some of the impacts of marine plastic pollution and create a diorama, or poster, to use as an inspiration to reduce plastic use at home.</p>	<p>https://encounteredu.com/steam-activities/plastic-threats</p>

Food web



Age 7+
(adult supervision)



20 minutes

Details

Each pair will need

- Cardboard
- Scissors
- Tape
- Wool or string

Safety and Guidance



Precautions

This activity requires cutting out a cardboard ring and making holes in the cardboard. These will need to be done using adult supervision or, for younger children, an adult can create the cardboard template for children and allow them to connect the different species using string.

Find out more



www.encounteredu.com/cpd/subject-updates/learn-more-food-webs

Overview

It is often quite tricky to 'see' all the relationships between the different plants and animals in an ecosystem and so scientists use the idea of a food web to show how different life in the ocean is connected. As you start to connect life in the ocean with wool or string, you will start to see the web develop. A healthy ocean requires a balance between the different living things. If any of the individual animals or plants is affected by human activity or natural events, then the whole ecosystem is affected.

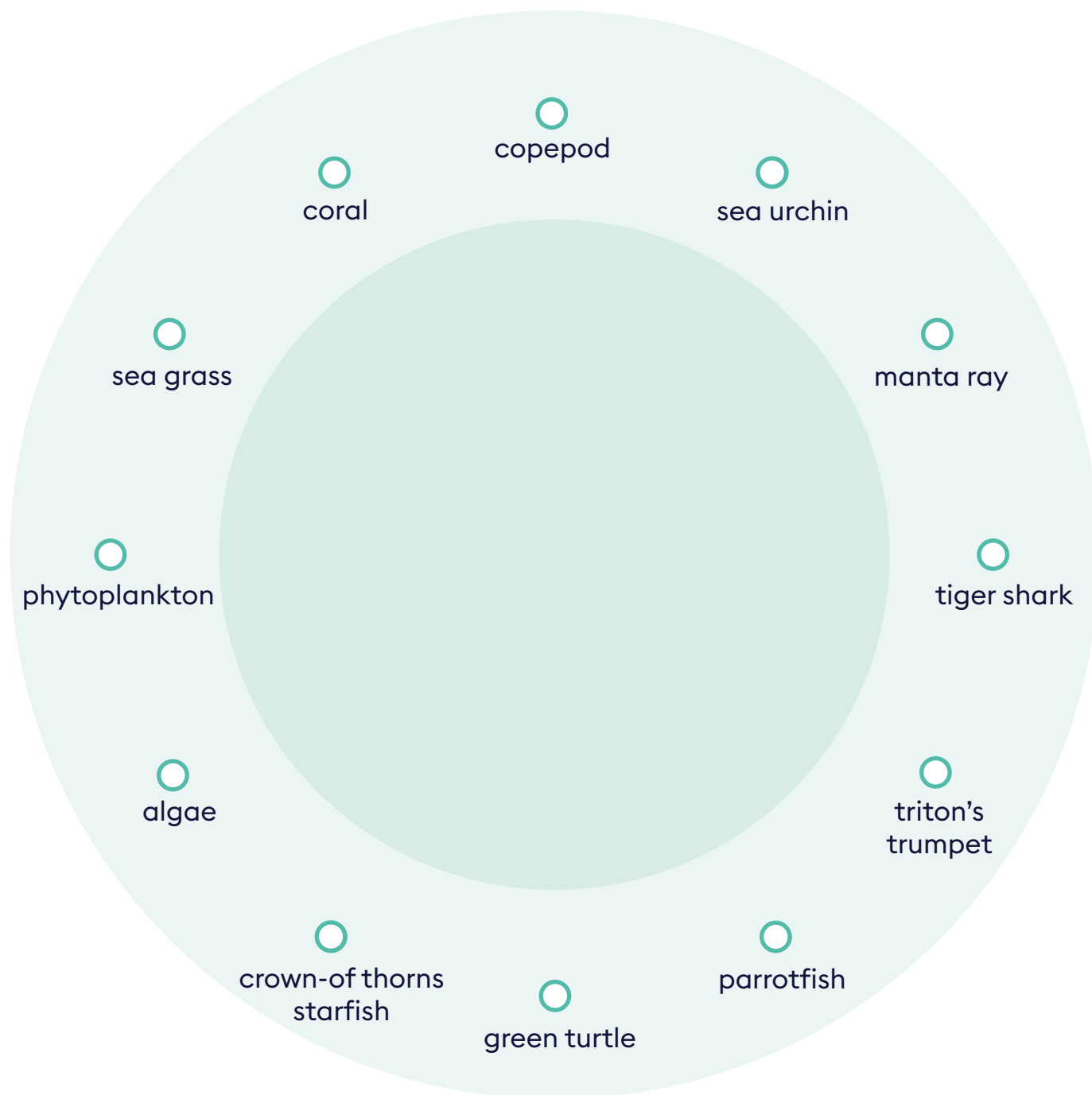
Running the Activity

1. Cut out a ring of cardboard at least 20 cm in diameter (or two rings and stick together to make stronger).
2. Punch 12 holes around the ring at evenly spaced intervals like a clock face.
3. Write the names of the following species next to the holes: coral, sea grass, phytoplankton, algae, crown of thorns starfish, green turtle, parrot fish, triton's trumpet, tiger shark, manta ray, sea urchin, copepod.
4. Cut some wool or string.
5. Tie the wool to a producer.
6. Link this producer to the next organism along the food chain by passing the string through each hole, e.g. link algae to sea urchin and then to triton's trumpet or crown-of-thorns starfish.
7. When you have reached the top predator, tie the wool or string again, to end the chain.
8. Repeat this process for all the producers, until you have created a food web.
9. Use Gallery: Coral life (advanced) to help you.

Expected results

- Students will understand how many different species are dependant on one another in the ocean and discover that if one is affected by plastic pollution this has an impact on other species and the wider food chain.

ACTIVITY OVERVIEW 5a



Plastic pollution case studies



Albatross

The albatross is a seabird found in the Southern Ocean and North Pacific. They are among the largest flying birds with the Great Albatross having a wingspan of up to 3.7m. They feed on squid, fish and krill by either scavenging, surface seizing or diving. They are colonial birds nesting on remote oceanic islands. Pair bonds between males and females last several years, pairs use ritualised dances to recognise each other and strengthen bonds. Both parents help raise the young; taking turns to incubate the egg and go fishing to bring food back for the chicks.



Of the 22 species of albatrosses, three species are critically endangered, five are endangered, seven species are threatened and seven are vulnerable. Threats include introduction of non-indigenous predators, hunting for feathers, over fishing and becoming caught on fishing equipment. As well as plastic ingestion.

A study of Laysan Albatross chicks in 2009 on Midway Island in the Pacific Ocean found large amounts of plastic in the stomachs of deceased chicks. Plastic takes up space in the albatross's stomach that should be for food or can cause an obstruction meaning no food can get through, which causes the bird to starve to death. Adults often regurgitate plastic for chicks to eat which means the chicks never eat enough nutrients and do not survive to adulthood.





Galapagos Green Turtle

Galapagos Green Turtles are found in subtropical waters in the Pacific Ocean and are the only species of green sea turtle to nest on the beaches of the Galapagos Islands. They differ from other marine turtles as they have serrated lower jaw and scales which cover their eyes, like eyelids. They can grow to 84cm long and weigh up to 136kg. Galapagos Green Turtles are extremely fast swimmers, their powerful flippers allow them to travel at speeds up to 35mph. They mainly feed on molluscs, crustaceans and seaweed, but also eat jellyfish and fish eggs.



Females return to the same beaches where they hatched to lay their eggs, laying between 50 and 200 eggs in nests dug out of the sand. After approximately two months the hatchlings emerge and immediately head for the sea. Those who make it can take up to twenty years to mature and return to lay their own eggs. Males can spend their whole lives at sea.



They are an endangered species. Many turtles ingest plastic bags mistaking them for jellyfish, causing fatal blockages in their guts or starving them because they feel full. Turtles also face the risk of becoming entangled in plastic debris such as plastic twine and nylon fishing lines, causing fatal injuries or drowning as they cannot surface to breath.



Zooplankton

Zooplankton are organisms drifting in oceans, seas and bodies of fresh water. The word zooplankton comes from the Greek zoon, meaning animal and planktos, meaning wanderer or drifter. Zooplankton are usually microscopic – copepods, a type of zooplankton could fit on the head of a pin. However, some such as jellyfish are larger and visible to the naked eye. They have hard shells and antennae to sense predators. Some copepods can move very quickly through the water at speeds up to one hundred times faster than Usain Bolt, relative to their size.



Zooplankton are found in surface waters where food is abundant, they feed on bacterioplankton, phytoplankton (tiny plants) and other zooplankton as well as 'marine snow' (tiny pieces of organic matter including dead animals). They are found in abundance across the ocean, their numbers are affected by water salinity and temperature.

They play a vital role in aquatic food webs as they are eaten by many higher consumers such as fish.



Recent research into copepods has been investigating whether ingestion of microplastics affects the health of these tiny creatures, which may then affect the carbon cycle and whether there are wider implications for animals further up the food chain who eat them.

What impact can plastic have? Part two



Age 7-11



60 minutes

Curriculum links

- Understand the variety of ways plastics can enter the ocean
- Debate, discuss and reflect on the social, ethical and sustainable issues related to plastics pollution

Resources



Slideshow 6:

What impact can plastic have? Part two



Student Sheet 6a:

Case Studies

Student Sheet 6b:

Plastic profiles

Student Sheet:

Innovation Diary



Gallery:

Marine plastic pollution

Extension or home learning

Students will learn about living more sustainably by creating their own plastic free wrapping paper.

<https://encounteredu.com/steam-activities/potato-stamp-wrapping-paper>

Lesson overview

This lesson sees students investigate how plastic gets into the ocean and affects marine life. Students discover how plastic pollution doesn't start when plastic litter enters the ocean. They go on to consider economic, political and social elements of human geography that impact ocean plastic pollution. Students examine case studies relating to plastic pollution at home and abroad to consider the various elements that contribute to the problem.

Lesson steps

Learning outcomes

1. How does plastic impact the ocean? (10 mins)

Students discuss different ways in which ocean plastic pollution can occur and how this might affect marine life.

- Describe three ways in which ocean plastic pollution can occur

2. Case studies (15 mins)

Through exploring the case studies students discover some complex social and ethical issues which affect the plastic pollution problem.

- Discover some of the ethical and societal issues related to ocean plastic pollution

3. How does this affect the global community? (25 mins)



Students consider the perspectives of different stakeholders and debate how economics, human rights and sustainability all influence plastics pollution. They then use everything they have learned to take part in a role-play.

- Discuss and describe how plastic pollution is linked to economics, human rights and sustainability

4. Innovation Diary (10 mins)

Students review the sustainable development goals and reflect on how ocean plastic pollution is related to many of the goals.

- Reflect on the sustainable development goals

Step	Guidance	Resources
1 10 mins	 <p>Step 1 demonstrates that plastic production can impact the ocean in a number of ways. Start by re-capping what they learned in the last lesson, using the marine plastic pollution gallery to support this.</p> <p>Using slides 5-11 explain how plastic production can impact the ocean from drilling for fossil fuels, through the chemicals involved in production, through littering and our throw-away culture, to microfibers and microbeads being washed down our drains.</p> <ul style="list-style-type: none"> After each slide encourage students to share their thoughts on what they have learnt. 	<p>Slideshow 6: Slides 1-11</p> <p>Gallery: Marine plastic pollution</p>
2 15 mins	 <p>The next step involves students studying one of three case studies, exploring some of the social and ethical issues around plastics.</p> <ul style="list-style-type: none"> In groups students read the information in their allocated case study and share their initial thoughts. They then write their responses to the talking points and make notes on the left of Student Sheet 6a. Have the groups feedback to the whole class what they learned from the case studies. 	<p>Slideshow 6: Slide 10</p> <p>Student Sheet 6a: Case studies</p>

Step Guidance

Resources

3

25
mins



Step 3 asks students to consider the perspectives of a variety of individuals affected by the plastic issue. Start by getting students to share how they think plastic production, consumption and pollution might impact different people and different countries in different ways before moving on to the profile cards.

As a class, briefly discuss each of the people on the profile cards. Explain to students that they will need to consider how the person on their profile card might be affected by plastic pollution. What specific problem/s does this person face because of plastic and what solutions could they offer to the problems? Encourage groups to think of lots of different types of solutions, for example, changes that could be made on an individual level, as a community, as a country, as a business or global changes that could/should be made.

Once they have discussed this as a group, they will need to prepare a short drama to share with the class:

- One student should play the role of the person on the profile card. They will need to explain who they are, where they are from, what they do, and what problems they face due to plastic consumption and pollution. "Please help!"
- The rest of the group will act as a community of advisors: they will offer advice to the student playing the role of the person in the profile card on how their problem could be solved. Each student should try to offer at least one piece of advice on changes that could be made and, as a group, advice should range from the individual level all the way up to the global.
- Have the groups share the dramas they have worked on with the class. Encourage them to share their thoughts and feelings about each group's presentation.

Slideshow 6:
Slides 13-14

Student Sheet 6b:
Plastic profiles

4

10
mins



The last step in this lesson asks students to reflect on the sustainable development goals and how they relate to this issue.

- Students look at the SDGs on the slide and discuss them in the context of what they have learned in today's lesson. For example, students should see a link between 'life below water' and the plastics issue but might require some guidance as to how 'decent work and economic growth' could be affected.
- They should then write a brief entry in their Innovation Diaries outlining which of the goals is directly or indirectly related to ocean plastic pollution, and how.

Slideshow 6:
Slides 12-14

+

30
mins



By some estimates, the UK uses 227,000 miles of wrapping paper each year! Conventional wrapping paper is often non-recyclable and made with plastic, giving it a shiny or crunchy feel. This activity is going to help students to reduce the amount of plastic that they use by creating some beautiful personalised plastic-free wrapping paper.

<https://encounteredu.com/steam-activities/potato-stamp-wrapping-paper>

Plastic impact: case studies



What do you think?

Should disposable cups be banned?

Is it up to the shops, the government or consumers?

What should be done?

Did you know?



99.75% of coffee cups are not recycled!

Case study 1: Disposable coffee cups in the UK

You might think that because most disposable coffee cups are paper that they are recycled. Well, you'd be wrong! The mixture of paper and plastic in the inner lining, which makes it both heat and leakproof causes great difficulties in the recycling process. They have to be taken to specialist recycling plants, only three of which exist in the UK.

Some of the biggest retailers of coffee in the UK including Costa and Starbucks say they have started recycling coffee cups – but you must return them to the store. Throwing your disposable coffee cup in public bins or even in your recycling bin at home contaminates the other rubbish and ultimately ends up in land-fill or being burnt. This results in plastic fragments entering the water system and eventually polluting rivers and oceans.

Cafe Nero, Greggs, Starbucks and Costa all offer a 25p discount to those who bring their own reusable coffee cups; Pret a Manger offers 50p discount. In 2018 the Environmental Audit Committee proposed a 25p “latte levy” on throw-away cups but ministers rejected the proposal saying it was better for shops to offer voluntary discounts to customers who bring their own cups.

Did you know?



Some of the rivers which are responsible for contributing the most plastic into the ocean are in developing countries, such as the Mekong river which flows through China, Myanmar, Laos, Thailand, Cambodia and Vietnam.

What do you think?

Who is to blame?

Who can help?

What should be done?

Case study 2: 10 rivers

Imagine an ordinary day and the amount of disposable plastic you consume. Every time you finish a product such as shampoo, toothpaste, bread, yoghurts, crisps, soft drinks and milk the packaging or container is thrown away, hopefully recycled if possible. Imagine if you didn't have bins outside your house. You know - the big ones that they come and collect once a week. Where would you put all that rubbish? What would you do with it if you couldn't dispose of it in the weekly refuse collection? Where are you going to put it? Maybe on the street? In your garden? Imagine the rubbish, every day piling up, getting bigger and bigger and no one taking it away.

Millions of people all over the world are faced with this dilemma. Developing countries often do not have regular refuse collections and implementing them would cost a huge amount for governments who have few resources and other great financial challenges, like tackling hunger and fighting disease. Nobody wants rubbish piling up in or around their homes. Sometimes rubbish is disposed of by burning it – however this isn't ideal as it releases toxic fumes in to the atmosphere. Often rubbish ends up being publicly dumped and then makes its way into rivers and water ways, where it is carried away from densely populated areas.

Without the infrastructure to effectively dispose of rubbish, people are left with a difficult choice about what to do. No one wants rubbish on their door step.

Did you know?



In many countries people make a living collecting, sorting and selling plastic trash. In Bangladesh waste pickers earn about £2 a day.

What do you think?

Who should change their behaviour?

Are there double-standards in how we view consumerism?

Case study 3: Consumerism, sustainability and double standards

Until 2018 China bought 45% of the world's plastic trash. It's cheaper for governments like the USA and UK to ship plastic rubbish to developing countries than to deal with it themselves. China purchased the plastic trash to recycle and use in manufacturing. However, in 2018 they closed their doors as the world's plastic dumping ground due to environmental concerns and the fact that they do not have the infrastructure to cope with the amount of trash they were receiving.

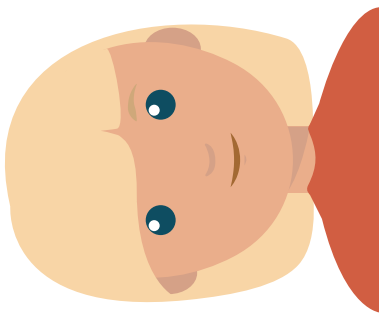
China is the largest producer of plastic, it accounts for more than a quarter of the global total. They manufacture 70% of the world's plastic toys, and are also the leading manufacturers of computer components, phone parts, textiles and trainers. They may be producing most of the plastic, but who is buying it? Multinational companies manufacture in China because labour and material costs tend to be low.

Around the world multinational companies produce small single-use sachets of products such as shampoo, detergents, condiments and even coffee which are inexpensive to buy meaning people in developing countries can also afford to enjoy these products. However, single-use sachets are not recyclable and therefore not worth collecting. Should single-use sachets be banned? Who is responsible for collecting this sort of plastic?



Plastic profiles

In groups consider the perspective of each of these individuals.
What would they say about the plastic problem?



Name:
Emma Peeters

Job:
Greenpeace officer

Location:
Brussels,
Belgium

.....

.....

.....

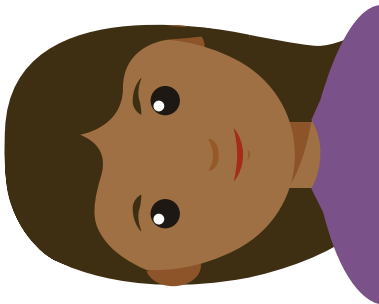
.....

.....

.....

.....

.....



Name:
Saanvi Acharya

Job:
Fisher on polluted river

Location:
Patna, River Ganges,
India

.....

.....

.....

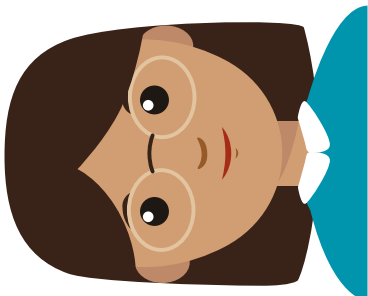
.....

.....

.....

.....

.....



Name:
Zhang Wei Li

Job:
Worker in a plastic toy
factory

Location:
Changzhou Province,
China

.....

.....

.....

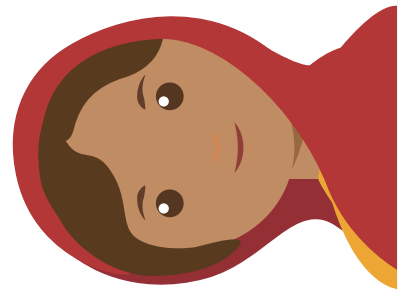
.....

.....

.....

.....

.....



Name:
Rifah Chakma

Job:
Plastic Picker

Location:
Chandpur,
Bangladesh

.....

.....

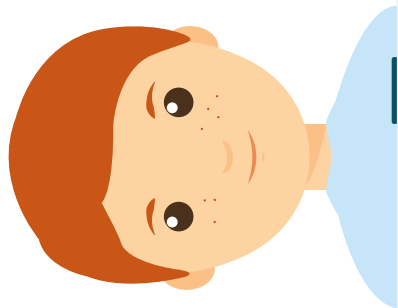
.....

.....

.....

.....

.....



Name:
Jim Williams

Job:
Owner of plastic
packaging factory

Location:
Sacramento,
USA

.....

.....

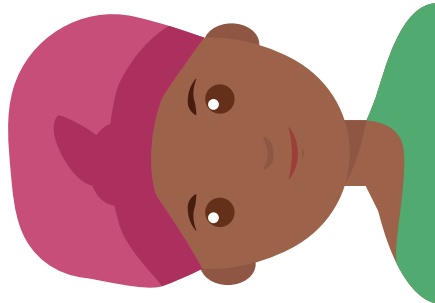
.....

.....

.....

.....

.....



Name:
Fatmata Kamara

Job:
Shop owner

Location:
Bradford,
Sierra Leone

.....

.....

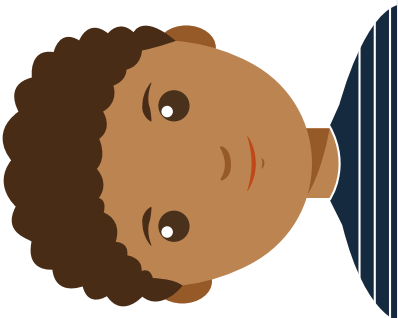
.....

.....

.....

.....

.....



Name:
Lucas Marchand

Job:
Coffee shop owner

Location:
Paris,
France

.....

.....

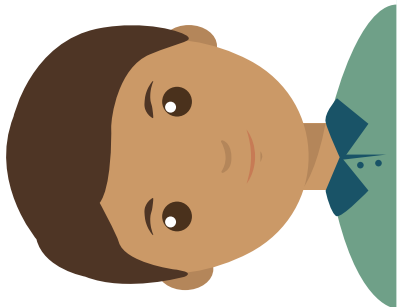
.....

.....

.....

.....

.....



Name:
Oliver Miller

Job:
Government official

Location:
London,
United Kingdom

.....

.....

.....

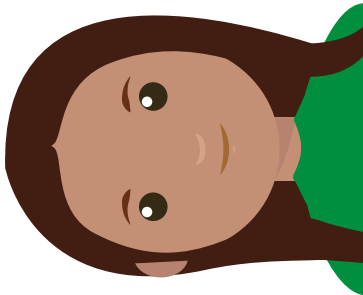
.....

.....

.....

.....

.....



Name:
Angela Ocampo

Job:
Government official

Location:
Manila, Philippines

.....

.....

.....

.....

.....

.....

.....

.....

What can I do?

Part one



Age 7-11



60 minutes

Curriculum links

- Understand the 6 Rs and how each one can be put into practice
- Plan and execute a collaborative campaign to reduce plastic consumption

Resources



Slideshow 7:
What can I do? Part one



Student Sheet 7a:
Our plastics project

Student Sheet:
Innovation Diary

Extension or home learning

This activity tests student's recycling prowess! They will need to collect as many items in their homes that they think could be recycled. Once they have their list of items, they will need to use their research skills to find out if their local council would recycle them or not.

<https://encounteredu.com/steam-activities/super-recycler>




Lesson overview

The last two lessons in this unit challenge students to work collaboratively to create a campaign based on the 6 Rs. First students find out about innovation, development and policy changes that have recently occurred. They are then briefed on their mission – to reduce the amount of plastic consumption at school. In groups students then design and implement their campaign, planning and launching it over the following week.

Lesson steps

Learning outcomes

- 1. The 6 Rs (5 mins)**
Students find out about each of the 6 Rs and make suggestions of how they could do more of each one.
 - Name the 6 Rs and explain what each one means
- 2. Innovation and technology (10 mins)**
Students find out about some recent innovations designed to improve plastics pollution, focussing on young people's contributions.
 - Understand developments in technology and innovation regarding plastics pollution
- 3. Plastic policy (5 mins)**
Students discover the changes to policy that have been recently enacted and discuss whether they believe enough has been done.
 - Discover how recent policy has been proposed and enacted relating to plastics pollution
- 4. Now it's your turn! (10 mins)**
Students will be enacting real change in their school environment. They receive their brief and mind map their ideas.
 - Reflect on how they can make a difference
- 5. Plan your campaign (30 mins)**
In groups students begin to plan their campaign, create a 'to do' list and allocate responsibilities. They can then begin working collaboratively on their tasks.
 - Work collaboratively to plan a plastics pollution campaign

Step	Guidance	Resources
1 5 mins	 <p>In step 1 students find out what each of the 6Rs stand for and discuss how they can implement change in their own lives. Create a class Venn to collect their ideas about what could be done about plastic pollution. They will need to think about how the 6Rs could be used by different actors.</p> <ul style="list-style-type: none"> Using slides 6-12 add any more ideas to the Venn based on the 6Rs: reduce, reuse, recycle, refuse, rethink, repair. 	Slideshow 7: Slides 1-12
2 10 mins	 <p>Step 2 introduces students to some of the innovations around plastics young people have recently made.</p> <ul style="list-style-type: none"> Use slide 13 to go through the websites of young entrepreneurs who have come up with innovative ways to reduce plastics consumption, tackle the use of single-use plastics and design products which aim to improve ocean health. This could be done as a whole class activity or, if you have the time, then you could let students work in groups or pairs to explore each of these websites to find out what action these companies are taking against plastic pollution. This could also be done as a group task, with each group assigned a different company that they need to learn about and the feedback to the class about. Ask students to share their impressions of each person and the work they've done. 	Slideshow 7: Slide 13
3 5 mins	 <p>The next step summarises some of the changes that have been made to legislation and asks students to reflect on these efforts.</p> <ul style="list-style-type: none"> Using slides 14-16 read through the recent policy changes that governments have enacted. Ask students to consider whether they think enough has been done in each case and if not, what more is required. Explain that this is background information they will need to know in preparation for the next task. 	Slideshow 7: Slides 14-16

TEACHER GUIDANCE 7 (page 2 of 2)

Step Guidance

Resources

4
10
mins



Step 4 introduces students to their task for the next few lessons.

- Explain that in groups students will be designing and implementing a campaign to reduce plastic use in the school community.
- Using slide 17 and its notes to talk through some of the possibilities and options they have for running their campaign, such as a reward for the class with the least plastic waste, or a competition to see which year group have the most reusable plastics in their lunches etc.
- Explain how students must find a way to measure success and makes some further suggestions for elements they may wish to use in their campaigns such as posters and speeches in assembly etc.
- Explain that students will be working in groups for this project and divide students accordingly.

Slideshow 7:
Slide 17

5
30
mins



The final step this lesson is for students to start planning their campaign.

- Using Student Sheet 7a: Our plastics project, students begin by deciding what their main aims are, and begin the planning process.
- You may wish to structure this activity by allowing students five minutes for discussion and then asking for feedback before moving on to the next section.
- It would be ideal if students could meet again before the end of the unit to make resources, plan their next steps and monitor progress, therefore an interim lesson could be allocated.
- Finally, students can share with the rest of the class their organisation name and what their main objective during the campaign will be.

Slideshow 7:
Slides 17-18

Student Sheet 7a:
Our plastics project

Student Sheet:
Innovation Diary

+
20
mins



This activity tests student's recycling prowess! They will need to collect as many items in their homes that they think could be recycled. Once they have their list of items, they will need to use their research skills to find out if their local council would recycle them or not.

<https://encounteredu.com/s/team-activities/super-recycler>

Our plastics project



**Mind-map
your ideas**

STUDENT SHEET 7a

Decide which idea to focus on

What would you like to do?

What impact do you think it will have?

How will you measure impact?

What are your three main action points?

--	--	--

What will you need?

Do you need support from your teacher? If so, what?

How will you ensure everyone is involved?

STUDENT SHEET 7a

First point of action

Time frame

Second point of action

Time frame

Third point of action

Time frame

By next lesson we hope to have achieved:

Organisation name

Members

What can I do?

Part two



Age 7-11



60 minutes

Curriculum links

- Review and reflect on achievements and challenges during their campaign
- Prepare and deliver a presentation

Resources



Slideshow 7:
What can I do? Part two

Student Sheet:
Innovation Diary

Extension or home learning

Plastic bags, often made from oil-based polymers, are not widely recycled. This has sparked material engineers to invent commercially available bioplastics, made from natural polymer materials such as starch, which are compostable and degradable, but do these claims stack up?

This activity will develop students' knowledge about materials and decomposition. It will also help to build the skills of a scientist, by observing changes over time.

<https://encounteredu.com/steam-activities/plastic-degradation-test>

Lesson overview

In the last lesson students review the success of their campaign and the impact it had on plastic consumption. They review their targets, reflect on what went well and decide what they would do differently. They then share their results and discuss what more they could do going forward. The unit of work could end with an assembly for students to share their findings and continue to spread their message.

Lesson steps

Learning outcomes

- 1. Review (10 mins)**
In groups students discuss their experiences, what they discovered, their results and anything that surprised them.
 - Review the impact of their campaign
- 2. Achievements and challenges (10 mins)**
They then go decide what has been their greatest achievement and what challenges they've encountered.
 - Reflect on achievements and challenges
- 3. Presentation (30 mins)**
In groups students prepare a brief presentation to share with a wider audience telling the story of their campaign and highlighting what they achieved, what they found challenging and what they would do differently.
 - Share findings and results with a wider audience
 - Reflect on how they can make a difference
- 4. The future (10 mins)**
In a whole class discussion, students reflect on the future of their campaigns and their thoughts on the future of ocean plastic pollution.
 - Discuss what they plan to do next

TEACHER GUIDANCE 8

Step Guidance

Resources

1
10
mins



Step 1 encourages students to discuss their experience of running a campaign.

- Using slides 1-3 ask students to reflect on the experience of running a campaign, what surprised them and their achievements.
- Encourage students to talk through each question with a partner.

Slideshow 8:
Slide 1-3

2
10
mins



Step 2 focusses on what the main challenges have been during the campaign.

- Using slide 4 students continue to discuss with their partner, focusing on the challenges they faced and any barriers they encountered.

Slideshow 8:
Slide 4

3
30
mins



In step 3 students work in their groups to create a presentation about their experiences.

- Explain that students will be working with their campaign group to create a brief presentation which outlines what they did, what they achieved, what challenges they faced and what they would do differently.
- Use slide 5 to structure the presentation.
- Explain that the groups will now have 20 minutes to prepare their presentation for the class.
- Students can gather any materials they may require for their presentation, including their campaign materials to show case.
- After 20 minutes allow each group to present to the class.
- Encourage feedback from other groups.

Slideshow 8:
Slide 5

4
10
mins




In the last step students engage in a whole class discussion about the future of their campaigns and the oceans plastics problem.

- Ask groups to make suggestions of how they could carry their campaign forward.
- Ask individuals to reflect on what they have taken from this unit of work and how they have changed their behaviour.
- Finally, ask students to reflect on what they predict the future holds for the plastics problem and our oceans.
- Students may wish to make some final observations or reflections in their Innovation Diaries to conclude.

Slideshow 8:
Slides 6-8

Student Sheet:
Innovation Diaries

Step	Guidance	Resources
+ 30+ mins	 <p>Plastic bags, often made from oil-based polymers, are not widely recycled. This has sparked material engineers to invent commercially available bioplastics, made from natural polymer materials such as starch, which are compostable and degradable, but do these claims stack up?</p> <p>This activity will develop students' knowledge about materials and decomposition. It will also help to build the skills of a scientist, by observing changes over time.</p>	https://encounteredu.com/steam-activities/plastic-degradation-test

Design Technology - The plastics problem



Age 7-11



60 minutes

Curriculum links

- Develop and communicate design ideas
- Evaluate existing products

Resources



Slideshow 9:
The plastics problem



Student Sheet 9a:
Solutions sheet

Student Sheet 9b:
Product analysis



Thinglink:
What's your bag?

Extension or home learning

Students consider a range of single use plastic products and research sustainable alternatives already in development. Share findings with the class.

Lesson overview

In this lesson students are posed with a problem; they need to design a product which can carry several items from one location to another. They should attempt to design a new product and consider its features including strength, usability and materials. Students go on to evaluate existing solutions to this product in terms of strength, cost, aesthetics, usability and finally sustainability. They conclude by evaluating whether a new product is required based on the existing alternatives.

Lesson steps

Learning outcomes

1. Design criteria (10 mins)

Students are posed with a problem; transporting a number of medium sized goods (tins of beans) from point A to point B.

- Understand design criteria

2. Developing ideas (15 mins)

In groups students discuss possible solutions to this problem, sharing and building on ideas.

- Develop and communicate ideas

3. Specifications (15 mins)

Students then consider in greater detail the strength, usability, materials and aesthetics of their designs.

- Discuss purpose, function and appeal of products

4. Analyse existing products (10 mins)

Students investigate a variety of existing similar products and analyse their strength, cost, aesthetics and usability.


- Investigate and analyse a range of existing products

5. Evaluate existing products (10 mins)

They then evaluate the sustainability of each of these products (and their own) and conclude whether a new product is required based on the existing alternatives.

- Evaluate ideas and products

Step	Guidance	Resources
1 10 mins	 <p>In step one students are presented with a problem; they must transport several items from one point to another.</p> <ul style="list-style-type: none"> Using slides 1-5 talk through the problem and ask students for their initial ideas on how they could solve the problem. Explain that they should think beyond products they already know of and try to come up with a novel way of completing the task. 	Slideshow 9: Slides 1-5
2 15 mins	 <p>In groups students then discuss possible solutions to the problem.</p> <ul style="list-style-type: none"> Ask students to discuss the problem with their group and share initial ideas. Encourage students to think outside the box and share the most unusual solutions with the whole class. Using Student Sheet 9a students sketch and annotate three ideas. 	Student Sheet 9a: Solutions sheet
3 15 mins	 <p>In Step 3 students further develop their ideas through considering the design specifications of their product.</p> <ul style="list-style-type: none"> Using slides 6-8 ask students to suggest the materials their product could be made from. Explain that they should avoid using products such as single-use plastics, to develop a more sustainable product. Students should also consider the strength, usability and aesthetics of their design, adapting where necessary. 	Slideshow 9: Slides 6-8 Student Sheet 9a: Solutions sheet
4 10 mins	 <p>Step 4 demonstrates some existing solutions and asks students to evaluate each product.</p> <ul style="list-style-type: none"> Using slides 9-12 share some of the existing solutions to the problem and ask students to comment on the strength, usability, aesthetics and sustainability of each product. As you go through the slides ask students to compare their own design against each criterion. 	Slideshow 1: Slides: 9-13 Thinglink: What's your bag?

Step	Guidance	Resources
5 10 mins	 <p>Step 5 asks students to make a detailed comparison of each existing product with their own, specifically focussing on sustainability and environmental impact.</p> <ul style="list-style-type: none">· Explain that students should complete Student Sheet 1b, commenting on each aspect of the design and comparing the sustainability and environmental impact.· They then conclude by writing a paragraph summing up their findings and stating whether a new product is needed or whether there are already enough sustainable solutions.· Explain that in the next lesson they will be looking at a design process in more detail to develop a new product to replace a single-use plastic.· Look at Diagram: A design process, to illustrate.	<p>Slideshow 1: Slides 14-17</p> <p>Student Sheet 9b: Product analysis</p> <p>Diagram: A design process</p>

Solutions sheet



How will you transport your items from one place to another? In groups suggest three different ways. Sketch your ideas and comment on the material, strength, usability, aesthetics and sustainability.

Product analysis



Strength:

Usability:

Aesthetics:

Sustainability:



Strength:

Usability:

Aesthetics:

Sustainability:



Strength:

Usability:

Aesthetics:

Sustainability:



Strength:

Usability:

Aesthetics:

Sustainability:



Strength:

Usability:

Aesthetics:

Sustainability:



Strength:

Usability:

Aesthetics:

Sustainability:

Is a new product needed? Explain why.

Design Technology - The plastics solution



Age 7-11



60 minutes

Curriculum links

- Investigate a range of designs
- Research and develop a sustainable product

Resources



Slideshow 10:
The plastics solution



Student Sheet 10a:
Product design

Extension or home learning

Students gather materials for their prototype at home to bring in to school for the practical lesson. Alternatively, the prototype can be set as a home learning project and later shared with the class.

Lesson overview

Students discover a range of products which have been redesigned with sustainability in mind. They then consider some of the other single-use plastics they know of and choose one to redesign using a sustainable alternative. Students then develop their designs considering the materials they will use and how it will be manufactured, pitching their idea to the class and reflecting on feedback. At the end of these two lessons the students can produce a prototype.

Lesson steps

Learning outcomes

1. Single-use alternatives (10 mins)

Students investigate a range of sustainable alternatives to single-use plastics and reflect on their specifications.

- Understand key events which have shaped the redesign of plastic products

2. Redesigning single-use plastics (10 mins)

They then consider a range of single-use plastics and decide which to re-design focussing on sustainability.

- Research and develop an idea

3. Developing ideas (15 mins)

Working in groups students model their design and develop a pitch to share with others.

- Model and communicate design ideas in a variety of forms

4. Reflect and develop (15 mins)




Upon receiving feedback on their initial idea students regroup and fine tune their designs.

- Evaluate ideas against criteria and consider the views of others

5. Prototype production (10 mins)

Students then create a product specification and design a prototype, researching tools and materials required for production. Populating a list of required materials.

- Select a range of tools and materials to develop a product

Step	Guidance	Resources
1 10 mins	 <p>Step one introduces students to some recent innovations in design technology, aimed at reducing plastic use.</p> <ul style="list-style-type: none"> Remind students of the design process with Gallery: A design process, before introducing the learning outcomes. Use slide 4 to demonstrate some alternatives to single-use plastics. Ask students to share their reactions to these products, reflecting on the design specifications for each, such as strength, longevity, sustainability. 	Slideshow 10: Slides 1-4
2 10 mins	 <p>Next students review a variety of commonly used single-use plastics and decide which they will redesign.</p> <ul style="list-style-type: none"> Go through slide 5 which demonstrate a number of single-use plastics in common use today. Discuss with students the design specifications of each and how they are met, discussing cost and ease of production. Ask students to think of any other single-use plastics and list their ideas. Explain that although these products are very efficiently designed for their purpose, they are environmentally unsustainable. Reviewing knowledge from the whole Ocean Plastics unit task. Ask students to share what they know about why these products are unsustainable. Students then select a single-use product and explain why they think this particular product needs redesigning. 	Slideshow 10: Slide 5
3 15 mins	 <p>Step 3 sees students begin to develop their design idea.</p> <ul style="list-style-type: none"> Once students have selected (or you have allocated) which product they will redesign, group them accordingly so they can develop their ideas collaboratively. Explain that students have 15 minutes to come up with an alternative design to meet the same specification. Or, an improved version of the existing product which has less environmental impact. Use Student Sheet 10a to work through the design specification. Explain that at the end of this time they will pitch their ideas to another group and take feedback. 	Slideshow 10: Slide 6 Student Sheet 10a: Product design sheet

Step Guidance

Resources

4

15
mins



In step 4 students share their ideas with an audience and take constructive feedback.

- Ask students to join with another group and spend a few minutes talking through their design.
- Explain that the audience group should give constructive feedback, such as scrutinising cost or availability of materials. Slide 7 provides guidance on the process of giving constructive feedback. The groups should then swap roles so both received feedback.
- After both groups have shared and received feedback they can regroup and adapt their designs accordingly.

Slideshow 10:
Slide 7

5

10
mins



Step 5 involves students planning what they require to make a prototype.

- Using Student Sheet 10b students finalise their design, annotating and adding details.
- Explain that they will then need to consider what materials they will require to construct a prototype, including any tools they will need for its construction.
- Once students have populated a list for the materials and tools, they can complete Student Sheet 10a, explaining why they believe their design will be effective and how it improves on existing designs.
- If you would like your students to construct their prototype you will need to allocate adequate time and budget for sourcing materials.
- A follow up practical lesson will develop student's practical and construction skills.
- You may wish to exhibit these prototypes or share during an assembly or parents evening. This could also coincide with the presentation at the end of lesson 8.

Slideshow 10:
Slides 8-10

Student Sheet 10a:
Product design



This is one of ten lessons which make up the Ocean Plastics 7-11 cross-curricular unit. If you have taken students on the journey of the full unit we would recommend creating space for students to reflect on their learning and the future of the plastic problem.

You may want to ask students, what do you think the ocean will look like in the future? Or, do you think we can remove the plastics that has already entered the ocean? A great example of creative engineering, which you can introduce to students, is Boyan Slat's floating boom (<https://theoceancleanup.com/>) which is a device designed to remove plastic debris from the ocean.

Product design



Before developing your idea think about who you are designing for and why you are designing / redesigning this product.

What are you planning to design?

Who are you designing it for?

Why are you designing this product?

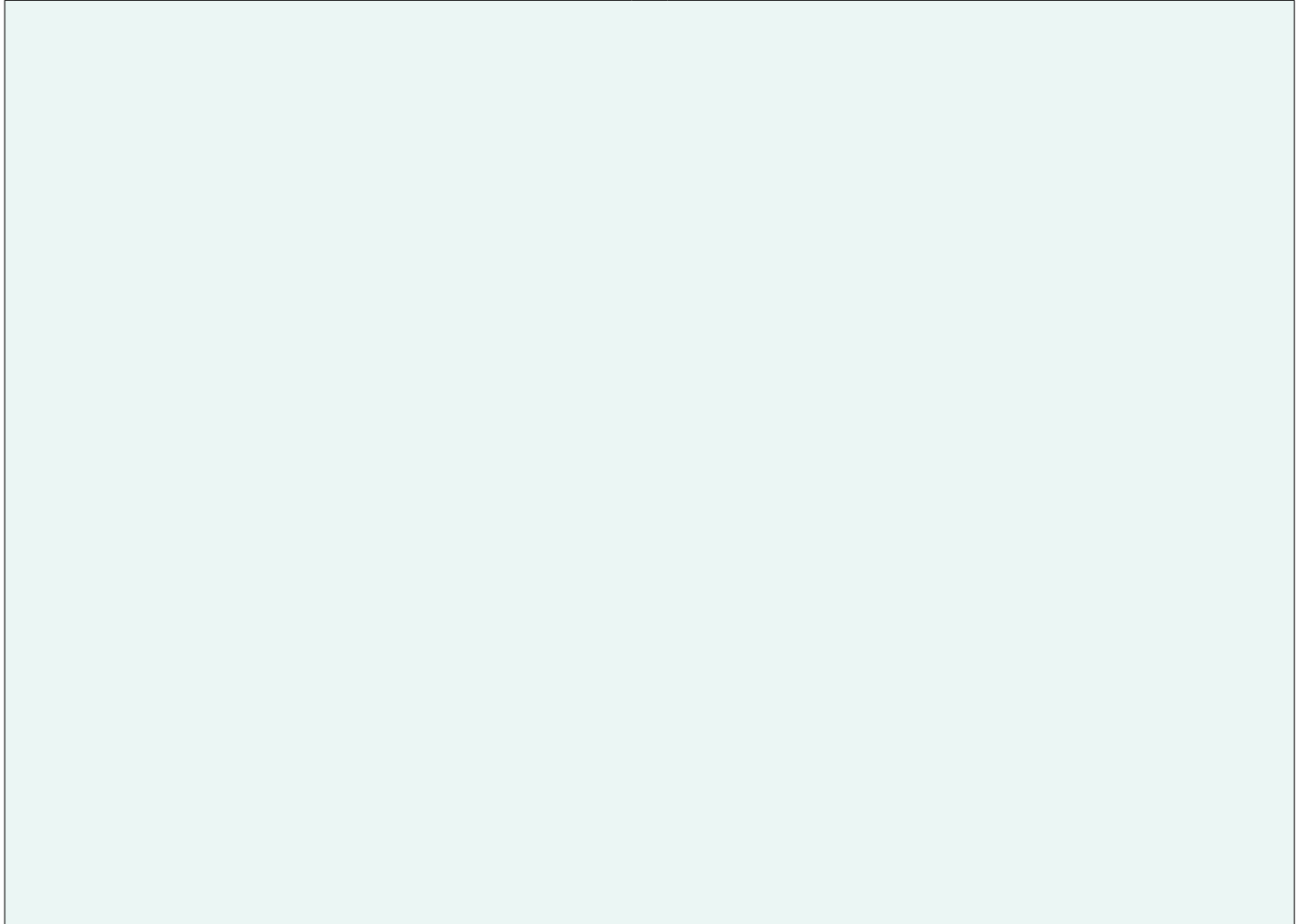
Design criteria

Agree on the criteria for your design and explain why below.

-
-
-
-
-

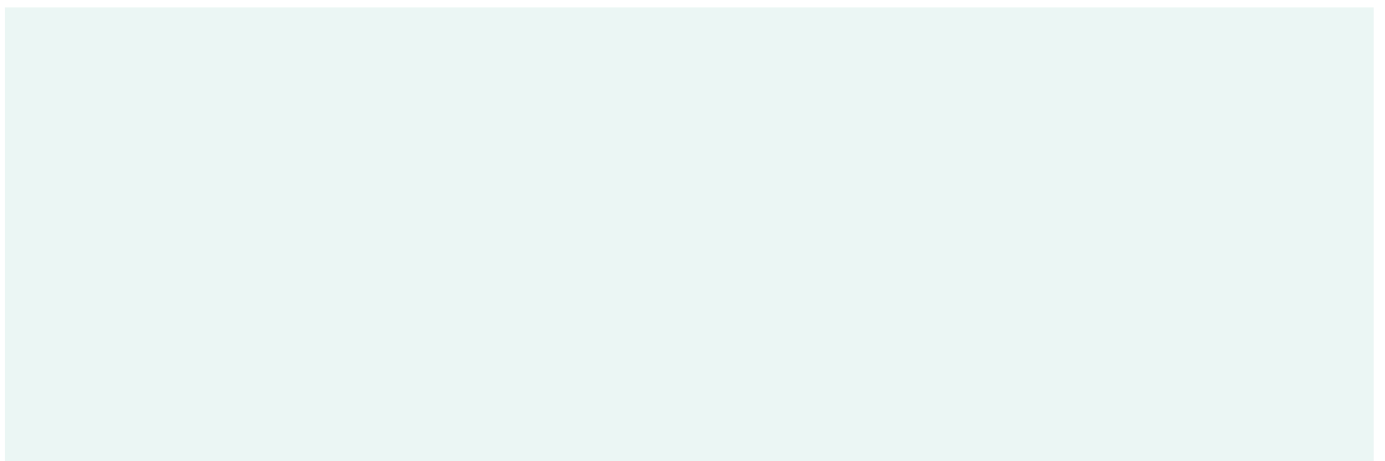
Design ideas

Sketch and annotate your ideas below, working as a group share your ideas, consider how to best meet the design criteria and how you will take one idea forward together.



Feedback

Make notes of any feedback you received on your design.



Production plan

Use the boxes below to plan how to make your product. Make a list of the materials and tools you will need.

Materials and tools:

Conclusion

What is effective about your design? How does it improve on existing products?

Other books in this series



Ocean Plastics X-Curric
5-7



Ocean Plastics Science
11-14



Ocean Plastics Geography
11-14



Ocean Plastics D&T
11-14

Photo credits

Cover

Plastic beach: Dustan Woodhouse
Plastic waste: Peter Clarkson

Student Sheet 1a

Soda can: Rustic USA
Stainless steel, Fibreglass, Rubber, Glass: PXhere
Polystyrene: JensRS
Twine: Annca
Brass: Conger Design
Carbon fibre: Struffel Productions
Iron: Piro4D
PET: Maxpixel
Pencil: Moritz320

Student Sheet 1b

Cup: Maria Vernigora

Student Sheet 2a

Plastic production: Pashminu

Student Sheet 3a

Bottles: Jonathan Chng

Student Sheet 4a

Plastic beach: US Fish and Wildlife Service

Student Sheet 5a

Clownfish: Catlin Seaview Survey

Student Sheet 5b

Albatross chick: Kklinzing
Dead albatross: Chris Jordan
Green turtle: Bill C
Swimming turtle: Jeremy Bishop
Turtle on beach: HHach
Zooplankton: University of Exeter

Student Sheet 6a

Coffee: Bruce Mars
Waste cups: PXhere
Rubbish: John Cameron
Waste beach: Hermes Rivera

Student Sheet 7a

Hands: Rawpixel

Student Sheet 9a

Spices: Glaucio Guerra

Student Sheet 9b

White plastic bag: Kjell Meek
Brown paper bag: Lisa Fotios
Totes: Daria Shevtsova

All other photos

Encounter Edu



Ocean Plastics 7-11 is a cross-curricular unit of work encompassing science and geography which also develops skills in mathematics, citizenship and spoken language. The unit addresses four key questions; what are plastics, where are plastics, what impact can plastics have and what can I do?

These questions are answered by developing students understanding of properties of materials, living things, habitats and human and physical geography.

The unit explores the pros and cons of a variety of plastic products, investigates how plastic finds its way to the ocean and looks at what changes can be made on a local and global scale. Students understand the complex issues surrounding oceans plastics through this units optimistic and innovative approach to challenging attitudes and behaviour.

**Common Seas
Education**

hello@commonseas.com

Gate House
2 High Street
Totnes TQ9 5RZ