



OCEAN FOR BEGINNERS

ENRICHMENT | AGES 11-14



A resource by Common Seas

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Design and Technology Association
Geographical Association



This resource has been assessed by Royal Meteorological Society against their *Quality Control Framework for Climate Education*, developed as part of the National Climate Education Action Plan.



Common Seas

Common Seas is never far from the ocean.

We see plastic in every part of life on Earth, from the farthest shores to deep inside our bodies.

Working with our partners across government, business and civil society, Common Seas develops and delivers solutions that tackle the source of the plastic problem.

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Welcome to Common Seas Education



Marine plastic pollution is a visible and pervasive environmental issue affecting our ocean. It's also inextricably linked to climate change. 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 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
Founder
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. We have also included links to Teach the Future's Tracked Changes curriculum¹, demonstrating where the curriculum can be strengthened to ensure climate change and sustainability are fully embedded so that every student has the tools to understand and take action on the climate crisis. Common Seas has used the UNESCO Learning Objectives for the ocean² 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 Teach the Future, Curriculum for a changing climate: <https://www.teachthefuture.uk/tracked-changes-project>

² UNESCO Ocean literacy for all: a toolkit <https://unesdoc.unesco.org/ark:/48223/pf0000260721> (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.

Oceans for beginners 11-14			
Ocean Plastics learning objective	Lessons		
	1	2	3
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, including how it impacts the climate crisis .			
• 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

Green text demonstrates where climate change and sustainability learning can be extended through the *Teach the Future Tracked Changes* curriculum.

KS3 Science

Element of the curriculum

Biology

Lessons

1 2 3

- How organisms affect, and are affected by, their environment.
- Differences between species.
- Understand the interdependence of organisms in an ecosystem.
- **Understand the dependence of almost all life on Earth on the ability of photosynthetic organisms, such as plants and algae**

✓
✓
✓
✓

Working scientifically

- Identify scientific evidence that has been used to support or refute ideas or arguments.

✓

KS3 Geography

Element of the curriculum

Lessons

1 2 3

Geographical skills

- Understand geographical similarities, differences and links between places.
- Understand how human and physical processes interact to influence and change environments and how human activity relies on effective functioning of natural systems.
- Build on their knowledge of globes, maps and atlases.
- Understand economic activity in the primary sector.
- Understand key processes relating to hydrology and coasts.
- Understand how human and physical processes interact to change environments.
- Develop geographical skills in analysing and interpreting different data sources.
- Understand how human and physical processes interact.

✓
✓
✓
✓
✓
✓
✓
✓

SCHEME OF WORK

Lesson 1: Our wonderful ocean 11-14

Overview

This lesson introduces the marine habitat and encourages a discussion around what students already know about the ocean. Students will use globes and maps to identify the location of the different ocean basins. They will then learn the names and key features of iconic species from the ocean. Students then use information sheets to discover how humans use the ocean, presenting their findings in a fact-sheet.

Learning outcomes

- Review prior knowledge of ocean
- Name and locate and describe the world's oceans
- Describe the features of iconic marine species
- Explain how humans use the ocean
- Reflect on learning

Resources



Slideshow 1:
Our wonderful ocean



Student Sheet 1a:
World map

Student Sheet 1b:
Marine ecosystems

Student Sheet 1c:
Competing creatures



Gallery:
Living reef

Gallery:
Deep-sea creatures

Gallery:
The Great Barrier Reef



Diagram:
Deep ocean poster

Lesson 2: Our ocean and us 11-14

Overview

This lesson introduces students to the concept of ecosystem goods and services and allows them to discuss and share their knowledge. Students write a letter to the Secretary of State for the Environment outlining their thoughts on the oceans significance and their concerns about it's health. Students also describe how damaging the marine ecosystem could be detrimental for all of us.

Learning outcomes

- Discuss the ecological goods provided by the ocean
- Describe the ecological services provided by the ocean **including it's role as a carbon sink**
- Evaluate the importance of the ecological goods and services provided by the oceans
- Consolidate learning about ocean goods and services
- Reflect on learning

Resources



Slideshow 2:
Our ocean and us



Student Sheet 2a:
Goods and services factsheet

Student Sheet 2b:
Goods and services worksheet

Lesson 3: Our ocean in crisis 11-14

Overview

This lesson challenges students to think about the potential myths we have been led to believe through selective media representation, by completing a true, false or uncertain activity. Students are then asked to think about the different motivations media outlets or organisations might have. Students conduct research about an 'Ocean hero' and create a poster encouraging others to pursue a career in that field. The lesson is concluded by discussing the changes we can implement in our lives which will make a difference to the levels of marine plastic pollution.

Learning outcomes

- Understand facts about plastics pollution
- Review prior knowledge of ocean plastic pollution
- Recall facts about plastic pollution
- Explain why it is important to know the validity of a source
- Create an informative and interesting poster about a 'Ocean hero'
- Share knowledge and understanding of marine plastic pollution by making a pledge

Resources



Slideshow 3:
Our ocean in crisis



Student Sheet 3a:
News articles

Student Sheet 3b:
Ocean hero profiles

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

Lesson 1: Our wonderful oceans 11-14

This lesson introduces students to the marine habitat and the wealth and diversity of life found in the ocean. Students will identify and locate the five ocean basins and study iconic marine species from each. Following this, students will learn how humans use the ocean.

Resources in this book:



Lesson Overview 1



Teacher Guidance 1



Student Sheet 1a: World map

Student Sheet 1b: Marine ecosystems

Student Sheet 1c: Competing creatures

Resources available online:



Slideshow 1: Our wonderful oceans



Gallery: Living reef

Gallery: Deep-sea creatures

Gallery: The Great Barrier Reef



Diagram: Deep ocean poster



Subject Update: How many oceans are there?

All resources can be downloaded from:
encounteredu.com/teachers/units/oceans-for-beginners-x-curric-ages-11-14

Our wonderful oceans



Age 11-14



60 minutes

Curriculum links

- Understand the geographical similarities and differences between places including the differences between species
- Use globes, maps and atlases to locate oceans and physical features

Resources



Slideshow 1:
Our wonderful ocean



Student Sheet 1a:
World map

Student Sheet 1b:
Marine ecosystems

Student Sheet 1c:
Competing creatures



Gallery:
Living reef

Gallery:
Deep-sea creatures

Gallery:
The Great Barrier Reef



Diagram:
Deep ocean poster



Subject Update:
Learn more: How many oceans are there?

Lesson overview

This lesson introduces the marine habitat and encourages a discussion around what students already know about the ocean. Students will use globes and maps to identify the location of the different ocean basins. They will then learn the names and key features of iconic species from the ocean. Students then use information sheets to discover how humans use the ocean, presenting their findings in a fact-sheet.

Lesson steps

Learning outcomes

1. Ocean habitat introduction (5 mins)

Students are introduced to the marine habitat and share their prior knowledge about the ocean.

- Review prior knowledge of ocean

2. The blue planet (30 mins)

Students study maps and globes to discover how much of the earth is covered in water, mapping the world's ocean basins, their physical features and important marine ecosystems.

- Name, locate and describe the world's oceans

3. Competing creatures (10 mins)

Using information about iconic marine species, students play a game of Competing creatures in pairs, matching the marine ecosystems and animals.

- Describe the features of iconic marine species

4. Humans and the oceans (10 mins)

Students compile a list of ways humans use the oceans and start thinking about how our actions affect the ocean.

- Explain how humans use the ocean

5. Reflection (5 min)

In pairs students recall three new things about ocean they learnt today. Students reflect on what else they would like to know and share questions with the teacher.

- Reflect on learning

Extension or home learning

Students create a fact-sheet about a marine ecosystem found in the UK, including a description of the environment, the animals that are found there and how humans use it.

Step Guidance

Resources

1
5
mins



Step 1 introduces students to the marine habitat and asks them to share their prior knowledge about the ocean and the creatures that reside there.

- Use slides 2-4 to introduce the lesson and the learning outcomes.
- Ask students to share what they know about the ocean with their partner.
- Take feedback from students.
- Explain that in pairs, students will have 30 seconds to name as many marine animals as they can think of, keeping a tally on mini-whiteboards. Encourage them to avoid repetition.
- Students share how many they listed.

Slideshow 1:
Slides 1-4

2
30
mins



Step 2 involves students locating the world's oceans and understanding marine ecosystems.

- Choose two students to answer the questions on the board. It is imperative that the students understand how important water is to humans.
- Hand out Student Sheet 1a and atlases. Students identify and label the five oceans.
- Using Student Sheet 1b and laptops or tablets, students access the online galleries and then annotate their world maps with information about the different environments and marine animals.
- Students colour a map showing where different environments and animals are found.

Slideshow 1:
Slides 5-12

Student Sheet 1a:
World map

Student Sheet 1b:
Marine ecosystems

Gallery:
Living reef

Gallery:
Deep-sea creatures

Gallery:
The Great Barrier Reef

Diagram:
Deep ocean poster

3
10
mins



In step 3 students work in pairs to compare and contrast different marine animals.

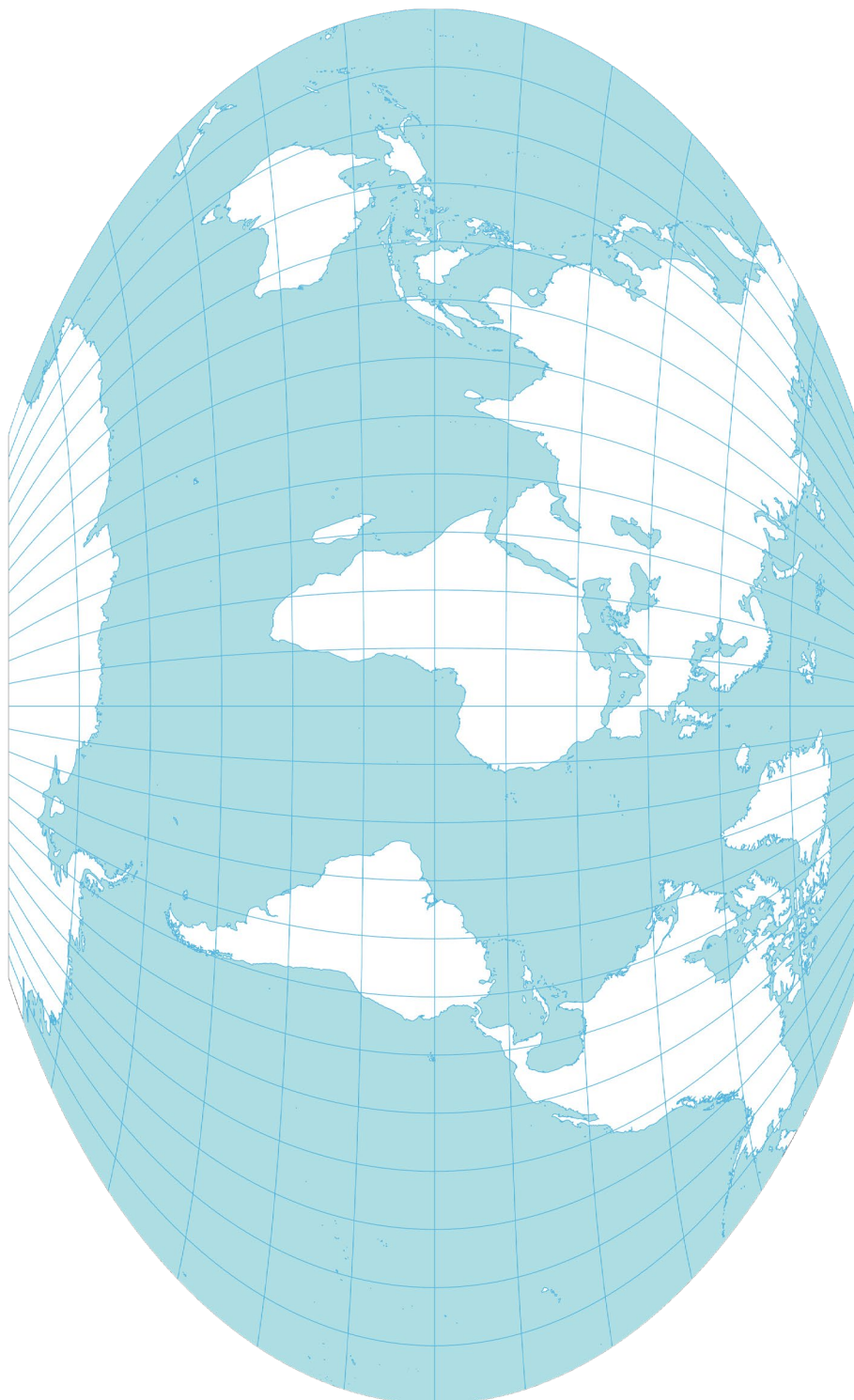
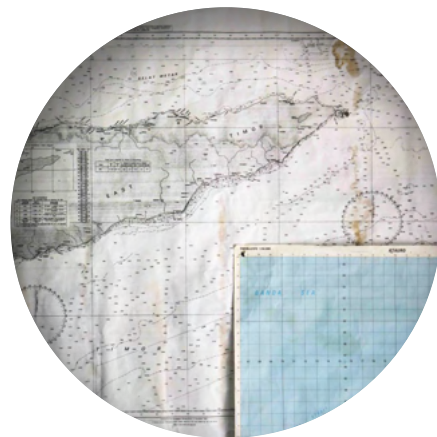
- Hand out Student Sheet 1c (cards need to be cut up and put into envelopes beforehand).
- On each card there are a number of statistics about different marine animals. In pairs students compare two animals by picking a particular statistic to compare. The student whose animal has the favourable statistic wins that round.
- Students continue until one student has won all the cards.
- Following this, students pick their favourite three animals and locate where they live on their world maps.

Slideshow 1:
Slide 13

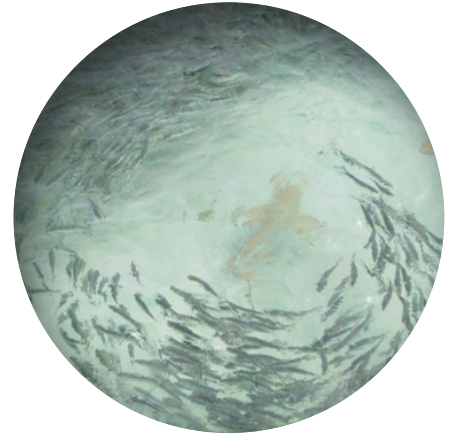
Student Sheet 1c:
Competing creatures

Step	Guidance	Resources
4 10 mins	 <p>Steps 4 asks students to consider the impact humans have on the world's oceans.</p> <ul style="list-style-type: none"> · In pairs, students list what we do and what resources we use that involve the ocean. e.g. fishing, surfing, etc. · Ask students to share their answers. · Students should then discuss how the actions of humans could affect the oceans. Share examples on the board. 	Slideshow 1: Slides 14-15
5 5 mins	 <p>Step 5 asks students to reflect on their learning and think of questions that they would like to find out more about.</p> <ul style="list-style-type: none"> · Choose students to explain how they have met the learning outcomes. For each question bounce it to at least one more student to assess learning. · Give students the opportunity to ask questions, this can be used as an opportunity to clear up any misconceptions or write a list of further questions for investigation. 	Slideshow 1: Slides 16-18
+ 30 mins	 <p>Students create a fact-sheet about a marine ecosystem found in the UK, including a description of the environment, the animals that are found there and how humans use it.</p>	

World map



Marine ecosystems



Coral reefs



Location:

They are found in over 100 countries around the world. The majority are found between the Tropic of Cancer and Tropic of Capricorn.

Characteristics:

They grow in temperate waters from 23-29°C, they prefer salty and clear water.

Facts:

Coral reefs are found in less than 1% of the ocean yet are home to 25% of all marine life on the planet.

Mangroves



Location:

They grow at tropical and subtropical latitudes near the equator. They are found in the intertidal zone of the coastline, where the ocean meets the land.

Characteristics:

Mangroves grow in areas with low-oxygen soil, where slow moving salt-water allows fine sediments to accumulate.

Facts:

They stabilize the coastline, reducing erosion from storm surges, currents, waves and tides. There are 70 species of mangroves.

Kelp forests



Location:

They are found in cool, nutrient rich, relatively shallow waters close to the coast. They are rarely found deeper than 40 meters.

Characteristics:

Kelp are a type of algae which provide food and shelter for many organisms such as fish, invertebrates and marine mammals.

Facts:

They can grow 30-60cm per day.

Physical features

Open ocean

More than 50% of the earth's surface is covered by ocean which is at least 2 miles deep (3.2km).

Deep ocean

The area of ocean located below 200m, where there is little light and close to freezing temperatures. Deep ocean makes up to 95% of the worlds living space, only 5% is mapped with a high resolution.

Mariana Trench

The world's deepest point at 10,994m deep. Located in the western Pacific, east of the Philippines approximately 124 miles east of the Mariana Islands. The trench measures 1,580 miles long and is on average 43 miles wide.

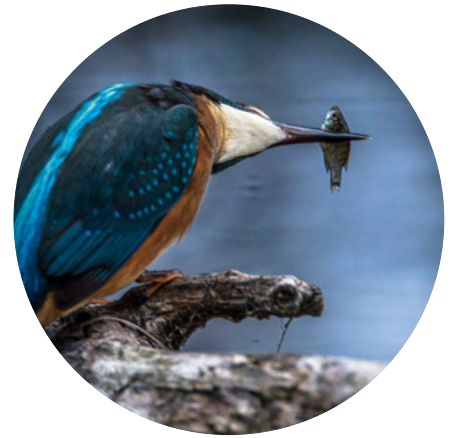
Mid-Atlantic Ridge

An underwater mountain range in the Atlantic Ocean that runs from 87°N to 54°S. It is on average only 3km above the ocean floor, ranging from 1000km to 1600km wide. It was created by tectonic plates moving away from each other. The North America plate and the Eurasian plate continue to move apart, causing the Mid-Atlantic Ridge to continue to grow at a rate of 2.5cm per year.

Facts about the ocean

- The ocean is estimated to cover 14 million square miles, combined with the depth, the ocean covers 1.35 billion cubic kilometres.
- The average depth of the ocean is 720m.
- Connected ocean ridges can measure up to 40,000 miles long. They weave through all major oceans and are the single largest feature on Earth. They are the result of the Earth's tectonic plates moving apart.
- The worlds highest mountain is Mauna Ke. At a height of 10,203m (33,500 feet) it is larger than Mount Everest which is 8,850m (29,035 feet), but only 4205m (13,796 feet) of Mauna Kea is visible above sea level.

Competing creatures



Stingray



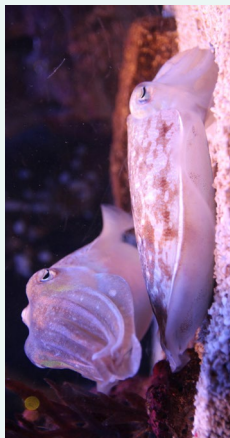
Size: Up to 2m
Weight: Up to 340kgs
Life span: 15 - 25 years
 Live in shallow warm water

Sperm whale



Size: 6 - 20.5m
Weight: 35,000 - 57,000kgs
Life span: 50 - 70 years
 Live in all oceans, in open water

Cuttle fish



Size: 15 - 50cm
Weight: 3 - 11kgs
Life span: 1 - 3 years
 Live in the Mediterranean and North and Baltic Seas

Japanese spider crab



Size: Up to 4m
Weight: 20kgs
Life span: 100 years
 Live in the Pacific Ocean around Japan

Nudibranch



Size: 2cm - 60cm long
Weight: Up to 1.5kgs
Life span: Up to 1 year
 Live in tropical waters

Crown-of-thorns starfish



Size: 20 - 40cm
Weight: Half a kilogram - 3.5kgs
Life span: Up to 8 years in captivity
 Live in the Indo-Pacific region



Great white shark



Size: 3m – 4.2m long

Weight: 680 – 1200kgs

Life span: 70 years

Live in temperate oceans;
North America, South Australia

Copepod



Size: 1mm – 5mm long

Weight: Less than half a gram

Life span: 6 months to 1 year

Live in all marine environments

Parrotfis



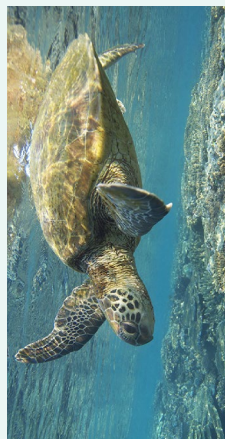
Size: 30 – 120cm

Weight: 20.5kgs

Life span: Up to 7 years

Live in tropical waters

Green turtle



Size: 80cm – 120cm

Weight: Up to 320kgs

Life span: 80 or more years

Live in tropical waters

Clownfis



Size: 10 – 20cm long

Weight: 0.25kgs

Life span: 3-6 years

Live in the Indo-Pacific region

Reef manta ray



Size: Up to 5.5m wide

Weight: Up to 900kgs

Life span: 20 years

Live in the Indo-Pacific region

Lesson 2: Our oceans and us 11-14

In this lesson students learn about the concept of ecosystem goods and services, following this they complete a quiz, peer assessing one another and reflecting on how dependent we all are on the ocean.

Resources in this book:



Lesson Overview 2



Teacher Guidance 2



Student Sheet 2a: Goods and services factsheet

Student Sheet 2b: Goods and services worksheet

Resources available online:



Slideshow 2: Our oceans and us



Subject Update: What are ecosystem goods and services?

All resources can be downloaded from:
encounteredu.com/teachers/units/oceans-for-beginners-x-curric-ages-11-14

Our ocean and us



Age 11-14



60 minutes

Curriculum links

- Understand the interdependence of organisms in an ecosystem
- Understand economic activity in the primary sector

Resources



Slideshow 2:
Our ocean and us



Student Sheet 2a:
Goods and services factsheet

Student Sheet 2b:
Goods and services worksheet



Subject Update:
Learn more: What are ecosystem goods and services?

Lesson overview

This lesson introduces students to the concept of ecosystem goods and services and allows them to discuss and share their knowledge. Students write a letter to the Secretary of State for the Environment outlining their thoughts on the oceans significance and their concerns about it's health. Students also describe how damaging the marine ecosystem could be detrimental for all of us.

Lesson steps

1. Ocean goods (10 mins)

Students are asked to reflect on how we rely on the oceans describing some of the ways such as for food and transport.

2. Ocean services (15 mins)

Students learn about key services provided by the ocean such as climate regulation and how marine environments such as mangrove forests prevent coastal erosion **and store blue carbon**

3. Letter to the Secretary of State for the Environment (20 mins)

Students write a letter to the Secretary of State for the Environment (inform students who this currently is) expressing their opinions and explaining why more needs to be done to protect the oceans.

4. Quiz (10 mins)

Students take a quiz which challenges their knowledge and understanding of the array of goods and services we use produced by the ocean.

5. Reflection (5 mins)

Students consider how the ocean is used and the subsequent threats to the oceans sharing their concerns with a partner.

Learning outcomes

- Discuss the ecological goods provided by the ocean

- Describe the ecological services provided by the ocean

- Evaluate the importance of the ecological goods and services provided by the oceans

- Consolidate learning about ocean goods and services

- Reflect on learning

Extension or home learning

Students conduct research about the fishing industry in the UK, creating a fact-sheet covering the following questions: Where do people fish, what is the value of the industry, how many people are employed in the industry and are there any restrictions?

Step Guidance

Resources

1
10
mins



Step 1 sees students learn about the goods and services ecosystems provide.

- Use slides 1-2 to introduce the lesson and the learning outcomes.
- Slide 3 provides students with definitions of ecological goods and services that they should copy into their books.
- Take some feedback from students of the examples they've thought of.

Slideshow 2:
Slides 1-3

2
15
mins



Step 2 involves students focusing on the services provided by ecosystems.

- Students match the key words to their definitions.
- Check answers by asking students for feedback.
- Using the information on Student Sheet 2a students are to complete Student Sheet 2b.
- Using slide 7-8 go through the different services that the ocean provides, ask students to further categorise the services, combining them into groups.
- Using slide 9 assess whether students have grouped the services correctly.

Slideshow 2:
Slides 4-9

Student Sheet 2a:
Goods and services factsheet

Student Sheet 2b:
Goods and services worksheet

3
20
mins



Step 3 involves the students writing a letter that is accurate, passionate and uses the correct format.

- Students are to write a letter to the Secretary of State for the Environment.
- Use slides 9-10 to demonstrate the correct letter format before beginning the task.
- Encourage students to use facts included on Student Sheet 2a in their letter as evidence, to make their arguments more convincing.

Slideshow 2:
Slides 10-11

4
10
mins





Step 4 asks students to reflect on their learning by completing a quiz.

- Students answer the questions on the board in their books, in full sentences.
- Students then compare their answers with a partner.
- Take feedback from class, if students are unable to answer the question, then bounce it to another pupil.
- Extension task - ask students to write five questions themselves and quiz their partner.

Slideshow 2:
Slide 12

TEACHER GUIDANCE 2 (page 2 of 2)

Step	Guidance	Resources
5 5 mins	 <p>Step 5 asks students to reflect on their learning and think of questions that they would like to find out more about.</p> <ul style="list-style-type: none">· Ask students to share what they've learned and any questions they have.· For each question check with other students to see if they already know the answer. This can be used as an opportunity to clear up any misconceptions or write a list of further questions for investigation.	Slideshow 2: Slides 12-14
+ 30 mins	 <p>Students conduct research about the fishing industry in the UK. Students create a fact-sheet covering the following questions: Where do they fish, what is the value of the industry, how many people employed in the industry, are there any restrictions?</p>	

Goods and services factsheet



Scientific research

The ocean not only covers 71% of the earth but it provides critical support for life on earth, such as the hydrological cycle. To ensure we implement the most effective policies we need to understand what we are protecting. Due to human behaviour the ocean faces increasing threats such as over-exploitation of marine life, pollution and rising sea temperatures. It is therefore no surprise that there is a crucial need for targeted scientific research that builds up our understanding of Earth's processes.

Raw material

In 2012, 93.5 million cubic metres of sand were removed from European waters. The Netherlands used approximately 63 million cubic meters. Roughly 37 million cubic meters was used to replenish the coastline and the rest was used to expand the port of Rotterdam.

Habitats for species

The ocean provides a range of habitats from warm, shallow, light-filled waters to deep, dark and cold areas. One example of a marine habitat is coral reefs. They cover less than 1% of the ocean, are found in warm, shallow tropical waters and support more species per unit area than any other marine environment. Another example of a marine habitat is The Deep Sea, it consists of approximately 80% of the ocean but is possibly the least understood environment on Earth, with much of it unexplored. It includes ocean found 200m deep and below.

Climate regulation

The surface of the ocean absorbs over half of all the heat reaching the Earth. This heat is then distributed around the world by the ocean currents. The ocean therefore, has a huge impact on weather and climate worldwide.

Food

In 2016, 171 million tons of fish were processed by the world's fisheries. These fisheries contribute to livelihoods, employment and income. The fishing industry is particularly important to coastal communities in developing countries. Recent statistics indicate that 59.6 million people are directly employed in the primary sector of capture fisheries and aquaculture. Fish and seafood are the major source of protein for over a billion people.

Biodiversity

The ocean covers 71% of the Earth and contains the greatest diversity of life on Earth. The ocean is vast, and some scientist have suggested that 91% of ocean species are yet to be classified and 95% of the ocean remains unexplored. There are an estimated 1,000,000 different species in the oceans. Only 250,000 species have been formally described in scientific literature.

Recreational services

The ocean is a popular place for recreational activities, including scuba diving, fishing, kayaking, whale watching and surfing. In Australia surfing is iconic and a huge part of the culture. It's no surprise that roughly 10% of the population surfs and surfing is estimated to have an annual economic value of AUS\$26 million.

Coastal defence

It is estimated 150,000km of shoreline in 100 countries and territories receive some protection from coral reefs. This saves countries billions of dollars each year, not only in the cost of coastal defence strategies and insurance costs but also avoiding loss of life and displacement.

Transportation

The ocean has been used as a source of transportation since the ancient Egyptians, around 3000BC. The ocean has therefore played a key role in migration and global trade networks.

With globalization that role has increased, for example the quantity of goods carried by containers has risen from around 102 million metric tons in 1980 to 183 billion metric tons in 2017. It is estimated there are over 20 million shipping containers in the world.

Nutrient cycling

Nutrients are not spread out evenly across the ocean. Different ecosystems have adapted how they utilize nutrients.

Coral reefs have developed 'tight recycling' of the nutrients. For example, some algae live inside coral polyps harnessing energy from sunlight to photosynthesise. The waste produced in this process is then available for the coral polyp to utilize.

Carbon sequestration and storage

Ocean waters absorb carbon dioxide (CO₂), the CO₂ changes state to hydrocarbon and can be used by corals to create their calcium carbonate skeleton. It has been estimated that over 50% of all biological carbon emissions have been absorbed by the ocean. Therefore, helping buffer the effects of climate change.

Spiritual services

The ocean evokes a sense of awe and wonder in many cultures across the globe. It often creates a special sense of place for people with it being referenced in many religious books. There is also research which suggests the sea can restore physical, mental and emotional well-being.

Goods and services worksheet



Service	Definitio	Examples	

Lesson 3:

Our ocean in crisis 11-14

In this lesson students share what they already know about marine plastics pollution and reflect on the validity of sources of information. Students then study the profile of an 'Ocean hero' and reflect on what they can do to make a difference.

Resources in this book:



Lesson Overview 3



Teacher Guidance 3



Student Sheet 3a: News articles

Student Sheet 3b: Ocean hero profiles

Resources available online:



Slideshow 3: Our ocean in crisis



Subject Update: Marine plastics

Subject Update: Marine plastics facts and figures

All resources can be downloaded from:

encounteredu.com/teachers/units/oceans-for-beginners-x-curric-ages-11-14

Our ocean in crisis



Age 11-14



60 minutes

Curriculum links

- Identify scientific evidence that has been used to support or refute ideas or arguments
- Analyse and interpret information

Resources



Slideshow 3:
Our ocean in crisis



Student Sheet 3a:
News articles

Student Sheet 3b:
Ocean hero profiles



Subject Update:
Learn more: Marine plastics

Subject Update:
Learn more: Marine plastics facts and figures

Extension or home learning

Students keep a record of how they have managed to fulfil their pledge over the next week i.e. not using straws or encouraging their parents to take reusable bags to the supermarket.

Lesson overview

This lesson challenges students to think about the potential myths we have been led to believe through selective media representation, by completing a true, false or uncertain activity. Students are then asked to think about the different motivations media outlets or organisations might have. Students conduct research about an 'Ocean hero' and create a poster encouraging others to pursue a career in that field. The lesson is concluded by discussing the changes we can implement in our lives which will make a difference to the levels of marine plastic pollution.

Lesson steps

Learning outcomes

1. Ocean plastic pollution (5 mins)

Students take part in a whole class discussion about ocean plastics pollution, share what they already know and consider where that information comes from.

- Review prior knowledge of ocean plastic pollution

2. True, false or uncertain (15 mins)

Students play a game of true, false or uncertain where they are presented with a 'fact' and must discuss with their partner whether it is true, false or uncertain.

- Recall facts about plastic pollution

3. Media coverage (20 mins)

Students are given a variety of news reports and asked to assess the reliability of each source. Students then consider what the motivation for interested parties might be to promote or embellish ideas.

- Explain why it is important to know the validity of a source

4. Ocean heroes (15 mins)

In groups students are allocated an 'Ocean hero' to research and create a poster encouraging people to pursue that career.

- Create an informative and interesting poster about a 'Ocean hero'

5. Pledges (5 mins)

Students investigate what they can do to make a difference to plastics pollution and write a pledge to share on a classroom display.

- Share knowledge and understanding of marine plastic pollution through making a pledge

Step Guidance

Resources

1
5
mins



Step 1 introduces students to the concept of ocean plastics pollution and encourages a class discussion around what students have seen or heard in the media.

- Display slide 3 and ask students to talk in pairs about what they have heard about ocean plastic pollution.
- Students share what they have heard and seen.
- Mind-map their ideas.
- Look at the Gallery: Marine plastics pollution which demonstrates the dangers of plastic pollution to marine life.

Slideshow 3:
Slides 1-4

Gallery:
Marine plastic pollution

2
15
mins



Step 2 involves playing a game of true, false or uncertain and asks students to reflect on why certain ideas might be promoted or embellished.

- Display slides 5-23, read aloud the popular 'fact' from each slide. Ask students to vote with a show of hands whether they think this 'fact' is true, false or uncertain. You may need to elaborate on what is meant by uncertain, explaining that in some cases we simply don't know the answer, or that there is not enough evidence to support it.
- After students have voted, reveal the following slide which has the truth of the 'fact' explained in more detail. Allow students time to respond to each point.
- As you go through the slides ask students to think about who might benefit from that 'fact' becoming a mainstream idea.
- Help students understand that the motivation might be benevolent and charitable, or it might be due to an economic interest, but that understanding the source of information is crucial to making informed decisions. They should use their critical thinking skills whenever they are presented with facts to consider the validity of the source.

Slideshow 3:
Slides 5-23

3
20
mins



Step 3 asks students to consider the practices used by the media to convey their messages and achieve their aims.

- In pairs students read the news articles on Student Sheet 3a.
- They then write a paragraph analysing each of the articles. They need to assess the reliability of the information, conclude what they think the aim of the article is and make a note of the practices used within the article such as persuasive language, numerical data, sensational headlines etc.

Slideshow 3:
Slides 24-27

Student Sheet 3a:
News articles

Step Guidance

Resources

4
15
mins



Step 4 introduces students to five 'Ocean heroes' who are paving the way to improve ocean health and reduce plastic pollution.

- Display slides 28-32 which give a brief summary of each of the ocean heroes and their work.
- Using Student Sheet 3a, students work in pairs or small groups to read in more detail about that person. They may also like to use tablets or laptops to find out more. A list of sources are listed at the bottom of each profile.
- Explain that students should read the information about their designated 'Ocean hero' and create an information poster that will encourage other students to pursue a career in that field.

Slideshow 3:
Slides 28-32

Student Sheet 3b:
Ocean hero profiles

5
5
mins



Step 5 encourages students to consider what they can do to make a difference to ocean plastic pollution and make a pledge to change one thing.

- Display slide 33 which has some suggestions for what we can do to make a difference to ocean plastic pollution.
- Ask students in pairs to discuss what they might do.
- Students choose one and write on a post-it-note.
- These pledges can form part of a classroom display and can be reviewed later in the term for students to reflect on their experiences.

Slideshow 3:
Slides 33-36

+
30
mins



Students keep a record of how they have managed to fulfil their pledge over the following week i.e. not using straws or encouraging their parents to take reusable bags to the supermarket.

News articles



ARTICLE 1

Plastic Garbage Patch Bigger Than Mexico Found in Pacific

WATER, WATER, EVERYWHERE – AND most of it filled with plastic.

July 25th 2017

A new discovery of a massive amount of plastic floating in the South Pacific is yet another piece of bad news in the fight against ocean plastic pollution. This patch was recently discovered by Captain Charles Moore, founder of the Algalita Research Foundation, a non-profit group dedicated to solving the issue of marine plastic pollution.

Moore, who was the first one to discover the famed North Pacific garbage patch in 1997, estimates this zone of plastic pollution could be upwards of a million square miles in size. (Read: A Whopping 91% of Plastic Isn't Recycled.)

The team is currently processing the data and weighing the plastic, so they can get a handle on exactly how much garbage they've discovered in this area off the coast of Chile and Peru.

The term “patch” referring to the plastic pollution in oceanic gyres can be misleading. The pieces of plastic are not necessarily floating bottles, bags, and buoys, but teeny-tiny pieces of plastic resembling confetti, making them almost impossible to clean up.

These microplastic particles may not be visible floating on the surface, but in this case, they were detected after collecting water samples on Moore's recent six-month expedition to the remote area that had only been explored for plastic once before.

On the first transect of the South Pacific gyre in 2011, Marcus Eriksen, marine plastic expert and research director at the 5 Gyres Institute, did not spot much plastic. In only six years, according to the new data collected by Moore, things have changed drastically.

Henderson Island, located in this South Pacific region, was recently crowned the most plastic-polluted island on Earth, as researchers discovered it is covered in roughly 38 million pieces of trash.

The problem of plastic pollution is becoming ubiquitous in the oceans, with 90 percent of sea birds consuming it and over eight million tons of new plastic trash finding its way into the oceans every year.

ARTICLE 2

Trash-mapping expedition sheds light on 'Great Pacific -Garbage Patch'

August 23rd 2015

Scientists and volunteers who have spent the last month gathering data on how much plastic garbage is floating in the Pacific Ocean returned to San Francisco on Sunday and said most of the trash they found is in medium to large-sized pieces, as opposed to tiny ones.

Volunteer crews on 30 boats have been measuring the size and mapping the location of tons of plastic waste floating between the west coast and Hawaii that according to some estimates covers an area twice the size of Texas.

"It was a good illustration of why it is such an urgent thing to clean up, because if we don't clean it up soon, then we'll give the big plastic time to break into smaller and smaller pieces," said Boyan Slat, who has developed a technology he says could start removing the garbage by 2020.

A 171ft mother ship carrying fishing nets, buckets, buoys and bottles, among other items, and two sailing boats with volunteers who helped collect the garbage samples arrived at San Francisco's Piers 30-32. The boats went on a 30-day voyage as part of the "Mega Expedition", a major step in an effort to clean up what is known as the Great Pacific Garbage Patch.

The expedition was sponsored by the Ocean Cleanup, an organisation founded by Slat, a 21-year-old innovator from the Netherlands.

Slat said the group would publish a report of its findings by mid-2016 and after that hoped to test out a one-mile barrier to collect garbage near Japan. The ultimate goal is the construction of a 60-mile (96.5km) barrier in the middle of the Pacific. Slat said he became passionate about cleaning the oceans of plastic while diving in the Mediterranean Sea five years ago. "I was diving in Greece and realised that there were more plastic bags than fish," he said, "and I wondered: why can't we clean this up?"

After dropping out of university after six months, Slat dedicated his life to developing the technology the group will start testing next year. He has envisioned using long-distance floating barriers that will attach to the seabed and target swirling ocean currents full of waste to skim garbage from the surface while aquatic life and currents pass underneath.

After a 2012 Ted Talk about his idea was viewed more than 2 million times, Slat decided to launch a Kickstarter campaign and raised \$2.27m, helping to start his organisation. Soon, his innovative solution got the attention of major philanthropists in Europe and Silicon Valley, including Salesforce.com chief executive Marc Benioff, who are helping pay for the data-gathering efforts and the technology's development.

The Pacific expedition, which will end in mid-September, will gather data more extensive than what has been collected in the past 40 years. It also will give a better estimate of the how much plastic waste is in the Pacific, Slat said.

ARTICLE 2 (CONTINUED)

Trash-mapping expedition sheds light on 'Great Pacific -Garbage Patch'

August 23rd 2015

The boaters are using GPS and a smartphone app to search for and record the plastic. They take samples and ship them to the Netherlands, where the plastics are counted and recorded.

The Great Pacific Garbage Patch was discovered by Charles Moore in 1997, as he returned home from the Transpacific Yacht Race.

ARTICLE 3

There Are 48 Times More Pieces of Plastic In The Ocean Than There Have Been Humans Ever

December 11th 2014

There are “at least 5.25 trillion plastic particles” in the world’s oceans, a new study found.

There are at least 5,250,000,000,000 pieces of plastic in the world’s oceans, a new study estimates. The study, published Wednesday in the scientific journal PLOS ONE, points out that “plastic pollution is ubiquitous throughout the marine environment.” To study the problem, scientists consequently embarked on a series of 24 expeditions to look at and haul up plastic. The researchers ultimately visited 1,571 locations around the world.

The researchers also estimated that all the plastic in the ocean weighs 268,940 tons. And that’s “highly conservative,” they wrote, because even more plastic may be lying around on beaches, inside animals, on the seabed, or hidden elsewhere in the water.

That means there are about 48 times as many pieces of plastic in the ocean as there are people who have ever lived on Earth. A widely cited estimate puts the total human population since the dawn of the species at about 108 billion. The estimate comes from the Population Reference Bureau and includes a number of qualifications. But assuming it’s more or less accurate, it means there are about 48 times as many pieces of plastic as there are humans in the history of the world.

Or, put another way, this means that if we took all the plastic out of the ocean and divided it up among all of humanity ever, everyone would get (at least) 48 pieces each.

Of course, a lot of those pieces are very, very small. The study found that 92.4% of the particles were “microplastics” that are 4.75 millimetres or less thick. Still, most of those particles came from larger pieces breaking up. And larger “macro plastics” – things like fishing gear, old buoys, and bottles – actually contributed the most to the overall weight of the oceans’ plastic content.

ARTICLE 3 (CONTINUED)

There Are 48 Times More Pieces of Plastic In The Ocean Than There Have Been Humans Ever

December 11th 2014

And speaking of weight...

All of this plastic weighs more than 500 fully loaded Boeing 747s. A 747 has a maximum take-off weight of nearly 500 tons, meaning that it would take nearly about 537 of the behemoth airplanes to equal as much weight as all the plastic in the ocean.

The plastic also weighs 26 times as much as the Eiffel Tower. So dump 26 Eiffel Towers into the sea, then that's more or less equal to the amount of plastic that's out there.

The plastic in the northern and southern hemispheres is comparable, which surprised the researchers. The southern hemisphere oceans had less, but were "still within the same range as for the northern hemisphere oceans." This surprised the researchers because there are more "inputs" – such as people, shipping routes, etc. – in the north.

The researchers speculate on a variety of reasons that they found so much plastic in the southern hemisphere: plastic may move more easily than expected; there may be pollution sources they hadn't considered; or the plastic could sink more in the northern hemisphere.

Ultimately the researchers point out that all this garbage floating around in the ocean is hurting animals. Even though much of the plastic is small, it ends up being consumed by sea creatures and working its way up the food chain. The researchers also write that it's "economically and ecologically prohibitive" to remove all this plastic, so it will probably end up buried in the sediment. That, the researchers write, reinforces the need to stop the flow of plastic into the ocean and "reverse this growing environmental problem."

ARTICLE 4

Oceans swallowed 13 million tonnes of plastic in 2010

12th February 2015

Vast floating islands of plastic are just a drop in the ocean compared with what's lurking deeper down. Between 5 and 13 million tonnes of plastic debris entered the marine environment in 2010 – and most of it is under water. What's more, without improvements in the way we manage waste, it could be 10 times as much each year by 2025.

It has been 40 years since the first scientific reports of plastic pollution in the ocean, but we still have plenty to learn. For instance, the combined results from 24 oceanic expeditions published late last year concluded there may be perhaps 244,000 tonnes

Oceans swallowed 13 million tonnes of plastic in 2010

12th February 2015

of floating plastic out there. This is puzzling, because conservative estimates suggest something like 9 million tonnes of plastic have entered the oceans since the 1970s.

Now we know there's even more missing plastic than that. Jenna Jambeck at the University of Georgia, Athens, and her colleagues have looked at data on plastic use and disposal in 192 coastal countries. They calculate that between 4.8 and 12.7 million tonnes entered the world's oceans in 2010 alone. This means the amount of plastic that has entered the ocean down the years might be 1000 times more than the mass of floating plastic that scientific surveys have measured.

Surprisingly, the 10 countries with the largest problem – many of which are in south-east Asia – generally have relatively low rates of plastic waste generation per person. For instance, in China – which tops the list with an estimate of up to 3.53 million tonnes of plastic marine debris a year – the average person generates about 1.1 kilograms of waste per day of which just 11 per cent is plastic. In the US – at 20 on the list – the average person generates more than twice as much waste. But the top offending countries also have high coastal populations and low rates of plastic recycling.

It's an interesting study, says Marcus Eriksen of the Five Gyres Institute in Los Angeles, who led last year's floating plastic study – but some of the assumptions used to arrive at the new calculations could be quibbled with. "I believe the authors underestimate the amount of trash that is scavenged, burned and buried before it reaches the ocean," he says. "I think there's much less leaving land."

Even so, there is clearly a huge mismatch between the plastic entering the ocean and the plastic we find there. "The disturbing conclusion is that much of the plastic entering the oceans is unaccounted for," says Carlos Duarte at the King Abdullah University of Science and Technology in Saudi Arabia, who has also helped conduct surveys into the amount of plastic in the oceans.

Plastic smog

Where is the missing plastic? Perhaps it's hiding in plain sight. "It's important to understand that plastic shreds rapidly into microplastics that distribute widely into the most remote waters on the planet," says Eriksen. "Of the 5.25 trillion particles of plastic we reported recently in PLoS One, 92 per cent are less than the size of a grain of rice."

Such small particles spread throughout the water column, says Eriksen, also finding their way into sea-floor sediments and ice cores. That means we should stop thinking of plastic waste in terms of unsightly chunks of debris floating in vast oceanic garbage patches, and instead see it more as a pervasive "plastic smog" of tiny particles spread through the entire volume of ocean water.

"It's not sensible to go to the ocean with nets to capture trash, but rather to focus on mitigation strategies on land," says Eriksen.

ARTICLE 4 (CONTINUED)

Oceans swallowed 13 million tonnes of plastic in 2010

12th February 2015

Yet the amount of plastic entering the ocean is likely to keep rising in the years to come. Jambeck and her colleagues point out that 16 of the top 20 plastic producers they identified are middle-income countries, where strong economic growth will probably result in even more plastic use, but where the infrastructure to deal with the waste is still lacking.

But the solution isn't to burden these developing countries with the cost of building effective waste management infrastructures, says Eriksen. Instead, we should require the plastics industry to rethink the way it designs its products – in particular, the industry should phase out plastic products designed for single use.

Change the way plastic is produced, says Eriksen, “and the plastic pollution issue would largely diminish”.

Ocean hero profile



Other books in this series



Oceans for beginners 5-7



Oceans for beginners 7-11



Oceans for beginners 14-16

Photo credits

Cover

Student Sheet 1b

Student Sheet 1c

Student Sheet 2a

Student Sheet 2b

Student Sheet 3a

All other photos

Boats: Free-Photos

Plastic bottle: Louis Hansel

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Kingfisher: Lubos Houska

Clownfish, Turtle, Nudibranch, Starfish, Shark, Parrotfish, Ray: XL Catlin Seaview Survey

Stingray: Dietmaha

Cuttlefish: Manseok

Spider Crab: Hans Hillewaert

Whale: Decokon

Copepod: Uwe Kils

Container: Heju

Boats: ThuyHaBich

Magazine: Kaboompics

Encounter Edu



This series of three lessons sets the scene for students who are about to commence Ocean Plastics 11-14.

The lessons introduce students to the breadth and depth of the ocean and the wonder of the creatures that inhabit it. The unit goes on to explore some of the many ways we depend on the ocean and asks students to write to the Secretary of State for the Environment expressing their concerns about ocean health.

The unit then reviews what is meant by ocean plastics pollution and encourages students to critically appraise information from different media sources. Students then go on investigate possible career opportunities within this field. At the end of these three lessons students will be fully prepared to embark on the full Key Stage 3 unit - Ocean Plastics 11-14.

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