Encounter Edu

Oceans for beginners

X-Curric | Ages 14 - 16

Common Seas

A resource by Encounter Edu and Common Seas

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With thanks to

Association for Science Education
Design and Technology Association
Geographical Association

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.

Encounter Edu

Encounter Edu designs and runs STEM and Global Citizenship education programmes, which make use of virtual exchange, live broadcast and virtual reality. These technologies create classroom encounters that widen young people's world view. Learning is further underpinned by an online library of teacher resources and training. Combined, these provide children with the experience and knowledge to develop as engaged citizens and critical thinkers for the 21st Century.

Contents

Foreword	page 2
Overview	page 3
Ocean Plastics learning objectives	page 4
Scheme of work	page 5
Resource guidance	page 7

Lessons

Lesson 1: Our wonderful ocean 14-16	section 1
Lesson 2: Our oceans and us 14-16	section 2
Lesson 3: Our ocean in crisis 14-16	section 3

Welcome to the Ocean Plastics Academy

Common Seas

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

About the Ocean Plastics Academy

What is the Ocean Plastics Academy?

Achieving the aim of plastic-free seas is likely to be a multi-generational endeavour. As with any environmental crisis, the important place to start is from a shared understanding of the problem and then move to solutions both in terms of individual behavioural change and advocating for changes at wider scales from the community-level upwards.

Literacy is the starting point for the education programme. A shared understanding of plastics across its entire life cycle including its impact on the marine environment is crucial in developing appropriate responses and informing action on a personal and community level. A plastics literate population will also be able to inform good governance, both as leaders and voters.

However you choose to address the issue of marine plastic pollution in your classroom, it can be hard to know what children should know. Common Seas has used the UNESCO Learning Objectives for the ocean[1] 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.

Literacy on its own is not enough and Common Seas will also be developing engagement tools that help to shift literacy into action, so do keep in touch!

How do I use the Ocean Plastics Academy?

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 to suit your needs.

You will find a suite of supporting multimedia resources online, and these are referenced throughout the lesson plans. It is assumed that you have access to a digital projector or interactive white board to display these resources and accompanying slideshows. Students with individual devices can also view multimedia without needing an account.

Is the Ocean Plastics Academy curriculum aligned?

Ocean Plastics Academy are aligned to the National Curriculum for England programmes of study for science, geography and design and technology. As the Ocean Plastics Academy develops, we will align the resources to additional curricula and standards.

[1] 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 Ocean Plastics Academy 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 14-16

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.			✓
• 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

KS4 Science

Element of the curriculum	Lessons 1	2	3
• How do communities of species and ecosystems interact with each other?	✓		
• Positive and negative human interactions with ecosystems.	✓		
• Evaluating social, economic and environmental implications.		✓	✓
• Identify scientific evidence that has been used to support or refute ideas or arguments.			✓

KS4 Geography

Element of the curriculum	Lessons 1	2	3
• Illustrate the concept of interrelationships within a natural system.	✓		
• Recognise and describe distributions and patterns of both human and physical features.	✓		
• Understand the interdependence of environments and people.		✓	✓
• Understand the impact of marine environment destruction.		✓	
• Interpret and analyse information from a variety of sources.			✓

SCHEME OF WORK

Lesson 1: Our wonderful ocean 14-16

Overview

This lesson will build on prior knowledge of marine environments. Students use globes and atlases to map the locations and key physical features of the oceans. Students will learn the names and notable characteristics of iconic species from different ocean habitats. They then use the information sheets to develop their knowledge and understanding of how humans use the ocean, presenting their findings in a fact-sheet.

Learning outcomes

- Review prior knowledge of the ocean
- Describe the physical features of the ocean
- Compare and contrast the features of 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

Student Sheet 1d:
Coral life

Gallery:
Living reef

Gallery:
Deep-sea creatures

Gallery:
The Great Barrier Reef

Diagram:
Deep ocean poster

Lesson 2: Our ocean and us 14-16

Overview

In this lesson students learn about the concept of ecosystem goods and services, following this they will answer GCSE style exam questions which they will peer assess, reflecting on how dependent we are on the ocean.

Learning outcomes

- List and describe the goods provided by the ocean
- List and describe the services provided by the ocean
- Consolidate understanding of ecosystem goods and services
- Evaluate the importance of the goods and services provided by the ocean
- Reflect and build 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 14-16

Overview

In this lesson students will consider some of the myths in the media relating to ocean plastics by completing a true or false activity. They then analyse different news reports considering the motivations different organisations and media outlets may have. Students conduct research about an 'Ocean hero' and create a detailed career plan to emulate the achievements of their chosen hero.

Learning outcomes

- Review prior knowledge of ocean plastic pollution
- Identify facts about ocean plastic pollution
- Analyse a variety of information about ocean plastic pollution
- Evaluate the work of a 'Ocean hero'
- Share knowledge and understanding through making a pledge

Resources

Slideshow 3:
Our ocean in crisis

Student Sheet 3a:
News articles

Student Sheet 3b:
Ocean hero profiles

Student Sheet 3c:
Career profile

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 ocean 14-16

This lesson introduces students to the marine environment focusing on the physical features of the ocean and the diversity of life found there. Students map the five ocean basins, study iconic marine species from each and understand 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

Student Sheet 1d: Coral life

Resources available online:


Slideshow 1: Our wonderful ocean


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-14-16

LESSON 1

Our wonderful ocean

Age 14-16

60 minutes

Curriculum links

- Understand the distribution of marine ecosystems
- Identify the interrelationships within a marine ecosystem

Resources

Slideshow 1:
Our wonderful ocean

Student Sheet 1a:
World map

Student Sheet 1b:
Marine ecosystems

Student Sheet 1c:
Competing creatures

Student Sheet 1d:
Coral life

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?

Extension or home learning

Students create a fact-file about UK marine environments, including information about the species found in UK waters and how humans use those waters.

Lesson overview

This lesson will build on prior knowledge of marine environments. Students use globes and atlases to map the locations and key physical features of the oceans. Students will learn the names and notable characteristics of iconic species from different ocean habitats. They then use the information sheets to develop their knowledge and understanding of 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 environment and share their prior knowledge.	• Review prior knowledge of the ocean
2. The blue planet (30 mins) Students study atlases and globes to map the world's oceans, their physical features and the important marine ecosystems.	• Describe the physical features of the ocean
3. Competing creatures (10 mins) Using information about a variety of marine species and habitats, students compare their features.	• Compare and contrast the features of marine species
4. Humans and the oceans (10 mins) Students list the different ways humans use the ocean and start to consider the consequences of human impact.	• Explain how humans use the ocean
5. Reflection (5 mins) In pairs students recall three new things they learnt today. Students reflect on what else they would like to know and share questions with a partner.	• Reflect on learning

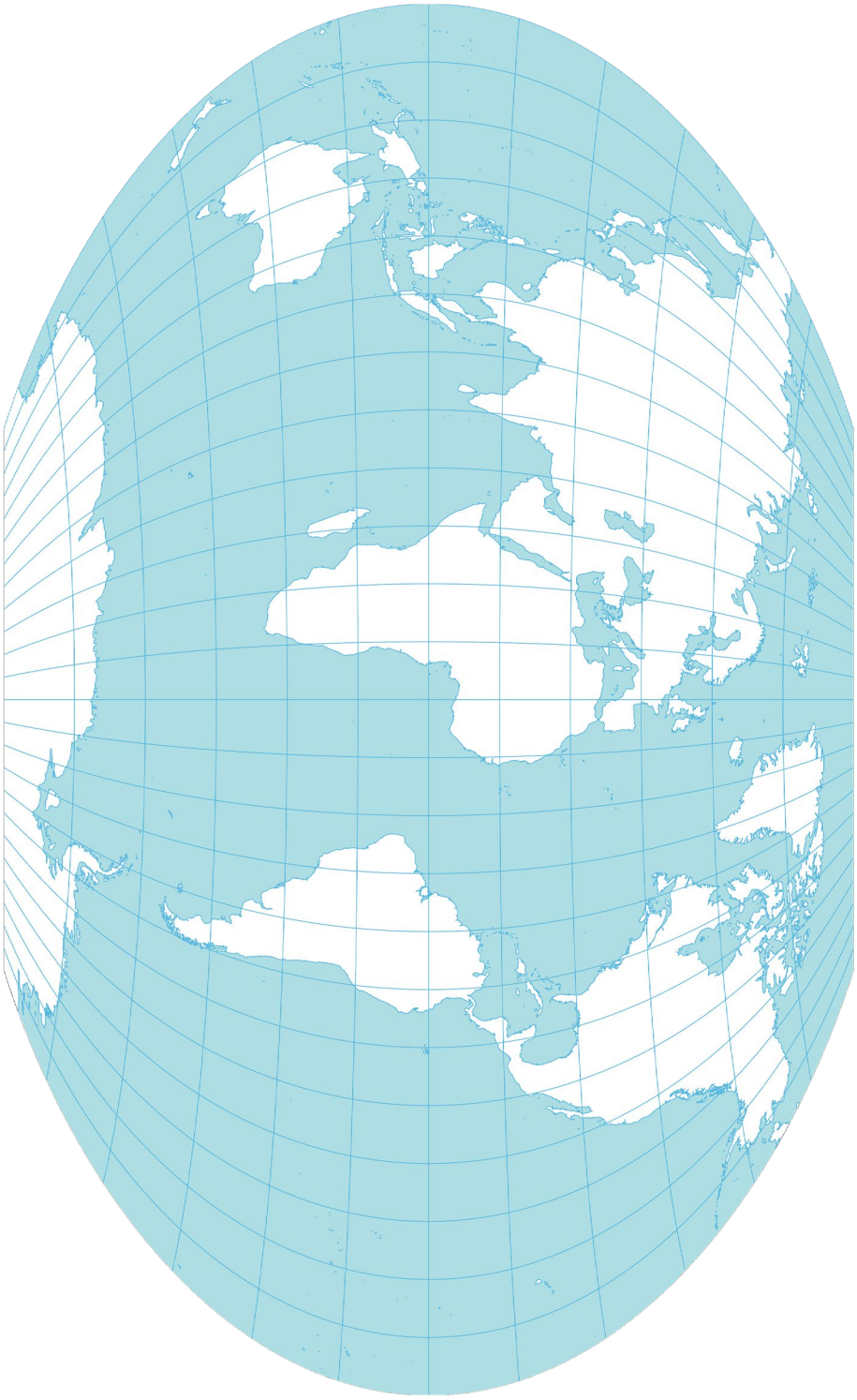
TEACHER GUIDANCE 1 (page 1 of 2)

Step	Guidance	Resources
1 5 mins	Step 1 introduces students to the marine environment 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. · Explain that in pairs, students will have 30 seconds to name as many marine species as they can think of, keeping a tally on mini-whiteboards or in their books. 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 describing marine ecosystems. · Choose students to answer the questions on the board. It is imperative that students understand how important water is to humans. · Hand out Student Sheet 1a and atlases. Students identify and label the oceans. · Extension – Students identify and label some of the world's seas. · Using Student Sheet 1b and laptops or tablets students access the online galleries. · Students annotate their world maps with information about the different marine species and habitats. Students then colour in the map showing where different species and habitats are found. · Students should include a number of physical features such as the location of ocean ridges such as the Mid-Atlantic ridge, linking to prior knowledge about plate tectonics.	**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	Step 3 asks students to compare and contrast different marine animals. · Hand out Student Sheet 1c and 1d. · Working in pairs students read the information about a variety of marine species. · Students compare similar marine species, for example stag horn coral and sea anemone or mantra ray and green turtle. Student shouldn't compare two extremely different animals like a great white shark and an anemone. They then write informative paragraphs comparing and contrasting the species. · Following this, students pick their favourite five species and locate where they live on their world maps.	**Slideshow 1:** Slide 13 **Student Sheet 1c:** Competing creatures **Student Sheet 1d:** Coral life

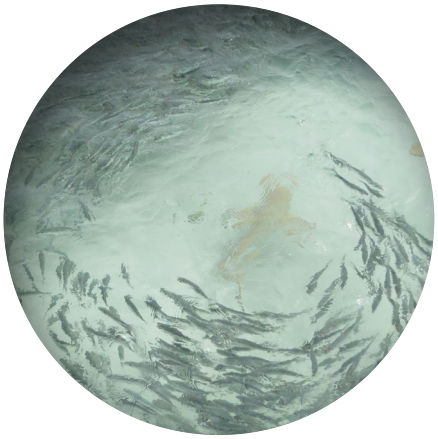
TEACHER GUIDANCE 1 (page 2 of 2)

Step	Guidance	Resources
4 10 mins	 Steps 4 asks students to consider the impact humans have on the world's oceans. · In pairs, students list what humans do and what resources we use that involve the ocean e.g. fishing, surfing etc. · Ask students to share their answers. · Following this students think about how the actions of humans could affect the ocean. Examples are shown on slide 15.	**Slideshow 1:** Slides 14-15
5 5 mins	 Step 5 asks students to reflect on their learning and think of questions that they would like to find out more about. · Choose students to express how they 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	 Students create a fact-file about UK marine environments, including information about the species found in UK waters and how humans use those waters.	

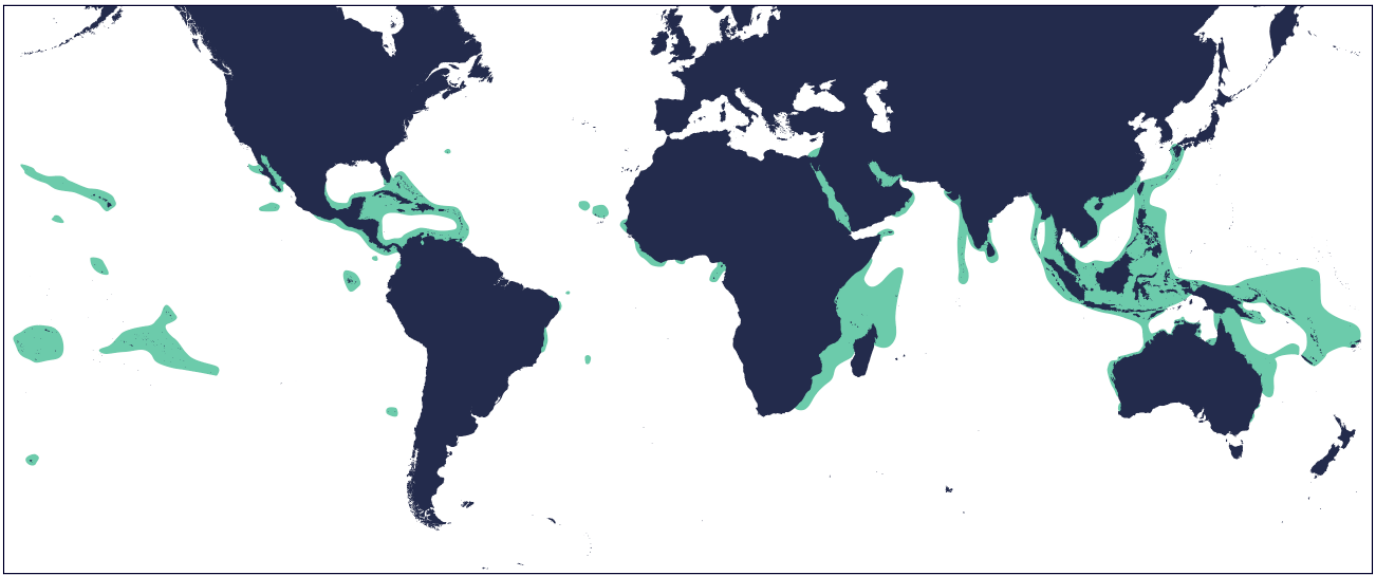
World map



Marine ecosystems



Coral reefs



Location:	Characteristics:	Facts:
They are found in over 100 countries around the world. The majority are found between the Topic of Cancer and Tropic of Capricorn.	They grow in temperate waters from 23-29°C, they prefer salty and clear water.	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:	Characteristics:	Facts:
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.	Mangroves grow in areas with low-oxygen soil, where slow moving salt-water allows fine sediments to accumulate.	They stabilize the coastline, reducing erosion from storm surges, currents, waves and tides. There are 70 species of mangroves.

Kelp forests

Location:	Characteristics:	Facts:
They are found in cool, nutrient rich, relatively shallow waters close to the coast. They are rarely found deeper than 40 meters.	Kelp are a type of algae which provide food and shelter for many organisms such as fish, invertebrates and marine mammals.	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).

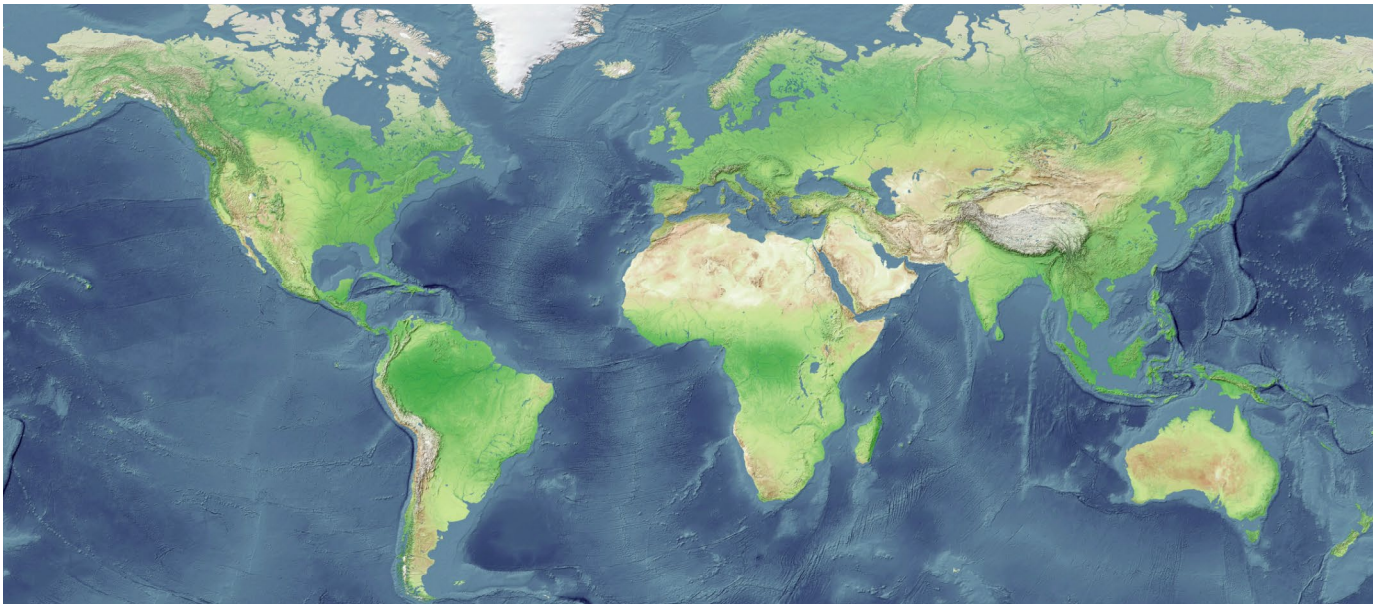
Deep ocean
The area of ocean located below 200 meters, where there is little light and close to freezing temperatures. Deep ocean makes up to 95% of the worlds living space, only 5% is mapped with a high resolution.

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, and ranges 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 Kea 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

Cuttlefish

Size: 15 – 50cm
Weight: 3 – 11kgs
Life span: 1 – 3 years

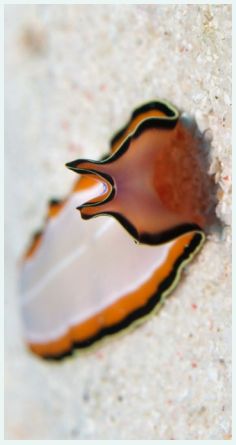
Live in the Mediterranean and North and Baltic Seas

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

Clownfish

Size: 10 – 20cm long
Weight: 0.25kgs

Life span: 3-6 years

Live in the Indo-Pacific region

Parrotfish

Size: 30 – 120cm
Weight: 20.5kgs

Life span: Up to 7 years

Live in tropical waters

Great white shark

Size: 3m – 4.2m long
Weight: 680 – 1200kgs

Life span: 70 years

Live in temperate oceans; North America, South Australia

Reef Manta ray

Size: Up to 5.5m wide
Weight: Up to 900kgs

Life span: 20 years

Live in the Indo-Pacific region

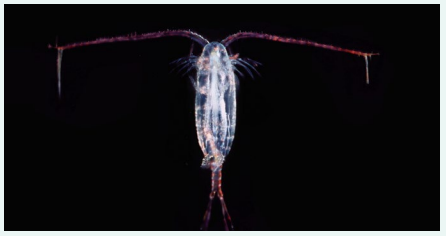
Green turtle

Size: 80cm – 120cm
Weight: Up to 320kgs

Life span: 80 or more years

Live in tropical waters

Copepod



Size: 1mm – 5mm long
Weight: Less than half a gram
Life span: 6 months to 1 year

Live in all marine environments

Coral life

Maori Wrasse
Cheilinus undulatus

Kingdom	Animal (Animalia)
Phylum	Chordate (Chordata)
Class	Bony fish (Osteichthyes)

The Maori wrasse is one of the largest reef fish and the largest of the wrasse family. They are voracious predators, eating anything from molluscs to echinoderms and crustaceans, as well as small fish. They are one of the few species to eat the Crown-of-thorns starfish.

Size
They can grow up to 2m in length

Feeding
They feed on molluscs, crustaceans and echinoderms. They have few natural predators.

Habitat
Reefs throughout the Indian and Pacific oceans, from the shallows to a depth of 100m.

Threats
They are vulnerable to overfishing and pollution from e.g. cyanide fishing.

Did you know?
They get their name from the markings on their face which resemble traditional Maori tattoos!

Cleaner wrasse
Genus *Labroides*

Kingdom	Animal (Animalia)
Phylum	Chordate (Chordata)
Class	Bony fish (Osteichthyes)

Cleaner wrasses are fish which specialise in cleaning other, larger fish. This symbiotic relationship allows larger fish to stay clean, and provides a food source for the wrasse. The cleaner wrasses congregate in 'cleaning' areas, where bigger fish visit to be groomed by the wrasses, which swim into their mouths and gills to ensure everything is clean.

Size
Most species of cleaner wrasse are small, no bigger than 20cm long

Feeding
They feed off the dead tissue and parasites of fish they clean and have few predators, as larger fish prefer the benefits of cleaning to a quick snack!

Habitat
They live mainly around coral reefs of the Indian and Pacific oceans.

Threats
They face no specific threats except those that threaten the coral reef ecosystem as a whole.

Did you know?
Some wrasses, instead of waiting for customers in the cleaning areas, make 'house visits' for shy fish!

Nudibranch
Order *Nudibranchia*

Kingdom	Animal (Animalia)
Phylum	Mollusc (Mollusca)
Class	Gastropod (Gastropoda)

Nudibranchs are a type of mollusc and some of the most colourful animals on the Great Barrier Reef. Often referred to as 'sea slugs', these animals have a variety of different defence mechanisms to avoid being eaten, from storing poisonous cells from anemones they eat, to appearing as bright and colourful as possible to scare of would-be predators.

Size
Nudibranchs range from 2cm to 60cm long.

Feeding
Nudibranchs eat sea anemones and jellyfish. Some species are also cannibalistic. They are eaten by large fish such as wrasse.

Habitat
They live in the warm shallows of coral reefs.

Threats
They can be threatened by eutrophication caused by run-off from coastal areas, as well as fishing techniques such as dredging and bottom trawling.

Did you know?
Nudibranchs are simultaneous hermaphrodites, meaning that they have both male and female sex organs!

Brown algae
Genus *Sargassum*

Kingdom	Protist (Protista)
Phylum	Brown algae (Phaeophyta)
Class	Phaeophyceae

Sargassum includes some of almost 2,000 species of brown algae. It is a type of seaweed which grows thickly, attached to rocks in shallow waters as well as floating with the ocean currents. Its fronds have small globe-shaped compartments filled with gas. This helps it float near the sea's surface to enable photosynthesis. It plays a dual role by helping to form habitats as well as providing a food source.

Size
A few centimetres to up to 12 metres in warmer waters.

Feeding
It absorbs sunlight through photosynthesis and is eaten by smaller, herbivorous fish and sea urchins.

Habitat
Temperate and tropical waters.

Threats
Pollution can affect their ability to build proteins.

Did you know?
It is edible and tastes slightly bitter... but it must be cooked first!

Christmas tree worm
Spirobranchus corniculatus

Kingdom	Animal (Animalia)
Phylum	Annelid (Annelida)
Class	Polychaete (Polychaeta)

Christmas tree worms are a type of worm known as polychaetes. This refers to the little 'chaeta' or feet they have along their sides. The distinctive feature of the Christmas tree worm is the two crowns shaped like Christmas trees. These are used to strain the water for small particles of food, which are then transported in mucus to the mouth at the base of the crown.

Size
Christmas tree worms have a huge range of size from a few millimetres up to 3 metres.

Feeding
Christmas tree worms filter the seawater for plankton. They are eaten by fish.

Habitat
The Christmas tree worm larvae settle on damaged coral polyps and create a burrow. Preference is shown for large coral 'bommies' or mounds.

Threats
Because of their dependence on live coral, anything that threatens the coral, impacts Christmas tree worms.

Did you know?
If a fish bites off the crown, it quickly grows back!

Crown-of-thorns starfish
Acanthaster planci

Kingdom	Animal (Animalia)
Phylum	Echinoderm (Echinodermata)
Class	Sea start (Asteroidea)

The crown-of-thorns starfish is one of the most studied echinoderms on the Great Barrier Reef, because of the effects that periodic population outbreaks have on coral reefs. It is an unusual species in that it is a specialist corallivore. They have been responsible for 42% of the decline in coral cover on the Great Barrier Reef since 1985.

Size
Adults are usually 20cm to 40cm in diameter.

Feeding
Crown-of-thorns starfish feed on hard corals and occasionally soft corals and anemones. They are eaten by few species, such as the trigger fish and a marine snail, Triton's trumpet.

Habitat
On coral reefs.

Threats
There are no known threats to the crown-of-thorns starfish, but populations die out when they run out of food.

Did you know?
Divers have killed up to 120 crown-of-thorns starfish an hour to control outbreaks!

Triton's trumpet
Charonia tritonis

Kingdom	Animal (Animalia)
Phylum	Mollusc (Mollusca)
Class	Gastropod (Gastropoda)

Triton's trumpet is a large predatory sea snail. This mollusc is one of the few species that eats the crown-of-thorns starfish, as it has become immune to its toxins. One of the largest sea snails, they also feed on other starfish and sea urchins. They immobilise their prey by injecting them with a paralysing agent in their saliva.

Size
Adults grow to between 10cm and 35cm long.

Feeding
Triton's trumpet feeds on sea urchins and starfish.

Habitat
On coral reefs.

Threats
Like all organisms with a carbonate structure or shell, Triton's trumpet can be affected by ocean acidification. In some areas, the collection of shells for ornaments can be a threat.

Did you know?
The name Triton's trumpet comes from the ancient practice of cutting off the tip of the shell and using it as a trumpet!

Clown Anemonefish
Amphiprion ocellaris

Kingdom	Animal (Animalia)
Phylum	Chordate (Chordata)
Class	Bony fish (Osteichthyes)

There are 30 different species of anemonefish, so called as they have a symbiotic relationship with anemones. The anemone provides shelter from predators and provides the fish with a food source. The fish eat invertebrates which could otherwise harm the anemone and protect the anemone from other predators.

Size
Typically between 10cm-20cm long.

Feeding
They eat zooplankton such as copepods, and are hunted by larger fish.

Habitat
Shallow reefs and lagoons of the Indian and Pacific oceans, including the Great Barrier Reef and Red Sea.

Threats
Anemonefish are popular aquarium fish. The release of the Disney film 'Finding Nemo' in 2003 saw a sharp increase in demand which saw clown anemonefish populations decline.

Did you know?
Anemonefish (as well as some types of damselfish) are the only fish to be unaffected by the very strong poison of the anemone!

Pearlfish
Carapidae

Kingdom	Animal (Animalia)
Phylum	Chordate (Chordata)
Class	Bony fish (Osteichthyes)

Pearlfish are tiny fish which live inside invertebrates, including starfish, clams and sea cucumbers. They enter their host's body cavity via their anus and live there, protected from predators and with a ready source of nutrients. Most species of pearlfish live at peace with their host, but others are parasitic.

Size
From a few centimetres long to 20cm.

Feeding
Small invertebrates and crustaceans, or some feed off the organs of their host. They are eaten by larger fish.

Habitat
They live in tropical waters of the Atlantic, Indian and Pacific oceans, to a depth of 2,000m but more usually in shallow waters of less than 30m.

Threats
They face no specific threats other than those that face the coral reef ecosystem in general.

Did you know?
Their anus is close to their head, enabling quick and easy defecation by popping their heads out of their host's bottom!

Bumphead parrotfish
Bolbometopon muricatum

Kingdom	Animal (Animalia)
Phylum	Chordate (Chordata)
Class	Bony fish (Osteichthyes)

This distinctive fish has a vertical forehead and huge teeth for ramming into and then eating corals. They grow slowly and can live for up to 40 years. They are found in groups, and sleep as groups too, often in the shelter of caves or shipwrecks.

Size
They grow to over 1m in length.

Feeding
They live off algae and live corals, eating over 5 tonnes a year, and are primarily hunted by sharks, as well as humans.

Habitat
Bumphead parrotfish live around reefs and lagoons of the Indian and Pacific oceans, to a depth of around 30m.

Threats
They face no specific threats other than those that face the coral reef ecosystem in general, but can suffer from over-fishing.

Did you know?
They are hermaphrodites – they begin life as females and turn into males as they mature!

Staghorn coral
Acropora cerviciornis

Kingdom	Animal (Animalia)
Phylum	Cnidaria
Class	Anthozoa

Staghorn coral is a branching stony coral. Such hard corals are actually colonies of tiny polyps, a small animal much like the sea anemone. The polyps form a carbonate shelter and as the polyps reproduce, these carbonate structures grow as long branches. Hard corals are essential in creating the 3D reef habitat that supports so many different species.

Size
Branches range from a few centimetres to over 2m.

Feeding
Hard corals receive energy from their symbiotic relationship with zooxanthellae. The polyps also catch plankton such as copepods.

Habitat
Back and fore reef habitats at a depth of 0-30m.

Threats
Damage from changes in salinity, pH level and especially from increases in sea temperature which can cause bleaching. Locally, threats include storm damage and being eaten by the crown-of-thorns starfish.

Did you know?
Polyps reproduce both sexually and asexually and the polyps are both individual animals and linked within a colony!

Sea anemone
Order *Actiniaria*

Kingdom	Animal (Animalia)
Phylum	Cnidaria
Class	Anthozoa

Anemones are a type of polyp, the same animal that forms corals. They are usually found as single polyps, but can also form colonies. They have tentacles formed around an oval body which have stinging capsules at their ends, to immobilise their prey. They have a symbiotic relationship with some species of fish, which use the anemones as a refuge and are not stung. In return, these fish protect the anemone from predators.

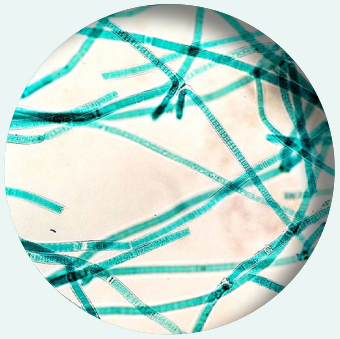
Size
Anemones range from 1cm across to over 1m in diameter.

Feeding
Sea anemones eat small fish and shrimp. They are eaten by nudibranchs, some sea stars and fish.

Habitat
They usually live on the hard bottom of the sea and are found in most tropical and temperate coastal areas.

Threats
There are no known threats to sea anemones other than the general threats to the coral ecosystem. It can be affected by outbreaks of the crown-of-thorns starfish.

Did you know?
Some species of sea anemone can live for over 50 years!



Blue green algae
Phylum *Cyanbacteria*

Kingdom	Bacteria (Monera)
Phylum	Cyanobacteria
Class	-

Cyanobacteria are microorganisms, bacteria which fix nitrogen and carbon. They also produce oxygen through photosynthesis, enabling other species to live in the surrounding environment. Some live within protists (e.g. algae) or sponges, providing energy to the host, or form part of lichens in the splash zone of rocky shore environments.

Size
Microscopic, although in aquatic environments occasionally create 'blooms' which can be seen from space!

Feeding
They obtain energy from the sun through photosynthesis. They supply nutrients to other forms of algae and form an important part of the marine food web.

Habitat
All land and aquatic environments across the entire planet.

Threats
Pollution can affect their ability to build proteins.

Did you know?
The oldest known fossils are made from cyanobacteria and are 3.5 billion years old!

Tiger shark
Galeocerdo cuvier

Kingdom	Animal (Animalia)
Phylum	Chordate (chordata)
Class	Sharks & rays (Chondrichthyes)

One of the largest sharks in the world, the tiger shark is one of the apex predators on the Great Barrier Reef. It gets its name from the dark vertical stripes along its sides that resemble a tiger's stripes. It is a solitary creature, mainly hunting at night.

Size
Adult tiger sharks commonly grow to between 3m and 4.2m long, and can grow over 5m in length.

Feeding
They are voracious predators and not very picky, eating anything from fish to turtles, squid, marine mammals, human rubbish and car number plates.

Habitat
Mainly throughout tropical and subtropical waters worldwide, and are often found close to the coast.

Threats
They are vulnerable to fishing due to their slow growth and long lifespan.

Did you know?
About 10 people a year die from shark attacks, but humans kill 100 million sharks every year!

Manta ray
Manta alfredi

Kingdom	Animal (Animalia)
Phylum	Chordate (Chordata
Class	Sharks & rays (Chondrichthyes)

Mantas are large graceful fish, that often look like they are flying through the water with their large pectoral fins. They are filter feeders, using lobes either side of their mouth to funnel plankton towards them. Mantas are often found visiting cleaning stations, where fish such as the cleaner wrasse nibble parasites and their dead skin.

Size
Reef mantas reach 5.5 metres wide.

Feeding
Mantas are filter feeders, eating plankton and fish larvae. The mantas main predators are large sharks and orcas (killer whales).

Habitat
Typically found throughout tropical and subtropical waters.

Threats
They are slow swimmers near the surface and often become entangled in fishing gear.

Did you know?
They have the largest brain of all fish and we still have much to learn about their social behaviour!

Green turtle
Chelonis mydas

Kingdom	Animal (Animalia)
Phylum	Chordate (chordata)
Class	Reptile (Reptilia)

Green turtles are one of the six species of sea turtle that are found on the Great Barrier Reef. In the non-breeding season, turtles from the Great Barrier Reef travel as far as Fiji and Indonesia. Green turtles lay their eggs in pits they dig on beaches on islands and bays.

Size
Green turtles usually have a carapace (shell) between 80cm and 120cm long.

Feeding
Green turtles feed mainly on algae and seagrass. They are eaten by humans and larger sharks.

Habitat
Green turtles are found throughout tropical and subtropical oceans, returning to beaches to nest and they feed on coral reefs and seagrass meadows.

Threats
Destruction of seagrass meadows is the main threat. They also risk being caught in fishing nets and having their nesting sites destroyed by coastal developments.

Did you know?
Green turtles are reptiles and cold-blooded and they have been known to sunbathe to warm themselves up!

Copepod
Subclass *Copepoda*

Kingdom	Animal (Animalia)
Phylum	Arthropod (arthropoda)
Class	Crustacean (Crustacea)

A copepod is a small marine animal. It is a crustacean, and is related to lobsters, shrimps and crabs. Copepods are zooplankton, small animals that are carried by ocean currents rather than making their own way in the world. The word copepod comes from two Greek words kope- oar and pod- foot. They are the most abundant animal on this planet.

Size
Copepods are typically 1mm to 2mm long.

Feeding
Copepods are secondary producers, eating algae and turning this into the more complex building blocks needed for larger marine life, such as filter feeders.

Habitat
Throughout the oceans from pole to pole.

Threats
Copepods are susceptible to a decrease in the pH of the ocean from the process of ocean acidification.

Did you know?
There are an estimated 1,347,000,000,000,000,000,000 copepods in the world's oceans!

Boulder coral
Family *Portidae*

Kingdom	Animal (Animalia)
Phylum	Cnidaria
Class	Anthozoa

Poritidae is a family of hard corals that can form large coral mounds, known as 'bommies'. Such hard corals are actually colonies of tiny polyps, a small animal much like the sea anemone. Hard corals are essential in creating the 3D reef habitat that supports so many different species. They grow very slowly at a rate of 1-2cm a year.

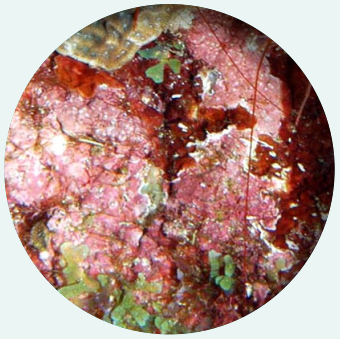
Size
These mounds can range up to 8m high and 5m across.

Feeding
Hard corals receive energy from their symbiotic relationship with zooxanthellae. The polyps also catch plankton such as copepods with their stinging tentacles.

Habitat
The 'bommies' favour lagoons and proximity to the reef slope.

Threats
Hard corals are susceptible to damage from changes in pH level and especially from increases in sea temperature which can cause bleaching. Locally threats include pollution from runoff and being eaten by the crown-of-thorns starfish.

Did you know?
Some of these coral colonies are over 700 year olds and they can be dated by counting their annual growth bands!



Red coralline algae
Genus *Porolithon*

Kingdom	Protist (Protista)
Phylum	Red algae (Rhodophyta)
Class	Rhodophyceae

Porolithon are pinkish algae which build and strengthen coral reefs. They live on rock, binding materials together and forming a calcified layer beneath them to protect the reef crest from the impact of waves and storms, and are known as ‘reef cement.’ They also convert nutrients into food for other species and generate oxygen.

Size
From microscopic up to 25cm.

Feeding
They absorb sunlight through photosynthesis and provide a food source for smaller, herbivorous fish.

Habitat
Primarily reef crests, as well as the inner and outer reef, in warm and tropical waters.

Threats
They are under threat from ocean acidification which makes it harder for the formation of their carbonate structures. Pollution and higher water temperatures also have an impact.

Did you know?
Although they appear red or pink in colour they also contain green chlorophyll!

Mantis shrimp
Order *Stomatopoda*

Kingdom	Animal (Animalia)
Phylum	Arthropod (Arthropoda)
Class	Crustacean (Crustacea)

Mantis shrimps are aggressive and typically solitary creatures. They kill their prey in two different ways, by spearing or smashing with their large front claws. Some species are 'spearers' impaling their prey and other are 'smashers', striking their victims and stunning or killing them.

Size
Mantis shrimps grow to between 1cm and 40cm long.

Feeding
'Spearers' prefer animals without a hard shell such as small fish. 'Smashers' prey on crabs, snails and other molluscs. They are preyed upon by larger fish.

Habitat
Mantis shrimps live in crevices in the coral or rock in lagoons and also burrow in the sand.

Threats
They face no known threats, except those that threaten the coral reef ecosystem as a whole.

Did you know?
Their smash is so powerful and fast it can create a sonic boom and there are reports of mantis shrimps kept in aquaria breaking the glass.

Sea cucumber
Class *Holothuroidea*

Kingdom	Animal (Animalia)
Phylum	Echinoderm (Echinodermata)
Class	Sea cucumber (Holothuroidea)

Sea cucumbers are a diverse and common type of echinoderm, found all along the Great Barrier Reef. Within sea cucumbers, a number of species have some quite surprising habits. Some sea cucumbers reproduce asexually, splitting in half to form two complete individuals. A favourite defence mechanism to avoid being eaten by fish, is to shoot their guts and internal organs out of their anus.

Size
Adults typically range from 10cm to 30cm in length.

Feeding
Most sea cucumbers sift through the sediment for plankton and decaying organic matter. They are eaten by a range of fish.

Habitat
Found on coral reefs, the intertidal zone and in deep water.

Threats
Edible species of sea cucumber (yes - they are widely considered delicious!), known as bêche-de-mer are under threat from overfishing.

Did you know?
Some species have also developed a symbiotic relationship with species such as the pearl fish, which shelters in the sea cucumber's anus to avoid predation!

Sea Urchin
Class *Echinoidea*

Kingdom	Animal (Animalia)
Phylum	Echinoderm (Echinodermata)
Class	Sea Urchin (Echinoidea)

Sea urchins are related to starfish and sea cucumbers. Most sea urchins hide during the day to avoid predators. They also have poisonous spines to protect them. Sea urchins are mainly herbivorous eating the algae that grows on the coral reef. They play an important role in making sure that the coral reef is not overrun by seaweed.

Size
Adults typically range from 6cm to 12cm in diameter, not including the spines.

Feeding
Most sea urchins eat algae. They are preyed upon by snails such as Triton's trumpet and also by some crabs, rays and sharks.

Habitat
Found on coral reefs, sand flats and seagrass beds.

Threats
Sea urchin larvae are extremely sensitive to ocean acidification as well as threats to the coral ecosystem.

Did you know?
Most sea urchins only have mild venom, and although not fatal to humans, can be very painful if stepped on!

Lesson 2:
Our ocean and us 14-16

In this lesson students learn about the concept of ecosystem goods and services, following this they will answer GCSE style exam questions which they will peer assess, reflecting on how dependent we 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 ocean and us


Subject Update: How ecosystems and economies compare

All resources can be downloaded from:
encounteredu.com/teachers/units/oceans-for-beginners-x-curric-ages-14-16

Our ocean and us

Age 14-16

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: How ecosystems (E7) and G7 economies compare

Extension or home learning

Students conduct research about the fishing industry in the UK then create a fact-sheet covering the key areas of the industry.

Lesson overview

In this lesson students learn about the concept of ecosystem goods and services, following this they will answer GCSE style exam questions which they will peer assess, reflecting on how dependent we are on the ocean.

Lesson steps	Learning outcomes
1. Ocean goods (10 mins) Students discuss ways in which we rely on the ocean and explore some of the ways we depend on it for things such as food, transport and livelihoods, linking to case studies.	• List and describe the goods provided by the ocean
2. Ocean services (15 mins) Students learn about key services provided by the ocean such as climate regulation, acting as a carbon store and how marine environments such as mangrove forests prevent coastal erosion.	• List and describe the services provided by the ocean
3. GCSE style exam questions (10 mins) Students answer GCSE style exam questions and peer assess using the mark scheme.	• Consolidate understanding of ecosystem goods and services
4. Letter to the Secretary of State for the Environment (15 mins) Students write a letter to the Secretary of State for the Environment expressing their opinion about the importance of the oceans and why more needs to be done to protect them.	• Evaluate the importance of the goods and services provided by the ocean
5. Reflection (10 mins) Students consider how the ocean is used and the subsequent threats to the ocean sharing their concerns with a partner and the teacher.	• Reflect and build on learning

TEACHER GUIDANCE 2 (page 1 of 2)

Step	Guidance	Resources
1 10 mins	Step 1 sees the students learn about the goods and services ecosystems provide for us. · 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 feedback and examples from students.	**Slideshow 2:** Slides 1-3
2 15 mins	Step 2 involves students examining some of the goods and services provided by the ocean. · Students match key words with definitions. · Check answers by asking for feedback. · Using the information on Student Sheet 2a students complete Student Sheet 2b.	**Slideshow 2:** Slides 4-7 **Student Sheet 2a:** Goods and services factsheet **Student Sheet 2b:** Goods and services worksheet
3 15 mins	Step 3 asks students to reflect on the learning they have done so far by completing GCSE style exam questions. · Students use the image on slide 8 to rank the services provided by the ocean from most important to least important. · They then answer questions in their books. · Students then peer assess their partners answers. · Take feedback from class if students are unable to answer the question, then bounce it to another pupil. · Extension: ask students to write a GCSE style exam question for their partner to answer.	**Slideshow 2:** Slides 8-10
4 15 mins	Step 4 involves 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. · Using slides 11-12 explain the correct letter format they should use. · Encourage students to use facts included on Student Sheet 2a in their letter as evidence, to make their arguments more convincing.	**Slideshow 2:** Slides 11-12

TEACHER GUIDANCE 2 (page 2 of 2)

Step	Guidance	Resources
5 5 mins	Step 5 asks students to reflect on their learning and think of questions they would like to find out about. · Choose students to explain how each learning outcome has been met. For each outcome 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 2:** Slides 13-15
+ 30 mins	Students conduct research about the fishing industry in the UK then create a fact-sheet covering key areas of the industry; where does fishing take place, what is the value of the industry, how many people are employed by it and are there any restrictions?	

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 behavior 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.

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.

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.

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 photosynthesize. The waste produced in this process is then available for the coral polyp to utilize.

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.

Carbon sequestration and storage

Ocean waters absorb carbon dioxide ($C0_2$), the $C0_2$ 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.

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.

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.

STUDENT SHEET 2b

Goods and services worksheet

Service	Definition	Examples	

Lesson 3:
Our ocean in crisis 14-16

In this lesson students will consider the impact the media has on us and our understanding of marine plastic pollution and how organisations might use media outlets to promote their own agenda. Students will 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: Life cycle of a plastic bottle

Student Sheet 3b: Ocean hero profiles

Student Sheet 3c: Career 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-14-16

LESSON 3

Our ocean in crisis

Age 14-16

60 minutes

Curriculum links

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

Resources

Slideshow 3:
Our ocean in crisis

Student Sheet 3a:
News articles

Student Sheet 3b:
Ocean hero profiles

Student Sheet 3c:
Career profile

Student Sheet 3d:
Ocean hero research

Gallery:
Marine plastic pollution

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

In this lesson students will consider some of the myths in the media relating to ocean plastics by completing a true or false activity. They then analyse different news reports considering the motivations different organisations and media outlets may have. Students conduct research about an 'Ocean hero' and create a detailed career plan to emulate the achievements of their chosen hero. The lesson concludes with a class discussion about the changes they can implement in their lives which could 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 (10 mins) Students to 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.	• Identify facts about ocean plastic pollution
3. Media coverage (20 mins) Students read a variety of news reports and working in pairs they analyse the reliability of the news report and the source.	• Analyse a variety of information about ocean plastic pollution
4. Ocean heroes (20 mins) Students are allocated an 'Ocean hero' to research. They then write an essay evaluating the importance of their work.	• Evaluate the work of 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 through making a pledge

TEACHER GUIDANCE 3 (page 1 of 2)

Step	Guidance	Resources
1 5 mins	Step 1 introduces students to the concept of ocean plastic 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 plastics pollution. · Students share their ideas, mind-map on the board. · Look at 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' on 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. Explain 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 news articles. They should 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

TEACHER GUIDANCE 3 (page 2 of 2)

Step	Guidance	Resources
4 15 mins	 Step 4 introduces students to five 'Ocean heroes' who are paving the way to improve the health of the ocean 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 3b and tablets or laptops to complete research, students write a career plan necessary to emulate the achievements of their 'Ocean hero'. · Students should consider what A-Levels a person would need, what undergraduate course they should complete, and consider whether a postgraduate degree would be necessary. Ask students what other skills might be required? · Using Student Sheet 3d, students read one piece of research completed by their designated ocean hero and evaluate it.	**Slideshow 3:** Slides 28-32 **Student Sheet 3b:** Ocean hero profiles **Student Sheet 3c:** Career profile **Student Sheet 3d:** Ocean hero research
5 5 mins	 Step 5 encourages students to find out what they can do to make a difference to ocean plastics pollution and make a pledge to change one thing. · Display slide 33 which has some suggestions of what we can do to make a difference to ocean plastics pollution. · Ask students in pairs to discuss what they could do to make a difference. · Students should choose one and write on a post-it-note what they pledge to do to make a difference. · 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'

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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

ARTICLE 4 (CONTINUED)

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 profiles

STUDENT SHEET 3c

Career profiles

Chosen career...

Ocean hero...

Personal skills required...

Educational requirements...

Career plan...

STUDENT SHEET 3d

Ocean hero research

Examples of research completed by the 5 different Ocean heroes

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Student Sheet 1d	Maori Wrasse, Cleaner Wrasse, Nudibranch, Clownfish, Staghorn Coral, Christmas Tree Worm, Bumphead Parrotfish, Sea Anemone, Manta Ray, Tiger Shark, Turtle, Sea Cucumber, Boulder Coral, Mantis Shrimp: XL Catlin Seaview Survey Blue Green Algae: Matthewjparker Triton's Trumpet, Red Coralline Algae, Sea Urchin: NOAA Brown Algae: Graça Gaspar Pearlfish: GBRMPA Copepod: Uwe Kils
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This series of three lessons sets the scene for students who are about to commence Ocean Plastics 14-16.

The lessons build on prior knowledge of oceans and the species and habitats it encompasses. Students explore ecosystem goods and services and answer GCSE style questions reflecting on how we use the oceans.

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 to consider careers in this field by evaluating the work of an 'Ocean hero'. At the end of these three lessons students will be fully prepared to embark on the full Key Stage 4 unit - Ocean Plastics 14-16.