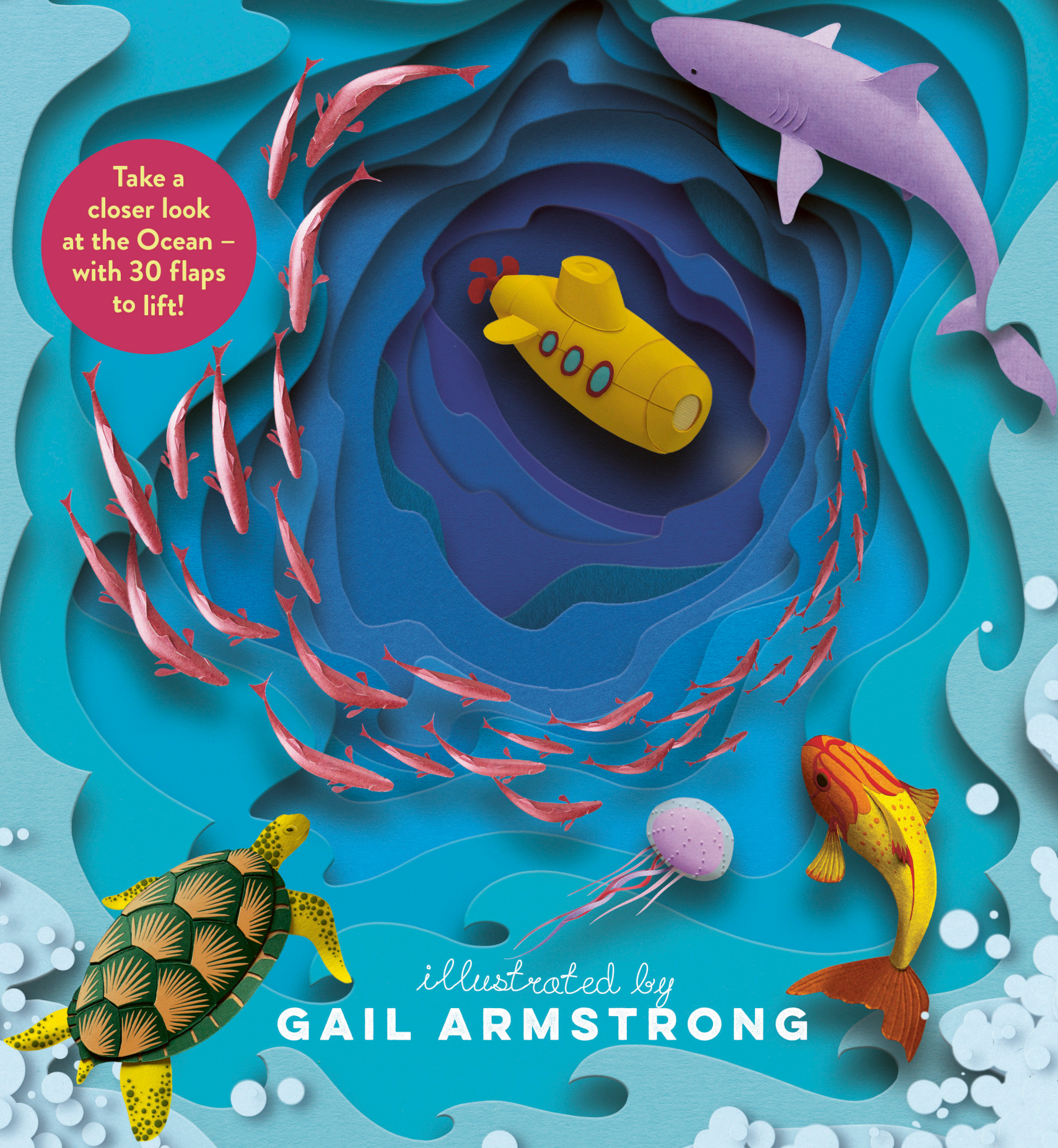


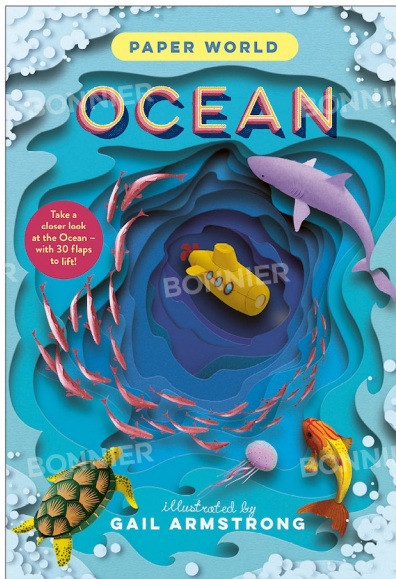
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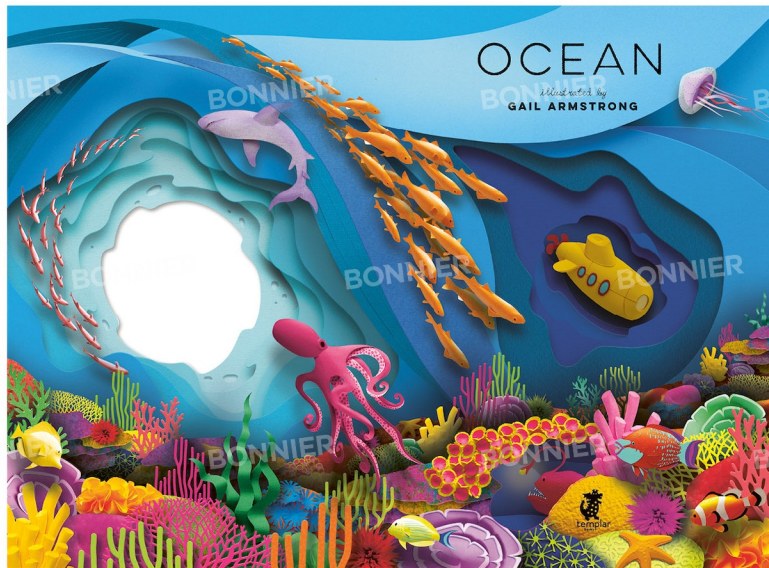
# OCEAN

Take a closer look at the Ocean – with 30 flaps to lift!



*illustrated by*  
**GAIL ARMSTRONG**





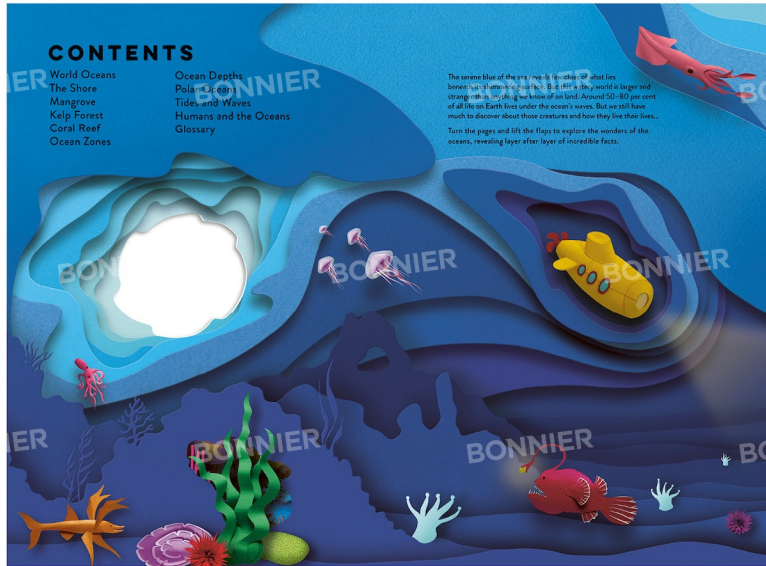
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The serene blue of the sea reveals few clues of what lies beneath its shimmering surface. But this wacky world is larger and stranger than anything we know of on land. Around 50-80 per cent of all life on Earth lives under the ocean's waves. But we still have much to discover about those creatures and how they live their lives.

Turn the pages and lift the flaps to explore the wonders of the oceans, revealing layer after layer of incredible facts.



# WATER WORLD

Viewed from space, Earth shimmers blue-green thanks to the vast oceans that cover two-thirds of its surface. Our 'blue planet' is the only place in the Solar System where life is known to exist. And water is the basis of all life as we know it.

Most water on Earth is found in the oceans, but it also occurs in lakes and rivers, as well as frozen in great blocks of ice at the planet's poles. Whenever it flows, water brings life – plants and animals cannot live long without it – and the oceans themselves form the largest habitat on Earth, a staggering 99 per cent of living space on the planet! Only a fraction of the oceans have been explored by humans. In fact, scientists estimate around 1.5 million marine species are still to be discovered.



**Ocean life**  
Scientists think about 95 per cent of animals in the ocean are invertebrates – animals without a back bone, such as jellyfish.

**Ocean explorers**  
Humans have always lived close to the oceans, using them for food and for transport. Evidence shows that the first boats were used up to 6,000 years ago.

### Studying the oceans

Scientists who study the oceans are called oceanographers. If they study the plants and animals that live there, they are called marine biologists. Being a marine biologist often involves getting into the sea to study a species!

### Atmosphere

The atmosphere is the blanket of gases surrounding Earth. The Sun warms the oceans; ocean currents spread warmth around the globe; and the warmth transfers into the atmosphere. Without the oceans and atmosphere working together, Earth's temperatures would be very extreme!



evaporation

precipitation

condensation

Going up  
The Sun warms water, making it evaporate and turn into moisture in the air. As it rises in the air, it cools and condenses to form rain or snow/dew.

Coming down

Water falling on land collects in rivers and lakes, or soaks through rock into underground rivers. It then flows back into the oceans where it can evaporate again.

**Water cycle**  
The water cycle is the constant movement of water around the Earth.

### Origin of life

Most scientists agree that life on Earth began in the oceans at least 3.7 billion years ago. Initially just single cells, only later did life evolve into large creatures.

**Life only in water**

395 million years ago

**Life moving onto land**

340 million years ago

**Life on land**

The first creatures left the water to walk on land around 400 million years ago.

CLICK HERE



**Seaweed**

A line of seaweed sometimes marks the high tide line, showing where the sea has been trapped there.

# THE SHORE

Where the land meets the sea, we find the coasts of the world. These habitats come in many forms: from soft, sandy beaches, to mud flats, craggy rocks, or sheer cliffs rising out of the water. Pounded by waves, conditions change by the hour, as the tides sweep in and out. For the creatures that live here, each moment brings new challenges.

Low tide reveals an array of wonders. Tiny creatures that live in the sand must burrow deep to escape the snagging beaks of seabirds, or hide themselves among fronds of seaweed. The retreating waters also expose colourful rockpools: a perfect miniature habitat where animals can shelter until the sea covers them over again.

**Rockpool**

When the tide goes out on rocky shorelines, it can leave pools of water trapped in hollows. Rockpools provide shelter for many animals until the next high tide.

**Starfish**

Starfish move using hundreds of tube feet on their underside.

**Rubbish dump**

Human objects are often washed up on shorelines, alongside bits of wood called driftwood. Some objects, such as glass and brick, are worn smooth by the action of the waves. But many plastics pose a danger to the wildlife in coastal habitats.

**Mussel shells**

Mussels sit on their flange shells that have been abandoned by one snail. As they grow, they change shells, a bit like moving house.

**Limpet**

At high tide, limpets move along looking for seaweed to eat. But at low tide, they clamp themselves to the rocks to protect their soft bodies from predators or from drying out in the sun.

**Sea anemone**

Anemones lock their tentacles inside their bodies at low tide. This stops them from drying out.

**Blenny**

These clever fish can survive out of water if they get caught out at low tide. They use their fins to wiggle and flap back to the nearest rock pool.

**Tides**

Tides are the rise and fall of the ocean, which occurs twice a day. They are caused by the Sun and Moon's gravitational pull on the Earth's waters. You can find out more about how the tides work here in this book.

CLICK HERE

**Seal**

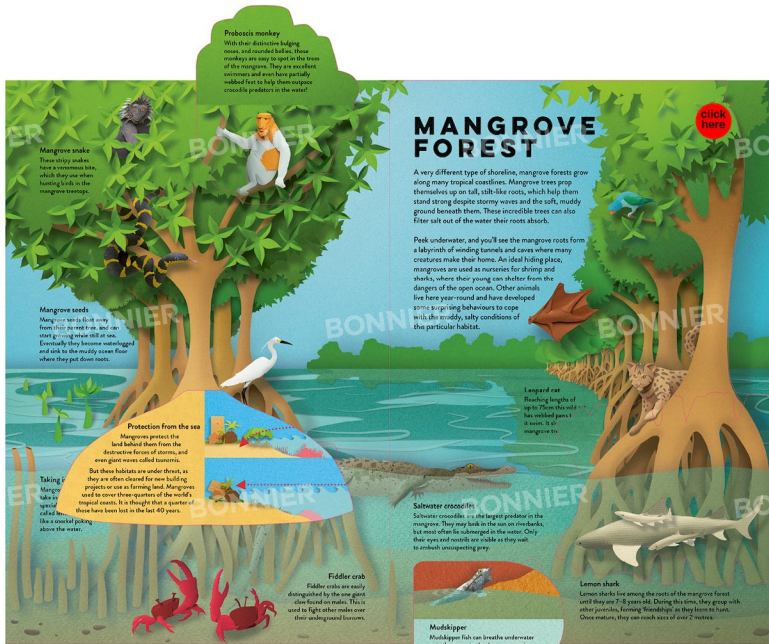
Some larger animals can be found on the coast, too. Seals come ashore to birth their young, called pups. Newborn pups are covered in white, fluffy fur, and drink their mother's milk until they are big enough to take to the sea and learn to fish.

**High water mark**

Creatures such as shells, mussels and tiny sea ticks bury themselves in the sand to stay out of sight of predators. However, many predators can dig deep into the sand to grab their prey.

**Sea birds**

Beaches are an important source of food for many birds. Cliffs also provide an excellent nesting site for seabirds, out of reach of predators such as cats and foxes. However, some species, such as the gull, only come to land to breed and spend the rest of their life on the open water.



#### Proboscis monkey

With their distinctive bulging noses and rounded bodies, these monkeys are easy to spot in the trees of the mangrove. They are excellent swimmers and even have partially webbed feet to help them outpace crocodile predators in the water!

#### Mangrove snake

These tiny snakes have a venomous bite, which they use when hunting birds in the mangrove canopy.

#### Mangrove seeds

Mangrove seeds float away from their parent tree, and can stay growing before still at sea. Eventually they become waterlogged and sink to the muddy ocean floor where they put down roots.

#### Protection from the sea

Mangroves protect the land behind them from the destructive forces of storms, and even giant waves called tsunamis.

But these habitats are under threat, as they are often cleared for new building projects or use as farming land. Mangroves used to cover three-quarters of the world's tropical coasts. It is thought that a quarter of these have been lost in the last 40 years.

#### Taking

Mangrove habitats are vital to many species of plants and animals. It is thought that a quarter of these have been lost in the last 40 years. Like a one-way pickup above the water.

#### Fiddler crab

Fiddler crabs are easily distinguished by the one giant claw found on males. They are used to fight other males over their underground burrows.

## MANGROVE FOREST

click here

A very different type of shoreline, mangrove forests grow along many tropical coastlines. Mangrove trees prop themselves up on tall, stilt-like roots, which help them stand strong despite stormy waves and the soft, muddy ground beneath them. These incredible trees can also filter salt out of the water their roots absorb.

Peek underwater, and you'll see the mangrove roots form a labyrinth of winding tunnels and caves where many creatures make their home. An ideal hiding place, mangroves are used as nurseries for shrimp and sharks, where their young can shelter from the dangers of the open ocean. Other animals live here year-round and have developed some surprising behaviours to cope with the muddy, salty conditions of this particular habitat.

#### Leopard crab

Feeding lengths of up to 75cm, this odd-looking crab has webbed feet to swim. It is a mangrove tree.

#### Saltwater crocodile

Saltwater crocodiles are the largest predator in the mangrove. They may look like an on riverbanks, but most often lie submerged in the water. Only their eyes and nostrils are visible as they wait to ambush unsuspecting prey.

#### Lemon shark

Lemon sharks live among the roots of the mangrove forest until they are 7-8 years old. During this time, they group with other juveniles, forming 'friendships', as they learn to hunt. Once mature, they can reach over 2 metres.

#### Mudskipper

Mudskipper fish can breathe underwater or in the open air, thanks to some unique adaptations. They also use their fins to 'shuffle' or 'skip' across muddy surfaces.

**Growing up**  
Some types of kelp can grow up to 60cm in a day! In fact, it's one of the fastest growing life forms on Earth.



## KELP FOREST

Kelp is a kind of seaweed that reaches astonishing lengths. Some varieties grow up to 45 metres tall, stretching from the rocky seafloor to the water's surface. Kelp Forests occur in cool coastal waters around the world. Like a forest on land, they offer shelter and food to a vast variety of wildlife. This kelp forest is located off the western coast of North America. Safe from the currents and predators of the vast Pacific Ocean, sea otters dive between the fronds, fish nibble on the kelp's leaves and sea urchins, lobsters and sea stars crawl across the ocean floor.

**Yikes!**  
There's a lot of life in a kelp forest, but sometimes a hungry shark will stick its fins through the window between strands of kelp.

**Seals**  
Seals and sea lions love the kelp forest. It provides a safe haven from their main predators: sharks like the great white. It's also full of fish to eat.

**Sea urchins**  
If there are too many sea urchins, and not enough otters to eat them, they can destroy a forest. However, if there are no urchins, there will be no space for new plants to grow.

**A safe space**  
Kelp forests don't just protect sea otters. They also provide a safe space for many other animals, including fish, lobsters, and sea stars.

**Sea otters**  
If a sea otter rocks its back open, shellfish is easy. They wrap themselves in kelp before going to sleep so that they won't drift away in the ocean currents.

**Floats**  
Air bubbles, called floats, help the kelp to grow upwards towards the sunlight it needs to grow.

**Kelp products**  
Kelp isn't just found in the ocean forests. It's found in a surprising range of products inside our homes, including ice cream and toothpaste!

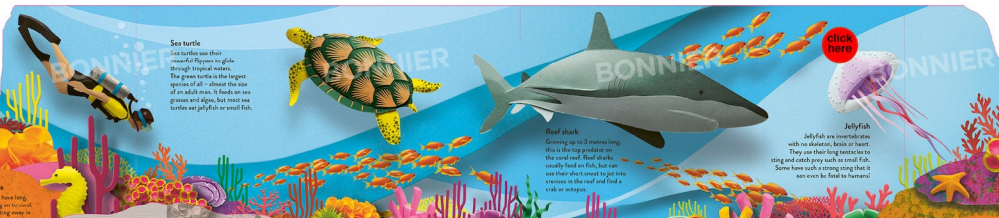
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help, please  
feedback and  
comments

**Rockfish**  
These fish can live for 100 years!

**Holdfast**  
Kelp doesn't have roots like plants on land. Instead it has a kind of foot, which grips onto the sea floor to anchor it in place. This is called a holdfast.





**Sea turtle**  
Sea turtles use their sense of magnetism to glide through tropical waters. The green turtle is the largest species of all - almost the size of an adult man. It feeds on sea grasses and algae, but most sea turtles eat jellyfish or small fish.

**Reef shark**  
Growing up to 3 metres long, this is the top predator on the coral reef. Reef sharks usually feed on fish, but can use their short snout to get into crevices in the reef and find a crab or octopus.

**click here**

**Jellyfish**  
Jellyfish are invertebrates with no skeleton, brain or heart. They use their long tentacles to sting and catch prey such as small fish. Some have such a strong sting that it can even be fatal to humans!

**Sashurra**  
These delicate fish have long, curly tails for hooking onto coral. They sleep there during the day in narrow crevices as they wait to feed. They use their pointed, hinged mouth to nibble the coral and then use their long, thin tentacles to catch their prey.

**The future of coral reefs**  
When the water gets warmer around coral reefs, the coral expels the algae living inside them. This means the coral often no longer has its vibrant colour - called coral bleaching.

Humans need to reduce the warming of ocean temperatures to protect coral reefs. We can also help reefs by keeping chemicals out of our waterways, never trawling or taking coral away and making sure the fish we eat is sustainable.

**Sea snake**  
Sea snakes have the most potent venoms of any snakes in the world!

**Octopus**  
Octopuses are invertebrate animals without a backbone! With eight long legs, covered in sticky suckers, they can squeeze into tiny spaces to hide from danger, and are also masters of disguise! able to change their colour to camouflage against their background. They have big brains and are very intelligent.

**Polyp**  
A coral polyp is a tiny creature, a little like an anemone, about a centimetre wide. It moves its tentacles to catch food, and as it has a hard skeleton, which it can hide inside. There are more than 800 types of coral.

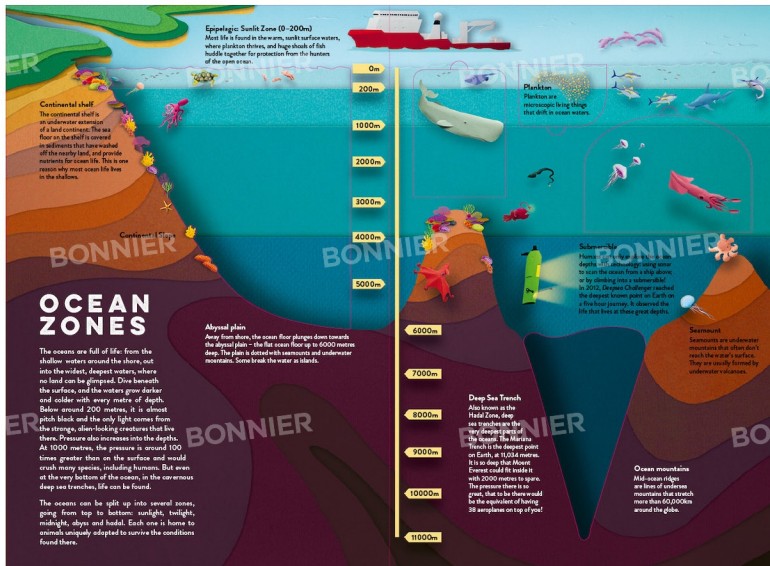
**Parrot fish**  
These fish use their hard, beak-like mouths to nibble at pieces of coral. When you see a parrot fish, it is the digestive system outside of the sand - the same you find on white sandy beaches!

**Brain coral**  
This coral polyp is linked in rows, which make it look a bit like a human brain!

**Tube sponges**  
Reaching heights of up to 2 metres, these tall, thin, deep sponges allow water to pass through them. The coral polyps that eat and get rid of food particles float in the water.

**Porcupine fish**  
When threatened, the porcupine fish will puff out its body to make it seem like a porcupine. This not only makes it look bigger, but it also makes it look like it has a hard shell of defence, it is deadly! Eaten.

**Crown-of-thorns starfish**  
This starfish has lots of arms and feeds on living coral. It is a voracious eater.



# OCEAN DEPTHS

In the cold, dark waters near the ocean floor, strange creatures glide through the gloom. They feed on dead algae and animals that drift down from the waters above – or else they hunt each other. The only light in it can be seen comes from the ocean creatures themselves: many of which emit their own light via bioluminescence.

The ocean floor is home to many important habitats, including strange chimney-like structures called hydrothermal vents that jet out of the Earth's crust. They are like deep-sea hot springs (or geysers), releasing clouds of super-hot seawater into the ocean. The water is full of chemicals from the Earth's crust, which nourish a host of sea creatures in this most unusual of habitats.

## Yolk stalks

First discovered in 2005, these crabs use their shaggy arms as a place to grow their favorite food – bacteria. To encourage good growth, the crabs wave their arms in front of the vents.

## Hydrothermal vent

Also known as black smokers, hydrothermal vents occur along the edge of the plates that make up the Earth's crust. Sea water seeps through cracks in the ocean crust, is heated to incredibly high temperatures, and is released as boiling-hot fluid packed full of chemicals. The chemicals sustain bacteria, which make food for crabs, clams and tube worms.

## Giant tube worms

The world's heaviest worms, giant tube worms grow up to 2 metres long, anchored by a hard tube attached to the ocean floor. The bacteria don't have mouths: instead their Siles use bacteria in their guts to convert chemicals from the seawater into energy they can eat!

## BONNIER

## Bioluminescence

Certain creatures, from bacteria to sharks, can make light through chemical reactions – this is called bioluminescence. Some use their light to attract prey. Others use it to flash messages to other members of their species.

## Gulper eel

The gulper eel's loosely-hinged jaws gape open, making a fleshy pouch like that of a python – perfect for scooping fish straight out of the water and into its mouth.

## Anglerfish

This unusual creature uses a light on the tip of a spine like a fishing rod, to lure small fish towards its fierce jaws.

## Viperfish

The long, aced viperfish flashes the 'fun' on top of its head to attract other fish. It then spurs them with its sharp fangs. But its teeth are so long that they cannot fit inside its mouth – it can only close its jaws by curving its teeth around its face.

It's common for fish to have long teeth as longer teeth are longer-lasting.

# POLAR WATERS

At either end of planet Earth are the poles: the Arctic in the north and the Antarctic in the south, seen here. Temperatures at the poles are freezing, icy winds whip across the landscapes, and the winters are long and dark. The only animals to survive these conditions on land are warm-blooded birds and mammals, insulated by thick fur or feathers and layers of fatty blubber under their skin.

The north pole lies in the centre of the Arctic Ocean. There is no land there; just a thick layer of permanent floating ice, called the ice cap. Most Arctic animals live where the ice meets the sea, or on the land surrounding the ocean. At the other end of the world, Antarctica is a mountainous landmass, covered in a layer of ice up to 4 kilometres thick. It is the driest and coldest continent on Earth. No life can live at the pole itself, but along the coast, tiny algae bloom in the waters, and seal, sea birds and whales cluster to feed and breed.

**Humpback whale**  
Humpback whales migrate from tropical waters to the Antarctic every summer to feast on the krill that swarm there. Despite reaching sizes of over 18 metres long, humpback whales can perform incredible acrobatics, leaping right out of the water.

**Wandering albatross**  
With a wingspan of 3.5 metres, the wandering albatross is the largest bird on the planet. Able to glide for hours at a time, it nests on the windswept Antarctic every year.

**Winter**  
For two months each winter, the polar regions are in total darkness as the sun never rises. Temperatures plummet, more of the ocean freezes and snow settles over nearby landscapes.

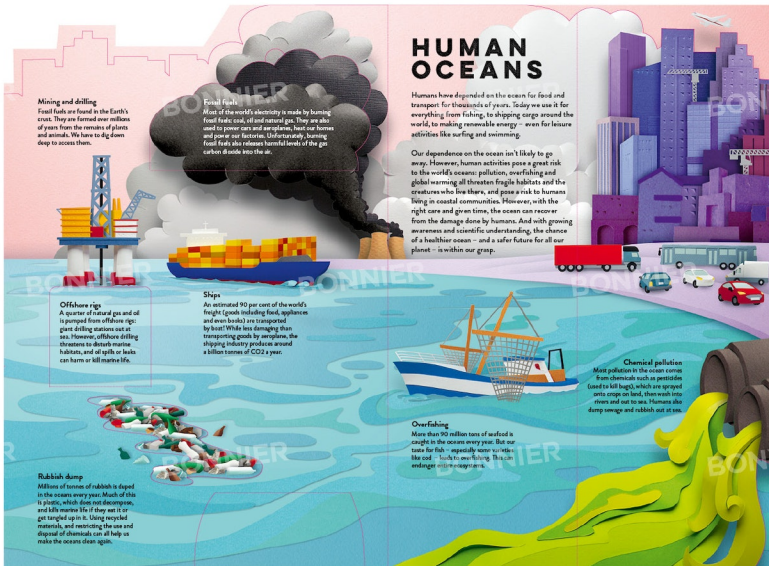
**Walrus**  
These huge, seal-like animals gather in their hundreds at the poles, where they come ashore to breed. They use their long, pointed tusks to prise shellfish from the seafloor. One walrus alone can eat 6000 clams at a time!

**Penguins**  
Penguins are flightless seabirds that live across the southern half of the planet. Four species live in Antarctica: the emperor, Adelia, gentoo and chinstrap penguins. They are inebriated on ice, waddling on their feet, or tobogganing on their bellies – but are swift and elegant swimmers.

**Antarctic fur seal**  
The large, furry seal is a graceful swimmer. It can also use its front flippers to walk clumsily over the land.

**Orca**  
Orca, or killer whales, reach lengths of up to 10 metres, and can be found all over the world. They hunt in family groups, called pods, caring for their young, and working together to hunt fish. Orcas also feed on larger prey, such as seals, birds and even large whales or sharks.





# HUMAN OCEANS

### Mining and drilling

Fossil fuels are found in the Earth's crust. They are formed over millions of years from the remains of plants and animals. We have to dig down deep to access them.

### Fossil fuels

Most of the world's electricity is made by burning fossil fuels: coal, oil and natural gas. They are also used to power cars and aeroplanes, heat our homes and power our factories. Unfortunately, burning fossil fuels also releases harmful levels of the gas carbon dioxide into the air.

### Offshore rigs

A quarter of natural gas and oil is pumped from offshore rigs giant drilling stations out at sea. However, offshore drilling threatens to destroy marine habitats, and oil spills or leaks can harm or kill marine life.

### Ships

An estimated 90 per cent of the world's freight (goods including food, appliances and even books!) are transported by boat! While less damaging than transporting goods by aeroplane, the shipping industry produces around a billion tonnes of CO<sub>2</sub> a year.

### Rubbish dump

Millions of tonnes of rubbish is dumped in the oceans every year. Much of this is plastic, which does not decompose, and litters marine life if they eat it or get tangled up in it. Using recycled materials, and restricting the use and disposal of chemicals can all help us make the oceans clean again.

Humans have depended on the ocean for food and transport for thousands of years. Today we use it for everything from fishing, to shipping cargo around the world, to making renewable energy – even for leisure activities like surfing and swimming.

Our dependence on the ocean isn't likely to go away. However, human activities pose a great risk to the world's oceans: pollution, overfishing and global warming all threaten fragile habitats and the creatures who live there, and pose a risk to humans living in coastal communities. However, with the right care and given time, the ocean can recover from the damage done by humans. And with growing awareness and scientific understanding, the chance of a healthier ocean – and a safer future for all our planet – is within our grasp.

### Chemical pollution

Most pollution in the ocean comes from chemicals such as pesticides (used to kill bugs), which are sprayed onto crops on land, then wash into rivers and out to sea. Humans also dump sewage and rubbish out at sea.

### Overfishing

More than 90 million tons of seafood is caught in the oceans every year. But our taste for fish – especially some varieties like cod – leads to overfishing. This can endanger entire ecosystems.

## GLOSSARY

### Algae

Algae are living things that are neither plants nor animals. However, like plants, they make their energy from the sun's light. Algae are commonly found in water, including in the oceans. Another word for algae is seaweed.

### Biotransescence

A light made by a chemical reaction.

### Coral

A tiny creature that lives in warm, clear seas and grows a hard skeleton (but some corals are soft, and some live in the deep sea). Coral polyps live in huge colonies, forming coral reefs that can be many kilometres long.

### Current

The constant movement of water in one direction. Ocean currents can be temporary or long-lasting and can occur in shallow or deep water.

### Erosion

The wearing away of rock and soil, caused by wind, water and the weather.

### Fin

A thin body part on many ocean-living creatures, used for movement and steering.

### Fish

An animal without legs that lives in the water and uses a tail and fins to swim. Fish usually have gills to take oxygen from the water.

### Habitat

The natural home of a plant or animal.

### Invertebrate

An animal without a backbone. Ocean-living invertebrates include starfish, anemones and the octopus family among others.

### Mammal

A warm-blooded animal that makes milk.

### Mangrove

A tree that grows in salty water along tropical coastlines.

### Migration

The movement of animals from one place to another. Some birds migrate seasonally, changing location between winter and summer. Others migrate throughout the day, as often occurs in deep sea creatures.

### Plankton

Microscopic living things that drift in ocean waters. Phytoplankton make energy from the sun just like plants do. Zooplankton are tiny microscopic creatures.

### Predator

An animal which hunts other animals for food.

### Prey

An animal which is hunted and killed by another animal for food.

### Shark

A large, ocean-dwelling fish with a row of sharp (back) fins. Most sharks hunt fish and other animals, but the largest shark in the world, the whale shark, feeds on plankton.

### Shoal

A large group of fish which gathers for safety in numbers.

### Shore

The land along the edge of a sea, lake or river.

### Tides

The rise and fall of the oceans, which occurs twice every day, caused by the Sun and Moon's gravitational pull on Earth's waters.

### Waves

The constant flow of surface energy moves through it. As they reach the shore, waves rise up into a curl shape that breaks on the shore.

### Whale

A large sea mammal which breathes air through a blow hole on the top of its head. Whales and dolphins are closely related.

### A TEMPLE BOOK

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