opening extract from

How the World Works

written by

Christiane Dorion

published by

Templar Publishing

Why does the sea move?

Water flows in large, circular movements called currents. Like rivers in the sea, these currents carry massive amounts of water, heat and oxygen around the ocean. Shallow currents are blown by the winds and transfer heat from warm to cool areas. Differences in temperature and saltiness in the ocean create deep currents. Colder, saltier water sinks, leaving room for warmer, less salty water to move in to replace it. And so the cycle continues.

August 2003: Duck sighting in the Hebrides, Scotland.

2000: Many sightings of ducks bobbing in the waves from Maine to Massachusetts, USA.

Cold, salty water is heavier and sinks

The **Gulf Stream** is a powerful current that brings warm water and mild weather from the sunny tropics into the North Atlantic.

The tides

Have you ever noticed the sea level rising and falling on the shore? This movement of water, called the tide, is caused by the moon's gravity: a force that pulls the ocean towards it.

What if the Gulf Stream stops?

Scientists fear that fresh water from the melting of the Arctic ice caps will make the water there less salty, stopping it from sinking and so breaking the cycle, disrupting the Gulf Stream. This would make Europe and North America much colder!

Atlantic Ocean

Indian Ocean

Pacific Ocean

Southern Ocean

A gyre is a large circular current at the surface of the ocean.

10 January 1992: Storm hits cargo ship. Thousands of rubber ducks spill overboard and drift in different directions.

Warm, less salty water is lighter and rises

Rubbish dump

In 1997 a scientist discovered an area of plastic rubbish twice the size of Texas floating in a slow, swirling current in the north Pacific. It's been called the Great Pacific Garbage Patch. It's estimated that 10% of everything made of plastic will end up here!

16 November 1992: First sighting of rubber ducks on the shores of Alaska, USA.

In 1992 a cargo ship was hit by a storm and thousands of rubber ducks were lost overboard. Scientists are following these intrepid ducks to research how currents work. Can you work out why they landed where they did?

Did you know that **80%** of the pollution in the ocean comes from things we have thrown away on the land?

Message in a bottle

About 310 BC, Theophrastus, an ancient Greek philosopher, launched messages in bottles to prove that the Atlantic Ocean flowed into the Mediterranean. In the 18th century, the American inventor Benjamin Franklin dropped bottles in the Atlantic. The returned messages helped him create a chart of the Gulf Stream.

The ocean coveyor belt

Ocean currents flow in a continuous loop around the earth like a large conveyor belt. Warm water travels from the Pacific to the Atlantic as a shallow current and cold water flows from the Atlantic to the Pacific as a deep current.

What is a food chain?

A food chain is a series of living things that depend on each other for food. All plants and animals, including us, could one day be food for something else. Plants capture their energy from the sun, whereas animals eat plants or other animals as a source of energy. Dead plants and animals are food for fungi and bacteria.

A simple food chain

producer

The food chain starts with a producer, usually a green plant. Plants use energy from the sun to produce their own food.

is eaten by the...

primary consumer

A consumer is a creature that eats something.

Primary consumers, such as caterpillars, rabbits and cows, only eat plants. They are also called herbivores.

is eaten by the...

secondary consumer

Secondary consumers, such as birds, spiders and sharks, eat the primary consumers. They are also called carnivores, which means 'meat eaters'.

is eaten by the...

tertiary consumer

Tertiary consumers eat secondary consumers. For example, a bird of prey might eat another bird that has eaten a caterpillar.

Wait a minute... Don't some animals eat both plants and animals? Yes! Like bears and pigs, humans are omnivores, meaning we eat everything. Can you think of any other omnivores?

is broken down by the...

decomposer

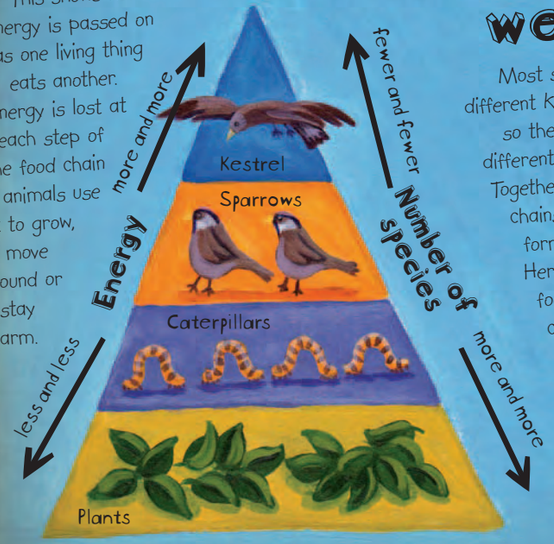
When living things die, they become food for decomposers. Fungi and bacteria break down dead matter and return nutrients to the soil, helping new plants to grow.

which produces nutrients for the...

What happens if you spray pesticides to get rid of the caterpillars that eat your plants? There'll be no food for the rest of the food chain!

The food pyramid

This shows how energy is passed on as one living thing eats another. Energy is lost at each step of the food chain as animals use it to grow, move around or stay warm.



Hmmm... What would happen if there were as many birds as caterpillars? Don't forget! Birds eat lots of caterpillars!

Food webs

Most species eat different kinds of food, so they fit into different food chains. Together, all the food chains in a habitat form a food web. Here is a woodland food web. It could contain thousands of other different species. Could you be in this food web?

What is bioaccumulation? (not as complicated as it sounds!)

Factories and farms can release poisonous substances into the environment. These build up along the food chain, as bigger animals eat lots of smaller ones that eat lots and lots of plants. Animals cannot get rid of these substances quickly. Instead they build up in their body fat. So a polar bear ends up with more poison in its body than any other creatures that has been eaten along the food chain.

Did you know? When you eat a burger, you get a tiny tiny portion of the sun's energy that went into the grass that went into the cow that went into your burger.

Kestrels
eat smaller birds like sparrows. They also eat voles.

Sparrows
eat spiders and caterpillars

Cats
eat birds such as thrushes.

Voles
Feed on plants

Swallows
eat aphids

Spiders
feed on caterpillars, millepede and aphids

Foxes
eat voles and snails

Aphids
feed on plants

Plants
are food for many animals and decomposers

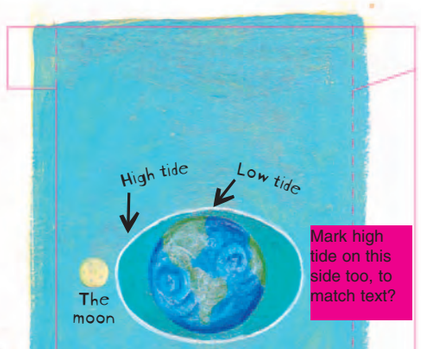
Caterpillars
feed on plants

Thrushes
eat slugs and snails.

Millipede
eat fungi

Slugs and snails
feed on plants

Fungi and bacteria
feed on dead plants



Mark high tide on this side too, to match text?

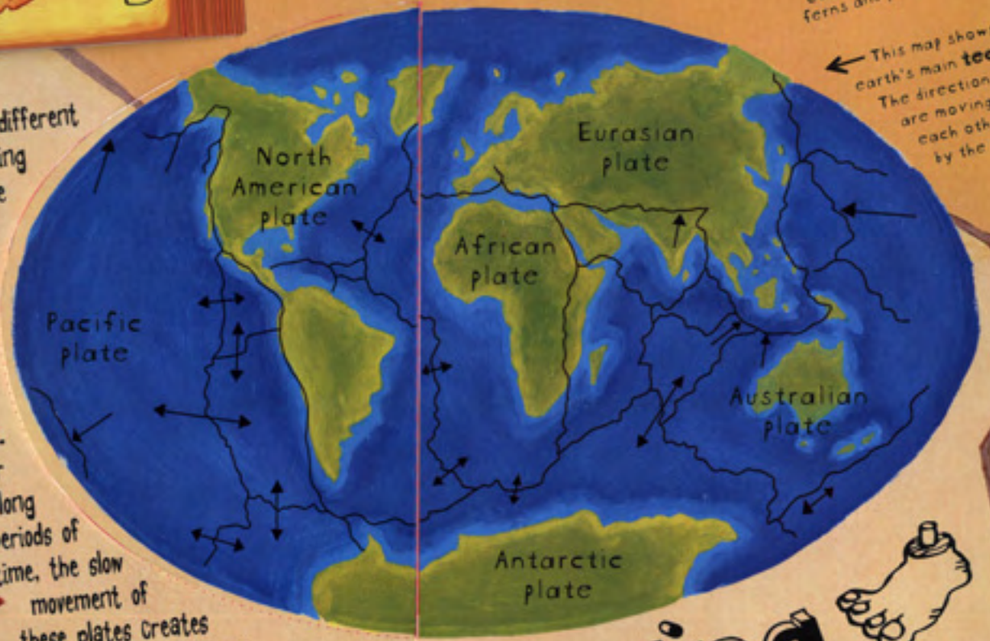
The pull of the moon makes the water rise into a high tide. As the earth spins, the water also bulges on the opposite side. So each place on earth has a high tide twice a day.

pull

Pangaea

On a map of the world, have you ever noticed that the continents seem to fit together like pieces of a puzzle? Scientists believe that a long time ago, they were all joined together to form one gigantic continent, Pangaea, which was surrounded by a single ocean. About 200 million years ago, this super-continent started to break apart, spreading to form today's continents.

This is how Pangaea's would have looked, covered in tropical ferns and palm trees.



This map shows the earth's main **tectonic plates**. The direction the plates are moving against each other is shown by the arrows.

The earth is made of different layers, which are moving slowly all the time. The crust of the earth is broken up into sections called tectonic plates. These plates float on the earth's mantle – a thick layer of hot, flowing rock. Over long periods of time, the slow movement of these plates creates mountains, volcanoes and earthquakes.

The Richter scale measures the magnitude of earthquakes. 1 is mild, 10 is **EPIC!**

Is the world moving beneath our feet?

In a word... YES! While you are reading this book, the surface of the earth is moving at a speed of 1 to 10 cm a year!

Moving plates

Where two plates meet, various things can happen to change the face of the planet:

Destructive plate boundaries

When an oceanic plate crashes against a continental pla underneath Magma the su plates, eruptio deep ma volcanoes are an ex of collision.

When two continental plates crash, the crust rocks are forced up to form a mountain range. As the plates continue to collide, the mountains become taller. The Himalayas, Alps and Andes are good examples of this.

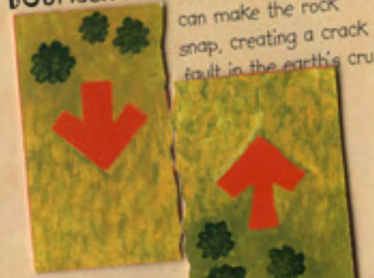
When two oceanic plates collide, one may be pushed under the other, forcing magma from the mantle to rise, forming volcanoes. The friction between the plates also creates earthquakes.

PULL

PULL

Conservative plate boundaries

When two continental plates slide past each other, a huge amount of friction is caused, which can make the rock snap, creating a crack or fault in the earth's crust.



More than a **millio** quakes rattle the earth each year!

This sudden movement creates earthquakes. We know where these may occur, but we can't predict when.

PULL

Constructive plate boundaries

When two plates move apart from each other, new land is formed between them by magma pushing up from the mantle to fill the cracks. A chain of gentle volcanoes forms. This occurs most frequently with oceanic plates. If a volcano rises high enough it can form an island.

PULL

The world's largest active volcano is **Mauna Loa** in Hawaii. It has erupted 33 times!