

# PLASTIC POLLUTION

## LINKS TO NATIONAL CURRICULUM

### Science

- Recognise that environments can change and that this can sometimes pose dangers to living things (*Year 4, Living things and their habitats*).

### Geography

- Understand how human and physical processes interact to influence, and change landscapes, environments and the climate ..... (*Key stage 3*).

### Citizenship

- Pupils should be taught about the different ways in which a citizen can contribute to the improvement of his or her community..... (*Key stages 3 & 4*).

## KEY LEARNING OBJECTIVES

1. Why do we use so much plastic?
2. What are the problems with plastic?
3. What is being done by the government and companies to tackle the plastic problem?
4. What can we all do to help?

## NOTES TO TEACHERS

- These teaching notes run alongside a Powerpoint presentation and all slides are referred to in the notes.
- The notes are designed to provide key information and suggested activities to help teachers deliver the topic, whilst the presentation is full of effective images that will bring the topic to life for students in the classroom.
- Can be adapted to suit different ages of students by adding/deleting slides on the presentation and/or varying the level of detail used from the teacher notes.

## GLOSSARY OF KEY TERMS

**Biodegradable** - able to break down into very small harmless parts by the action of living things (such as bacteria).

**Bioplastic** - biodegradable plastic that is made or derived from biological materials.

**Compostable** - a product is capable of disintegrating into natural elements in a compost environment, leaving no toxicity in the soil.

**Downcycle** - the recycling of waste where the recycled material is of lower quality and functionality than the original material.

**Enzyme** - substances in plants and animals that speed biochemical reactions.

**Food chain** - shows how plants, animals and humans rely on each other for food.

**Fossil fuel** - a fuel (such as coal, oil, or natural gas) formed in the earth from plant or animal remains. Fossil fuels are **nonrenewable** as they will run out one day.

**Global warming** - a gradual increase in the overall temperature of the earth's atmosphere generally attributed to the greenhouse effect.

**Great Pacific Garbage Patch** - a large area of marine debris concentration that has formed by rotating ocean currents called **gyres**. These exist throughout the oceans - the Great Pacific Garbage Patch is just the most famous.

**Greenhouse effect** - a warming of the Earth's surface and the air above it. It is caused by gases in the air that trap energy from the sun. These heat-trapping gases are called greenhouse gases. The most common greenhouse gases are water vapour, carbon dioxide, and methane.

**Landfill** - huge holes in the ground that we fill with rubbish and then cover with soil.

**Over-packaged** - when products are wrapped in more material than is needed or wanted.

**Plastic** - a kind of material that is made by people and can be formed into almost any shape.

**Pollution** - when the environment is contaminated, or dirtied, by waste, chemicals, and other harmful substances.

**Recycle** - to make something new from something that has been used before.

**Sustainable** - able to be maintained at a certain rate.

# 1. WHY DO WE USE SO MUCH PLASTIC?

## SUGGESTED STARTER ACTIVITY

Ask students to think about plastic in their everyday lives and how much they rely on it. They could compile a list of how they use it throughout the day e.g. plastic milk bottle at breakfast, plastic bag for bread, plastic tub for margarine, cling film to wrap sandwich, lunch box, bottle of water, chair, telephone, cycle helmet, computer, television, games console. How would their lives be different without it?

## TEACHER NOTES

### Plastic Is All Around Us

**Slide 4:** **Plastic** is a big part of all of our lives. Many of us make our first contact with plastic on the day we're born when the midwife puts the plastic identity bracelet on the newborn's ankle. From that moment on, we grow up in a world that's full of plastic and worryingly, it's getting fuller every day.

### What is the History of Plastic?

Plastic hasn't actually been around for all that long. In 1850, an English inventor called Alexander Parks, created the first plastic-like substance called *Parkesine*. Despite further attempts by other inventors, it wasn't until the early 1900s that plastic production really took off.

**Slide 5:** In 1907 Leo Baekeland invented *Bakelite* - it was light, durable, easy to mould and kept its shape when hot. This revolutionary new material was used to make items such as telephones, toys, building materials and car parts. Other forms of plastic then followed and over the years they have become lighter, stronger and more durable. There are now about 50 main types of plastic.

### What are The Benefits of Plastic?

**Slide 6:** Plastic is a brilliantly useful material and has the following benefits:

- Strong
- Long-lasting
- Light (meaning less fuel needed to transport it)
- Can be moulded into different shapes
- Can resist damage by water, heat, chemicals and electricity
- Able to retain its shape when heated
- Can be made in lots of different colours
- Cheap to make

**Slide 7:** In developed economies, about a third of plastic is used in packaging and roughly the same in buildings for things such as piping and plumbing. Other uses include cars (up to 20% plastic), furniture and toys.

## How Much Plastic Do We Use?

**Slides 8-9:** The world's annual consumption of plastic materials has increased from around 5 million tonnes in the 1950s to around 450 million tonnes today. We've produced a massive 8.3 billion metric tons of plastics since the 1950s - that's enough plastic to cover every inch of the UK ankle-deep **more than ten times over** (Greenpeace).

## When We Throw Plastic Away Where Does It Go?

### Landfill

**Slide 10:** If you throw a plastic bottle in the bin, it will end up in **landfill** - huge holes in the ground that we fill with rubbish and then cover with soil.

### Oceans

**Slide 11:** Plastic ends up in our oceans in various ways:

### Rubbish Discarded

**Slide 12:** Plastic that is simply dropped or left behind on streets or in the environment can be carried by wind and rain into our drainage networks or rivers that then flow into the sea. Holiday makers visiting beaches and leaving behind their bottles and food packaging on the sand directly contribute to plastic getting into the ocean. Ships also dump their rubbish at sea.

### Rubbish Flushed Down The Loo

**Slide 13:** Products containing plastic such as cotton buds, tooth flossers and face wipes are flushed down the loo. Sewerage networks and waste water treatment works are not specifically designed to remove these sort of items, so more and more are ending up in our rivers and on our beaches.

### Fibres From Washing Machines

**Slide 14:** There are plastic fibres in some clothing that shed in the washing machines. Hundreds of thousands of tiny fibres are washed out of clothes in the washing machine - these are then carried in the waste water into the sewage system. But they are far too small to be removed in the treatment plants, so they escape into rivers and then oceans.

## 2. WHAT ARE THE PROBLEMS WITH PLASTICS?

### TEACHER NOTES

#### It Doesn't Go Away

**Slides 16:** Plastic does not rot away so all the plastic ever made is still in existence on our planet's surface. Much of the plastic we throw away ends up in **landfill** sites.

**Slide 17:** When exposed to sunlight for long periods, plastic can become brittle and break into smaller pieces. But it is thought that a bottle floating in the ocean would still take 450 years to break down and whilst the fragments get smaller and smaller over time, they never fully disappear.

#### It's Not Easy to Recycle

**Slide 18:** Recycling plastic is not straightforward. The main problem is that all the plastic melted down has to be of the same type. If different types of plastic were melted down in one pot, it would result in layering and weaknesses in the resulting plastic. Also, the dyes and additives used in plastics make them more difficult to recycle as it is difficult to remove them.

**Slides 19-20** But plastics can also be "**downcycled**," that is, they are used to make a lower-quality form of plastic. Plastic water bottles, for example, can be melted down and made into other items such as fleece jackets and plastic chairs. To do this, the recycled plastic is broken down into flakes, before being melted and moulded into a new shape.

#### It's Used To Make Many Single Use Items

**Slide 21:** Research carried out by the Ellen MacArthur Foundation concluded that 95% of plastic packaging around the world is used only once. Items such as straws, cotton buds, coffee cups and cutlery are often made from plastic and are only used once before being thrown away. Cotton buds are consistently one of the most regularly reported items on UK beaches, even though paper ones are available.

#### It's Polluting Our Oceans

**Slides 22-24:** Scientists have shown that around 2 million tonnes of plastic is entering the world's oceans every year. This can be plastic thrown into the sea by people living on coastlines, sailors, offshore rigs and cargo vessels. It can also have been thrown on the ground by people living inland and have blown into rivers or streams, ending up in the sea. There is also plastic that goes down the drain and ends up in our oceans - products flushed down the loo and even fibres from our washing machines.

## Synthetic Fibres In The Oceans

**Slide 25:** Everytime a synthetic garment is washed, tiny strands of plastic like nylon and acrylic (called **microfibres**) are washed out of the garment and into the wastewater from the washing machine. These microfibres ultimately end up in our oceans. As up to 1,900 microfibres can be released by a single garment, this is a big problem. They are becoming lodged in the intestines of fish and the birds that eat fish.

**Slide 26:** As they are too small to be filtered by our water treatment plants, these microfibres could also be in our drinking water. Research has shown that 83% of tap water samples taken from various sites around the world were contaminated with microscopic plastic fibres. In the UK, they were found in 72% of samples. Scientists think that many of the fibres are falling into water from the air. As it has been shown that up to 700,000 microfibres can be released into a single load in a washing machine, it is likely that tumble driers would then release them into the air.

**Slide 27:** These microfibres have also been found in bottled water. Scientists found roughly twice as many plastic particles within bottled water as were found in a study of tap water. So how do they get there? As they are easily airborne, they can come into bottling factories through fans or on clothing and get into the bottled water during the packing processes.

## Garbage Patches

**Slide 28:** Ocean currents cause huge areas of plastic rubbish to form in specific places. For example, the **Great Pacific Garbage Patch** is a mass of floating plastic waste that has been collected there by currents and covers an area of ocean roughly twice the size of France. In some places it is up to 10 metres deep!

A remote, tiny and uninhabited island in the Pacific Ocean called Henderson Island has been found to have the highest density of plastic rubbish found anywhere in the world. There are almost 18 tonnes of plastic, broken into 37.7 million separate pieces. Crabs have been found living in pieces of rubbish such as cosmetics jars and plastic bottle caps. So how has all this plastic ended up there? The Island is near the centre of the Pacific Gyre - a huge rotating current, which is why it has picked up so much rubbish.

There are beaches on Pacific Islands that seem to be covered in multi-coloured sands. But when you look more closely, they are actually tiny fragments of plastic that have been broken up and washed ashore.



## Wildlife

**Slides 29-30:** Large plastic debris floating in the sea can kill animals such as seals and dolphins. Plastic bags drifting underwater are eaten by turtles who mistake them for jellyfish; they block their digestive systems and result in starvation.

**Slide 31:** Laysan Albatrosses are large sea birds living in the Pacific. They catch fish and squid by skimming the surface of the water with their beaks and pick up lots of floating plastic that they then feed to their chicks. Adults can regurgitate the plastic they swallow but the chicks can't, so it gradually fills their stomachs. This either damages their stomach linings or makes them feel full when they are actually starving.

**Slide 32:** Small fish eat little fragments of plastic. The bigger fish that eat them get a larger dose of pollutants as they eat lots of smaller fish. As you progress further up the **food chain**, the pollutants become more and more concentrated. We don't yet know the implications when humans in turn eat these fish.

Toxic chemicals floating in the oceans are attracted to plastic and often 'stick' to it, so when fish eat little bits of plastic they are eating the toxic chemicals too. This is then passed onto humans when we eat fish.

## SUGGESTED ACTIVITY

### Class Debate / Persuasive Writing

Hold a class debate or produce a piece of persuasive writing on one of the following topics:

- Is plastic fantastic?
- Should there be a plastic ban?
- Should plastic packaging be banned?
- How important is it that we reduce our use of plastic?

### 3. WHAT IS BEING DONE TO TACKLE THE PLASTIC PROBLEM?

#### SUGGESTED STARTER ACTIVITY

There has been a great deal of coverage in the news recently about plastic pollution, particularly since David Attenborough's moving Blue Planet 2 documentary on the impacts of plastic pollution (2017). How much do students know about what is being done to address the problem? Have they noticed changes in their local supermarkets or coffee shops? Have they heard about it on the news? A possible homework task could be to make a list of actions that are being taken to reduce our use of plastic.

#### TEACHER NOTES

##### 1. Developing Alternatives To Plastic

A number of plastic alternatives have been developed e.g. corn-based plastic, PHA polyesters, chicken feather plastic and starch as an additive. But how many problems do they actually solve?

##### Corn-Based Plastic

**Slide 34:** This can **biodegrade** within 47 days in an industrial composter. It doesn't emit fumes when burned and uses up to 50% less **fossil fuels** than making petroleum based plastic. BUT it won't degrade in the environment or in landfill. It's also brittle and doesn't stand up to heat well. Another key issue is that it uses up corn or other crops that could otherwise be used to feed people.

##### Sugar Cane Plastic

**Slide 35:** The first Lego pieces made from plant-based plastic sourced from sugar cane are due to come on sale later this year (2018). They will be made from polyethylene - a soft, durable and flexible plastic that can now be made with ethanol extracted from sugar cane material. As a **bioplastic**, it can be recycled many times, though it is unlikely to be 100% biodegradable. This is Lego's first step in its commitment to make all Lego bricks using **sustainable** materials.

##### Problems with Biodegradable Plastic and Bioplastic

- Many use crops as the raw materials - these could otherwise have been used to feed people who desperately need it
- Neither bioplastic or biodegradable plastic can be recycled easily
- Some can only be broken down in industrial digesters, so will often still end up in landfill



- Some bioplastics produce methane when they break down in landfill - this is a powerful **greenhouse gas** that contributes to **global warming**.

### New Discoveries

Scientists have recently accidentally created an **enzyme** that helps to breakdown plastic. Although there is a long way to go before these enzymes could be used on a large scale to help break down and recycle plastics, it may hopefully lead to a solution to the problem in the future.

## 2. Acting Together - Pledges and Pacts

A full transformation of the plastics system is needed and this can only be achieved by bringing together all the links in the chain under a shared commitment to change.

### Companies Pledge on Plastic Packaging

**Slide 36:** Companies are now starting to take responsibility and take action together to address the plastic problem. In April 2018, over forty companies signed up to a pact to cut plastic pollution over the next 7 years. Their pledges include:

- Eliminate unnecessary single use plastic packaging through better design
- Make 100% of plastic packaging recyclable or compostable
- Make sure 70% of plastic packaging is recycled or composted
- 30% of all plastic packaging to include recycled material

### UK Plastics Pact

These companies have joined with the government, trade associations and campaigners to form the *UK Plastics Pact*, promising to make 100% of plastic packaging ready for recycling or composting by 2025.

## 3. Charging For Carrier Bags

**Slide 37:** In the UK large retail stores now have to charge customers 10 pence for plastic carrier bags. According to Defra, this has led to 9 billion fewer plastic bags being distributed.

## 4. Recycling, Composting and Reusing Coffee Cups

### Recycling

**Slide 38:** Coffee cups are difficult to recycle as they have a mixture of paper and plastic in their inner lining to make them heat and leakproof. Some of the biggest sellers of coffee in the UK have started recycling them but they can only do this when customers dispose of them in-store. Many companies are trialling new approaches to try and make their coffee cups fully recyclable.

## Compostable

**Slide 39:** Use of **compostable** cups is growing, but they must be properly disposed of in food waste bins as they will contaminate the plastic recycling - this then costs money to sort and can result in the whole batch of recycled items being rejected. So compostable cups only work well in places where waste can be controlled e.g. at a festival where people will dispose of their cups on-site.

## Reusable

**Slide 40:** The three largest coffee retailers in the UK now provide incentives for customers to bring in their own reusable mugs instead of using a disposable cup.

## 5. Deposit Return Schemes for Plastic Bottles

**Slides 41-43:** A deposit return scheme involves a small extra charge being added to the price of a drink - this is then refunded to the customer when they take it back to be recycled. Forty countries and 21 US states now have some kind of deposit return scheme in operation.

Research shows that countries with these schemes tend to recycle between 80-95% of their plastic bottles. For example, in Norway 95% of all plastic bottles are now recycled compared with 57% in England (March 2018). Germany has had a deposit return scheme since 2003 and 99% of plastic bottles are recycled there, compared with 43% in the UK.

The UK government announced in March 2018 that people in England will soon pay a deposit when they buy drinks in bottles and cans. This will hopefully reduce single use plastic and glass bottles, along with steel and aluminium cans. However, it is going to be complicated to introduce as it will involve installing special machines in stores that will receive and sort bottles, as well as giving refunds to customers for the bottles they return. But it is something that needs to be done in order to address the growing problem of plastic waste.

## 6. Ban On Single Use Plastics

The UK government is planning a ban on single-use plastics like drinking straws, drink stirrers and cotton buds.

## SUGGESTED ACTIVITIES

### Local Business Audit

What is being done by your local businesses e.g. coffee shops and supermarkets to reduce their use of plastic? Can you find out how successful their initiatives are? Could they be doing more?

## Make Your Own Bioplastic

Did you know you can make your own bioplastic using a couple of simple ingredients?

You will need:

- Corn flour
- Water
- Cooking oil
- A measuring spoon
- A microwave
- A microwavable container
- An adult (if required - to help with the microwaving!)

1. You can make as much as you like, but the proportions of ingredients to use are 1 tablespoon of cornflour to 1.5 tablespoons of water to 4 drops of cooking oil.
2. Mix the ingredients well in your microwavable container until you have a milky liquid.
3. Put the mixture in the microwave and give it about 30 seconds on high. It should start to bubble and become slightly transparent. If you have made a larger amount of mixture, you may have to heat it for longer to get it to bubble. Keep watching and don't let the mixture start to burn!
4. When the mixture is looking slightly transparent, ask your grown-up to take it out of the microwave very carefully. It will be hot! Make sure you let the plastic cool down until you are able to handle it safely. This will take 5 minutes or more.
5. Knead the plastic until it feels like play dough. You can now cut or mould it into the shape you want.
6. Leave it to cure for 24 - 48 hours. It should then be solid and maintain its shape. If you'd like to make coloured bioplastic, try adding food colouring to your mixture before microwaving.

## 4. WHAT CAN WE DO TO HELP?

### SUGGESTED STARTER ACTIVITY

Ask students to make a list of everything they do in their daily lives to reduce their use of plastic e.g. recycling, using paper earbuds, bringing a reusable water bottle to school, not using plastic straws. Do they think they are doing enough? Perhaps they could rate their efforts out of ten. Can they suggest other things they could do at home or school to help reduce plastic use?

### TEACHER NOTES

Plastics are getting into our lives, our homes, the water we drink and the air we breathe. We're only just beginning to realise how much plastics are impacting upon our environment.

**Slide 45:** But plastics are so useful that we're not going to just stop using them soon. Many of the alternatives to plastic are also damaging to the environment. The crucial thing is that we must be far more careful about **how much** plastic we use. Even more importantly, we need to minimise the amount of plastic we throw away and make sure that what we do have to throw away is **recycled** properly.

#### 1. Avoid Single-Use Plastics

**Slide 46:** You don't have to wait for the ban on single-use plastics to come into force - you can declare your own ban straight away! Making just a few small changes can have a big impact on the amount of plastic we use on a day-to-day basis.

Here are some ideas for how you can reduce your plastic use:

- Don't use plastic straws. If you do need straws, buy paper ones which will biodegrade or reusable ones made from materials like stainless steel
- Avoid buying water in plastic bottles and instead carry a reusable bottle with you. In the UK we use over 35 million plastic bottles every year, so carrying a reusable bottle is a great way to cut your plastic use and save money too
- Try not to use disposable cutlery
- Carry a shopping bag with you so you don't need plastic bags
- Buy cotton buds with cardboard sticks that will biodegrade

#### 2. Cut Down On Foods Wrapped In Plastic Packaging

**Slide 47:** There are many foods that do not need to be bought in plastic packaging. Try to buy your fruit and vegetables loose in the supermarket and carry them in canvas/cotton bags instead of plastic ones. Or use local shops and markets where you

can pack your fresh produce into paper or reusable bags. A few shops now encourage shoppers to bring in their own containers to fill up with oats, nuts, rice etc.

### 3. Recycle Plastic Whenever You Can

**Slides 48-49:** Every council in the UK now provides a collection service for plastic bottles, with only a few not collecting them directly from homes. 70% of local authorities offer kerbside collection for plastic pots, tubs and trays.

But in the UK we currently only recycle around 50% of plastic bottles and just 12-15% of mixed plastics (WRAP). Most families throw away about 40 kg of plastic per year, which could otherwise be recycled. So this is an area where we can definitely all help to make a great improvement.

### 4. Dispose of Plastic Responsibly

**Slides 51-52:** When away from home, recycling your plastic waste is not always possible yet. But always dispose of plastic waste in a bin - never drop it on the ground or throw it in a stream/river/sea as it could end up in the ocean and could kill a marine creature.

## SUGGESTED ACTIVITIES

### Plastic Recycling Audits

#### 1. Audit of School Recycling

Have any measures been taken to reduce plastic use at your school? Is any plastic reused or recycled? Could more be done to increase awareness of the importance of reducing plastic use?

#### 2. Food Packaging Labels and Home Audit

Have a look at the contents of your kitchen cupboard. Is plastic packaging clearly labelled with recycling information? How much of it is recyclable?

Is your household trying to limit items bought with plastic packaging?

#### 3. Overpackaging

Can you find a product that has been **over-packaged** with unnecessary plastic? Why do you think it has been packaged like this? How could the packaging be made more environmentally friendly? You could also think about how people packaged food 50 or 100 years ago and draw comparisons.

#### 4. Local Recycling Facilities

Carry out research to discover what services and facilities there are for recycling plastic in your local area? Do you feel they are adequate? How could they be improved?

## Poster Design

Design a poster informing pupils at your school about the importance of reducing single-use plastic. Try to make it as persuasive as possible.

## Hold a School Assembly

Plan and deliver an assembly to your school about plastic. It should inform everyone about the dangers of plastic, the need to reduce our use of plastic and suggestions for how they can help at home and in school.

## Creative Task

Try to think of as many ways as possible for **reusing** plastic packaging that would otherwise go to landfill or for recycling. How imaginative and creative can you be in finding new uses?

## A Kitchen Recycling Guide

Devise a recycling guide for your kitchen at home. This could be displayed on the wall/fridge and enable everyone in the household to be involved in recycling plastic. It should include information such as which items can/can't be recycled and whether they need washing before being recycled.

## We value your feedback!

Let us know what you thought of this lesson plan by completing this feedback form <https://e.mail-2schools.org.uk/form/BPE-Lesson-Plan>. Thank you!