

Key Stage 5 Worksheet

Earth LIVE Lessons: How to Save Your Planet From Home



What is it about?

In this video, Dr Tara Shine, Director of sustainable working company Change By Degrees, and author of “How To Save Your Planet, One Object At A Time”, talks about simple actions individuals can take relating to five common household objects to try to reduce their impact on the environment. Tara suggests that although international agreements and government actions are required to tackle climate change, individuals also need to change their behaviour in order for those agreements to be effective, such as travelling by bike instead of car, decreasing energy use, and eating food produced locally.

Watch video here:
youtu.be/6-WhnPp4YRo

Open file in your web
browser to click on the
links.



Object 1: Toilet paper

People use an average of 57 sheets of toilet paper every day! An area the size of 27 football pitches of forest is lost every day, and part of this is to produce toilet paper. Making paper also requires large amounts of water and energy, so decreasing the amount of paper, including toilet paper, used will have a positive impact on the environment. Consumers can also make more sustainable choices when purchasing toilet paper, for example, checking the label to ensure the paper is FSC (Forest Stewardship Council) certified. **FSC certification** indicates that the trees used to produce the paper have been grown sustainably, biodiversity is being protected and that the management of the forest benefits the lives of local people.

Consumers can also check whether the paper is bleached (toilet paper production uses **253,000 tons of bleach in the USA** alone every year), and whether it is made from virgin paper (i.e. paper created from trees), or recycled paper. Research shows that the amount of **recycled paper used to make toilet rolls in the UK has decreased** since 2011, fuelled by the demand for luxury, “super soft” products.

Toilet paper continued...

In the UK, we currently recycle around **50% of our household waste**. Recycling is often considered an important solution to help reduce the amount of waste going to landfill and the amount of energy, water and other resources used to create products and packaging, however, if there is no demand for the products created from it, there is no environmental benefit.

Some toilet paper is made from bamboo instead of trees, which has its own environmental benefits. **Bamboo** grows 30% faster and absorbs 35% more carbon dioxide than trees, as well as producing very soft toilet paper to meet consumer demand. Bamboo can also be regularly cut and will re-grow rapidly, unlike trees which are cut down and then need to be replanted.



Modify a toilet roll tube to create a biodegradable pot to plant a seed.

In this video, Tara also advises to recycle the cardboard inserts or to use them, for example to **plant seeds in**. The toilet roll tubes are stood upright in a tray and filled with soil, and one seed planted in each of them. Once the seedlings have grown enough to be planted outside, the whole toilet roll tube and soil can be planted out, as the tube will decompose over time, avoiding disturbing the roots of the seedling. This can be particularly beneficial for plants like peas, which develop long taproots that don't respond well to disturbance.

Object 2: Plant pots

In the UK, half a billion plastic plant pots are used every year, most of them **ending up in landfill or being incinerated**. This is because new plants purchased from garden centres come in black plastic pots that cannot be recycled. Black plastic, used not only for plant pots but also for food packaging, for example the trays used for ready meals, is difficult to recycle because recycling facilities sort the different materials using an optical scanner, which bounces a beam of light off them as they progress along a conveyer belt and detects them by colour. Black plastic cannot be detected by the optical scanner.

Plant pots continued...

Black plastic is used for plant pots as it stops light from reaching and damaging the plants' roots. One plant pot manufacturer has now begun producing **grey-brown plant pots** instead to facilitate recycling, which will still protect the plants' roots from light.

Plastic recycling faces another challenge, as not all types of plastic are recyclable. Plastics are made via a polymerisation reaction from different monomers. Plastics can either be **homopolymers** (made up of repeated units of the same monomer) or copolymers (made up of more than one type of monomer). Some plastics are called **thermoplastics** (or thermosoftening plastics), which can be melted down and reshaped, making them easy to recycle. Others are thermosetting plastics, which burn when heated and can only be recycled using sophisticated chemical processes.

Compostable plant pots may seem like an environmentally friendly alternative, but many of them are made from peat, just like most compost. This peat is extracted from peat bogs, which support specialist species specifically adapted to their unique environment, including carnivorous plants that eat insects.

Peat bogs need to be maintained, rather than dug up to produce compost and compostable plant pots, not only to protect their unique biodiversity, but because they are the **most important terrestrial stores of carbon**.

Peatlands contain at least twice as much carbon as the world's forests, but take up a small fraction of the space, around 3% of the Earth's surface.



In peatlands, as in all ecosystems, plants absorb carbon dioxide during their lives via photosynthesis. However, in peatlands, when the plants die, they don't completely decompose, which would release carbon dioxide back into the atmosphere. Instead, they partially decompose to form peat, in which the carbon remains locked up and stored (sequestered), reducing levels of atmospheric carbon dioxide and therefore helping to mitigate (reduce) climate change.

Instead of using peat-based compostable plant pots, Tara recommends using old egg boxes. She also suggests buying peat-free compost, which can also be made at home using a compost bin. If you don't have a compost bin, make sure to separate your food waste for collection. Food waste collected by local councils is sent to an industrial composter, which also produces peat-free compost.

Object 3: Soap

Liquid soap requires five times as much energy to produce as bar soap, and its packaging uses 20 times as much energy! Bar soap lasts a long time, is cheaper, and is sold in very little packaging, or even none at all. If you are using liquid soap and would like a more sustainable option, some shops now sell refills so the bottle it comes in can be reused. Reusing packaging is much more sustainable than recycling. Tara shares a simple tip to make bar soap last even longer – put a bottle cap in the bottom of a bar of soap to stop it from coming into contact with water in the soap dish, which will help it to last even longer and not disintegrate.

Some liquid soaps have a further negative environmental impact because they contain triclosan, an antibacterial compound which is **toxic to some aquatic plants and animals**. Triclosan can act as an endocrine disruptor, affecting the levels of hormones in aquatic species such as fish, impairing their reproductive function. Triclosan is lipophilic (fat soluble), and therefore can be stored in the fatty tissues and passed up through the food web through the process of **bioaccumulation**.

Object 4: Jeans

Jeans are one of the most worn items of clothing in the industrialised world, but their manufacture has a **considerable environmental impact**. 4000 litres of water are needed to make a pair of jeans, including to grow the cotton and during dyeing, production and transport. 37% of the carbon footprint of a pair of jeans comes from the washing and drying of them in the home, so reducing how frequently jeans are washed can help to reduce their impact. The guideline is to wash jeans once every 10 wears.

Hanging washing outside to dry rather than using a tumble dryer can also help to reduce energy consumption and therefore greenhouse gas emissions. The fashion industry produces **20% of all global wastewater and 10% of all global carbon emissions** – more than international flights and shipping goods across the oceans! Consumers can also reduce their carbon and water footprint by buying fewer clothes, and jeans can often be repaired by sewing on patches, replacing buttons, and at the end of their useable life using patterns available online to turn them into shorts, skirts or even **bags**.

The dye used to produce blue jeans is indigo, which can **cause water pollution** if not properly controlled, causing harm to aquatic wildlife and impacting the health of people living near the factory producing the jeans. New techniques are being developed all the time to use less indigo and water in the production of jeans, but at the moment, textile dyeing is the second largest polluter of water in the world.

Object 5: Plastic bottles

Many products come in plastic bottles and if these are not properly disposed of, they can end up in the ocean where they contribute to marine pollution. The most common items of marine pollution found during beach cleans are **cigarette butts** (which also contain plastic), food wrappers and plastic bottles. Plastic can be consumed by animals such as turtles, seals, **whales and dolphins**, clogging up their digestive tract and preventing them from feeding properly. Animals can also become entangled in plastic, especially discarded fishing nets, limiting their mobility and therefore their ability to hunt their prey and evade predators. Animals might also become trapped inside plastic bags and suffocate.

Sea turtles have barbs along the oesophagus, which close to allow the turtle to expel sea water through its mouth after consuming its preferred prey, jellyfish, without the prey escaping. Unfortunately, this adaptation leaves sea turtles vulnerable to plastic pollution. When a turtle feeds on plastic bags, perhaps mistaking them for jellyfish, the barbs trap the plastic inside the turtle.

Plastics do not biodegrade, so in the ocean they break down through mechanical weathering and UV-radiation photo oxidation reactions from sun exposure causing chemical bonds in the plastic polymers to break (**photolysis**), forming smaller and smaller particles called microplastics, which can also be **harmful to marine organisms**. Microplastic pollution in the oceans is so extensive that even a new species of isopod discovered in 2020, 7km below sea level in the Pacific Ocean, contained plastic fibres in its digestive system. The scientists who discovered it named it ***Eurythenes plasticus***, hoping to raise awareness of the scale of the problem.

Compostable plant-based materials have been developed to use instead of plastic in packaging, however, as many local councils do not have the facilities to recycle them, the majority still **ends up in landfill**.

Humans consume microplastics through our food and drink. For example if you eat marine fish such as tuna, you will be eating the microplastics consumed by the fish during its life. Scientists estimate that each person consumes **between 39,000 and 52,000 microplastic pieces** every year. The effects of **plastic exposure on human health and not yet known**, but research in this area is ongoing.

Consumers can help by avoiding purchasing plastic-free products where possible (e.g. bar soap or refillable soap), and by reusing and recycling any plastic they do buy. For example, two one litre bottles can be filled with water to turn them into 1kg weights for strength training, and the top can be cut off a milk bottle to turn it into a scoop, for example for scooping compost.



Marine plastic pollution is widespread, with plastic the most common litter found on beaches

Plastic bottles continued...

500ml bottles can also be **turned into bird feeders**. Use a bradawl to make a hole in each side near the bottom of the bottle and then push a stick through for the birds to use as a perch. Use the bradawl to make another hole above each perch for the birds to access the food, then fill with bird seed, put the lid back on and tie a string around the neck of the bottle to hang it up in the garden.



500ml plastic bird feeder.

Find out more!

- Explore how paper is produced from trees **here** and the paper recycling process, including its environmental benefits, **here**.
- Learn more about *Eurythenes plasticus*, the new marine species identified in 2020 with plastic in its digestive system, despite living 7km below sea level **here**.
- Find out about some of the campaigns to reduce ocean plastic pollution, and ideas on how to reduce your own plastic consumption, from **Marine Conservation Society** and **Whale and Dolphin Conservation**.
- Explore the **Ocean Cleanup project**, which aims to remove plastic from the **Great Pacific Garbage Patch**, where through the action of the ocean gyre a floating patch of plastic three times the size of France has accumulated. You can watch a video about how the plastic is removed **here**.
- Find out more about the plastic recycling process **here**, and developments in chemical recycling processes to enable us to recycle thermosetting plastics **here**.
- The environmental impact of water abstraction for cotton farming to make clothes like jeans can be seen **here**.
- Read about the “Zero Discharge of Hazardous Chemicals” initiative aiming to put a stop to the discharge of toxic chemicals into the environment by the textiles industry **here**.
- Find out how “fast fashion” is harming the environment **here**.
- Discover more common household objects with harmful environmental impacts **here**.

Questions

Interactive: Click on box to start typing

Name three choices consumers can make to reduce the environmental impact of the products they buy.



Why are black plastics and thermosetting plastics difficult to recycle?

How do peatlands store large amounts of carbon?

How does plastic break down in the ocean, and what does it break down into?

How are sea turtles adapted to feed on jellyfish?

Try an exercise!

Conduct an analysis into the environmental impacts of some different brands of toilet paper, including those made from virgin paper, recycled paper and bamboo. Write a short report analysing the advantages and disadvantages of the different types, followed by your recommendations for consumers to minimise their environmental impact. Consider financial, health and environmental implications, and when investigating the environmental impact, don't forget to consider all stages of the product's lifecycle, including manufacture, packaging and shipping.

For teachers and home schoolers

Links to Science in the National curriculum for Wales (KS5)

<https://www.wjec.co.uk/media/gcgjtvqj/wjec-gce-biology-spec-from-2015.pdf>

AS Biology: Biodiversity and Physiology of Body Systems - All organisms are related through their evolutionary history [(n) the different types of adaptations of organisms to their environment including anatomical, physiological and behavioural adaptations] – the adaptation of sea turtles to be able to expel sea water whilst trapping jellyfish in the digestive tract.

A2 Biology: Energy, Homeostasis and the Environment – Population size and ecosystems [(m) the effects of human activities on the carbon cycle including climate change affects the distribution of species and is a possible cause of extinction] – the role of peatlands in storing carbon and human disruption to this process by digging up peat for compost, and the role of paper demand as a cause of deforestation.

A2 Biology: Energy, Homeostasis and the Environment – Human impact on the environment [(d) the increased human pressures on the environment including the need to achieve sustainability by changes in human attitudes and making informed choices] – human impacts on the environment relating to climate change, water consumption, deforestation, peat extraction and water pollution, and how consumers can make informed choices to reduce their environmental impact.

<https://www.wjec.co.uk/media/wijlspii/wjec-gce-geography-spec-from-2016-e.pdf>

A2 Geography: 3.1.7 Carbon stores in different biomes [Changes in the size of carbon stores due to human activity including land-use change (deforestation, afforestation and agricultural activity)] – the carbon capture extent of peatlands and how this has been reduced by human drainage and peat extraction, and the deforestation caused by the demand for virgin paper.

A2 Geography: 3.2.10 Managing ocean pollution [Plastic garbage patches] – the composition of marine litter and the impact of plastics, including microplastics, on marine organisms.

A2 Geography: 4.2.3 Biodiversity under threat [Ecosystems at greatest risk including tropical rainforests, coral reefs and wetlands] – threats to peatlands caused by peat extraction, affecting the specialist species adapted to live in these regions.

<https://www.wjec.co.uk/media/akbbkvwh/wjec-gce-chemistry-spec-from-2015.pdf>

AS Chemistry: Energy, Rate and Chemistry of Carbon Compounds - 2.5 Hydrocarbons [(k) nature of addition polymerisation and the economic importance of the polymers of alkenes and substituted alkenes] – the chemical process to form plastics and the challenges of chemical recycling.



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