A whirlwind tour of issues relating to plastic waste

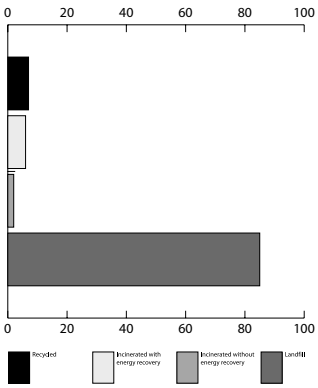
The figures

Plastics account for between 8-11% (by weight) of waste in the UK.

60% of domestic plastic waste comes from packaging

Each of us uses over 90kg of plastic per year.

Plastic waste disposal



Take action

Try and have a waste free lunch day, so no packed food (drinks cartons, crisp packets.)

Do a waste audit at school, separate your waste out and weigh each component (metal paper and plastic) and think how you could reduce each one.

Get involved in a 'Clean up' day with a Wildlife Trust or Marine Conservation Society group. If there isn't one in your area then organise one!

The issues

Resource use - Oil is one of the main raw materials used to make plastics. Plastic production accounts for about 8% of the world's oil consumption. Half is used in transportation and half in production.

Landfill - the UK is running out of space to build new landfill sites and as existing sites fill up we no longer have the option of burying our plastic rubbish in a hole and forgetting about it.

Toxic by-products - indiscriminate disposal of plastics can release highly toxic substances, like deadly dioxins, into the environment.

Wildlife impact - 2 million seabirds die each year due to eating or getting wrapped in plastic. Of the 312 species of sea bird, 111 are known to ingest plastic. In tropical waters turtles ingest plastic bags mistaking them for jellyfish, their favourite food. In France, a Minke whale was found stranded on a beach with nearly a kilo of plastic in its stomach. Not surprising considering that 60% of litter found on beaches is plastic (source FOE).

A Gannet entangled in plastic fishing line

The politics

The EC Directive on Packaging and Packaging Waste sets targets for member states to recover 50 - 65% of packaging waste, with a minimum recycling target of 15% for each material (including plastics).

These targets were transposed into UK law via the Producer Responsibility Obligations (Packaging Waste) Regulations 1997. The new plastic recycling target for 2006 is proposed at 20%.

For more information on the multitude of laws relating to plastics see the legislation section of the Waste Online website at www.wasteonline.org.uk

The solutions

Reduce plastic packaging where possible; don't take a plastic bag if you don't need one!

Reuse plastic bags and containers rather than buying new ones. Look out for 'refill packs' and buy goods made from recycled goods where possible, for example a fleece made from recycled plastic bottles.

Recycle your plastics by identifying the type of material and putting it into the correct recycling facility. If this isn't done correctly the plastic can be 'contaminated' and made useless. Recycling saves between 65-80% of the energy required to make virgin plastic, two thirds of the sulphur dioxide emissions, and half of the nitrous oxide emissions.

Recycling one plastic bottle saves the energy to run a 60w lightbulb for 6 hours!

25 plastic bottles = 1 fleece jacket

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Investigating plastics

Aim

The aim of these activities is to find out about different plastics. Firstly, by identifying six samples of plastic, and then looking at the uses of these plastics. This is a practical activity that highlights why we are so dependent on plastics.

You will need

- 2cm squares of each of the most common types of plastic (one set for each group)
- A container half filled with water
- Washing-up liquid.

What to do

- Half fill a jar with water. Add the pieces of plastic and stir. Four pieces of plastic will float because they are lighter or less dense than water. They are polyethylene (HDPE and LDPE), polypropylene and polystyrene.
- Now add a drop of washing-up liquid to the water and stir. One piece of plastic (polystyrene) will now sink.
- The other types of plastic (PET and PVC) will not float because they are denser than water.

The children should draw up a table with 10 questions (e.g. does it float? Is it transparent?) and test each plastic in turn to find out its properties. This can then lead on to a discussion about why different plastics are used for different purposes and why we use so many different types of plastic.

Extension activities

Find out where your nearest plastic recycling banks are and what types of plastic can be recycled there. Draw a map to show others where it is.

Fill two empty margarine tubs with soil. Bury a square of plastic (from a plastic bag) in one and an apple core in the other. Which one degrades first? Try and find a biodegradable plastic bag (from the Co-op or the Body Shop) and see how long it takes to biodegrade.

Make a list of plastic items that can be reused in a useful way. How many can you think of? How many of these can you start using at school or at home?

Write a letter to a manufacturer that you think over-packages its products asking why their products need so much packaging around them, and why the packaging can't be made from recyclable plastic.

Test whether plastic conducts heat. Place a plastic spoon, a wooden spoon and a metal spoon in a jug of hot water. Feel the handles frequently. Which warms up the quickest? Can you tell which is the best conductor? Which is the worst conductor?

Plastics recycling

1 • PET

Polyethylene terephthalate

Fizzy drink bottles and oven ready meal trays. Very similar to PVC bottles but can be identified by a hard white spot in the bottles base.

2 • HDPE

High-density polyethylene

Bottles for milk and washing up liquids

3 • PVC

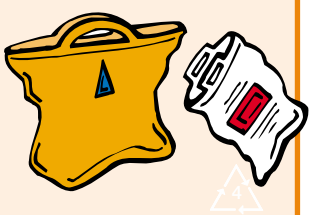
Polyvinyl chloride

Food trays, cling film, bottles for squash, mineral water and shampoo. Note the absence of a hard white spot in the centre of the bottle's base.

4 • LDPE

Low density polyethylene

Carrier bags and bin liners.



5 • PP

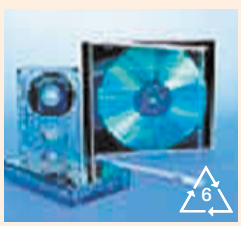
Polypropylene

Margarine tubs, microwaveable meal trays. Also used for DVD cases.

6 • PS

Polystyrene

Yoghurt pots, foam meat trays, hamburger boxes and egg cartons, vending cups, protective packaging for electronic goods and toys.



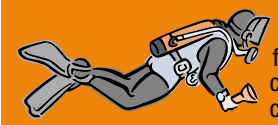
A brief history of plastics

1839 – Vulcanite
In 1839 Charles Goodyear added sulphur to latex rubber and produced Vulcanite, a hard wearing flexible compound which could be moulded. It was immediately used to make tyres for the infant car industry.

1870 – Celluloid
This polymer, made by hardening cellulose nitrate with camphor was once used in dentistry and later in the film industry. Nowadays celluloid's only real commercial use is for making ping-pong balls as no other plastic has its unique properties!

1907 – Bakelite
A trademark of Baekeland (USA), who created a phenolic compound which had a myriad of uses (telephone and radio casings for example). "The word Bakelite" became a generic word of the day for all things plastic.

The 1930's
Polystyrene (PS) - Large scale production of styrene was undertaken during World War II, especially for the production of synthetic rubbers. Even tougher materials based on copolymers were introduced in the 1950s, which are now used in motorcycle helmets and briefcases due to their toughness and durability. General purpose polystyrene is not the familiar white plastic used to protect new electrical goods. One of its most familiar forms is used to make the cases for CDs.



Neoprene - neoprene is formed from the polymerisation of chloroprene (which has a similar chemical structure to natural rubber), and is renowned for its resistance to chemicals, oil and water. Neoprene became commercially important in manufacturing protective clothing and wetsuits.

Polyester - trade and political problems between the USA and Japan in the 1930's made it imperative to find a synthetic replacement for silk. In February 1935, Wallace Hume Carothers polymerised adipic acid (C6) and hexamethylene diamine (C6) to give 'Fibre 66' which had good physical properties when it was drawn into a fibre. In September 1938, the material was re-christened Nylon 66. Sadly, Carothers died before the importance of his discovery was realised.

Polyvinyl Chloride (PVC) - Waldo Semon started the commercial production of a plasticized vinyl chloride in the 1930's. The material was used for a multitude of products including hollow articles such as squeaky toys and dolls.

Polyethylene (PE) - was discovered largely by accident in 1933 by scientists working for ICI. It wasn't until 1939 that this long chain, low density polymer could be extruded as a film and was christened 'polythene'.

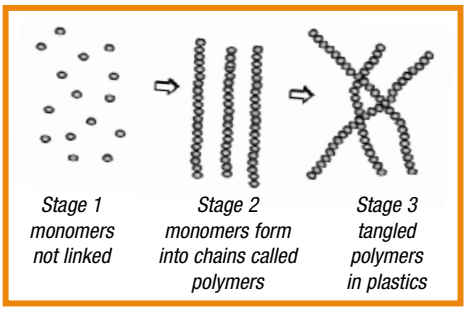
The 1940's
Polyethylene terephthalate (PET) - Dickson and Whinfield patented the reaction of polyethylene glycol with terephthalic acid. PETs became of great commercial importance following the development, in 1977, of a mass production technique to blow mould bottles made from the material.

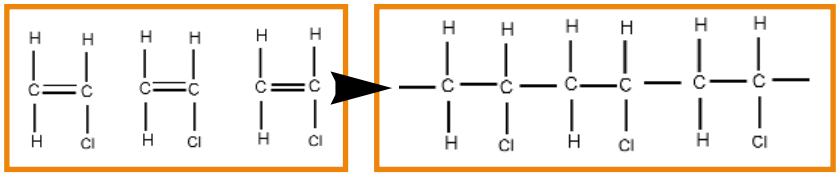
Silicone Polymers – In 1943 the Dow-Corning Corporation started production of silicone polymers. Silicone polymers have an unusual combination of properties including water repellency, low surface tension, anti-stick properties and high temperature resistance. They are particularly useful for electrical insulation and are now essential to communication technologies such as computers, TVs and satellites.

Polypropylene (PP) – Polypropylene is a highly crystalline polymer produced from propylene, a gas obtained from petroleum 'cracking'. It is an important plastic and used in many different forms. For example polypropylene fibres can be found in textiles, while a different form is used for the cases of DVDs.

Plastic chemistry

Most plastics are made up of small, carbon based molecules called monomers. These molecules are joined together to form long chains called polymers. The long chains tangle together like a ball of string, giving plastic its familiar strength.



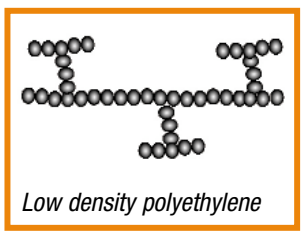


Equation for the synthesis of polyvinyl chloride

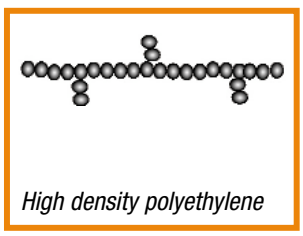
For example polyvinyl chloride (PVC) is made from many vinyl chloride monomers joining together.

Plastics have different properties and are used for quite different purposes. The properties of a type of plastic depend on which monomers are used, how the chains are attached together, and the length of the chains.

Plastics that have strong bonds between chains have higher melting points. With HDPE there is very little side branching on the chains, therefore they can squeeze together very closely and form strong bonds. However with LDPE the polymer chains have lots of side branches which means that they pack together loosely and therefore have weaker bonds. Therefore, HDPE is harder and has a higher melting point than LDPE.



Low density polyethylene



High density polyethylene

When polymers are heated, the chains within them move and cause the plastic to soften. However there are some plastics that do not melt, these are known as thermosetting plastics.

Thermosetting plastics have strong covalent bonds between their chains. Covalent bonds are where two atoms share the same electron and this results in a very strong bond. These plastics do not melt and burn when heated. Burning produces black smoke as un-burnt carbon is released. If the monomer making up the plastics contains other elements, quite dangerous gases can be given off, such as hydrogen cyanide.

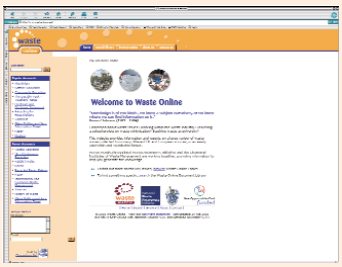
TEACHERS RESOURCE

useful websites

All the information you need is out there on the internet – somewhere! We tell you where to look.

Waste Watch
www.wastewatch.org.uk
Brilliant website from the leading UK organisation promoting action on waste minimisation. Waste Watch will be publishing a report entitled 'Resource Flow Analysis of Plastics in the UK' in Spring 2003 – visit the website to get a copy.

Waste Online
www.wasteonline.org.uk
Crammed with every conceivable fact about waste issues, including plastics. This is a 'must see' website for anyone who wants to know about tackling the waste problem.



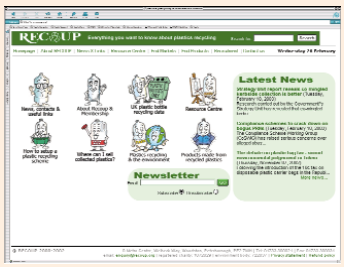
Recycled Products Guide
www.recycledproducts.org.uk
A useful database filled with hundreds of products made from recycled waste. There is also good background information on buying recycled products, logos and accreditation schemes.

Recycle More
www.recycle-more.co.uk
This site is provides information on recycling in the UK. There are areas specially designed for your home, business and school.

British Plastics Federation
www.bpf.co.uk
This site covers all aspects of the plastics industry, from environmental issues to materials and the history of plastics.

Remarkable
www.remarkable.co.uk
A fantastic company which turns waste vending cups, tyres and milk cartons into recycled stationery. Rubbish has never looked this good!

RECOUP
www.recoup.org
A national organisation promoting plastics recycling in the UK, Recoup also provides educational and training tools. A superb resource all round.



Save a Cup
www.save-a-cup.co.uk
A recycling company who collect hard-wall plastic vending cups used in drinks machines and recycles them.

Marine Conservation Society
www.mcsuk.org
Information on all aspects of marine conservation. The MCS also organises 'Beachwatch' projects to clean up marine habitats around the UK; a great way to do your bit for the environment.

Plastics Museum
www.plastics-museum.com
A great resource of information, the history section is fascinating, and it's all presented in style.

Wildlife Trusts
www.wildlifetrusts.org
Leading UK charity working for conservation of wildlife. Filled with news and information, this is also a good place to find out about conservation activities in your area.

Focus on Mali

Location	Mali is a land locked nation in Northern Africa
Population	approx. 10 million
Capital	Bamako
Geography	Mali is one of the countries where the Sahara desert and the savannah meet.
Main river	Niger

Mali and plastic

Mali's consumption of plastics provides an interesting contrast to the UK. Much less plastic is used per person in Mali, with a different distribution of the types of plastic used.

Type of Plastic	LDPE	HDPE	PP	PVC	PS	PET	Non recyclable
Typical Use	Carrier bags	Milk bottles	Tubs	Squash bottles	Cups	Pop bottles	Electrical fittings
UK (%) of total plastic use	15%	10%	15%	10%	7.5%	7.5%	22.5%
UK plastic use kg/person/year	13.5	9	13.5	9	6.75	6.75	20
Mali (%) of total plastic use	66%		10%	19%			5%
Mali plastic use kg/person/year	1		0.15	0.3			0.075

Comparison of plastic use in Mali and UK.

The majority of Mali's plastic is low density polyethylene (LDPE) i.e. plastic bags. The main associated problems with LDPE in Mali are:

- Sanitary risk – the bags block open wastewater channels allowing stagnant water to build up, ideal for mosquitoes to breed in and for disease to spread.
- Soil degradation – the bags enter the soil, reducing the soil's permeability and ability to absorb water.
- Herd animals often eat the plastic and can die.
- As there is no formal waste disposal people burn plastic in the street. This has negative health impacts.

End use of plastics

Mali has a very efficient informal recycling network with virtually 100% of the Polypropylene (PP) and PVC being recycled. Firstly, plastic is collected or purchased door to door and sorted by type. Then the plastic is washed and non plastic material removed. Finally, the plastic is shredded injection moulded or extruded into new shoes, drainpipes, or wire insulation. It is likely that over 1000 people scrape a living collecting and reprocessing PVC and PP.