

Water for Life, bottle for longer: background information

List of photographs included:-

Producing the Plastic Bottles (n=8)

Oil-rig extracting oil > Oil tanker transporting oil > Oil refinery > Tanker distributing fractions for plastic (naptha) > Factory making plastic > Lorry distributing plastic pellets > Plastic bottles made from 'pre-forms' at the bottling plant > Collection of Plastic Bottles.

Producing the Paper label (n=8)

Trees in a forest > Logging & deforestation > Logs on a Lorry > Wood Pulp factory > Wood Pulp distribution > Paper Mill > Label Making machine > Bottle Labels

Producing the Water (n=7)

Rainwater > Reservoir > Water Treatment Works (filtering and chlorination) > Domestic Pipe network > Local Water Supply > Water cleansing to high quality > Chiller / Carbonation tank / Deaeration tank

From bottle to glass (n=8)

Water bottle production line > Water bottles shrink wrapped & palletised > Warehouse awaiting shipping > Transportation to supermarket > Supermarket Shelves > From shop to home > Bottle of water in the fridge > A glass of fizzy water

Recycle or Landfill (n=8)

Empty plastic bottle > Collection of rubbish > Sorting and separating of rubbish > Plastics bundled together for reprocessing > plastic reprocessing factory > clothes factory > fleece jacket from reprocessed plastics > Clothing exports, often shipped from China

General background information relevant to all of the processes

- **All the vehicles in the photographs (boats, lorries, cars) run on derivatives of the fossil fuel oil (petrol, diesel). These are non-renewable resources and supplies are being depleted. Burning fossil fuels in engines produces air pollutants such as nitrous oxides and carbon dioxide, a greenhouse gas which contributes to global warming.**
- **Much of the machinery in the photographs is powered by electricity. Electricity is generated in power stations, which are usually powered by fossil fuels (oil, coal, gas) or nuclear energy. Electricity generation produces air pollutants such as carbon dioxide and sulphur dioxide (a major cause of acid rain).**

Producing the Label

Trees are a **renewable resource** - more can be planted to replace those which are cut down. Like all green plants, they carry out **photosynthesis**, using energy from sunlight to produce the carbohydrates, proteins and fats needed for growth. Photosynthesis uses carbon dioxide (CO_2) from the air and is an important mechanism in keeping the amount of CO_2 in the atmosphere constant. This helps to counteract the effects of global warming which is caused by an increase in greenhouse gases

such as carbon dioxide. Trees are also important habitats and food sources for a wide variety of animals.

Large-scale **tree-felling** (deforestation) has a huge impact on the environment. Fewer trees mean less photosynthesis and less absorption of carbon dioxide. Animals' habitats and food sources are destroyed which may result in extinction of certain sensitive species. There is an increased risk of soil erosion and flooding. The heavy machinery used in the logging industry uses fossil fuel and produces noise and atmospheric pollution. Many other small plant species are destroyed in the process of getting the machinery on site and removing the logs.

Transporting the logs to the wood pulping factory requires large trucks and building the necessary road infrastructure results in further habitat destruction.

At the **wood pulping factory**, the logs are turned into wood pulp, the raw material for paper making. The machinery used will either be powered by fossil fuels directly or by electricity.

Transporting the wood pulp to the paper making factory requires a lorry/train/boat.

At the **Paper Making Factory** the wood pulp is made into paper and some of the paper is used to make milk bottle labels, which are then printed. All of these processes involve machinery which is powered either directly by fossil fuels or indirectly (by electricity)

Finally, the **bottle labels themselves or material to print labels are transported** by another lorry to the water-bottling factory, to be stuck onto the milk bottles.

Producing the Bottle

The raw material used to make plastic is **crude oil**. Crude oil is a non-renewable fossil fuel, formed over millions of years from the dead bodies of sea creatures. It is a finite resource and world supplies are steadily decreasing.

On an **oil rig**, drilling machinery is used to extract the crude oil from deep under the seabed. This results in both air and water pollution and there is always the possibility of an accident causing large amounts of crude oil to escape into the sea, as happened in the Gulf of Mexico in April 2010, resulting in widespread damage to wildlife

The crude oil is transported from the oil rig to an oil refinery by an **oil tanker**. Again, accidents can lead to crude oil escaping from storage tanks into the sea.

Crude oil is a mixture of many different compounds. At the **oil refinery**, a process called fractional distillation is carried out and the crude oil is separated into a number of different fractions which each have different boiling points. The fractions include gasoline, kerosene, diesel oil, fuel oil and naphtha. Naphtha is the starting point for the manufacture of many chemical and plastics. Fractional distillation uses a lot of energy and produces a lot of air pollution.

The naphtha is then transported by **road tanker** to a factory that makes plastic from oil.

At the **factory the naphtha is used to produce plastic chips**. The machinery required for this process is powered by electricity.

Food grade plastic pellets are transported by **lorry** to the Plastic Bottle Factory.



Here they are moulded into bottles. The pellets are melted and formed into 'pre-forms' in an injection molding machine. The 'pre-forms' have air injected into them in a bottle forming machine. All the machinery required for this process is powered by electricity.

Finally, if not being bottled and labelled 'at source' the **bottles may need to be transported** by another lorry to the spring where they are labelled and filled with local mineral water (which may then be distributed all around the country).

Groups of bottles are shrink wrapped together before being palletised and covered in plastic wrap for distribution.

Although not part of this activity, students may suggest glass-bottles as an alternative. The process involved in glass making and recycling, is highly energy-rich, and their increased weight compared with PET, increases transport costs compared with plastic bottles.

'Producing' the Water.

There are three types of bottled water: Natural Mineral Water, Spring Water and Table waters (referred to in law as 'Other' bottled water). These are all governed by special regulations.

Natural Mineral Water must come from an identified and protected source. It is guaranteed to be consistent in composition and naturally wholesome without any treatment - except in some cases the addition of carbon dioxide to make the water sparkle. Natural Mineral Water status is only granted to waters that are demonstrated to be free from pollution and have a characteristic stable composition.

In the UK, like Natural Mineral Water, Spring Water must originate from an underground source, be bottled at source and be microbiologically safe without treatment. However, in the UK, unlike Natural

Mineral Waters, certain other treatments are permitted for Spring Waters. Treatments may include the removal of certain minerals as defined by the European Union Scientific Committee for Food, which has yet to issue its guidelines. These allow the removal of undesirable substances

Table water (so called by the industry but referred to in the Regulations as 'other bottled waters') is usually bottled filtered water which is sourced as mains (tap) water.

Further details (UK), <http://www.britishbottledwater.org/vitalstats.html>

Morally and environmentally there are two highly contentious issues regarding bottled water. The amount of money spent on bottled water (when tap water is safe to drink around the developed world) while billions of people live with water shortages / unsafe water supplies. Secondly the widespread use of PET plastics for bottling which cannot be easily recycled and accumulate in landfill.

From bottle to glass

Lorries are used to transport bottles around the country and aeroplanes / ships where the product is exported.

Supermarkets are often built on large, out-of-town sites. Their construction results in the loss of many natural plant and animal habitats and their day-to-day running consumes large amounts of electricity (heating, lighting etc)

Since many people live some distance away from a supermarket, they may use their **car** to travel there to do their shopping.

Recycle or Landfill

Once the water **has been drunk**, the empty plastic bottle can either be thrown away, in which case it will probably end up in a landfill site, or recycled. Non-biodegradable plastics resist any form of biological decomposition and many of them give off poisonous gases if incinerated. The bottles are also quite bulky and use up lots of space in the ground.

Recycling the bottle

The empty plastic bottle is washed and put into the **plastics recycling bin**. The **recycling collection lorry** transports the used plastic materials to the recycling sorting centre.

At the **recycling sorting centre** waste materials are sorted onto a large conveyor belt. Plastics are sorted into different groups, depending on their chemical structure. The machinery used is powered by electricity.

Another **lorry** transports the sorted plastic to the plastic recycling factory.

At the **plastic recycling factory** the waste plastic undergoes a number of different processes which eventually produce plastic chips. The plastic chips can be used to produce synthetic fabrics such as those used to make fleeces and anoraks. The machinery involved is powered by electricity. As such, plastics are reprocessed rather than recycled.

The fabric made from reprocessed plastic is then transported by another **lorry** to a **clothing factory**, where it is used to make clothes such as fleece jackets and anoraks. The factory uses electricity and produces pollutants. Due to cheaper labour costs, many such products are manufactured in the Far East/China and then imported by ship back to Western markets.



What has changed?

Safe drinking water has been widely available in the developed world for the last 60 years, with the advent of chlorination and improved sewerage systems. Many water-borne pathogens have all but been eliminated.

The situation is far different in developing countries. More than 1 billion people in developing countries still have no access to clean drinking water, while 2.4 billion lack access to sanitation facilities.

Alongside these disparities 'bottled water' is now a global brand, obtainable around the globe
http://www.finewaters.com/Bottled_Water/index.asp

The global bottled water market advanced by nearly 5% in 2008, with bottled water volumes reaching 218 billion litres in the year. With a 7% compound annual growth rate in the years 2003 to 2008, bottled water is a significant part of the soft drinks industry.

In terms of growth of volume consumption, Asia/Australasia has maintained its lead, as emerging Asian economies such as China, India and Indonesia, with double digit growth rates, boosted worldwide volumes. Africa and the Middle East also sustained strong volume increases with 14% and 6% respectively. Consumption per person rose in all regions, apart from in the West Europe and North America regions, which exhibited marginal declines in volume, in part due to low summer temperatures and high rainfall (data from Zenith International, www.zenithinternational.com)

The different types of bottled water (discussed above) require different degrees of processing before they reach our homes, yet many billions of people have access to clean-water from their tap, requiring no packaging and no transportation.

Extension Challenge

How can we reduce the environmental impact of the processes involved in water production and distribution today?

The steps that an individual could take might include:

- Drink water direct from the tap
- Buy Natural Mineral Waters only - avoiding the energy inputs from carbonation and other processes including bottling at source.
- Taking the bus to and from the supermarket
- Making sure that plastic bottles are recycled

Steps which require action from governments or large companies might include:

- Generating electricity using renewable energy sources (solar, wind, biofuels etc)
- Making bottles and labels from recycled plastic and paper to conserve oil supplies and reduce deforestation.

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