PUPIL KS3

Water Treatment

Why do we need to clean our water?

The water we drink comes from different sources (see Water Cycle sheets):
- rivers
- reservoirs
- aquifers (underground supplies)

On its journey into rivers and reservoirs, rainwater collects substances from rocks (giving water its natural mineral content), plants, soil, and from the waste of homes and industries, making the water dirty and possibly harmful.
Water may appear to be clean, but dissolved chemicals and microscopic bacteria could make you seriously ill if you drank it.

Diseases carried by unclean water

Before water was treated in the UK, waterborne diseases like typhoid, cholera, dysentery and diarrhoea were common, and many people died from them.

Typhoid and cholera are spread by bacteria in food or drink. Typhoid starts with a fever, constipation then diarrhoea. We now have vaccines to protect against typhoid. In severe cases of cholera people get diarrhoea, vomiting, and leg cramps.

Dysentery is caused by amoebae which are microscopic parasites found in contaminated food or drink. Some types of amoebae are able to burrow through the intestinal wall and spread through the bloodstream to infect other organs, such as the liver, lungs and brain.

When chlorination was used as part of properly designed water treatment systems in the early 1900s, these diseases were effectively eliminated. The water supply in the UK is now one of safest in the world. But in the developing world, these diseases are still killing thousands of people every day because they do not have access to clean water.

Did you know?

Across the world, diarrhoea caused by dirty water and poor toilets kills a child under five every two minutes.

Did you know?

WaterAid is a charity dedicated to providing clean water for the world's poorest people http://www.wateraid.org.uk

Pollution and waste

Organic pollution comes from organic waste matter, such as dead plants and animals. This is biodegradable and so is broken down by natural processes, for example, by bacteria.

Inorganic pollution is usually man-made and non-biodegradable so can harm the environment in the long term.

The main sources of waste are:

Domestic waste

- washing powders and detergents add phosphates to our waste
- some dishwasher detergents are caustic and can kill useful bacteria in the sewage works
- using too much bleach also kills bacteria in the sewage works
- left-over DIY chemicals and engine oil must not be poured down the drain - they should be disposed of correctly by taking them to your local refuse centre
- unused medicines must not be put down the toilet - they should be returned to the pharmacist for safe disposal

Agricultural waste

Farmers use fertilisers, pesticides and herbicides on their fields. When it rains, these harmful chemicals can run off the land into rivers and streams where these poisons can kill life in the rivers and harm birds and animals that feed on river animals.

- Farmers use nitrate fertilisers to fertilise fields during the growing season and these nitrates can run off into rivers in winter. The levels of nitrate fertiliser in the water is rising in some areas. This can lead to nitrates in drinking water being above the set limits. High levels of nitrates can also promote weed and algae growth that can choke rivers and lakes.
- Herbicides are often used to control weeds and pests on farms, roadsides and railway tracks. However, some are non-biodegradable which means they stay in the environment and are not broken down by the action of bacteria. Water companies then have to install expensive treatments to remove them from drinking water.

Industrial waste

- Toxic chemicals from manufacturing processes can sometimes be discharged into rivers where they can kill river life. If discovered, the companies can be prosecuted.
- A large power station uses 5 million litres of water a day in its cooling towers. This water is returned to the river several degrees warmer that when it left. Warm water holds less oxygen which is vital for animals and plants.
- Detergents are used by almost every factory and industry. When released into rivers, this can lead to an increase in bacteria and algae which use up dissolved oxygen.

Read the sheets on Wildlife to see how river pollution affects the wildlife in the stream

Cleaning water

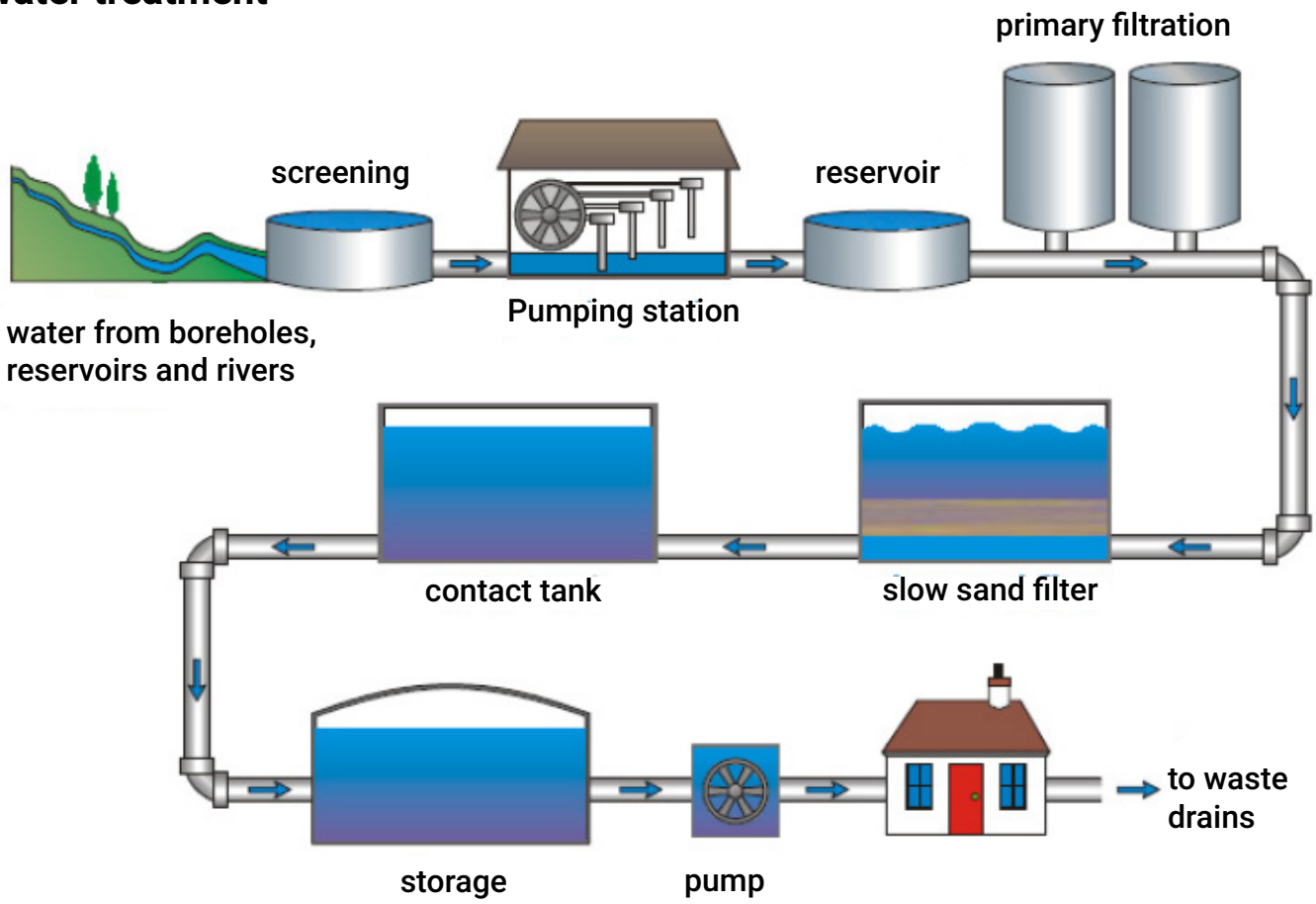
Almost all natural water needs to be treated before we drink it.

The purest water is groundwater from springs and boreholes which has been naturally filtered through the rock and may only require chlorination to kill bacteria. But even though a borehole is 60 metres underground, ground water can become polluted over time and this contamination may find its way down into the aquifer water supply.

Landfill sites, for example, can leach harmful substances that could pass into the aquifer or watercourse. So as well as testing water as it is treated, the water company has to take samples as the water is abstracted.

Each water company can treat water in a slightly different way. Here is an example:

Water treatment



Water from boreholes, reservoirs and rivers is screened to protect fish, remove weeds and floating debris.

The pumping station forces water round.

Primary filters: This is the first stage of treatment where the water is passed through sand and gravel. This process removes fine particulate matter.

Water is pumped to the slow-sand filters to undergo secondary treatment where very fine matter and other impurities are removed. Carbon filters remove pesticides and organic compounds.

In the contact tank, the chlorine disinfects the water. The water is dechlorinated to provide a small residual level of chlorine to protect the water once it is in supply.

Water is stored in large underground tanks or water towers such as Newton Ferrers water tower (built around 1960). By storing it in this way, there is enough clean water to meet peak demands.

Water is then pumped to our homes along water mains pipes - you might have seen these strong, blue, plastic pipes when roads are dug up. Used water is taken to waste drains.

Cleaning sewage

Sewage from industry, our homes and rainwater all run into the drains and flow to a sewage treatment works. Sewage water contains waste food, detergents, human waste, chemicals, oil and sand.

Primary sewage treatment

- The water is first screened for large objects such as paper, plastic and sticks.
- In the sedimentation tank grit from roads, soil and sand is allowed to settle and form a sludge at the bottom. About 70% of the solids are removed by these processes.
- The settled sewage, or effluent, is piped on to the next treatment phase.

Secondary sewage treatment

The sewage water is then cleaned by passing it over gravel filters.

- The water may be passed into a tank with a biological filter containing millions of useful microorganisms.
- These eat the organic matter, removing harmful waste.
- Small particles settle out in the final settling tank.
- The cleaned water, or effluent, can then be released into rivers and return to the water cycle.

Sewage treatment produces about 53 million tonnes of untreated sludge each year which has to be disposed of safely.

Sludge can be:

- treated and used as a fertiliser on farmland
- burnt
- used in industry
- converted to carbon dioxide and methane gas by special bacteria

Waterborne disease

During the 1830s and 1840s there were several outbreaks of cholera across Britain and many people died. At the time, nobody knew what caused the disease and how it was spread.

In 1854 Dr John Snow studied a map of London and marked the areas where people had died of cholera. He also talked to people who were ill and worked out that many of those people had drunk water from the same water pump where sewage had seeped into the drinking water. The pump was closed and cholera in that area was soon over.

Today we know that harmful bacteria in drinking water can make us ill and we know how to kill this bacteria. However, we still need to take care that our sewage does not seep into rivers and get into our drinking water.

Testing water

Every week, South West Water tests hundreds of water samples from around the region so that the water quality can be carefully monitored.

At least every week, water is tested from:

- boreholes
- rivers
- treatment works
- reservoirs
- and your taps at home

Samples are tested to monitor a wide range of parameters including:

- nitrate and nitrite
- chlorine (added to ensure your water is microbiologically pure)
- fluoride
- hardness (calcium and magnesium)
- lead
- copper
- iron
- aluminium
- phosphate
- pesticides and herbicides
- harmful bacteria