Purifying water

Water is an essential resource across the world. It is used in the home for drinking, washing, cooking and cleaning. In industry, it is used as a coolant, solvent and as a raw material in chemical reactions.
Raw water comes from both surface and subsurface sources. Surface sources include *ponds*, lakes, and other water *bodies*. Subsurface water sources include springs and wells located underground.
Raw water may contain pollutants, microbes, dissolved salts and minerals and insoluble materials like sand and stones, so it must be adequately treated before being fed into the public supply to be used for drinking, cooking, washing and cleaning. Water treatment is aimed primarily at the *elimination* of pathogenic microorganisms to prevent waterborne *diseases* such as cholera and typhoid.
Purification methods of raw water include: physical *processes* (like filtration, sedimentation and distillation), biological processes (like slow sand filters or biologically active carbon), chemical processes (like flocculation and chlorination) and electromagnetic radiation (such as ultraviolet light).
Raw water is initially seeded with e.g. alum to coagulate small particles of suspended matter and is then left in settling tanks (sedimentation basins) where the coagulated parts form a sediment. A *proportion* of the microflora is eliminated with the sediment. The water then passes through a sand filter, i.e. a bed of gravel supporting a layer of sand. As it trickles through, different-sized insoluble solids are removed. Rapid sand filters act mainly as mechanical sieves, removing up to ca. 90% of bacteria in addition to much of the non-coagulated organic matter. In slow sand filters, the particles of fine sand in the upper *layers* bear a film of protozoa and other microorganisms. Most of the bacteria and larger microorganisms are removed by sieve action or are ingested by the protozoa of the biofilm.
Microorganisms are not necessarily removed by the filtration and coagulation *stages* in the treatment of water. Chlorination, the injection of chlorine gas into the water, is aimed at killing any pathogenic microorganisms which have passed through the filters. The *effectiveness* of chlorination depends on the concentration used, the contact time, the pH, the temperature, the *amount* of organic matter and the number of microorganisms. Excess chlorine is removed from the water by contact with sulphur dioxide or by passage through activated carbon, leaving sterilised water.
Ozone also may be used to disinfect water supplies. Ozone is a very reactive gas that can oxidise bacteria, moulds, organic material and other pollutants found in water. It is considered to have superior bactericidal action to chlorine and creates no taste problems.
Ultra-violet light can be an effective microbicide. Since UV has very little penetrating power, it is most effective either for surface sterilisation of objects or for treating clear liquids.

GLOSSARY

aimed: *directed*
alum: *white mineral salt*
to bear: *to carry, to have*
fed: *introduced, delivered*
gravel: *small stones*
raw: *natural, untreated*
seeded: *inoculated*
sieve: *wire net used for separating solids from liquids*
spring: *point where water flows out of the ground*
upper: *higher*
waterborne: *carried by water*
well: *a deep hole dug into the ground to get water*

1 *PAIR WORK. In turns, use the prompts to ask and answer questions about the reading passage.*

1. Where / raw water / come from?
2. Why / raw water / must / be properly treated?
3. What / the main aim of water treatment / be?
4. What / the stages of water treatment / be?
5. How / rapid sand filters / work?
6. What / the purpose of chlorination / be?
7. What factors / the effectiveness of chlorination / influence?
8. How / excess chlorine / from superchlorinated water / be removed?
9. What / the advantages of ozone over chlorine in disinfecting water / be?
10. Why / UV light only effective with clear liquids / be?

2 *Which of these nouns can be used instead of those in italics in the passage?*

1. areas: ....
2. efficacy: ....
3. illnesses: ....
4. percentage: ....
5. phases: ....
6. pools: ....
7. procedures: ....
8. quantity: ....
9. removal: ....
10. strata: ....

International World Water Day is held annually on 22 March to focus attention on the importance of freshwater (water that is not salty) and support the sustainable management of freshwater.
If you want to learn more about the International World Water Day, visit: www.unwater.org/worldwaterday

3 *Complete the chart with the name of the processes involved in water purification: chlorination, filtration, sedimentation.*

.... removes large suspended particles. A chemical is added which causes tiny solid particles (which would pass through a filter) to clump together into larger particles. These can then be allowed to settle out or may be filtered.

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.... removes small suspended particles. The water is sprayed onto specially-prepared layers of sand and gravel. As it trickles through, different-sized insoluble solids are removed. The filter beds are cleaned periodically by pumping clean water backwards through the filter.

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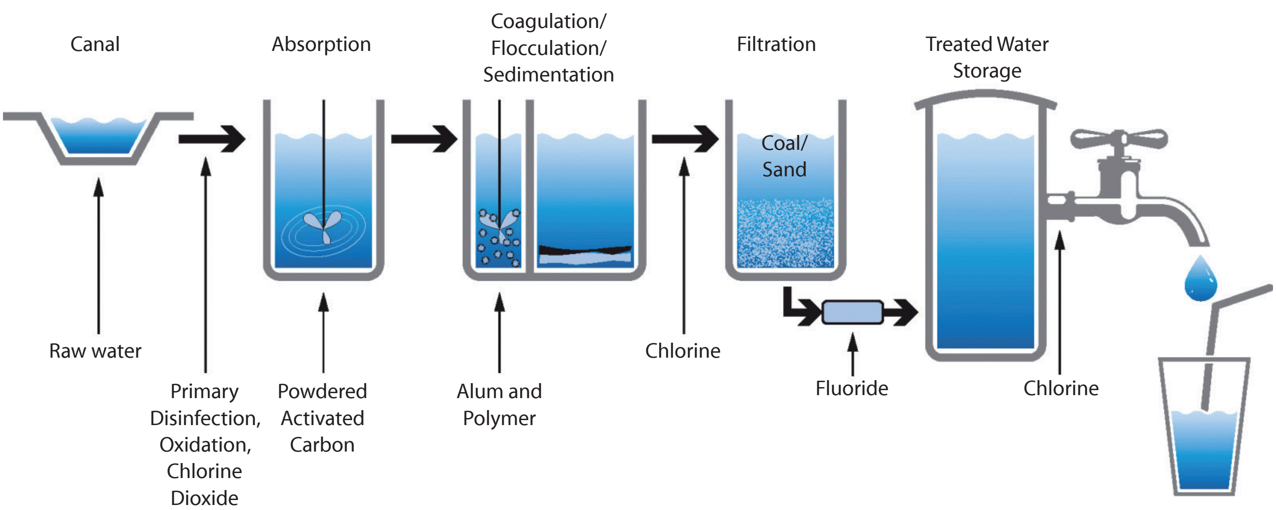
.... kills microbes in water. Microbicidal chlorine gas is injected into the water to sterilize it.



4 *Listen to the recording and complete the passage with the missing words.*

Sewage treatment – wastewater and industrial effluents

Treatment of the large quantities of (1) .... generated by industrialisation and urbanisation before disposal is crucial worldwide. In (2) .... treatment plants, (3) .... are used to remove pollutants from wastewater before it is discharged into rivers or the sea. The five key stages of wastewater treatment are:

1. Preliminary treatment – grit, (4) .... and floating debris are removed.
2. Primary treatment – suspended matters are removed.
3. Secondary treatment – the (5) .... content of the sewage is degraded by (6) .... and (7) .... microorganisms.
4. Tertiary treatment – specific (8) .... are removed (ammonia and phosphate).
5. Sludge treatment – (9) .... are removed (final stage).

Aerobic Biological Treatment

Trickling (10) ...., rotating biological contactors or contact beds, usually consist of an inert material (rocks/ash/wood/metal) on which the (11) .... grow in the form of a complex (12) .... In these processes the degradable (13) .... is oxidised by the microorganisms to CO_2 that can be vented to the (14) ....

Activated Sludge Process

This process is used in the treatment and removal of dissolved and (15) .... waste. The microorganisms found in this sludge are usually (16) ...., fungi, protozoa and rotifers. The costs of wastewater treatment can be reduced by the (17) .... of waste into practical products. Most anaerobic wastewater treatment systems produce useful (18) .... In some cases, the (19) .... of the pollution-fighting microorganisms can be put into good use, as in the case of (20) ...., for example.