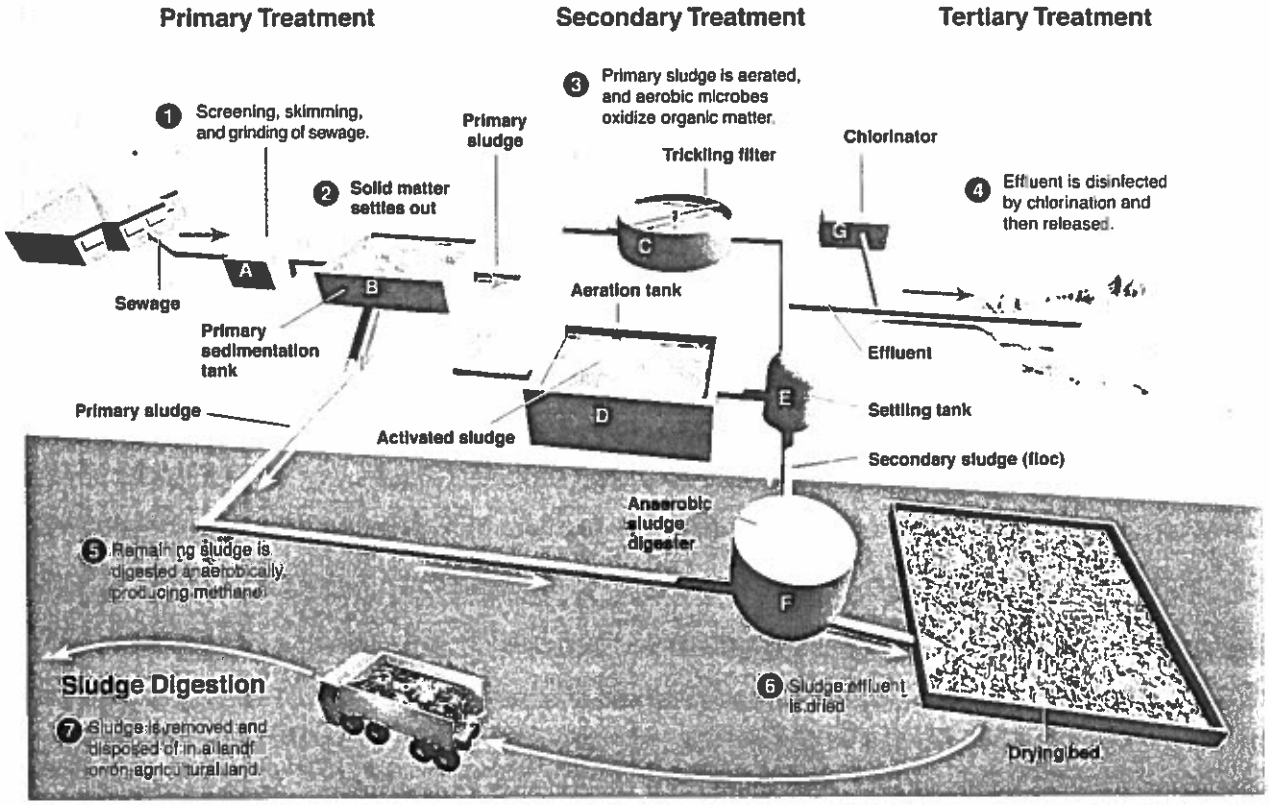
Sewage Treatment

Once water has been used by household or industry, it becomes sewage. **Sewage** includes toilet wastes and all household water, but excludes storm water, which is usually diverted directly into waterways. In some cities, the **sewerage** and stormwater systems may be partly combined, and sewage can overflow into surface water during high rainfall. When sewage reaches a treatment plant, it can undergo up to three levels of processing (purification). Primary treatment is little more than a mechanical screening process, followed by settling of the solids into a sludge. Secondary sewage treatment is primarily a biological process in which aerobic and anaerobic microorganisms are used to remove the organic wastes. Advanced secondary treatment targets specific pollutants, particularly nitrates, phosphates, and heavy metals. Before water is discharged after treatment, it is always disinfected (usually by chlorination) to kill bacteria and other potential pathogens.



1. Using the information provided in the diagram and text above, classify each of the processes indicated A-G as either mechanical, biological, or chemical. If you wish, color code these on the diagram for easy reference:

   A: _____ D: _____ G: _____

   B: _____ E: _____

   C: _____ F: _____

2. Using the diagram above for reference, investigate the sewage treatment process in your own town or city, identifying the specific techniques and problems of waste water management in your area. Make a note of the main points to cover in the space provided below, and develop your discussion as a separate report. Identify:

   (a) Your urban area and treatment station: _____

   (b) The volume of sewage processed: _____

   (c) The degree of purification: _____

   (d) The treatment processes used (list): _____

   (e) The discharge point(s): _____

   (f) Problems of waste water management: _____

   _____

   (g) Future options or plans: _____

   _____

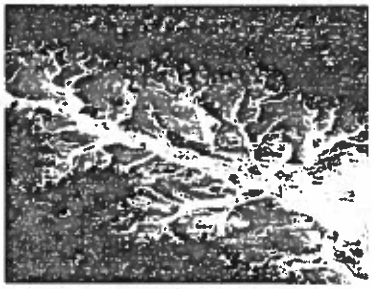
Periodicals: The activated sludge process

Related activities: *Types of Pollution, Water Pollution*

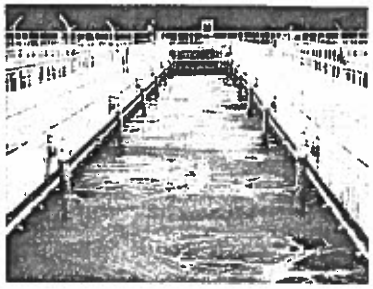
Water Pollution

Water pollution can occur as a result of contamination from many sources, from urban and industrial to agricultural. Pollutants may first enter the groundwater where they are difficult to detect and manage. Some enter surface waterways directly through runoff from the land, but most are deliberately discharged at single (point) sources. Some pollutants alter the physical state of a water body (its temperature, pH, or turbidity). Others involve the addition of potentially harmful substances. Even substances that are beneficial at a low concentration may cause problems when their concentration increases. One such form of pollution involves excessive nutrient loading of waterways by organic effluent. This causes accelerated enrichment (**cultural eutrophication**) of water bodies and results in excessive weed and algal growth. It also increases the uptake of dissolved oxygen by the microorganisms that decompose the organic matter in the effluent. This reduces the amount of dissolved oxygen available to other aquatic organisms and may cause the death of many. An indicator of the polluting capacity of an effluent is known as the **biological oxygen demand** or **BOD**. This is measured as the weight (mg) of oxygen used by one liter of sample effluent stored in darkness at 20°C for five days. Developing global and national initiatives to control water pollution is important because many forms of water pollution cross legislative boundaries. The US is the world's largest user of water but loses about 50% of the water it withdraws. Water conservation is required to enable more effective use of water, reduce the burden on wastewater systems, decrease pollution of surface and groundwater, and slow the depletion of aquifers.

Sources of Water Pollution



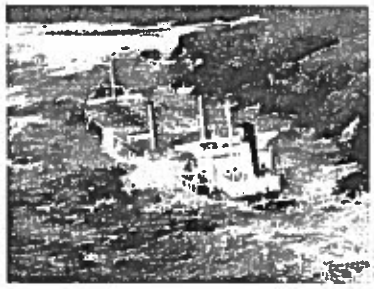
Sediment pollution: Soil erosion causes soil particles to be carried into waterways. Apart from erosion destroying the topsoil, the increased sediment load may cause choking of waterways, buildup behind dams, and the destruction of aquatic habitats.



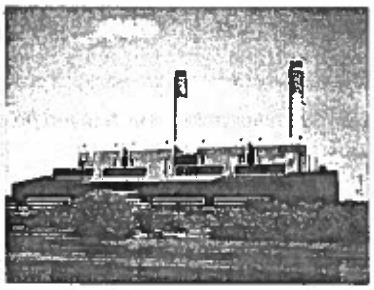
Sewage: Water containing human wastes, soaps and detergents from toilets, washing machines, and showers are discharged into waterways such as rivers, lakes and the sea. Without treatment this may lead to outbreaks of disease such as cholera.

Disease-causing agents: Disease-causing microbes from infected animals and humans can be discharged into waterways. This is particularly a problem during floods when human waste may mix with drinking water, causing the spread of disease.

Inorganic plant nutrients: Fertilizer runoff from farmland adds nitrogen and phosphorus to waterways. This nutrient enrichment accelerates the natural process of **eutrophication**, causing algal blooms and prolific aquatic weed growth, which can lead to the suffocation of aquatic animals.



Organic compounds: Synthetic, often toxic, compounds, may be released into waterways from oil spills, the waste products of manufacturing processes (e.g. dioxin, PCBs, phenols, and DDT) and the application of agrichemicals. These can build up in the food chain and poison human consumers.



Thermal pollution: Many industrial processes, including thermal power generation (above), release heated water into river systems. The increase in water temperature reduces oxygen levels and may harm the survival of river species as all as creating thermal barriers to fish movement.

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Radioactive substances: Mining and refinement of radioactive metals may discharge radioactive materials. Accidental spillages from nuclear power stations, such as the Chernobyl accident of 1986, may contaminate land and water causing genetic defects, especially in developing fetuses.

Inorganic chemicals: Acid drainage from mines and acid rain can severely alter the pH of waterways. Runoff from open-caste mining operations can be loaded with poisonous heavy metals such as mercury, cadmium, and arsenic which can cause severe nerve damage and other health problems.

Detecting Pollution

Water pollution can be monitored in several ways. The nutrient loading can be assessed by measuring the **BOD**. **Electronic probes** and **chemical tests** can identify the absolute levels of various inorganic pollutants (e.g. nitrates, phosphates, and heavy metals). The presence of **indicator species** can give an indication of the pollution status for a waterway. This method relies on an understanding of the *tolerance levels* to pollution of different species that should be living in the waterway (e.g. worms, insect larvae, snails, and crustaceans).

Related activities: *Monitoring Change in an Ecosystem, Sewage Treatment*
Weblinks: *Caring For Our Water*

1. Explain the term **cultural eutrophication** and its primary cause:

2. Describe three uses of water for each of the following areas of human activity:

   (a) Domestic use:

   (b) Industrial use:

   (c) Agricultural use:

3. (a) Explain what is meant by the term **biological oxygen demand** (BOD) as it is related to water pollution:

   (b) Describe how human use of a water body could create a very high BOD:

   (c) Describe the likely effect of a high BOD on the invertebrates and fish living in a small lake:

   (d) Explain why, when measuring BOD, that the sample is kept in darkness:

4. Sewage effluent may be sprayed onto agricultural land to irrigate crops and plantations of trees:

   (a) Describe an advantage of utilizing sewage in this way:

   (b) Describe a major drawback of using sewage effluent in this way:

   (c) Suggest an alternative treatment or use of the effluent:

5. When studying aquatic ecosystems, the species composition of the community (its biodiversity) in different regions of a water body or over time is often recorded. In general terms, suggest how a change in species composition of an aquatic community could be used to indicate water pollution: