

## Water Quality

Water quality describes how pure (clean) the water is. Water quality can be measured by the types of substances that are found in it; including living organisms, organic material, minerals and other chemicals.

### Substances Dissolved In Water

Many different substances can be present in water. Most substances that are found dissolved in water are salts. The most common salt is sodium chloride (table salt). The total amount of all salts found in water is called salinity. Saltwater (found in oceans) has a higher salinity (average of 3.5%) than freshwater.

### Hard Water

Water described as "hard" is high in dissolved minerals, specifically calcium and magnesium. Hard water is not a health risk, but a nuisance because of mineral buildup on plumbing fixtures and poor soap and/or detergent performance.

### Organisms In Drinking Water

Fresh water contains organisms and organic matter, some of which are harmful and some which are not. Escherichia coli ( E coli ) is a type of microscopic bacteria that can cause sickness and even death.

### Water Quality Testing

Water that comes from deep below the ground is protected from pollutants. However, most cities and towns get their drinking water from surface water sources (lakes and rivers). The water they use needs to be filtered and treated with chemicals. Just looking at water in a glass will not tell you if the water is safe to drink. Smelling it may give you additional information – like it may contain hydrogen sulphide (which is harmful to humans) giving it a rotten egg smell. Ocean water is very clear, but cannot be consumed because of its high salinity. Some of the things to test - to determine water quality - are:

- Taste and odor
- Turbidity (cloudiness) and colour
- Toxic substances and other pollutants
- Bacteria
- Hardness or mineral content
- pH (how acidic or basic the water is)
- Dissolved oxygen level
- Suspended solids (including those floating)
- Dissolved solids

### Water Quality and Living Things

When changes occur in the environment, the water supply can be affected. The quality can change when natural events or human activities affect what is being added or taken from the water.

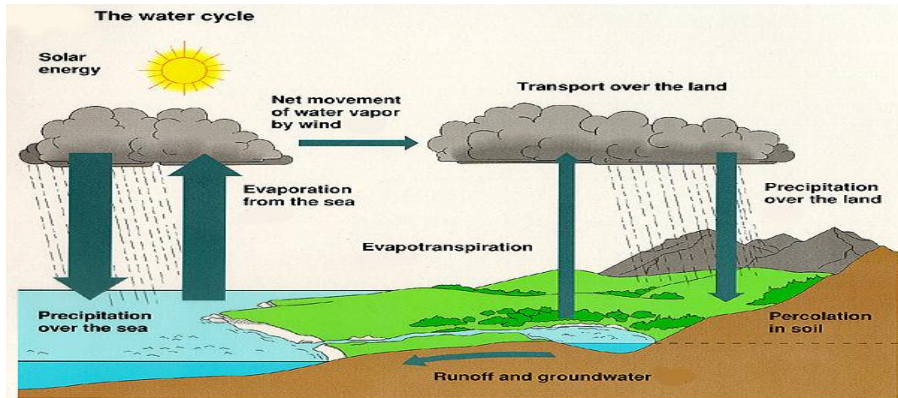
### Changes in Water Quality

A wide range of species depends on the quality of the water for survival. Some species can tolerate certain changes because those changes are within their range of tolerance. Other species may have a very different range of tolerance to certain conditions and will not be able to survive when the water quality changes.

### Examples of Water Quality Changes

Acid rain can kill a lake. The lake's death results from altering the conditions, which specific species can tolerate. When this happens, because of a higher than normal acid level, not only the species that cannot tolerate the increased acid level dies, but those species which depend on that species for survival (in the food chain) will also perish. Sometimes light is blocked by algae growing on the surface of the water. This increased growth can occur when fertilizer is added to the water supply by runoff. Even though the algal bloom grows rapidly, water plants, which produce oxygen for other organisms in the water, die (because they don't get enough light). When there is not enough oxygen in the water, other organisms also perish, and soon, the lake cannot support any life at all (it dies).

## Human activities affect aquatic environments.



Water is recycled around the world through the water cycle. This doesn't mean that any one area will always have the same amount of water. In fact, it means just the opposite. No one area can expect the same amount of water year after year. This is because of other natural cycles and human intervention (use) that can cause changes to occur.

There are direct (domestic or personal use) and indirect (industrial and agricultural) ways that humans use water. Many indirect uses can have negative effects on Earth's water supply. Negative effects may include:

- Pollution of surface and groundwater
- Depletion of groundwater supply
- There are benefits and costs to using water.

## The Major Uses Of Water

| Water Use  | Direct/Indirect | Benefit ( + )                         | Cost ( - )   |
|--|-----------------|---------------------------------------|--|
| Agriculture ( irrigation )                                 | 73% - indirect  | Food<br>Economy<br>Jobs               | Soil salinity<br>Decreases vegetation<br>Depletes groundwater supplies |
| Industry ( coolant, solvent, washing, diluting pollutants) | 22% - indirect  | Jobs<br>Consumer Products<br>Services | Pollution contributor<br>Depletes groundwater supplies                 |
| Domestic   | 5% - direct     | Convenience<br>Jobs                   | Cost   |

## Practices And Technologies Affect Water Quality

**Power stations** - can discharge warm water into lakes or rivers (thermal pollution) killing organisms that cannot tolerate the increased temperature.



**Runoff** - from farmland contains fertilizers that can cause excessive plant growth. It may also contain toxic chemicals (pesticides and herbicides) that can kill living organisms. Runoff - from cities contains large amounts of oil and salt, which can affect plants and animals in the water.

**Factories** - may add toxic chemicals (which can cause tumors, birth defects, sterility and even death) or, add to the thermal pollution problem.





**Habitat destruction** takes away the places where animals and plants can live and interact in an aquatic ecosystem.

**Sewage** - contains large amounts of nitrogen, which causes micro-organism populations to increase. These micro-organisms use up the oxygen in the water and many organisms can die as a result.



**Oil Spills** - from ships transporting oil from place to place can cause harm to plants and animals in, on or near the water.

## Monitoring and Assessing Water Quality



One way to help guard against problems with water quality is to monitor the water supply. To **monitor** means to observe, check, or keep track of something for a specific purpose. Town and city water supplies have to be monitored on a regular basis to ensure that the quality of the water remains high. Water technicians (freshwater biologists) regularly measure the level of chemicals in the water and the numbers and kinds of different species of organisms. They also make observations on how it looks and smells. In this way they can identify potential problems in the water supply and adjust the treatment of the water to eliminate them. Research scientists use monitoring techniques (evidence of toxins in the water and living organisms) to help them develop technologies to help protect the environment.



Ongoing monitoring of a site helps scientists observe change. The information they gather is then interpreted and suggestions are made to help the ecosystem recover. This can be through regulations to limit human activities in this ecosystem or develop technologies, which can address the problem and protect the environment. The studies they undertake are long-term and all encompassing, so that as many of the interactions as possible that are affected, will be addressed.

Guidelines are established by many different levels of government to monitor the 'safe' levels of substances that can be added to the water system. Water quality standards are set for ...

- Drinking water for people
- Protection of organisms living in or near water
- Drinking water for livestock
- Irrigation of crops
- Recreational uses (swimming, boating, fishing, etc.)

## Measuring Water Quality

Besides the pH level of the water there are other indicators, or variables that determine the quality of the water. The table lists some below ...

| Basic properties | Solids    | Acidity | Nutrients        | Toxic substances | Organisms      |
|------------------|-----------|---------|------------------|------------------|----------------|
| temperature      | sediments | pH      | phosphorus       | heavy metals     | bacteria       |
| rate of flow     | turbidity |         | nitrogen         | chemicals        | plants         |
| oxygen level     |           |         | dissolved solids |                  | animal species |
| colour           |           |         |                  |                  |                |
| odor             |           |         |                  |                  |                |

## Organisms In Water

The diversity of aquatic organisms in a water system helps to indicate the quality of the water. The level of dissolved oxygen will determine which species will be able to survive and, which ones will perish. High levels of dissolved oxygen would likely see a vast diversity of aquatic organisms. However, not all of these species are positive indicators, because some micro-organisms can cause disease and death.

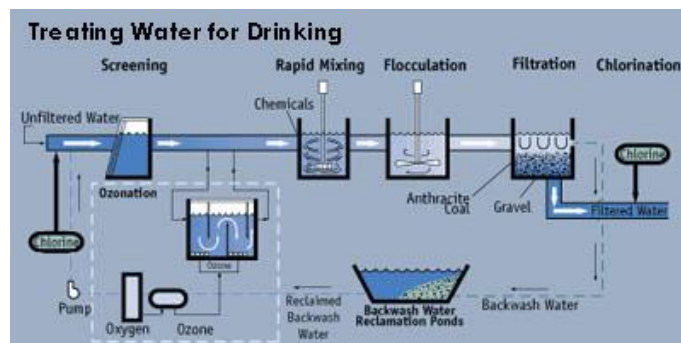
## Bio-Indicator Species

Organisms that are affected by changes in the environment or in the quality of the water help us to identify what is positive and negative. These organisms are called bio-indicator species because they can tell scientists how different environmental factors can influence normal growth and development of a species.

## Purifying Water

To make water safe to drink, or potable, for humans it has to be treated. The treatment of water involves screening, mixing, sedimentation, filtering, and adding chemicals.

After water has been used by humans, the solid and liquid waste - sewage - , has to be treated again before it goes back into the water system as effluent. In rural areas an underground treatment system for this sewage involves using a septic tank.



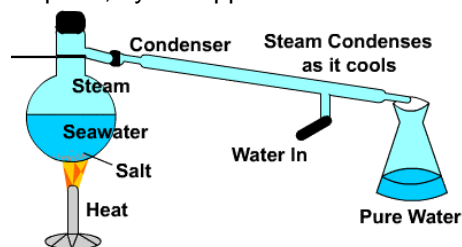
## Sustaining Water Resources

Additional processes are used to increase the potable water supplies in different parts of the world.

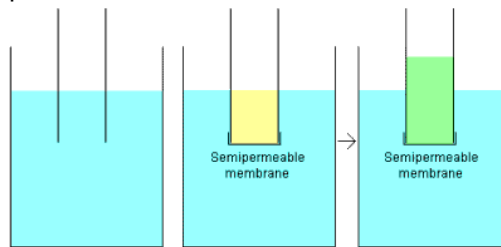
## Changing Salt Water to Fresh Water

There are two common processes that can change saltwater into freshwater. These processes are distillation and reverse osmosis.

**Distillation** - a process in which a liquid or vapour mixture of two or more substances is separated into its parts, by the application and removal of heat.



**Reverse Osmosis** – forces saltwater through a filter (membrane) allowing water to pass but not salt.



## Water Management

Water systems everywhere need to be monitored and cleaned up if they are causing a problem. The solutions to many of the problems may already be available, or new technologies should be developed to address the concern. Most importantly people must work together to solve the problems, because our water supply is our life source and without it, we will all perish. Maintaining a reliable and safe water supply is called water management.

## Problem Solving Needs More Than Science And Technology

Problem solving requires a strong commitment from people. They need to decide what needs to be done and then commit themselves and others to get it done. In many cases the solutions will require money and a way to raise it so the solution can be implemented without delay.

## People Working Together

Water systems everywhere need to be monitored and cleaned up if they are causing a problem. The solutions to many of the problems may already be available, or new technologies should be developed to address the concern. Most importantly people must work together to solve the problems, because our water supply is our life source and without it, we will all perish.

**We all impact the water supply**  
**RESPONSIBLE use of water will help to sustain this valuable resource.**