

PENANG SANGAM HIGH SCHOOL
P.O.BOX 44, RAKIRAKI
LESSON NOTES

Year/Level: 11 C/D

week 26

Subject: Chemistry

Strand	5 Environmental Chemistry
Sub Strand	5.2 Water and water Pollution
Content Learning Outcome	<ul style="list-style-type: none">✓ Describe some properties of water✓ Describe the stages of water treatment processes and its importance to human health✓ Describe stages of sewage treatment

Properties of Water

Surface Tension of Water

- Is the attraction of liquid on the surface of the liquid.
- The surface acts like a “skin”, with the molecules sticking together.
- This “skin” is under tension, and the effect is known as surface tension.

Density of Water and Ice

- Water expands when frozen; therefore, the density of ice is less than that of water.
- Thus ice floats on top of water.
- Water molecules in ice arrange themselves in a regular hexagonal pattern held together by hydrogen bonding.
- This arrangement occupies more space than liquid water

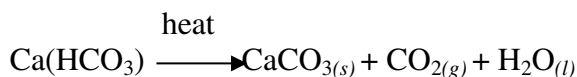
Melting and Boiling point

- For pure **water**, the **boiling point** is 100 degrees Celsius at one atmosphere of pressure, and the **melting point** is 0 degrees Celsius at one atmosphere of pressure.

Hardness in Water

Hard and Soft Water

- ✓ Water which will not form lather with soap is called hard water.
- ✓ The opposite is true for soft water.
- ✓ Hard water contains dissolved salts which react with soap and detergent and prevent it from forming lather.
- ✓ Usually the soap causes an insoluble scum to form in hard water.
- ✓ Temporary hardness is caused by **calcium hydrogen carbonate** and can be removed by boiling.



- ✓ Permanent hardness is caused by **calcium sulphate** and cannot be removed by boiling.
- ✓ Washing soda and ion exchange is used to remove permanent hardness as well as temporary hardness.
- ✓ **Water softening** is removal of calcium ions from hard water.

Sources, Effects and the Types of Water Pollution in Fiji

Type	Examples	Effects	Sources
<i>Toxic</i>	Oil, pesticide, cyanide	Poisons fish and drinking water	Auto repair shops, paint factories, petrol storage areas, pesticides, leaching from rubbish dumps
<i>Heavy metals</i>	Lead, mercury, copper, chromium	Makes fish unsafe to eat	Battery manufactures, electroplating shops, paint factories, wire manufacture, wood treating, leaching from dumps
<i>Organic</i>	Food particles, sugar, milk solids	Uses up oxygen in water and kills fish	Food manufacturing, brewery, sugar mills
<i>Human waste</i>	Toilet waste	Contains bacteria, makes water unsafe for bathing and drinking	Toilets, septic tanks

Reducing Water Pollution

1. DO NOT dispose of household chemicals or cleaning agents down the sink or toilet.
2. Avoid using a garbage disposal. Keep solid wastes solid. Make a compost pile from vegetable scraps.
3. Install a water efficient toilet.
4. Use the minimum amount of detergent and/or bleach when you are washing clothes or dishes. Use only phosphate free soaps and detergents.
5. Minimize the use of pesticides, herbicides, fertilizers. DO NOT dispose of these chemicals, motor oil, or other automotive fluids into the sanitary sewer or storm sewer systems. Both of them end at the river.

Sewage Treatment

- Human waste contains solids, organic particles, nitrates, phosphates, and bacteria
- A sewage treatment plant separates sewage into effluent and sludge
- **Primary treatment** removes solids. **Secondary treatment** removes organic particles. **Tertiary treatment** removes nitrates and phosphates
- **Effluent** – is the liquid that is released from the sewage treatment plant.
- **Sludge** – solid from the primary and secondary clarifier.

Stages of Sewage Treatment

Stage	Removes	Description
Primary	Solids	Solids settle to the bottom in a primary clarifier
Secondary	Organic particles	Liquid from the primary clarifier is sprayed over rocks (trickling filtration process) or mixed with sludge in an aeration tank (activated sludge process)
Tertiary	Nitrates and phosphates	Phosphates are removed by precipitation with lime, nitrates are removed by expensive chemical methods

Effect of Discharging Sewage

- contamination of the coastal marine environment by sewage leads to significant numbers of infectious diseases linked to bathing and swimming in marine waters and to the consumption of seafood
- adds nutrients to rivers which causes algal blooms and results into death of many aquatic organisms
- loss of bio diversity

Importance of Treating Sewage

- Harmful bacteria gradually die out.
- Algae can reduce hardness.
- Causes less environmental pollution
- Does not causes disease and sickness

Water Treatment

- ✓ Drinking water in Fiji comes from rainwater, surface water and ground water
- ✓ Surface water near cities maybe polluted with dirt and bacteria. It must be treated before it can be used for drinking
- ✓ There are three steps in the treatment of drinking water: Coagulation, filtration and chlorination.
 - **Coagulation**: Aluminium sulphate, $\text{Al}_2(\text{SO}_4)_3$ helps coagulate dirt particles, copper sulphate, CuSO_4 prevents algae growth, sodium carbonate neutralizes acidity and softens water
 - **Filtration**: layers of sand and gravel remove floc
 - **Chlorination**: chlorine kills bacteria, fluoride reduces tooth decay and lime neutralizes acidity

Importance of Treating Drinking Water

- Disinfection is the process of chlorination, which control disease-causing microorganisms by killing or inactivating them.
- This process reduces the effect of water borne diseases-typhoid, cholera, dysentery

Bottle Water Extraction in Industries in Fiji

- **Fiji Water** is a brand of [bottled water](#) derived, bottled, and shipped from [Fiji](#).
- It is available in 330ml, 500ml, 700ml, 1 liter, and 1.5 liter [bottles](#).
- According to marketing materials, the water comes from an [artesian aquifer](#) in [Viti Levu](#).

Importance of Fiji Water

- Rises the economy of the country
- It is more efficient whereby waste is recyclable and some are even biodegradable
- Provides employment to the local people

Questions:

1. Recently, a broken sewerage pipe led to untreated sewage spill in some rivers in Suva. These spills can lead to a reduction in dissolved oxygen in the water, which will most likely lead to
 - A. a decrease in water temperature.
 - B. an increase in all fish populations.
 - C. an increase in the depth of the water.
 - D. a decrease in most aquatic animal populations.
2. The purpose of adding fluoride during water treatment is to
 - A. prevent tooth decay.
 - B. prevent algae growth.
 - C. help coagulate dirt particles.
 - D. neutralise acidity and soften water.
3. Which of the following is removed in the primary sewage treatment process?
 - A. Effluent
 - B. Organic particles
 - C. Nitrates and phosphates
 - D. Faeces and vegetable peelings
4. During water treatment, aluminium sulphate ($\text{Al}_2(\text{SO}_4)_3$) is added to
 - A. kill bacteria.
 - B. reduce acidity.
 - C. coagulate dirt particles.
 - D. prevent algal growth.