CHEMICALS FOR CONSUMERS

By the end of this chapter, you should be able to:

- ✓ Analyze properties of *soap and detergent*, and compare and contrast the effectiveness of their cleaning action.
- ✓ Evaluate the use of *food additives*.
- ✓ Understand the importance of *chemicals in medicine*.
- ✓ Appreciate the importance of the *chemical industry and its contribution* to our lives.

HISTORY OF SOAP MANUFACTURING

Soap got its name from an ancient Roman legend about Mount Sapo. Legend says that soap was first discovered on soap Hill in Rome when group of Roman women were washing their clothes in the River Tiber at the base of a hill, below which animal fats from the sacrifices ran down into the river and created soapy clay. The earliest recorded evidence of the production of soap-like materials dates back to around 2800 BC in ancient Babylon. A formula for soap consisting of water, alkalis and cassia oil was written on a Babylonian clay tablet around 2200 BC. By the 7th century, soap-making was an established art in Italy, Spain and France.

STRUCTURE OF SOAP

A soap anion consists of a long hydrocarbon chain with a carboxylate group on one end. It consists of two parts known as a head and a tail. Hydrocarbon chain – hydrophobic (soluble in oils/grease). Ionic part of carboxylate group – hydrophilic (soluble in water).

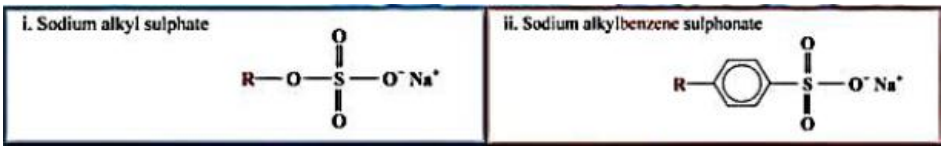
Questions

What chemicals are used to make soap?

Write the general chemical name and formula of soap

DETERGENTS

Any cleaning agent that is not soap produced from synthetic resources such as petroleum fractions. Sodium salts of sulphonic acid. Anion part of the detergent also consist of a hydrophilic part and hydrophobic part. Has a sulphonate group/sulphate group as ionic structure instead of carboxylate group. Examples



Activity: Finding out the processes involved in manufacture of a detergent

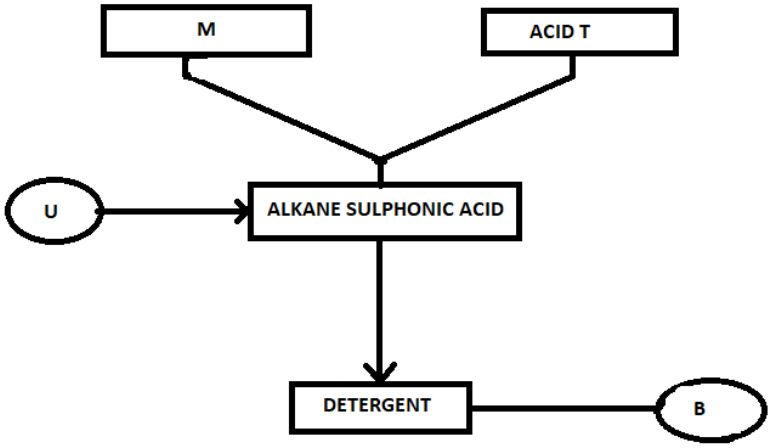
What you need:

- Textbooks

What to do

Study the figure below and use it to answer questions that follow. Use the textbooks provided as your reference.

The figure below shows processes involved in manufacture detergent



Question

a) Identify each of the following
- ***i)*** Raw material ***M***
- ***ii)*** acid ***T***
- ***iii)*** substance ***U***
- ***iv)*** substance ***B***

b) State the role played by substance ***U.***

c) Suggest once source of substance ***M***.

d) What role is played by substance ***B***?

e) Name at least three examples of detergents used at home.

Comparisons between soap and detergent

Condition	Soap	Detergent
Soft water and Hard water (contain calcium & magnesium ion)	Effective cleaner in soft water. Form an insoluble precipitate in hard water = soap scum (formation of soap scum causes wastage of soap)	Detergent is effective cleaner in soft water. Form soluble substances in hard water = calcium or magnesium salts (do not form scum)
Sources	Made from natural resources (animals fat & vegetable oils).	Made from synthetic resources such as petroleum fractions.
Acidic water (contain hydrogen ion)	Form insoluble long-chain fatty acids (reduces the amount of soap used for cleaning)	Detergent is effective cleaner. Form soluble substances (Do not form scum)
Environment	Soap is biodegradable & do not pollute environment.	Soap is non-biodegradable & give thick foams that kills aquatic lives.

Additives present in detergents

Different detergents with different characteristics carry out various cleaning functions.

Many additives are added to detergents to provide such functions.

Additives In Detergent (Effeciency Enhancer)

Additives	Function	Example
Biological enzyme	Remove protein stains	Amylase, lipase , cellulases & protease
Foam control agent	Control foaming in detergent	Silicones
Builder	Enhance the surfactant efficiency	Sodium phosphate, sodium tripolyphosphate.
Filler	Make the solid detergent dry and enable the liquid detergent to be poured easily	Sodium silicate, sodium sulphate
Fragrance	Add fragrance	-
Optical brightener/whitener	Add brightness by convert UV radiation to blue light and whiteness	Fluorescent dye
Stabilizing agent	Lower the production of foam	Silicones
Suspension agent	Prevent the dirt particles removed from redepositing onto cleaned fabrics	Sodium carboxymethylcellulose, carboxymethylcellulose
Whitening agent	Bleach stains	Sodium hypochlorite, sodium perborate

FOOD ADDITIVES

Today, there are many substances which are added to the processed food that we eat.

Activity: Finding out additives in most common packaged food.

Key question. What are the most common additives in common packaged food staff?

What you need

- Empty used packaging materials
- Textbooks
- Internet

What to do

1. Collect three used packaging materials of your choice could be for soda, yoghurt, and biscuit.
2. Carefully observe the label paper on each packaging material. Record the ingredients present in each food staff in a table below;

Name	Ingredients

Questions

1. Which of the ingredient is common among the food staff chosen? What could be its use?
2. The ingredients identified can be called food additives. What could this mean?
3. Which of the ingredients are;
   - ***a)*** preservatives,
   - ***b)*** flavoring agents,
   - ***c)*** thickeners,
   - ***d)*** antioxidants,
   - ***e)*** nutrients,
   - ***f)*** stabilizers and
   - ***g)*** dyes/colorings
4. identify any plant or plant extract that is used as a preservative at home

A food additive is any (non-food) substance added to food to maintain or improve its flavor, safety, freshness, texture, appearance or shelf life. Usually, additives are on food containers, under listed “ingredients”, and often used in small quantities. Commonly used additives are:

- preservatives,
- flavoring agents,
- thickeners,
- antioxidants,
- nutrients,
- stabilizers and
- dyes/colorings

Preservatives

These are substances added to food to slow down or prevent the growth of microorganisms. Retard the growth by introducing conditions that interfere with the metabolism of microorganisms. This extends food storage life.

Natural preservatives are: salt, sugar, vinegar and smoking (smoking is a process of allowing warm air containing smoke (formaldehyde and phenols) to pass over food).

Examples of preservatives

<table>
<tr><th>Preservatives</th><th>Functions</th><th>Example</th><th>Side effect</th></tr>
<tr><td>Salt</td><td rowspan="2">Draws the water out of the cells of microorganisms. Retards the growth of microorganisms.</td><td>Salted vegetables, fish, meat</td><td>Increase the risk of cardiovascular diseases</td></tr>
<tr><td>Sugar</td><td>Fruit jam, condensed milk</td><td>Tooth decay, diabetes and obesity</td></tr>
<tr><td>Vinegar</td><td>Lowers pH to inhibits the growth of microorganisms (grows at pH 6.6 – 7.5).</td><td>Pickled cucumber</td><td>-</td></tr>
<tr><td>Sodium nitrite / sodium nitrate</td><td>Slows down the growth of microorganisms. Stabilize red colour in meats.</td><td>Sausage</td><td>Carcinogenic</td></tr>
<tr><td>Benzoic acid / sodium benzoate</td><td rowspan="2">Slows down the growth of microorganisms.</td><td>Tomato sauce</td><td>-</td></tr>
<tr><td>Sulphur dioxide</td><td>Grape juice</td><td>Asthma and allergies</td></tr>
</table>

Antioxidants

Antioxidants—substances that inactivate oxygen-derived free radicals—is thought to slow the pace of damage caused by free radicals. Important dietary antioxidants include selenium, zinc, **antioxidant vitamins**; vitamins—***C, E,*** and beta-carotene (a provitamin).

Antioxidants prolong the edible period of food and retain its nutrients by inhibiting the effects of excessive oxygen on food (oxidation), which is directly beneficial to human health.

Examples of Antioxidants

Antioxidant	Functions	Example	Side effect
Vitamin E (tocopherols)	Prevent oils from turning rancid	Palm oil & sunflower oil	No
Vitamin C (ascorbic acid)	Preserve the colour of fruit juice and the formation of nitrosamines	Fruit juice & cured meat	No
Sodium citrate	Stop rancidity in fats	Ice-cream	-
BHA (Butylated hydroxyanisole) BHT (Butylated hydroxytoluene)	Retard rancidity in fats, oils and oil-containing foods	Margarine & cereal	Carcinogenic

Flavouring

Food additives which give/strengthen the taste/smell of a particular food. It restores taste loss due to processing and allows food to be sweet, sour, salty, bitter and so on. There are two types of flavouring agents:

- natural flavouring (extracted from natural resources – oranges, peppermint and screw pines leaves)
- Synthetic flavourings (substances derived from sources other than natural resources – MSG).

Examples of Flavourings

Flavouring	Functions	Example	Side effect
MSG (monosodium glutamate)	Bring out the flavour	Salad dressing, frozen food, spice mixes, meat / fish-based products & canned / dry soup	Headache, allergy, thirsty, nausea & chest pain.
Aspartame & Saccharine (non-sugar sweetener)	Sweeten food (about 180 – 200 times than sugar). Fewer calories than sugar.	Soft drinks, low-calories frozen desserts & diet drinks	Increase the risk of leukemia, cancer and neurological problems.
Synthetic essences (esters)	Produce artificial flavours which resemble natural flavour. Cheaper to use than the real fruits.	Methyl butanoate (apple flavour), octyl ethanoate (orange flavour), pentyl ethanoate (banana flavour), Ethyl butanoate (pineapple flavour)	-

Stabilizers

Used in production of food which contains water and oil to provide a firmer texture to food and prevent an emulsion from separating out. Works by stabilizing emulsions through the inhibition of reactions between chemicals in food.

Examples of Stabilisers

Stabilisers	Functions	Example
Mono-glycerides/ Di-glycerides of fatty acids	Mix oil and water	Ice-cream, chewing gum, beverages, whipped topping and margarine
Acacia gum	Mix two liquids that do not mix together. Forms an emulsion.	Marshmallow, gumdrop, edible glitter, carbonated drink syrup & gummy candies
Lecithin	Reduces viscosity. Replaces more expensive ingredients. Controls sugar crystallisation and the flow properties of chocolate. Helps in the homogeneous mixing of ingredients. Uses as a coating.	Margarine, dough, candy bar & cocoa powder
Gelatin	Mixture of peptides and proteins of collagen extracted from the boiled bones, connective tissues, organs and some intestines of animals	Fruit jam, jelly babies, shells of pharmaceutical capsules, margarine & yogurt

Thickeners/thickening agents

These increase the viscosity of food without significantly altering other physical or chemical properties and give the food dense, smooth and uniform texture. Thickeners are relatively specific to the type of foods due to the different responses in the physic-chemical conditions of the food.

Thickeners	Functions	Example	Side effect
Acacia gum (as well as stabilizer)	Reduces the surface tension of liquid. Leads to increased fizzing. Mix two liquids that do not mix together. Forms an emulsion.	Marshmallow, gumdrop, edible glitter, carbonated drink syrup & gummy candies	-
Gelatine (made from the boiled bones, skins and tendons of animals)	Mixture of peptides and proteins of collagen extracted from the boiled bones, connective tissues, organs and some intestines of animals	Fruit jam, jelly babies, shells of pharmaceutical capsules, margarine & yogurt	-
Pectin	Dietary fiber	Fruit jam	-
Starch	Thicken food	Soup, custard, pudding, noodles and pasta	-
Modified starch	Increase their visco-stability	Instant soups & cheese sauce granules	-
Xanthan gum	Helps to prevent oil separation. Increase in the viscosity of a liquid	Sauce & salad dressing	Allergies

Food dyes/food colourings

Substances added to food (include solid food and drinks) to give it a new colour.

Functions

- enhance the looks of food, especially when their natural colouring are lost during the processing and packaging.
- Adds coloured vanished and replace colour vanished during food processing.
- Makes food appear more attractive.

EXAMPLES OF FOOD DYES

Dyes / Colourings	Function	Examples	Side effect
Tartrazine E102 / Sunset yellow E110 (artificial dye)	Yellow azo dye	Orange drinks, sweet & custard powder	Hyperactive in children
Brilliant blue FCF Blue 1 (artificial dye)	Blue triphenyl dye	Ice-cream, beverages, jellies & blue raspberries flavoured product.	Allergic
Carmosine E122/ Azorubine (artificial dye)	Red azo dye	Sweet, jellies & confections	Carcinogenic & allergic
Anthocyanin (natural dye – red grape, red cabbages, sweet potatoes and tomatoes)	Natural red colouring	Ice-cream & sweet	-
Carotenoids / saffron (natural dye – carrots, sweet potatoes and palm oil)	Natural red colouring	Cooking oil & confections	-
Paprika	Natural red colouring	Dessert food	-
Butterfly pea (clitoria ternatea)	A blue food dye	Dessert food & confections	-
Pandan (pandanus amaryllifolius)	A green food dye	Noodles & confections	-

BANNED FOOD ADDITIVES

Some food additives can trigger allergic reactions and other mild health problems. However, some food additives pose serious health risks, and have been banned for consumption.

Food additive	**Reasons for banning**
Bisphenol A.	Act like estrogen in the body and change the timing of puberty, decreases fertility and increases body fat.
Phthalates.	Affect male genital development and increases childhood obesity.
Nitrates/nitrites.	Cause tumors in the digestive and nervous system.
Synthetic artificial food colours.	They have an effect on child behavior and attention.

Question

Discuss and report on life without food additives.

CHEMICALS IN MEDICINE

Chemicals that help to cure infections and maintain our health and wellbeing. They can be obtained from natural sources or synthetic chemicals. There are two types of medicine:

- Traditional medicine
- Modern medicine

Traditional medicine

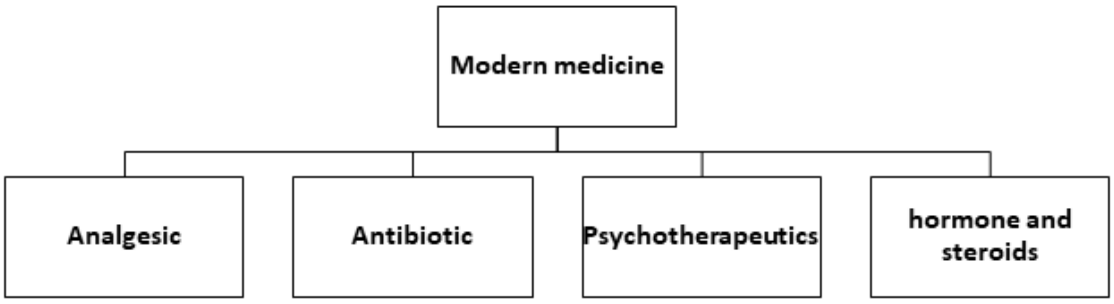
Medicine obtained naturally from animals and plants without processing them. For example;

Traditional medicine	Source	Function
Garlic extract	Garlic leaves	Controlling the level of cholesterol and blood pressure
Guava leaf and flower extract	Guava plant	Treats malaria, ulcers, coughs, diarrhea
Aloe vera extract	Aleo vera plant	Treatment of malaria
Lemon juice	Lemon plant	Treats hypertension, obesity, bronchitis, and fever.
Pawpaw leaf and root extract	Pawpaw	A natural contraceptive, improves liver and kidney functions.

Think of other traditional medicines, state their sources and functions.

Modern medicine

Medicines that are made by scientists in the laboratories which are based on substances found in nature that is identified, extracted and purified. Based on the effect of modern medicine to the human body, chemicals in medicine can be classified into four categories namely:



Analgesics

An analgesic (commonly known as painkiller) is any member of the diverse group of drugs used to relieve pain but do not cure the disease. Common analgesics include; aspirin (mild analgesics), paracetamol (mild analgesics) and codeine (strong analgesics).

Drug	Functions	Side effects
Aspirin	Aspirin or acetylsalicylic acid is a drug in the family of salicylates, often used as an analgesic (against minor pains and aches) Antipyretic (against fever), Anti-inflammatory (such as arthritis), Anti-coagulant used to prevent blood clotting	Can cause bleeding in the stomach. Can causes allergic reactions, skin rashes and asthmatic attack. Can cause brain and liver damage to children with flu/chicken pox.
Paracetamol	Taken to relieve mild and moderate pain – headache, muscle and joint pain, backache and period pain. NB: can be taken by children	Causes skin rashes, blood disorders and acute inflammation of the pancreas. Overdose can cause liver damage
Codeine	A drug that may be synthesized from morphine and used in headache tablets and in cough medicine.	Abuse of this medicine may lead to skin rashes, addiction, depression and nausea. May cause drowsiness.

ANTIBIOTICS

These are chemicals made by microorganisms (bacteria and fungi) that destroy or prevent/slow down the growth of bacteria. They are used to treat various diseases caused by bacteria. Antibiotics are not effective against diseases caused by viral infections such as influenza, measles or small pox, fungi and other non-bacterial infections. Two examples of antibiotics are: penicillin and streptomycin.

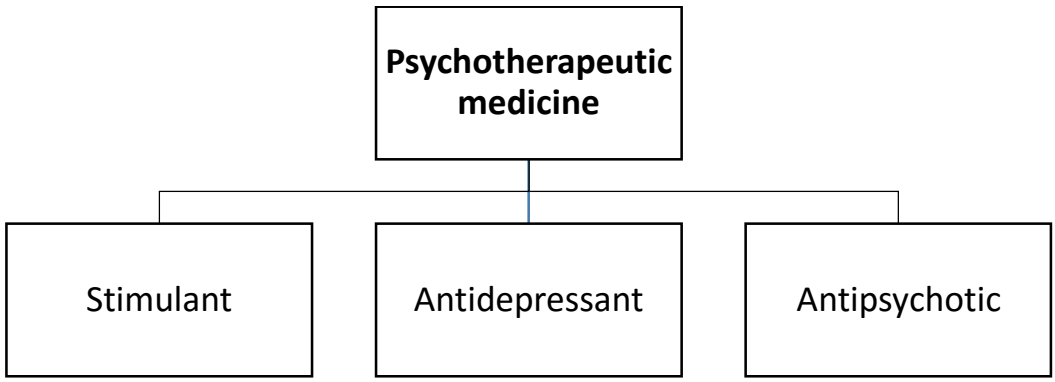
Penicillin: penicillin was originally isolated from penicillium chrysogenum (formerly known as penicillin notatum) mold. Penicillin is used to cure diseases caused by bacteria infections

such as gonorrhea, syphilis, anthrax, pneumonia and meningitis. Generally, penicillin is safe to be used because there are very few people sensitive to penicillin.

Streptomycin: streptomycin is an antibiotic produced by soil bacteria of the genus Streptomyces and was the first antibiotic remedy for; dry cough, tuberculosis, urinary infection, pneumonia and dysentery. Streptomycin cannot be given orally, but must be administered by regular intramuscular injection.

PSYCHOTHERAPEUTIC MEDICINE

These are medicines used to treat mental illness. They can be divided into three groups:



a) Stimulant

A stimulant is a medicine that can increase the activity of the sympathetic nervous system and produces a sense of alertness. It can be used as recreational or therapeutically drugs to increase alertness. Sometimes it is abused to boost endurance and productivity or to suppress appetite. Examples of stimulants are; caffeine, nicotine, amphetamines, cocaine.

High dose or excessive use of stimulants over long periods of time can lead to anxiety, hellucinations, severe depression, or physical and psychological dependence.

b) Antidepressant

These are used to treat depression, reduced tension and anxiety.

Examples of Antidepressant

Example	Side effects
Tranquilisers	Tranquilisers cause drowsiness, poor coordination or light-headedness. Overdose of these drugs can lead to respiratory difficulties, sleeplessness, coma and even death.
Barbiturates	Barbiturates cause addition. People who rely on barbiturates to fight against insomnia sometimes kill themselves accidentally by taking an overdose.

c) Antipsychotic

These are used in treating psychiatric illness like schizophrenia.

Example	Side effects
Chlorpromazine, haloperidol and clozapine	Antipsychotic medicines cause drowsiness, rapid heartbeat and dizziness.

HORMONES AND STEROIDS

Hormones; are organic substances secreted by plants and animals that function in the regulation of physiological activities and in maintaining homeostasis. Hormones carry out their functions by evoking responses from specific organs or tissues that are adapted to react to minimum quantities of them.

Steroids; is a lipid characterized by a carbon skeleton with four fused rings. Cholesterol is an important steroid, being a common component of animal cell membranes. However, a high level of it can cause various conditions and diseases, such as atherosclerosis.

Anabolic steroids; are substances similar to the male sex hormone testosterone. They work by mimicking the protein-building effects of this hormone. The result is muscle growth, which gives the athlete increased muscle strength and endurance.

Side effects from excessive use

- In men, use of this drug can bring about increased aggression, impotence, baldness, kidney and liver damage and even development of breasts.
- In women, there is development of male features, facial and body hair and irregular periods.

Question

Discuss and report on the importance of the correct usage of modern and traditional medicine.

CONTRIBUTION OF CHEMICAL INDUSTRY TO PEOPLE'S LIVES

Chemical industries are the prime factors to convert the raw materials into desired products that we use in our day- to- day life. This has brought a great change in the way the things operate. The chemicals from the chemical industries serve as the raw materials for other industries. The chemical industries support industries like food, pharmaceuticals, textile, agriculture, environment, hygiene, decoration and transport.

COMMON TRAITS AMONG SCIENTIST IN CARRYING OUT RESEARCH

Activity: Exploring qualities of scientists in carrying out research

What you need

- Internet
- Relevant chemistry textbooks

What to do

1. Research and note down the traits shared among researchers.
2. Discuss the role of each of the following qualities

a) Patience

b) Meticulousness

c) Perseverance

d) Innovativeness

3. State any other two such qualities.

4. Explain the contribution of the chemical industry to people's life.

Sample activity of integration

In Rwera community, there is a variety of people producing various products. Some of the local farmers produce agricultural products like milk, honey, fruits, fruit juice and groundnut paste. Others make traditional medicine extracts from herbs and other plants.

However, they have a challenge as their products get spoiled very fast and also their clients complain that their products are not good enough like other products on the market.

Task

As a learner of chemistry, you have been invited by the district Health Officer to address the community of Rwera on how to improve the quality of their products, make them last longer and maximally utilize the locally available chemicals. Write a special message that you would deliver.