32. CHEMISTRY IN EVERYDAY LIFE

1. DRUGS

1.1 Introduction

Chemistry in everyday life deals with the overall body mechanism, when in the normal and under abnormal conditions faced by it. It also talks about the various drugs to be consumed, their effects, their side-effects and their effects after overconsumption.

The classification of drugs is done on various grounds to highlight their functional areas, throwing light on their mechanism.

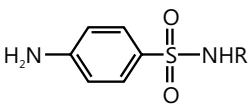
Drugs: Drugs are chemicals of low molecular masses (~100 – 500u), interacting with macromolecular targets to produce a biological response.

Medicines: Medicines are chemicals, useful in diagnosis, prevention and treatment of diseases. A dose consumed higher than the recommended can cause harm.

Therapeutic Effect: It is a desirable or beneficial drug effect like treatment of symptoms and cure of a disease on a living body. Such use of chemicals for therapeutic effect is called **chemotherapy**.

1.2 Classification of Drugs

Table 32.1: Drug classification

On the basis of	Explanation
Pharmacological Effect Greek origin: Pharmakon -poison/drug logia- study of It is concerned with the study of drug action.	This effect is used by the specialists to prescribe a drug for a particular disorder from a whole category of drugs. E.g. Analgesics kill pain while antiseptics kill or arrest a microorganism's growth.
Drug action	Release of a specific compound in a body or a biochemical process under consideration can be treated by various ways by a single category of drug. E.g., Antihistamine inhibits the action of the compound, histamine, which causes inflammation in the body. Thus, various ways exist to block the action of histamines.
Chemical structure	This typically depends on the chemical structure of the drug. Similar functional groups show common pharmacological activity.  E.g., Structure of sulphonamide show the common functional group

On the basis of	Explanation
Molecular targets	Drugs are very specific in action and have their targets decided. They interact with biomolecules such as carbohydrates, lipids, proteins and nucleic acids. Common structural features show same mechanism of action.

1.3 Drug Target Interaction

The interaction between the drug and the target i.e. a part of the body is the major part of the action of a drug. Enzymes-the biological catalyst action serves as the best example for this interaction. These proteins named enzymes hold a major position in the communication system of the body. They are called as receptors which carry polar molecules across the cell membrane. Similarly, nucleic acids have codes for passing on the genetic information across various cells.

1.3.1 Enzymes as Drug Targets

Enzymes, as known to us, are the biological catalysts which have two major functions as seen in the Fig. 32.1.

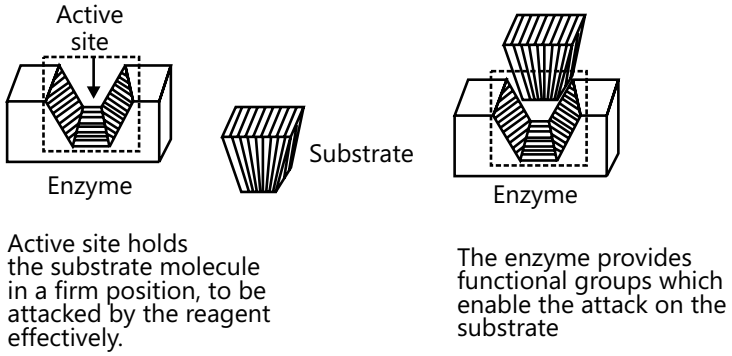


Figure 32.1: Enzyme substrate interaction

Drug Enzyme interaction

When drugs are taken, it either increases or decreases the enzyme catalyzed reactions. Enzyme inhibition is the role of a drug done in two ways-Competitive or Non-competitive. The drug is an enzyme inhibitor which inhibits the catalytic activity of enzymes or blocks the binding site which eventually prevents the binding of substrate with enzyme.

(a) Competitive Inhibition: Competitive Inhibitors are the drugs which attach themselves (as shown in the Fig. 32.2) onto the active site of an enzyme by competing with the substrate for the space.

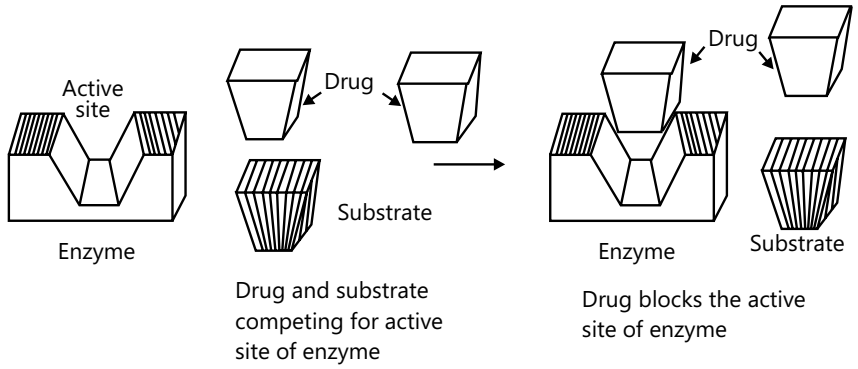


Figure 32.2: Steps involved in competitive inhibition

(b) Non-Competitive Inhibition: Non-competitive drugs change the shape of the active site by binding themselves to an allosteric site, due to which the substrate is unable to identify the active site and is thus disabled to attach itself. The presence of a strong covalent bond between an enzyme and an inhibitor blocks the enzyme. Degradation of this complex gives a new enzyme. Non-competitive inhibitor changes the active site of enzyme after binding at allosteric site.

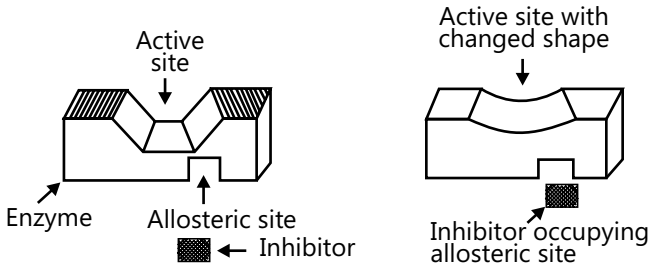


Figure 32.3: Steps involved in non-competitive inhibition

1.3.2 Receptors as Drug Targets

Receptors are selective in nature. Every binding site has a different shape, structure and an amino acid which suits a specific chemical messenger.

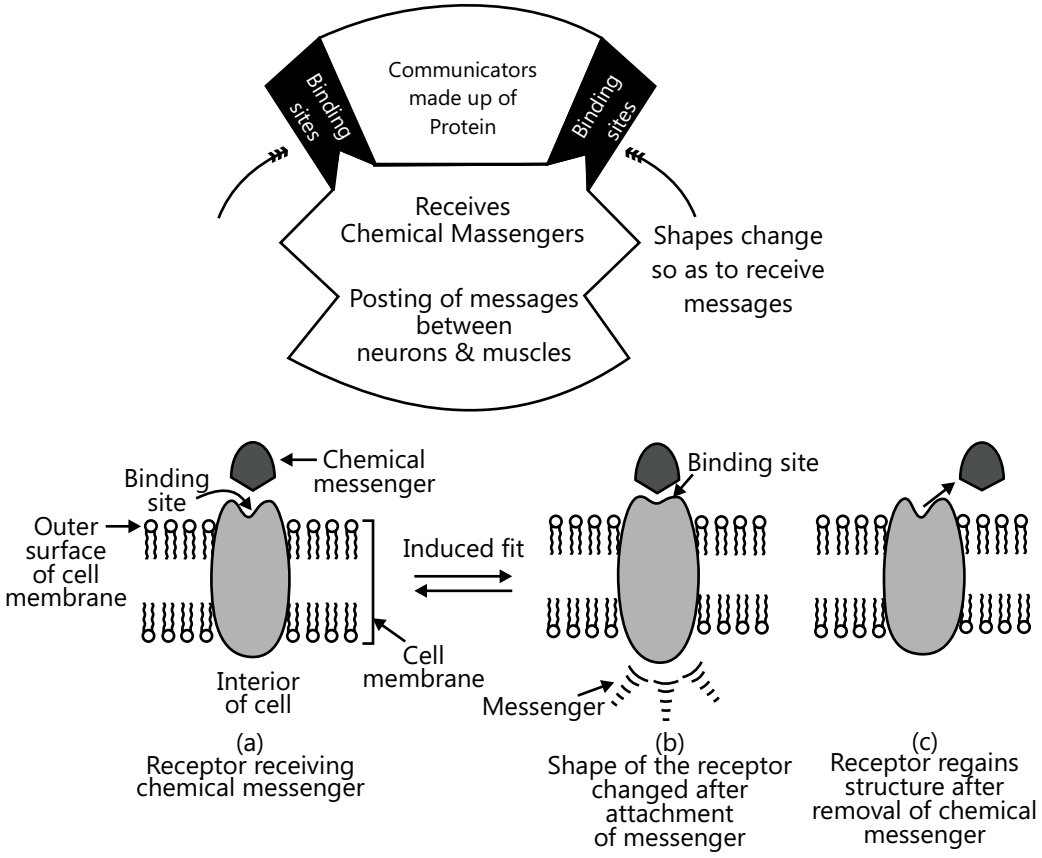
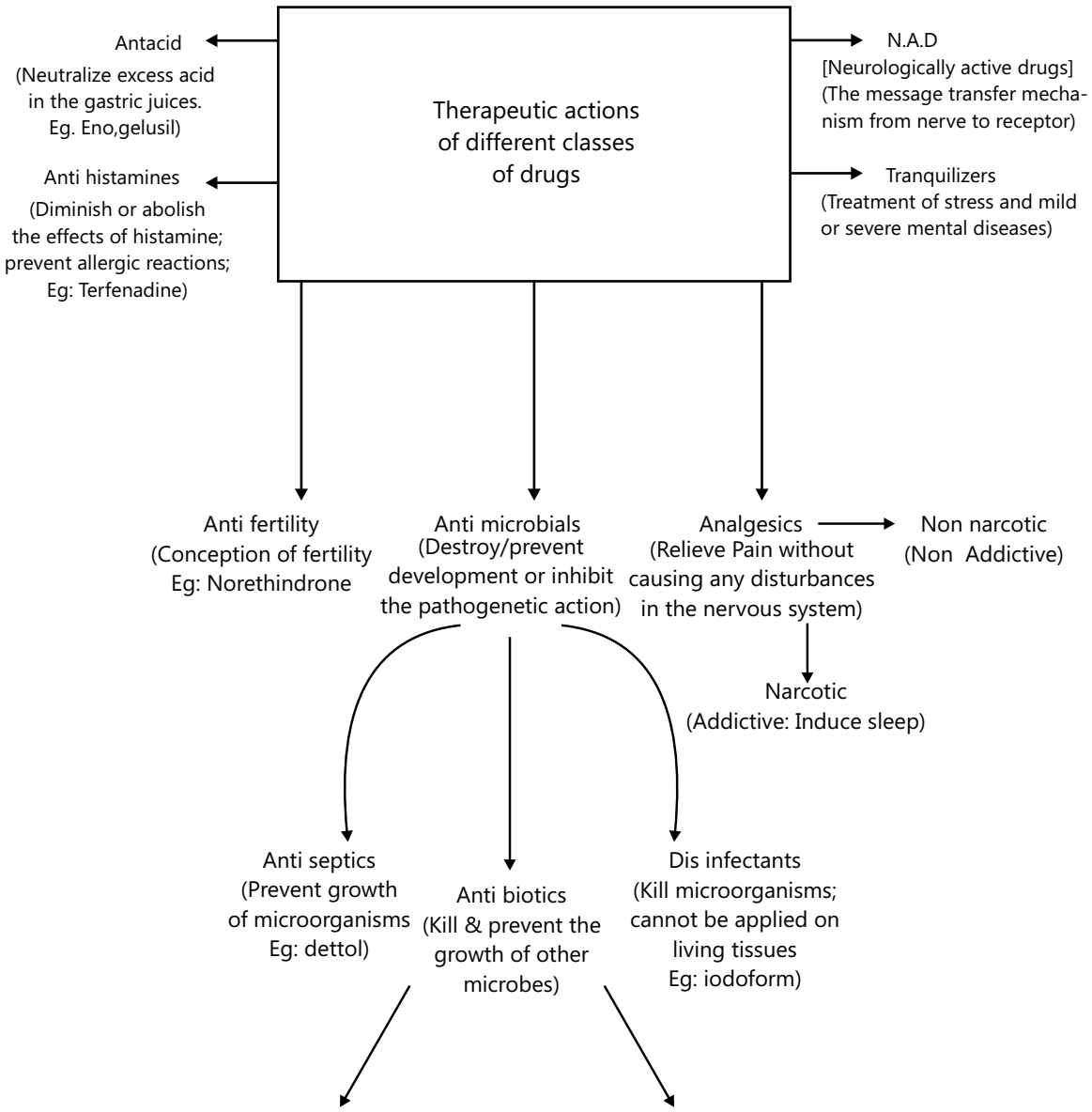


Figure 32.4: Receptors as drug targets

Antagonists are the drugs which bind with the receptor site and inhibits its natural function. These are useful when blocking of message is required. Drugs that mimic the natural messenger by switching on the receptor are called **agonists**. These are useful when there is lack of natural chemical messenger.

1.4 Therapeutic Actions of Different Classes of Drugs



On basis of mode of control of microbial diseases:

Bactericidal	Bacteriostatic
Drugs that kills organisms in body	Drugs that inhibits growth of organisms
Examples: Penicillin, Aminoglycosides, Ofloxacin	Examples: Erythromycin, Tetracycline, Chloramphenicol

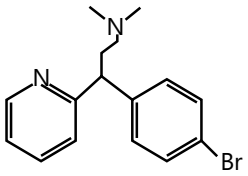
On basis of its spectrum of action:

Brand spectrum antibiotics	Narrow spectrum antibiotics	Limited spectrum antibiotics
Antibiotics which kill or inhibit a wide range of Gram-positive and Gram-negative bacteria	Antibiotics which are effective mainly against Gram-positive or Gram-negative bacteria	Antibiotics effective against a single organism or disease
Examples: Ampicillin and Amoxycillin	Examples: Penicillin G	

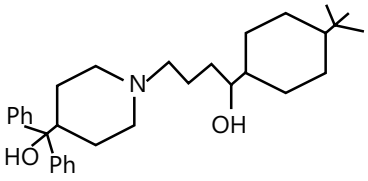
Flowchart 32.1: Classification of drugs and therapeutic action

Antihistamines

Brompheniramine

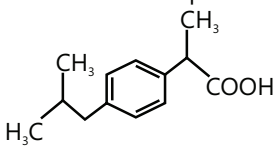


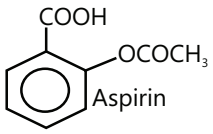
Terfenadine (Seldane) (Dimetapp, Dimetane)



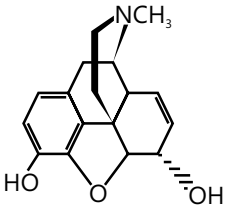
Non-Narcotic Analgesics:

Ibuprofen

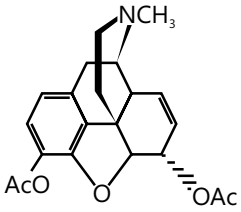




Narcotic Analgesics:

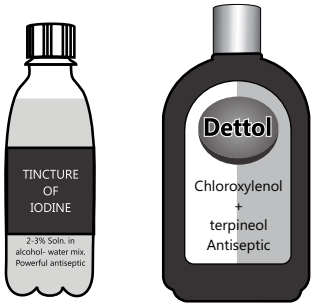


Morphine

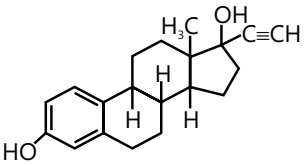


Heroin

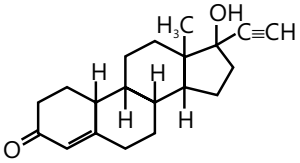
Antiseptics:



Antifertility Drugs



Ethynylestradiol (novestrol)



Norethindrone

2. CHEMICALS IN FOOD / FOOD ADDITIVES

Food additives are the substances added to food to preserve its flavour or improve its taste and appearance

Table 32.2: Different types of food additives

No.	Name of food additive	Examples
1	**Artificial Sweetening Agents:** These chemical compounds give a sweetening and flavouring effect to the food.	Aspartame, Sucralose and Alitame
2	**Food preservatives:** These chemical substances on adding to food material prevents its spoilage due to microbial growth.	Sugar, Salts, Sodium benzoate

No.	Name of food additive	Examples
3	**Food colours:** These substances adds to the attractiveness and acceptability in the market.	Allura Red AC, Tartrazine
4	**Nutritional supplements:** These substances improves the nutritional value of the food.	Vitamins, minerals etc.
5	**Fat emulsifiers and stabilizing agents:** These agents give stability and a good consistent nature to the food.	Egg yolk (where the main emulsifying chemical is Lecithin)
6	**Antioxidants:** These agents prevent the oxidation of food materials.	Butylated Hydroxy Toluene (BHT), Butylated Hydroxy Anisole (BHA)

3. SOAPS AND DETERGENTS

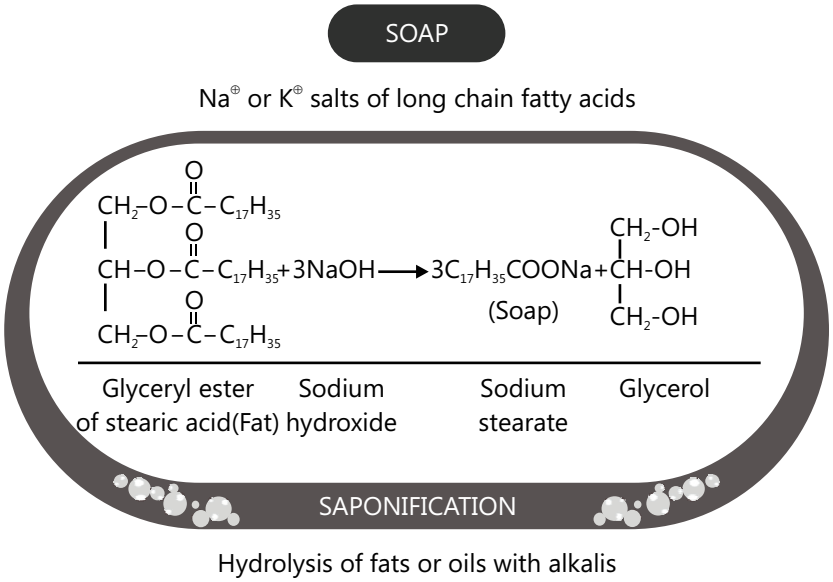


Figure 32.5: Saponification

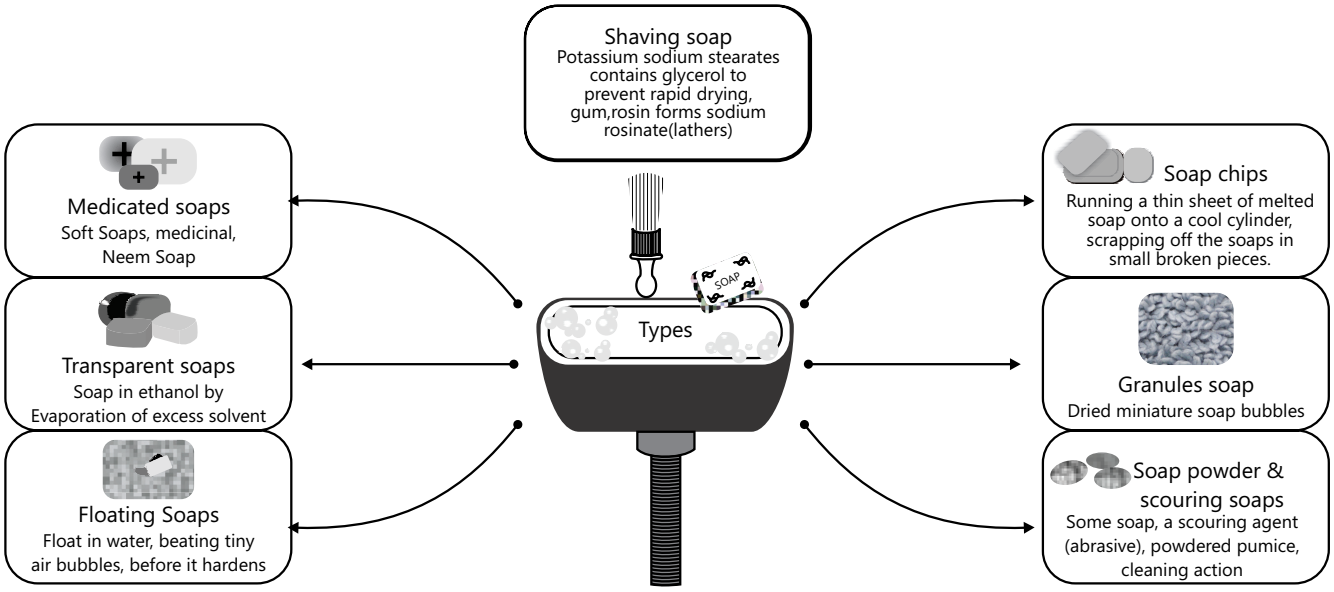


Figure 32.6: Different types of soap

Table 32.3: Advantages and disadvantages of soap

Advantages of using soaps:	Disadvantages of using soaps:
(a) Being a good cleanser, it is 100% biodegradable i.e. oxidation of the soap by the micro-organisms in the sewage water. (b) Does not cause pollution.	(a) Use in hard water gives the formation of white precipitate with the Ca^{2+} and Mg^{2+} ions present in the water. $2\underset{\text{Soap}}{C_{17}H_{35}COONa} + CaCl_2 \rightarrow 2NaCl + \underset{\text{Insoluble calcium Stearate (Soap)}}{(C_{17}H_{35}COO)_2Ca}$ $2\underset{\text{Soap}}{C_{17}H_{35}COONa} + MgCl_2 \rightarrow 2NaCl + \underset{\text{Insoluble Magnesium stearate (Soap)}}{(C_{17}H_{35}COO)_2Mg}$ Due to the formation of precipitates, the soap is unable to perform its function of removing the oil from the clothes. The gum-like precipitates stick to the fibres of the cloth. (c) The insoluble free fatty acids get precipitated in acidic medium and stick to the fabric blocking the oil-removing ability of the soaps.

3.1 Detergents

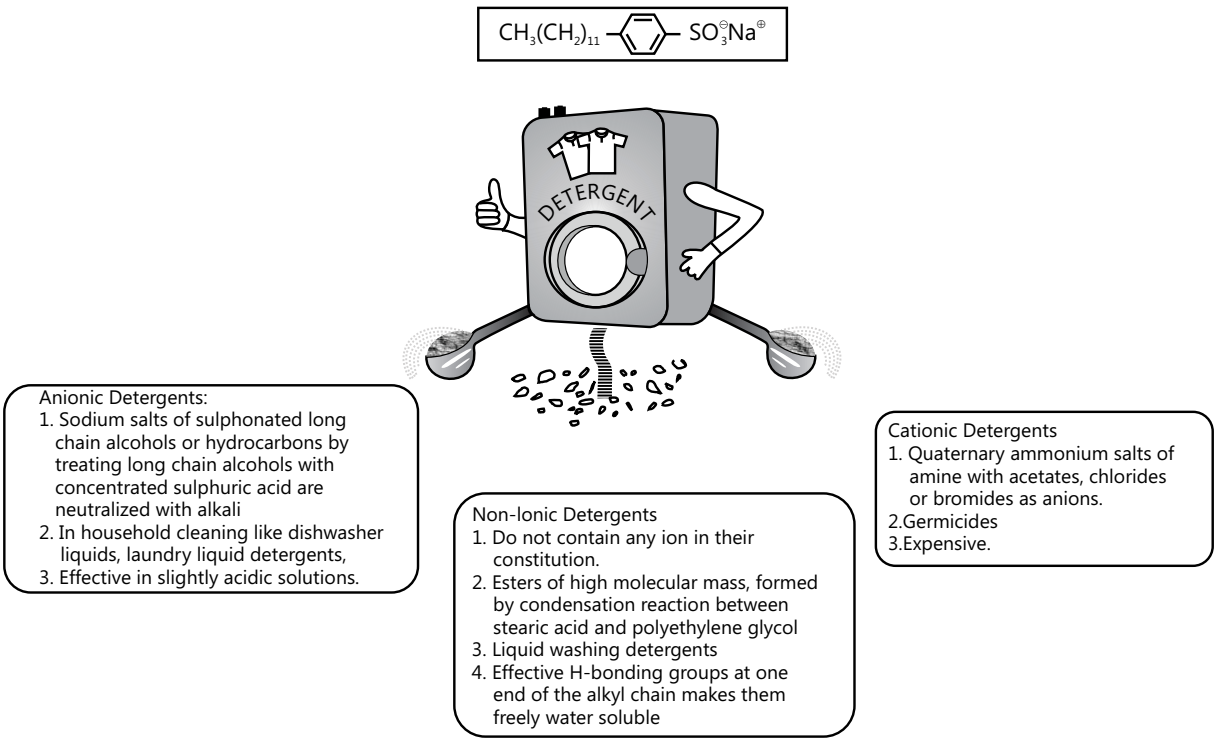
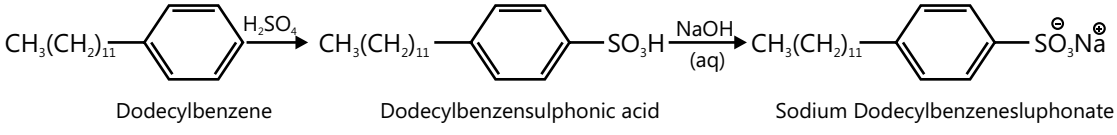


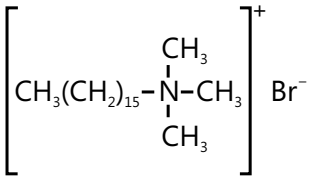
Figure 32.7: Classification of detergents

Anionic detergents:

$$\underset{\text{Lauryl alcohol}}{CH_3(CH_2)_{10}CH_2OH} \xrightarrow{H_2SO_4} \underset{\text{Laurylhydrogensulphate}}{CH_3(CH_2)_{10}CH_2OSO_3H} \xrightarrow{NaOH(aq)} \underset{\substack{\text{Sodium laurylsulphate}\\ \text{(Anionic detergent)}}}{CH_3(CH_2)_{10}CH_2OS\overset{-}{O}_3\overset{+}{N}a}$$



Cationic detergents:



Cetyltrimethylammonium bromide

Non-ionic detergents:

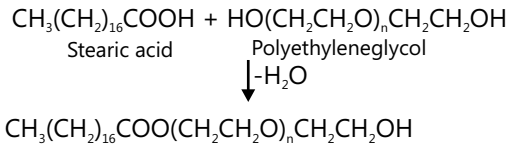
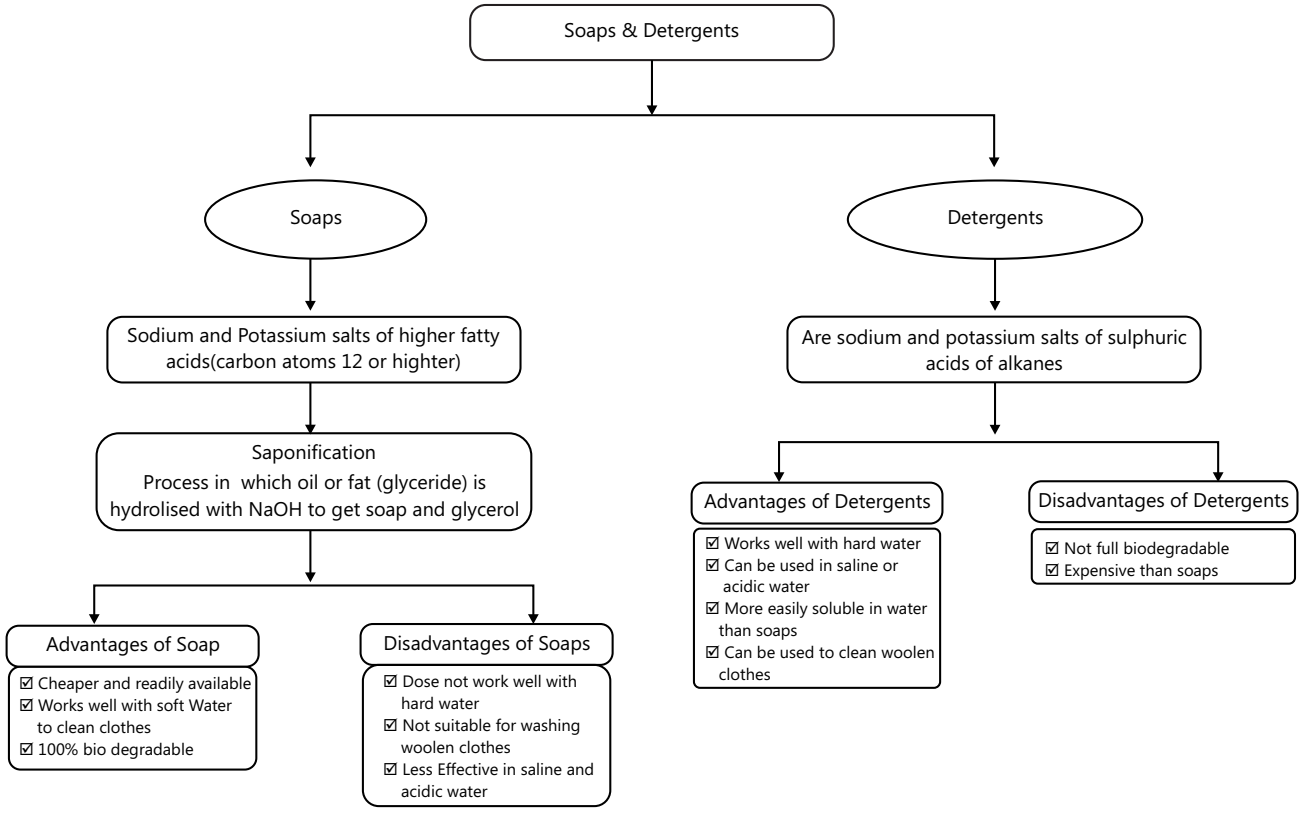


Table 32.4: Difference between biodegradable and non-biodegradable detergents

Biodegradable detergents	Non-Biodegradable detergents
1. Have straight hydrocarbon chains. 2. They can be easily decomposed by microorganisms. **Example:** Sodium lauryl sulphate	1. Have branched hydrocarbon chains 2. They cannot be easily decomposed by microorganisms.



Flowchart 32.2: Difference between soaps and detergents

POINTS TO REMEMBER

Sr. No	Terms	Description
1	**Drugs**	Drugs are chemicals of low molecular masses (~100 – 500u). These interact with macromolecular targets and produce a biological response.
2	**Medicines:**	Medicines are chemicals that are useful in diagnosis, prevention and treatment of diseases
3	**Therapeutic Effect**	Desirable or beneficial effect of a drug like treatment of symptoms and cure of a disease on a living body is known as therapeutic effect.
4	**Enzymes**	Proteins which perform the role of biological catalysts in the body are called enzymes.
5	**Receptor**	Those which are crucial to communication system in the body are called receptors
6	**Competitive Inhibition**	Competitive Inhibitors are the drugs that compete with the natural substrate for their attachment on the active sites of enzymes
7	**Non-Competitive Inhibition**	Some drugs do not bind to the enzyme's active site, instead bind to a different site of enzyme called allosteric site. This binding of inhibitor at allosteric site changes the shape of the active site in such a way that substrate cannot recognize it.
9	**Cationic Detergents**	Quaternary ammonium salt of amines with halide or acetate as anions.
10	**Non-ionic detergents**	Do not contain any ion, they are esters of high molecular mass.

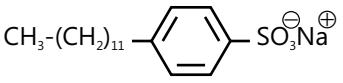
Solved Examples

JEE Main/Boards

Example 1: In order to wash clothes with water containing dissolved calcium hydrogen carbonate, which cleaning agent will you prefer and why: soaps or synthetic detergents? Give one advantage of soaps over synthetic detergents?

Sol: Calcium salts of soaps are soluble in water thus lot of soap is wasted.

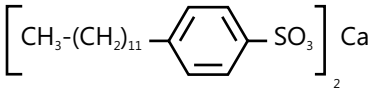
- Hard water contains salt of calcium and magnesium.
- Thus water containing calcium hydrogen carbonate is hard water.
- In order to wash cloths with hard water detergents are preferred over soaps
- This is because calcium salts of detergents are soluble in water while calcium salts of soaps are insoluble.



Sodium-4-(-dodecyl) benzene sulphonate (synthetic detergent)

+

$Ca(HCO_3)$(Hard water)



Calcium 4-(1-dodecyl) benzene sulphonate

+

$2NaHCO_3$

As a result, lot of soap is wasted.