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Chapterwise Student Friendly Synopsis For *Quick-and-Easy Revision*

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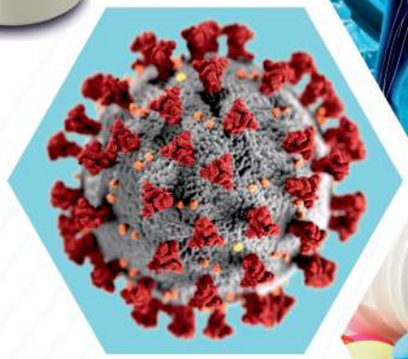

Features

- Easy to understand
- Rapid one shot Revision Guide
- Based on Latest Syllabus
- Section and Topicwise
- Designed by Team of Experts
- Full of Tricks and Mnemonics

Boost Your GPAT Score

Essential for GPAT Examination

Theory Book

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GPAT AT YOUR FINGERTIPS

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Second Updated and Revised Edition

Boost Your GPAT Score

by

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PREFACE AND ACKNOWLEDGEMENTS

Welcome to the **Second edition** of **"GPAT at Your Fingertips"** This book is an updated and revised version of the previous edition, and it is designed to provide comprehensive guidance to students preparing for the GPAT, NIPER and all other Pharma Competitive examinations.

The book is divided into various chapters covering all the important subjects of the GPAT and NIPER syllabus. Each section starts with an introduction to the topic, followed by a detailed explanation of the concepts. This updated edition includes new chapters and updated information, ensuring that the book is relevant to the latest syllabus and exam pattern.

We hope this book will help you in your preparation for the GPAT, NIPER, and all other Pharma Competitive exams and enable you to achieve your goals.

We would like to acknowledge the reviewers and critics who have provided insightful and constructive feedback on earlier versions of this book. Their comments and suggestions have helped us to refine our ideas and improve the overall quality of this work.

We would like to extend our sincere thanks to our contributors *Miss. Ahilya Kanwar, Miss. Sanskriti Nishad, Miss. Bharti Vaishnaw, Miss. Jyoti Yadav, Miss. Savita Dewangan, Miss. Mridula Singh, Miss. Divya Tripathi, Miss. Sheebu Sonwani, Mr. Pratyush Swarnkar, Mr. Surya prakash Suryavanshi, Mr. Pradeep Sahu, Mr. Omprakash Patel, Mr. Krishna Kant* for their scientific inputs.

We also wish to thanks *Mr. Vidyadhar Sahu, Mr. Chandranayan Sahu, Mr. Hitesh Pradhan* who have made this publication possible in very efficient manner.

Finally, we would like to thank our readers for their interest in this book. We hope that it will inspire, challenge, and entertain you as much as it has me.

Best of luck for your exams !

"The only way to do great work is to love what you do."

PEEYUSH JAISWAL
Director, GDC

Content

PHARMACEUTICS

PHARMACOLOGY

PHARMACOGNOSY

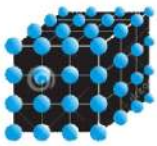
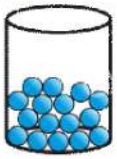
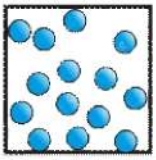
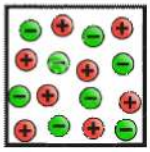
PHARMACEUTICAL CHEMISTRY

OTHER SUBJECTS

Physical Pharmacy

States of Matter

- **Three states** of matter are **:- Solid, Liquid, Gas and Plasma** is the fourth state of matter that seldom occurs on the earth.
- The **state of matter** that shows the **uniformity of behavior.**

SOLID	LIQUID	GAS	PLASMA
Have **strong** intermolecular force.	**Weak** intermolecular force.	**Very weak** intermolecular force.	**Negligible**
Very less intermolecular space.	**Large** intermolecular space.	**Very large** intermolecular space.	**Particles are far apart as in a gas**
Have **definite shape and volume**	Do **not** have **definite shape but have definite volume**	**No definite shape and volume**	**Not have fixed shape**
Have **high density**	**Density is low**	**Very low density**	**Flow in all direction**
Solids cannot be compressed	**Liquids can be compressed**	**Gases can be highly compressed**	**Highly compressible**
			

❑ CRYSTALS

- Crystal lattice is constructed from **repeating units called unit cells.**
- External appearance of a crystal is described by **crystal habits, such as needles, prisms, rosettes etc.**
- Polymorphism is the ability of a compound to crystallize as more than **one distinct crystalline** species with **different internal lattice.**
- The crystal form of sulphacetamide is **Orthorhombic.**
- Molecules in the **Smectic liquid crystals** are characterized by **Mobility in two directions and rotation in one axis.**

❑ VAN DER WAALS FORCES AND OTHER INTERMOLECULAR ATTRACTIONS

BOND TYPE	BOND ENERGY
Dipole – Dipole interaction, orientation effect, or Keesom force	1 - 10
Dipole – Induced dipole interaction, induction effect, or Debye force	
Induced dipole – Induced dipole interaction, dispersion effect, or London force	

❑ GAS LAW

Ideal gas equation :- PV=nRT

Where,

- **P= Pressure V= Volume, n = Amount of substance**
- **R= Gas constant T= Absolute temperature**

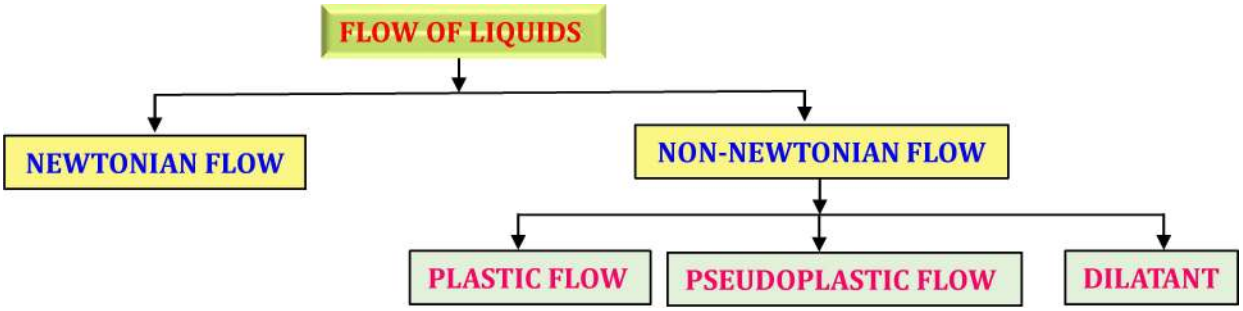
NAME OF LAW	EQUATION USED	COMMENTS
Gay – Lussac law	$\frac{P_1}{T_1}=\frac{P_2}{T_2}$	Volume constant
Boyle's law	$P_1V_1=P_2V_2$	Temperature constant
Charle's law	$\frac{V_1}{T_1}=\frac{V_2}{T_2}$	Pressure constant
Avogadro's law	$\frac{V_1}{n_1}=\frac{V_2}{n_2}$	–
Van der waals equation	$\left(P+\frac{an^2}{V^2}\right)(V-nb)=nRT$	a, b = Constant a/V^2 = Internal pressure /mole

❑ CRITICAL TEMPERATURE AND TRIPLE POINT

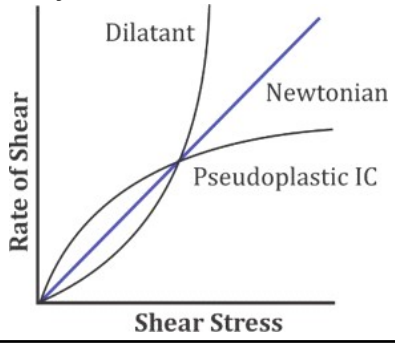
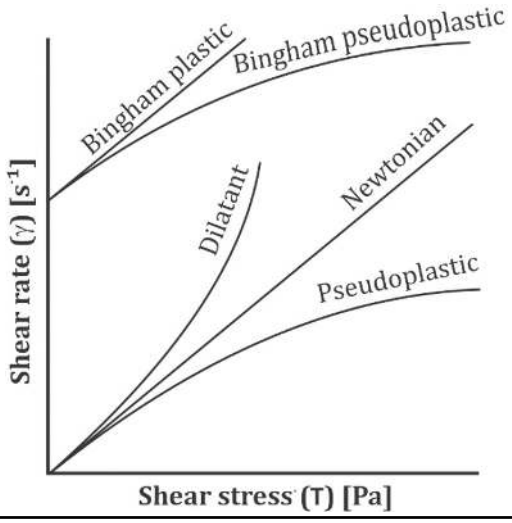
CRITICAL TEMPERATURE	TRIPLE POINT
• This **temperature** above which a **liquid can no longer exist**, is known as the **critical temperature.** • The pressure required to **liquefy a gas** at its **critical temperature** is the critical pressure • The **critical temperature** of **water is 374°C or 647°K** and it **critical pressure is 218 atm.**	• The **triple point** of a substance is the **temperature and pressure** at which the three phases **(gas, liquid, and solid)** of that substance coexist in **thermodynamic equilibrium.** • Its **upper limit** is at the critical temperature, **374°C for water**, and its lower end terminates at **0.0098°C,** called the **triple point.**

Rheology

- The term **rheology** was suggested **by Bingham and Crawford.**
- **Rheology** is defined as the study of the **deformation of solid and flow of a fluid.**



❑ FLOW OF LIQUIDS

NEWTONIAN FLOW	NON-NEWTONIAN FLOW
It follows Newtonian's law	It doesn't follow Newtonian's law
States that viscosity = $\frac{\text{Shearing stress (F)}}{\text{Rate of shear (G)}}$ $\eta = \frac{F}{G} = \frac{F'/A}{dv/dr}$ **Examples –** Water, Glycerine, Chloroform, **castor oil**, olive oil, ethanol, solution of syrup, very dilute colloidal solution. 	**Examples –** Colloidal solution, Emulsion, Suspension, Ointment 

❑ ARRHENIUS EQUATION

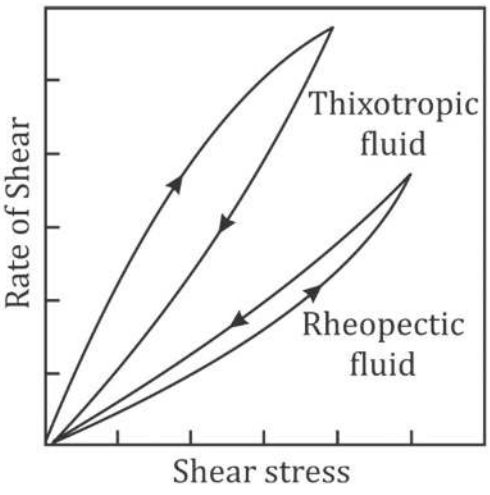
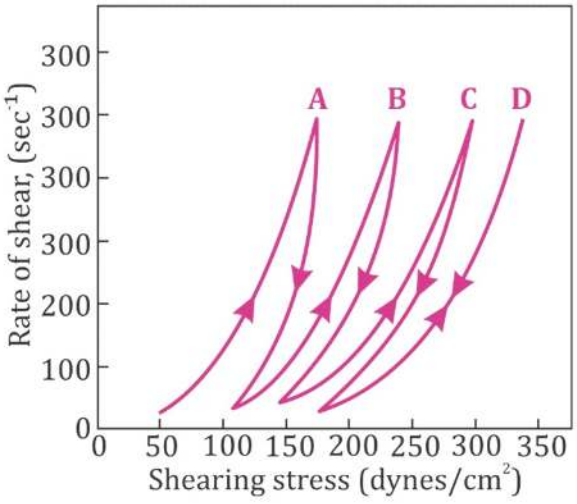
- The **effect of temperature** on the **viscosity of a liquid** is expressed by **Arrhenius equation.**

$$\eta = Ae^{-E/RT}$$

- η = Specific rate constant
- A = **Constant and depends** upon molecular weight and molar volume
- E = **Activation energy**
- R = **Gas constant**
- T = **Temperature in kelvin**

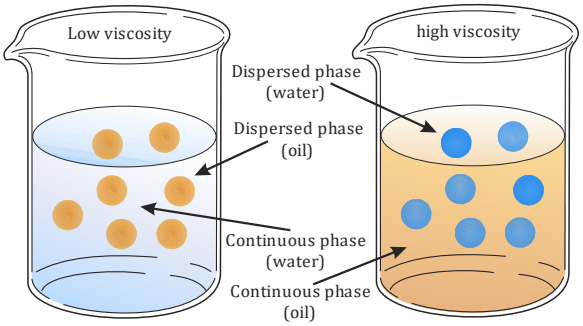
eg - Flocculated particles in concentrated suspension/ Suspension of ZnO in mineral oil, certain paints, ointments	**eg -** Liquid dispersions of natural and synthetic gums (tragacanth, soidum alginate, methyl cellulose, and sodium carboxy methyl cellulose). Jellies, liquid paraffin.	**eg - Suspension of corn starch in water**; Suspension containing high **concentration of solids;** Inorganic pigments in water; kaolin in water; zinc oxide in water.

➢ **Time dependent**

THIXOTROPY	NEGATIVE/ ANTITHIXOTROPY
GEL-SOL-GEL system.	**SOL-GEL-SOL system** Also called **rheopexy**
Shear thinning system. **Time Dependent behavior** • It is the decrease in viscosity as a function of time upon shearing, then recovery of **original viscosity** as a function of time without shearing.	**Shear thickening system** Viscosity increases so, downward curve more towards right.
• At rest, its **Rigidity** is like Gel. As shear applied, the structure begins to break and the material undergo **Gel-to Sol transformation.** Finally, at rest the structure is **restored again (Sol to Gel).** • Materials whose **consistency depends** on the **duration of shear**, as well as on the rate of shear thixotropy. 	• Rheogram of magnesia magma showing anti-thixotropic behavior. • The **material is sheared** at repeated increasing and then decreasing rates of shear. • At stage *D*, further cycling no longer **increased the consistency**, and the up **curves and down curves** coincided. 
Example → Procaine penicillin G (40-70% w/v in water)	**Examples → Low solid content (1-10%)** flocculating system; magnesia magma at equilibrium it forms solution.

Emulsion

- It may be defined as **biphasic liquid dosage** form in which **two liquids are immiscible** with each other.
- **Emulsion** is **coarse dispersion** having **globule size 0.1-100µm.**
- **Water soluble bases** are also known as **Greaseless ointment bases.**
- **Emulsions** having **large globules** are called as **coarse emulsion.**



- A **transparent emulsion** is produced when the 2 phases have the **same refractive index.**
- **Radio opaque emulsions** are used as **diagnostic agents** in **x-rays examination.**

❑ CLASSIFICATION OF EMULSION

BASED ON DISPERSED PHASE	BASED ON GLOBULE SIZE	SPECIAL TYPE
Oil in water (O/W) Eg - Vanishing cream	**Microemulsion** **Size - 0.01µm**	O/W/O emulsion
Water in oil (W/O) Eg - Cold cream	**Fine emulsion** **Size - 0.25 to 25 µm**	W/O/W emulsion

❑ APPEARANCE AND IDENTIFICATION

Dye solubility test	• It is based on the dye can be **dispersed uniformly** throughout the phase in which it is **more soluble.** • **Water soluble dye – Amaranth and Methylene blue** • **Oil soluble dye – Sudan III and Scarlet red**
Dilution test	It is depend on the fact that when a **dispersion medium** is added to an emulsion, no phase separation is possible.
Conductivity test	Based on the **ability of water** to conduct electricity. The deflection of indicator in **voltmeter.**
Creaming test	Identifies the emulsion type, if the **densities of aqueous** and oil phase are known.

❑ EMULSIFYING AGENTS

- According to **Bancroft's rule**, **"If the surfactant is more soluble in water, then the aqueous phase becomes continuous phase, i.e., o/w emulsion will be obtained."**
- Example- **Tweens, Acacia, Bentonite** is useful to form **o/w emulsions**
  Span are useful to form **w/o emulsions**

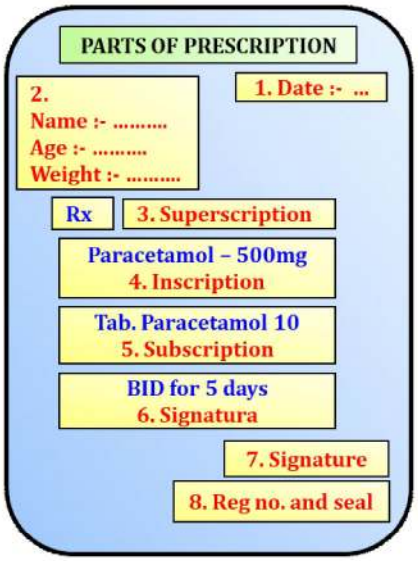
Prescription

It is an **order written by** a **physician, dentist, veterinarian or a registered medical practitioner (RMP)** to a **pharmacist** to **compound and dispense** a specific drug for the patient

The word "prescription" is derived from the **Latin term praescriptus.** (**Prae - 'before'** and **scribere - meaning 'to write'**).

❑ PARTS OF PRESCRIPTION

Superscription (Symbol R_x)	• It is represented by **R_X (Latin term) "recipe"** which means **"take thou"** or **"you take".** • In olden days, the symbol was considered to be originated from the **sign of Jupiter.** • Jupiter is the **Greek God of healing.**
Inscription (Medication prescribed)	• It is the **main part of the prescription.** • It contains the **names and quantities** of the **prescribed medicaments.**
Subscription (Direction to Pharmacist)	• In this part **the prescriber gives direction** to the **pharmacist** regarding the dosage form to be prepared.
Signatura (Direction for Patient)	• To be placed **on the label.** • It is usually written as **"Sig"** • The signatura written in **English and use some Latin** abbreviations like t.i.d (thrice a day), b.i.d (twice a day) and o.d (once a day).



Biopharmaceutics and Pharmacokinetics

Perfusion Rate	✓ **Perfusion Rate =** $K_t \times K_{t/b}$ K_t = First order **distribution rate constant** $K_{t/b}$ = **Tissue/Blood partition coefficient**
	✓ **Question:** What is the perfusion rate of liver if first order distribution **rate constant 0.6 per minute** and tissue/blood partition **coefficient is 1**? ✓ **Solution:** = **0.6 x 1 = 0.6** The perfusion rate of **liver is 0.6 ml/minute.**
Fraction of Drug Unbound in Plasma (f_u)	$F_u = \frac{C_u}{C}$ C_u = Concentration of unbound drug in plasma C = Total plasma drug concentration
	✓ **Question:** If concentration of unbound drug in **plasma is 2 µg/ml**, and total plasma concentration of **drug is 8µg/ml**, then what is the fraction of unbound drug in Plasma ✓ **Solution:** $\frac{2}{8} = 0.25$ So the fraction of **unbound drug in plasma is 0.25**
Renal Clearance ratio	$Q = \frac{Cl_d}{Cl_{cr}}$ Cl_d = Renal clearance of drug Cl_{cr} = Renal clearance of creatinine
	✓ **Question:** What is the renal clearance ratio of a drug if its renal clearance value is **300ml/min** Given: Renal clearance of creatinine = **150 ml/min** ✓ **Solution:** $Q = \frac{300}{150}$ So **renal clearance ratio was 2.**
Renal clearance	$Cl_r = \frac{R_f + R_s - R_r}{C}$ R_f = Rate of filtration R_s = Rate of secretion R_r = Rate of reabsorption C = Total plasma drug concentration
	✓ **Question:** The rate of filtration of paracetamol is **10 mg/min** the rate of secretion is **8 mg/min** and rate of reabsorption is **6 mg/min.** What will be renal clearance of paracetamol if its plasma concentration is **2 mg/ml.** ✓ **Solution:** $Cl_r = \frac{10 + 8 - 6}{2} = 6$ so renal clearance is **6 ml/min.**

Kinetics

Equation for zero order reaction	$K = \frac{A_0 - A_t}{t}$ Where, K = Zero order reaction rate constant A_0 = Initial concentration A_t = concentration at time 't'
Half-life of zero order reaction	$t_{\frac{1}{2}} = \frac{A_0}{2K}$ Where, K = Zero order reaction rate constant A_0 = Initial concentration
Shelf life of zero order reaction	$t_{0.9} = \frac{A_0 - 0.9A_0}{K}$ K = zero order reaction rate constant A_0 = initial concentration
Equation for first order reaction	$K = \frac{2.303}{t} \times \log \frac{C_0}{C}$ Where, K = first order reaction rate constant C_0 = Initial concentration C = concentration at time 't'
Half-life of first order reaction	$t_{1/2} = \frac{0.693}{k}$ K = first order reaction rate constant ✓ **Question:** In a first order reaction the half life of substance is 15 min, what is the rate constant ✓ **Solution:** $t_{1/2} = \frac{0.693}{k}$ $k = 0.693 / 15$ $= 0.0462$
Shelf life of first order reaction	$t_{0.9} = \frac{0.1052}{k}$

Hospital & Clinical Pharmacy

HOSPITAL - A hospital is a health care institution providing patient treatment with specialized health science and auxiliary healthcare staff and medical equipment.

❑ CLASSIFICATION OF HOSPITALS

Type I. On Clinical Basis & Ownership and control basis

CLINICAL-BASIS			NON-CLINICAL-BASIS	
Medicine	**Surgery**	**Maternity**	**Governmental**	**Non-Governmental**
1. Paediatrics 2. Psychiatric and Nervous diseases 3. T.B. Hospital 4. General medicine	1. Orthopaedic 2. Gynecology 3. ENT.	1. Short-term 2. Long-term	• Army hospital • Navy hospital • City hospital • Civil hospital • Big hospitals • AIIMS/PGI etc.	Private Hospitals for Profit Non-Profit Church hospital Community hospital Missionary hospital Charitable hospital

Type II – On size basis

TYPES	DESCRIPTION
Large Hospital (Beds 1000 and above)	King George's Medical University, Lucknow (4,500 beds)
Medium Hospital (Beds between 500-1000)	Bombay hospital, Mumbai (700 beds)
Small Hospital (Beds between 100-500)	Hinduja National Hospital, Mumbai (175 beds)

❑ FLOOR SPACE REQUIREMENT

Area in sq.ft. for	50 beds	100 beds	200 beds
Compounding and dispensing	205	320	495
Parenteral solution laboratory		185	200
Store room		125	200
Manufacturing laboratory			120
Office and library			105
Circulation			60
Total	**205**	**630**	**1,180**

Cosmetic Technology

Cosmetics have been generally defined as "**articles intended to be applied** to the **human body by being rubbed, poured, sprinkled, or sprayed for cleansing, promoting attractiveness, beautifying, or altering the appearance**"

❑ CLASSIFICATION OF COSMETICS

❑ LIPSTICK

- Lipstick used to impart an attractive color & glossy moisture appearance to the lips. Contain **pigment/dye in an oil-wax base**, stiff enough to form a stick, suitably **perfumed & flavoured molded product.**

➢ Formulation of lipstick

S.NO.	COMPOUNDS	FEATURE/ DESCRIPTION
1.	BASE	Wax and oil are used
	Wax and percentage used	• Hard paraffin - 1-5% used • Cetyl alcohol - 2-3% used • White bees wax - 5-20% used • Lanolin - 5-15% used
	Oil & percentage used	• Liquid paraffin - 1-5 % • Castor oil - 30-40%
2.	Bromo mixture	When a product having high staining properties is desired. • **Tetrabromo fluorescein (30-40%)**
3.	Color mixture	**Insoluble dyes and lakes** colors are used as main coloring material
4.	Titanium dioxide	It is used to **modify shade of basic pigments**
5.	Antioxidant	To prevent rancidity • **Propyl gallate,** • **Butylated hydroxyanisole(BHA)** • **Butylated hydroxytoluene(BHT)**
6.	Preservatives	• **Propyl-Para hydroxybenzoate (PPHB)**
7.	Flavours	To mask the fatty odour of base

➢ Evaluation of lipstick

PARAMETERS	DESCRIPTION
Drop point test	Temperature at which lipstick start **oozing out oil** within the case is known as drop point
Breakage point	It determines **strength** of lipstick
Test for penetrability	It is done by needle, indicates **rheological properties** of lipstick.
Stability test	By means of accelerated stability test in which lipstick for surface defects and color and application characteristics.
Rancidity test	The **Oxidation of oil such as castor oil** and many others ingredients may result in bad odour and taste and also result in a sticky product.

➢ Formulation related problems of lipstick

S.NO.	PROBLEMS	DESCRIPTION
1.	Sweating	• Occurs due to **increase oil content**
2.	Bleeding	• Separation of **colored liquid** from waxy base
3.	Blooming	• Surface appears dull instead of desired glass • It occurs due to the **increased percentage of Cetyl alcohol** (>5%)

Flow of Fluids

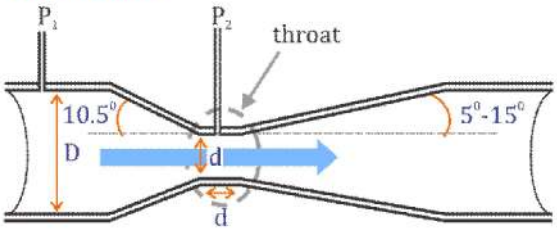
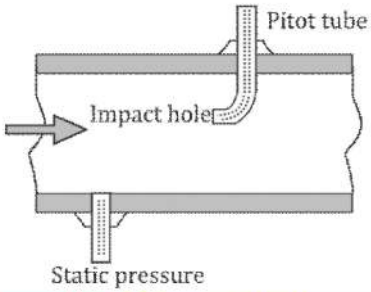
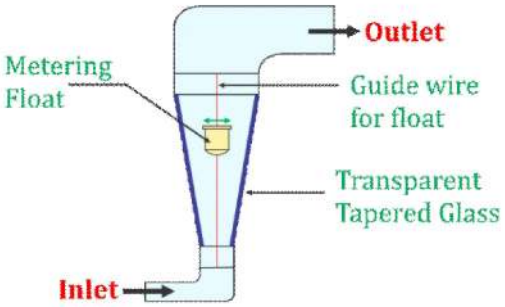
- **Flow of fluids** is the flow of substance **(liquids and gases)** that **does not permanently resist distortion**.
- Fluid mechanics is divided into **Fluid statics and Fluid dynamics**.
  - ➢ Fluid statics deals with **fluids at rest in equilibrium.**
    - It is employed in the **working of manometers.**
    - It is also applied for quantification of fluid flow as in **Bernoulli's theorem.**
  - ➢ Fluid dynamics deals with **fluids in motion.**
    - Manufacture of **dosage form**
    - Handling of **drugs for administration**

❑ MANOMETER

- Manometers are the devices used for measuring the **pressure difference**.

➢ **Different types of manometers**

SIMPLE MANOMETER	DIFFERENTIAL MANOMETER	INCLINED MANOMETER
• It is a device which **measures pressure** at a point in a fluid contained in a pipe or vessel. • **U tube fluid** manometer	• It is a manometer which **measure the difference of pressure** between any two points in a pipe or vessel containing fluid. • **Two-fluid U-tube** manometer	• It is a device which **measures the minute pressure** differences between any two points in a fluid contained in a pipe or vessel.
USES • Used in measuring the consumption of gases in chemical reactions. • Used in conjunction with flow meters for measurement of flow of fluids	**USES** • Useful for measuring even small gas pressures • Used in measurement of small pressure differences.	**USES** This type of manometer increases the accuracy of the pressure determination of particularly for small head.

Venturi meter (Variable head meter) Venturi Tube 	• Venturi meter is referred to as variable head meter, i.e., it measures the **variable differential pressure across** a fixed constriction placed in the path of flow. • It is used for liquids, **especially water.** • It is used in **on-line installation and for measurement of gases.**
Pitot tube (Insertion meter) 	• It is used to measure the **velocity head of the flow**. • Pitot tube measures the velocity at **one point only.**
Rotameter (Area meter) 	• It measures the area of flow, so as to produce a **constant head differential.** • Used in bulk drug chemical industries and in fermenters for **control of air supply.**

❑ VALVES

- Valves are **used to control** the **rate of flow of fluids in a pipeline.**

➢ Types of Valves

NAME OF VALVE	USES
Plug cocks valve	Used for **stopping or starting** the flow of fluid.
Globe valve	Used for **regulating flow or pressures** as well as complete shutoff flow.
Gate valve	Used to **completely shut off fluid flow** or, in the fully open position, provide full flow in a pipeline.
Diaphragm valve	Used to **control fluid flow** by regulating the area with which media can enter and exit the valve, effectively changing its speed and velocity.
Needle valve	It is Precise control of flow .

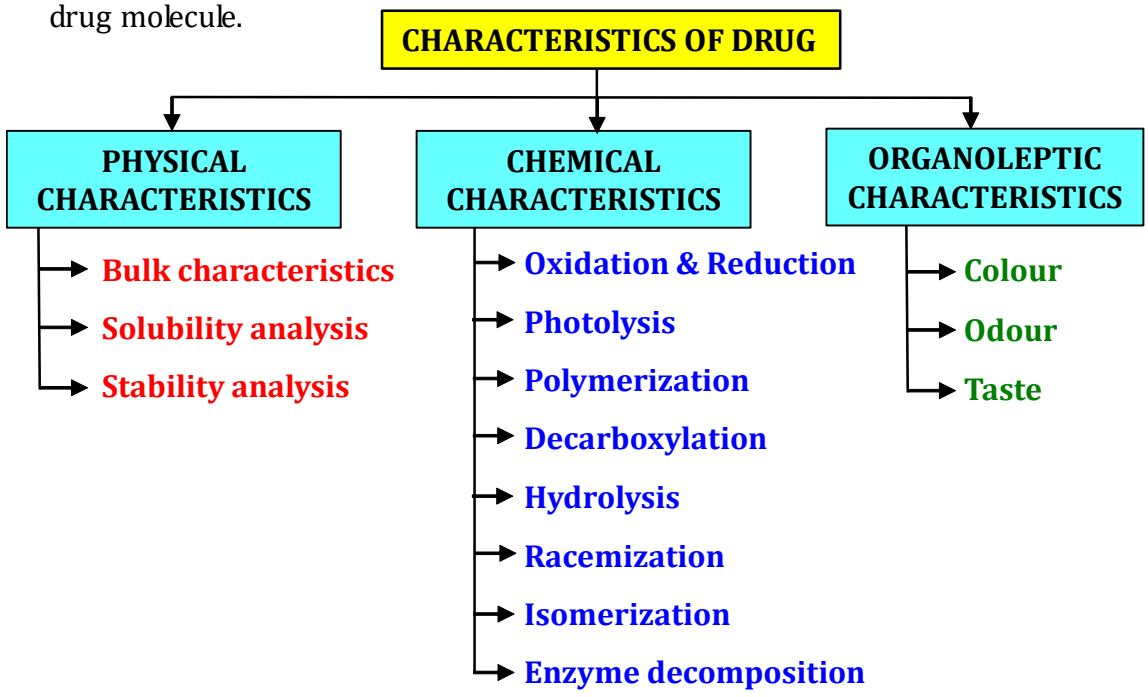
Pharmaceutical Technology

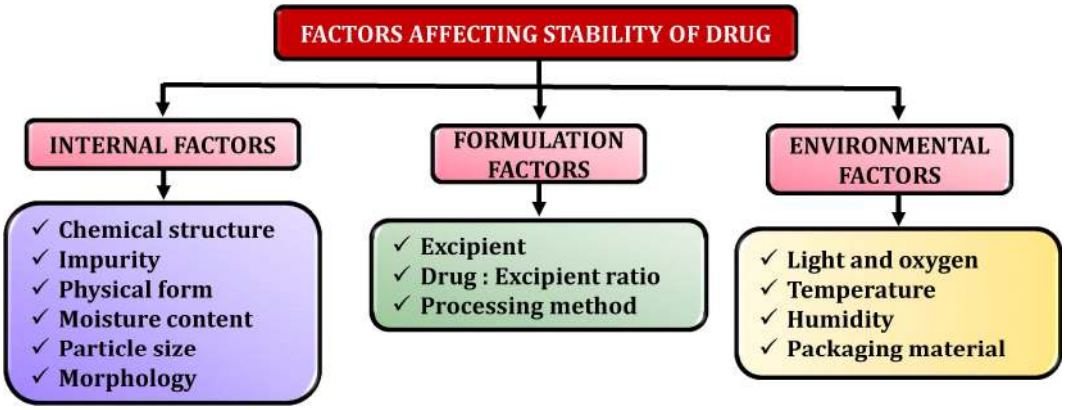
Preformulation

- This is an **investigation** of **physical and chemical properties** of drug substance alone and when **combined with excipients.**

❑ OBJECTIVES

- To formulate an **elegant, safe, efficacious** dosage form with **good bioavailability.**
- To formulate **new dosage form** of an **already existing drug.**
- Determination of all the **properties of drug** and the best suitable dosage form for the drug molecule.





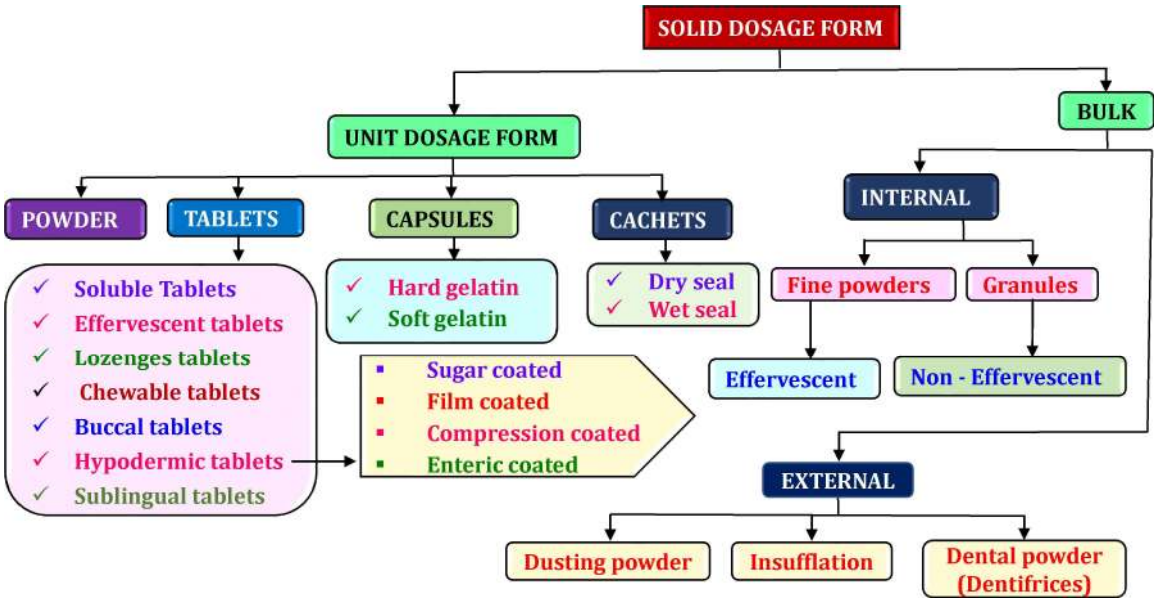
❑ BIOPHARMACEUTICAL CLASSIFICATION OF DRUGS

- Proposed by G.L. Amidon
- Maximum drugs falls under BCS class-II and IV

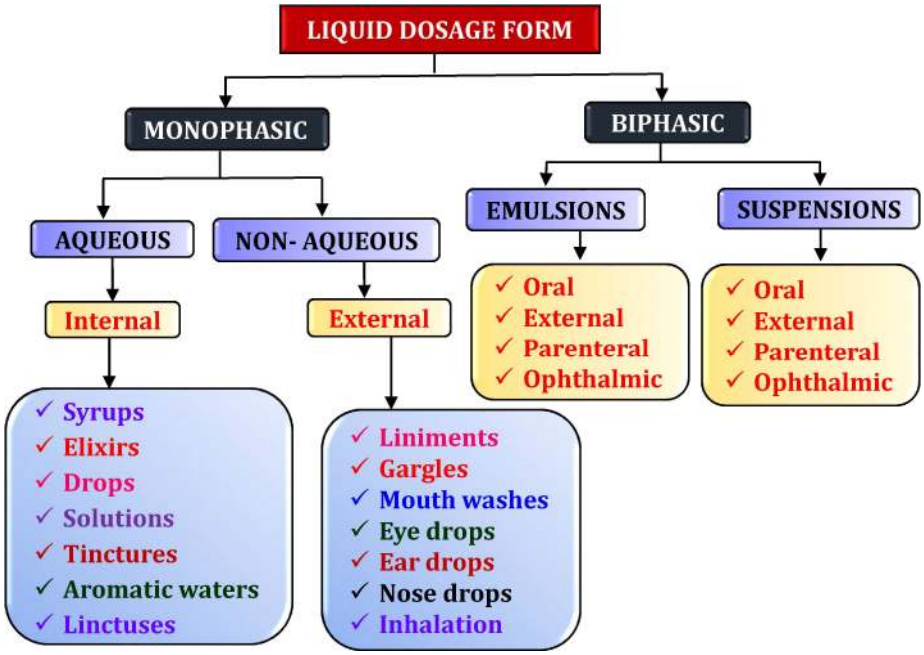
CLASS	SOLUBILITY	PERMEABILITY	ABSORPTION	EXAMPLE
I	High	High	Well absorbed	Diltiazem, Propranolol, Metoprolol
II	Low	High	Variable	Nifedipine, Carbamazepine, Naproxen
III	High	Low	Variable	Insulin, Metformin, Cimetidine
IV	Low	Low	Poorly Absorbed	Taxol, Chlorothiazide, Furosemide

Classification of Dosage Form

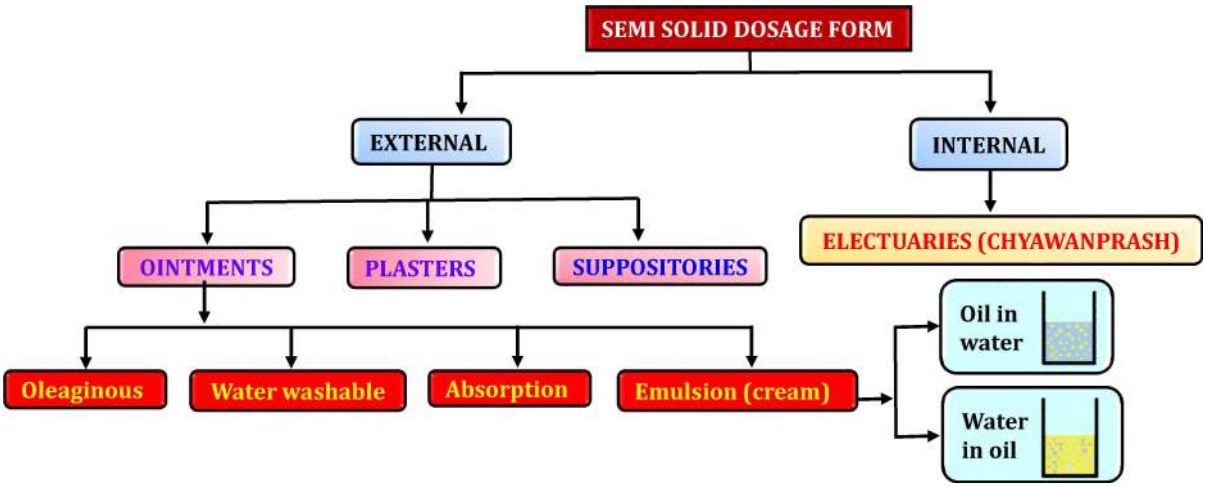
❑ SOLID DOSAGE FORM



❑ LIQUID DOSAGE FORM



❑ SEMISOLID DOSAGE FORM



Liquid Oral Preparation

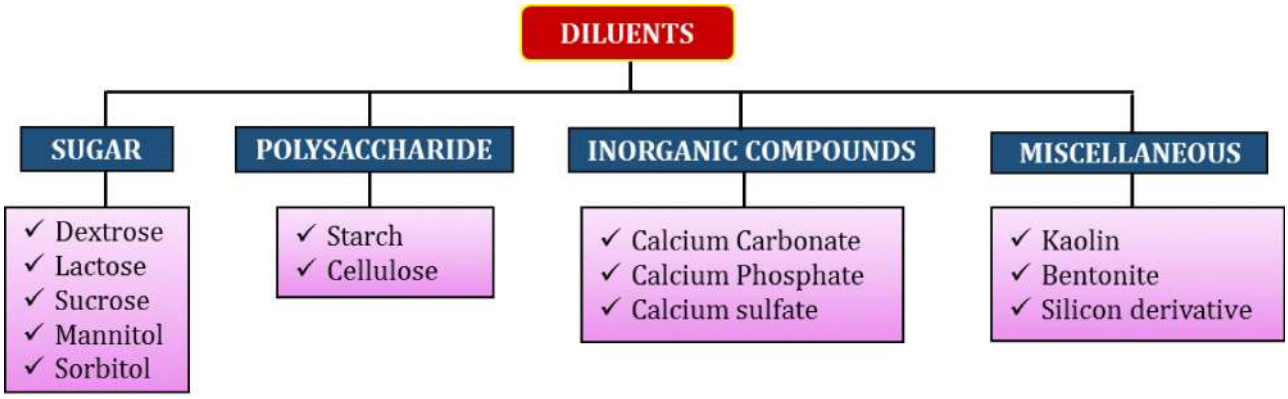
LIQUID DOSAGE FORMS	DESCRIPTION
Aromatic water	Solution of **aromatic material** in water.
Solution	Solutions are liquid preparation that contains **one or more chemical substances**. They are prepared by dissolving the **active ingredients** in an aqueous or non-aqueous solvent.
Syrup	**Aqueous solution** containing **sugar.**
Spirit	Solution of **aromatic material in alcohol**
Injection	Prepared to be **sterile and pyrogen free** and intended for **parenteral administration.**

Tablets

Solid unit dosage form containing medicaments **with or without excipients**.

❑ TYPES OF TABLETS

TYPES OF TABLETS	DESCRIPTION
ORAL TABLETS FOR INGESTION	
Compressed Tablet	**Uncoated tablet** made by compression and intended **to provide rapid disintegration and drug release.**
Multiple compressed Tablet	These are compressed tablet in which the granules of different drug **compressed into two or more layer** in the same tablet. **Two class –** Layered tablets and compression coated tablet
	Multiple layered tablets - These are compressed tablets in which the granules of different drugs are compressed into two or more layers in the same tablet. **Versa press** is used for the preparation of layered tablets.
	Compression coated tablet (Tablet in tablet)- In this, one drug is compressed around previously compressed tablet of another drug, usually called as precompressed tablet.
Enteric coated Tablet	Tablet are **coated with polymer** (**eg - cellulose acetate phthalate**) that does not dissolve under acidic condition of stomach but **dissolve in alkaline condition of the small intestine.**
Chewable Tablet	Intended to be **chewed in the mouth before swallowed.** Provide unit medication for infant and children and not required disintegrants. **eg - Antacid and Vitamin tablet.**
Film coated Tablet	These are the **conventional tablet coated** by the film of polymer to improve the **appearance of the formulation and mask the taste.**
Sugar coated Tablet	Sugar coated tablet is done for **mask the bitter taste of drug and improve appearance.**
Controlled release Tablet	They are designed to release a drug at a predetermined rate in order to **maintain a constant drug concentration drug concentration** for a specific period of time with minimum side effects
Repeat action Tablet	Repeat action tablets are prepared so that an initial dose of drug is released immediately followed later by a second dose.
TABLETS USED IN ORAL CAVITY	
Buccal Tablet	Placed in the **side of cheeks**, absorbed directly into buccal cavity, by first pass metabolism
Sublingual Tablet	**Placed under tongue** **eg - Nitroglycerine, Erythrityl tetranitrate, Glyceryl trinitrate**



DILUENTS	BRAND NAME
Dextrates	Emdex
Dextrose	Cerelose, Tabfine
Maltose	Advantose
Mannitol	Pearlitol
Lactose monohydrate	Zeparox, Pharmatose, Tablettose
Starch, pregelatinized	Pharma-Gel, Pre-Jel, Starch 1500, Sta-Rx 1500
Sugar, compressible	Dipac, Nutab
Cellulose, microcrystalline (MCC)	Avicel, Emcocel, Vivacel
MCC silicified	Prosolv
Calcium carbonate	Cal-Carb, Millicarb, Pharma-Carb,Sturcal
Calcium sulfate	Cal-Tab, Compactrol

2. BINDERS

Used to improve cohesive property of compressing material

BINDER	BRAND NAME
Acacia mucilage, Alginic acid, Gelatin, Guar gum	----
Ethyl cellulose	Aquacoat
Methylcellulose	Celacol, Methocel
Hydroxypropyl methyl cellulose	Methocel, Pharmacoat
Magnesium aluminum silicate	Pharmasorb, Veegum
Povidone	Kollidon, Plasdone

3. DISINTEGRANTS

Used to facilitate breaking up of tablet in contact with water in the gastrointestinal tract.

DISINTEGRATION	BRAND NAME
Starch, Alginic acid, Docusate sodium, Guar gum	-----
Sodium lauryl sulfate	Empicol, Stearowet
Magnesium aluminum silicate	Veegum
Polacrilin potassium	Amberlite
Starch, pregelatinized	Lycatab, Pharma- Gel, Pre-Jel, Sepistab

❑ STEPS OF SUGAR COATING

STEPS OF SUGAR COATING

1. Seal/Sugar Coating
To prevent moisture penetration into the tablet core.
E.g., Zein, Shellac

2. Sub coating
Round the edges and build up the tablet size (↑se tablet weight 50-100 %).
E.g., Sticky Binder: Gelatin, Acacia

3. Smoothing
Cover and fill imperfection in the tablet surface caused by sub coating step. Colorants are added in this step.

4. Color coating
To impart and elegancy and uniform color

5. Polishing
Provide desired luster on the surface of tablet.
E.g., Wax (Beeswax or Carnauba)

6. Printing
Printing on the surface of tablet is done by rotogravure. To facilitate identification with manufacturer's logo or code

❑ COMPONENTS OF FILM COATING

COMPONENTS OF FILM COATING

Film former

Enteric materials	Non-enteric materials
• Cellulose Acetate Phthalate • Acrylate Polymers (Eudragit L and S) • Hydroxypropyl Methylcellulose Phthalate • Polyvinyl Acetate Phthalate	• HPMC • Methyl Hydroxyethyl cellulose • Ethyl cellulose • Hydroxy propyl cellulose • Povidone • Sodium CMC • Polyethylene Glycols • Acrylate Polymers (Eudragit)

Solvents
- Water
- Ethanol
- Methanol
- Isopropanol
- Chloroform
- Acetone
- Methyl ethyl ketone
- Methylene chloride

Opaquant-extenders
- Titanium dioxide
- Silicates (talc, aluminum silicate)
- Carbonates (magnesium carbonate)
- Sulfates (calcium sulfate)
- Oxides (magnesium oxide)
- Hydroxides (aluminum hydroxide

Miscellaneous Coating Solution
- Flavours
- Sweetener
- Surfactants
- Antioxidants
- Antimicrobials

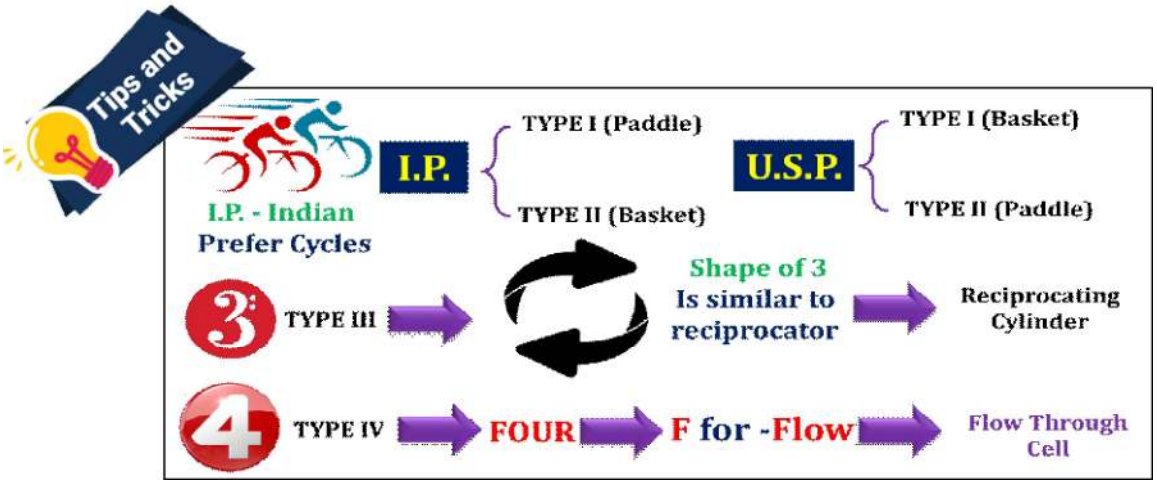
Colorants
- Inorganic materials (e.g., Iron oxides)
- Natural coloring materials (e.g., Anthocyanins, Caramel, Carotenoids, Chlorophyll, Indigo, Flavones, Turmeric, and Carminic acid)

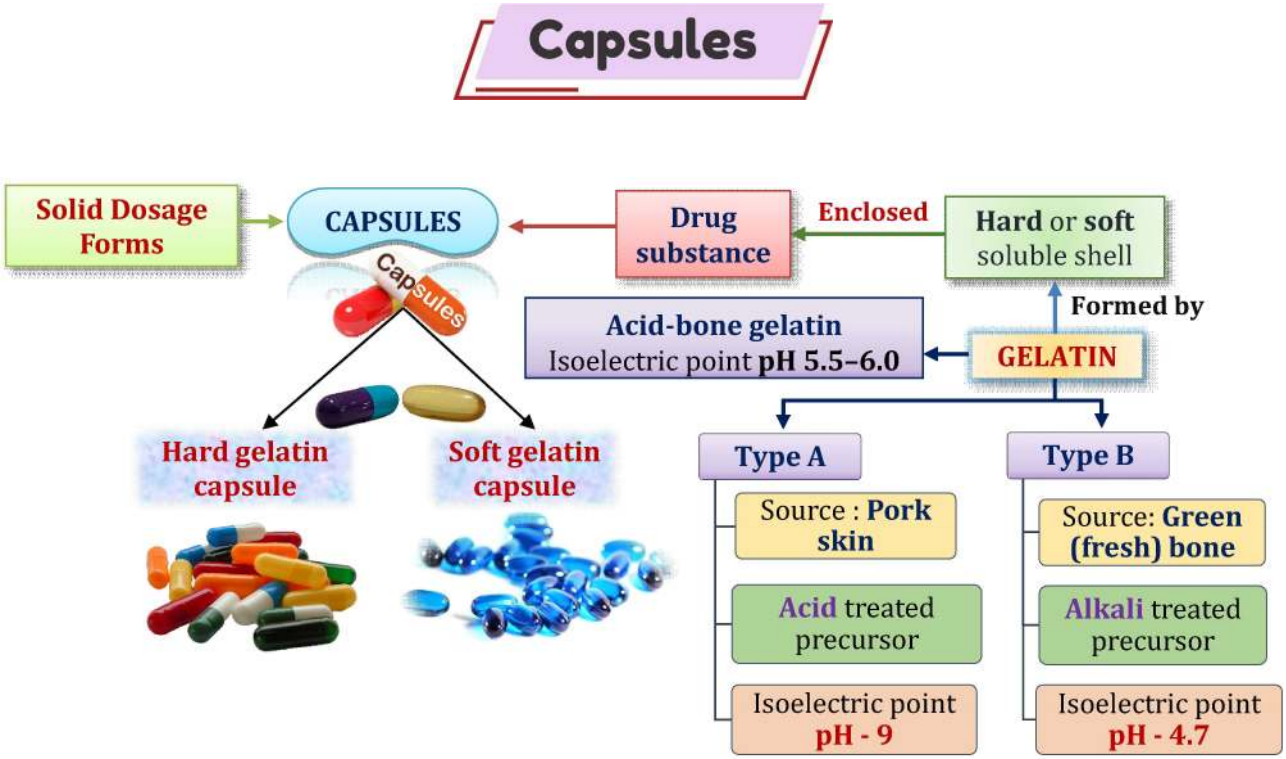
Plasticizers
- Castor oil
- Propylene glycol
- Glycerin
- Polyethylene glycols of 200 and 400 series

❑ TERMS RELATED WITH TABLET COATING

TERMS	DEFINITION
Opalux	Opaquant colour concentrate for sugar coating
Opaspray	Opaquant colour concentrate for film coating.
Opadry	Complete film coating concentrate

❑ TRICK TO REMEMBER DISSOLUTION APPARATUS





❑ DIFFERENCE BETWEEN HARD & SOFT GELATIN CAPSULES

CRITERIA	HARD GELATIN CAPSULES	SOFT GELATIN CAPSULES
Shell	Not plasticized	Plasticized (Glycerin, Sorbitol, PEG)
Moisture	12-16%	6-10%
Sizes	Limited	Many
Shapes	Two-piece	One-piece
Content	Usually dry solids	Usually liquids or suspensions
Closure	Traditional friction-fit, mechanical interlock, banding	Hermetically sealed (Inherent)

2. **Pre-determined release rates** for an extended period of time.
3. Duration for **short half-life** drugs may be increased.
4. By targeting the site of action, **side effects may be eliminated.**
5. **Frequent dosing and wastage of the drug** may be reduced or excluded.
6. **Better patient compliance may be ensured.**

❑ LIPOSOMES

- Liposomes are **vesicle of lipid bilayer which encloses an aqueous compartment**. Liposomes are phospholipid-based **colloidal vesicular structures** in which **hydrophilic core is entirely enclosed by membranous lipid bilayers. Size range from 25-500nm.**

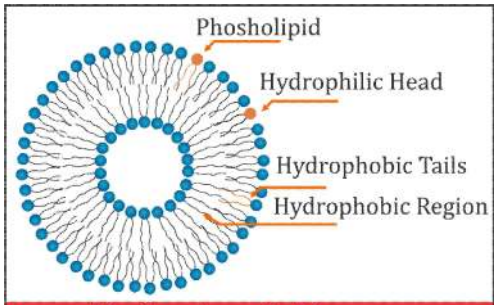


Fig: Structure of a Liposome

➢ **Liposome can interact with cell by four different mechanism**

1. Fusion with the plasma cell membrane
2. Endocytosis by phagocytic cells
3. Transfer of liposomal lipid to cellular as subcellular membrane
4. Adsorption to the cell surface

➢ **Clinically approved liposomal formulation**

ACTIVE INGREDIENT	TRADE NAME
Amphotericin B	AmBisome
Cytarabine	DepoCyt
Daunorubicin	DaunoXome
Doxorubicin	Myocet
Morphine	DepoDur

➢ **CLASS IFICATION OF LIPOSOMES**

LIPOSOMES

Based on structural parameters

- **Multilamellar large vesicles (MLV) - >0.5 μm**
- **Oligolamellar vesicles (OLV) - 0.1-1 μm**
- **Small unilamellar vesicles (SUV)- 20-100 nm**
- **Large unilamellar vesicles (LUV) - > 100 nm**
- **Multivesicular vesicles (MV) - > 1 μm**

Based on method of preparation

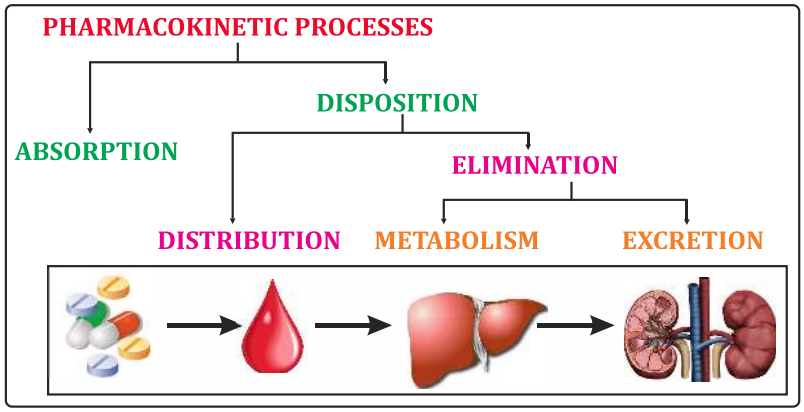
- **Vesicles prepared by reverse phase evaporation method (REV)**
- **Multilamellar vesicles made by REV (MLV-REV)**
- **Vesicles prepared by extrusion technique (VET)**
- **Dehydration-Rehydration method (DRM)**
- **Stable plurilamellar vesicles (SPLV)**
- **Frozen and thawed MLV (FATMLV)**

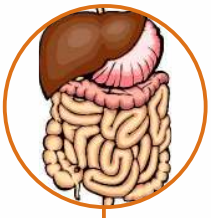
Biopharmaceutics

Biopharmaceutics is defined as the study of factors influencing the **rate and amount of drug that reaches the systemic circulation** and the use of this **information to optimize therapeutic** efficacy of drug products.

Pharmacokinetics

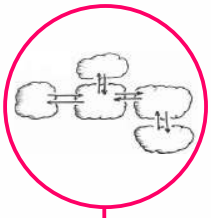
The term **"Pharmacokinetics"** is derived from Greek words **Pharmakon (drug)** and **Kinesis (movement).** It is the **quantitative study of drug movement** into through and out of the **body and their relationship** with the **pharmacological, therapeutic or toxicological response in man or animals.** The frequency of administration of a drug in a particular dose is **called Dose regimen.**





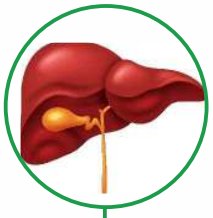
ABSORPTION

The **process of movement of un changed drug** from the site of **administration to systemic circulation**



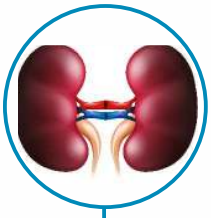
DISTRIBUTION

The movement of drug between one compartment and the other (general blood and the extra-vascular tissues) is **referred to as drug distribution**



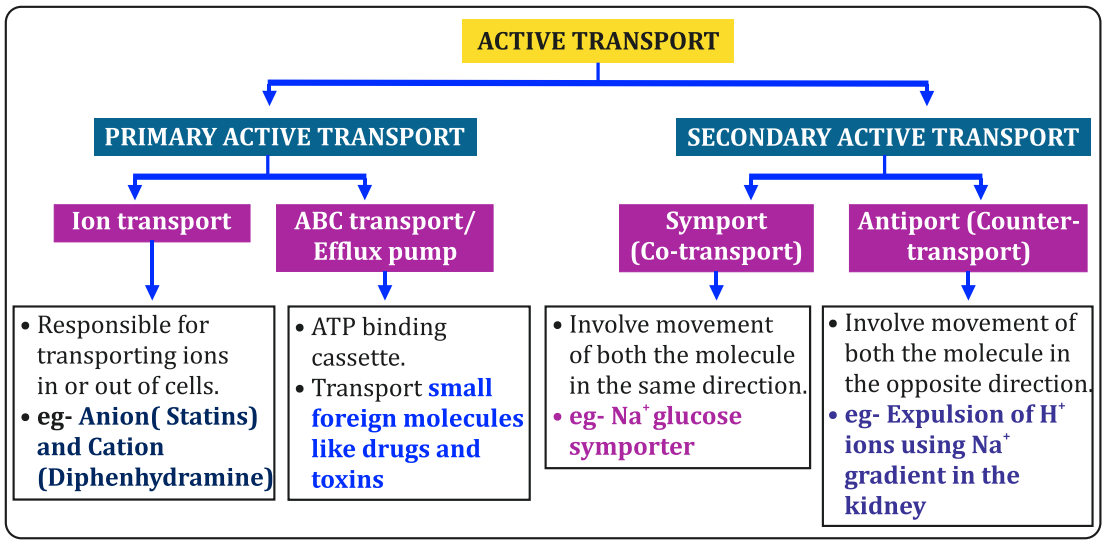
METABOLISM

Chemical reactions that which are easier to eliminate. The products of these chemical reactions are **called metabolites.**

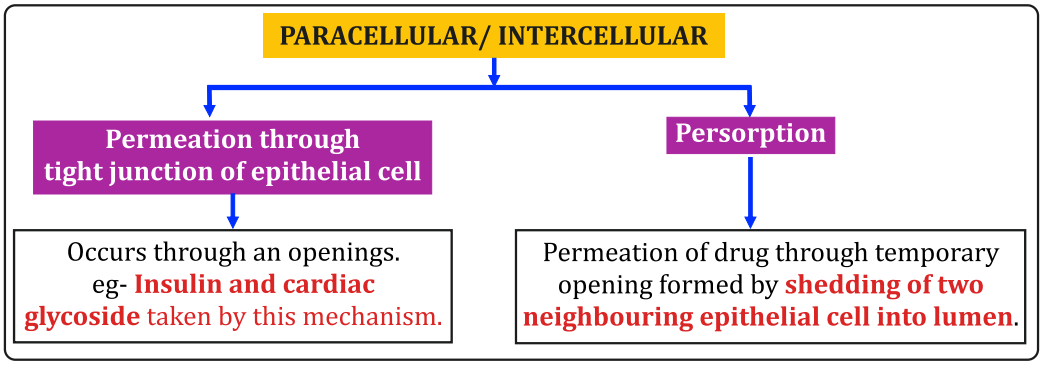


ELIMINATION

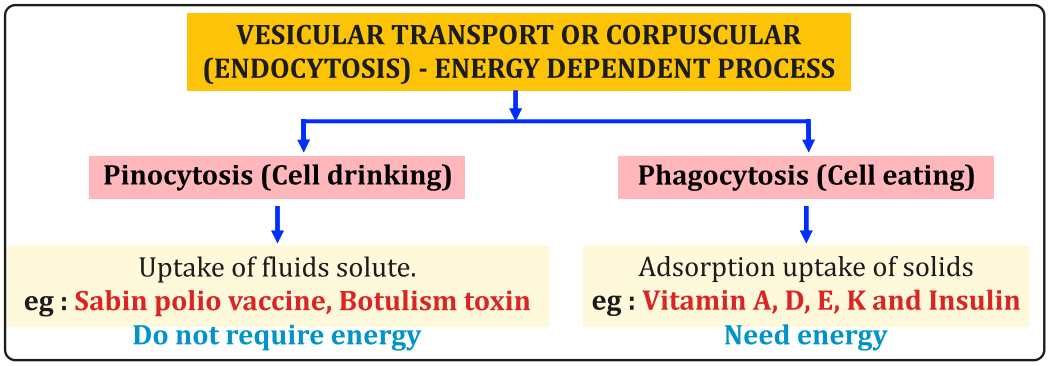
Elimination is defined as the process that tends to **remove the drug** from the body and terminate its action. **Elimination occurs by two processes**

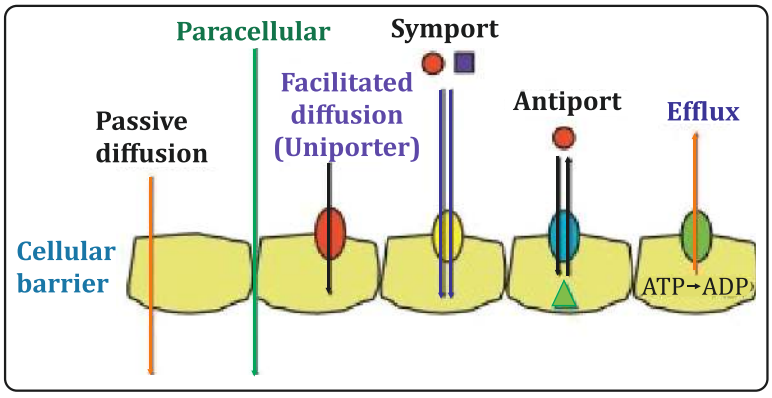


2. PARACELLULAR/ INTERCELLULAR TRANSPORT



3. VESICULAR TRANSPORT OR CORPUSCULAR (ENDOCYTOSIS) - ENERGY DEPENDENT PROCESS





DISTRIBUTION

DISPOSITION (Processes that tend to lower the plasma concentration of drug)

- **DISTRIBUTION (Reversible transfer of a drug between blood and extravascular fluids**
- **ELIMINATION (Irreversible loss of a drug from body**

RATE LIMITING STEP IN DISTRIBUTION

- **Tissue Permeability** (When drug is ionic, polar or water soluble)
- **Blood Perfusion** (When drug is highly lipophilic)

IMPORTANT POINTS

01. **Driving force** for Distribution is **concentration gradient** between blood and extravascular fluids
02. In **polar drugs Driving force is effective partition coefficient**
03. Drugs which **bind selectively to plasma proteins** or other blood compartment, eg- Warfarin have **apparent V_d smaller than their true V_d**
04. Drugs which **bind selectively to extravascular tissues**, eg- Chloroquine have **apparent V_d larger than their real V_d**
05. Methods for studying drug distribution pattern- **Microdialysis**, Matrix-assisted laser desorption ionization- **mass spectrometry** imaging (MALDI-MSI), **Autoradiography**, **Positron emission tomography**

❑ FLUID COMPARTMENTS OF A 70 KG ADULT

S.NO.	BODY FLUID	VOLUME (LITRES)	% OF BODY WEIGHT	% OF TBW
1.	Vascular fluid/blood (Plasma)	6(3)	9 (4.5)	15 (7.5)
2.	Extracellular fluid (excluding plasma)	12	17	28
3.	Intracellular fluid (excluding blood cells)	24	34	57
4.	Total Body Water (TBW)	42	60	100

❖ PLASMA CONCENTRATION - TIME PROFILE GRAPH

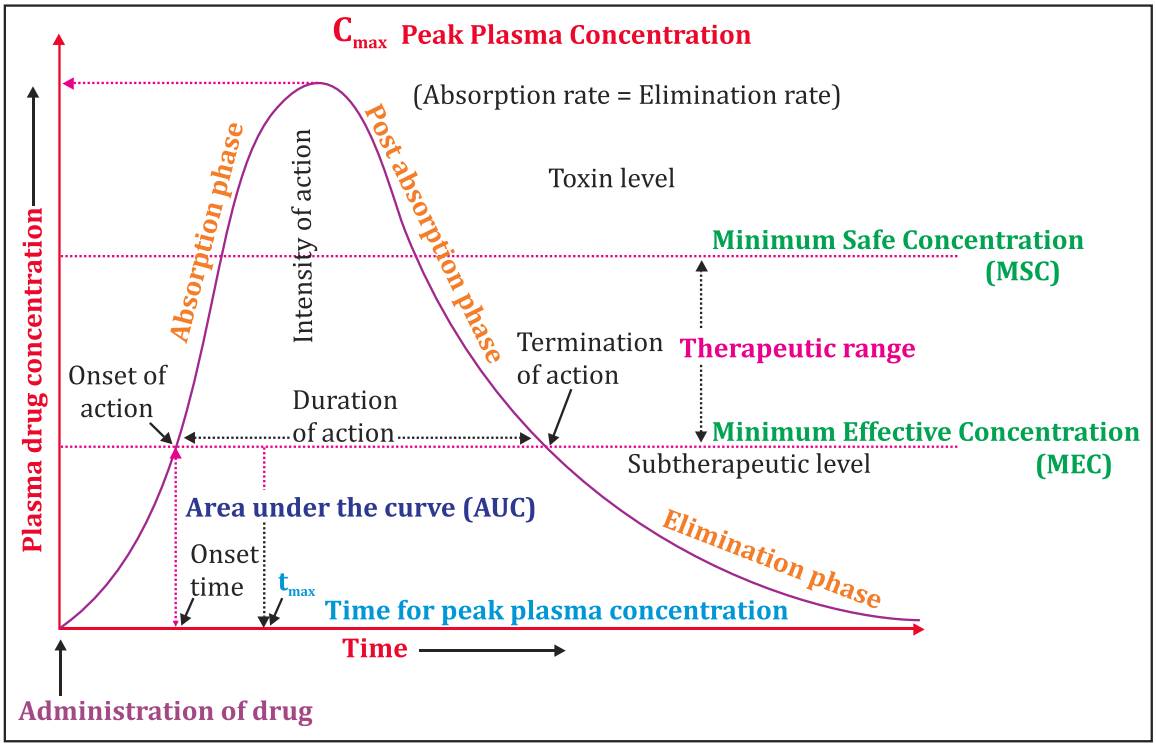


Fig:- Typical Plasma concentration- time profile showing Pharmacokinetic and Pharmacodynamic parameter obtain after oral administration single dose of a drugs

PHARMACOKINETIC PARAMETER	DESCRIPTION
Peak Plasma Concentration (C_{max})	The **point of maximum concentration of drug in plasma** is called as the peak and the concentration of drug at peak is known as **peak plasma concentration.** It is also called as peak height concentration and maximum drug concentration. **C_{max} is expressed in mcg/ml.**
Time of Peak Concentration (t_{max})	The **time for drug to reach peak concentration in plasma** (after extravascular administration) is called as the time of peak concentration. It is expressed in **hours** and is useful in **estimating the rate of absorption.** Onset time and onset of action are dependent upon t_{max}.
Area Under the Curve (AUC)	It represents the **total integrated area under the plasma level-time profile and expresses** the total amount of drug that comes into the systemic circulation after its administration. **AUC is expressed in mcg/mL X hours.** Important parameter in evaluating the bioavailability of a drug from its dosage form as it represents the **extent of absorption.**

Pharmaceutical Jurisprudence

Pharmaceutical Legislation in India

❑ INTRODUCTION TO JURISPRUDENCE

TERMS	DESCRIPTION
JURISPRUDENCE	The **study of fundamental legal principles** and is also **science and philosophy of law.**
ETHICS	Ethics is the **science of human conduct**. With reference to the human conduct there is the ideal moral code and the **positive moral code.**
LAW	Rules of **human conduct binding** on all person in a **state or nation.**
PHARMACEUTICAL JURISPRUDENCE	It is a **branch of pharmacy which deals with the knowledge of laws relating to drugs** and pharmaceuticals and **about pharmacy profession.**

❑ HEALTH SURVEY AND DEVELOPMENT COMMITTEES

COMMITTEES	DESCRIPTION	CHAIRMANSHIP
BHORE COMMITTEE	• **Oct. 1943 - Health Survey and Development Committee** by Govt. of India	**Sir Joseph William Bhore** 
BHATIA COMMITTEE	• **In 1953 - Pharmaceutical Enquiry Committee** by Government of India	**Major General S. L. Bhatia** 
MUDALIAR COMMITTEE	• **June 1959 - Health Survey and Planning Committee** by Govt. of India	**Dr. A. Lakshman swami Mudaliar** 
HATHI COMMITTEE	• **8th February 1974 – Drug and Pharmaceutical Industry** by Govt. of India	**Jaisukhlal Hathi** 

❑ SCHEDULES TO THE RULES

SCHEDULES	SIGNIFICANCE	
A	**Performa for Application** for the licenses, issues and renewal of licenses, for sending memoranda.	
B	**Rates of Fee** structure for drug analysis by **CDL** or by the Govt. Analyst.	
B_1	**Fees for the test or analysis** by the **pharmacopoeia laboratory** for Indian medicine or the government analyst.	
C	list of Biological and special products (injectable) applicable to special provisions. Eg. Surgical dressings and ophthalmic preparations etc.	
C_1	List of **other special products (non-parenteral)** whose import, sale, distribution and manufacture. Eg. Digitalis, Ergot, Adrenaline, Fish liver oil etc.	
D	Drugs **exempted** from the provision of **import of drugs.**	
D_1	**Information and undertaking required** to be **submitted by the manufacturer** with the application form for a **registration certificate.**	
D_2	**Information required to be submitted by the manufacturer** with the Application Form for registration of a **bulk drug/formulation/special product** for its import into India.	
E_1	**Poisonous** substances under Ayurvedic, Siddha and Unani system of medicines.	
F	**Part XII B-** Requirement for the **functioning and operation of blood bank** and/ or for the preparation of blood component.	
F_1	**Part-I**	Production of **bacterial and viral vaccine.**
	Part-II	Production Of **all sera from living animals.**
	Part-III	Manufacture and standardization of **diagnostic agents (bacterial origin).**
F_2	Standards of **surgical** dressings.	
F_3	Standards of sterilized **umbilical** tapes.	
FF	Standards for **ophthalmic** preparations.	
G	List of drugs/ substances to be used under the **medical supervision** and which are to be labelled accordingly.	
H	List of drugs to be sold on the **prescription of an RMP.**	
J	**Diseases and ailments** which a drug may not purport **to prevent or cure or make claims to prevent or cure.**	
K	Drugs **exempted** from provisions related to **manufacture of drugs.**	
M	Requirements of **manufacturing premises, GMP requirements of factory premises, plants and equipments.**	
Part-I	**Good manufacturing practices for premises and materials.**	
	Part-IA	Specific requirements for manufacture of **sterile products, parenteral preparations** (small volume injectables and large volume parenterals) and sterile ophthalmic preparations.
	Part-IB	Specific requirements for manufacture of **oral solid dosage forms** (tablets and capsules).
	Part-IC	Specific requirements for manufacture of **oral liquids** (syrups, elixirs, emulsions and suspensions).
	Part-ID	Specific requirements for manufacture of **topical products,** i.e., external preparations (creams, ointments, pastes, lotions etc.)

MANUFACTURE, SALE & DISTRIBUTION OF DRUGS AND COSMETICS

❑ FORMS FOR IMPORT, MANUFACTURE, REPACKAGING AND SALE OF DRUGS

PURPOSE	DRUGS	APPLICATION MADE IN FORM	LICENSE GRANTED IN FORM
IMPORT	(i) Drugs specified in schedule C and C1	8	10
	(ii) Drugs specified in Schedule X	8A	10A
	(iii) Import of drugs for testing and analysis	12	11
	(iv) Small quantity of drugs for personal use	12A	12B
MANUFA--CTURE	1. Homoeopathic drugs	24 C	25 C
	2. (i) Cosmetic	31	32
	(ii) Loan manufacture of Cosmetic	31A	32A
	3. (i) Ayurvedic and Unani Drugs	24D	25D
	4. (i) Drugs specified in schedule C, C1, and X	27B	28B
	(ii) Drugs specified in schedule C and C1 excluding those specified in Schedule X	27	28
	(iii) Drugs other than those specified in schedule C, C1 and X	24	25
	(iv) Drugs specified in schedule X	24 F	25 F
	5. Manufacture for examination test or analysis	30	29
REPACKING LICENSE	Drugs other than specified in schedule C and C1	24-B	25-B
SALE OF DRUGS			
(A) WHOLE SALE	(i) Homoeopathic Drugs	19B	20D
	(ii) Drugs other than those specified in schedule C, C1 and X	19	20B
	(iii) Drugs other than those specified in schedule C, C1 from a motor vehicle	19AA	20BB
	(iv) Drug specified in schedule X	19C	20G
	(v) Drugs specified in schedule C and C1 but not included in schedule X	19	21B
	(vi) Drugs specified in schedule C and C1 but not included in Schedule X from a motor vehicle	19AA	21BB

- **II, VII, IX, X** inactive clotting factor is activated by the vitamin K as a Coenzyme.
- **Hemophilia A** is caused due to the reduction in the quantity or activity of the **Clotting factor VIII.**
- Heparin prevent blood coagulation by inhibiting **thrombin** catalyzed conversion of **fibrinogen** to **fibrin.**
- **Heparin** is the **natural anticoagulant** due to which blood **does not coagulate** in blood vessels.

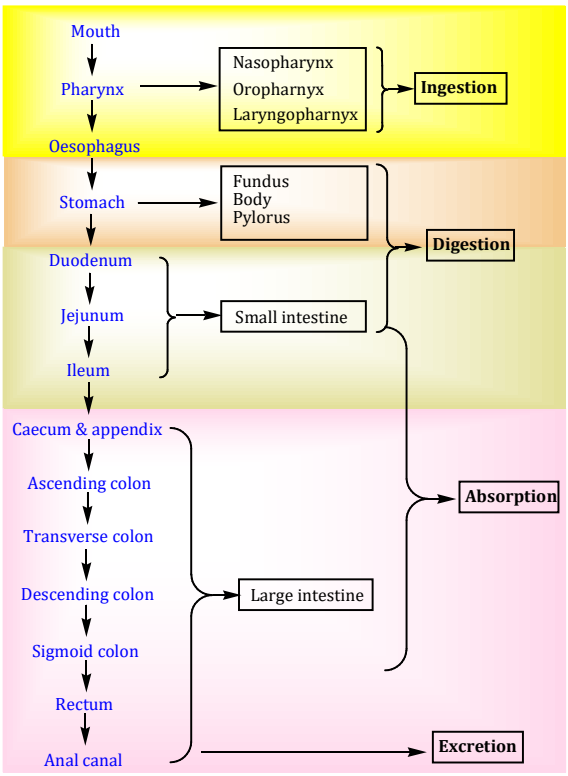
❑ DISEASES RELATED TO WBC & RBC

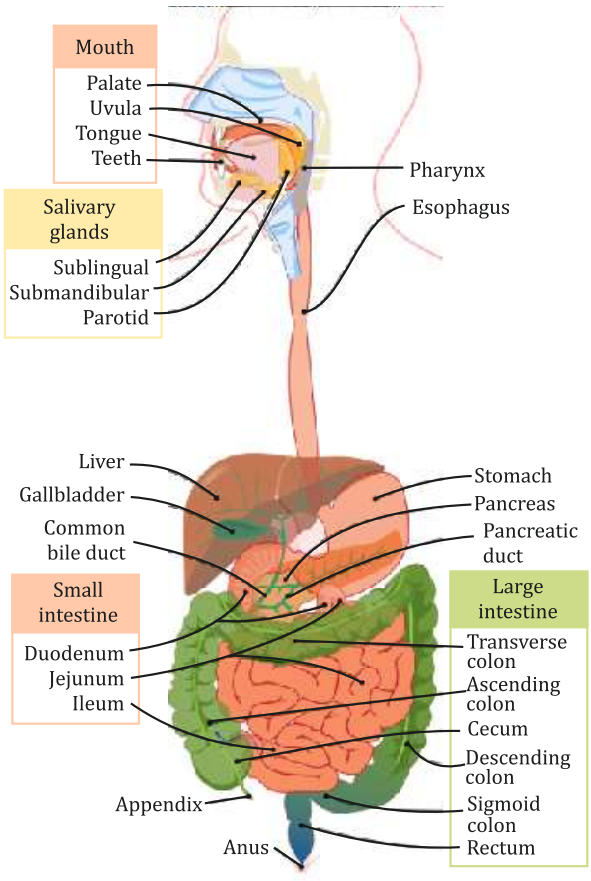
Polycythemia	Excess production of RBC **Hematocrit 65% to 70% indicates Polycythemia**
Anemia	**Less production of RBC**
Erythroclasia	**Destruction of RBC**
Leukocythemia (leukaemia)	**No. of WBC increase**
Leukopenia	**No. of WBC decrease**

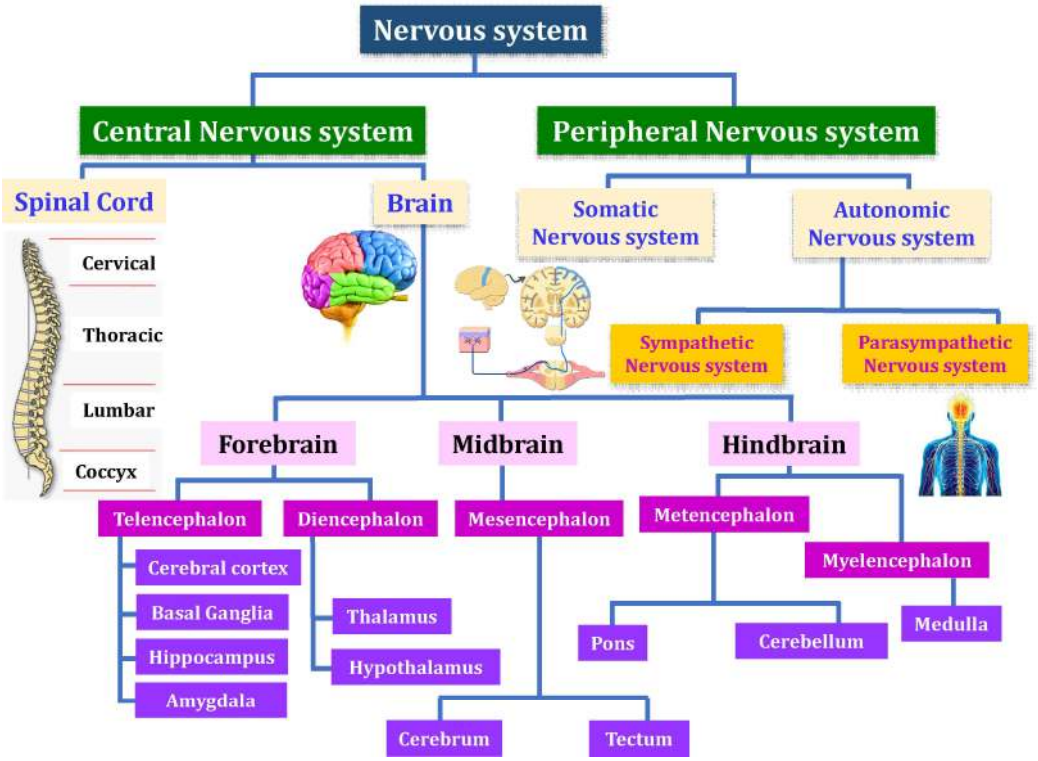
Digestive System

❑ INTRODUCTION

- Digestive system is made up of **gastrointestinal tract (GI tract)** or **alimentary canal** and **accessory organs**, which help in the process of **digestion** and **absorption**.







❑ BRAIN

- The brain is enclosed within the **skull**, which provides **Frontal, Lateral and Dorsal protection.**
- Brain and spinal cord are surrounded by connective tissue membranes called meninges. There are 3 meninges in humans:
- Outer layer called, **Dura mater**
- Very thin middle layer called **Arachnoid**
- Inner layer called **Pia mater.**

BRAIN PART	FUNCTION
Area occipital	Vision
Caudate nucleus	Movement
Putamen	Movement
Thalamus	Emotion
Pulvinar thalami	Sensor system
Cortex cerebri	Thinking
Lobulus parietalis superior	Knowledge
Gyrus frontalis medius	Cognitive function
Cerebellum	Equilibrium
Corpus callosum	Tract
Hippocampus	Limbic system

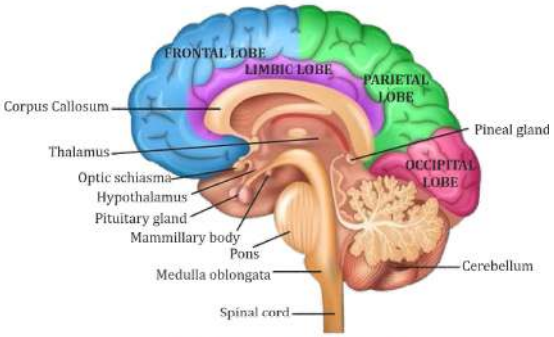
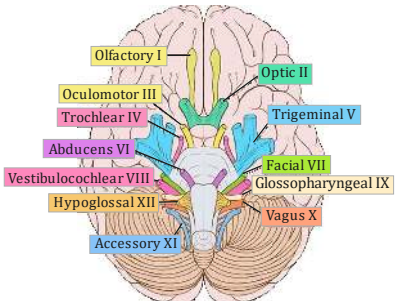


Fig:- Anatomy of Brain

❑ CRANIAL NERVES

- The trigeminal nerve is the **largest cranial nerve**

*** CN = Cranial nerve**
****Both = (Motor + sensory)**



CRANIAL NERVES

TRICK	NAME	TYPES	TRICK	FUNCTIONS
On	Olfactory (CN I)	Sensory	Some	Smell
Occasion	Optic (CN II)	Sensory	Say	Visual
Our	Oculomotor (CN III)	Motor	Marry	Eye movement, Pupil dilation
Trusty	Trochlear (CN IV)	Motor	Money	Vertical eye movement
Truck	Trigeminal (CN V)	Both**	But	Facial sensation facial smell
Acts	Abducens (CN VI)	Motor	My	Lateral movement of eyeball
Funny	Facial (CN VII)	Both**	Brother	Taste, Facial expression
Very	Vestibulocochlear (CN VIII)	Sensory	Says	Hearing + Balance
Good	Glossopharyngeal (CN IX)	Both**	Big	Taste + Gad reflex
Vehicle	Vagus (CN X)	Both**	Brains	Parasympathetic innervations
Any	Accessory (CN XI)	Motor	Matter	Head + Shoulder movement
How	Hypoglossal (CN XII)	Motor	More	Tongue movement

❑ NEUROTRANSMITTERS

Amino acids	GABA	Cerebral cortex, cerebellum, basal ganglia, spinal cord and retina	Inhibitory
	Glycine	Forebrain, brainstem, spinal cord, and retina	Inhibitory
	Glutamine	Cerebral cortex, brainstem and cerebellum	Excitatory
	Aspartate	Cerebellum, spinal cord and retina	Excitatory
	Nitric oxide	Many parts of CNS, Neuromuscular junction and GI tract	Excitatory
Amines	Noradrenaline	Postganglionic adrenergic sympathetic nerve ending, cerebral cortex, hypothalamus, basal ganglia, brainstem, locus coeruleus and spinal cord	Excitatory and Inhibitory
	Adrenaline	Hypothalamus, thalamus and spinal cord	Excitatory and Inhibitory
	Dopamine	Basal ganglia, hypothalamus, limbic system, neocortex, retina and sympathetic ganglia	Inhibitory
	Serotonin	Hypothalamus, limbic system, cerebellum, spinal cord, retina, GI tract, lungs and platelets	Inhibitory
	Histamine	Hypothalamus, cerebral cortex, GI tract and mast cells	Excitatory

❑ WAVES OF NORMAL ECG

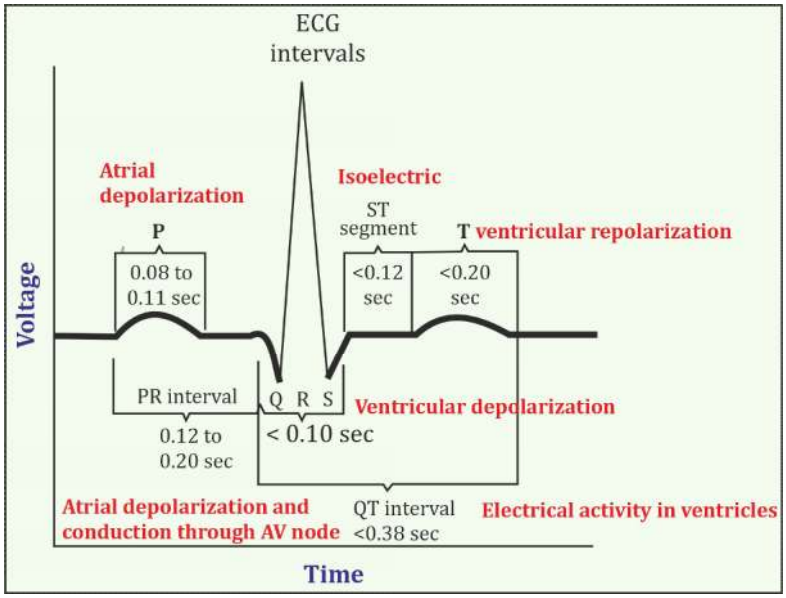


Fig :- ECG Complex Intervals

Lymphatic System

❑ INTRODUCTION

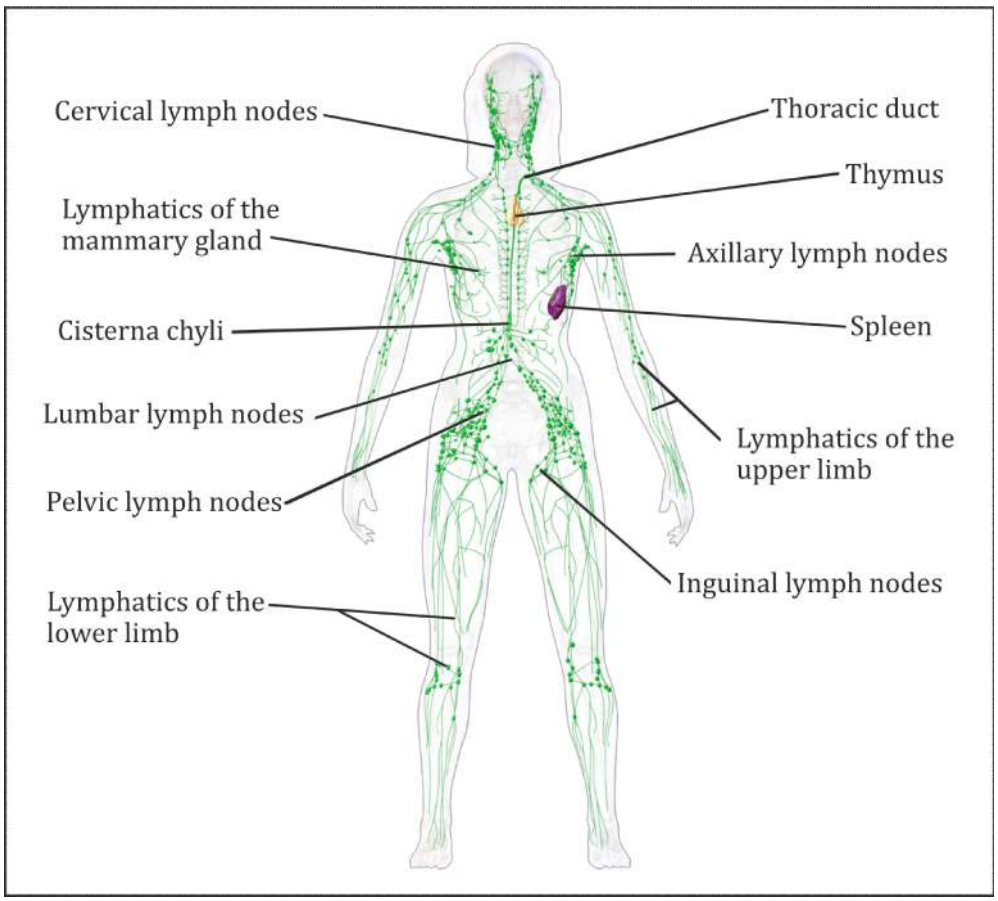


Fig :- Anatomy of Lymphatic System

Pathophysiology

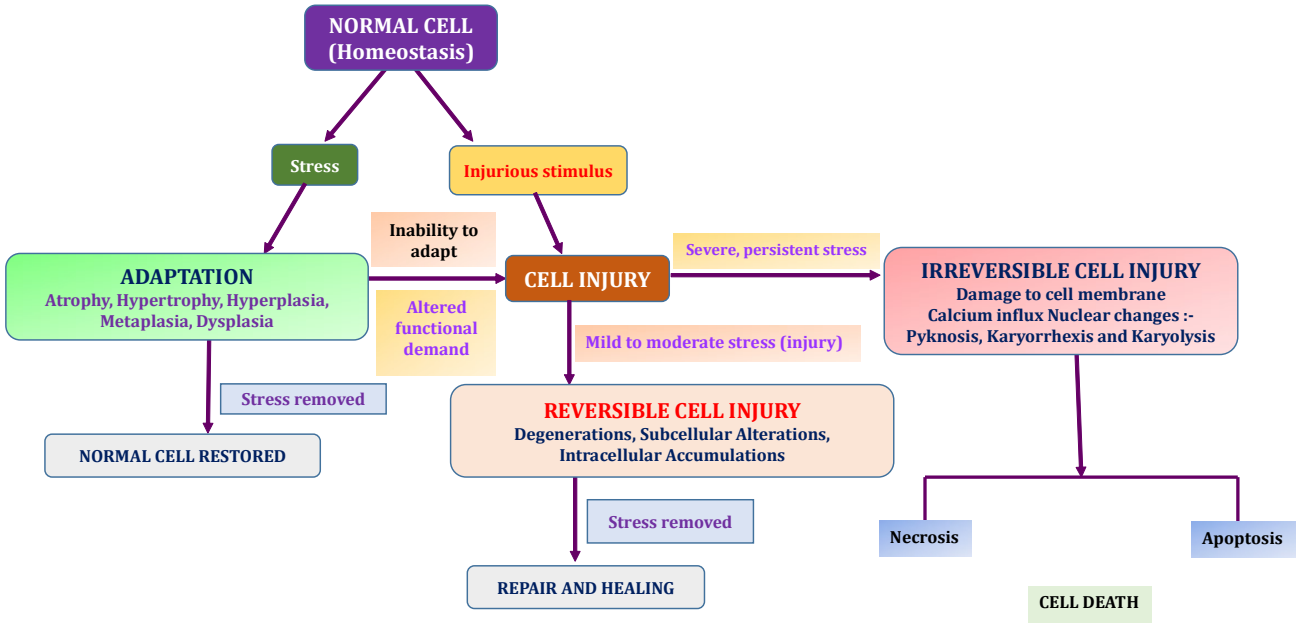
Pathophysiology is a **science dealing** with the **study of diseases.**
Rudolf Virchow coined the term **'Cellular pathology'**

➢ Four important components of pathology are

i. **Etiology** (causative factors)
ii. **Pathogenesis** (mechanism or process by which disease develops)
iii. **Morphology** (appearance of cells, tissues or organs)
iv. **Clinical features.**

Cell Injury & Adaptation

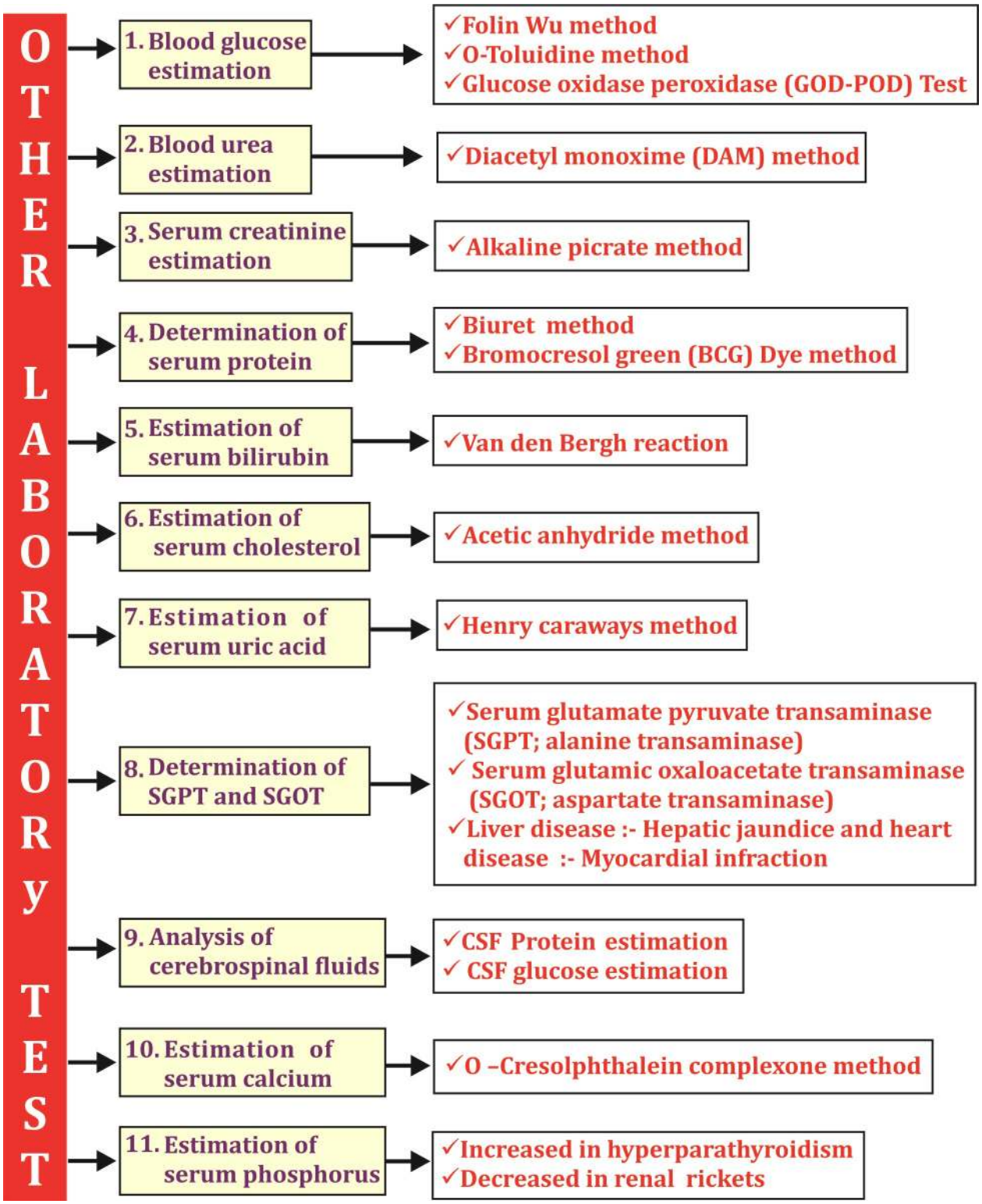
- When the cell is exposed to an **injurious agent/stress/stimulus**, and it **leads to injury of the cell**, it is termed **Cell injury.**



- **Hypoxia :-** Due to **decrease in oxygen supply to the cells.**
- **Ischemia :-** Ischemia is **insufficient blood flow to cells or organs** that to **maintain** their **normal function.**
- The major mechanism of damage to plasma membrane in ischemia is **Increased Ca^{++} ions in the cytosol.**
- **Caseouse necrosis** is a good example of **Structure less necrosis.**

5.	Amenorrhea	**Absence of menstrual period**
6.	Acromegaly	Over production of Growth Hormone in adults
7.	Agranulocytosis	when body doesn't make enough white blood cells (called neutrophils)
8	Apoptosis	A controlled, preprogrammed cell death occur with aging
9	Granulocytopenia	A marked decrease in the number of **granulocytes.**
10	Anaphylaxis	A severe potentially life-threatening allergic reaction
11	Aplastic anemia	Is a condition that occurs when your body stops producing enough new blood cells
12	Anisocytosis	Red blood cells (RBCs) that are unequal in size
13	Angiogenesis	Formation of new blood vessels
14	Bartter's syndrome	Kidney disorder (**inability to reabsorb salts, Na^+, K^+, Cl^-**)
15	Brucellosis	**Bacterial infection spread** from animal to humans
16	Candidiasis	Fungal infection caused by **candida**
17	Cholestasis	A decrease or blockage in the flow of bile.
18	Chemotaxis	The **movement of an organism** in response to a chemical stimulus
19	Choriocarcinoma	Fast growing **cancer** that occur in women's uterus(womb)
20	Catalepsy	Condition characterized by lack of response to external stimuli and muscular rigidity.
21	Cyanosis	Bluish discoloration of the skin and mucous membrane due to lack of oxygen in blood
22	Dyspnea	Shortness of breath
23	Dysmenorrhea	**Cramps and pelvic pain with menstruation**
24	Dysgeusia	An altered or **impaired sense of taste (Taste disorder).**
25	Erythropoiesis	The process through which new red blood cells are created; it begins in the bone marrow.
26	Emphysema	Destruction of alveolar walls and permanent dilation of airspaces distal to terminal bronchioles (Shortness of breath)
27	Fibrosis	Slightly rise in serum transaminase level
28	Gestational hypertension	Pregnancy induced Hypertension
29	Hepatitis	**Elevated liver function**
30	Hypocorticism (Addison's Disease)	A disorder in which adrenal gland doesn't produce enough adrenocortical hormones
31	Hypercorticism (Cushing's syndrome)	A condition that occurs from **exposure to high cortisol level for long time**
32	Infarction	Localized area of tissue death due to lack of blood supply
33	Hemostasis	Stoppage of bleeding or hemorrhage
34	Hemangiosarcoma	A rapidly growing, highly invasive variety of tumor that arises from the cell lining blood vessel.
35	Hemolytic anaemia	Red blood cells are destroyed faster than they can be made
36	Hemosiderin	It is an iron-storage complex that is composed of p digested ferritin and lysosomes

3.	Examination of blood and urine	1. Plasma clearance is seen a. GFR is measured b. Renal plasma flow is measured c. Renal blood flow is measured



Pharmacology

General pharmacology

PHARMACOLOGY - **Science of drugs (Greek : *Pharmacon* - drug, *logos* - discourse in).** It deals wth interaction of exogenously administered chemical molecules with living systems

❑ CONTRIBUTION AND THEIR SCIENTIST NAME

CONTRIBUTION	SCIENTISTS
Father of Indian Pharmacology	Ram Nath Chopra
Father of Indian pharmacy education	Prof. Mahadeva Lal Schroff
Father of Pharmacology	Oswald Schmiedeberg
Father of Chemotherapy	Paul Ehrlich
Father of Medicine	Hippocrates
Founded first institute of Pharmacology	Rudolf Buchheim
Discovery of Penicillin	Alexander Fleming
Discovery of Streptomycin	Selman Waksman
Discovery of Insulin	Banting and Best
Discovery of antimicrobial effect of Prontosil	Gerhard Domagk
Discovery of Homeopathy	Samuel Hahnemann
Discovery of Blood types	Karl Landsteiner
Discovery of Vaccination	Dr. Edward Jenner
Discovery of Neurotransmitters	Otto Loewi

- **ORPHAN DRUG – Used for diagnosis/prevention of rare disease.**
- **Orphan drug** may be life saving for same patient.

Trick – SR DDLg Ka FAN hai		
SR	**DDLg**	**FAN**
S → **S**umatriptan, **S**odium stibogluconate, **S**odium thiosulfate **R** → **R**ifabutin, **R**ifaximin, **R**ituximab	**D** → **D**igoxin antibody **L** → **L**iothyronine (T_3)	**F** → **F**omepizole **A** → **A**mphotericin B **A**zacitidine **N** → **N**itrates, **N**ilotinib

- **ESSENTIAL DRUGS –** According to WHO, drug that **satisfy priority healthcare & need** of majority of the population. eg - Amoxicillin, Ciprofloxacin, Metronidazole
  - **WHO Model List of essential drug** – 1977 (First), 23rd list **2023 (Latest)** → 591 drugs.
  - **India National Essential Drug List** – 1996 (First), revised in 2011, 2015 & **2022 (Latest)** → 384 drugs.
  - **National List of Essential Medicine** – 337 Medicines

❑ TYPES OF RECEPTORS

1. Ligand-gated ion channels (Inotropic receptors)
2. Enzymatic (Tyrosine kinase receptor)
3. Nuclear receptor
4. G-Protein coupled receptor (Metabotropic receptor)

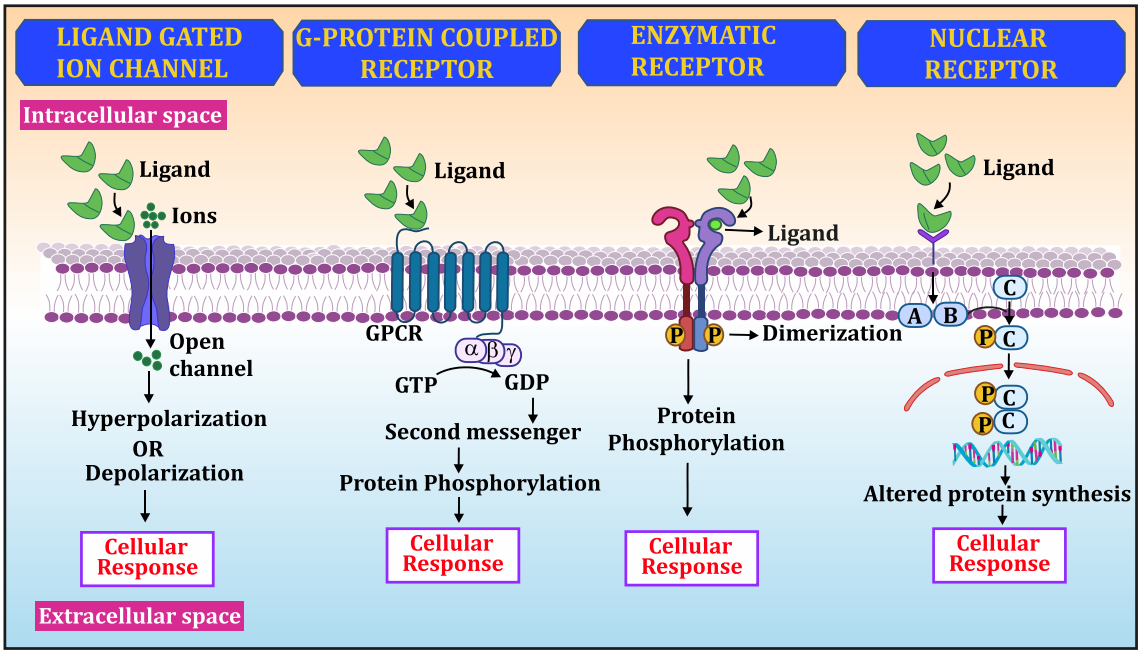
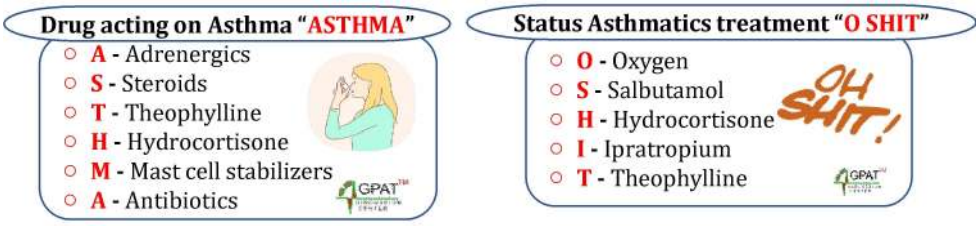


Fig : Types of Receptors

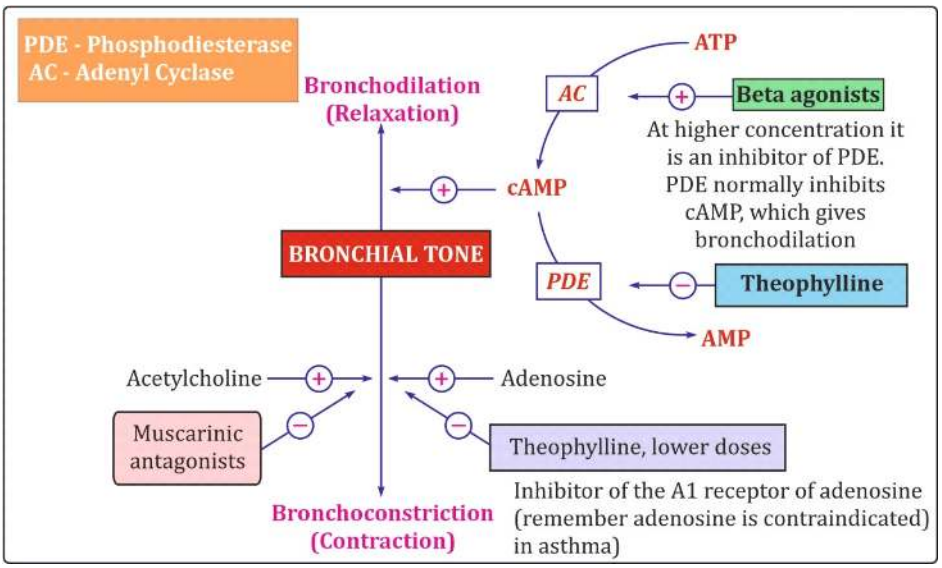
❑ TYPES OF RECEPTORS, THEIR MECHANISM AND EXAMPLES

RECEPTORS	DESCRIPTION	EXAMPLES
Ion channel receptor OR Cell surface receptors OR Ligand gated ion channels OR Inotropic receptor	• **Fastest acting.** • Binding of agonist to ion channel → Opens the ion channel **(Na^+, K^+, Ca^{2+} or Cl^-)** → Flow of ions through channel → causes depolarization/ hyperpolarization → Tissue response.	• **Nicotinic receptor** • Cholinergic receptor • $GABA_A$ receptor • Inhibitory - Glycine receptor • Excitatory - Glutamate (NMDA and AMPA) and $5HT_3$ receptors.
Transmembrane enzyme-linked receptors	• Binding of agonist to extracellular domain of receptor → dimerization of the receptor → stimulates kinase (tyrosine kinase) activity → activates intracellular signaling pathways → gene transcription → tissue response.	• Insulin epidermal growth factor (EGF) • Nerve growth factor (NGF) • **JAK-STAT binding receptors**
Nuclear Receptors - Regulate Gene Expression	• These are intracellular (cytoplasmic or nuclear) soluble proteins which respond to lipid soluble chemical messengers that penetrate the cell.	• **Steroidal hormones** • Thyroxine hormone • Vitamin D and A

3.	**MAST CELL STABILIZER**	• Sod. cromoglycate • Nedocromil • Ketotifen	Inhibit degranulation of mast cells cause **inhibition of release** of inflammatory mediator's PGs, LTs, PAF & Interleukins etc. It also restrict the release of mediators of asthma.
4.	**CORTICOSTEROIDS**	• Hydrocortisone • Prednisolone • Beclomethasone • Flunisolide • Budesonide • Dipropionate • Budesonide • Ciclesonide	Glucocorticoids are **not the bronchodilators**, they benefit by reducing bronchial hyper reactivity, mucosal edema and by suppressing inflammatory response to Ag:Ab reaction.
5.	**ANTI-IgE ANTIBODY**	• Omalizumab	It neutralizes IgE in circulation & IgE is the mediators of inflammation.



❑ TREATMENT OF BRONCHIAL ASTHMA



❑ DRUG OF CHOICE OF SOME RESPIRATORY DISORDERS

DISORDER	DRUG OF CHOICE
Acute Bronchial Asthma	Salbutamol (β_2 agonist)
Chronic asthma	Inhaled corticosteroids
Bronchial Asthma in pregnancy	Salbutamol
Prophylaxis of Bronchial Asthma	Corticosteroids
Exercise-induced asthma	Salbutamol
Aspirin-induced asthma	Salbutamol
COPD	Ipratropium & Tiotropium

❑ CLASSIFICATION OF OPIOIDS

CLASSES	SUBCLASS	DRUGS
Opioid μ receptor agonists	Natural opium alkaloids	Morphine, Codeine, Thebaine*, Papaverine*, Noscapine*
	Semisynthetic opioids	Diacetylmorphine (Heroin), Pholcodine*, Ethylmorphine
	Synthetic opioids	Pethidine (Meperidine), Fentanyl, Methadone, Tramadol, Tapentadol, Remifentanil, Dextropropoxyphene
Complex action opioids	Agonist-antagonist	Nalorphine, Nalbuphine, Pentazocine, Butorphanol
	Partial μ agonist+ κ antagonist	Buprenorphine
	Pure opioid antagonists	Naloxone, Naltrexone, Nalmefene

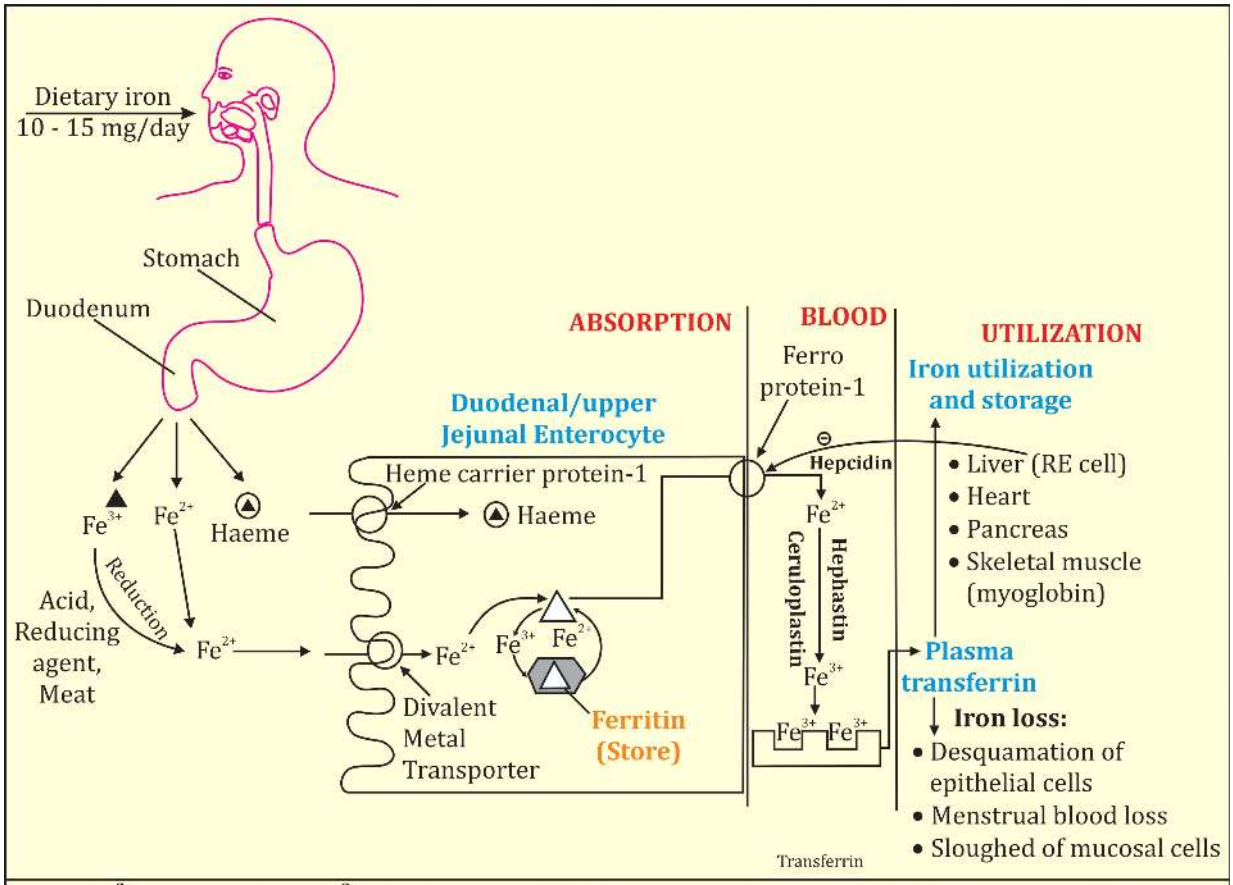
Pharmacological action of morphine
"MARPHINE CVS"

- **M** – **M**eiosis
- **A** – **A**nalgesia
- **R** – **R**espiratory depression
- **P** – **P**hysical and psychological dependence
- **H** – **H**istamine release, Hypotension, Hypothermia
- **I** – **I**tching
- **N** – **N**ausea and vomiting
- **E** – **E**uphoria
- **C** – **C**ough suppressants, Constipation
- **V** – **V**egal Stimulation (Bradycardia)
- **S** – **S**edation and Hypnosis

❑ INDIVIDUAL DRUGS

S. NO.	DRUG	DESCRIPTION
1.	Codeine	• **Less potent (1/10th as analgesic)** than morphine. • Used as **antitussive and antidiarrheal.** • **Constipation** is side effect.
2.	Loperamide	• It is a **pethidine congener.** • Used in the symptomatic **treatment of diarrhea.**
3.	Fentanyl	• A pethidine congener and it is **80 to 100 times more potent** than morphine. • **Transdermal patch** available for cancer or other types of **chronic pain.** • **Remifentanil** is **faster acting** congener of fentanyl.
4.	Pethidine (Meperidine)	• Onset of action is rapid and shorter (2-4 hrs). Less potent than morphine. • Better absorbed than morphine. • Preferred opioid analgesic during labour.

Maturation factors	**Vitamin B_{12}** → Cyanocobalamin Hydroxocobalamin Methylcobalamin Folic acid → Folinic acid (leucovorin, citrovorum factor)
Adjuvant haematinics	Copper, Pyridoxine, Riboflavin



Fe^{2+}: Ferrous iron, Fe^{3+}: Ferric iron, HCP1: Haeme carrier protein 1, Hb: Haemoglobin, RE cell: Reticuloendothelial cell, Fp1: Ferroportin, Tf: Transferrin, TfR: Transferrin receptor

Fig : Iron Absorption and Storage

❑ PREPARATION OF IRON

CLASS	DRUGS
Oral iron	• Ferrous sulfate • Ferrous gluconate (12% iron) • Ferrous fumarate (33% iron) • Colloidal ferric hydroxide (50% iron) • Carbonyl iron
Parenteral iron	Iron dextran, Iron-sorbitol-citric acid.
Other forms of iron present in oral formulations	• Ferrous succinate (35% iron) • Iron choline citrate, • Iron calcium complex (5% iron) • Ferric ammonium citrate (20%) • Ferrous aminoate (10%) • Ferric glycerophosphate • Ferric hydroxyl polymaltose.

❑ MECHANISM OF ACTION OF ANTIBIOTICS

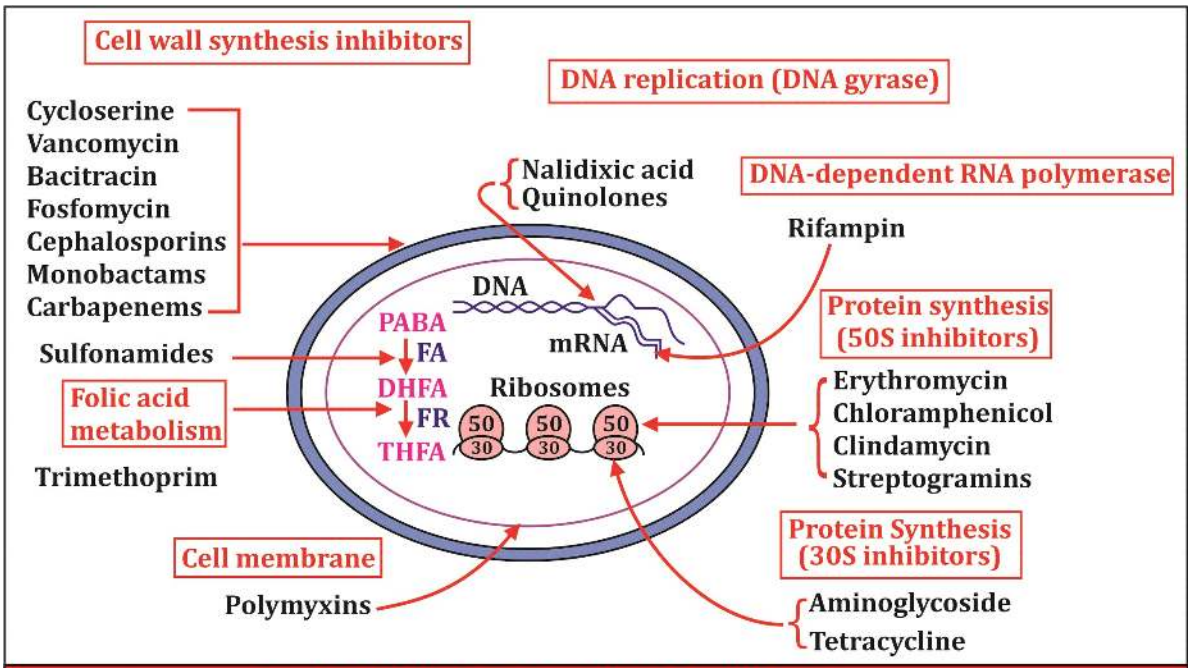


Fig: MECHANISM OF ACTION OF ANTIBIOTICS

❑ **DRUG RESISTANCE :** It refers to unresponsiveness of microorganism to antimicrobial agents.

TYPES OF DRUG RESISTANCE	DRUGS
Tolerance to drug (a) Loss of affinity of the target Molecule	Penicillin, Rifampin
(b) Alternate metabolic pathway	Sulfonamides
Destruction of drug by enzyme	β-lactamase antibiotics, Chloramphenicol, Aminoglycoside, Tetracycline
Impermeability to drug (a) Decrease access into the bacterial cell through porins	Aminoglycoside, Chloroquine, Tetracycline
(b) Active efflux of the drug from cell	Erythromycin, Fluoroquinolones

❑ TOXICITY OF DRUGS

S. NO.	DRUGS	TOXICITY
1.	**Aminoglycoside**	Ototoxicity, Nephrotoxicity
2.	**Tetracyclines**	Hepatotoxicity, Nephrotoxicity
3.	**Chloramphenicol**	Gray baby syndrome, Bone marrow depression, Diarrhoea
4.	**Quinolones**	Phototoxicity
5.	**Bacitracin, Polyenes, Polypeptide**	Nephrotoxicity
6.	**Polymyxin B**	Neurotoxicity, Nephrotoxicity
7.	**Vancomycin**	Redman syndrome, Ototoxicity, Nephrotoxicity
8.	**Penicillin, Cephalosporin**	Hypersensitivity reaction

CEPHALOSPORINS

- The 1st Cephalosporin was obtained from a fungus ***Cephalosporium acremonium.***
- Cephalosporin's are β-lactam antibiotics with **7-aminocephalosporanic acid nucleus.**

❑ CLASSIFICATION OF CEPHALOSPORINS

DRUG	CLASSIFICATION	MECHANISM OF ACTION	ADVERSE EFFECT
CEPHALOSPORIN	**First generation:** **Parenteral**: Cefazolin **Oral**: Cephalexin, Cefadroxil **Second generation:** **Parenteral**: Cefuroxime, Cefoxitin **Oral**: Cefaclor, Cefprozil, Cefuroxime **Third generation:** **Parenteral**: Cefotaxime, Ceftizoxime, Ceftriaxone, Ceftazidime, Cefoperazone. **Oral**: Cefixime, Cefpodoxime, Cefdinir, Ceftibuten **Fourth generation:** **Parenteral**: Cefepime, Cefpirome **Fifth generation:** **Parenteral**: Ceftaroline fosamil, Ceftobiprole medocaril	β-LACTAM ANTIBIOTICS ↓ Binds PBP ↓ Inhibits cross- linking of peptidoglycan ↓ Cell wall deficient bacteria ↓ Undergo lysis ↓ Bactericidal effect	Hypersensitivity reactions, Nephrotoxicity, Diarrhoea, Bleeding, Low WBC count

MNEMONICS

FIRST GENERATION	SECOND GENERATION	THIRD GENERATION
Dr : Cefa**Dr**oxil **Lo** : Ceph**Lo**ridine **Lo's** : Ceph**Lo**thin **X in** : Ceph**aleX**in **Zoo** : Cefa**Zo**lin	**Fa** : Ce**Fa**clor **Lo** : **Lo**racarbef **Ma** : Cefo**Ma**ndole **Ur** : Cef**Ur**oxime **Ta** : Cefote**Ta**n **Xi** : Cefo**Xi**tin **Pr** : Cef**Pr**ozil Note: FaLo (Fallow) Ma Ur (mayur=peacock) Ta Xi (taxi) Pr(per=on)	**Delhi** : Cef**Di**nir, Cefpo**Do**xime **P** : Cefo**P**erazone **M** : **M**oxalactam **T** : Cef**T**riaxone, Cef**T**izoxime, Cefo**T**axime, Cef**T**azidime **Exam** : Cefi**X**ime

❑ IMPORTANT POINTS

- Cefazolin → **Drug of choice for surgical prophylaxis.**
- Cefotetan, Cefmetazole and Cefoxitin are **active against anaerobes like Bactericides fragilis.**
- **Ceftriaxone** → First drug of choice Gonorrhea, salmonellosis (including typhoid), *E. coli* sepsis, Proteus, Serratia, Haemophilus and empirical therapy for bacterial meningitis

	• Relapsing fever (Doxycycline) • Lyme's disease (Doxycycline) • Rickettsial infections (Doxycycline) • Chlamydial infections (Doxycycline)	**E –** Expired drugs can cause Fanconi's syndrome **V –** Vestibular dysfunction (maximum with minocycline)

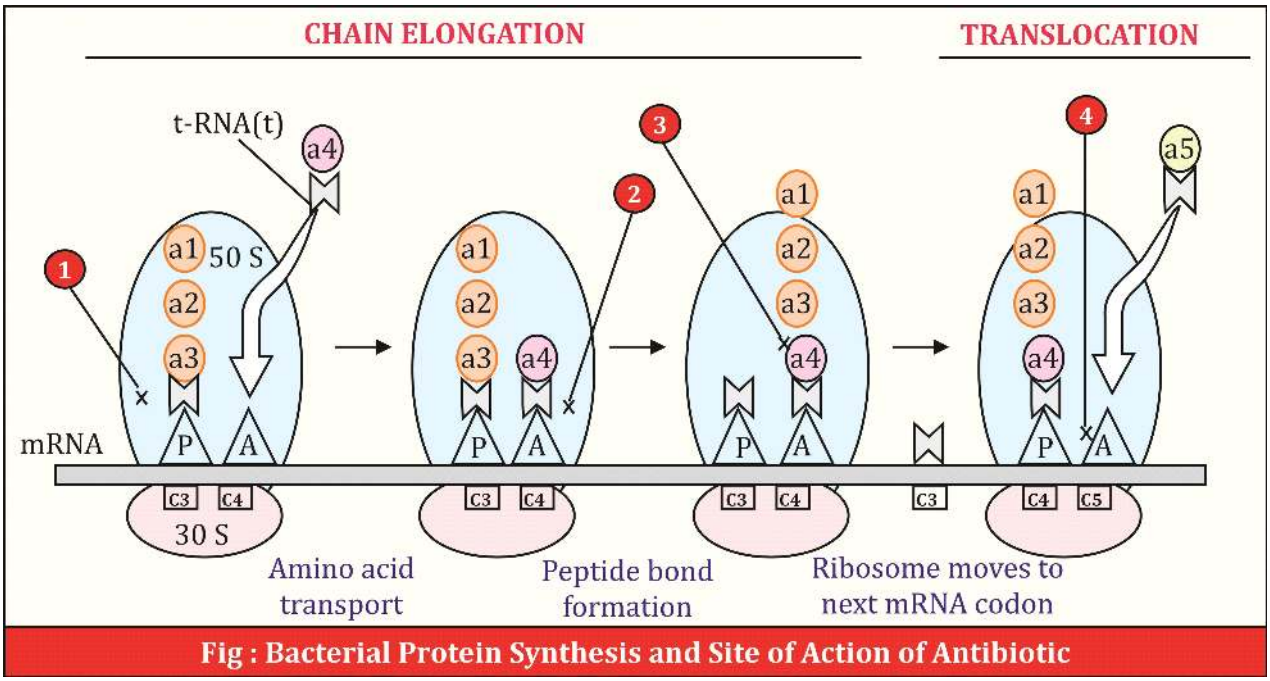
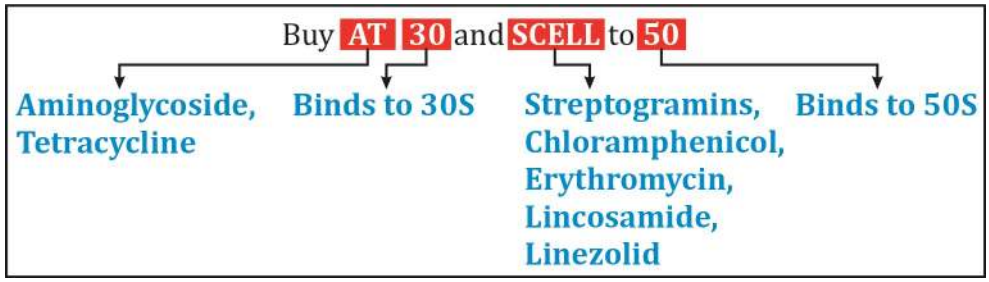


Fig : Bacterial Protein Synthesis and Site of Action of Antibiotic

Freeze initiation	Aminoglycoside
Inhibit elongation	Tetracycline and Chloramphenicol
Inhibit translocation	Erythromycin and Clindamycin



❑ IMPORTANT POINTS

- Tetracyclines having chelating properly so food, dairy products, antacid, Iron preparation etc. **decrease their absorption [except Doxycyclines & Minocycline]**
- All tetracycline are nephrotoxic drugs except **Tigecycline**, **Doxycycline** and **Minocycline** which can be safely used in renal failure.
- Tetracyclines are **extreme photosensitivity**.
- All Tetracyclines are **excreted in urine [except Doxycycline and Minocycline].**
- All tetracycline are **secreted through breast milk**.

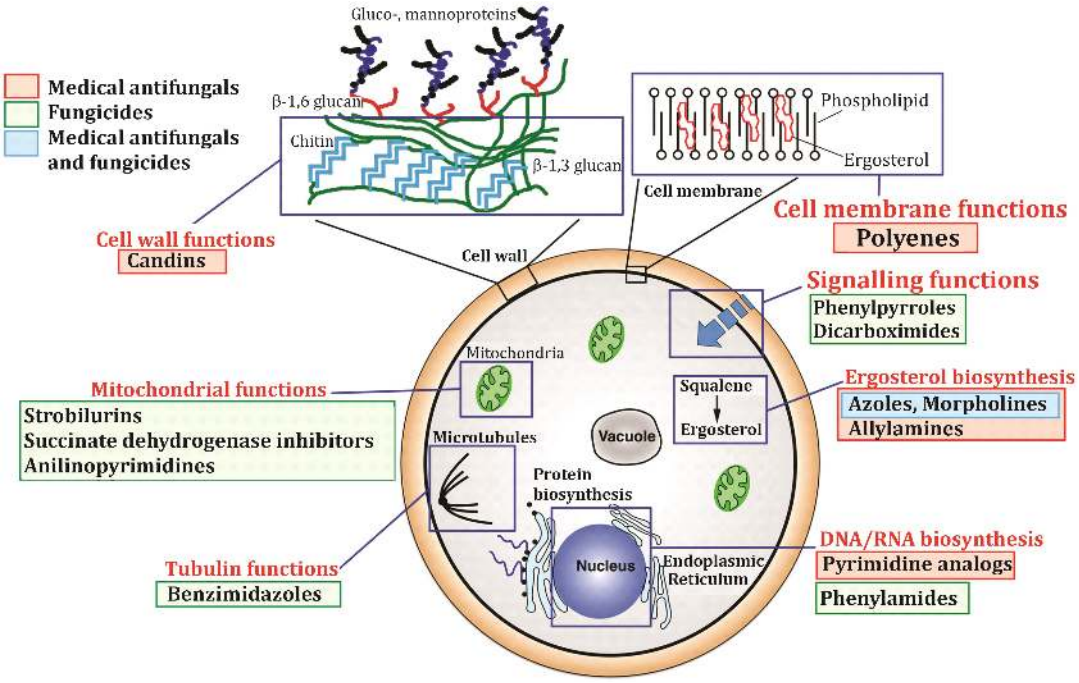


Fig : Mechanism of Antifungal Drugs

❑ CLASSIFICATION AND MECHANISM OF ACTION OF ANTIFUNGAL DRUGS

CLASS	DRUGS	MECHANISM OF ACTION
Antibiotics	**Polyenes:** Amphotericin B	It binds the ergosterol and alter the permeability of cell membrane which lead to leakage off ions and macromolecules causing destruction of fungal cell wall.
	Echinocandins: Caspofungin, Micafungin Anidulafungin	It inhibits synthesis of β-1,3 glucan which is the unique component of fungal cell wall.
	Heterocyclic benzofuran: Griseofulvin	Cause abnormal metaphase configuration. (Interfere with mitosis)
Antimetabolites	Flucytosine (5-FC)	After uptake into fungal cell converted into 5 FU and then 5-fluorodeoxyuridylic acid which inhibit the thymidylate synthetase and interfere with DNA synthesis.
Azoles	**Imidazole:** Clotrimazole, Econazole, Miconazole, Oxiconazole, Ketoconazole **Triazole:** Fluconazole, Itraconazole, Voriconazole	They Inhibit the enzyme lanosterol 14-demethylase and thus impair ergosterol synthesis leading to cascade membrane abnormalities in the fungus.
Allylamine	Terbinafine	It acts as selective non-competitive inhibitor of squalene epoxidase, inhibiting the synthesis of lanosterol & indirectly inhibit the biosynthesis of ergosterol.

Exo-erythrocytic cycle	• Some the **exo-erythrocytic cycle outside RBC.** • Schizonts remains dormant in **liver and this dormant hepatic stage** is Exo-erythrocytic stage is **Responsible for relapse of malaria**, Exo-erythrocytic stage is absent in *P. falciparum.* So relapse do not occurs. • These drugs kill the exo-erythrocytic form. *eg* - **Primaquine**.

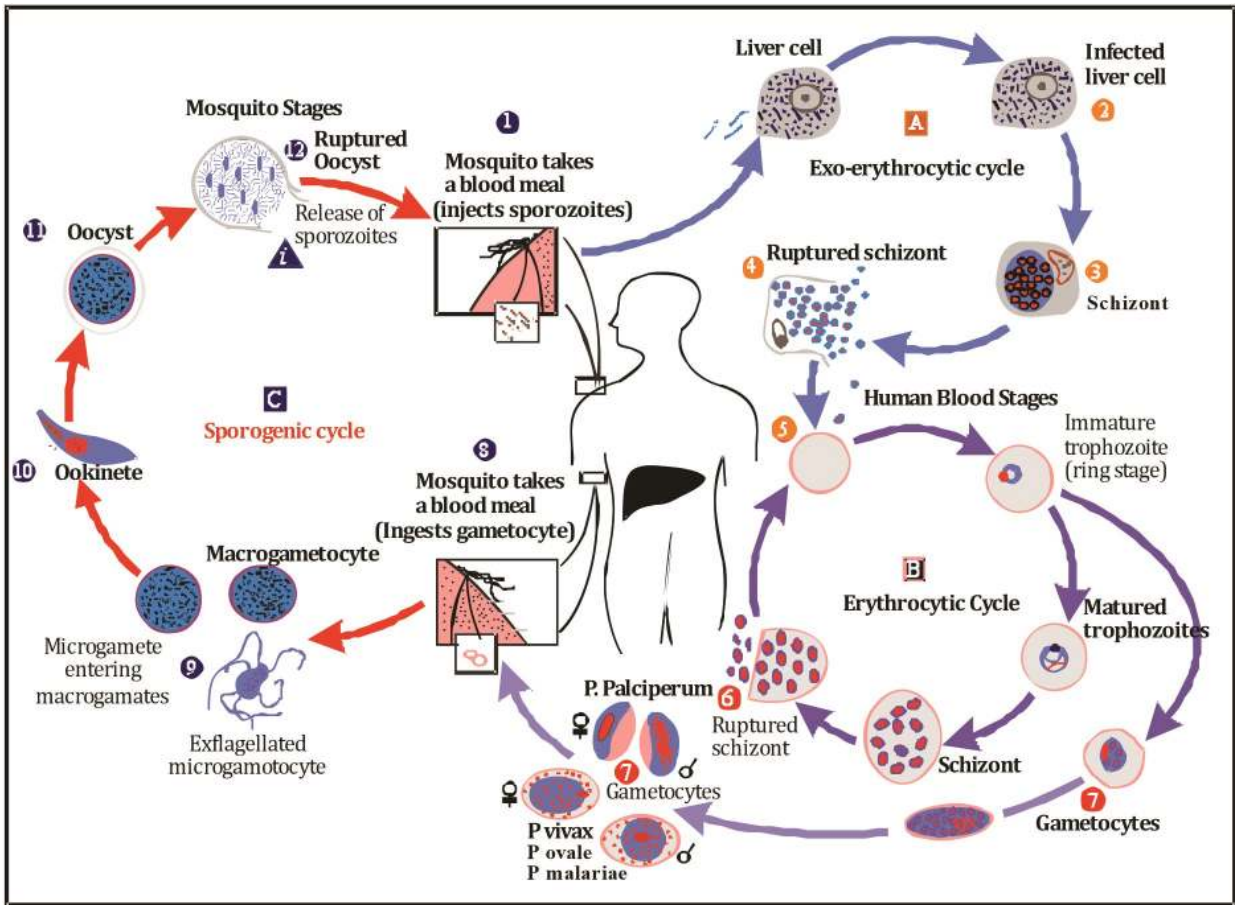


Fig : Life cycle of Malarial Parasite

❑ CLASSIFICATION AND MECHANISM OF ACTION OF ANTIMALARIAL DRUGS

CLASS	DRUGS	MECHANISM OF ACTION
4-Aminoquinolines	Chloroquine (CQ), Piperaquine, Amodiaquine (AQ)	It prevents polymerization of heme to hemozoin resulting in accumulation of heme that is toxic for the parasite
8-Aminoquinolines	Primaquine, Tafenoquine	
Quinoline-methanol	Mefloquine	
Cinchona alkaloid	Quinine, Quinidine	
Biguanide	Proguanil (Chloroguanide)	Act by inhibiting DHFRase enzyme
Diaminopyrimidine	Pyrimethamine	Act by inhibiting DHFRase enzyme
Sulfonamides and sulfone	Sulfadoxine, Dapsone, Sulfamethopyrazine	Inhibits folate synthetase

❑ IMPORTANT POINTS

- Chloroquine is rapidly acting **erythrocytic schizonticide** against all **species of *plasmodium*.**

Pharmacognosy

Introduction of Pharmacognosy

- Pharmacognosy is defined as the scientific study of the **structural, physical, chemical and biological characters of crude drugs** obtained from natural source (plant, animal and mineral and marine). Derived from greek word

HISTORY OF PHARMACOGNOSY

 Dioscorides	**Father of Pharmacognosy** (Materia Medica - In 19th century covered about 600 plant drug along with some animal & mineral product's).
 Papyrus Ebers	Oldest document containing 700 medicinal herbs and more than 870 formulae.
 Seydler	A German scientist ,who coined the term "Pharmacognosy" in 1815 in the title of his work "Analecta Pharmacognostica".
 Theophrastus	**Father of Botany** Know for his studies on plant kingdom.
 Aristotle	**Father of Zoology, Father of Natural History** Wrote on animal kingdom.
 Hippocrates	**Father of Medicine** Contribution on anatomy and physiology of human beings.
 Galen	**First pharmacist, Father of Experimental Physiology** Described the different methods of preparation containing active constituents of crude drugs. The branch dealing with extraction of plant and animal drugs known as Galenical Pharmacy.
 Swede Linnaeus	Classified plant and introduce the system of naming of the plant (Binomial nomenclature).
 Bentham & Hooker	**Plant classification** was further developed by them.

❑ BIOSYNTHESIS OF GLYCOSIDES

CLASS	PATHWAY	PRECURSOR	EXAMPLE
Anthraquinone	Acetate	Polyketide	Rhein, Aloe-emodin, Emodin
Cardioactive sterol	Acetate mevalonate	Squalene	Digitoxigenin, Digoxigenin
Saponins	Acetate mevalonate	Squalene	Diosgenin
Flavonoids	Shikimic acid	Cinnamoyl – Coa	Quercetin, Hesperidin, Kaempferol
Cyanogenetic	Shikimic acid	Phenylalanine and tyrosine	Amygdalin and Prunasin
Coumarin	Shikimic acid	Cinnamic acid	Psoralen, Khellin
Isothiocyanate	Amino acid	Methionine and Phenylalanine	Sinigrin

ADULTERATION AND EVALUATION OF CRUDE DRUGS

Adulteration is broadly defined as **admixing or substitution of original or genuine drugs with inferior, defective or otherwise useless, worthless or harmful substance.**

Deterioration	It refers to the **change in drug quality**
Admixture	It refers to **addition of one or more items to the drug either due to ignorance or carelessness**
Sophistication	Intentional adulteration meant for material gains
Substitution	Some other drug is presented as the original drugs
Inferiority	It Refers to any substandard drug and spoilage is due to the attack of microorganisms

TYPE OF EVALUATION

Morphological
- **Colour**
- **Odour**
- **Taste**
- **Size,**
- **Shape**
- **Special feature**
- **Texture**

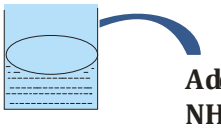
Microscopical
- **Leaf Constants** or Diagnostic Characters of leaves
- **Stomata**
- **Trichomes**
- **Calcium Oxalate Crystals**
- **Quantitative Microscopy**
- (Lycopodium Spore Method)

Chemical
Detection of
- **Alkaloids,**
- **Glycosides,**
- **Phytosterols,**
- **Fixed oil & Fats,**
- **Saponins,**
- **Tannins,**
- **Gum,**

Physical
- **Moisture Content**
- **Viscosity**
- **Melting Point**
- **Solubility**
- **Optical Rotation**
- **Refractive index**
- **Ash Values**
- **Ash content**
- **Extractives**

Biological
- **Hepatoprotective**
- **Hypoglycaemic**
- **Anti-fertility**
- **Anti-inflammatory**
- **Neuropharmacological activity**

❑ CHEMICAL TEST FOR GLYCOSIDES

ANTHRAQUINONE GLYCOSIDES			
Borntrager's test: (break –C- O-bond)	Drug → Boiled with dil. H_2SO_4 → Get filtrate after flitration → Add chloroform or ether → Organic layer is separated → Add NH_3 → Ammonical Layer become pink due to anthraquinone 		
Modified Borntrager's test : (break –C- C-bond)	In this acid + $FeCl_3$ use to break the –C-C- bond		
RHUBARB	**FLUORESCENCE (in U.V light)**	**CHEMICAL TEST AND ACTIVITY**	**OTHER FEATURES**
Rhapontic (Chinese)	**Blue**	Contain **rhaponticin having strong estrogenic activity**	Sweet odour
Indian	**Deep violet**	Not contain **Rhaponticin, the characteristic odour** of the essential oil is due to the presence of eugenol	Orange brown cork cells
Other test for rhubarb	Shows red colour with addition of alkali, Give positive result for Modified Borntrager's test		

ALOES	VARIETY OF ALOES			
	CURACAO	**CAPE**	**SOCOTRINE**	**ZANZIBAR**
Modified Borntrager's test indicate presence of C-glycoside which is aloe emodin	Aq. Solution of drug + $FeCl_3$ + HCl → on hydrolysis gives free anthraquinone which is Collected add organic solvent organic layer separated and shaken with ammonia . **Ammoniacle layer shows rose pink** to cherry colour			
Nitrous acid test (This test is due to isobarbaloin)	Sharp pink to carmine color	**Faint pink**	Very less change in colour	
Nitric acid test	Deep brown red colour	**Brown colour to Green**	Pale brownish - yellow colour	Yellowish brownish
Cupraloin test (Klung's Isobarbaloin test) $CuSO_4$ + NaCl + 90% alcohol	Wine red persisting for 4 hrs	**Faint colour to Yellow**	No colour	

CARDIAC GLYCOSIDES	
DIGITALIS	**DESCRIPTION**
Keller kiliani test (to detect the presence of digitoxose sugar)	**1 gm Drug + 10 ml 70% Alcohol** → (2-3 min.) **Extract + Lead acetate** $FeCl_3$ → (Glacial acetic acid) → **Transferred to a tube containing 2 ml conc. H_2SO_4** → **Reddish Green Color**

Basic Terms of Atomic Structure and Popular Units

❑ POPULAR UNITS & THEIR SI EQUIVALENTS

PHYSICAL QUANTITY	UNIT WITH SYMBOL	EQUIVALENT IN SI UNIT
Mass	1amu	1.6605×10^{-27} kg
Energy	1eV	1.602×10^{-19} joule
Length	1 Å	10^{-10} m (10^{-1} nm)
Volume	1 liter	10^{-3} m^3 = dm^3
Force	1 dyne	10^{-5} N
Pressure	1 atm	760 torr (760 mm Hg)
	1 bar	101325 pa or 10^5 pa
	1 torr	133.322 N m^{-2}

❑ TERMS ASSOCIATED WITH ATOMIC STRUCTURE

TERMS	DESCRIPTION	EXAMPLE
Isotopes	Same atomic number but different mass number	$_6C^{12}$, $_6C^{13}$, $_6C^{14}$
Isobars	Same mass number but different atomic number	$_1H^3$, $_2He^3$
Isodiaphers	Same difference of number of Neutrons & Protons	$_5B^{11}$, $_6C^{13}$
Isotones	Having same number of Neutron	$_1H^3$, $_2He^4$
Isosters	They are the molecules which have the same number of atoms & electrons	CO_2, N_2O
Isoelectronic	Species having same no. of Electron	Cl^-, Ar

❑ MOLE CONCEPT

- A mole is defined as the **amount of substance** which contains **same number of elementary particles** (atoms, molecules or ions) as the **number of atoms** present **in 12g of carbon** (C-12).

$$\text{Number of moles} = \frac{\text{Amount of substance (in gram)}}{\text{Molar mass}}$$

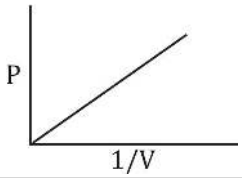
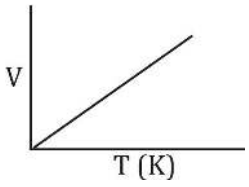
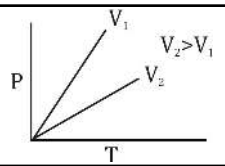
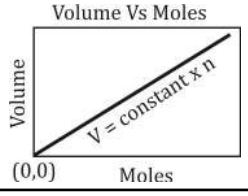
State of Matter

❑ INTERMOLECULAR FORCES

- The forces of attraction existing among the molecules of a substance (gaseous, liquid and solid) are called intermolecular forces.
- The different types of intermolecular forces are-

S.NO	INTERMOLECULAR FORCES	DEFINITION
1	**Dispersion forces or London forces**	Dispersion forces or London forces are present among non-polar atoms and molecules, eg- among the atoms or chlorine molecules These are the weakest intermolecular forces.
2	**Dipole-dipole interactions**	Dipole-dipole forces act between the molecules possessing permanent dipoles.
3	**Dipole-induced dipole forces**	They act between the polar molecules having permanent dipole and the molecules lacking permanent dipole.
4	**Hydrogen bond**	This is found in the molecules in which highly polar N-H, O-H or H-F bonds are present.

❑ GAS LAWS

LAW	DESCRIPTION	RELATION	GRAPH
BOYLE'S LAW	The volume of a given **mass of a gas is inversely proportional to its pressure** at constant temperature.	$V \propto \frac{1}{P}$ $P_1V_1 = P_2V_2$	
CHARLE' S LAW	The volume of a **given mass of a gas is directly proportional to its absolute temperature** at constant pressure.	$V \propto T$ $\frac{V_1}{T_1} = \frac{V_2}{T_2}$	
GAY LUSSAC'S LAW	The pressure of a **given mass of a gas at constant volume is directly proportional to absolute temperature**.	$P \propto T$ $\frac{P_1}{T_1} = \frac{P_2}{T_2}$	
AVOGADRO'S LAW	It states that **equal volumes of all gases under the same conditions** of temperature and pressure contain **equal number of molecules.**	$V \propto n$ $\frac{V}{n} = K$	

Organic Chemistry

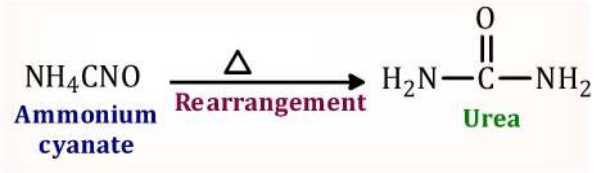
Introduction of Organic Chemistry

❑ INTRODUCTION

- Organic chemistry is the **major branch of chemistry which deals with the scientific study** of **preparation, structure, properties, composition and reactions of carbon containing compounds.**
- In organic chemistry, **not only hydrocarbons** are studied but also compounds in which **carbon is bonded with any other atoms like oxygen, halogens, nitrogen, phosphorus and sulfur etc.**
- Almost **all organic compounds contain atleast one carbon hydrogen bond (C-H)** in it.

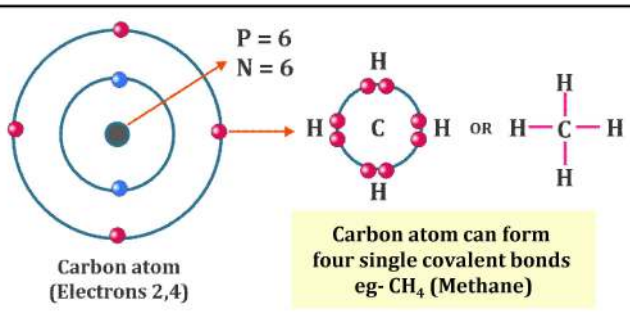
❖ VFT (Vital Force Theory): By Berzelius in 1815.

- Upto 1815, any **organic compound could not be synthesized in lab**. So Berzelius suggested that there is a **mysterious force in living organisms** which was named as **Vital Force** and said that **organic compounds cannot be synthesized in lab.** This theory was called as VFT.
- **But in 1828 a German scientist Wohler synthesized an organic compound in lab.** Which was 'urea'. So VFT was failed. Urea was synthesized in lab by heating of Ammonium cyanate (NH_4CNO).



❖ CHARACTERISTICS OF CARBON ATOMS

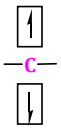
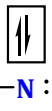
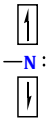
- Atomic number of Carbon - 6
- Electronic configuration - 2,4
- Valence of electrons - 4
- Tendency to form multiple bonds



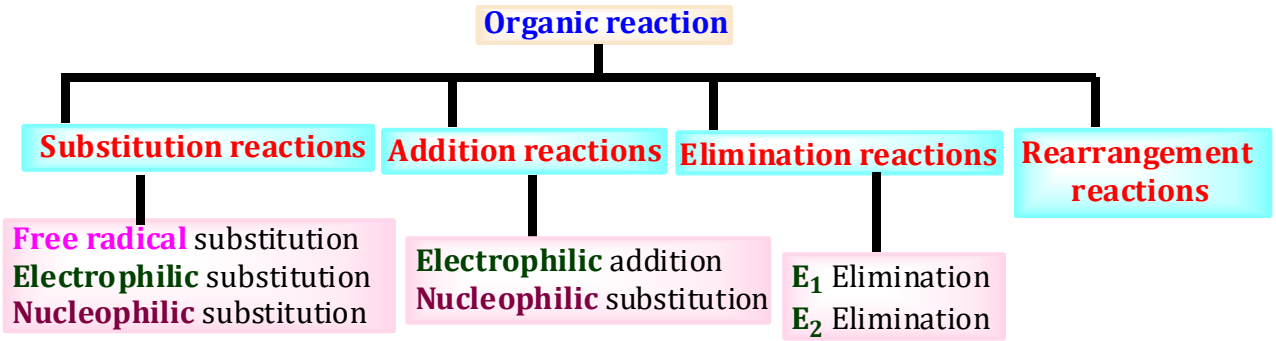
❑ COMPARISON OF CARBOCATION, CARBANION & FREE RADICAL

PROPERTY	CARBOCATION	CARBANION	FREE RADICAL
Representation			
Number of electron	6	8	7
Bond fission	Heterolytic	Heterolytic	Homolytic
Electrical nature	Positive	Negative	Neutral
Hybridization	sp^2	sp^3	sp^2
Shape	Planar	Pyramidal	Planar
Magnetic nature	Diamagnetic	Diamagnetic	Paramagnetic
Reagent	Electrophile	Nucleophile	Electrophile

❑ COMPARISON OF CARBENE & NITRENE

PROPERTY	SINGLET CARBENE	TRIPLET CARBENE	SINGLET NITRENE	TRIPLET NITRENE
Representation				
Nature	Neutral	Neutral	Neutral	Neutral
Number of electron	6	6	6	6
Hybridization	sp^2	sp/sp^2	sp^2	sp/sp^2
Shape	V - Shape	Linear	Linear	Linear
Stability	Less	More	Less	More

Types of Organic Reactions



SUBSTITUTION REACTIONS

Reactions in which **one atom or a group of substrate is replaced** by other atom or group are called as substitution reactions.

(A) Free radical substitution reactions

Substitution reaction in **alkanes show free radical mechanism**

They give following reaction: Halogenation, Nitration, Sulphonation & Chlorosulfonation

Drugs Acting on ANS

- **Autonomic nervous system (ANS)** is **involuntary** in nature and the activity of this is **maintained automatically**
- **The ANS has two divisions** – **Parasympathetic** and **Sympathetic**. Sympathetic system is **more widely** than Parasympathetic activity.

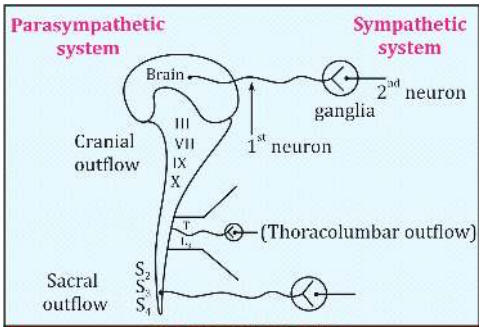
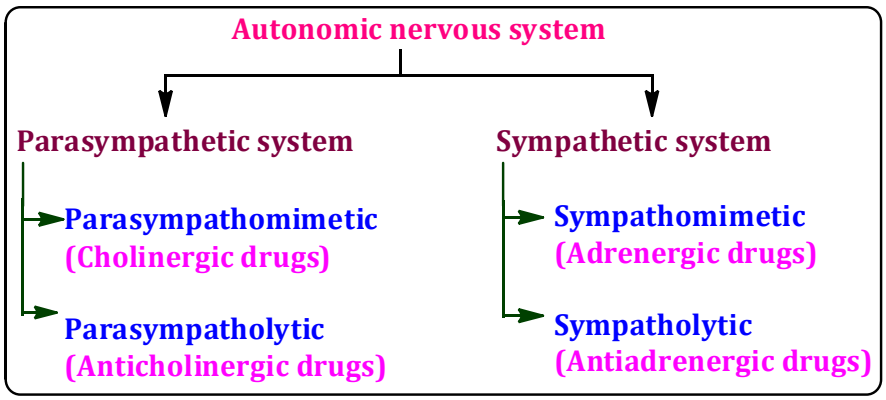


Fig. DIVISION OF ANS



❑ CHOLINERGIC DRUGS (PARASYMPATHOMIMETIC)

- **Acetylcholine receptor** stimulants and **cholinesterase inhibitors** together comprise a large group of drugs, called as **cholinergic drugs** that mimic the actions of **acetylcholine.**
- **Cholinoceptor stimulants** are classified pharmacologically by the spectrum of action depending on the type of receptor **muscarinic or nicotinic.**

❖ Basic moiety of Cholinergic drugs

DRUG NAME	BASIC MOIETY
Acetylcholine	Onium group
Muscarine	Tetrahydrofuran
Pilocarpine	Tetrahydrofuran and imidazole
Physostigmine	Indole and pyrrolidine

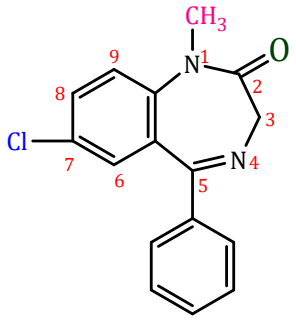
❖ Basic moiety of Sedatives & Hypnotics Drugs

DRUG NAME	BASIC MOIETY
Phenobarbitone, Pentobarbitone, Amobarbital, Barbital and Mephobarbitone,	Barbituric acid
Diazepam, Nitrazepam, Oxazepam & Prazepam	1,4-benzodiazepine-2-one
Chlordiazepoxide	1,4-benzodiazepine-4-oxide

❖ Structures and IUPAC Name of Drugs

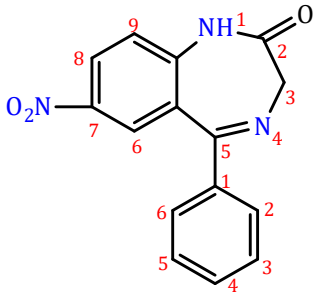
BENZODIAZEPINES

Diazepam



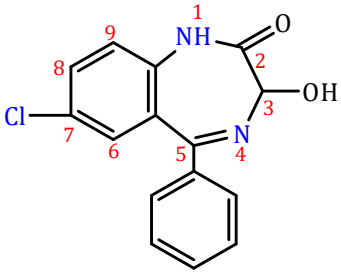
7-Choloro- 1-methyl-5-phenyl 3H- 1,4-benzo diazepin2-one

Nitrazepam



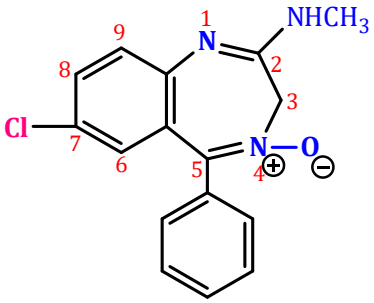
7-Nitro-5-phenyl-1H-1,4-benzo diazepin-2-one

Oxazepam



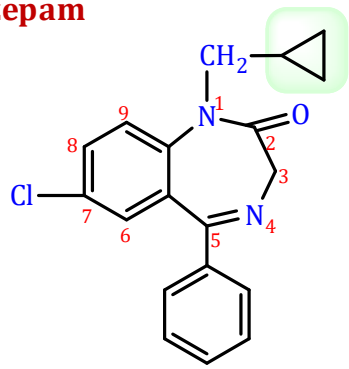
7-Chloro-3-hydroxy-5-phenyl -1,4 benzodiazepine-2-one

Chlordiazepoxide



7-Chloro-2-methylamino-5-phenyl-3H-1,4-benzodiazepine-4-oxide

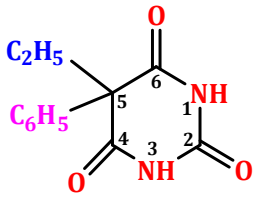
Prazepam



7-chloro-1-(cyclopropyl methyl)-5- phenyl- 2H-1, 4-benzodiazepine -2-one

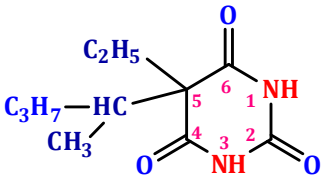
BARBITURATES

Phenobarbitone



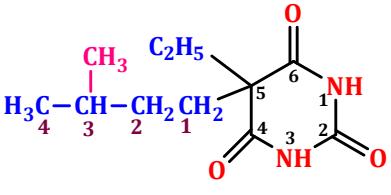
5-Ethyl-5-phenyl barbituric acid

Pentobarbitone

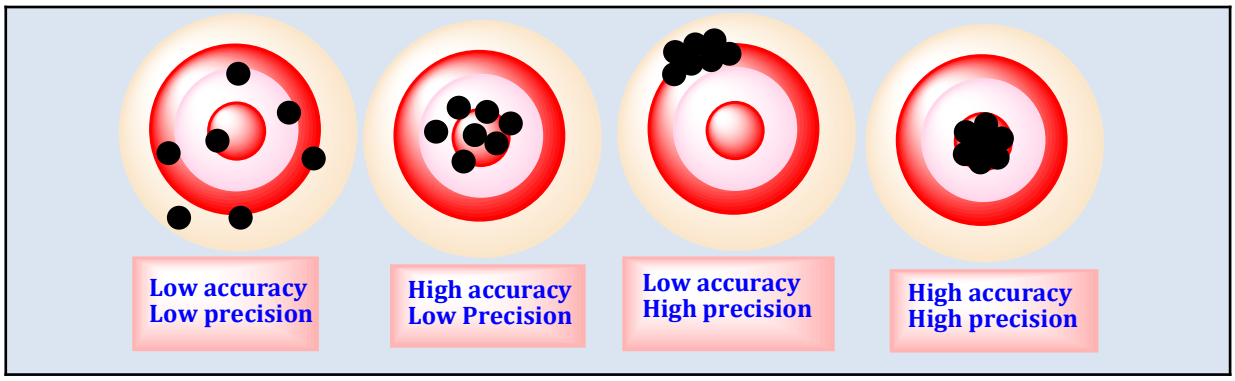


5-Ethyl-5-(1-methylbutyl) barbituric acid

Amobarbital



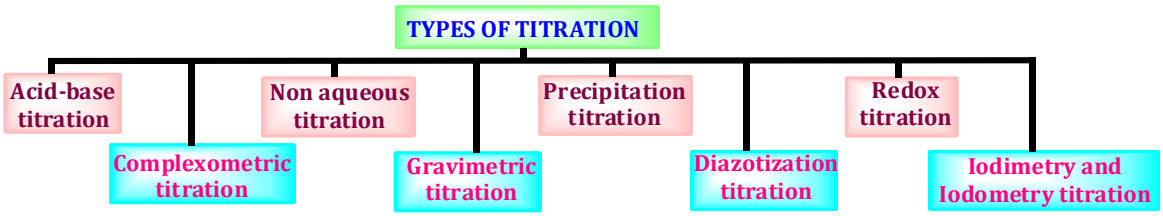
5-Ethyl-5-(3-methylbutyl) barbituric acid



Titration

❖ TITRATION

- A titration is a technique where a **solution of known concentration** (called a titrant) is used to **determine the concentration of an unknown solution.**



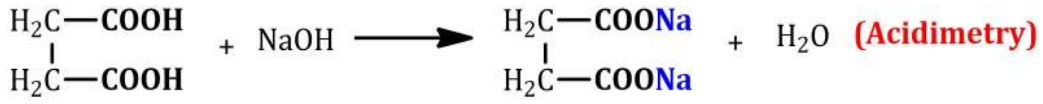
ACID BASE TITRATION

❖ INTRODUCTION

- Also called as **neutralization or aqueous acid-base titrations.**
- Acid-Base titrations are usually used to find the amount of a known acidic or basic substance through acid base reactions.
- It **involves strong or weak acids/bases.**
- Indicator electrode **- Glass electrode**

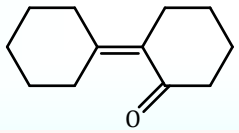
❖ THEORY OF ACID-BASE TITRATION

- A neutralization reaction involves the titration of free base with a standard acid (Acidimetry) and the titration of free acid with a standard base (Alkalimetry)

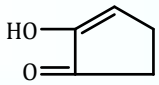
NAME	DESCRIPTION
Acidimetry	Determine concentration of acidic substances by titration with a standard base solution. 

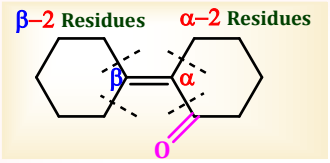
Woodward Fieser Rules for α, β-Unsaturated carbonyl compounds

Q.1

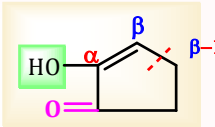


Q.2





α–OH group



Parent value of α, β-unsaturated 6 membered cyclic ketone	= 215nm
1 Ring residue at α-position	=10nm
2 Ring residues at β-position 2 x 12	= 24nm
2 Rings Double bond exocyclic 2 x 5 = 10 nm	
Calculate value	**= 259 nm**
Observed value*	**= 256 nm**

Parent value of α, β-unsaturated 5 membered cyclic ketone	= 202 nm
1 Ring residue at β-position	=12 nm
α-OH	= 35nm
Calculate value	**= 249 nm**
Observed value*	**= 247 nm**

❖ APPLICATIONS

- Detection of impurities
- Structure elucidation of organic compounds
- Structural analysis of organic compounds
- Quantitative and qualitative analysis

IR SPECTROSCOPY

❖ INTRODUCTION

✓ IR is the most **powerful analytical technique** which offers the **possibility of chemi cal identification**

✓ This technique **based upon** the simple fact that a **chemical substance** shows marked **selective absorption in IR region**

Principle - Bending and Stretching
Graph- Transmittance Vs Wave number / Wavelength

❖ RANGE

INFRA RED REGION		
Near infrared (Overtone region)		**0.8 µm to 2 µm**
Middle infrared (Fundamental region)	**Functional region**	**2 µm to 8 µm (1300 – 4000 cm^{-1})**
	Fingerprint region	**8 µm to 15 µm (650 – 1300 cm^{-1})**
Far infrared (Rotational vibration)		**15 µm to 1000 µm**

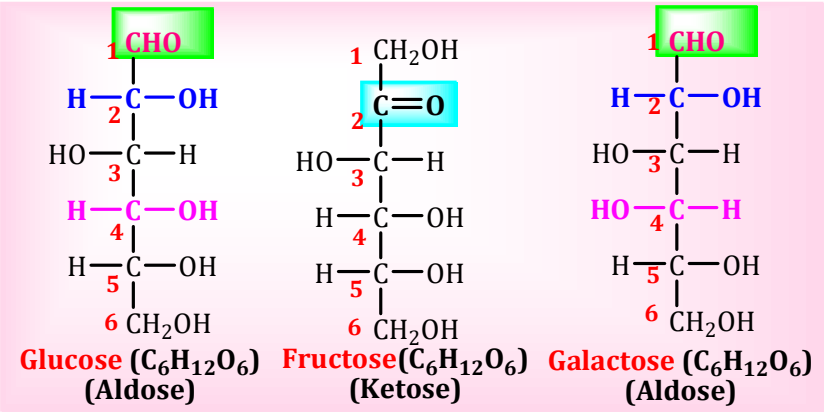
Biochemistry

- **Biochemistry** can be **simply defined** as, **"chemistry of the living cell".**
- **The term Biochemistry was introduced by Carl Neuberg in 1903.**

Carl Neuberg

Carbohydrates

- Carbohydrates are **organic compounds** with **general formula** $C_n(H_2O)_n$.
- Carbohydrates may be **defined chemically** as **aldehyde or ketone** derivatives of **polyhydroxy (more than one hydroxy group) alcohols** or as compounds that yield these derivatives on **hydrolysis.**
- The term **'sugar'** is applied to **carbohydrates soluble in water and sweet to taste.**
- They are the most abundant dietary source of **energy (4 Cal/g) for all organisms.**



❑ CLASSIFICATION OF CARBOHYDRATES

CLASSIFICATION	TYPES	EXAMPLES
MONOSACCHARIDES	Triose ($C_3H_6O_3$)	Glyceraldehyde, Dihydroxyacetone
	Tetrose ($C_4H_8O_4$)	Erythrose, Erythrulose
	Pentose ($C_5H_{10}O_5$)	Ribose, Ribulose, Deoxyribose, Xylose, Xylulose
	Hexose ($C_6H_{12}O_6$)	Glucose, Galactose, Mannose, Fructose
	Heptose ($C_7H_{14}O_7$)	D-Sedoheptulose

Glycogen (Animal starch)	Polymer of **α- D Glucose**	Jointing point - **α (1 → 4)** Branching points - **α (1→6)**
Chondroitin sulphate	**D-Glucuronic acid + N-Acetyl galactosamine 4-sulfate**	-
Dermatan sulphate	**L-Iduronic acid + N-Acetyl galactosamine 4-sulfate**	-
Keratan sulfate	**D-Galactose + N-Acetyl glucosamine 6-sulfate**	-
Heparin sulphate	**D-Glucuronate-2-sulfate + N-Sulfoglucosamine 6-sulfate**	**α – (1→4)**
Hyaluronic acid	**D-Glucuronic acid + N-Acetylglucosamine**	**β (1→3)**

- The **monosaccharide glucose** is **the central molecule in carbohydrate metabolism** since all the major pathways of carbohydrate metabolism are connected with it.

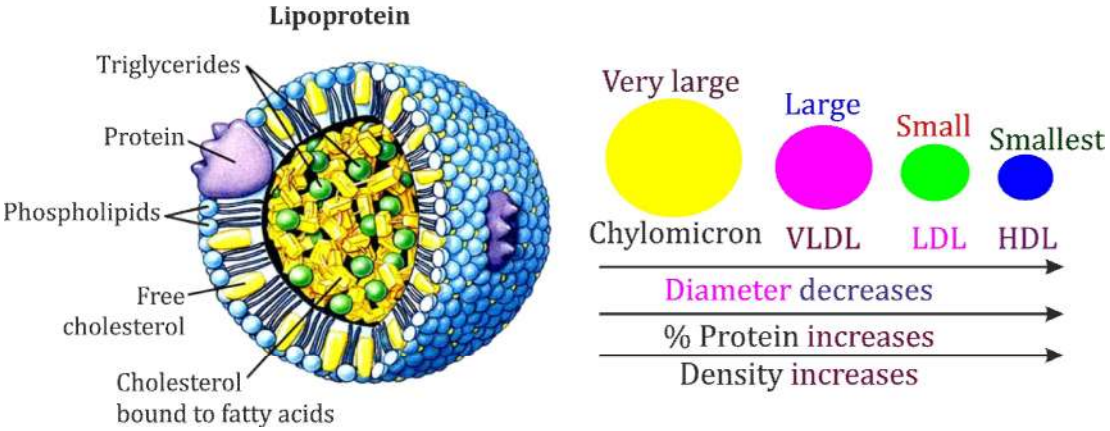
❑ PATHWAYS AND THEIR RATE LIMITING STEP

PATHWAY	DESCRIPTION	RATE LIMITING STEP / ENZYME	LOCATION
Glycolysis	**Oxidation of glucose → Pyruvate & lactate**	Phosphofructokinase	**Cytoplasm**
Gluconeogenesis	**Formation of Non-carbohydrate precursor (amino, glycerol) → Glucose**	Fructose 1, 6 bi-phosphate	**Cytosol / some precursor produced in the mitochondria**
Glycogenesis	**Formation of Glucose → Glycogen**	Glycogen synthetase	**Cytosol**
Glycogenolysis	**Break down of Glycogen → Glucose**	Phosphorylase	**Cytosol**
Citric Acid Cycle (Krebs Cycle)	**Acetyl COA→CO_2 and H_2O**	Isocitrate dehydrogenase	**Mitochondria**
Pentose phosphate pathway (HMP shunt)	**Alternative pathway to glycolysis and TCA cycle for oxidation of glucose**	Glucose 6-phosphate Dehydrogenase	**Cytosol**
Uronic acid pathway	**Conversion of Glucose → Glucuronic acid**	UDP-Glucose 6-dehydrogenase (UGDH)	**Liver**

Essential fatty acid: - Fatty acid that cannot be synthesized by human body, commonly they are polyunsaturated fatty acid (PUFA).

- **Arachidonic acid**
- **Linoleic acid**
- **Linolenic acid**

- **Lipoproteins consist** of a lipid core containing nonpolar **triacylglycerol** and **cholesterol ester** surrounded by a **single layer** of **amphipathic phospholipids** and free **cholesterol molecules** with some proteins **(apoprotein).**



❑ CLASSIFICATION OF LIPOPROTEINS

LIPOPROTEINS	DIAGRAM	DIAMETER (nm)	TRIACYLGLYCEROL (%)	PROTEIN (%)	FUNCTION
HDL (High density lipoprotein)		**10-20**	**12**	**40**	• **Formed** in the liver • Deliver cholesterol from peripheral tissue to liver
LDL (Low density lipoprotein)		**20-25**	**12**	**20**	• Derived from VLDL remnant • They transport cholesterol from liver to other tissues.
VLDL (Very low-density lipoprotein)		**30-90**	55	**10**	• Formed in the liver • Carry endogenous triacylglycerol
Chylomicron		**100-1000**	88	**2**	• Formed in the intestine • Carry dietary triacylglycerol to various tissues

- **Sugars of nucleic acids -** The **five carbon monosaccharides (pentoses) are found** in the nucleic acid structure. **RNA contains D-ribose while DNA contains D-deoxyribose.**

✓ **The nucleic acids are of two main types:**

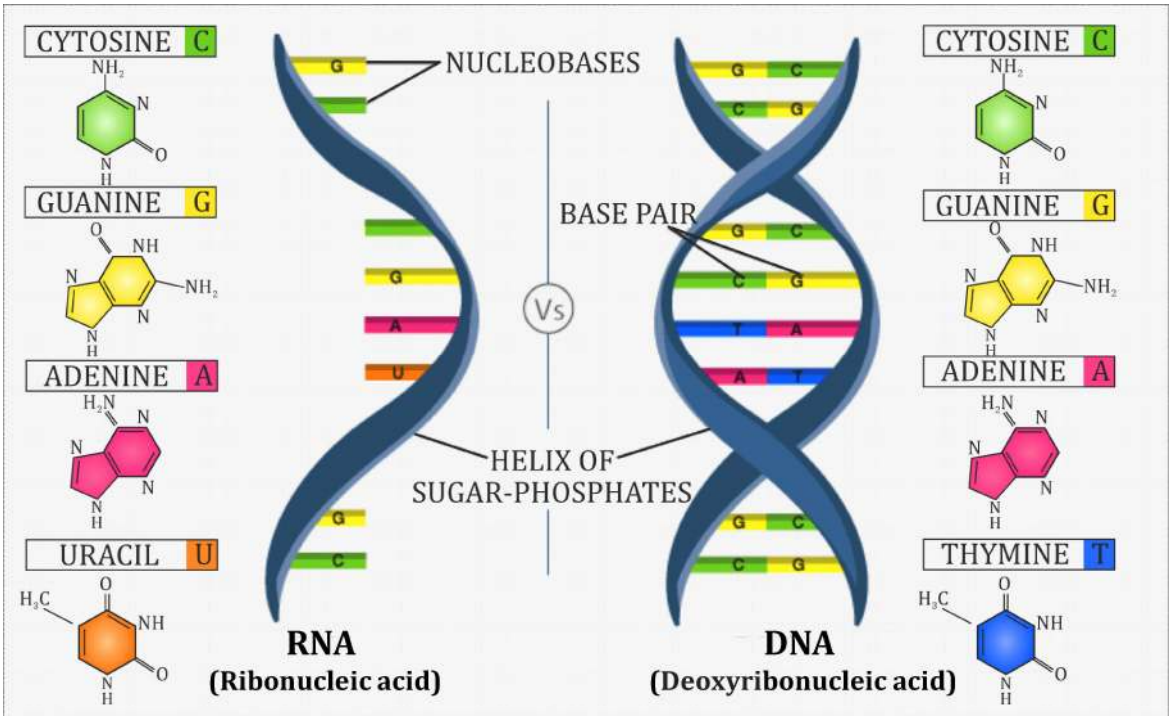
1. **Deoxyribonucleic acid or DNA**
2. **Ribonucleic acid or RNA**

1. Deoxyribonucleic acid or DNA

- **DNA is Basic unit** of genetic information.
- DNA is a polymer of **deoxyribonucleotides.**
- **Double helical structure of DNA** was proposed by **Watson and Crick.**
- Dextrorotatory **(polarized light to right).**

2. Ribonucleic acid or RNA

- RNA is a polymer of ribonucleotides held together by **3',5'-phosphodiester bridges.**
- Most abundant RNA is rRNA, **longest is mRNA** and **smallest are tRNA.**



❑ DIFFERENCE BETWEEN DNA AND RNA CHARACTERISTICS

CHARACTERISTICS	DNA	RNA
Present in	In chromosome & little in mitochondria & chloroplast	Mostly in cytoplasm also in nucleus and ribosome
Strands	**Double (3'→5')**	**Single (5' →3')**
Sugar	**Deoxyribose sugar**	**Ribose sugar**
Nitrogenous base	**A, G, C & T**	**A, G, C, & U**
Transcription	**DNA→ DNA (replication)** **DNA→RNA (transcription)**	RNA dose **not replicate**
Nucleotide	Made up of **large number** of nucleotides up to 4 million	Consist of **less no. of nucleotide** up to 12000

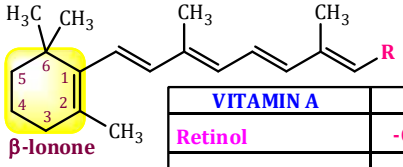
❑ VITAMINS, RINGS, CHEMICAL NAME AND THEIR ACTIVE FORM

VITAMINS	CHEMICAL NAME	RINGS	ACTIVE FROM
Fat Soluble Vitamins			
A	Retinoids	β- ionone ring	Retinol, Retinal, Retinoic, acid
D	Cholecalciferol	Steroidal ring	1,25, dihydroxy cholecalciferol
E	Tocopherol	Chromane ring	α-tocopherol
K	Phylloquinone Menaquinone Menadione	Naphthoquinone	Vitamin K_1 (Phylloquinone) Vitamin K_2 (Menaquinone) Vitamin K_3 (Menadione)
Water Soluble Vitamins			
B_1	Thiamine	Pyrimidine +Thiazole	Thiamine Pyrophosphate (TPP)
B_2	Riboflavin	Isoalloxazine	FMN (Flavin mono-nucleotides), FAD (Flavin adenine dinucleotide)
B_3	Niacin	Pyridine-3-carboxylic acid	NAD^+, $NADP^+$
B_5	Pantothenic acid	Amide between Pantoic acid + β-alanine	Coenzyme A (CoA)
B_6	Pyridoxine	Pyridine ring	Pyridoxal phosphate (PLP)
B_7	Biotin	Imidazole + thiophene	Biocytin (bound biotin)
B_9	Folic acid	Pteridine + PABA+ Glutamic acid	Tetrahydrofolic acid (THF)
B_{12}	Cobalamin	4-Corrin ring	Methyl cobalamin
C	Ascorbic acid	Resemble with hexose	Ascorbic acid

❑ STRUCTURE OF VITAMINS

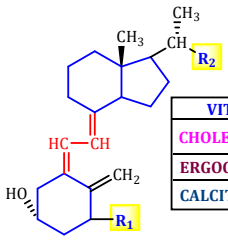
FAT SOLUBLE VITAMINS

VITAMIN A



VITAMIN A	R
Retinol	$-CH_2OH$
Retinal	-CHO
Retinoic acid	-COOH

VITAMIN D



VITAMIN D	R_1	R_2
CHOLECALCIFEROL	-H	$-CH_2-CH_2-CH_2-CH(CH_3)_2$
ERGOCALCIFEROL	-H	$-CH=CH-CH(CH_3)-CH(CH_3)_2$
CALCITRIOL	-OH	$-CH_2-CH_2-CH_2-C(CH_3)_2OH$

Biotechnology

Introduction of Biotechnology

- Biotechnology is a branch of **biology** involving the use of **living organisms** and **bioprocesses** in **engineering**, **technology**, **medicine** and other fields using **bio products**.
- The **father of biotechnology** is **Louis Pasteur**.
- **Insulin** was the **first pharmaceutical product** of **recombinant DNA technology** approved for **human use.**

❑ HISTORICAL BACKGROUND OF BIOTECHNOLOGY

NAME OF SCIENTIST	YEAR	DISCOVERIES
Karl Ereky	1917	Term biotechnology
Robert hooke	1665	Cell
Robert brown	1833	Nucleus (Plant cell)
Johann friedrich	1869	DNA
Watson and crick	1953	DNA structure
Wilhelm ludvig Johannsen	1909	Gene
Thomas hunt morgan	1919	XY (male) , XX (female)
Marshall Nirenberg	1964	Genetic code
William j rutter	1987	Genetically engineered vaccine against hepatits B
Boyer and cohen	1973	Recombinant DNA technology
Kohler and Milstein	1975	Production of monoclonal antibodies
Yuet wai kan	1976	Sickle cell anaemia
Albrecht kossel	1879	Nucleic acid
Edouard van beneden	1882	Specific no. of chromosomes
Oswald T. avery	1944	Genetic information

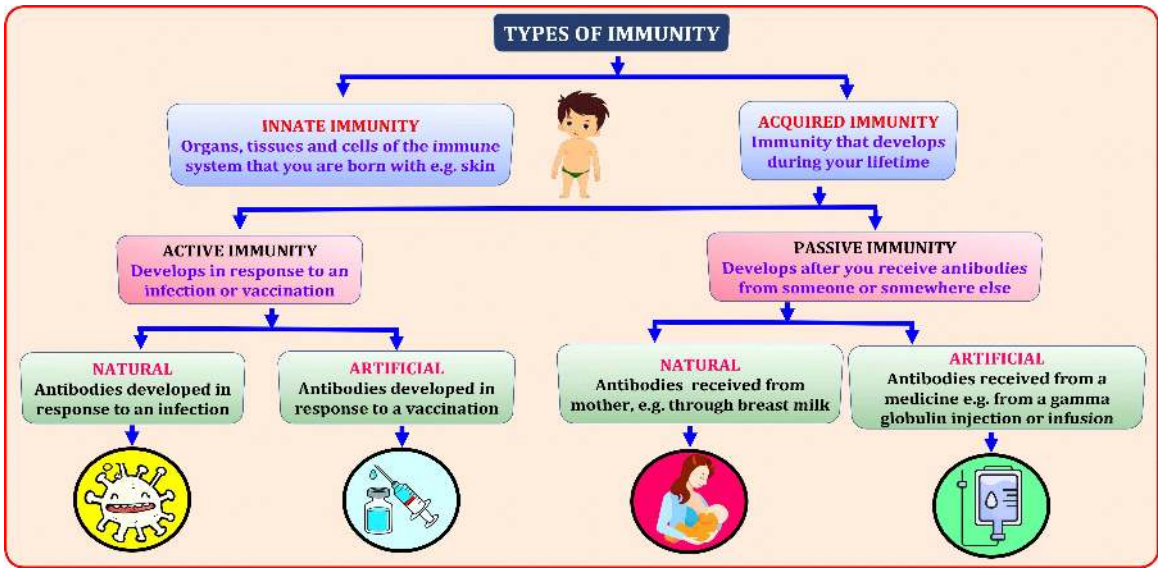
Plant Tissue Culture

- The **father of plant tissue culture** is **Gottlieb Haberlandt (1902).**
- **Plant tissue culture** is a practice used to **propagate plant under sterile condition** often to produce clone of plant.

Renaturation	As the **temperature of the mixture** is slowly **cooled to about 55 ˚c** , the primers base pair with the complementary regions flanking **target DNA strands.**
Synthesis	**Taq polymerase** is commonly used for this purpose. It is done at a temperature of 75-80 ℃ (72℃). The DNA polymerase adds nucleotides in the **5'-3' direction** and synthesis the complementary strand of the **DNA template.**

Immunology

- The **father of immunology** was ***Edward jenner* (1749 – 1823)**
- The **immune system** way of **protecting the body against an infectious disease.**



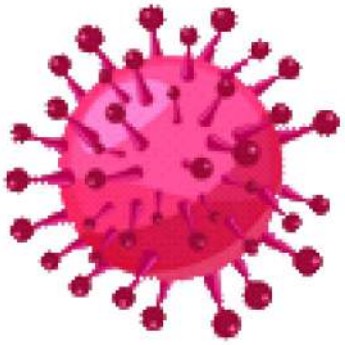
❑ DIFFERENCE BETWEEN INNATE AND ACQUIRED IMMUNITY

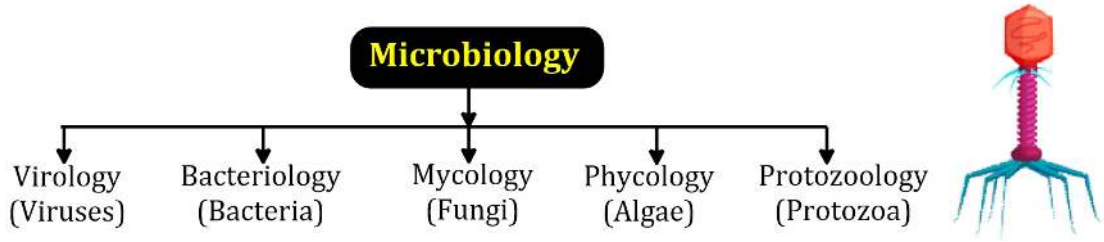
INNATE IMMUNITY	ACQUIRED / ADAPTIVE IMMUNITY
Resistance to infection that an individual **possesses from birth**.	Resistance to infection that an individual acquires **during his lifetime.**
Immune response occurs in **minutes**.	**Immune response** occurs in **days.**
Prior exposure to the antigen is **not required.**	Develops following the **antigenic exposure.**
Diversity is limited, acts through a **restricted set of reactions.**	More varied and **specialized responses.**
Immunological **memory responses are absent.**	Immunological **memory responses are present.**
Components :- Skin, Mucosa, Neutrophils, Macrophages, Monocytes, Natural killer, Mast cells, Dendritic cells and Cytokines (IL-1, IL-6, IL-8, IL-12, IL-16, IL-18)	**Components :-** T cells, B cells and Cytokines (IL-2, IL-4, IL-5, IFN-γ)

Microbiology

Introduction of Microbiology

- Microorganisms are **living organisms** that are usually **too small to be seen clearly with the naked eye.**
- Microrganisms are used to make different products. (e.g. Penicillin, Streptomycin, Chloromycetin), vaccines, vitamins, enzymes and many more important products.
- At present there is general agreement to include five major groups as microorganisms.The subdivisions are
- The diameter of microorganisms are 1 mm or less
- Microorganism play an important role in the recycling of organic and inorganic material like C, N and S cycles, and maintain the stability of the biosphere.





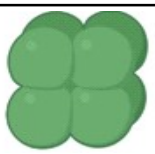
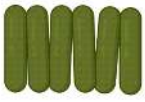
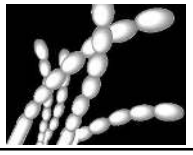
❑ DISCOVERY OF MICROBES & THE DAWN OF MICROBIOLOGY

- The term microbiology was given by French chemist **Louis Pasteur (1822-95).**
- **Antonie van Leeuwenhoek is considered as the "Father of microbiology" & "Father of bacteriology".**
- Pasteur in 1862 suggested that mild heating at **62.8°C (145°F)** for **30 minutes**
- The process was called **Pasteurization.**
- **Domagk** was awarded **Nobel prize in 1939** for the discovery of the **first sulpha drug.**
- Recombinant Hepatitis B vaccine developed in 1982.
- The discovery of microbiology as a discipline could be" traced along the following historical eras:

Discovery **Transition** **Golden** **In 20th Century:**

❑ CLASSIFICATION OF BACTERIA

1. On basis of arrangement

S. NO.	TYPES	BACTERIA	ARRANGEMENT	STRUCTURE	EXAMPLE
1.	SPHERICAL (COCCI) (0.75 to 3 µm)	Micrococci	Occur singly		*Micrococcus*
		Diplococci	Two cell joints together		*Streptococcus pneumoniae*
		Streptococci	Divided in one plane & forms chain like structure		*Streptococcus pyogenes*
		Tetracoccci	In group of four		*Gaffkya tetragena*
		Staphylococci	Grapes like cluster arrangement		*Staphylococcus aureus*
		Sarcina	Arrangement of group of eight cell		*Sarcina ventriculi*
2.	ROD SHAPE (BACILLUS) (0.75 to 10 µm length and 0.75 to 3 µm diameter)	Bacillus	Single cells		*Bacillus cereus, Salmonella chole raesuis*
		Diplobacillus	Pair of bacilli		*Coxiella burnetii, Klebsiella*
		Streptobacillus	Chain of bacilli		*Bacillus subtilis*
3.	CURVED/ SPIRAL	Spirochetes	Spiral shape		*Treponema pallidum*
		Vibrio	Coma shape, curved rod.		*Vibrio cholerae*
		Spirilla	Longer rigid rod with several curve coil. (S shaped)		*Spirillum rupae, Helicobacter pylori*
4.	PALISADE	Corynebacterium	Palisade arrangement		*Corynebacterium*
5.	MOLD LIKE	Streptomycetes	Mold like filament		*Streptomycetes*

14	Framycetin	*Bacillus pumilus* *Bacillus subtilis*	A	32-35° C
15	Neomycin	*Staphylococcus epidermidis*	A	32-35° C
16	Novobiocin	*Staphylococcus epidermidis*	A	32-35° C
17	Oxytetracycline	*Staphylococcus aureus*	A/B	32-35° C
18	Spiramycin	*Bacillus pumilus*	A	32-35° C
19	Tetracycline	*Staphylococcus aureus*	A/B	32-35° C
20	Tylosin	*Staphylococcus aureus*	B	32-35° C

Vaccines and Sera

❑ DEFINITIONS

Vaccines	Vaccine is biological preparation that provide **acquired immunity** to a particular disease. It contain agent resembles to disease causing microorganism. **Edward Jenner** discovered **first vaccine (Small Pox)**
Toxoids	Toxoids are the **inactivated toxin** in which toxicity is suppressed by heat or chemical which promote immune response against bacterial toxins.
Antiserum	Antiserum is **human or non-human blood serum** containing monoclonal or polyclonal antibodies & it acts against many infections by passive immunity
Antitoxin	Antitoxin is antibody with ability to **neutralize a specific toxin**

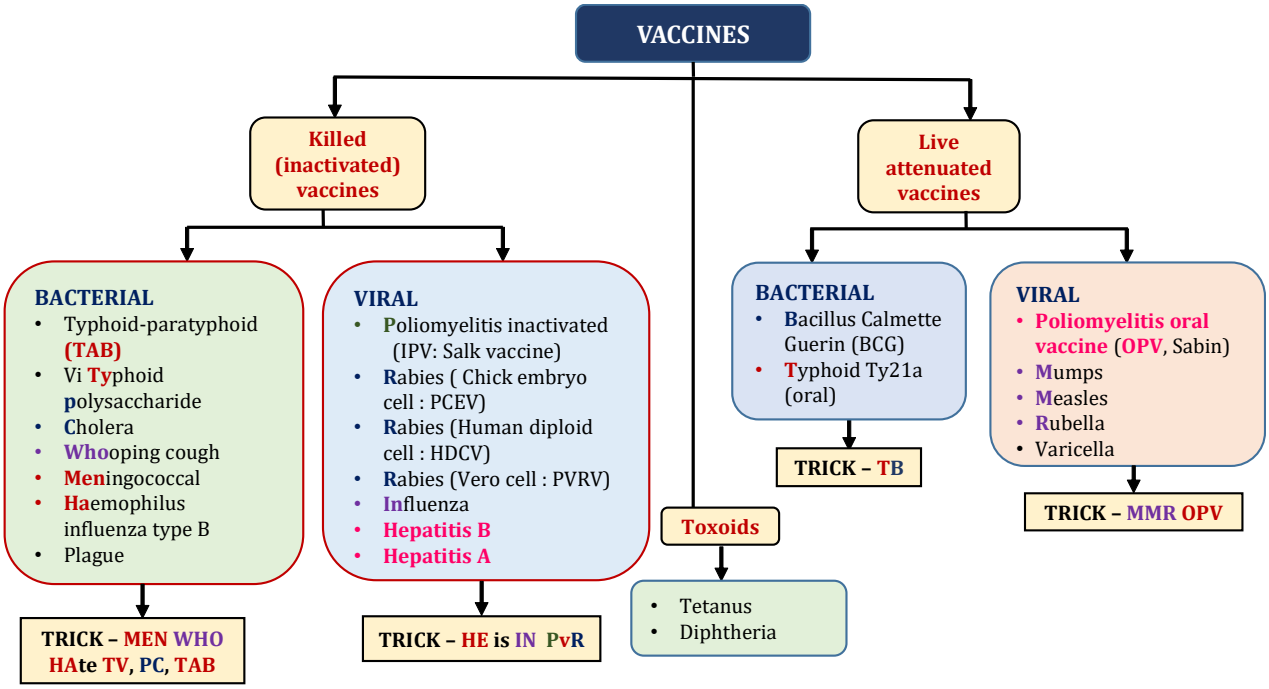


Fig :- Process of MBO

- **MBO** as explained by **Peter Drucker.**
- MBO is most closely associated with **goal setting theory** of work motivation.

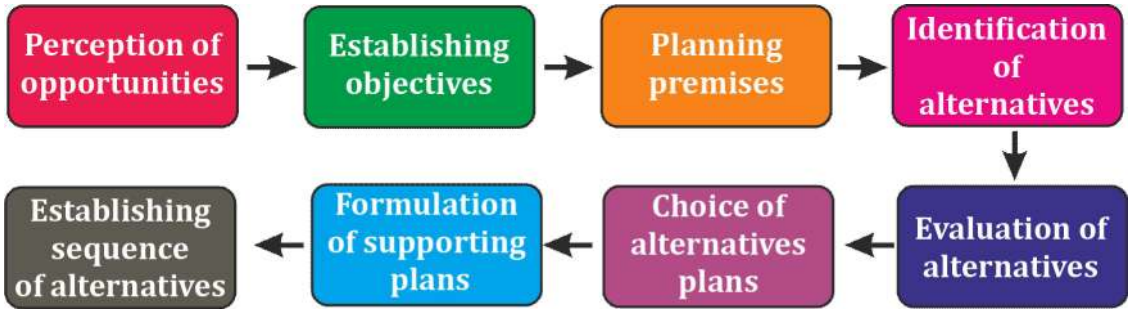
Planning and Forecasting

- Planning is referred to forecasting future circumstances and **requirements, deciding objectives, making long-term and short-term plans, determining policies and setting standards.**

❑ **Planning is classified**

Corporate planning, Functional planning, Strategic Planning, Tactical planning

❑ **Process of planning**



- **Forecasting** is the process of **projecting past sales demand into the future.**

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