



TISHK INTERNATIONAL UNIVERSITY
FACULTY OF APPLIED SCIENCE
MEDICAL ANALYSIS DEPARTMENT

Mechanisms of Drugs' Action

Fall Semester

Course Name: Pharmacology and Clinical Pharmacology (MA 411)

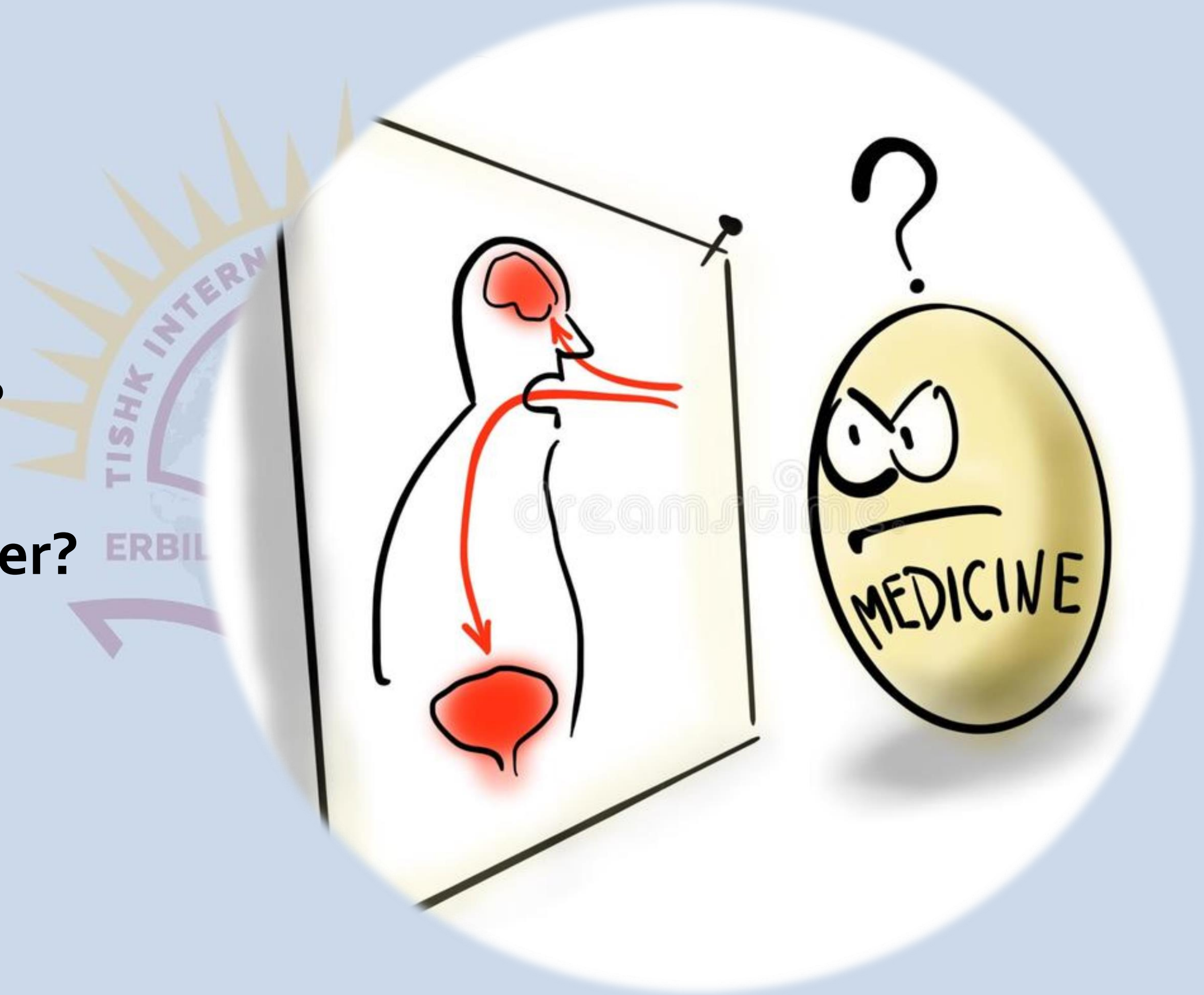
Stage: Grade 4

Lecture: Dr. Jaafaru Sani Mohammed



Expectations

- ✓ From the topic?
- ✓ From the lecturer?



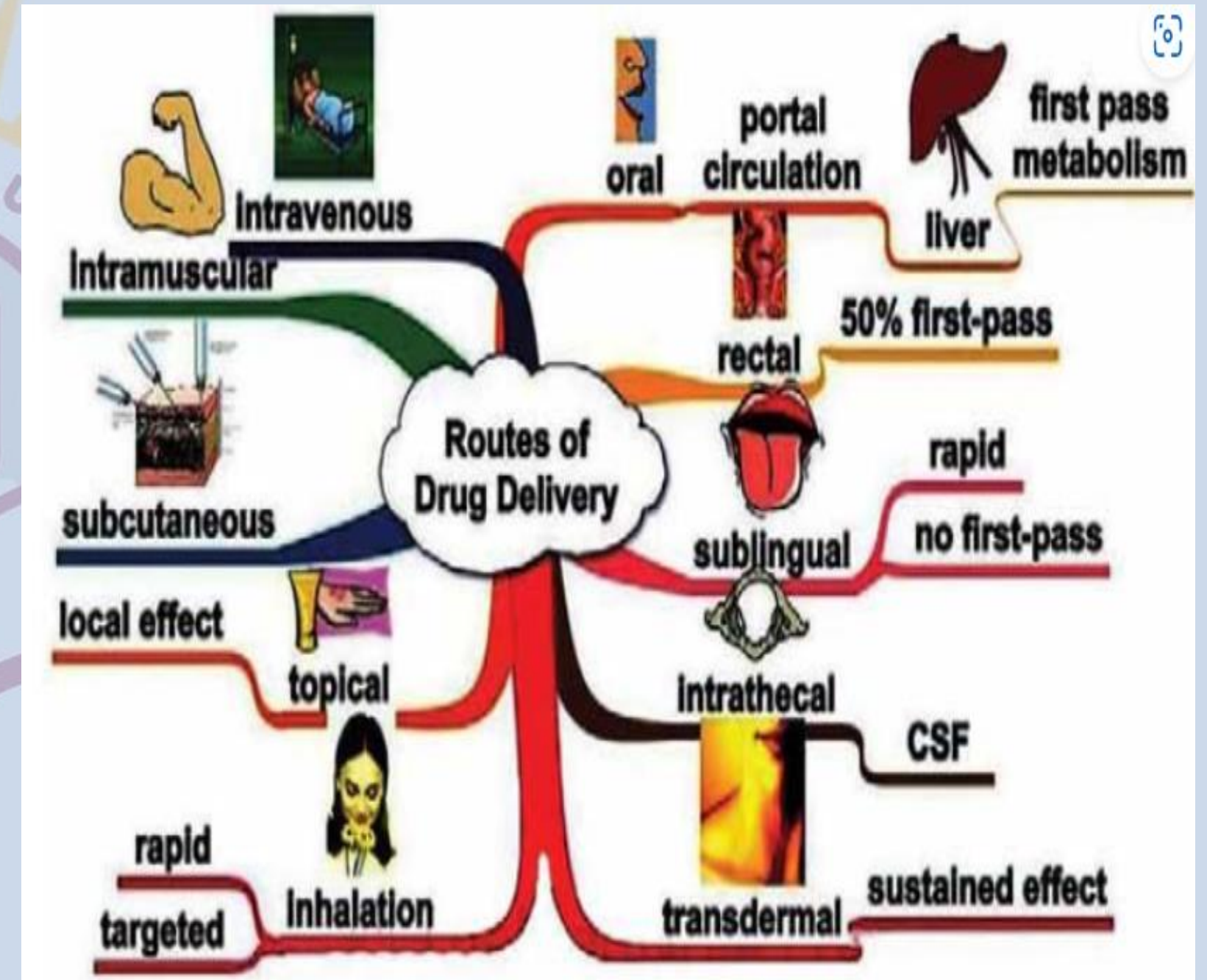
Learning Objectives

The students should be able to understand:

- ✓ Basic principles of drug actions and terminologies involved.
- ✓ Various types of mechanisms through which drugs act.
- ✓ Difference(s) between classic and modern mechanisms of drug actions

Introduction

- ✓ Biochemical reactions through which the drug produces its effects on the target site (Drug mechanism of action).
- ✓ The first requirement for drug action is **drug delivery** to the site of action.
- ✓ Drugs are delivered to their site of action through the body's circulatory system.



Principle of drug action

States that newly administered drug (except genetic-based drugs) does not trigger a new action on the target site or on any cell, tissue, organ, or organ system.

The administered drug, however, changes the pace or speed of ongoing activity.

Principles of drug action include **Stimulation, Depression, Irritation, Replacement, and Cytotoxic action.**

Principle of drug action

☐ Stimulation:

- Administered drug selectively enhances the activity of the specialized cell. E.g.
- ✓ **Adrenaline** selectively enhances the activity of **Heart**.
- ✓ **Pilocarpine** enhances the activity of **salivary glands**.
- ✓ Excess stimulation turns to depression.
(**Picrotoxin- CNS stimulant- Convulsion- coma- death**).

Principle of drug action

☐ Depression:

- It is completely opposite to Stimulation. Here when drug is administered it selectively decreases the activity of the specialized cell. E.g.
- ✓ Quinidine depresses heart,
- ✓ Barbiturates depress CNS and produce sedative and hypnotic effects.

Principle of drug action

- ❑ Irritation: (unwanted noxious effect, undesirable to the human body).
- The non-selective and noxious effect occurs on non-specialized cells such as **epithelial cells and connective tissue.**
- Irritation may be mild or sometimes severe. E.g.
- ✓ Production of bitterness that increases salivary and gastric secretions.
- ✓ However, Counter-irritants produce increased blood flow to the site.

Principle of drug action

- ❑ **Replacement: using other things in place of actual.**
- Pharmacologically, this referred to the use of natural substances such as metabolites, hormones, or congeners in the deficiency state of the actual drug. E.g.:
 - ✓ **Use of L-dopa in place of dopamine during Parkinsonism.**
 - ✓ **Use of synthetic insulin in diabetes mellitus,**
 - ✓ **iron supplement in iron deficient anemia.**

Principle of drug action

☐ Cytotoxic action:

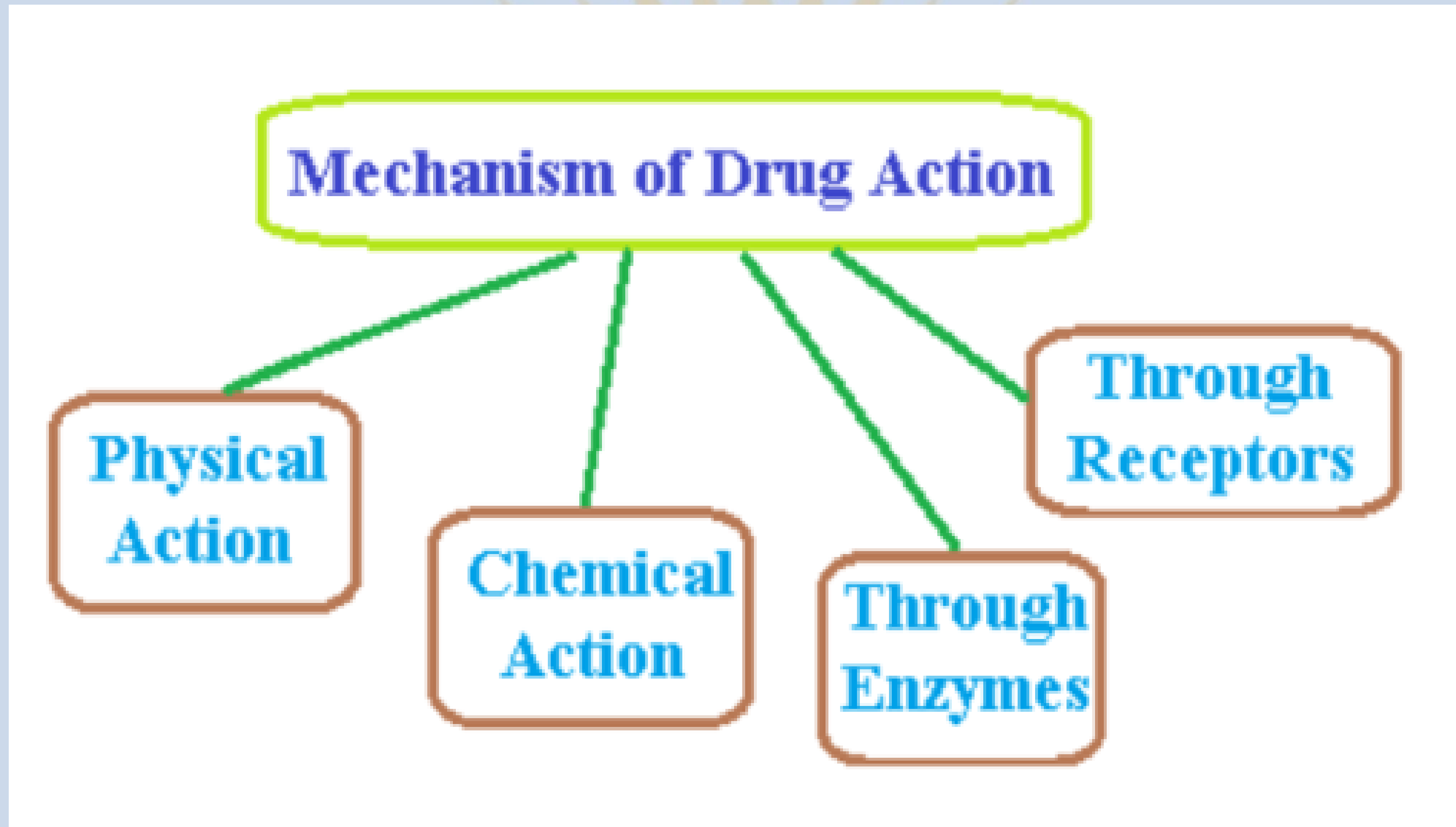
- ✓ Cytotoxic action means **administering a drug that produces effect(s) against only the affected cell(s), not the normal cell.**
- ✓ Seen during **cancer therapy**, where the drug shows its significant effect on the cancerous cell only and most other cells are unaffected or have minimal effect.

Summary of Drug's Principle of Action

Action	Mode	Example
Stimulation	Selectively enhances the activity of the specialized cell. If Excess stimulation occurs stimulation turns to depression	Adrenaline- Enhances the activity of Heart Pilocarpine-Enhances the activity of salivary glands
Depression	Decreases the activity of the specialized cell. Stimulate one type of cell but depress the other	Quinidine depresses heart. Barbiturates depress CNS.
Irritation	Unwanted, Noxious effect on non-specialized cells.	Bitterness increases salivary secretions and gastric secretion. Counterirritants increase blood flow to the site.
Replacement	Use of natural metabolites, hormones or congeners.	L-dopa in place of dopamine during Parkinsonism. Use of insulin in diabetes mellitus. Iron in iron deficiency anaemia.
Cytotoxic action	Cancer therapy, case of cancer and neoplasm.	Penicillins and Chloroquine.

Drug Mechanism of action and its types

✓ Broadly mechanism of drug action can be categorized as:



Cont.

- ❑ **Physical action:** determined by the **physical property of the drug.**
- ✓ Mechanism of action of **Bulk Laxatives such** polysaccharides.
- ✓ It forms a hardy mass in the intestine by absorbing water around it and blocking the lumen which creates pressure with consequent smooth peristalsis

Mass of the drug	Bulk laxative (Bran) and Ispaghula
Radio opacity	Barium sulphate
Osmotic activity	Mannitol and magnesium sulphate
Radioactivity	Radioactive atom of iodine (I-131)
Adsorptive property	Kaolin and charcoal
Absorption of UV rays	Para-amino benzoic acid

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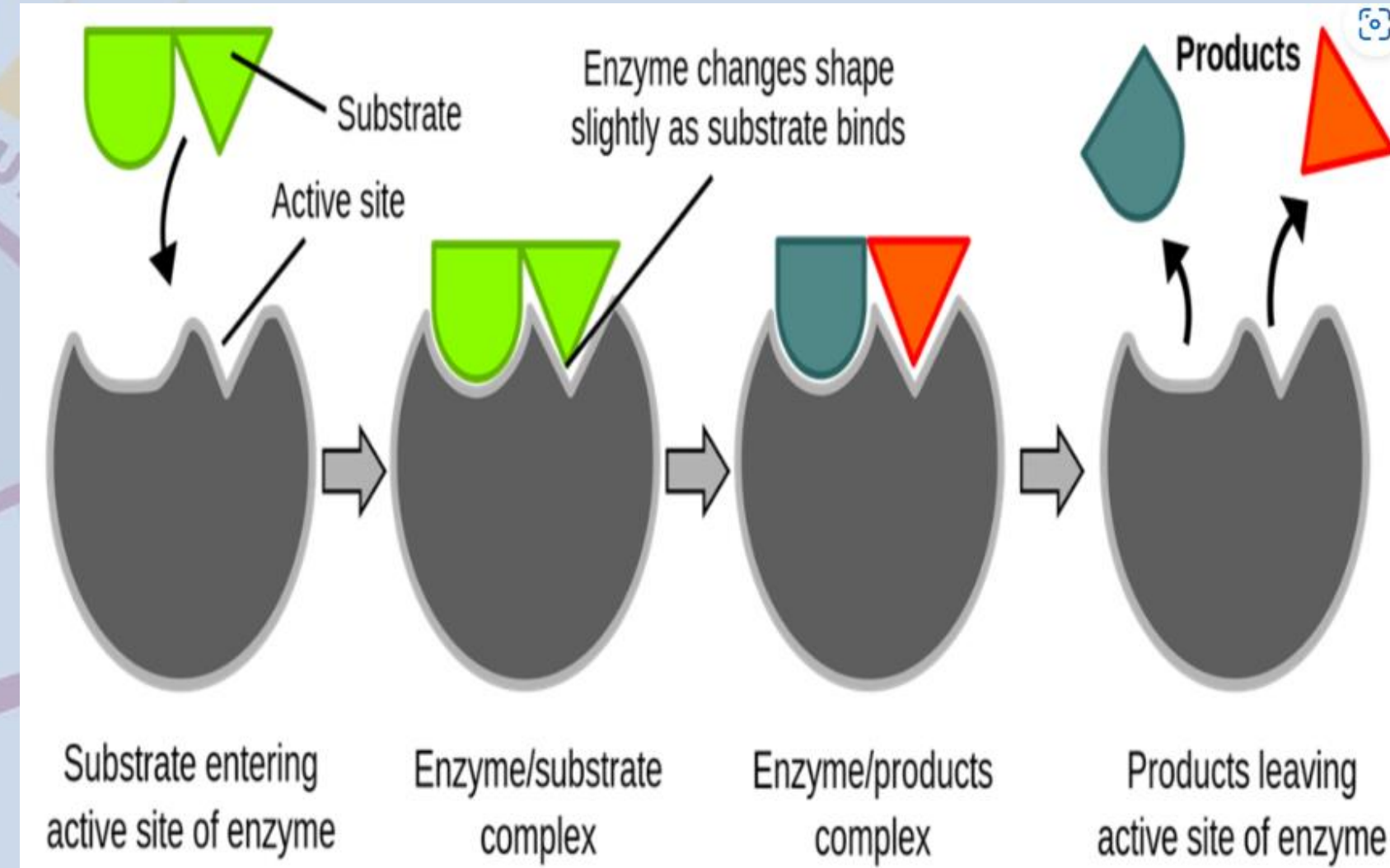
❑ **Chemical action:** (action of drugs extracellularly via a **chemical reaction**).

Neutralization of gastric HCl	Antacids like Aluminium hydroxide.
Alteration of pH of urine	Acidifying agent like Ammonium chloride and alkalizing agent like Sodium bicarbonate.
Complexing agents	EDTA, BAL
Oxidizing agent	Potassium permanganate, Iodine.
sequestration of bile acids	Cholestyramine

Cont...

□ Enzymatic Reaction:

- Enzymes are proteins that speed up of chemical reactions without taking part and can be recovered.
- ✓ All reactions in living system are carried out with the help is **enzymes**.
- ✓ Drugs form complexes with enzymes and influence the rate of enzymatic activity.

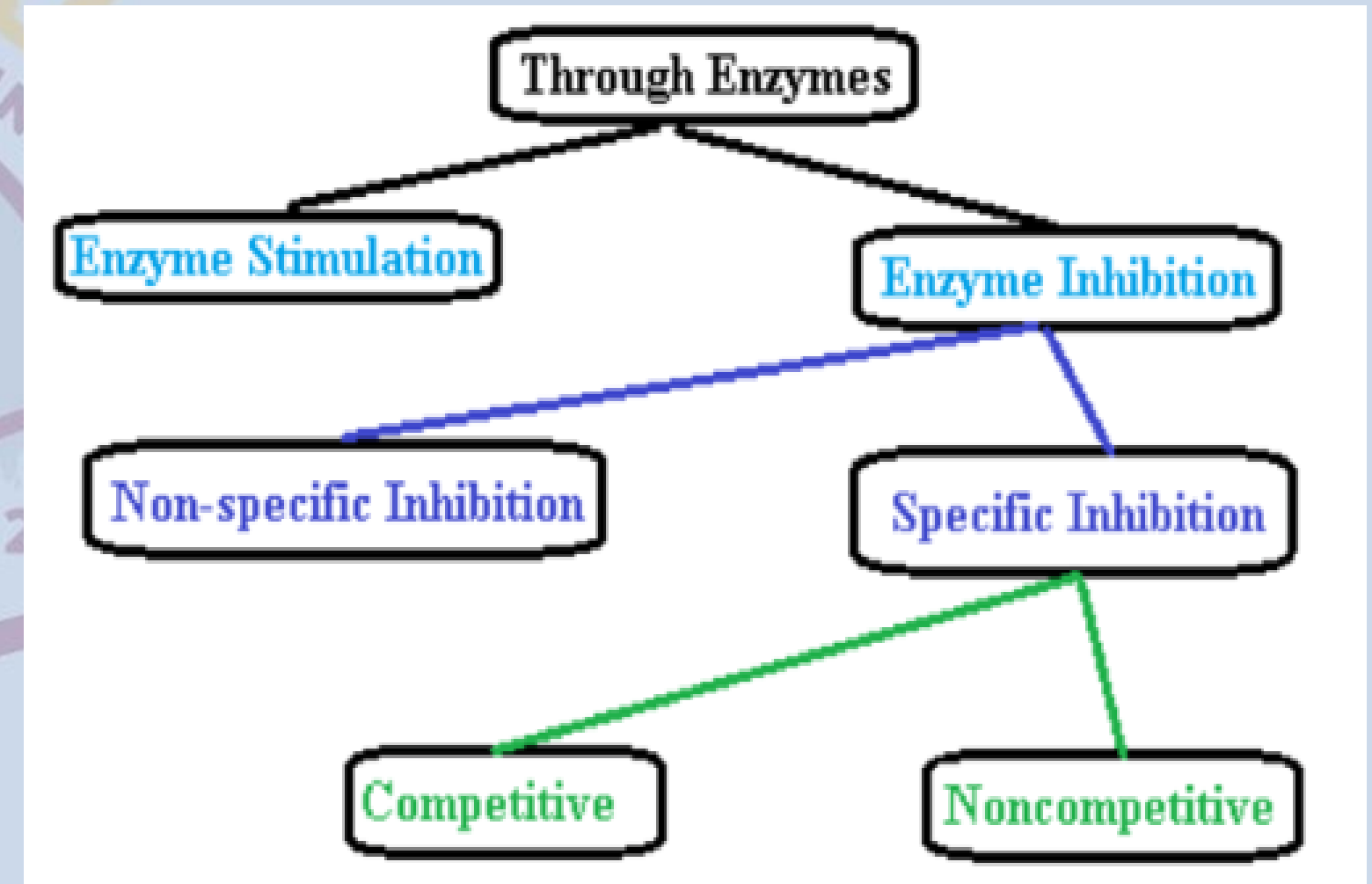


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Sub-Types

❖ Enzyme stimulation:

- Stimulation of enzyme increases the affinity of substrate to an enzyme.
- ✓ Many endogenous mediators and modulators get stimulated by enzyme.
- ✓ Pyridoxine increases decarboxylase activity.
- ✓ Adrenalin stimulate Adenylyl cyclase.



Cont...

❖ Enzyme inhibition:

Inhibition of enzyme is more common mechanism of drug action as compared to enzyme stimulation.

▪ Sub-type

○ Non-Specific Inhibition:

As the name implies **alcohols as drugs** denature the tertiary/quaternary structure of the enzyme, thus affecting its function negatively.

○ Specific Inhibition:

As the name implies, the drug affects a specific enzyme and denatures it. Thus, affecting its function negatively.

○ Division of specific inhibition:

- **Competitive type:**

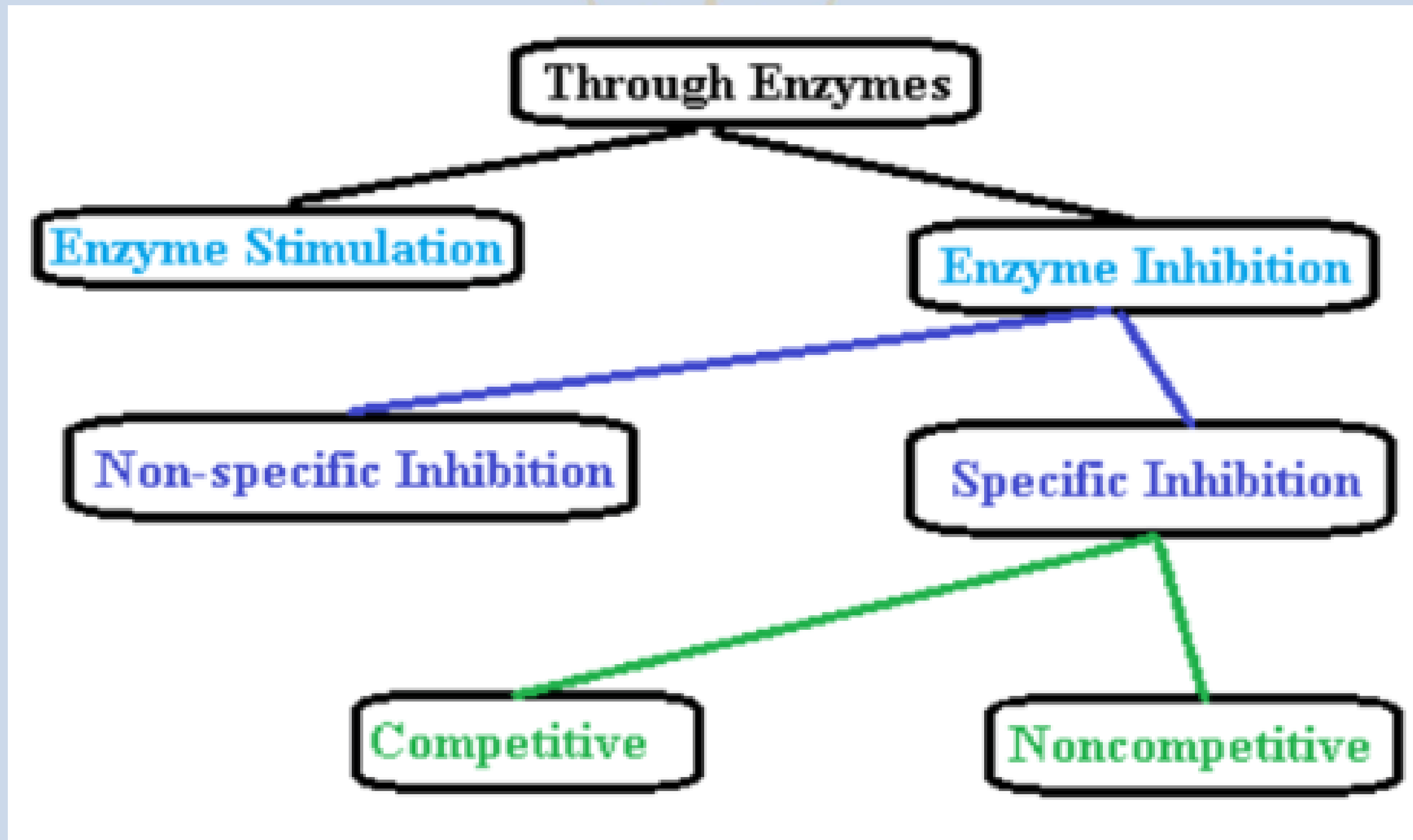
Competitive inhibition: drug competes with the normal substrate and binds to catalytic site. E.g. Neostigmine competes with Ach to cholinesterase.

- **Non-competitive type:**

The inhibitor reacts with the enzyme on **allosteric site** to prevent substrate binding on the catalytic site.

Drugs	Enzymes
Disulfiram	Aldehyde dehydrogenase
Aspirin	Cyclooxygenase
Acetazolamide	Carbonic anhydrase
Digoxine or digitoxin	Sodium-potassium ion channel

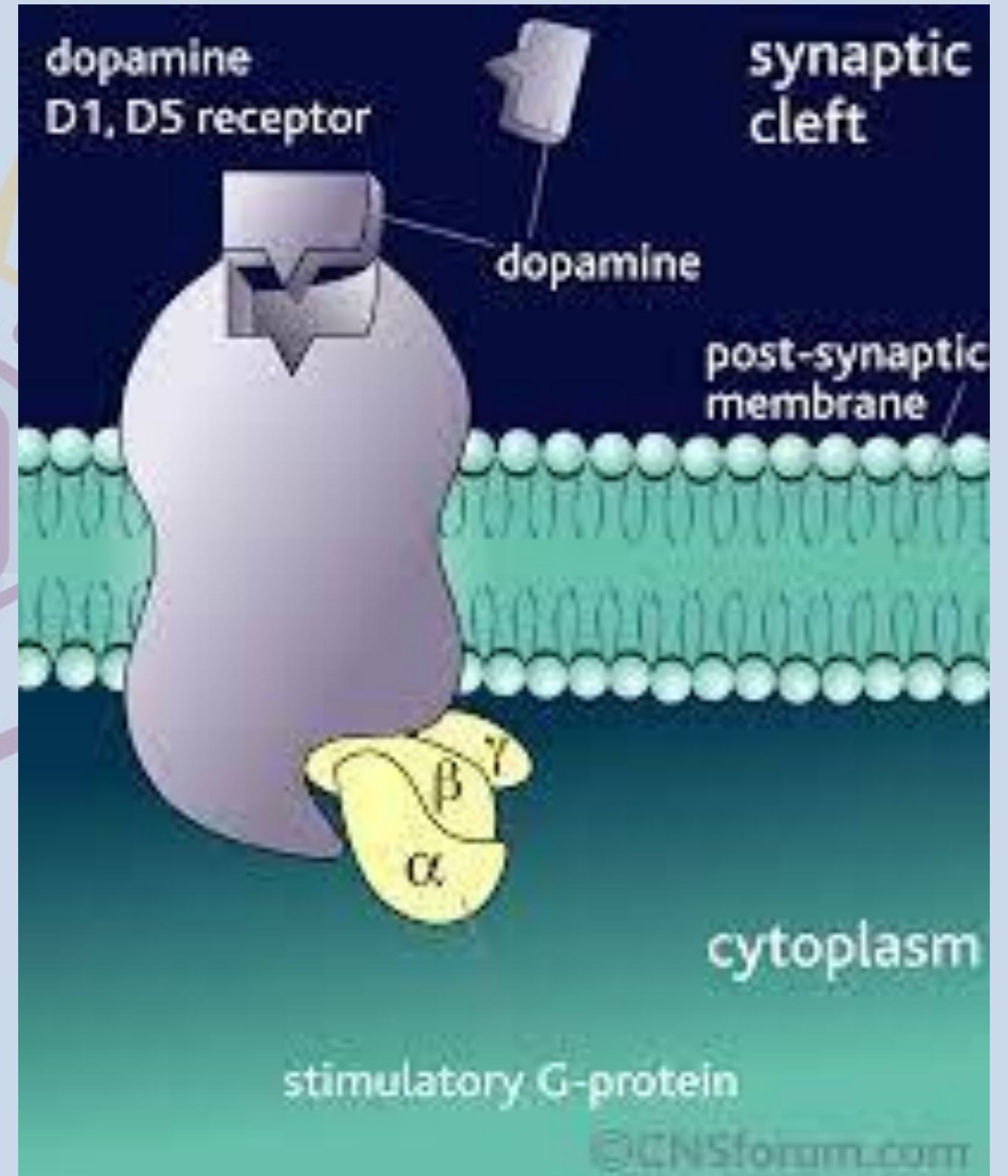
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❑ Through Receptors:

- ✓ Receptors are **macromolecules** that provide a specific site for drug binding to elicit biological action.
- ✓ Outer surface, transverse or Inner surface
- ✓ Generally, receptors provide binding sites for substances or chemical molecules to carry out further functions.



Summary

- ✓ Stimulation, Depression, Irritation, Replacement, and Cytotoxic action are the principles of drug action.
- ✓ The physical and chemical mediated actions are classical forms of drug action. However, they are upgraded to a universal standard.
- ✓ The enzyme and receptor-mediated drugs are preferred for their better and more efficient actions
- ✓ Majority of drugs act through the **receptor-mediated response**.
- ✓ Receptor provides the site for natural material in the body.

QUESTIONS/ COMMENTS?



THANK YOU
SEE YOU IN THE NEXT CLASS