Regulation of Enzymes

Enzymes are vital for metabolic pathways. Regulation ensures efficiency and prevents waste. Key mechanisms include induction, repression, and allosteric control.

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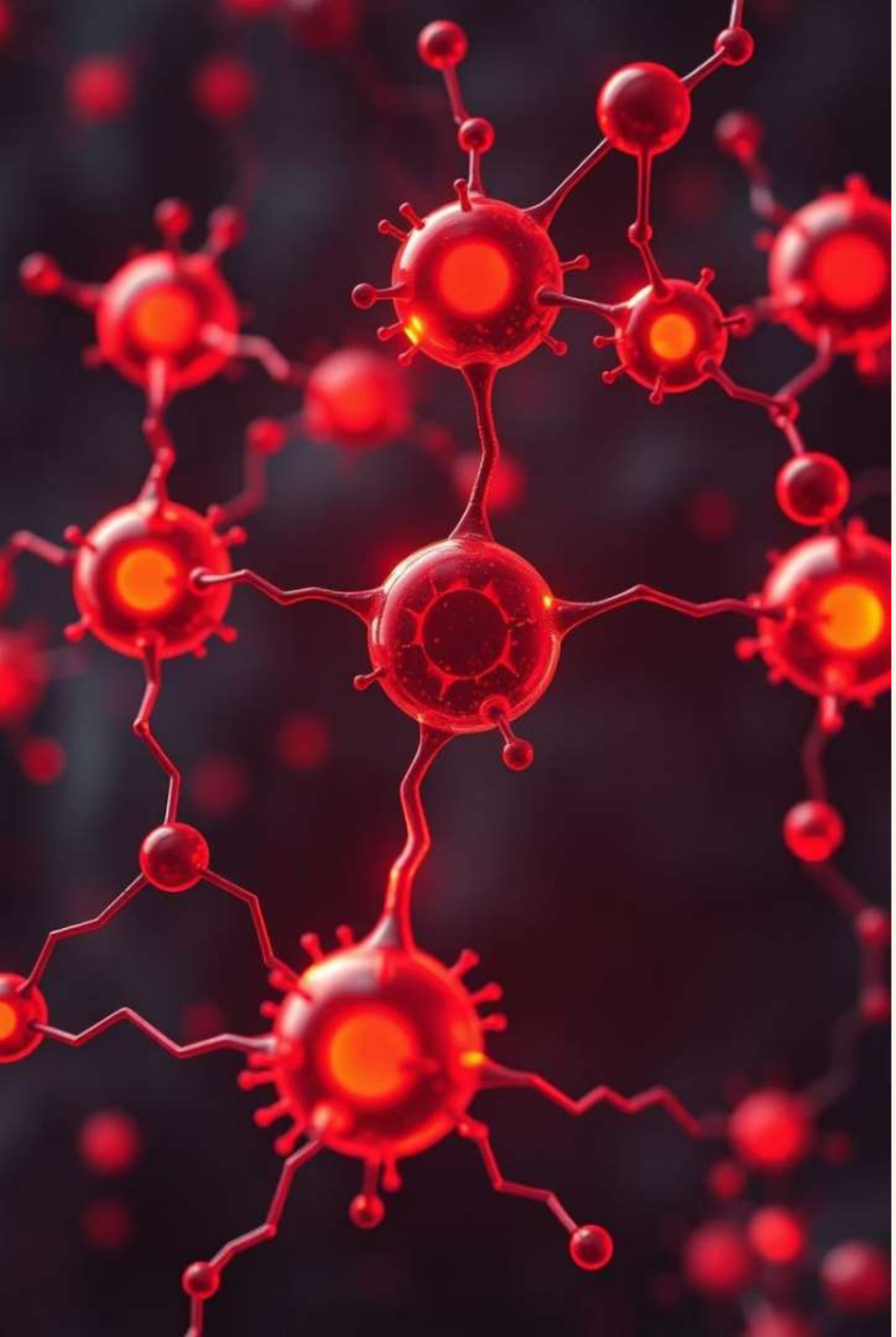


Enzyme Regulation: An Overview

Fast Regulation

Allosteric control and feedback inhibition adjust activity quickly.

Slow Regulation

Controls enzyme levels via synthesis and degradation.

Goal

Maintain homeostasis and adapt to environmental changes.

Enzyme Induction

What It Is

Enzyme synthesis increases when triggered by a specific signal.

Example: lac Operon

- Lactose presence triggers induction.
- β-galactosidase, permease, transacetylase are produced.
- Enables lactose utilization as energy.

Enzyme Repression

What Happens

Enzyme production decreases in response to high product levels.

Example: Tryptophan Operon

- High tryptophan causes operon repression.
- Stops overproduction of tryptophan.
- Conserves cellular resources effectively.

Allosteric Enzymes

Features

- Regulatory binding sites distinct from active site.
- Binding induces conformational changes.
- Can activate or inhibit enzyme function.

Example: PFK-1

ATP acts as inhibitor, AMP as activator, fine-tuning glycolysis.

Allosteric Regulation Mechanisms

1

Sigmoidal Kinetics

Shows cooperativity unlike typical Michaelis-Menten kinetics.

2

Cooperativity

Binding at one site affects affinity at others.

3

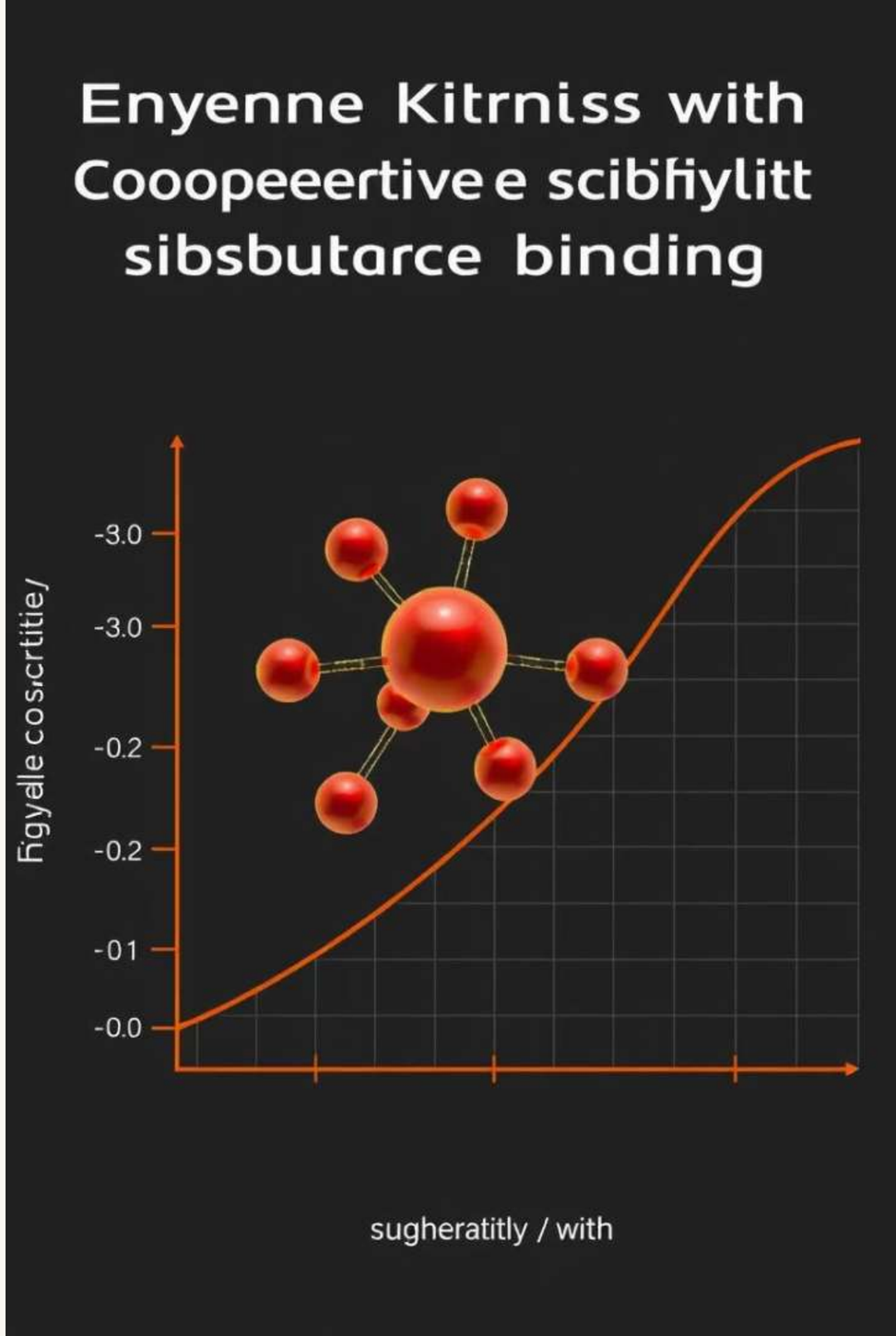
Regulatory Binding

Effectors bind allosteric sites to modulate activity.

4

Conformational Change

Alters active site shape and function.



Examples of Allosteric Regulation

ATCase

- Inhibited by CTP
- Activated by ATP
- Controls pyrimidine biosynthesis

Hemoglobin

O2 binding increases affinity for more oxygen molecules.

Demonstrates positive cooperativity in allosteric regulation.

Glycogen Phosphorylase

Regulated through phosphorylation altering enzyme activity.

Summary: Enzyme Regulation

Induction/Repression

Controls enzyme synthesis levels to match cellular needs.

Allosteric Regulation

Modulates existing enzyme activity rapidly and reversibly.

Importance

Essential for metabolic control and maintaining homeostasis.