

UNIT 1

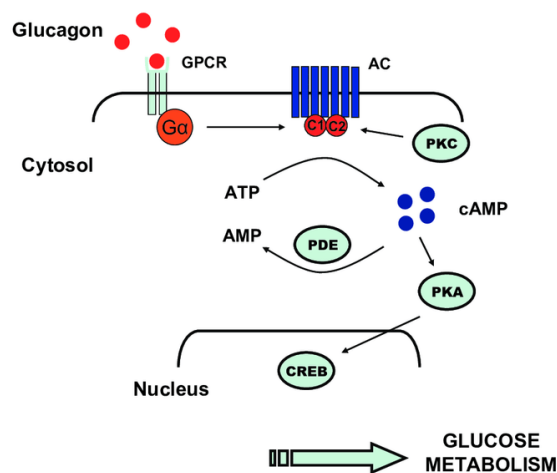
COURSE NAME: MEDICINAL BIOCHEMISTRY

TOPIC: cAMP

Case Study Question 1: Fight or Flight Response

During a stressful situation, an individual experiences increased heart rate and dilated airways due to the release of adrenaline (epinephrine). This hormone binds to receptors on target cells, triggering a rapid intracellular response without entering the cell.

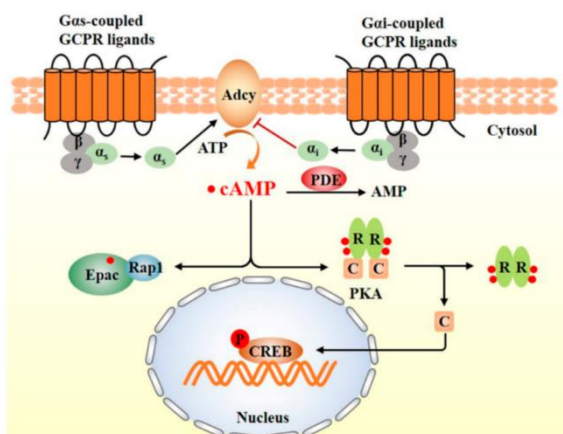
Question: Describe the role of the cAMP pathway as a second messenger system in the activation of G-protein-coupled receptors (GPCRs) by hormones like epinephrine.



Case Study Question 2: Hormone Signal Amplification

A patient with a tumor overproducing a certain hormone shows exaggerated responses in liver cells, leading to excessive glucose release. The signal from one hormone molecule results in the production of many second messenger molecules.

Question: Explain how adenylyl cyclase catalyzes the conversion of ATP to cAMP, and why this step leads to signal amplification in the pathway.



In a research study, elevated cAMP levels cause the dissociation of a key enzyme, releasing active catalytic subunits that phosphorylate target proteins.

[illegible]

During fasting, glucagon release stimulates liver cells to break down glycogen stores, rapidly increasing blood glucose levels through a cascade involving phosphorylation events.

The diagram illustrates the metabolic pathways of glycogen metabolism and glycolysis. Key components include:

- Glycogen Metabolism:**
 - Glycogen Synthesis:** Glucose is converted to Glucose-1-phosphate (G1P) by **Glucose-1-phosphatase**. G1P is then used by **UDP-glucose pyrophosphorylase** to form UDP-glucose, which is incorporated into Glycogen by **Glycogen Synthase**. **Glycogen Synthase Kinase 3** (GSK-3) inhibits Glycogen Synthase.
 - Glycogen Breakdown:** Glycogen is broken down into G1P by **Glycogen Phosphorylase**. **Protein Phosphatase 1** (PP1) activates Glycogen Phosphorylase.
- Glycolysis:**
 - G1P is converted to Glucose-6-phosphate (G6P) by **Glucose-1-phosphatase**.
 - G6P is converted to Fructose-1,6-bisphosphate (F1,6BP) by **Hexokinase**.
 - F1,6BP is cleaved into Dihydroxyacetone phosphate (DHAP) and Glyceraldehyde-3-phosphate (GAP) by **aldolase**.
 - GAP is converted to Pyruvate by **Glyceraldehyde-3-phosphate dehydrogenase** (GAPDH).
 - Pyruvate can be converted to Lactate by **Lactate dehydrogenase** (LDH) or enter the **Citric Acid Cycle** via **Pyruvate dehydrogenase** (PDH).
- Regulation:**
 - Glucagon** stimulates **Adenylate Cyclase**, which produces **cAMP**. cAMP activates **Protein Kinase A** (PKA), which in turn activates **Protein Phosphatase 1** (PP1).
 - ATP** inhibits **Adenylate Cyclase** and **Protein Kinase A**.
 - ATP** also inhibits **Glycogen Phosphorylase** and **Glycogen Synthase**.

In cholera infection, a bacterial toxin modifies a G-protein, preventing GTP hydrolysis and causing persistent activation of the pathway, leading to severe diarrhea due to ion secretion in intestinal cells.