

Name: _____ Period: _____ Date: _____

Open [peebedu.com](https://www.peebedu.com) and navigate to **Signal Transduction Visualizer**. Click **Start Exploring** to dismiss the introduction popup. Read the introduction, which describes how to select pathways, control animations, and highlight components. Begin with the **GPCR/cAMP** pathway selected.

Free Response Questions

Question 1 – Conceptual Analysis

Simulation Task: Select the **GPCR/cAMP** pathway and click **Start Signaling**. Reduce the animation speed to observe each step. Watch the *Amplification* and *Active Molecules* counters as the signal moves from the ligand through the G protein, adenylyl cyclase, cAMP, and PKA to the cellular response.

(A) (1 pt) **Describe** the role of protein modification in relaying and amplifying an intracellular signal from receptor activation to cellular response.

(B) (1 pt) **Explain** why a single ligand molecule binding to one receptor can result in the activation of thousands of intracellular molecules by the end of the signaling pathway.

(C) (1 pt) **Predict** how the rate of glycogen breakdown in liver cells would change if a mutation prevented a G protein from converting GTP back to GDP, compared to cells with a normal G protein.

(D) (1 pt) **Justify** your prediction.

Question 2 — Analyze Model / Visual Representation

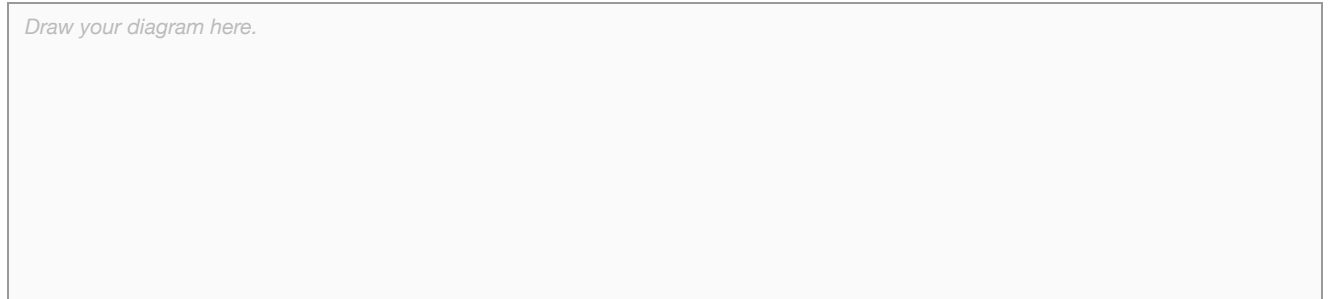
Simulation Task: Select the **GPCR/cAMP** pathway and click **Start Signaling**. Observe the complete pathway. Then switch to the **Steroid Hormone** pathway, reset, and click **Start Signaling** again. Compare where the receptor is located and how the cellular response differs between the two pathways.

(A) (1 pt) **Describe** the relationship between the location of a receptor protein and the type of signaling molecule it recognizes.

(B) (1 pt) **Explain** why a steroid hormone can alter gene expression in a target cell without the use of a second messenger cascade, whereas a peptide hormone binding to the same cell's surface requires an intracellular signaling cascade to produce a response.

(C) (1 pt) **Draw** a labeled diagram showing the path of a lipid-soluble signaling molecule from outside the cell to the activation of transcription in the nucleus, including the phospholipid bilayer, the signaling molecule, the receptor, the nuclear envelope, DNA, and mRNA.

Draw your diagram here.



(D) (1 pt) **Explain** how variation in receptor protein structure among individuals in a population could lead to differences in reproductive success when a new signaling molecule becomes prevalent in the environment.
