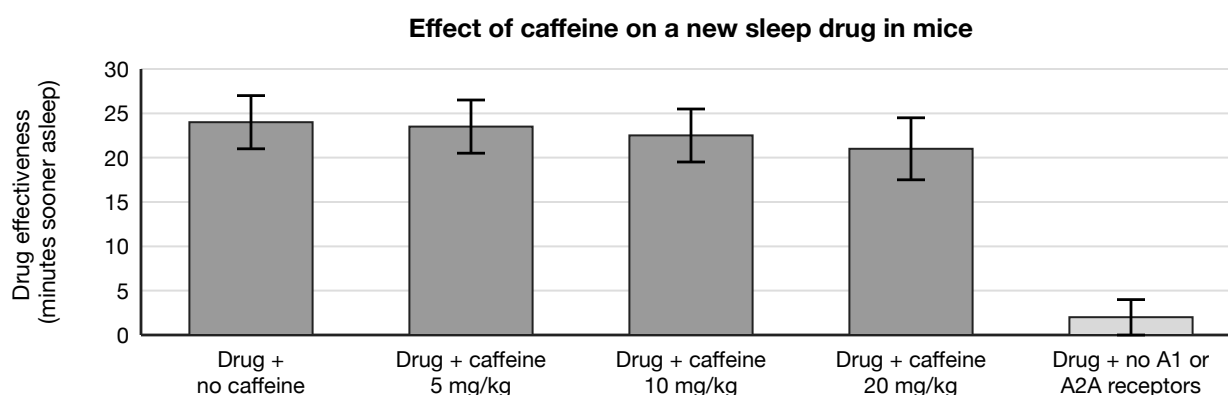


Name: _____ Period: _____ Date: _____

Open [peebedu.com](https://www.peebedu.com) and navigate to **Caffeine Simulation**. Choose **Start the day**, use **Next** to move forward an hour at a time, and tap any molecule in the neuron for its tooltip.

Question 1: Analyze Data

Experiment: A new sleep drug was designed to activate A1 and A2A adenosine receptors. Mice (12 per group) got caffeine at different doses, then the drug an hour later; researchers measured how many minutes sooner each fell asleep than after a placebo in place of the drug. One group, bred without A1 or A2A receptors, got the drug alone. Error bars show 95% confidence intervals.



(A) (1 pt) **Describe** the relationship between caffeine dose and drug effectiveness in normal mice.

(B) (1 pt) **Describe** the inhibitory effect of the highest caffeine dose on the drug's effectiveness.

(C) (1 pt) **Evaluate** the hypothesis that the drug activates A1 and A2A receptors, using the data.

(D) (1 pt) **Explain** how the drug is able to activate the A1 and A2A adenosine receptors.

Question 2: Conceptual Analysis

Game Task: Start the day without drinking anything and move forward several hours. As adenosine binds, open the tooltips for the A1 and A2A receptors, both G proteins, adenylyl cyclase and cAMP. Then tap a caffeinated drink and keep moving forward, watching what happens at the receptors and to cAMP.

(A) (1 pt) **Describe** the characteristics of a receptor protein that allow it to receive a signal.

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

(C) (1 pt) **Predict** how the amount of cAMP made in a neuron with active A2A receptors would change if a chemical blocked adenylyl cyclase from converting ATP into cAMP, compared with the same neuron with no chemical present.

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

4.2.B.1, 4.2.B.2, 4.3.B.2