



Sample Long Free Response Question (Experimental/Data Based Question)

The regulation of gene expression is a crucial homeostatic mechanism in embryonic development. The table shows mRNA levels, protein levels, and enzyme activity levels for 3 different enzymes. These enzymes are coded for by genes X, Y, and Z after being expressed both in the absence and presence of Protein A and Protein B.

	Untreated			+ Protein A			+ Protein B		
	Gene X	Gene Y	Gene Z	Gene X	Gene Y	Gene Z	Gene X	Gene Y	Gene Z
mRNA levels	1200	2000	1400	2100	250	1400	1200	2000	1400
Protein levels	400	1100	300	750	20	300	400	1100	300
Total enzyme activity levels	20,000	32,000	18,000	35,000	5	18,000	20,000	50,000	200

Describe the probable role of Protein A and/or Protein B in the expression of genes X, Y, and Z. **Describe** when during gene expression regulation occurs and **explain** a possible mechanism including a potential binding partner for Protein A and/or Protein B.

In a follow-up experiment, Protein A and Protein B are combined. **Draw** a graph (or many graphs) predicting the effect on the mRNA, protein production, and enzyme activity of Genes X, Y, and Z. Be sure to show untreated levels.



Sample Long Free Response Question (Non-Data/Experiment Based)

Describe the chemical nature of genes. **Discuss** the replication process of DNA in eukaryotes. **Explain** the types of gene mutations can occur during replication and their potential effects on organism phenotypes.