Gene Regulation practice questions

1. Trying to predict whether a pre-cancerous cell will become malignant, you look at DNA methylation patterns and find high levels of methylation right next to a gene known to repress cell division. How does this result affect your prediction?

Galactose metabolism in yeast

2. If *GAL3* were deleted, what would the phenotype of the yeast be?

3. If a mutation in the enhancer region meant GAL4 could no longer bind to it, what would the effect be?

4. If a mutation in *GAL80* changed the binding site with GAL3 so that it no longer bound, what would the effect be?

5. A mutant yeast strain lacks the ability to metabolize galactose. Mapping of the mutation has found that it is not located in a gene, and the nearest gene sequence is approximately 450 base pairs away. How does this mutation act to inhibit galactose metabolism? What is the name of this type of sequence?

6. Both prokaryotes and eukaryotes have sets of genes that need to be expressed at the same time. Both groups have ways of ensuring that coordinated transcription can happen. How are these mechanisms different between the two groups?

Many plants alter their physiology in response to drought, in order to be able to survive. A hypothetical experiment (all of these genes are made-up) used a microarray to look at expression of several genes for plants grown in control (well-watered) conditions and drought (low water) conditions. In the heatmap below, dark grey indicates high levels of expression and light grey indicates low levels.

Gene:	Drought			Control		
DRY4						
DRY19						
WLT						
HLC						
THM						
DES1						
DES8						
DES12						

a. Which genes potentially make proteins that are useful under drought conditions?

b. Which genes are not expressed under drought conditions?

c. Which gene is probably not involved in drought response at all?

A researcher decides to do some more in-depth investigations of the regulation of *DRY4* under three different water conditions. They find that in well-watered plants, expression is very low. In plants under moderate water stress, expression is moderate. When plants have very little water, expression is high.

Come up with a potential mechanism to explain this pattern. Make up sequence elements and transcription factors as necessary. Sketch the DNA and associated proteins under each of the three conditions. When you're done, share your mechanism with a neighbor (there are many possible answers).