

Practice Problems:

Use the following piece of DNA to answer the following questions:

Coding: 5' T C G A A T G C C C T C A G A G T C A T A A C C C A C A C C 3'

Template: 3' A G C T T A C G G G A G T C T C A G T A T T G G G T G T G G 5'

mRNA: 5' U C G A AUG CCC UCAGAG UCA UAA G G G A C A C C 3'

Met Pro Ser Glu Ser *Stop*

1. This is the **coding** (non-template) strand of DNA. What is the Template strand of DNA? What is the mRNA? The protein coded by the mRNA?

Remember that Stop is not an amino acid. Protein = Met-Pro-Ser-Glu-Ser

2. If the base marked T is changes to a C, what will be the resulting change in the protein?

UCA becomes CCA, so Serine changes to Proline

3. What is the amino acid associated with tRNA's with the following anticodons?

3' CCC 5'
5' GGG 3'

3' UCA 5'
5' AGU 3'

5' CGU 3'
3' GCA 5'

5' UCA 3'
3' AGU 5'

Proline

Serine

Threonine

No such tRNA

Make sure you read the codons 5' to 3'. The last one is a trick question as there is no tRNA with an anticodon that complements with the three stop codons!

4. Make a drawing illustrating the basic principles of DNA replication. Be sure to include the following: helicase, topoisomerase, DNA polymerase, leading strand, lagging strand, Okazaki fragment, ligase.

5. What is the difference between a leading strand and a lagging strand? A lagging strand and an Okazaki fragment.

The leading strand is the strand of newly formed DNA that forms 5' to 3' in the direction of helicase unwinding. The lagging strand is the strand of newly formed DNA that forms 5' to 3' away from the direction of helicase unwinding. A lagging strand is composed of many Okazaki fragments.

6. Draw a $2n=4$ cell in Metaphase of Mitosis. Metaphase I of Meiosis. Metaphase II of Meiosis. How are they different?
7. What would happen if the repressor protein in the *trp* operon was mutated so that it no longer had an affinity for tryptophan? If the operator region of DNA was removed? What if the operator region was modified so that it would permanently bind the repressor protein.

If the repressor protein of the *trp* operon mutated so that it no longer had affinity for tryptophan, it would never change form and bind to the operator to shut down the operon. The operon would be effectively always on, making tryptophan regardless of the concentration of tryptophan.

If the operator region of DNA was removed, there would be no place for the repressor protein to bind. Again, regardless of the concentration of tryptophan, nothing could block RNA polymerase from binding to the promoter, and the operon would be on.

If the operator would permanently bind DNA, then once the repressor bound to the operator, it would eventually permanently turn the operon off.

8. What are the four basic levels of control in eukaryotic gene expression? Give examples of each. Which is the most common method of regulating eukaryotic genes?

Transcriptional control: The binding of TFIID to the TATA box, the binding of Transcription factors to their promoter regions, enhancers and silencers affecting transcription factor binding

Post-transcriptional control: The removal of introns (forming a mature mRNA), the addition of the 5' Guanine cap and the 3' poly-A tail which stabilize the mRNA

Transcriptional control: The binding of transcription enhancers and inhibitors which affect the rate at which initiation occurs. Other factors which affect the rate of mRNA degradation

Post-transcriptional control: The modification of a protein after transcription making it an active form (like when the C-chain is removed from proinsulin forming insulin)