**DNA to protein: Study guide and readings**

**Required readings: None**

1. Briefly explain why faithful replication and being capable of change are both attributes that make DNA an ideal genetic material, and why they are not mutually exclusive.
2. Draw a nucleotide of DNA. Label the three principal components and label the carbon atoms in the 5-carbon sugar.
3. Given the sequence ATGGACACATAG (sense strand), use base pairing rules to write the corresponding sequence of nucleotides (antisense strand). Label the 5’ and 3’ ends of both strands. Now, write the corresponding mRNA sequence. Label the 5’ and 3’ ends. Using a codon translation table, determine the sequence of amino acids specified by this DNA sequence.
4. Compare and contrast the starting and end points of transcription and translation.
5. Briefly describe and define three types of mutations that can result from a change in a single nucleotide.
6. Are changes in DNA sequence more likely to be causal (in terms of change in phenotype) if they are in (a) exons or (b) introns?
7. If neutral DNA polymorphisms do not affect phenotype, why are they of potential interest to geneticists and plant breeders?
8. Give an example of how naturally occurring mutations have played key roles in generating economic value in crop plants. What advantage do apples have, over barley, in terms of plant breeders being able to capitalize on naturally occurring mutations?
9. How do DNA replication errors and repair processes relate to mutations?
10. Give an example of how a deletion or an insertion mutation can lead to a premature stop codon.
11. If mutations are changes in DNA sequence, how could their effect on phenotype be due to changes in sequence, changes during transcription and/or changes during translation?
12. The following questions related to the Genbank example of the Nud gene (KP245804.1).
    1. Why is the “gene” sequence longer than the “mRNA” sequence?
    2. What is the sequence starting with nucleotide 84 and ending with nucleotide 283 called?
    3. Using the codon translation table provided in the class notes,
       1. What is the translation of the first three bases of the *Nud* gene?
       2. What is the translation of the last three bases of the *Nud* gene?
13. Using the codon translation table provided in the class notes,
    1. What is the translation of the first three bases of your favorite gene in your favorite plant?
    2. What is the translation of the last three bases of your favorite gene in your favorite plant?
14. Compare and contrast information, functional, and regulatory RNAs
15. Later in this class, we will review, in some detail, the Shulaev et al. (2011) paper on “The genome of woodland strawberry”. For now, in that paper, the authors state that they identified 569 tRNA genes.
    1. Explain why there were so many tRNA genes. In your explanation, include consideration of the degeneracy of the DNA code, the number of essential amino acids, and the frequency of translation events that are likely occurring in a plant cell during G1.
16. Distinguish between a codon and an anticodon.
17. Ribosomal RNA genes exist in multiple copies – why?
18. What is the role of a promoter in transcription?
19. What is the key difference between the primary structure of a protein and its secondary, tertiary and/or quaternary structures?
20. Give an example of how naturally occurring mutations have played key roles in generating economic value in crop plants. What advantage do apples have, over barley, in terms of plant breeders being able to capitalize on naturally occurring mutations?