

Problem Set 4 on Central Dogma

(due Monday Oct. 19th, in class or by 5:00pm in Prof. Goutte's office)

1. Define the following terms as they are used in regular English language AND give the special meaning each term has when applied to the living cell.
 - a. Replication
 - b. transcription
 - c. translation
 - d. splicing

2. Now for some numbers...
 - a. How many different types of nucleotides are found in RNA?
 - b. How many different types of amino acids are found in proteins?
 - c. How many nucleotides are needed to code for a single amino acid?
 - d. How many different codons are there in the genetic code?
 - e. How many codons code for amino acids?

3. Myoglobin is 153 amino acids long.
 - a. What would be the minimum number of nucleotides required to encode myoglobin?
 - b. Why might the size of the myoglobin primary RNA transcript be larger than your answer above?

4. Use the genetic code to identify which of the following nucleotide sequences would code for the polypeptide sequence arginine-glycine-aspartate:
- 5'-AGAGGAGAU-3'
 - 5'-ACACCCACU-3'
 - 5'-GGGAAUUU-3'
 - 5'-CGGGGUGAC-3'
5. Explain why if you are given a protein sequence, you cannot predict the exact RNA sequence that was used by the cell to generate that sequence.
6. Consider the hypothetical protein represented by single letter amino acid designations:
A-M-H-E-R-S-T.
- Propose one RNA sequence that *could* encode this sequence (don't worry about start codons for this exercise).
 - Can you figure out mathematically how many different RNA sequences could code for this mini protein?
7. Here is the beginning of a protein-encoding gene sequence.
- 5' -ATGAAGTTTGGCACTTAA-3'
3' -TACTTCAAACCGTGAATT-5'
- Give the RNA transcript that would be transcribed off of the bottom strand:
 - Translate this RNA sequence into a protein sequence.
 - Give the RNA transcript that would be transcribed off of the top strand:
 - Translate this RNA sequence into a protein sequence.

7 continued

- e. Let's assume that the bottom strand is the strand that is used as a template strand when this gene gets transcribed. What would be the effect on the final protein product if a mutation caused the following single base-pair insertion:

5' -ATGAAG**A**TTTGGCACTTAA-3'
3' -TACTT**C**TAAACCGTGAATT-5'

- f. What would be the effect on the final protein product if a mutation caused the following single base-pair substitution:

5' -ATGAAGTT**C**GGCACTTAA-3'
3' -TACTT**C**AAGCCGTGAATT-5'

- g. What would be the effect on the final protein product if a mutation caused the following single base-pair substitution:

5' -ATGAAGTTT**C**GCACTTAA-3'
3' -TACTT**C**AAAGCCGTGAATT-5'

- h. What would be the effect on the final protein product if a mutation caused the following single base-pair substitution:

5' -ATG**T**AGTTTGGCACTTAA-3'
3' -TAC**A**TCAAACCGTGAATT-5'

- i. Which of the above mutation(s) would you expect to be the most severe in terms of the overall effect on the person carrying such a mutation? Explain.