

CSC 314, Bioinformatics Lab #4
Gene Expression

Name: _____

Use the genetic code (on page 13 of the Gene Expression notes) to answer the following questions. To answer these correctly, it is important to understand the difference between the DNA **template (anti-sense) strand** and the DNA **sense strand**, that transcription produces an RNA molecule from its 5' to 3' end by reading the DNA template strand from 3' to 5', and that translation produces a protein by reading a mRNA from its 5' to 3' end. Assume that unless otherwise indicated, DNA sequences do *not* contain introns. Note that for this exercise, not all transcripts will begin with a start codon, or end with a stop codon. However, translation of stop codons should be indicated with an **X**, indicating that translation stops (i.e., no more amino acids are produced).

Note: You may use a translation tool such as <http://web.expasy.org/translate/> to check your work, though **your answers must use the 3 letter amino acid abbreviation codes** (<http://www.ddbj.nig.ac.jp/sub/ref2-e.html>). Note that the Expasy tool translates DNA *sense* strands and mRNA sequences only. Also, note that you will be asked to complete similar questions using only the Genetic Code table on the 1st exam.

1. What is the amino acid sequence of the protein produced from translation of the following mRNA molecule?

5' — AUGUCCCCUGUUUGA — 3'

2. What is the mRNA sequence and amino acid sequences of the protein produced following transcription and translation of the DNA sequence on the *sense* strand of the DNA molecule?

5' — ATGAATCATTAGGGT — 3'

3. What is the mRNA sequence and amino acid sequences of the protein produced following transcription and translation of the DNA sequence on the *sense* strand of the DNA molecule?

3' — TACAGTCAGGGAGTA — 5'

4. What is the mRNA sequence and amino acid sequences of the protein produced following transcription and translation of the DNA sequence on the *template* strand of the DNA molecule?

5' — GTATTATCTAGGCAT — 3'

5. What is the mRNA sequence and amino acid sequence of the protein produced from the following DNA sequence on the *sense* strand of the DNA molecule, with exons and introns as indicated?

| Exon | intron | exon | Intron | Exon |
|---------|--------|--------|--------------|------------|
| 5' —ATG | ACGATG | AAAACC | TTGACTATGTCA | ACATGG— 3' |

6. Consider the DNA sequence on the sense strand

5' – ATGTGTCACAACGAGTGA – 3'

that will express the following protein:

Met-Cys-His-Asn-Glu-X

The DNA sequences below each contain a mutation relative to the above sequence. Identify the *type* of mutation and the protein sequence that will be produced.

- wild-type sequence: 5' – ATGTG**T**CACAACGAGTGA – 3'
mutated sequence: 5' – ATGTG**A**CACAACGAGTGA – 3'
- wild-type sequence: 5' – ATGTGTCACAACGAGTGA – 3'
mutated sequence: 5' – ATGTGTC**A**TAAACGAGTGA – 3'
- wild-type sequence: 5' – ATGTGTCACA**A**CGAGTGA – 3'
mutated sequence: 5' – ATGTGTCAC**C**GAGTGA – 3'