The Key: 7.013 Recitation 7 – Spring 2018

1. The following is a partial sequence from the hypothetical gene, gene X. The boxed region is the promoter, and the arrow indicates the direction of transcription. Transcription begins at and includes the first G/C base pair after the box.

```
5′ ATCAGACAACGTCTCATGGGAGTACTTGGATGGAAGAGTAGAAGGTCATGACCAACCTCTTCCAATCCAACCACAAACAG
   +---------+---------+---------+---------+---------+---------+---------+---------
3′ TAGTCTGTTGCAGAGTACCCTCATGAACCTACCTTCTCATCTTCCAGTACTGGTTGGAGAAGGTTAGGTTGGTGTTTGTC

5′ AAAATCAGCCAATATGTCCGACTTCGAGAACAAGAACCCCAACAACGTCCTTGGCGGACACAAGGCCACCCTTCACAACC
   +---------+---------+---------+---------+---------+---------+---------+---------
3′ TTTTAGTCGGTTATACAGGCTGAAGCTCTTGTTCTTGGGGTTGTTGCAGGAACCGCCTGTGTTCCGGTGGGAAGTGTTGG
```

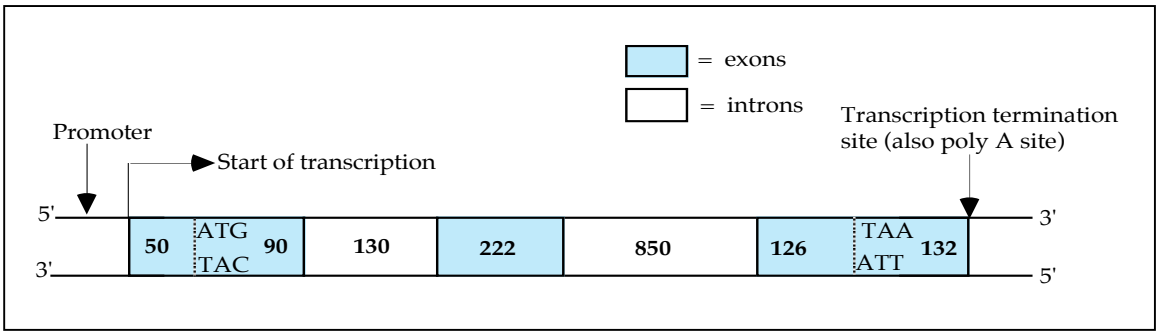
Give the first 10 nucleotides of the mRNA produced from Gene X. *5'CUUCCAUCCA3'*

2. The mature mRNA sequence has some nucleotides that are not represented in the template strand of the genomic DNA sequence.

a) What nucleotide(s) is added to the 5' end of the mature mRNA? Why is it important?
5'methyl guanosine

b) What nucleotides are added to the 3' end of the mature mRNA? Why are they important?
3'Poly A tail

3. Shown below is the genomic structure of Gene A. The numbers within the boxes indicate the length (in nucleotides) of each region. The DNA sequences corresponding to the start codon and the stop codon are indicated.



a) What is the length (in nucleotides) of the nascent mRNA? ***1600b***

b) What is the length (in nucleotides) of the mature or processed mRNA? *620b*

c) If you were to consider alternative splicing how many mature mRNA transcripts could be produced from this gene? Give the length (in nucleotides) of each. ***Two: 620b and 398b***

4. Assume that the sequence of DNA below is a short protein-encoding gene; the sequences in between the transcription start and stop sites are shown. The entire DNA sequence of the very short gene is:

```
5' CGCTTATAGAACCCAATCTCTCATAGGC  3'
3' GCGAATATCTTGGGTTAGAGAGTATCCG  5'
```

a) What would the resulting mRNA be if the top strand of this DNA molecule were used as a template in transcription? Label the 5' and 3' ends of your molecule. *5'GCCUAUGAGAGAUUGGGUUCUAUAAGCG3'*

b) What is the full sequence of the protein that would be translated from this RNA? Label the N and C termini of your molecule. *N-Met-Arg-Asp-Trp-Val-lLeu-C*

c) What would happen to the encoded protein if the underlined nucleotide **C** were mutated to a **T**?
N-Met-Arg-Asp-C (This creates a premature stop codon resulting in a truncated protein).

5. Complete the table below.

	Translation
Subcellular organelle (s) in eukaryotic cell where translation occurs	*Cytoplasm and/ or ER membrane*
Monomer used to form proteins	*Amino acids*
Rule for adding a type of incoming monomer?	*Adding is to the –COOH end*
Covalent bond formed between two adjacent monomers in a growing polypeptide chain?	*Peptide bond/ amide bond*
Number and type of template (RNA or DNA) for protein synthesis	*One, mRNA template*
In what direction is the template read?	*5→3'*
In what direction is the polypeptide chain synthesized?	*N-> C*

6. Drawn below is part of a wild-type gene. The DNA sequence shown encodes the last amino acids of a protein that is normally 380 amino acids long. The **bold** & **underlined** codon indicates the correct reading frame of this gene. The lower strand of the gene is used as the template during the transcription of mRNA from this gene.

…**GCT**AAGTATTGCTCAAGATTAGGATGATAAATAACTGG–3′
…CGATTCATAACGAGTTCTAATCCTACTATTTATTGACC–5′

a) In the copy of the sequence drawn above, circle one base pair that you could change to make a mutant form of the gene that produces a protein that is now 381 amino acids long. Indicate the identity of one new base pair that could take its place.
You should change the stop codon immediately after the codon for 380th amino acid to get a protein that is 381 amino acids long. Please note that the codon immediately after the first stop codon is also a stop codon.

b) In the copy of the sequence drawn above, draw a slash between two base pairs where you could add one extra base pair in order to make a single mutant form of the gene that produces a protein that is 373 amino acids long. Indicate the identity of the one new base pair you are adding.
You should add a "T" before the 1st base in the 374th codon so that you get a stop codon.

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