Transcription Questions: ANSWERS

1. Notice that the process of transcription is similar to DNA replication. What are some **similarities** between transcription and DNA replication?

- **nucleus**
- **polymerase**
- **nucleotides (A,C,G)**
- **base pairing rules**
- **bubble/forks**
- **DNA template**
- **5'-3' direction**
- **promoter region**

2. There are also a few important differences between DNA replication and transcription. Fill in the blanks in the following table to summarize these differences.

	DNA replication	Transcription
Section	The whole chromosome is replicated.	**Gene transcribed**
What is made?	A double-stranded DNA molecule is made.	**Single stranded mRNA**
Enzyme(s)/ proteins	**DNA helicase** – splits the DNA into leading and lagging strands **DNA polymerase III** – attaches DNA nucleotides **Primase** – attaches the RNA primer **DNA polymerase I** – removes the RNA primer and replaces them with DNA nucleotides **DNA ligase** – links the Okazaki fragments with phosphodiester bonds	**Transcription factors – binds RNA polymerase** **Promoter region/TATA box** **Rho protein**

3.Why does mRNA need to be modified before leaving the nucleus?

- 5' cap provided binding site for ribosome: no cap = no translation
- Poly A tail needed to protect mRNA when it leaves the nucleus
- splicing removes non-coding introns, not need to make polypeptide chains

4. Research a gene that interests you. Show how the first 18 nucleotides are transcribed into mRNA. **bit.ly/410itR4**

Gene: _____ # base pairs: _____

DNA

3'																		5'

mRNA

__'																		__'

Draw lines on mRNA above to separate codons

Amino acids

Take the quiz:

1. In eukaryotic cells, transcription cannot begin until:

a. the two DNA strands have completely separated and exposed the promoter.
b. the appropriate transcription factors have bound to the promoter.
c. the 5' caps are removed from the mRNA.
d. the DNA introns are removed from the template.
e. DNA nucleases have isolated the transcription unit from the noncoding DNA

2. Which of the following is *not* true of a codon?

a. It consists of three nucleotides.
b. It may code for the same amino acid as another codon does.
c. It never codes for more than one amino acid.
d. It relates to both DNA and RNA.
e. It is the basic unit of the genetic code.

3. Which of the following is *not* true of RNA processing?

a. Exons are excised and hydrolyzed before mRNA moves out of the nucleus.
b. The presence of introns may facilitate crossing over between regions of a gene that code for polypeptide domains.
c. Ribozymes may function in RNA splicing.
d. RNA splicing may be catalyzed by spliceosomes.
e. A primary transcript is often much longer than the final RNA molecule that leaves the nucleus.

4. Using the genetic code table identify a possible 5' 3' sequence of nucleotides in the *DNA* template strand for an mRNA coding for the polypeptide sequence Phe-Pro-Lys.

a. UUU-GGG-AAA
b. GAA-CCC-CTT
c. AAA-ACC-TTT
d. CTT-CGG-GAA
e. AAA-CCC-UUU

mRNA
5' UU(U/C) – CC( ) – AA(A/G) 3'

DNA
3' AA(A/G) – GG ( ) – TT(T/C) 5'

x

Translation Questions:

1. Explain why a cell needs both mRNA and tRNA in order to synthesize a protein. First, explain their functions.

- mRNA has information from DNA, only way to get information from DNA out of nucleus while protecting DNA

- tRNA carries amino acids to make polypeptides, need amino acids to build polypeptide

2. How do tRNA and mRNA work together to result in the right amino acids in the right sequence as a polypeptide is synthesized?

- codon in mRNA codes for specific amino acids. tRNA has amino acids based on codons in mRNA. Anticodon on tRNA binds to codon on mRNA. They are opposites so they can bind together inside the ribosome.

3. a) Why it makes sense to use the word translation to describe this part of protein synthesis.

- translation means to change languages, in this case macromolecules from nucleotides (nucleic acids) to amino acids (proteins)

b) Explain why it would not make sense to use the word translation to describe mRNA synthesis (transcription).

- transcription still uses the same "language" of nucleotides just DNA to RNA

4. In the table below, compare the DNA for the *Beginning of the Normal Hemoglobin Gene* vs. the *Beginning of the Sickle Cell Hemoglobin Gene*. What is the only difference?

*Beginning of **Normal** Hemoglobin **Gene***	**CACGTAGACTGAGGACTC**					
Transcription produces:	codon 1	codon 2	codon 3	codon 4	codon 5	codon 6
*Beginning of **Normal** Hemoglobin **mRNA***	**GUG**	**CAU**	**CUG**	**ACU**	**CCU**	**GAG**
Translation produces:	amino acid 1	amino acid 2	amino acid 3	amino acid 4	amino acid 5	amino acid 6
*Beginning of **Normal** Hemoglobin **Protein***	**VAL**	**HIS**	**LEU**	**THR**	**PRO**	**GLU**
*Beginning of **Sickle Cell** Hemoglobin **Gene***	**CACGTAGACTGAGGACAC**					
Transcription produces:	codon 1	codon 2	Codon 3	codon 4	codon 5	codon 6
*Beginning of **Sickle Cell** Hemoglobin **mRNA***	**GUG**	**CAU**	**CUG**	**ACU**	**CCU**	**GUG**
Translation produces:	amino acid 1	amino acid 2	Amino acid 3	amino acid 4	amino acid 5	amino acid 6
*Beginning of **Sickle Cell** Hemoglobin **Protein***	**VAL**	**HIS**	**LEU**	**THR**	**PRO**	**VAL**

5. How does DNA determine whether you develop sickle cell anemia?

- Sickle cell has VAL as 6th amino acid instead of GLU. By changing the polypeptide chain it changes the tertiary structure and shape of the protein.

6. Why does a cell need to carry out transcription before translation?

- Information from DNA needs to leave the nucleus (mRNA) to be used as a template to make polypeptide

7. To summarize what you have learned, explain how a gene directs the synthesis of a protein. Include in your explanation the words amino acid, anti-codon, codon, cytoplasm, DNA, mRNA, nucleotide, nucleus, protein, ribosome, RNA polymerase, tRNA, transcription, and translation.

Answers will vary

8. Considering that we are all made up of the same 4 nucleotides in our DNA, the same 4 nucleotides in our RNA, and the same 20 amino acids in our proteins, why are we so different from each other?

- DNA is very long and very few differences (0.1%) can end up creating many different polypeptides/proteins which will function differently in each person