RNA & PROTEIN SYNTHESIS ACTIVITY

DNA is the nucleic acid that is responsible for storing a cell's genetic information in the form of coded instructions. Because DNA does not leave the cell's nucleus, the instructions must be copied onto a messenger that can bring the genetic information from the nucleus to the ribosomes. Once here, the ribosomes make proteins, which control the biochemical pathways within the cell.

The nucleic acid that is responsible for performing these functions is RNA. RNA consists of a single chain of nucleotides. Each nucleotide contains a 5-carbon sugar (ribose), a phosphate group, and one of the following nitrogenous bases: guanine (G), cytosine (C), adenine (A), or uracil (U).

Although a cell contains many different forms of RNA, there are three main types that are involved in expressing the genetic code. The three main types of RNA are messenger RNA (mRNA), transfer RNA (tRNA), and ribosomal RNA (rRNA). The process of transferring the genetic information from DNA to mRNA is called transcription. The process that decodes mRNA into a protein is known as translation.

**Transcription:**
1. On your answer sheet you have a very small segment of a DNA molecule. Use this segment to transcribe a molecule of mRNA. Start transcribing your mRNA molecule when you find “TAC” and stop when you find “ATT”. Remember, each combination of three nitrogenous bases on mRNA is called a codon.

2. Cut out your nucleotides from the cutouts sheet.

3. Glue the sequence of nucleotides you transcribed to the back of your answer sheet and draw in the covalent bonds to complete the “backbone” of your mRNA molecule.

4. Please answer the questions in the Transcription section on your answer sheet.

At the end of Transcription the mRNA separates from the DNA and leaves the nucleus. This is the end of Transcription and the beginning of Translation. By gluing your mRNA stand to your paper you have moved your mRNA molecule out of the nucleus and into the cytoplasm. The mRNA will travel to the ribosomes where the genetic information must be decoded. There are tRNA molecules present in the cell's cytoplasm. On each tRNA molecule, there are three exposed nitrogenous bases (called an anticodon) that will pair with a codon on mRNA. An anticodon specifies for each of the cell's 20 amino acids. By matching the tRNA anticodon to the mRNA codon, the correct amino acid is put into place in the ribosome.

**Translation:**
1. Cut out the amino acid pieces and the tRNA pieces.

2. Without gluing, use the symbols to match the amino acids to their specific tRNA molecule.

There are 61 tRNAs with different anticodons. That means there are three codons that do not have corresponding tRNAs with complementary anticodons. These three codons serve as stop codons. When a ribosome encounters a stop codon on mRNA it will wait for a tRNA with the right anticodon to come over, but it does not wait for long. A stalled ribosome will quickly cleave off the bound tRNA of the growing protein chain and then move on to translate another mRNA. No tRNAs in the cell have anticodons that complement any of the three possible stop codons. Therefore, stop codons are able to end the translation process when the completed protein is completed.

3. Glue the tRNA molecules next to the mRNA strand you have already constructed by matching the mRNA codons to the tRNA anticodons.

4. Now glue the amino acids down in the correct order and add peptide bonds between each of the amino acids.

5. Please label your diagram (mRNA strand, Amino Acid, protein chain, and peptide bond) and answer the rest of the questions on your answer sheet.
mRNA Nucleotides

Amino Acids

Methionine

Serine

Valine

Proline
RNA & Protein Synthesis

Transcription:

Small DNA Segment ➔ GCA-CAA-TAC-TCA-CAA-GGA-ATT-TCA

Transcribe your mRNA molecule ➔ ____________________________

1. Which nitrogenous base in mRNA complimentary base pairs with the following DNA nitrogenous bases?
   A binds with ____  T binds with ____  C binds with ____  G binds with ____

2. Where does transcription take place?
   __________________________________________________________

3. Why does a disposable copy of DNA need to be made?
   __________________________________________________________
   __________________________________________________________________

Translation:

1. Where does translation take place?
   __________________________________________________________

2. Can your tRNA molecule join with your mRNA molecule in any other configuration? ______
   a. Explain your answer __________________________________________________________________

3. Which nitrogenous base in tRNA complimentary base pairs with the following mRNA nitrogenous bases?
   A binds with ____  U binds with ____  C binds with ____  G binds with ____

4. Why is the mRNA codon UAA missing a tRNA molecule to bind with? _________________________________
   __________________________________________________________

5. What is the order of the amino acids in the protein chain you produced?
   __________________________________________________________________________

6. The monomer of RNA is called a ___________________. Color ONE of these molecules red on your mRNA strand and label it with your answer to the first part of this question.

7. Color the last codon on your mRNA strand blue (and label it “codon”) and Color ONE anticodon green (and label it “anticodon”).

8. List the three ways RNA is different that DNA.
   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

9. List the 3 parts that make up a monomer of RNA?  
   __________________________________________________________

10. List the three main types of RNA.
    __________________________________________________________
    __________________________________________________________
    __________________________________________________________

11. The process of making mRNA from DNA is known as______________________________

12. The process of making a protein based on the sequence of mRNA is known as ____________________