Biology
Morales

Name: _____
Date: _____ Period: _____

Transcription and Translation

Directions: Read the following and answer the questions in complete sentences.

DNA is the molecule of heredity – it determines an organism's traits and characteristics. But how, exactly, does it do this? It does so by providing the instructions for making proteins! It's actually the proteins in your cells and throughout your body that determine your characteristics. Recall that proteins are made at the ribosomes in the cytoplasm of a cell. So if DNA is confined to the nucleus of a cell, how does it make proteins? That's where RNA comes in! RNA is an intermediate molecule that actually carries the information in DNA to the ribosomes, so the proteins can be made. RNA is made from DNA in the nucleus by a process called transcription. See Figure 1.

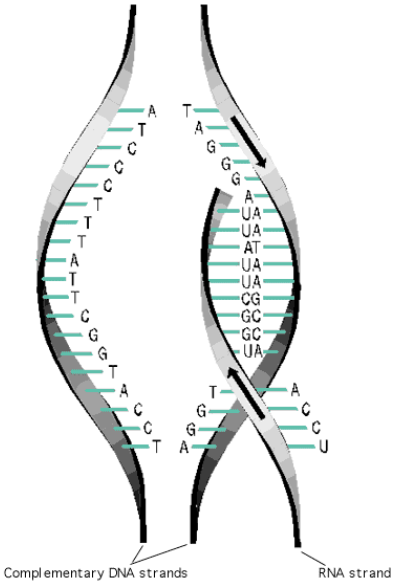


Figure 1

Let's practice transcribing a segment of DNA. Let's imagine that one side of a DNA molecule has the following sequence of nucleotides:

TACACCTTAGCTAAGTCC

Recall that the base pairing rules for DNA are
Adenine – Thymine
Cytosine – Guanine

Also recall that RNA does not have thymine, instead it contains uracil, therefore the base paring rules when creating RNA from DNA are:
Adenine – Uracil
Cytosine - Guanine

The RNA that would be produced would be:

AUGUGGAAUCGAUUCAGG

1. Now you try! Transcribe the following segment of DNA.
   T A C T G G A G C T T A G A T C C T

2. Transcribe this segment:
   T A C A A G T A G C C G A A T C G T

3. What is the name of the process of making RNA from DNA?

4. Where does this process occur?

5. What are the four steps of this process? You may use your notes, but write your answer in your own words.

6. What enzymes are involved in the process?

7. Why does transcription have to happen? In other words, why can't DNA be used directly to make proteins?

Now that we have created a segment of RNA, the information to make proteins can be taken to the ribosomes. Remember that the monomers, or building blocks of proteins are amino acids. How do the amino acids get to the ribosome? Recall that there are several types of RNA – tRNA, mRNA, and rRNA.

8. Which type of RNA carries the amino acids to the ribosomes?

9. Which type of RNA delivers the message of DNA to the ribosomes?

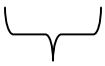
10. What does rRNA do?

So how is the RNA used to create proteins at the ribosomes? This process is called translation. The process starts when the mRNA goes to the ribosomes. The ribosome holds the mRNA in place. Recall that the mRNA is made up of nucleotides.

11. What are the three components of an RNA nucleotide?

Every three nucleotides is called a **codon**. For example, below is a segment of RNA made during transcription.

A U G C C U A C G A U C G U C



This is one **codon**.

12. How many codons are shown in the segment of RNA above?

13. What is the first letter of the second codon?

Each codon in a segment of RNA "codes for" or calls for one particular amino acid. The tRNA that carries that amino acid has a complementary trio of nucleotides called an "anticodon." The order of the amino acids determines what protein is made. Each protein is made up of a different sequence of amino acids. We can use a tool called the Codon Table to determine which codon codes for which amino acid.

Refer to the Codon Table attached to the back of this packet. Detach the page. Observe the left side of the table. There is a column with the words, "First Letter" at the top. Then across the top, you'll notice it says, "Second Letter." And finally, on the right side, there is a column entitled, "Third Letter." You will use these three columns to find the particular amino acids that form the protein. Let's say, for example, that the first codon in a segment of RNA is **A U G.** What is the amino acid coded for by this codon? The first letter of the codon is **A**. Find the letter **A** in the column at the left of the table, where it says, "First Letter." The amino acid will be somewhere in that row. The second letter of the codon is **U**. Keeping one finger on the row for the first letter of **A**, find the column for the second letter of **U**. The amino acid will be either isoleucine or methionine (start). Which one will it be? Use the last column ("Third Letter") to find out. Keeping your fingers where the first letter of **A** and the second letter of **U** meet, find the last letter, **G**, in the column on the right. Which amino acid is it? You should have chosen methionine.

Let's practice.

14. What amino acid is coded for by the codon **C G A**?

Now I'll do a whole RNA segment. Then you can practice.

A U G C C A A G U U A C C G A

I like to put in lines to separate the codons, as such:

A U G | C C A | A G U | U A C | C G A

Then you use the table to find the amino acids:

Methionine – proline – serine – tyrosine – arginine

15. Now you try:

A U G A A U G C G U U U A G C

If you're having trouble, ask someone in class to help you!

16. Let's try another:

A U G C A U U U G A C G C C A G A A

17. What is the name of this process – that is, creating proteins from a strand of RNA?

Notice that many of the mRNA segments in the examples start with **AUG**. This is called the start codon. All proteins start with a start codon. Proteins end with a stop codon.

18. For example, translate the following segment of RNA. (What amino acids will be coded for?)

A U G A U U C G C A C C U A A G C U

The second to last codon was a stop codon. Even though there is one more codon after the stop codon, you do not need to translate it. The stop codon tells you exactly what to do, stop!

19. Where is this process happening in your cells?

Now let's start from scratch.

20. Using the following segment of DNA, write the complementary DNA strand. Be careful here, I'm asking for DNA!

T A C T T A C G T C T T A G C C A C

21. Now transcribe the same segment of DNA as in #20.

22. What molecule was created during transcription?

23. Now write the sequence of amino acids that will be coded for. (Use your codon table.)

24. As a review, explain the difference between transcription and translation.

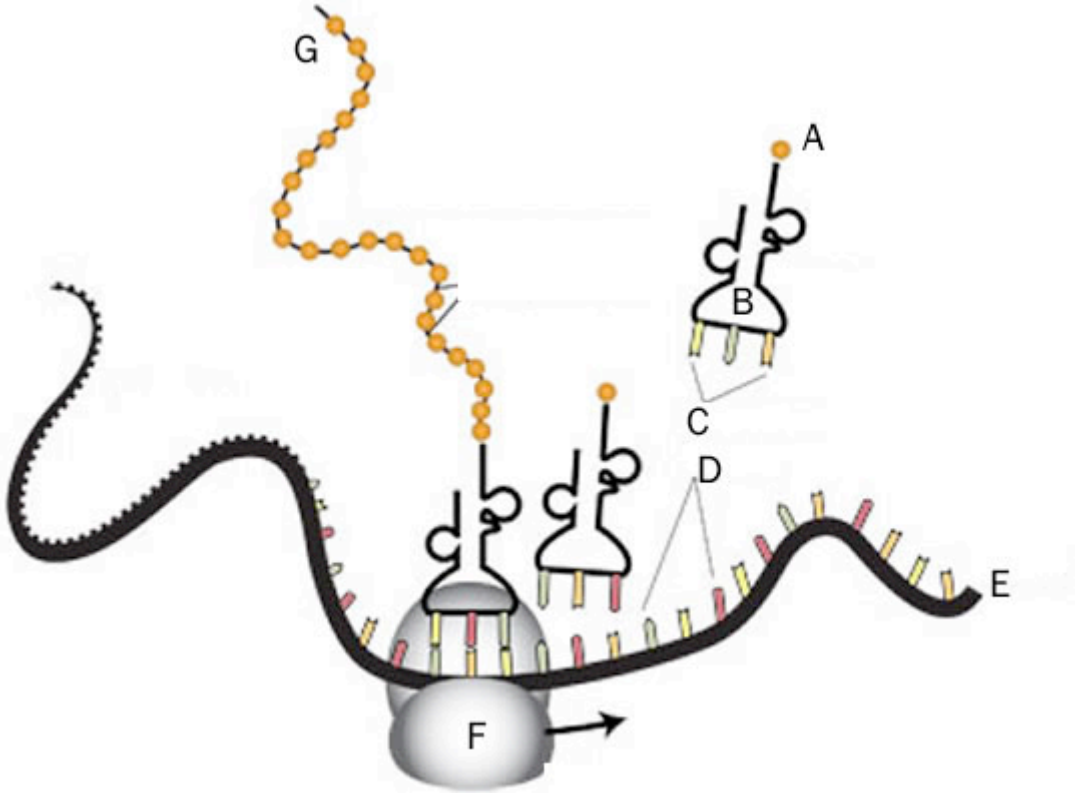
Recall that earlier, it was mentioned that the tRNA molecules which carry the amino acids to the ribosomes have a trio of nucleotides called an anticodon that is complementary to the codon. For example, if a codon on mRNA is **C G A**, the anticodon found on the tRNA would be **G C U**.

25. You try one. What is the anticodon for the codon, **U A G** ?

26. What molecule is a codon found on?

27. What molecule is an anticodon found on?

Below is a diagram which illustrates the process of translation. Try to identify the structures labeled A – F.



A.

B.

C.

D.

E.

F.

G.

Codon Chart

First Position (5′)	Second Position: U	Second Position: C	Second Position: A	Second Position: G	Third Position (3′)
U	Phenylalanine	Serine	Tyrosine	Cysteine	U
	Phenylalanine	Serine	Tyrosine	Cysteine	C
	Leucine	Serine	Stop	Stop	A
	Leucine	Serine	Stop	Tryptophan	G
C	Leucine	Proline	Histidine	Arginine	U
	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
A	Isoleucine	Threonine	Asparagine	Serine	U
	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
	Methionine	Threonine	Lysine	Arginine	G
G	Valine	Alanine	Aspartic acid	Glycine	U
	Valine	Alanine	Aspartic acid	Glycine	C
	Valine	Alanine	Glutamic acid	Glycine	A
	Valine	Alanine	Glutamic acid	Glycine	G