Name: _____ TOC#____

Our Classroom is a Cell!!

And Today, you are the protein synthesizers.

Introduction:

DNA, deoxyribose nucleic acid, is the genetic blueprint for all life. DNA is the instructions used in the development and functioning of every living organism. Knowledge of its structure and functions is key in understanding molecular biology.

Background:

Less than sixty years ago the nature of the genetic code still eluded scientists. Understanding the structure of DNA helps to explain many life processes and leads to an understanding of why we are who we are. In this activity, the major processes of DNA will be modeled. Each step of the procedure will simulate a key DNA structure or process.

A simplified diagram of a short section of DNA is shown in Figure 1. The diagrammed segment contains seven base pairs. A real chromosome may contain a single DNA molecule with as many as 10^8 (100 million) base pairs! Since these base pairs represent the genetic code, the chromosomes can store a lot of messages!

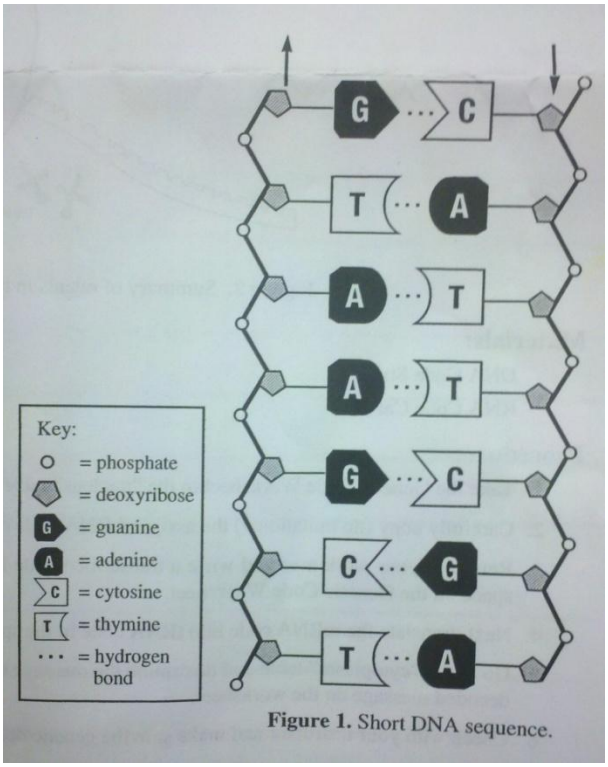


Figure 1. Short DNA sequence.

Pre-Lab Question Set #1:

1. The structure of DNA is called:

2. A the monomer of DNA is called a _____,

   which contains 3 parts: _____,

   _____, and_____

3. Circle a nucleotide in figure #1.

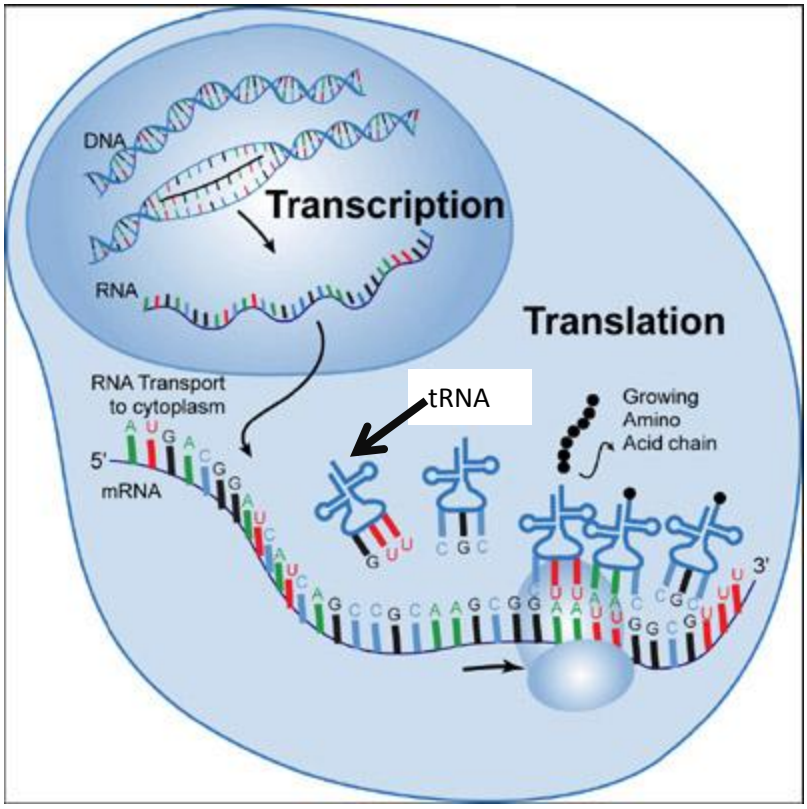
4. It is important for DNA to replicate so that:

5. DNA replication occurs in three steps, facilitated by three enzymes. Describe each:

Background Continued:

It is important that DNA replicates so that every cell in an organisms has a copy of the genetic information. However, having the information is not sufficient for living organisms to function. Most importantly, DNA serves as the template and storage place for genetic messages.

In order for the messages to be processed **protein synthesis** must occur. This process occurs in two steps: *transcription* and *translation*. The first step involves the synthesis of messenger RNA (**mRNA**) from a section of the DNA template by the process of **transcription**. In this step, mRNA is transcribed, or copied, from DNA for a specific gene/protein that will be expressed. This mRNA then carries the transcripted message to the ribosomes. In RNA, thymine is replaced by uracil as the base complement to adenine.



The code in the newly synthesized mRNA is transported to the ribosome, where proteins are synthesized. There, the mRNA undergoes the process of **translation** and is used to produce a specific sequence of **amino acids**, i.e., a specific protein. This occurs by reading the mRNA codon by codon, or, three nucleotides at a time. This translation process involves another type of RNA, called transfer RNA (**tRNA**). The tRNA has a three-base section called the anticodon which is the key to linking its specific attached amino acid to the growing chain of amino acids. These anticodons are complementary to the codons on mRNA.

The order in which the tRNA molecules are brought to the ribosome is determined by the codon sequence of the mRNA, which, of course, was originally encoded in the DNA in the nucleus.

Pre-Lab Question Set #2

1. Why does Protein synthesis occur?

2. What are the two steps of protein synthesis? Where does each occur?

3. What role does mRNA play?

4. What role does tRNA play?

5. What is a codon? What is an anticodon? How do they interact?

Our Activity Today:

Today, we will simulate many processes that involve DNA. Our entire classroom is a cell! Lets understand how:

1. The walls of the classroom represent the cell membrane, which keeps the cells contents secure.
2. Each tray on the floor contains segments of DNA (if we taped them together we would have the entire sequence), each segment codes for a specific gene.
3. The circle of desks in the middle is the nucleus, where DNA must remain.
4. After transcription, the mRNA may leave the nucleus through nuclear pores, represented by the space between each desk.
5. Each lab station is one of many ribosomes in a cell. Here, protein synthesis takes place.
6. At the ribosome, mRNA codons are read and matched with tRNA codons. These matching codon/anticodons are represented by the slips of paper at the ribosomes.
7. On the back of the slips, there are words, these are our amino acids.
8. When they link together in the correct order dictated by the original DNA fragment they make a sentence, or a protein.

Materials:

1) DNA Code Strips 2) RNA Code Cards 3) Genetic Code Worksheet

Procedure:

1. Find your "color" group and meet at the correct "ribosome"
2. With your group taking the "Genetic Code Worksheet" with you, enter the nucleus through a pore and find the tray labeled with the correct color DNA.
3. Choose one gene (one strip of DNA) to express first. Copy the number of the sequence onto the worksheet where it says "DNA #___".
4. Copy the code for the gene onto the line after "DNA# ____:"
5. While still inside the nucleus, transcribe your DNA into mRNA (remember there is no Thymine in RNA) onto the line labeled "mRNA"
6. Carry your mRNA code outside the nucleus, through the cytoplasm, and back to your ribosome.
7. At the ribosome, identify your codon sequence on the mRNA by drawing a line every three nucleotides, how your ribosome would read the message, for example:

AUG	**CCA**	**GUA**	etc.

8. For each codon, write the matching anticodon that would be found on tRNA, which would carry a specific amino acid. Extend the line from the mRNA strand. For example:

AUG	**CCA**	**GUA**	etc.
UAC	GGU	CAU	

9. Then, with your group, find the correct **codon/**anticodon card from the pile at your ribosome. Place them in the order you have written from steps 7/8.
10. On the line labeled "decoded message" copy the words on the back of your **codon/**anticodon card.
11. Linking these words (amino acids) should create a coherent sentence (protein) and you have correctly expressed a gene!
12. Check your sentence with Ms. Pender, and start again. Your goal is to complete protein synthesis for 6 genes.

Genetic Code Worksheet

1) DNA #____: _____

mRNA_____

tRNA_____

Decoded Message:_____

2) DNA #____: _____

mRNA_____

tRNA_____

Decoded Message:_____

3) DNA #____: _____

mRNA_____

tRNA_____

Decoded Message:_____

4) DNA #____: _____

mRNA_____

tRNA_____

Decoded Message:_____

5) DNA #____: _____

mRNA_____

tRNA_____

Decoded Message:_____

6) DNA #____: _____

mRNA_____

tRNA_____

Decoded Message:_____