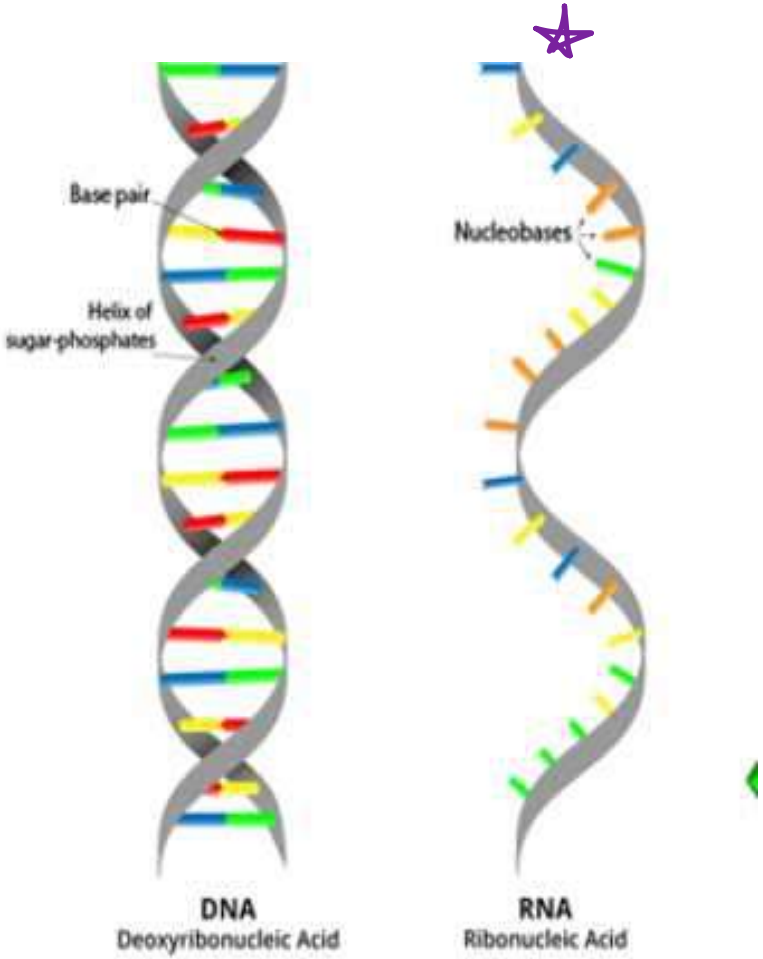
Lesson 4- Protein Synthesis Part 1- From DNA to mRNA



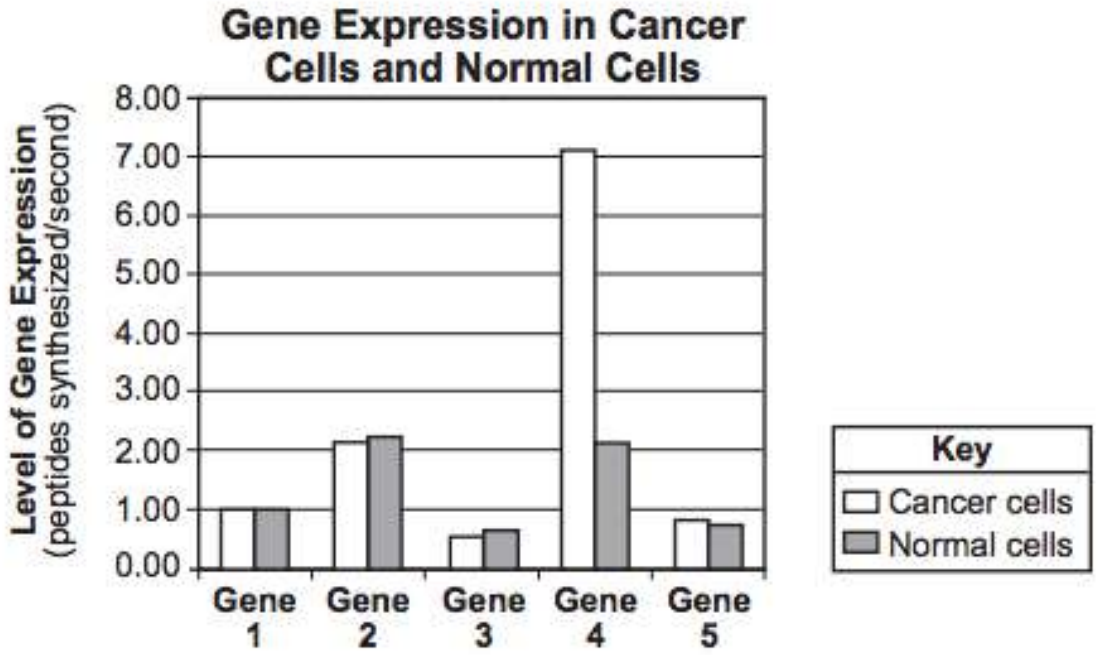
Learning Objectives:

- Identify the role of the nucleus and the ribosome in protein synthesis
- Explain how DNA and RNA compare and contrast
- Synthesize a strand of mRNA from a DNA template
- Explain the role of mRNA in protein synthesis


NASA
MARK KELLY
CAPTAIN USN
NASA
SCOTT KELLY

- Genes are expressed.
- Gene expression can change; gene expression can increase
- Genes code for proteins
- Proteins control your traits
- Cell express genes.

- Genes produce proteins
- Your genes increases
- Your genes changed
- The genes have many cancer cells
- There are more genes in the cancer cells
- The twins have slightly different genes



AIM: ***How do the nucleus and the ribosome work together for protein synthesis?***

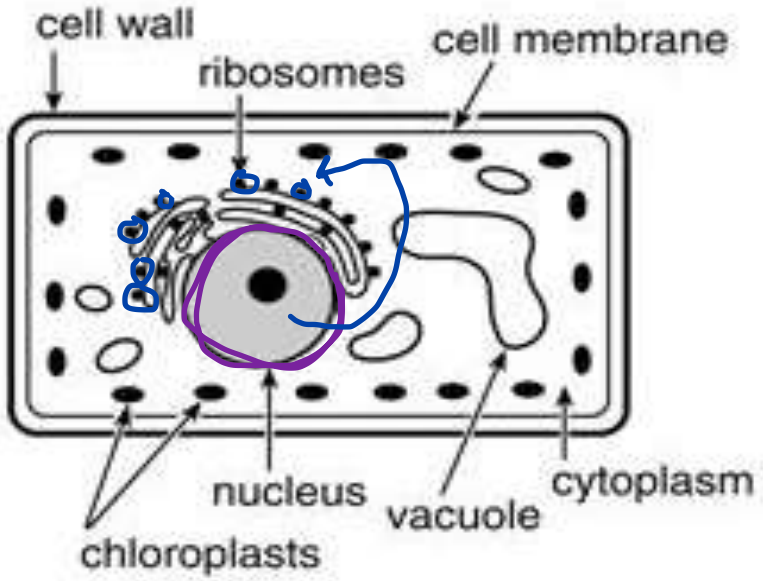
Ok! I get it! Genes code for proteins! And proteins control traits! But HOW does DNA code for proteins? Doesn't the ribosome make proteins? …

Look at the two cell diagrams. Recall that the **nucleus** *stores the genetic material* in a cell. The **nucleus** *stores the DNA* and all of your **genes**. Just outside of the nucleus, you will find **ribosomes**. Ribosomes are *where proteins are built.*

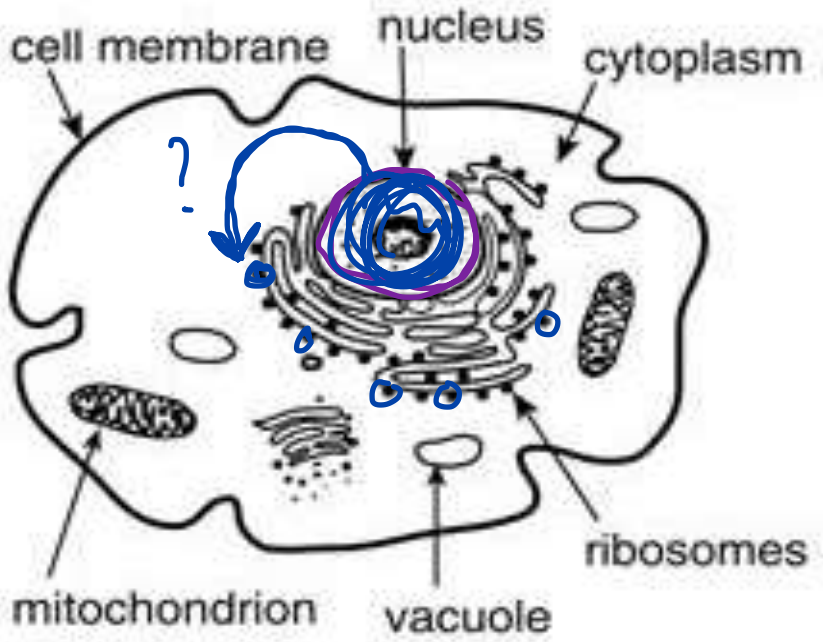
protein

- **Nucleus** = stores the instructions for building proteins Genes
- **Ribosome**= site of protein synthesis

Plant Cell



Animal Cell

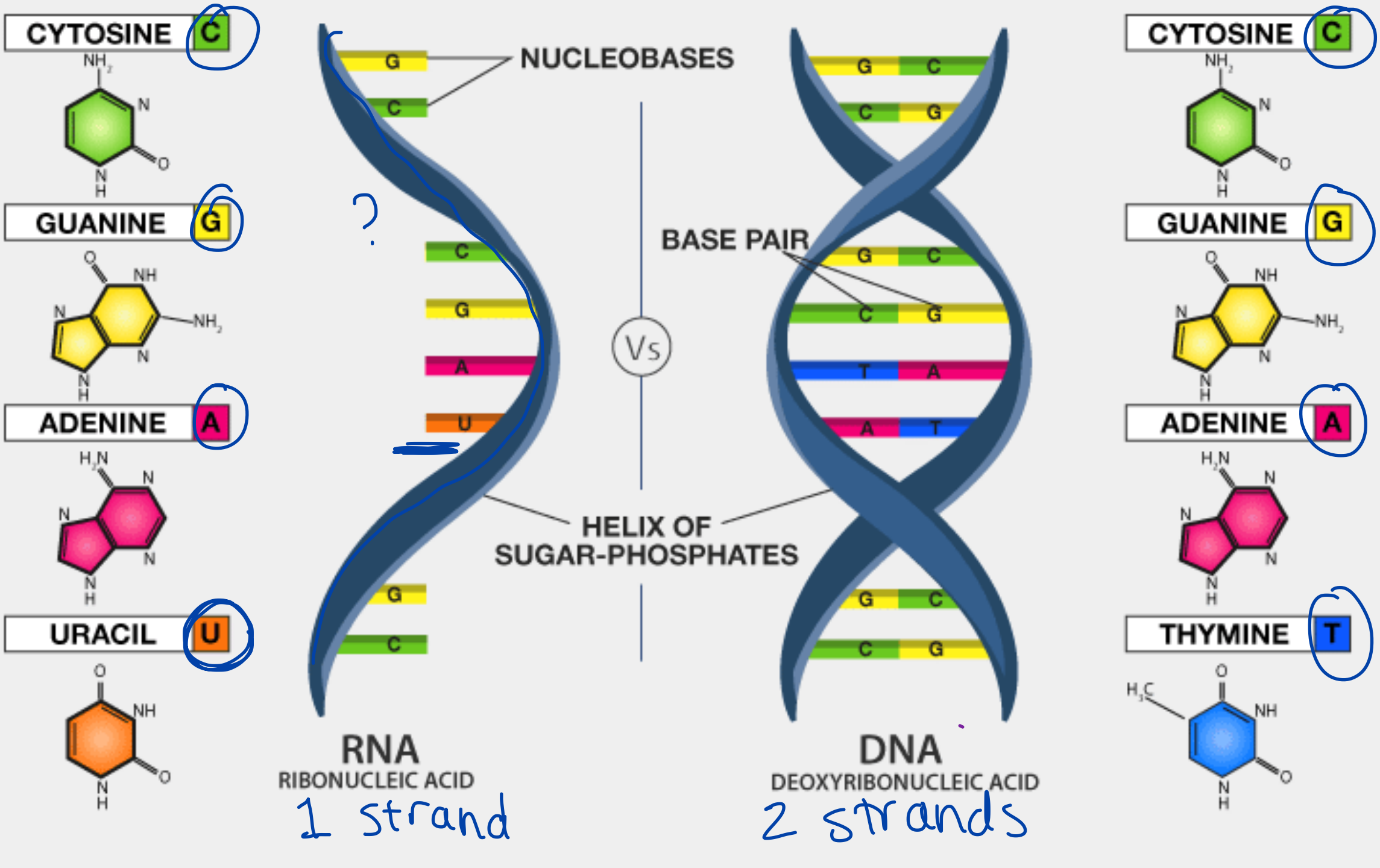


But, we have 2 problems:

- Each cell contains ONE copy of your DNA, and the DNA *never leaves the nucleus.*
- The ribosome can't even read DNA!! It reads a molecule called RNA.

Solution:

- In the nucleus, DNA is used to make a strand of **RNA**. RNA *leaves the nucleus* and goes to the ribosome. The RNA carries the information from the gene so that the ribosome knows how to make the protein. RNA is another *information molecule* similar to DNA


CYTOSINE C
GUANINE G
ADENINE A
URACIL U
NUCLEOBASES
BASE PAIR
HELIX OF SUGAR-PHOSPHATES
Vs
RNA
RIBONUCLEIC ACID
1 strand
DNA
DEOXYRIBONUCLEIC ACID
2 strands
CYTOSINE C
GUANINE G
ADENINE A
THYMINE T

How is DNA used to code for RNA?

- RNA is a very similar molecule. The one difference is that RNA does **NOT** have the base "T" (thymine). Instead, it has the base "**U**" (uracil). U is so similar to T, *that it can still pair with A.*
- SO, the DNA bases are **G**, **C**, **A**, and **T**
- The RNA bases are **G**, **C**, **A**, and **U**

When a strand of DNA is *being used to code for RNA,* we will use the following rules for base pairs:

- If the DNA template says G, the matching RNA will be a C
- If the DNA template says C, the matching RNA will be a G
- If the DNA template say T, the matching RNA base will be A
- If the DNA template the A, **the matching RNA base will be U**
- **Look at the example below.**

DNA →	mRNA
G	C
C	G
A	U
T	A

"Gene"

DNA template: G T T A C G A T G A T C

mRNA strand: C A A U G C U A C U A G

DNA template: G T A T G T C A C

mRNA: C A U A C A G U G

DNA →	mRNA
G	C
C	G
A	U
T	A

DNA template: T T A G A G A C T

mRNA: A A U C U C U G A

DNA →	mRNA
G	C
C	G
A	U
T	A

When DNA is used to make RNA, we call the RNA that is being produced "**mRNA.**" The **m** stands for ***messenger***. Once complete, the single strand of mRNA *leaves the nucleus* and goes to the **ribosome**. The mRNA message contains the information needed to build a specific protein.

- SO, **DNA** can act as a *template* to make *more DNA for DNA replication*.
  - Use the DNA base-pair rules FOR DNA REPLICATION QUESTIONS.
- OR, **DNA** can act as a *template* to make a *strand of mRNA for protein synthesis.*
  - Use the DNA to RNA base-pair rules for PROTEIN SYNTHESIS QUESTIONS.

^ This pic shows a sequence of DNA being used to code for a strand of mRNA

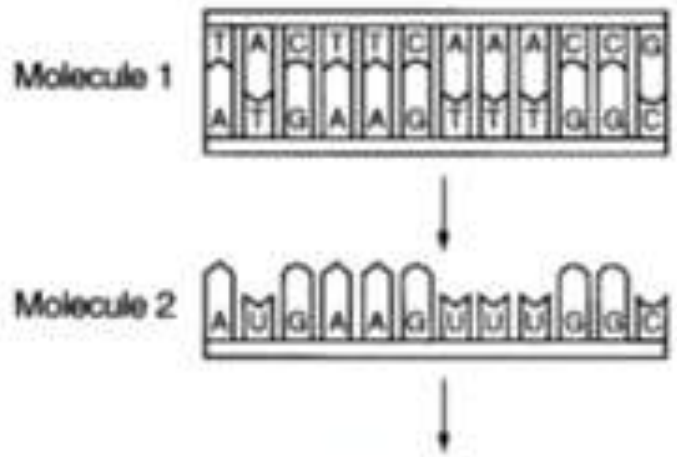
A DNA molecule with the base sequence A-G-C-T-C-A was used as a template for the synthesis of a messenger RNA molecule. Which base sequence correctly represents the corresponding portion of this RNA molecule?

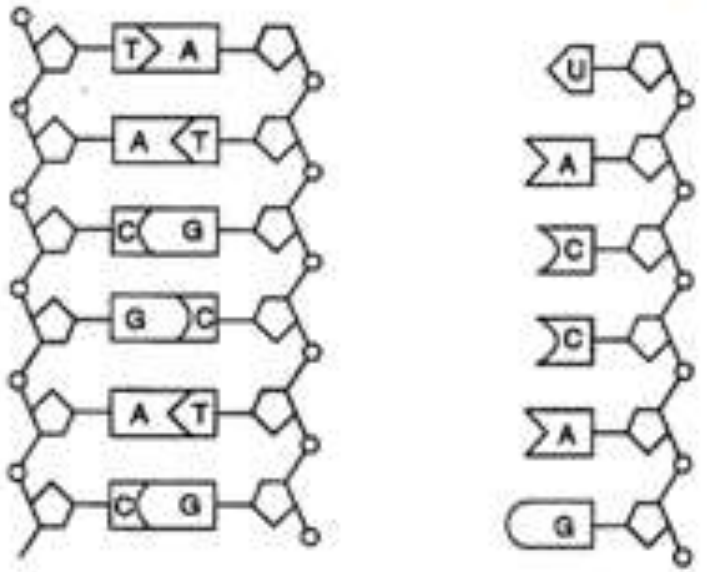
a) T-C-A-G-C-A *b) U-C-G-A-G-U c) A-G-C-U-C-A d) A-T-G-A-C-T

If one strand of DNA molecule has the base sequence A-G-C-T-A, the complementary strand of DNA would have the base sequence

a) A-G-C-T-A b) U-C-G-A-T c) U-C-G-A-U *d) T-C-G-A-T

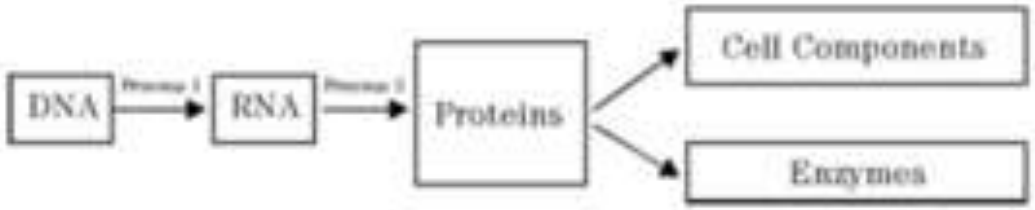
Here are some important pictures to analyze! Please look at every picture and read each caption!!!

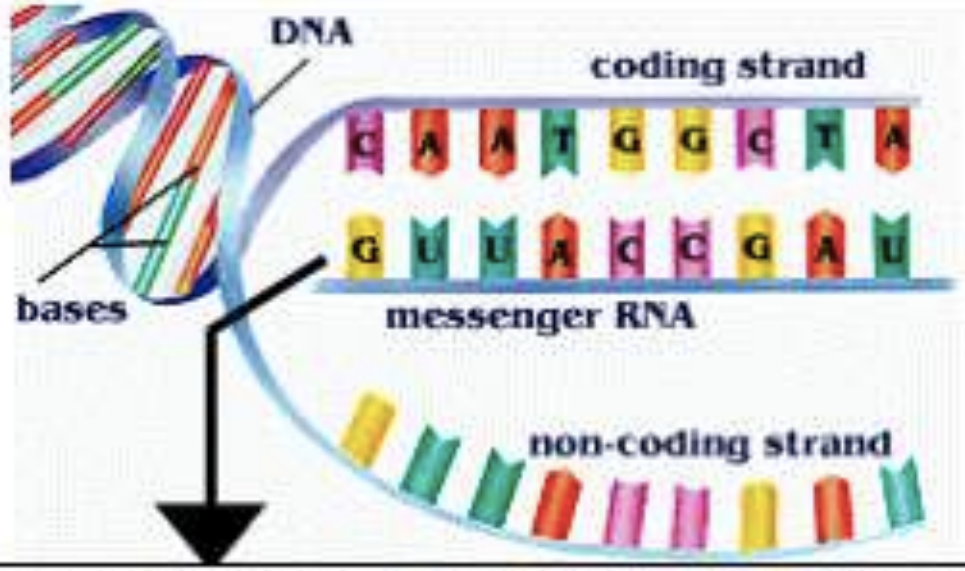
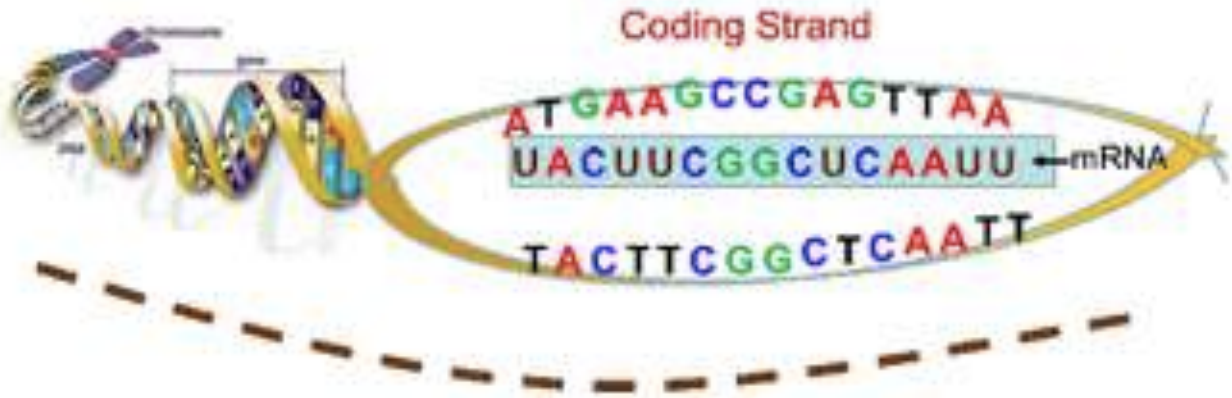




- **Molecule 1** represents DNA. I can tell because its double-stranded, and I see the 4 DNA bases (G, C, A, and T).
- **Molecule 2** represents mRNA. I can tell because it is single-stranded, and I see the 4 RNA bases (G, C, A, and U)

- The first molecule represents DNA.
- The second molecule represents a strand of RNA.
- DNA can be used to code for RNA.

	DNA → RNA → Protein → Trait
• This shows me that *DNA can be used to make RNA*. This process happens in the **nucleus**. • *mRNA* then goes to the **ribosome**. The mRNA is *read by the ribosome to build proteins.* • **Proteins** in the body can become various parts of cells, enzymes, or other things.	• **DNA** can be used to code for **mRNA**. This takes place in the **nucleus**. • **RNA** is used by the **ribosome** to build **proteins**. • **Proteins** give rise to various **traits**.

	
This picture shows how one strand of my DNA is used to make the strand of messenger mRNA.	Here is another picture that shows how a sequence of DNA can be used to make a strand of mRNA to send to the ribosome.

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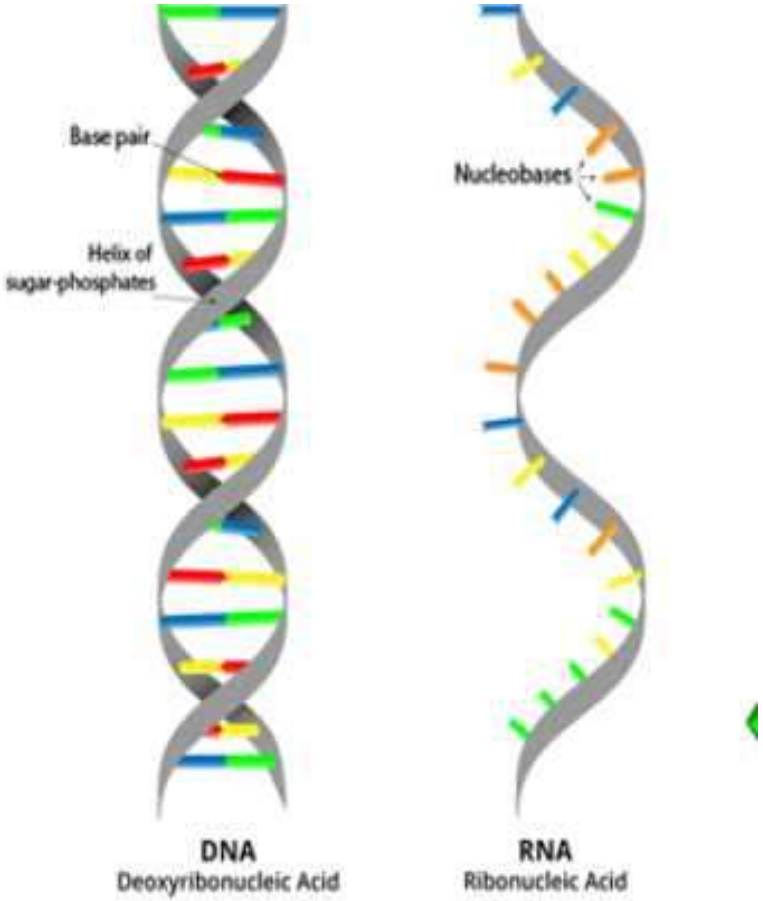

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