Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Lab\_\_\_\_\_\_ Block\_\_\_\_\_\_

**Molecular Basis of Heredity**

* **DNA Structure, Function and Replication**
* **Protein Synthesis and RNA Transcription**
* **Protein Synthesis and RNA Translation**
* **Genetic Mutations**

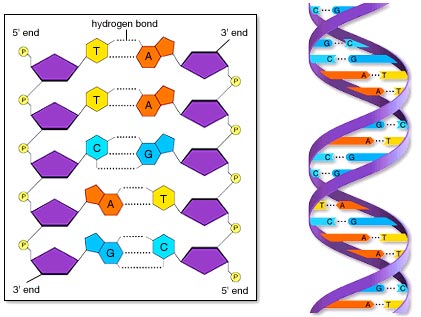
**DNA Structure, Function and Replication**

**Objectives**  
Explain that DNA replication take place during Interphase if the cell cycle  
Explain that DNA replication takes place inside the nucleus

Explain that DNA is composed of a phosphate, sugar and nitrogen bases  
Demonstrate the paring of adenine and thymine and the pairing of guanine and cytosine  
Model the double helix composition of a DNA strand  
Explain that the function of DNA is to store and replicate instructions to make the organism  
Explain the process of DNA replicating a strand

**NOTES**  
**DNA Structure**  
DNA = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

DNA is made up of\_\_\_\_\_\_\_\_\_\_\_ part \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ containing:

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* One of these four \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (also called nucleic acids):
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The nucleotides assemble forming a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_ structure.

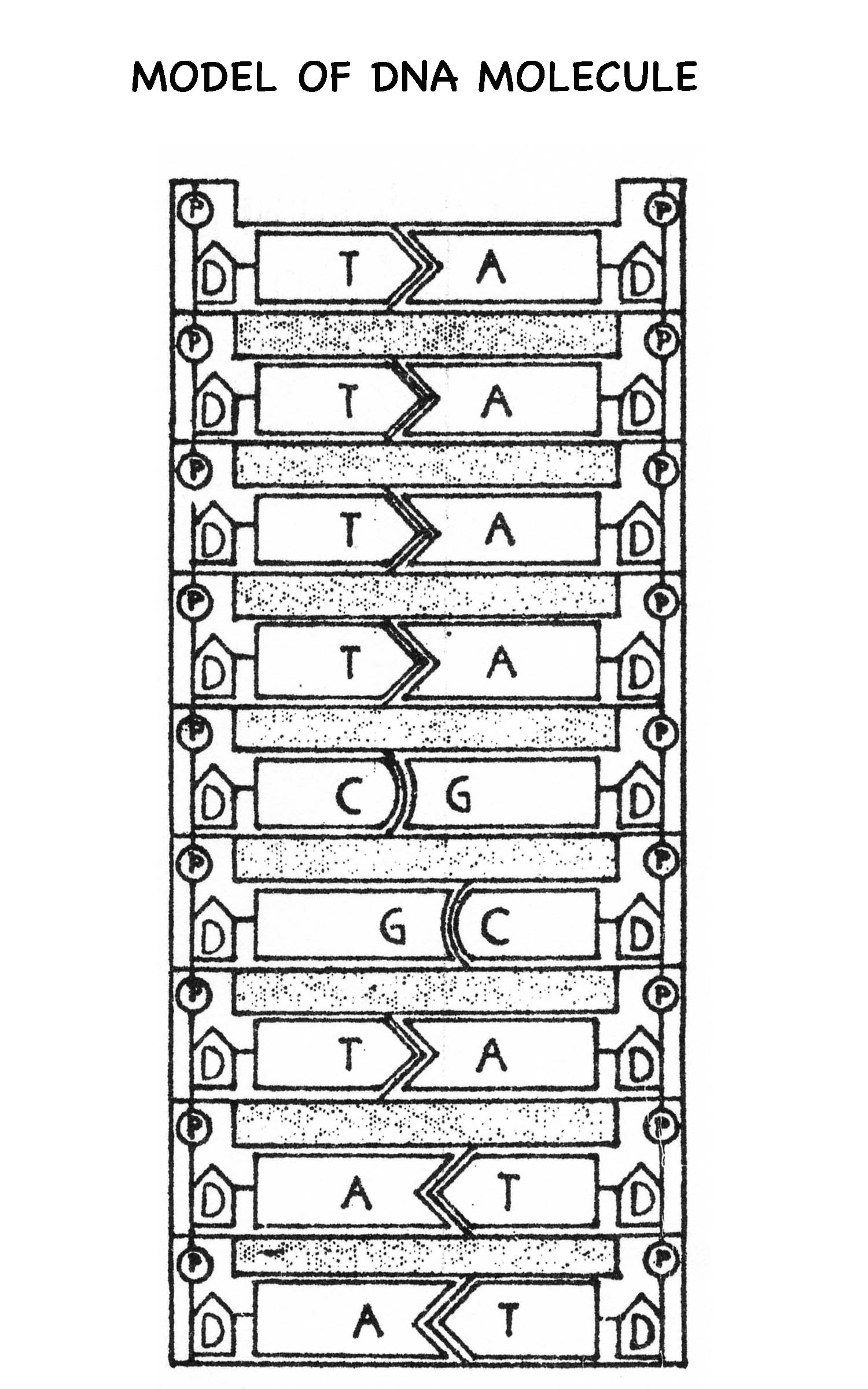
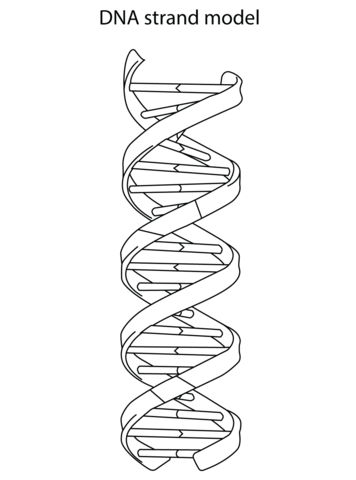
**Instructions**: Circle four nucleotides, one with each of the four bases, in each of the diagrams on the right.

**Base Pairing Rules**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ always pair, represented with an **“A & T”**

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ always pair, represented with a **“C & G”**

**Illustrate  
Instructions:** Color the two DNA models below. Use the same colors on each model so the model on the left side serves as a key for the model on the right. Remember the base pairing rules.



**Instructions**: Practice base pairing.

ATG CCG ACG TAC GGC GTC AAG TAG

\_\_\_ \_\_\_ \_\_\_\_ \_\_\_ \_\_\_\_ \_\_\_ \_\_\_\_ \_\_\_

**DNA Function**

DNA contains the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to make you.

“ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” = all of your DNA

“\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_” = one set of instructions within your DNA

**“The Animated Genome”Video  
Instructions: Watch the video and answer the following questions. The video time codes are noted, you may have to pause the video as you complete the information:**

:04 Inside each cell is a code of instructions for life.

This is your \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

When unfolded, it is \_\_\_\_\_\_ feet long!

All cells have the same genome, true or false? (circle one)

:23 What is your genome made of? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

It is the parts list and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for life.

What are the names of the 4 chemicals used by your genome?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

:58 How many letters form words in your genome? \_\_\_\_\_\_\_

What does each word code for? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is each sentence in your genome called? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is working hard so you may breathe, move and think? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2:04 What is the fancy word for all of your DNA? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Can the way you live influence the way your genome works? yes or no (circle one)

2:57 DNA has \_\_\_\_\_\_\_\_\_\_\_\_ complimentary strands.

\_\_\_\_\_\_\_ always matches \_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_ always matches \_\_\_\_\_\_\_\_\_

When cells divide, the strands \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3:22 What repairs matching errors? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What is the cause of many cancers? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

During cell division, the genome gets condensed into groupings called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

You get 23 chromosomes from your mother and father.

3:55 What happens if you get a faulty chromosome from one parent?

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What did the video mean by “that’s why you don’t marry your sister”

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

What percent of your genome is identical to the person next to you? \_\_\_\_\_\_\_\_\_\_

What percent of your genome is identical to a mouse? \_\_\_\_\_\_\_\_\_\_

What percent of your genome is identical to a fly? \_\_\_\_\_\_\_\_\_\_\_

What percent of your genome is identical to a banana? \_\_\_\_\_\_\_\_\_end of video.

**DNA Replication**

\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ takes place during \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the cell cycle.

The purpose of DNA Replication is to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the DNA that was divided during anaphase.

DNA replication takes place in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the cell.

**Enzymes**

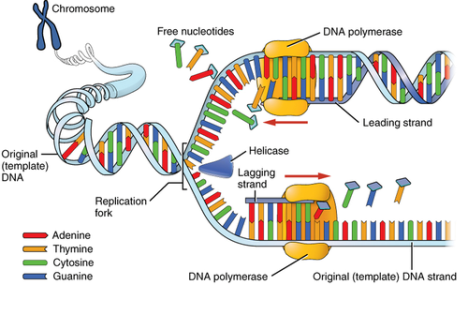
\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ play a crucial roll in DNA replication.

DNA \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ separates the strands of DNA by breaking the bonds between the bases.

To remember: Think of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_ flying in and splitting the DNA strand!

DNA \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ builds bond between the free floating nucleotides and the DNA strand.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ binds the base pairs.



**Protein Synthesis and RNA Transcription**

**Objectives**  
Explain that DNA must be transcribed into a message the ribosome can read  
Explain that thymine must be replaced with uracil so the ribosome can read the genetic code  
Explain that transcription takes place in the nucleus  
Explain that the enzyme “RNA polymerase” synthesizes the mRNA strand from free floating nucleotides  
Know that mRNA is “Messenger RNA”  
Know that mRNA will take the DNA code, or message to the ribosome  
Know the base pairing rules of transcription: G & C pair; A & U pair

**NOTES**

**Two Steps in Protein Synthesis:**  
  
1.

2.

**mRNA**

mRNA =   
  
RNA =

The structure of RNA is similar to DNA with three important differences:

* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (not double helix)
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ instead of thymine
* The sugar is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ instead of deoxyribose

**Transcription of DNA to mRNA**:

Transcription takes place during \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ phase of the cell cycle.

Purpose: Transcribe DNA into a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can read.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_the message to the ribosome.

**THINK:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Transcription to mRNA occurs inside the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the cell.

Transcription to mRNA is similar to \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Thymine** is replaced with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pair; \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pair.

\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the enzyme that synthesizes mRNA

**Transcription to mRNA Summary**

Ribosomes read the genetic code in DNA, however ribosomes can’t read the “Thymine” base, so Thymine is replaced with “Uracil”in a strand of mRNA. Then the message is taken from the nucleus to the ribosome by mRNA.

**Protein Synthesis Model Rubric:**

|  |  |
| --- | --- |
| **Illustrate Protein Synthesis** **10 Points for Each Item, 170 points total** | **Points** |
| 1. Label Nucleus |  |
| 2. Label Ribosome |  |
| 3. DNA strand |  |
| 4. Replicated DNA Strand |  |
| 5. DNA Polymerase synthesizing DNA strand |  |
| 6. Label DNA Replication |  |
| 7. DNA Helicase degrading DNA strand |  |
| 8. DNA Ligase sticking base pairs together |  |
| 9. Transcribed mRNA Strand |  |
| 10. RNA polymerase synthesizing mRNA strand |  |
| 11. Label Transcription |  |
| 12. mRNA exiting nucleus |  |
| 13. mRNA surrounded by Ribosome subunits |  |
| 14. tRNA anti-codons attached to mRNA codons |  |
| 15. Amino acids forming polypeptide chain |  |
| 16. Label translation |  |
| 17. Protein |  |
| Total Points: |  |

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**Leave Blank for Back of Project**

**Protein Synthesis and RNA Translation**

**Objectives**  
Explain that mRNA strands leave the nucleus and travels through the cytoplasm to the ribosome.  
Explain that Translation occurs in the cytoplasm between ribosome subunits  
Explain that the genetic code carried by mRNA contains the instructions for making proteins  
Explain that amino acids are assembled into proteins based on the genetic code on the mRNA strand  
Explain that mRNA is read in triplicates called “codons”  
Explain that each codon codes for a specific amino acid  
Explain there are 20 amino acids that make up all living things  
Explain that the anti-codon on tRNA matches codons on the mRNA strand  
Demonstrate translation of mRNA strand into a protein  
Explain that tRNA is “Transfer RNA”  
Explain that tRNA transfers amino acids to the ribosome sub units to be assembled into proteins

**NOTES  
Translation to Protein**

Takes place during the \_\_\_\_\_\_\_ phase of Interphase.

Purpose: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the message delivered by the mRNA strand

To make a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_from \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Think: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Once the mRNA strand has been transcribed, it travels out of the nucleusthrough the

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Translation occurs in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Ribosome subunits read the mRNA strand and signal \_\_\_\_\_\_\_\_\_\_\_\_\_ to transfer

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to the active site.

**tRNA =** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Triplicates in the mRNA strand, called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ code for specific \_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_.

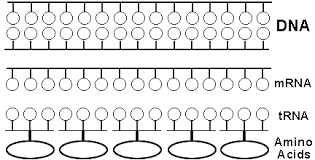
tRNA \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ pair with the codons.

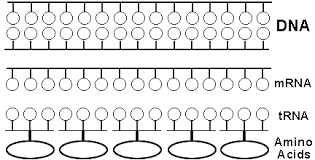
mRNA base pairing rules apply: \_\_\_\_\_\_\_&\_\_\_\_\_\_\_ pair; \_\_\_\_\_\_\_ & \_\_\_\_\_\_\_ pair.

\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ transferred by tRNA bond forming a protein.

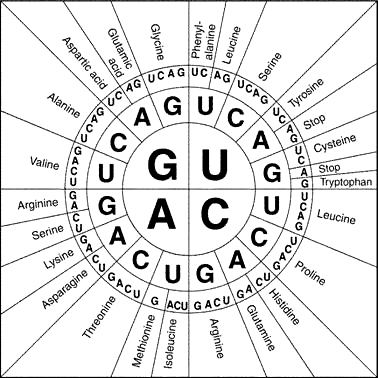
\_\_\_\_\_\_\_\_\_\_\_\_\_ & \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ codons mark the beginning and end of each gene.

**Protein Synthesis Practice:**





**Codon Table:**



**Genetic Mutations**

**Objectives**Explain that a mutation is a change in an organism’s DNA  
Explain that mutations can be caused by errors in DNA replication  
Explain that point shift mutations occurs when one nucleotide is improperly replicated  
Explain that DNA polymerase usually corrects point shift mutations, but not always  
Explain that frameshift mutations occur when a nucleotide is added or deleted causing the entire strand to shift  
Explain that environmental factors causing DNA mutations are called “mutagens”  
Give three examples of mutagens  
Explain that mutagens affecting cell division may cause cancer  
Explain that mutations to a gamete can be passed on to offspring  
Explain that mutations to somatic cells will not be passed on to offspring

**NOTES**:

Genetic mutations are simply \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in an organisms DNA.

Sometimes they are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Sometimes they are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Causes of Mutations**

* Errors in \_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Errors during \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ factors, these are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Heritable Mutations**

* Mutations to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can \_\_\_\_\_ be inherited
* Mutations to the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can be inherited

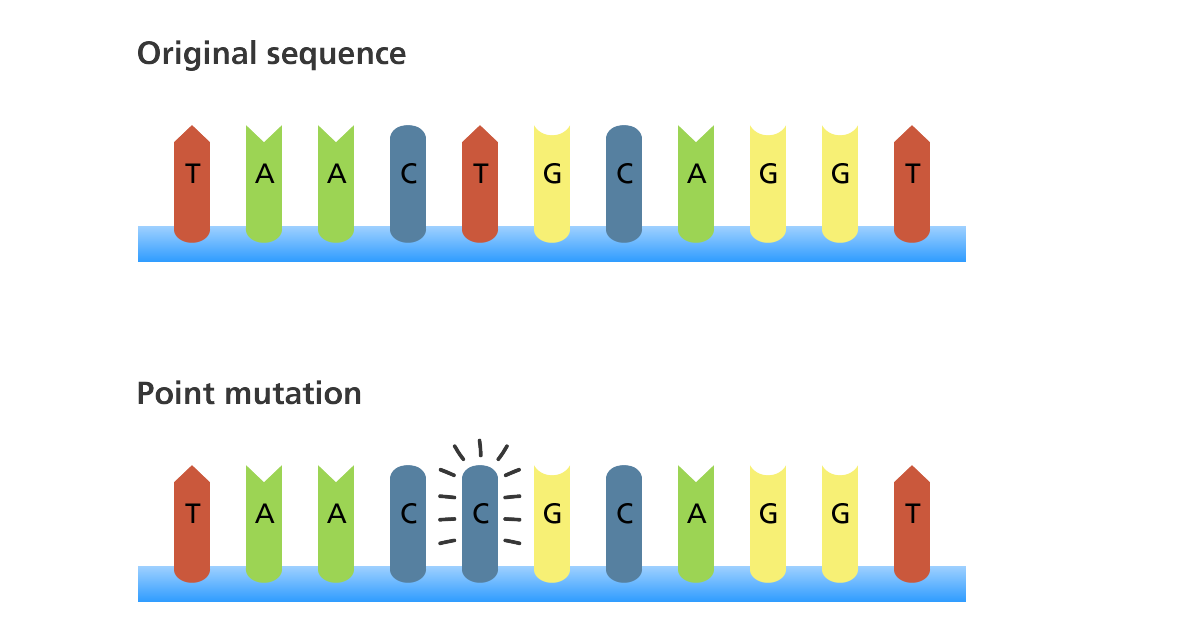
**Types of Mutations**

**Point Mutations**

* One base is replaced with another
* Usually occurs during DNA replication
* Usually corrected by DNA polymerase
* Might even code for the same amino acid and go unnoticed

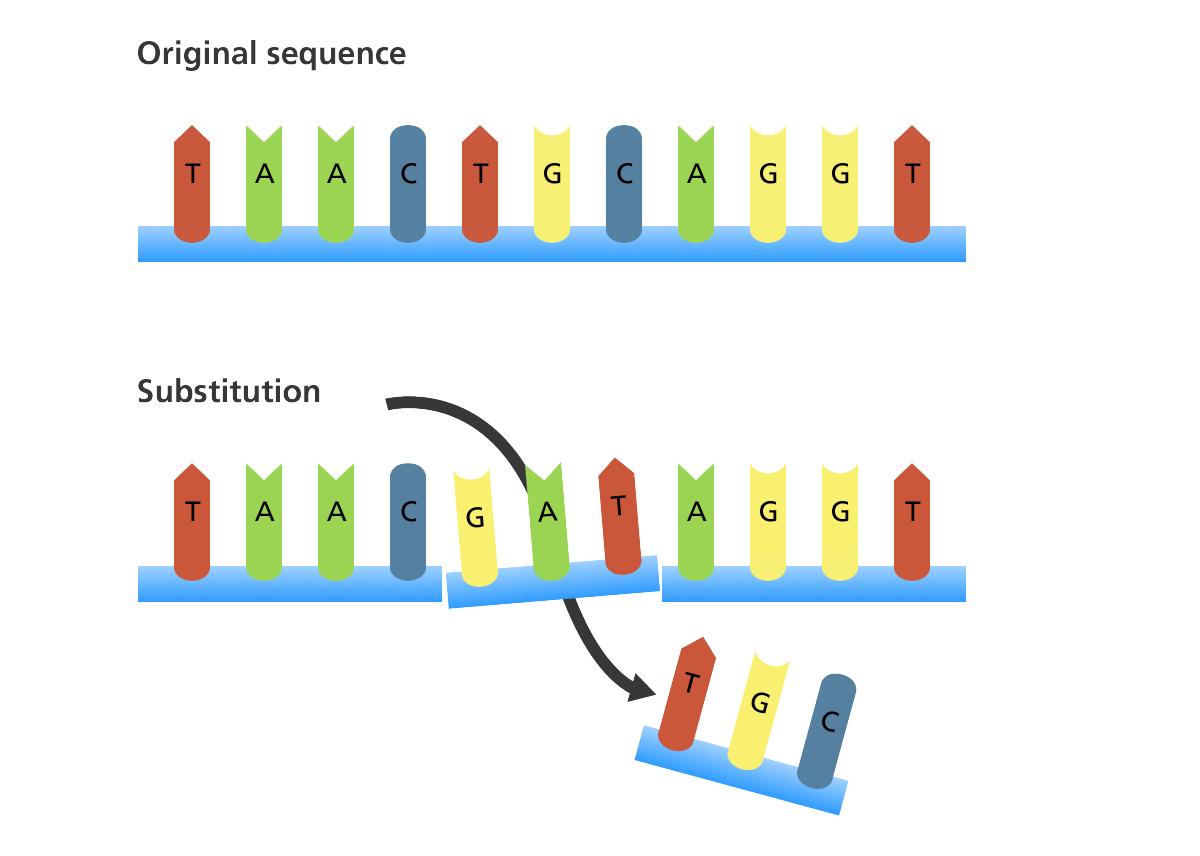
**Instructions**:

Circle the point mutation below. What base should have been in its place? \_\_\_\_\_\_\_\_\_\_

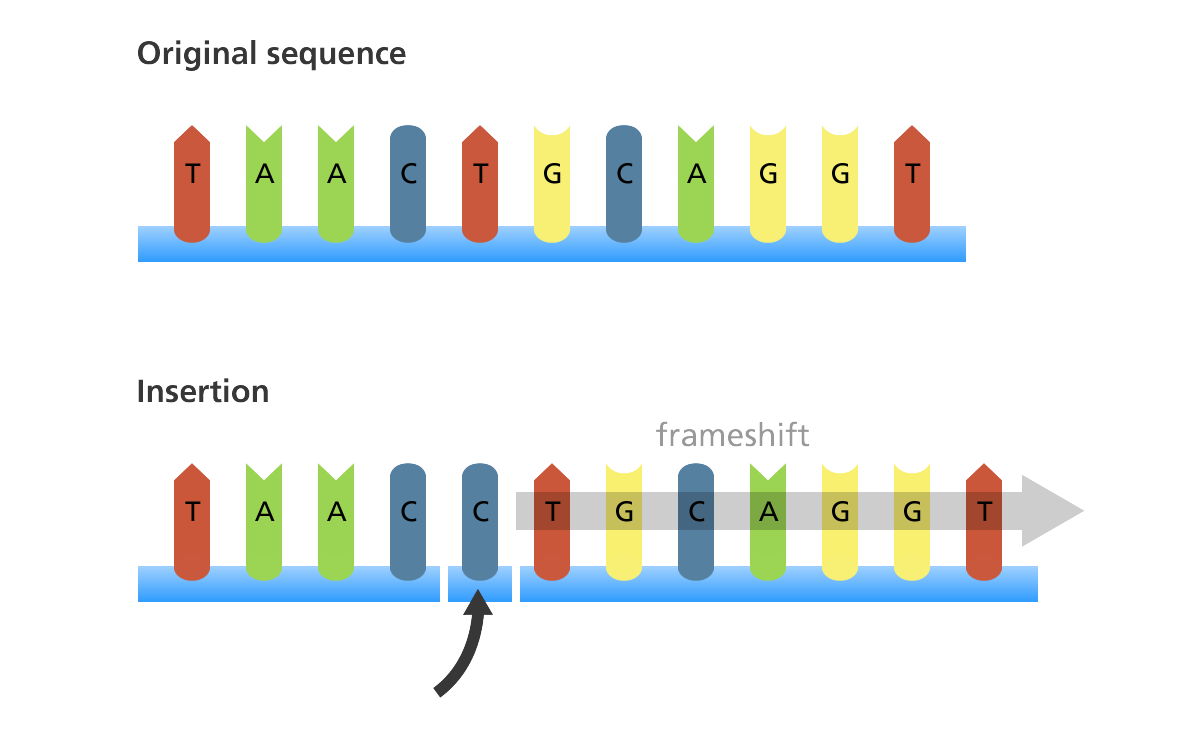
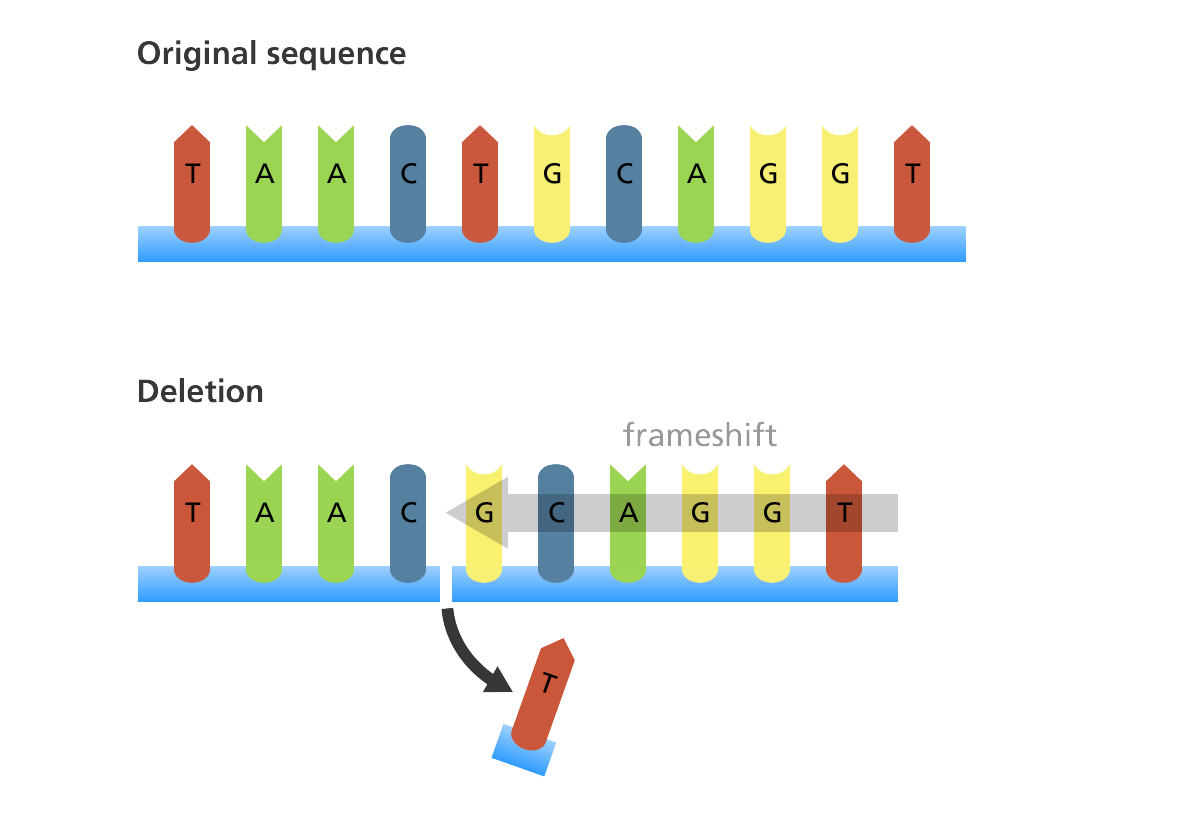


**Substitution**

* Similar to point mutation, however it may affect more than one base



**Frame Shift Mutations**

* Base is inserted or deleted causing a shift in strand of DNA.
* Serious mutation that changes the resulting protein

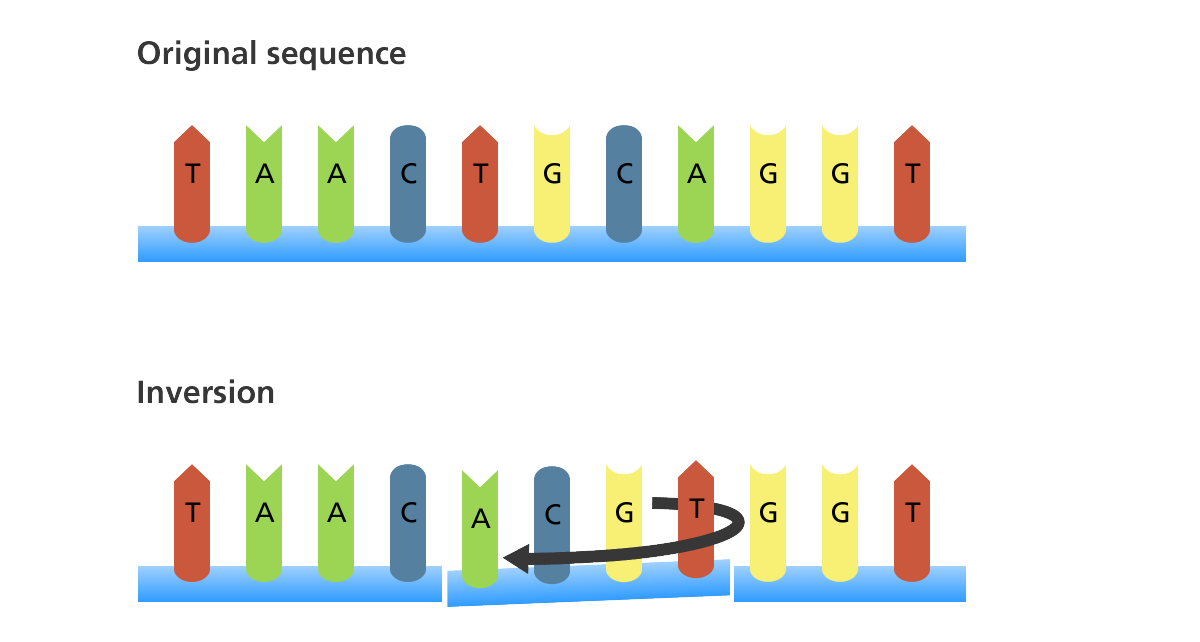
**Inversion**

* Segment of DNA inverts 180 degrees
* This type of mutation happens during crossing over in meiosis
* Changes the resulting protein

**Instructions**:

Circle the inverted segment of DNA.

What should the order of bases have been? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



**Bee Lab**

**Lab is worth 100 points**

**Instructions:**Work with a partner to create bees based on the instructions on the lab sheet. Some of your bees will be a healthy bee. Others will have a genetic mutation. Not all students have a bee with the same mutation, so your bee may not look the same your neighbor’s.

**Post Lab Questions**:

What type of mutation does your bee have, point or frame shift?

How did it affect the physical characteristics of your bee?

Is this mutation positive, negative or neutral?

Will this mutation affect the overall health of your bee?