Name: _____

DNA – RNA – Protein

DNA is used for more than just holding your genetic information; it also makes or codes for proteins. Proteins are not only important for membranes, enzymes, antibodies, non-steroid hormones, and structure but also for gene expression. DNA only holds our genes. Proteins make it possible for our genes to be shown.

To make proteins, there are three steps: DNA replication, mRNA transcription, and protein translation. In the first step, DNA makes an exact copy of itself. The second step uses the genes in the replicated DNA strand to make mRNA. The mRNA is then broken down into sets of three. These sets of three bases match up with a specific amino acid. In the third step, the amino acids are bonded together to build a protein. These proteins with fold to form a specific shape – where the shape then gives the protein a function – like being a strand of hair!

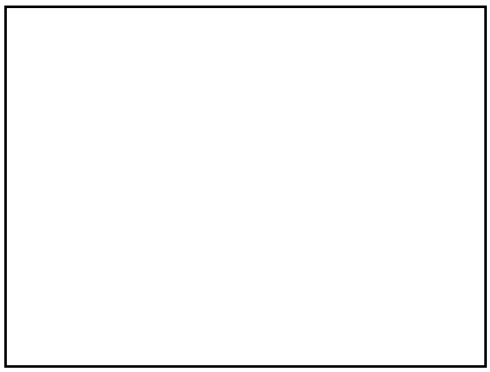
Sometimes mutations can occur in this process. Mutations in DNA are not always a bad thing. Some changes in the DNA can cause absolutely no change in the overall synthesis of proteins – which allows the protein to still fold and take shape as it normally would. In other cases, mutations in the DNA replication process can cause the protein being made to fold differently and have a different shape, giving the protein a different function. These different functions can allow for different gene expressions – causing genetic variation. Genetic variation can either be advantageous or not.

Part 1: DNA Structure

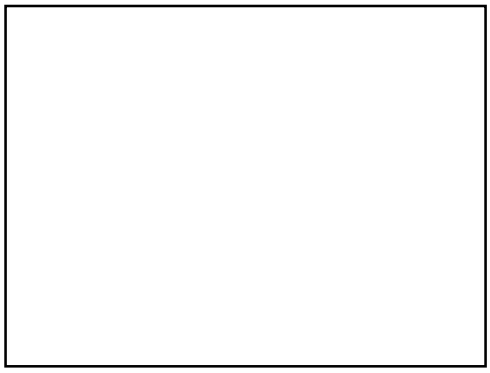
Google *"Nobel Prize DNA Double Helix"*
Click on the first link.
Click on *"Play the DNA – The Double Helix Game"*

Answer the following questions:

1. Did you know that most living organisms have the same sort of genetic material in their cells?
    a. The remarkable and very long molecule _____ or _____.
2. The shape of the DNA molecule resembles a spiral staircase. Do you know what it is usually called?
    a. The _____
    b. Draw the double helix in the box:



3. The molecule has two intertwining strands made of sugar and phosphate with links or rungs across the middle. Do you know what these rungs are made of?
    a. The rungs are _____ made of _____ different DNA bases, represented by the letters _____, _____, _____, and _____.
4. Do you know how the rungs are put together?
    a. The letters on the DNA molecule always come in _____. _____ always pairs with _____, and _____ always pairs with _____.
    b. Draw the pairings in the box:



DNA goes through something called replication. Replication is a process where it makes an exact copy of itself using the base pairing rules (A-T, G-C). In the game, it is going to be your job to make exact copies of DNA from three random organisms and figure out which organism it is.

Part 2: DNA Replication

	Organism 1	Organism 2	Organism 3
Number of genes			
Number of chromosomes			
Number of base pairs (millions)			
Number of mutations			
Name of organism			

Part 3: Transcription and Translation of Genes in DNA

Go to: http://learn.genetics.utah.edu/
Click on *"Basic Genetics"*
Scroll down to *"More About Proteins"*
Click on 'Transcribe and Translate a Gene'

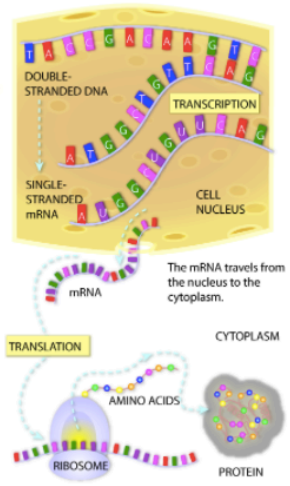
Read the information ***below* the activity before you begin and answer the question in a ***complete sentence***

1. What base replaces thymine in RNA?

Once you are done reading, scroll back up and begin the activity. In this online activity, we will begin to decode DNA into protein. In order to do this, you transcribe the information from DNA into a strand of RNA, then find out which amino acids have been coded for. You will first need to build the RNA strand. Once the strand is complete, you will need to find the "start" sequence before you can begin translating. Read the instructions below the box on the screen. When you have completed the activity, ***answer these questions in complete sentences***:

TRANSCRIPTION: In the nucleus, the cell's machinery copies the gene sequence into messenger RNA (mRNA), a molecule that is similar to DNA. Like DNA, mRNA has four nucleotide bases - but in mRNA, the base uracil (U) replaces thymine (T).

TRANSLATION: The protein-making machinery, called the ribosome, reads the mRNA sequence and translates it into the amino acid sequence of the protein. The ribosome starts at the sequence AUG, then reads three nucleotides at a time. Each three-nucleotide codon specifies a particular amino acid. The "stop" codons (UAA, UAG and UGA) tell the ribosome that the protein is complete.



2. What was the "start" sequence on the mRNA strand? What amino acid does it code for?

3. How many nucleotides code for one amino acid?

4. What was the "stop" sequence?

5. Thinking question: Suppose a gene in a strand of DNA were mutated so that one of the codons in the middle of the gene would now code for the "stop" sequence in the RNA strand. What would happen to the protein that the particular gene codes for in that cell?

6. What is Transcription?

7. What is Translation?

Part 4: Mutations

Navigate back to Basic Genetics
Scroll up to *"Tour of Basic Genetics"*
Click on *"What is a Mutation?"*

Read the information provided on the page and ***answer the following questions in complete sentences.***

1. How do mutations occur in DNA?

2. Explain what mutations generate and the importance of this.

3. Explain in detail why genetic variation is useful.

4. Explain the differences and similarities between mutations and variations.

5. What are some other ways mutations can form in DNA?

6. Can mutations be reversed? If so, how?

7. What happens if there are too many mutations that remain in the DNA sequence over time?

8. Why are mutations important?

Navigate back to Basic Genetics
Scroll down to *"More About Mutation"*
Click on *"The Outcome of Mutation"*

_____ _____: The Outcome of Mutation

Mutation is a process that changes a _____. But how does a difference in a gene's DNA sequence (genotype) lead to a difference in an observable trait (phenotype)?

Click on the following pictures and fill in the chart below.

	Trait	**Protein**	**DNA**	**Examples in Other Species**	**Variation, Disease, Both?**
Shar Pei Dogs					
Mendel's Wrinkled Peas					
Double- Muscled Cattle					

Continue onto the back! →

	Trait	Protein	DNA	Examples in Other Species	Variation, Disease, Both?
Disease Resistance/Cystic Fibrosis					
Extra-Toed Cats					
Red Hair					
Curly Hair					
Song Learning in Birds					