DNA Replication: Paper Clip Activity

Name _____ Per. _____ Date: _____

Partner: _____

Learning Target: *DNA Structure & Replication*

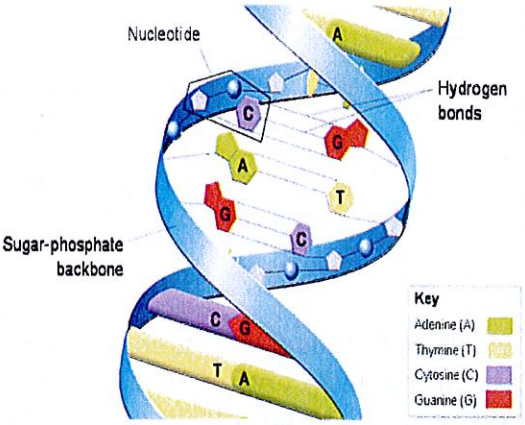
***I Can…* Create a simulated gene segment of DNA and take the segment through the process of replication.**

I Will…

- **Create a simulated primary segment of a gene representing the nucleotide types within the sequence with assigned colored paperclips.**
- **Predict and create a complementary strand of DNA using the base pairing rules.**
- **Unzip and replicate the DNA gene segment explaining the steps of the process.**
- **Infer and predict what may result from creating an alteration in the nucleotide sequence.**

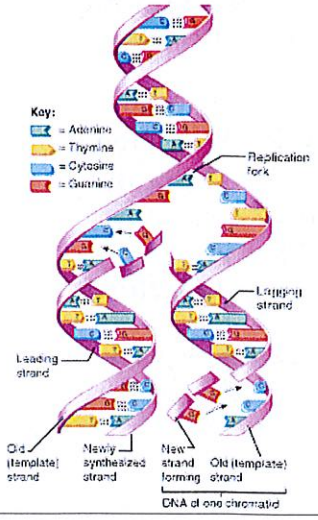
Quick Review:

- Each DNA molecule has a unique structure that makes it different from other DNA molecules (Remember – A chromosome is condensed DNA and segments of DNA are genes.)
- This difference occurs because the sequence of A, T, C, and G vary from one molecule and gene segment to another.



What You Need to Know About DNA Replication:

- To "replicate" DNA means to produce an exact copy of itself. DNA is the only known molecule that can do this regularly.
- DNA is able to make an exact replica of itself because of the base pairing characteristics stressed earlier (A with T and C with G).
- When DNA makes a duplicate molecule of itself, the two strands unwind.
- After the two strands have pulled apart, new bases (A, T, C, & G) as well as new sugar and phosphate units come into place according to the base pairing rules.
- A comes in opposite of T, and C is opposite of G.
- When this occurs, two identical DNA molecules are created.



Activity Overview:

You will be making a short sequence of a human gene that controls the body's production of the growth hormone, which causes growth during childhood and adolescence. Genetic engineers call this gene the hGH (human Growth Hormone) gene. This gene is actually made of 573 nucleotide base pairs. You will only construct the first ten bases in the gene.

For this activity, each pair of students will need the following:

14 Blue Paperclips	Adenine (A)
14 Yellow Paperclips	Thymine (T)
9 Red Paperclips	Cytosine (C)
9 Green Paperclips	Guanine (G)

- **STEP ONE**: Use the colored paper clips according to the key above and construct the primary (top) strand of the hGH according to the diagram of the gene below. Link the ten appropriate colored clips for the top chain shown below.

1	2	3	4	5	6	7	8	9	10
A	**A**	**G**	**C**	**T**	**T**	**A**	**T**	**G**	**G**

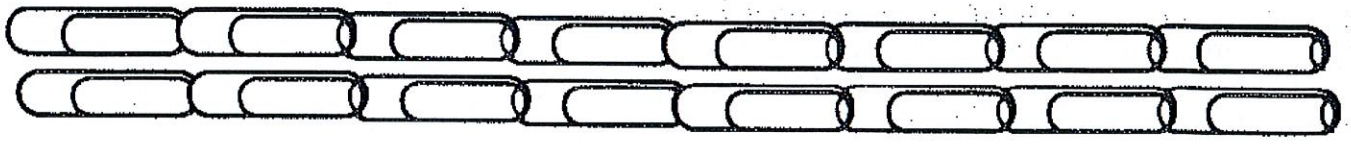
- ***Predict** and fill in the complementary nucleotide base for each of the 10 primary nucleotide bases in the empty row following the rules for base pairing.

Have the teacher check your progress before you continue. Teacher initials: _____

** Notice that the bottom strand of the DNA molecule should follow the "Rule of complimentarily", which means that A bonds with T, and C bonds with G. **

- **STEP TWO**: Now construct the complementary (bottom) strand of the hGH gene by linking ten more clips into a chain according to the pattern above. The entire sequence of this gene is known. Your DNA model should resemble the following:

Have the teacher check your progress before you continue. Teacher initials: _____

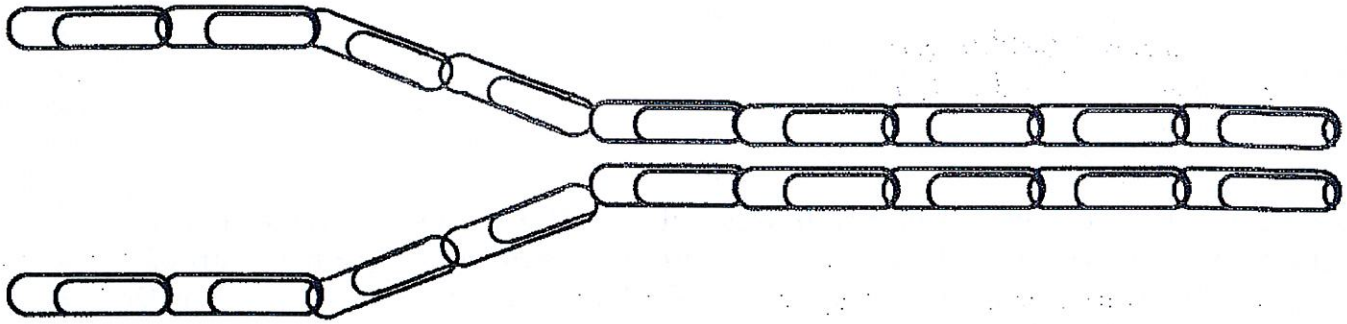


- **STEP THREE**: Set the two chains side-by-side as shown in the drawing above so that A bonds with T, and C bonds with G.

You now have a model of the hGH gene (the first ten bases only.)

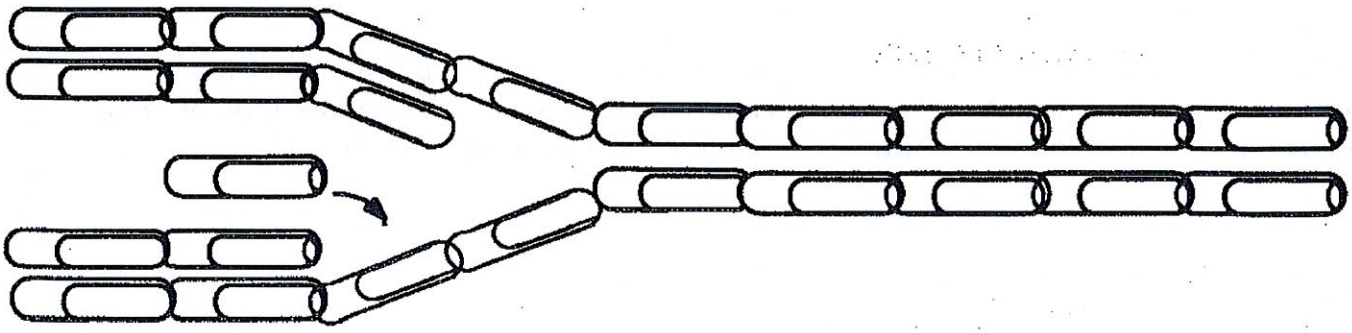
Compare the two chains with each other side-by-side to verify that C bonds with G, and A bonds with T. When this gene replicates in the nucleus of a cell, the double-strand begins to separate at one end. As it separates, new nucleotide bases are moved into place by enzymes, which form the beginning of two new identical molecules. These A, T, C, and G bases are present in the nucleoplasm of the nucleus of each cell, and come from food molecules. When these new bases are brought into place by enzymes and proteins so that the A bonds with T, and the C bonds with G.

- **STEP FOUR**: Open your hGH DNA molecule as shown below:



Have the teacher check your progress before you continue. Teacher initials: _____

- **STEP FIVE**: Now use the other available clips to create the beginning of two new strands. Remember A with T and C with G. Connect the clips as follows:



- **STEP SIX**: Continue separating the strands and bring in appropriate new bases (clips) to create two complete new double-stranded hGH gene molecules. Remember that A bonds opposite to T, and C is opposite of G. You should have six clips left. Save them for later.

Have the teacher check your progress before you continue. Teacher initials: _____

Answer the questions that follow:

1. Examine the two double-stranded DNA molecules. Are they identical or different in any way? ***Fully support and explain your answer.***

2. If you were asked to replicate each of the two DNA molecules on your table to create four identical DNA molecules, ***explain the steps you*** would use to accomplish the replication process.

3. You now have two copies of a segment of the hGH gene on your table. During periods of growth and cell division, the chromosomes, which are made up of genes, must divide. What features about DNA replication causes each new DNA molecules to be exactly like the original?

*Cells can divide along with their DNA in this manner without any errors for thousands of replications. On occasion an error can occur. When this type of error occurs in a cell it is called a "mutation". How would you define what a mutation is?

When you have completed this activity, please separate all the paper clips and count them – you need to have 14 blue and 14 yellow, 9 red and 9 green. Then put them all back in the Ziploc baggie and leave the activity station ready for the next class.