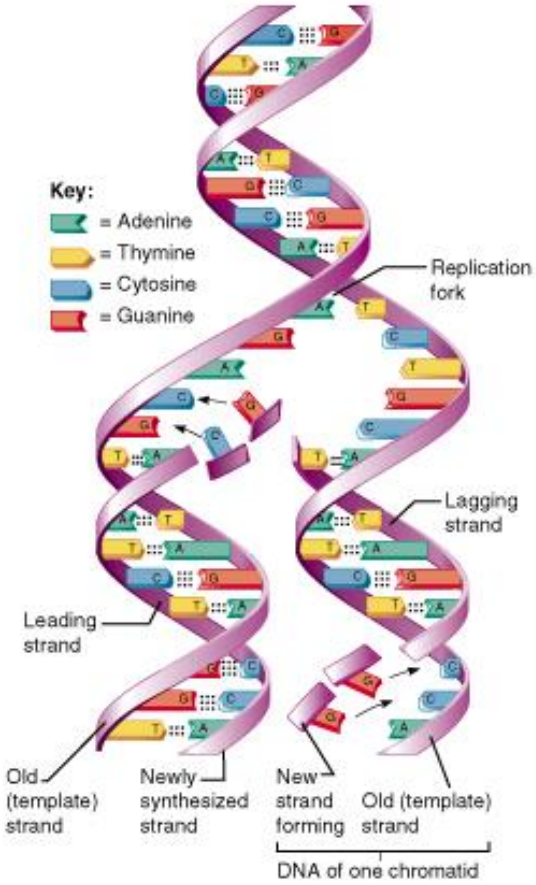
Paperclip DNA Replication

DNA Replication Overview:

- To "replicate" DNA means to produce an exact copy of itself.
- DNA is able to make an exact replica of itself because of the base pairing characteristics (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.



Introduction

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

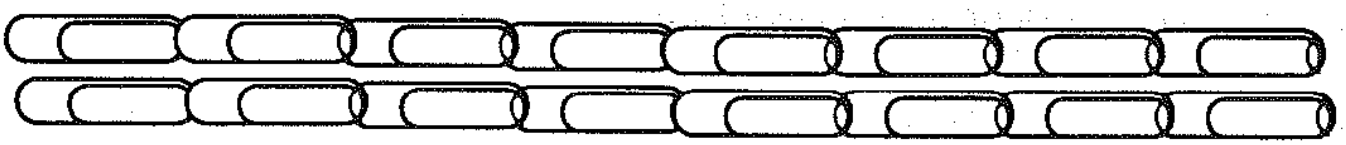
For this activity, each group of students need the following:

# of Paper Clips	
14	Red Paper Clips = Adenine
14	Green Paper Clips = Thymine
9	Blue Paper Clips = Cytosine
9	Yellow Paper Clips = Guanine

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.

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

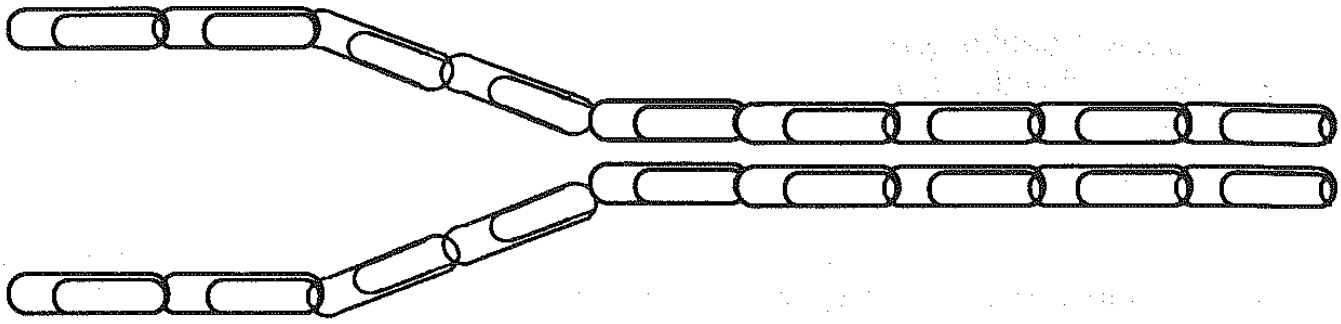


STEP THREE: Set the two chains side-by-side as shown in the drawing above so that A bonds with T, and C bonds with G.

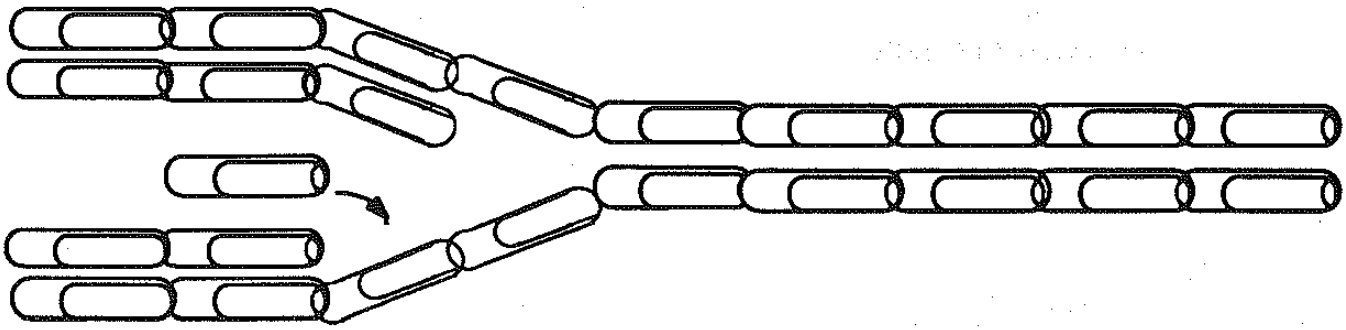
You now have a model of the hGH gene (the first ten bases only.)

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 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:



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.

Answer the questions that follow:

1. Examine the two double-stranded DNA molecules. Are they identical or different in any way?

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?

STEP SEVEN: To demonstrate a gene mutation, place one of your paper clip hGH DNA strands in front of you. Identify the second nucleotide base called Adenine (A), which is red. To cause a mutation, remove this 2nd blue clip and replace it with a blue Cytosine (C) clip. You have just demonstrated how a mutation occurs. This replacement usually occurs when the DNA is replicating.

4. When this mutated DNA molecule replicates, will the resulting new DNA be similar or different from the original hGH gene? Explain.

6. In your own words, explain how mutations can occur in cells and how this might affect the resulting protein.