

Name: _____ Period: ____ Date: _____

Partner: _____

DNA Structure and Replication: Paper Clip Activity

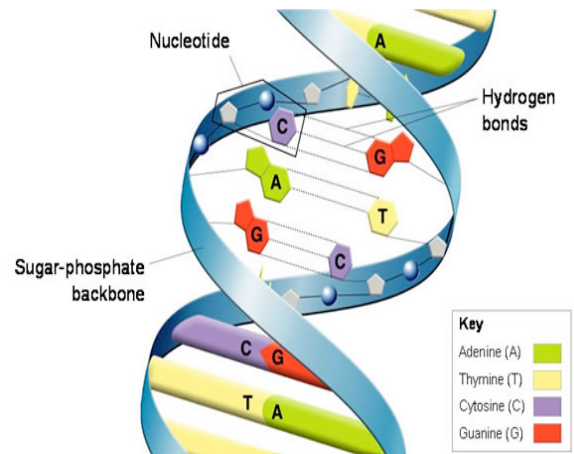
I Will...

- 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.

So that I Can... take a segment of DNA through the process of replication.

What we need to know about DNA:

- Each DNA molecule has a unique combination that makes it different from other DNA molecules.
- This difference occurs because the sequence of A, T, C, and G nucleotides vary from one molecule and gene segment to another.
- Each nucleotide is composed of 3 parts: a sugar, phosphate and base (A,T, C or G)



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 rules **(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 nucleotides come into place according to the base pairing rules.
- When this occurs, two identical DNA molecules are created.

Pre-lab questions

1. What are the 3 parts of a nucleotide? _____, _____, _____
2. The 4 types of bases are: _____, _____, _____, _____
3. Nucleotides are the monomers or building blocks of what macromolecules? _____
4. Which bases ALWAYS pair together? _____ and _____ ; _____ and _____
5. Complete the strand of DNA by placing the correct base underneath

G C G C G C T C G A T C A A A T T G C

6. DNA replication occurs in what part of the cell? (hint- In what organelle is DNA located?) _____

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. Biologists 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.

Make a key to show the color paper clip that will represent each nucleotide:

Color	Nucleotide
	Adenine (A)
	Thymine (T)
	Cytosine (C)
	Guanine (G)

STEP ONE:

A) Use the colored paper clips according to your key and construct the primary (top) strand of the hGH according to the table below that shows the gene's structure. Link the ten appropriate colored clips for the top chain shown below.

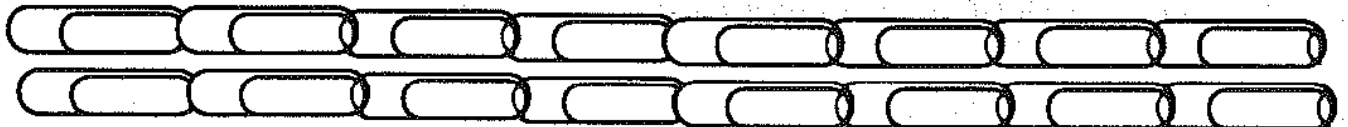
	1	2	3	4	5	6	7	8	9	10
Primary strand	A	A	G	C	T	T	A	T	G	G
Complementary strand										

B) **Predict** and fill in the complementary nucleotide base for each of the 10 primary nucleotide bases in the empty boxes, following the rules for base pairing.

Notice that the bottom strand of the DNA molecule should follow the "Rule of complementarity", 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: _____

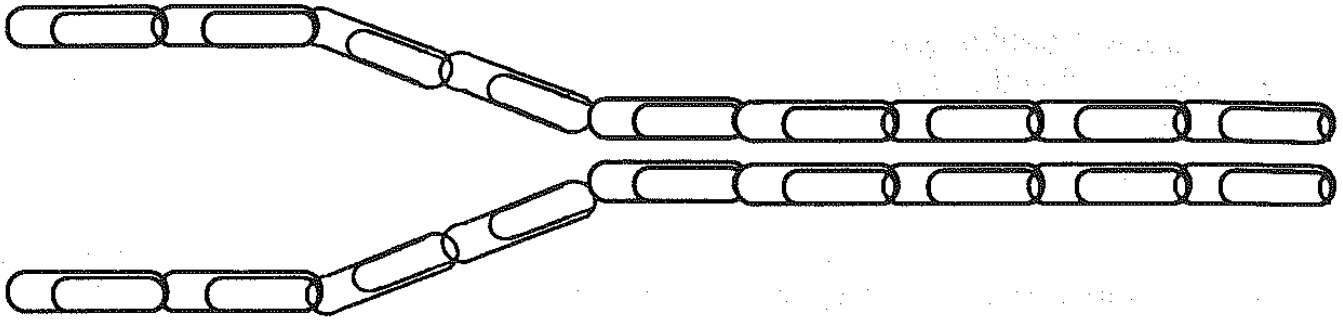


STEP THREE: Set the two chains side-by-side as shown in the drawing above so that A bonds with T, and C bonds with G.

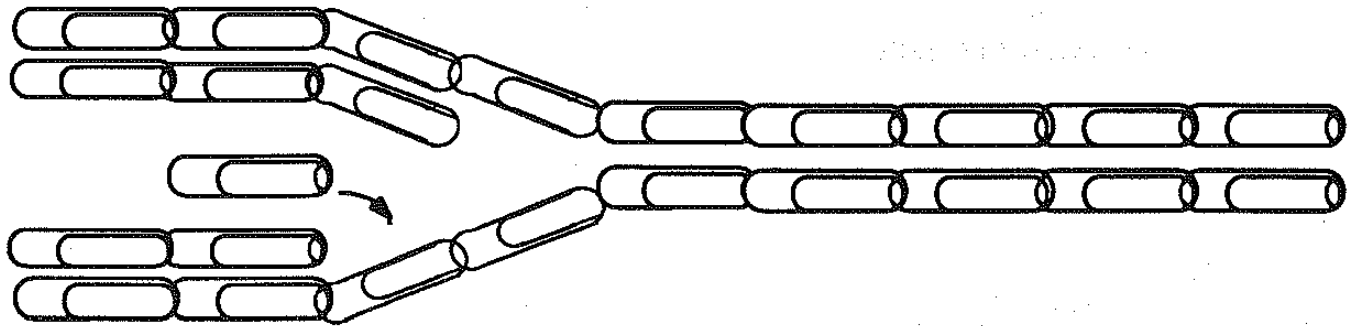
You now have a model of the hGH gene (the first ten bases only.)

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 delivered by enzymes to each open strand, which form the beginning of two new identical molecules. These new A, T, C, and G bases are present in the food we eat. When these new bases are brought into place, 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:

- A) 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.
- B) Sketch what you now have below:

Summarize:

1. Do your two molecules of DNA look identical?_____ Why? (complete sentences)

2. You just made two copies of a piece of the hGH gene on your table. During periods of growth and cell division (mitosis!), the chromosomes, which are made up of DNA, must divide. **What features about DNA replication causes each new DNA molecules to be exactly like the original?** (complete sentences)

Analysis Questions:

1. Why is it important that the 2 molecules of DNA are identical? Consider what happens to the DNA after it is replicated. ***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 by answering the questions below:

a. Describe what the double helix must do before DNA replication can begin? What did you do to show this during the activity?

b. What happens after the double helix separates? What did you do to show this during the activity?

3. Unzip and replicate the following piece of DNA:

A - T
C - G
C - G
G - C
G - C
T - A
A - T
T - A



UNZIP



REPLICATE

4. Unzip and replicate the following piece of DNA:

G - C
A - T
C - G
T - A
T - A
G - C
C - G
G - C



UNZIP



REPLICATE