

DNA Replication: Paper Clip Activity

What You Need to Know About DNA Replication:

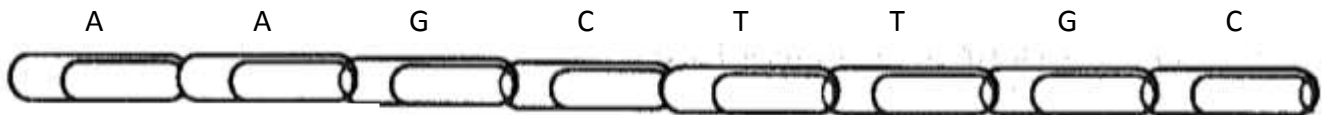
- To “replicate” means to produce a copy of itself. DNA is the only molecule that can do this.
- DNA is able to make an exact replica of itself because of
 - complimentary base pairing (A with T and C with G), and
 - its double strand structure.
- When DNA replicates:
 1. The two strands unwind.
 2. DNA polymerase adds new nucleotides on top of the old strands according to the base pairing rules (As with Ts; Gs with Cs).
 3. When finished, two identical DNA molecules are produced, each made of an old strand and a new strand. Each new DNA molecule also identical to the original DNA molecule

Activity Overview: You will be making a short sequence of a human gene and modeling its replication.

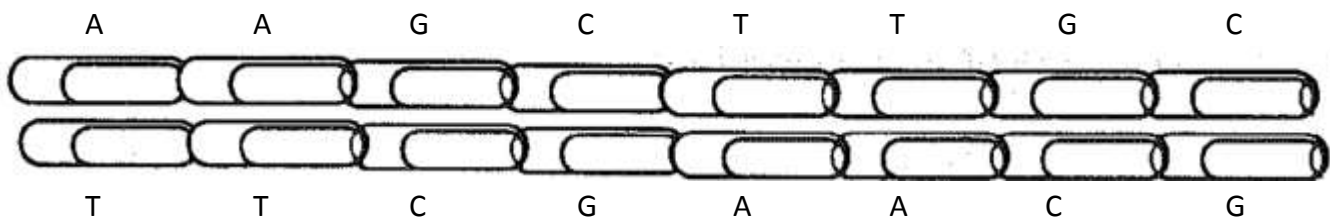
For this activity, you will need the following (ignore the silver paperclips for now):

- 14 **Blue** clips = Adenine (A)
- 14 **Yellow** clips = Thymine (T)
- 9 **Red** clips = Cytosine (C)
- 9 **Green** clips = Guanine (G)

STEP ONE: Use the multicolored paper clips to make the top strand of the gene (as shown below) according to the key above. Link the ten paperclips together to simulate the **strong covalent bonds of the sugar-phosphate backbone**.



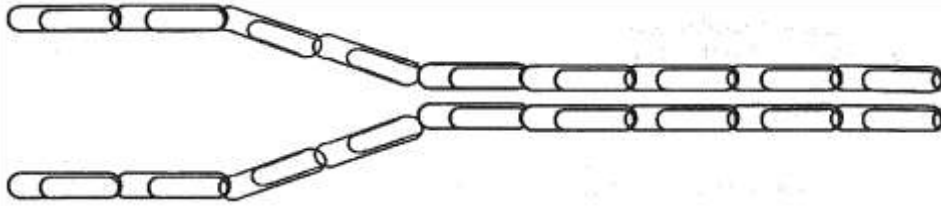
STEP TWO: Now construct the complimentary strand of the gene by linking ten more clips into another chain according to **complimentary base pairing rules**. The entire sequence of this gene is known. Your DNA model should resemble the following:



Continued on back.

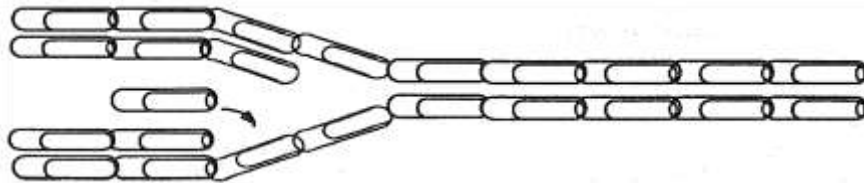
STEP THREE: Open your DNA molecule as shown below:

- When this gene replicates in the nucleus of a cell, the double-strand begins to separate at one end.



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

- As the 2 strands separate, new nucleotides are moved into place by the enzyme DNA polymerase, according to complimentary base pair rules (A to T, G to C).
- These nucleotides are present in the nucleus of each cell and come from digested food molecules.



STEP FIVE: Continue separating the strands and bringing in appropriate new nucleotide paperclips to create two complete double-stranded DNA molecules. **HAVE MAJ WESTER CHECK YOUR MODEL.**

Extension: Mutations

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.” So what is a gene mutation?

STEP SIX: To demonstrate a gene mutation,

- Place one of your paper clip DNA strands in front of you.
- Identify the second nucleotide base called Adenine (A), which is blue.
- To cause a mutation, remove this 2nd blue clip and replace it with a red Cytosine (C) clip.
- You have just demonstrated how a mutation occurs. This replacement usually occurs because the DNA polymerase makes a mistake during replication.

Name _____ Block _____ Date _____

DNA Replication: Paper Clip Activity Discussion Questions

1. Examine the two new double-stranded DNA molecules. How do they compare to each other? (1 pt)
 2. How does each new DNA molecule compare to the original DNA molecule? (1 pt)
 3. What part of the DNA molecule is represented by clipping each strand together, and what kind of chemical bond holds this part of the DNA molecule together? (2 pts)
 4. What kind of chemical bond is represented by the spaces in between the opposite strands of paperclips (e.g. in between each A-T pair and each C-G pair). (1 pt)
 5. Why is it important for DNA replication that this bond between the DNA strands is weak? (1 pt)
 6. What 2 features of the DNA molecule make it easy to replicate faithfully (without mistakes)? (2 pts)
 7. What is the purpose of DNA replication? Why do cells replicate their DNA? (1 pt)
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8. When this mutated DNA molecule replicates, will the resulting new DNA be mutated as well, or return to the original genetic sequence? Explain your answer. (2 pts)
 9. The sequence of nitrogen bases in a DNA molecule helps control cell activities. Do you think a cell that experiences this mutation is likely to act like a cell with the original DNA sequence, or behave differently? Explain your answer. (2 pts)
 10. DNA must be replicated every time a cell divides, and each time it replicates, mutations may occur. How would you expect an older person's DNA to compare to a younger person's DNA? Explain your answer. (2 pts)
 11. DNA controls mitosis and cell division and regulates when a cell should and should not divide. Explain why the answer to #10 explains why older people are more likely to develop cancer. (2 pts)