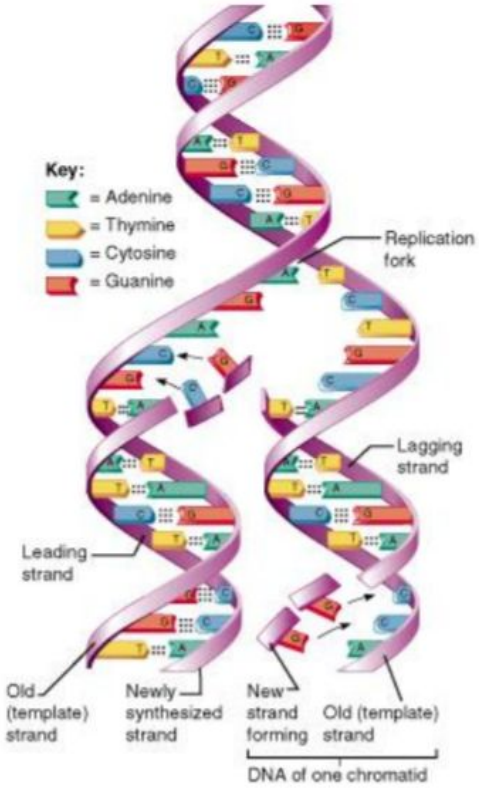
DNA Replication - student sheet

Replication - DNA copying itself.
molecule - a collection of atoms bonded together. DNA is one long repeated molecule.
gene - a section of DNA code responsible for a certain structure or function.
nucleotide - a molecule made up of one base, one sugar and one phosphate.
mutation - a change in the DNA base sequence.
protein - molecules made by ribosomes that make up the structures of living organisms.
enzyme - a protein that speeds up a reaction in the body. A ribosome is an example.

DNA is able to make an exact copy of itself. It does this every time a new cell is made. It is able to do this because of the base pairing rule (A-T; C-G). When the DNA makes a copy of itself, the two strands unwind and new nucleotides (sugar, phosphate, base) attach themselves in the correct place to make two identical molecules of DNA. Look at the diagram on the right.



Procedure - Pair up with the person next to you. If your table has 3, work as a group of three.

You will be making a short sequence of a gene that controls growth during childhood. The gene is 573 base pairs long, but you will only be making the first ten bases.

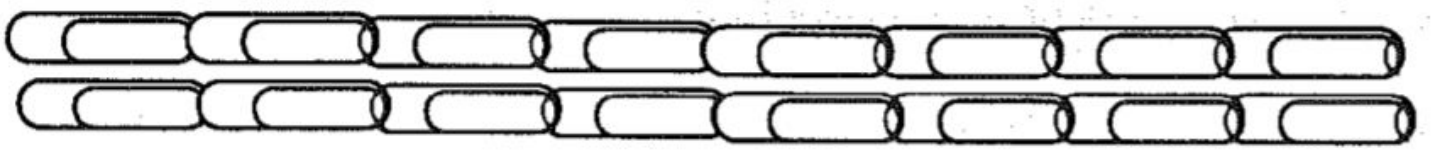
1. From the bin on your table, collect the following. If you are short a color, find from another group or ask the teacher.

# of paperclips	Base	Color (your choice)
14	Adenine	
14	Thymine	
9	Cytosine	
9	Guanine	

2. Using the paper clips, construct one strand of the DNA. Follow the sequence below. This will be the primary strand. Make sure to link the paperclips together.

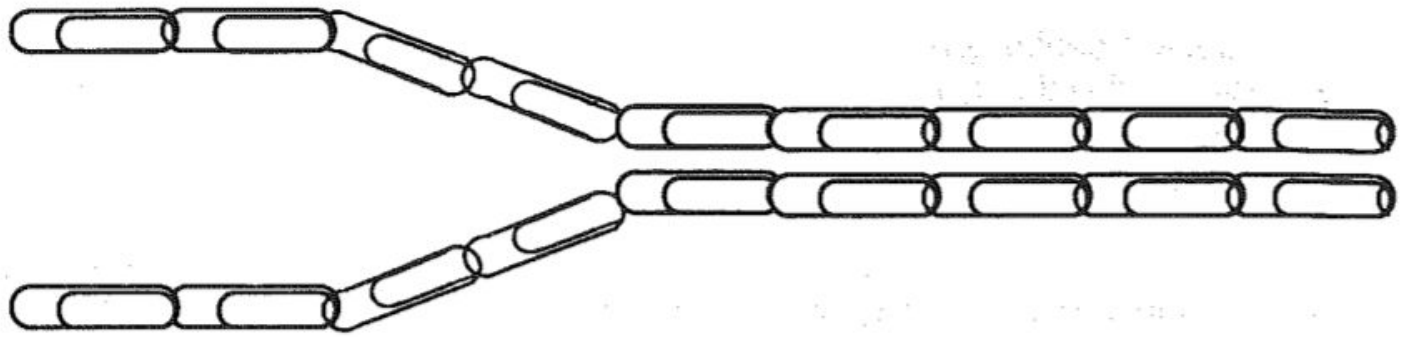
1	2	3	4	5	6	7	8	9	10
A	A	G	C	T	T	A	T	G	G

3. Now construct the complementary strand of the sequence. Remember the base pairing rule. Your strands should be lined up like below with the base pairs lined up correctly.

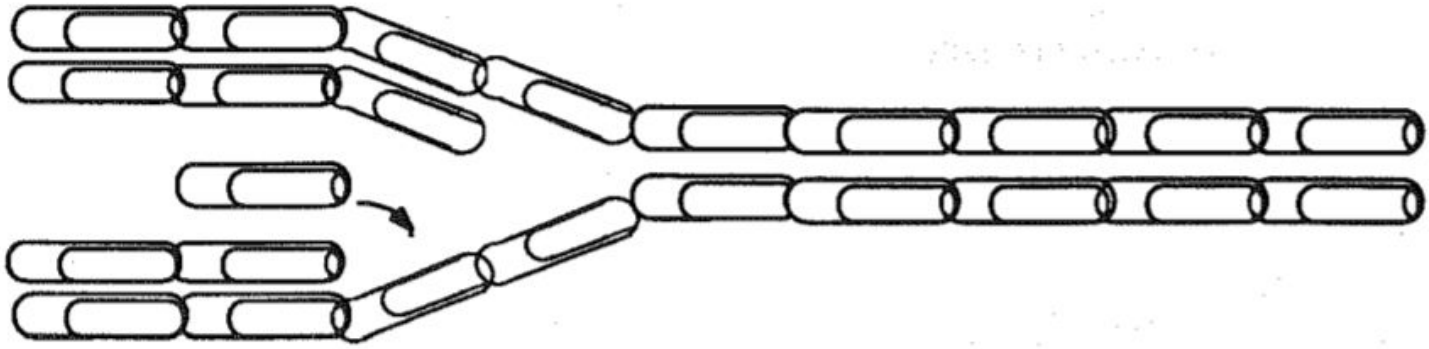


DNA Replication - CLASS SET - PLEASE DO NOT WRITE ON THIS

4. The DNA is now going to copy itself (replicate). When this happens, the two strands begin to separate at one end. As it separates, new nucleotide bases are moved into place and begin to form two identical molecules of DNA. Check out the diagram on the first page again. As always, A bonds with T and C bonds with G. **Begin to open up your DNA molecule as shown below.**



5. Now use the other paper clips to create the beginning of two new strands. Remember the base pairing rule. Connect the clips together like below.



6. Continue separating the strands and bringing in the new bases until you have two complete strands. Check to make sure they are exactly the same.

<u>Answer the following questions in the 'DNA' section of your notebook</u>

1. Compare the two molecules of DNA.
2. What happened to the 2 original strands of DNA?
3. Explain how <u>you think</u> the structure of DNA makes replication possible? Base pairs, backbone, etc. *This is what is called a <u>thinking question</u>. You may not know the answer, but you should try to think about it and provide an answer. It's OK if you don't have many ideas about this at this point.*
4. Cut out the diagram and vocabulary from the STUDENT SHEET and glue into your notebook in the DNA section.

MUTATIONS - THIS SECTION MAY BE CHALLENGING. TRY TO GET WHAT YOU CAN OUT OF IT.

Mutations are changes in the structure of DNA. They can occur during replication.

To demonstrate a gene mutation, place **one** of the DNA strands in front of you. Identify the second base (**A**denine). To cause a mutation, replace this with a **C**ytosine. This is a **substitution** or **point** mutation.

Answer these thinking questions in your notebook.

1. If this copying error is not fixed by an enzyme (which usually happens), what would happen when this strand of DNA replicates again?
2. What effect would this have on the protein that the mutated gene makes? How do you think this would affect the organism. We have barely learned about this so it's ok if you don't know.

Insertion mutation

Pretend you are an enzyme and fix the mutation from above. Add any clip to only one strand of the DNA molecule.

Answer these thinking questions in your notebook.

1. What does this do to the shape of the molecule? Remember Chargaff's rule.
2. What would happen during replication of this strand? What effect would that have on resulting proteins? How would this possibly affect the organism?

Deletion mutation

Use your other non-mutated strands. Take one clip away from the middle of one of the strands. Reattach the strand. Compare it to the last original strand.

Answer these thinking questions in your notebook.

1. What does this do to the shape of the molecule? Remember Chargaff's Rule.
2. What would happen during the replication of this strand? What effect would that have on the resulting proteins? How would this possibly affect the organism?