What is the monomer of a nucleic acid?

Nucleotide

What is the shape of DNA?

Double Helix

Get out homework on your desk- I will write in the grade on my clipboard

What molecules are found on the sides of the DNA

Sugar and Phosphate

Write the complementary strand:

AACTAGA

TTGATCT

Analysis:

Homework Review

1. What base does adenine pair with?

   Thymine

2. What base does guanine pair with?

   Cytosine

3. The shape of a DNA molecule is described as a:

   Double Helix

4. What is the name of the sugar in DNA?

   Deoxyribose

5. What are the three components of a nucleotide?

   Sugar, Phosphate, and Base

6. Suppose you know that the sequences of bases on one DNA strand (one side of the DNA ladder) is AGGCTCGT. What is the sequence of the bases on the opposite strand?

   AGGCTCGT
   TCCGAGCA

7. If one strand of DNA is arranged in a 5' to 3' fashion, how must the other strand align? What do you notice about your two strands?

The other strand goes 3′ to 5′. They go in opposite directions

8. Assume that a 100 base pair DNA molecule contains 45 cytosines. How many adenines are there? Explain your reasoning.

55 100 BP – 45 (C-G)= 55 A-T

9. Why would attaching guanine with adenine make the DNA molecule weaker?

Guanine and Adenine both have double rings. It would make The center of the molecule bigger than normal

10. The paper model of DNA has definite strengths and weaknesses when showing the structure of DNA. How does this model show DNA's structure well? How could this model be improved?

Model doesn't show spiral helix very well. It does show how the bases line up. Doesn't show hydrogen bonds.

The Structure of DNA

April 5: The structure of DNA .pdf of powerpoint notes

Go to weebly and open April 5: The structure of DNA .pdf of powerpoint notes. Fill in the notes. We will go over them together after everyone has filled them in.

DNA is a type of nucleic acid

- Nucleic acids store information in their sequences of chemical units

- There are two types of nucleic acids:
  a. Deoxyribonucleic acid (DNA)
     - Double helix
     - the "blueprint of life"
     - Stores all heritable genetic information
  b. Ribonucleic acid (RNA)
     - single stranded
     - Stores genetic information in some organisms; transfers information in other organisms (humans)
     - Three types: mRNA (Messenger RNA), tRNA (Transfer RNA), and rRNA (Ribosomal RNA)

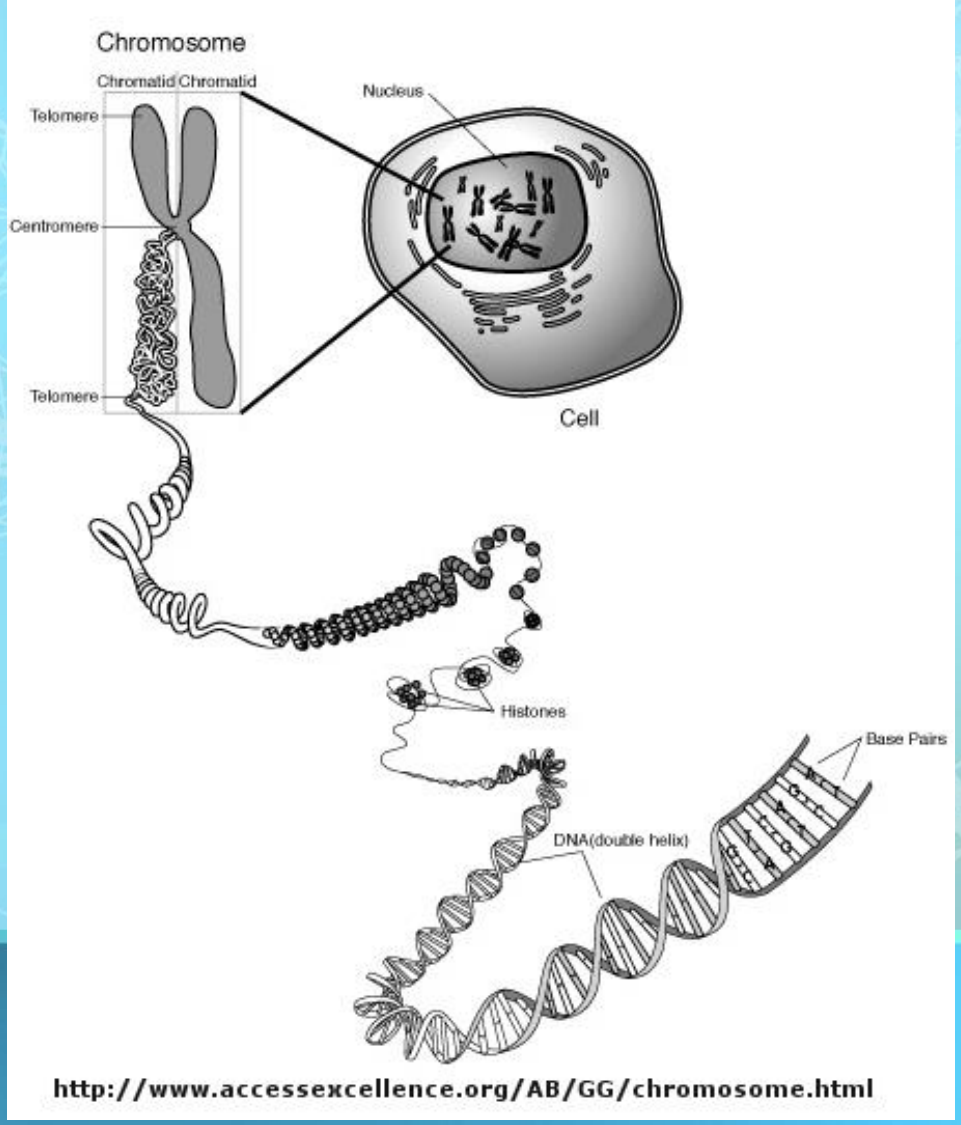
- Nucleic acids are polymers composed of long chains of monomers called nucleotides.

Nucleic acids

- Nucleic acids dictate the amino acid sequence of proteins

DNA → RNA → Protein

- Nucleic acids store genetic information in chromosomes, which are passed from parents to offspring during reproduction



Nucleotides are the building blocks of nucleic acids

- Nucleotides have THREE parts:

a. phosphate group (P)

b. pentose sugar (ring-shaped, 5-carbon sugar)

- Either deoxyribose (DNA) or ribose (RNA)

c. nitrogenous bases (made of C, H, N):

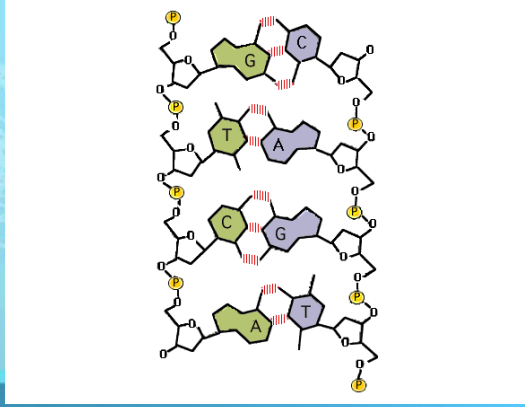
adenine (A)

thymine (T) – in DNA only

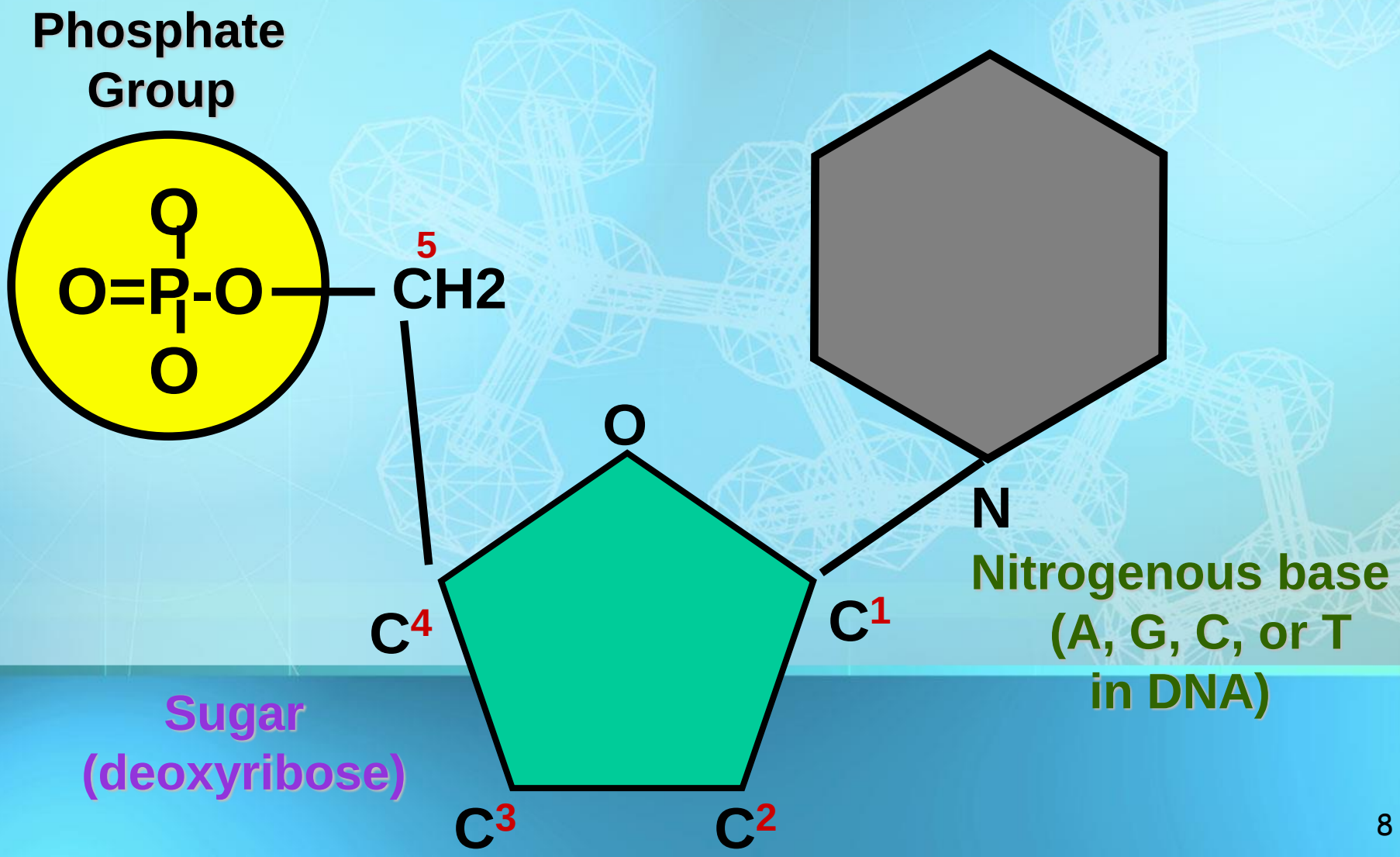
cytosine (C)

guanine (G)

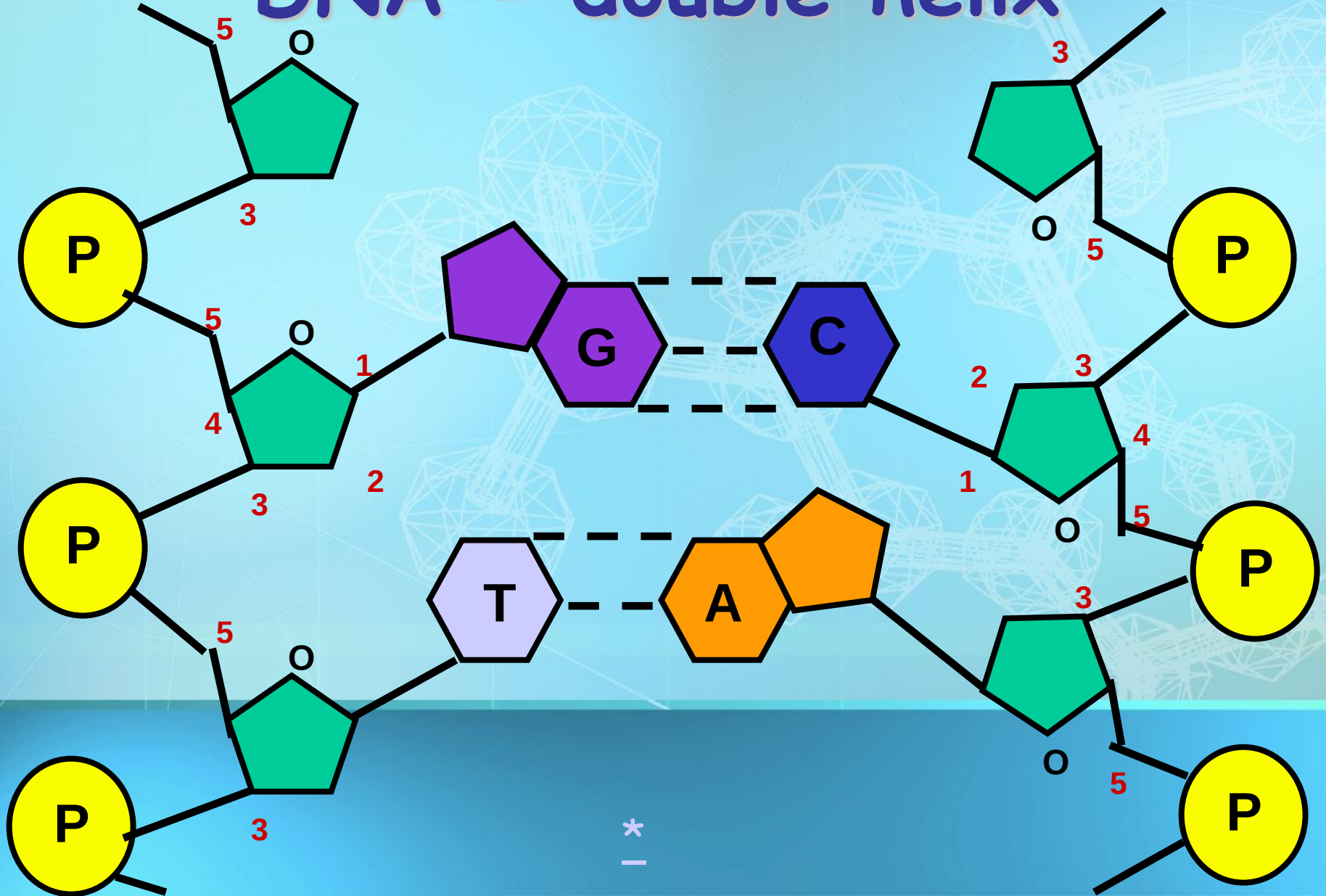
uracil (U) – in RNA only



Nucleotide


Phosphate Group
O
O=P-O
O
5
CH2
O
N
Nitrogenous base (A, G, C, or T in DNA)
C4
C1
Sugar (deoxyribose)
C3
C2

DNA - double helix

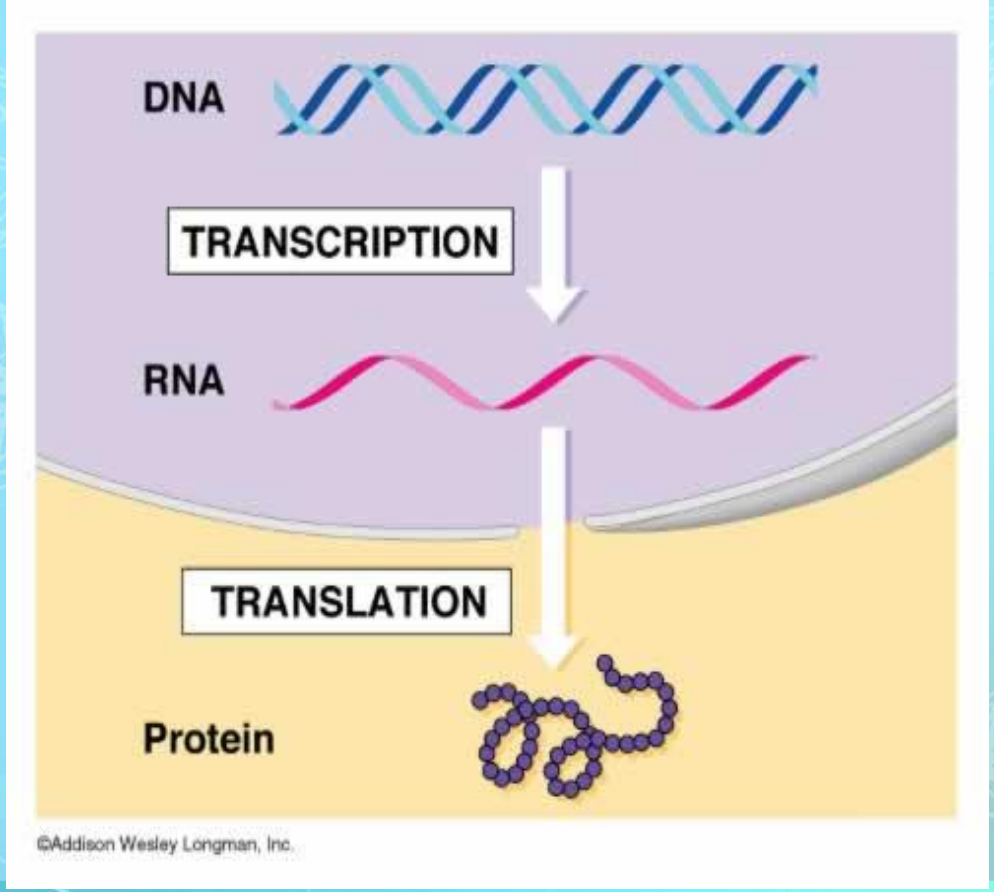


How Does DNA Work?

1. DNA stores genetic information in segments called genes

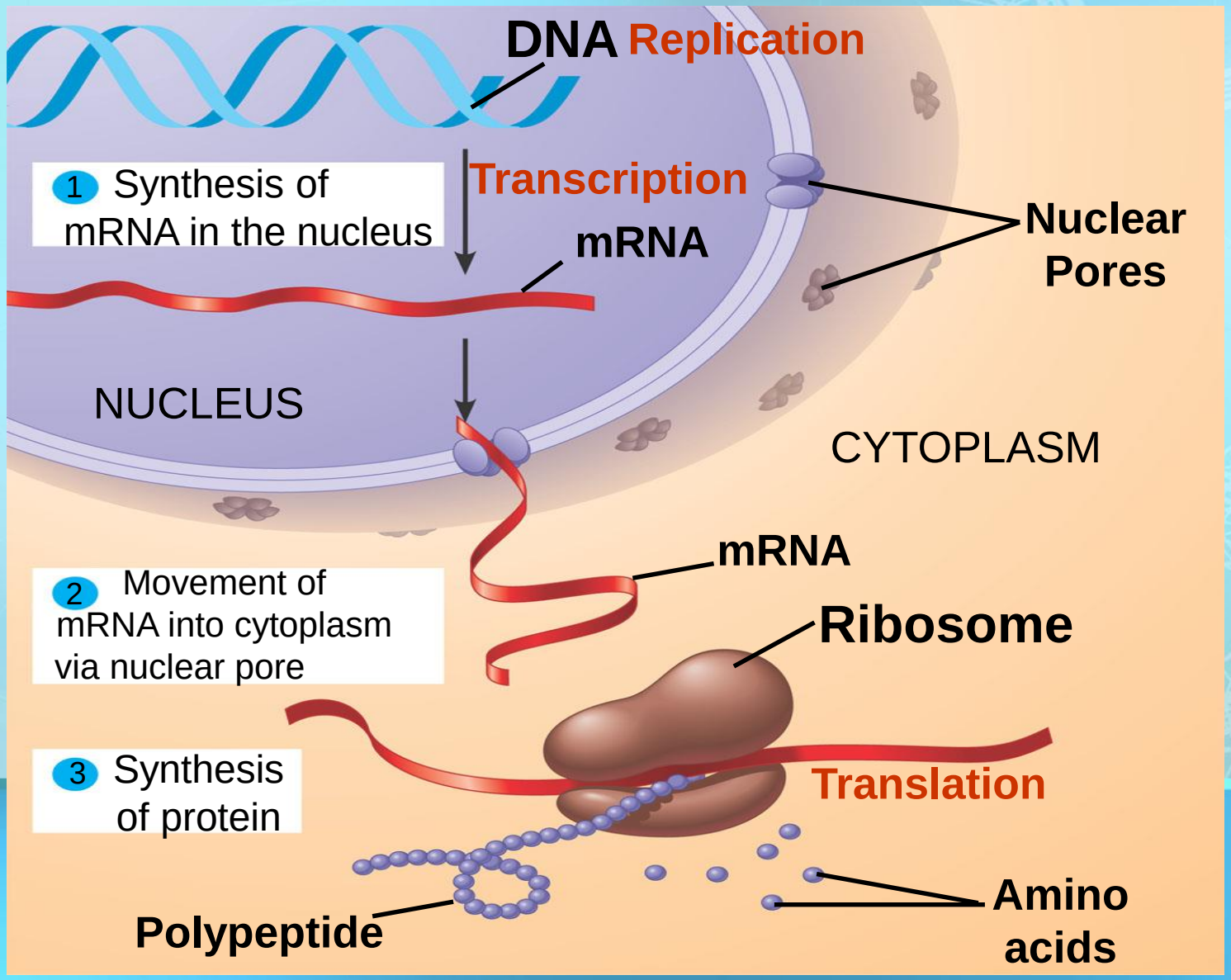
2. The DNA code is in Triplet Codons (short sequences of 3 nucleotides) ex. GCA

3. Each codon is translated by the cell into a specific amino acid.



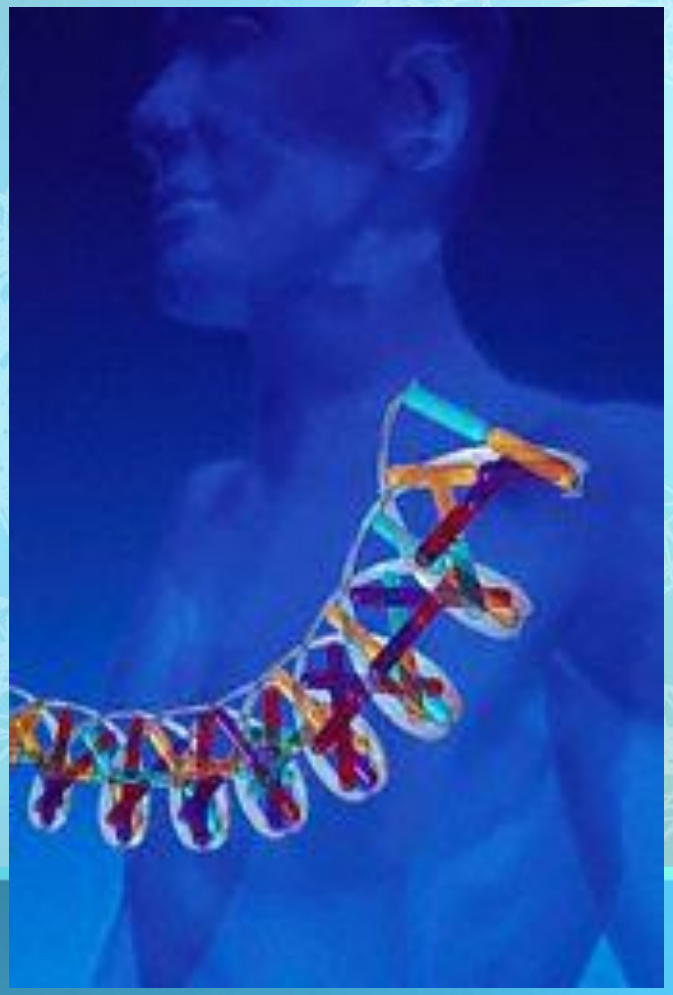
4. The sequence of nucleotides in DNA indicates the sequence of amino acids in a protein.

Overview Of This Unit



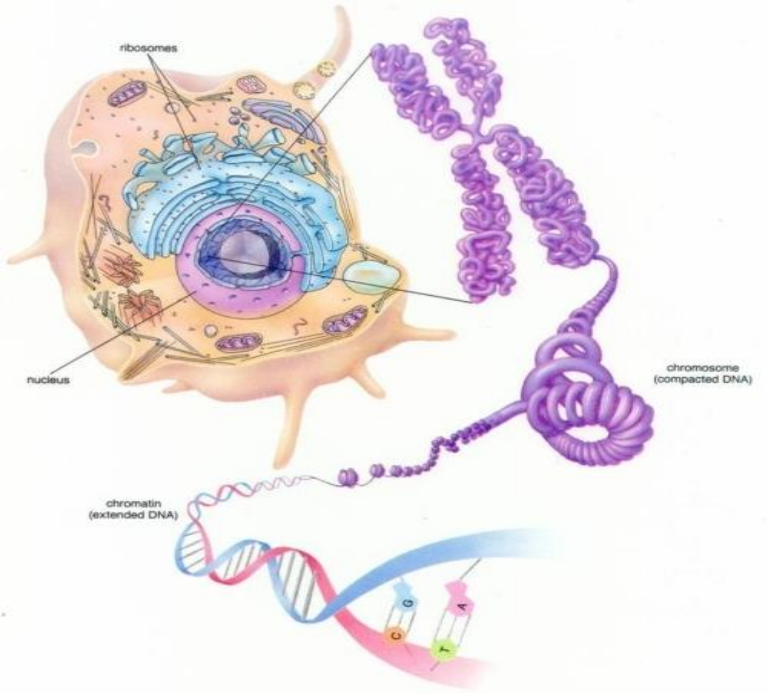
DNA – An Overview

- DNA is often called the blueprint of life – it stores an organism's genetic information.
- DNA contains the instructions for making proteins within the cell.

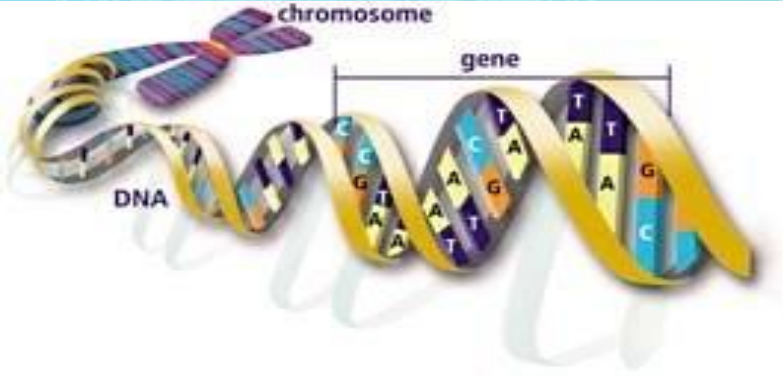


Chromosomes and DNA

- <u>Chromosomes</u> are made up of compacted DNA.

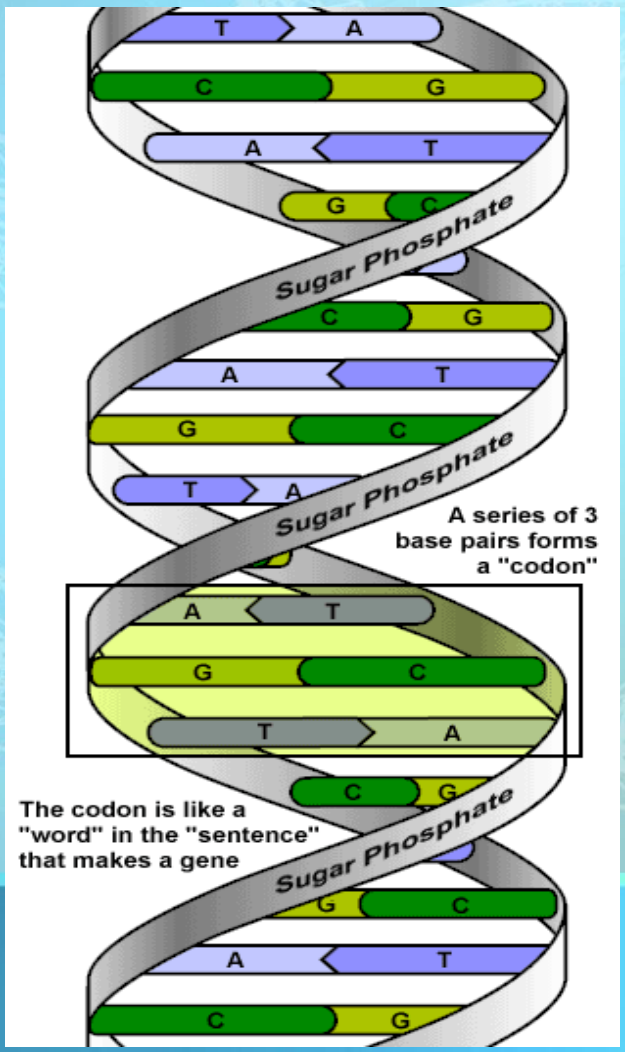


- <u>Genes</u> are segments of DNA molecules located on our chromosomes.



The Shape of the Molecule

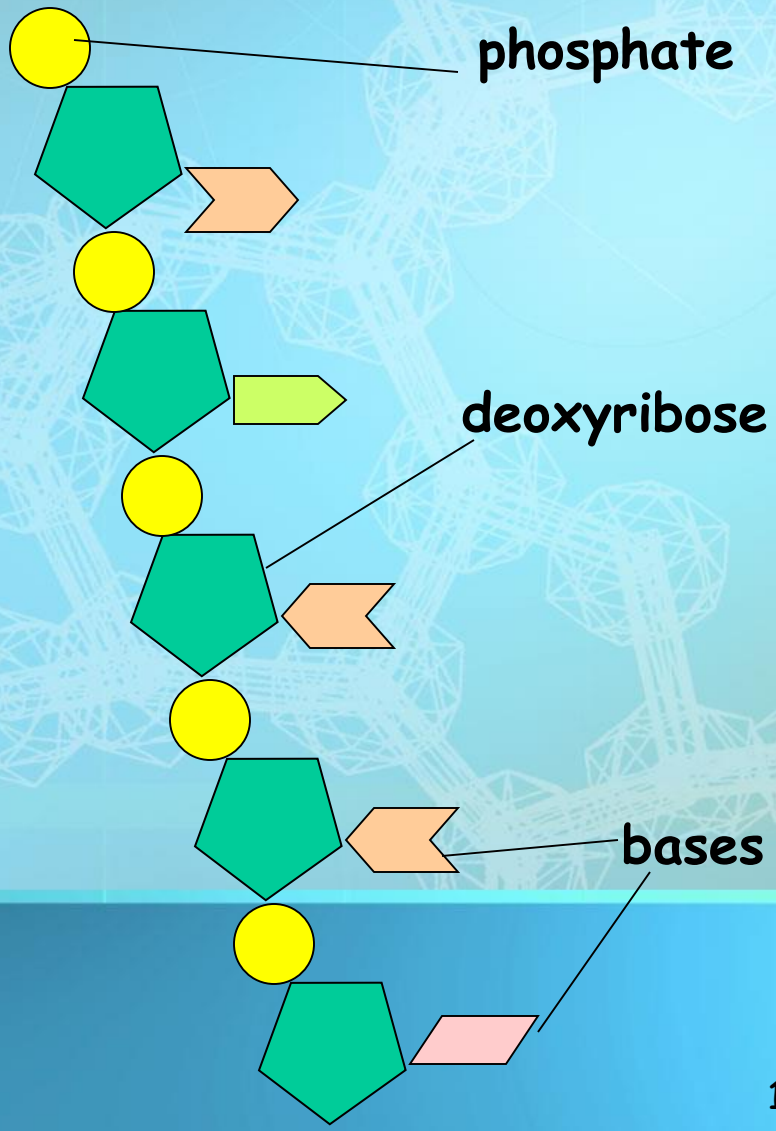
- DNA is a very long polymer made up of <u>nucleotides</u>.
- The basic shape is like a twisted ladder or zipper.
- This is called a <u>*double helix*</u>.
  - In 1953, Watson and Crick published the double-helical structure of DNA, consisting of two strands of nucleotides winding around one another, with the nitrogenous bases (A, T, C, G) on the inside.



One Strand of DNA

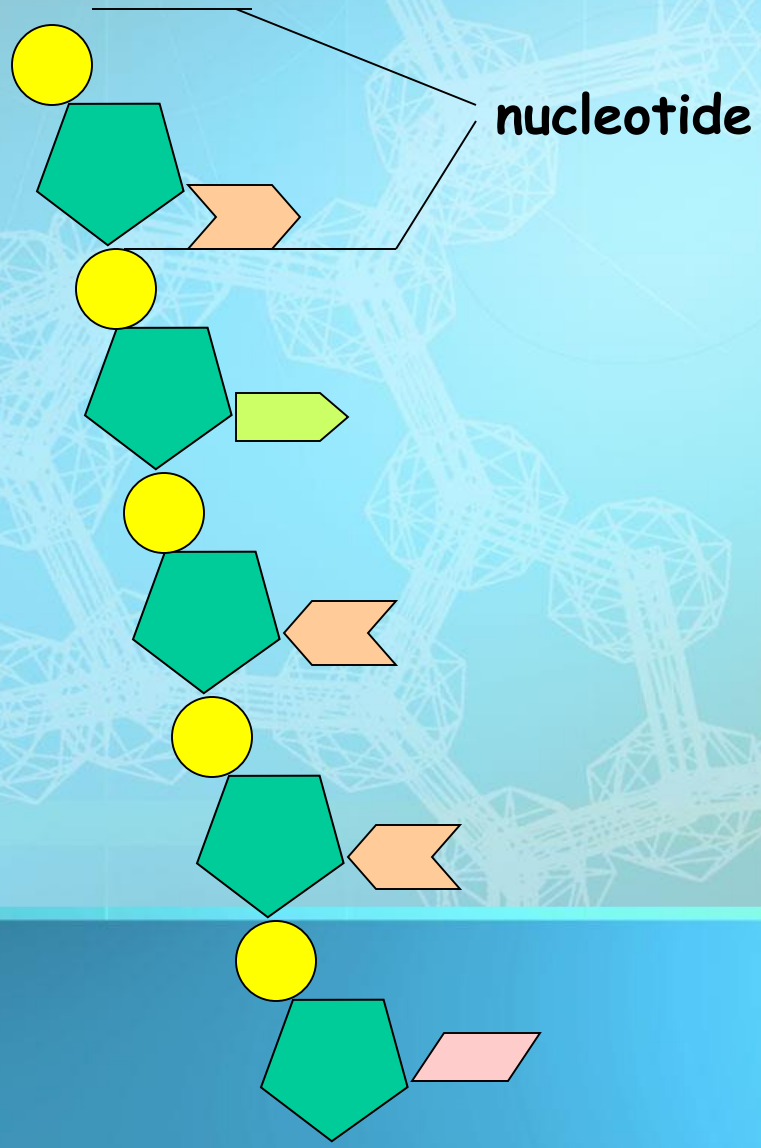
- The backbone of the DNA molecule is made of alternating phosphate groups and deoxyribose sugars.
- The "rungs of the DNA ladder" are the nitrogenous bases (either A, C, T, or G).
- A always pairs with T and G always pairs with C.

This is known as complimentary base pairing.



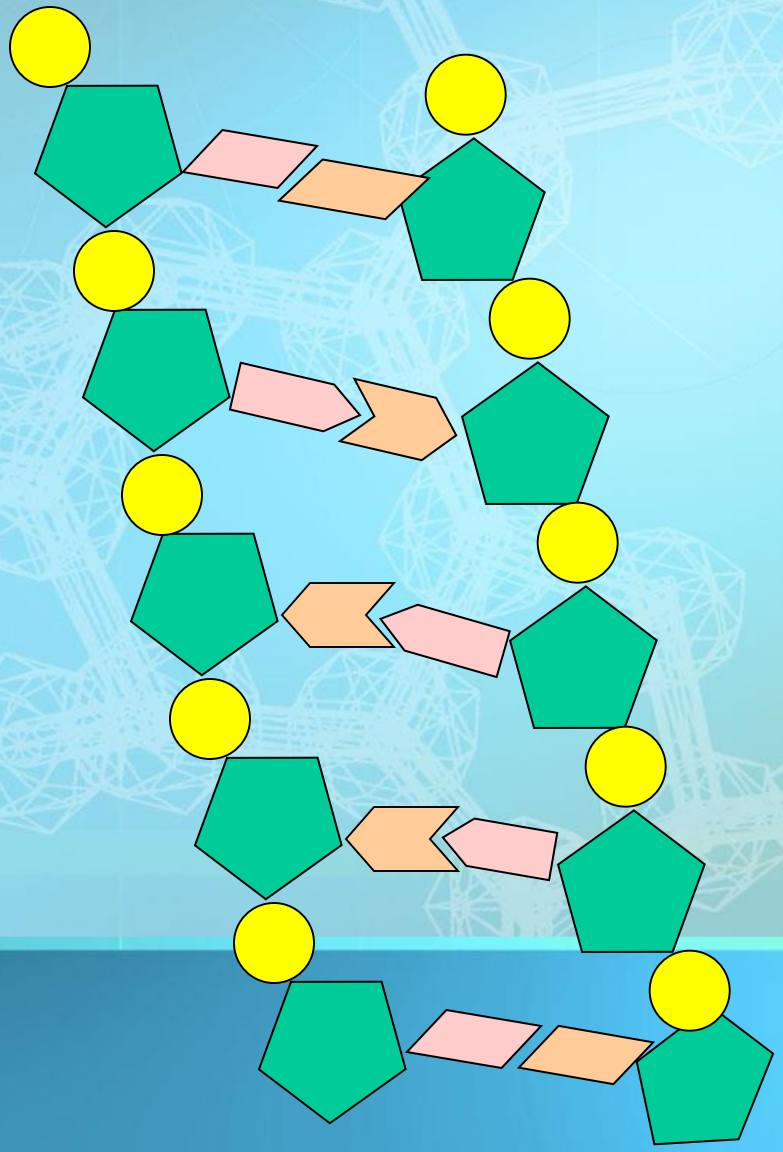
One Strand of DNA

- One strand of DNA is a polymer of nucleotides.
- One strand of DNA has millions of nucleotides.
- The nucleotides are connected to each other by covalent bonds that join the sugar of one nucleotide to the phosphate group of the next nucleotide.



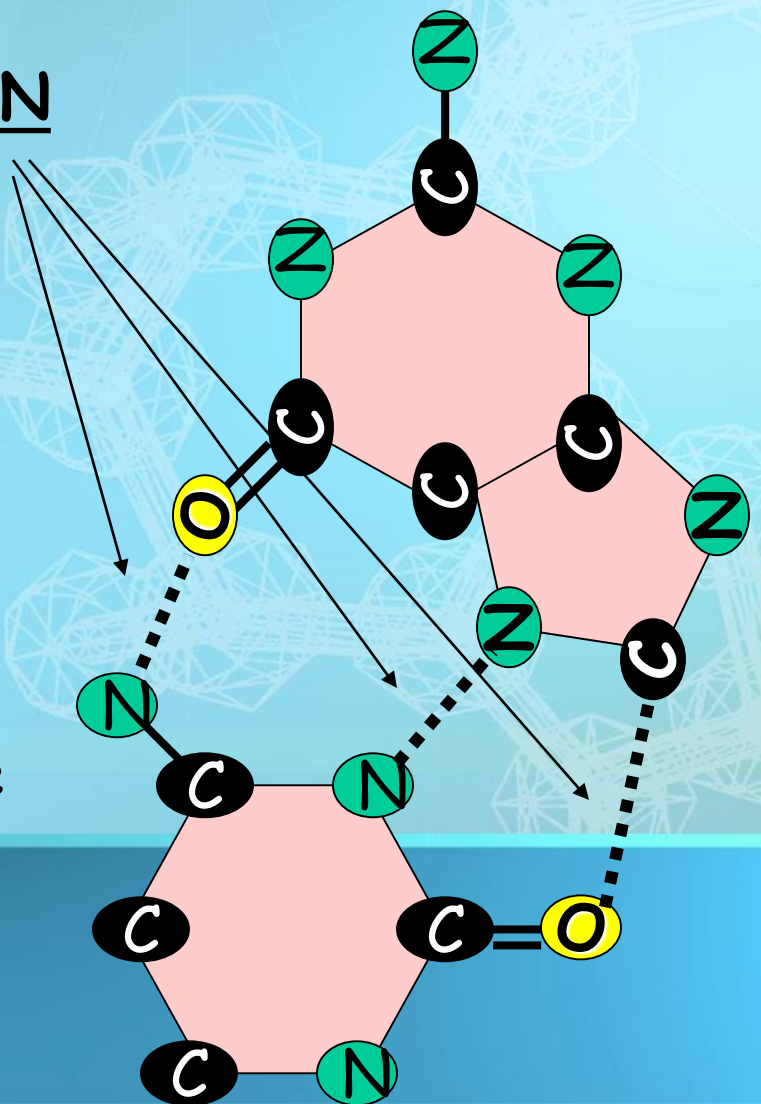
Two Stranded DNA

- Remember, DNA has TWO strands that fit together like a zipper.
- The teeth of the zipper are the nitrogenous bases, but why do they stick together?



Hydrogen Bonds

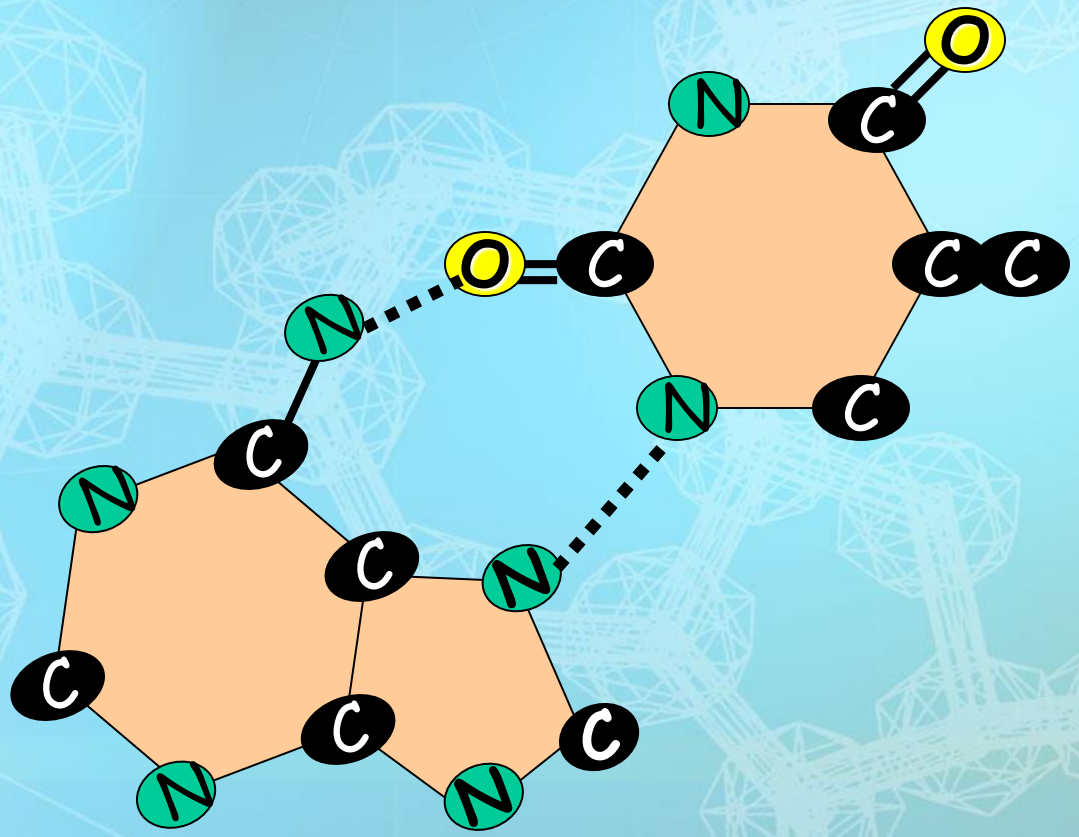
- The bases attract each other because of <u>HYDROGEN bonds.</u>
- Hydrogen bonds are weak, but there are millions and millions of them in a single molecule of DNA.
- The bonds between cytosine and guanine are shown here with <u>dotted lines</u>



Hydrogen Bonds

- When making hydrogen bonds, cytosine always pairs with _guanine_.
- Adenine always pairs with _thymine_.

Adenine is bonded to thymine here →



DNA by the Numbers

- DNA has a diameter of only 0.000000002 m.
- Each cell has about 2 meters of DNA!
- The average human has 75 trillion cells, which means that…

The average human has enough DNA to go from the earth to the sun more than 400 times!! (The Earth is 150 billion meters or 93 million miles from the sun.)

DNA Replication – A Review

Steps in DNA Replication

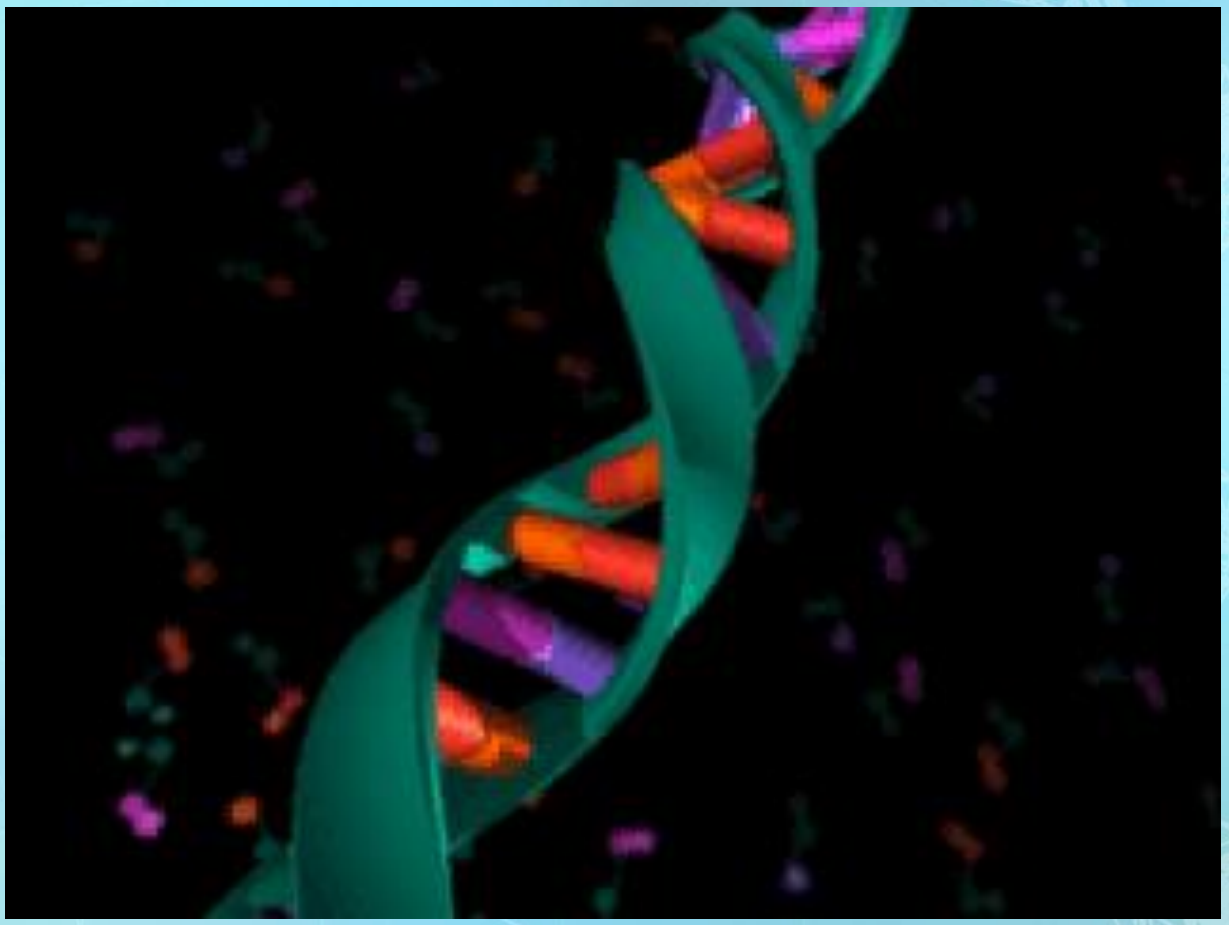
- Occurs when DNA duplicates during interphase.
- An enzyme called helicase "unzips" the DNA molecule breaks the hydrogen bonds between the bases.
- Nucleotides are added to the template strand by an enzyme called DNA polymerase.
- The end product of DNA replication is two, identical molecules of DNA.
- Each old strand of nucleotides serves as a template for each new strand.
- This is called semi-conservative replication.

Review

- **What is the complementary Strand?**

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

A video about DNA Replication…

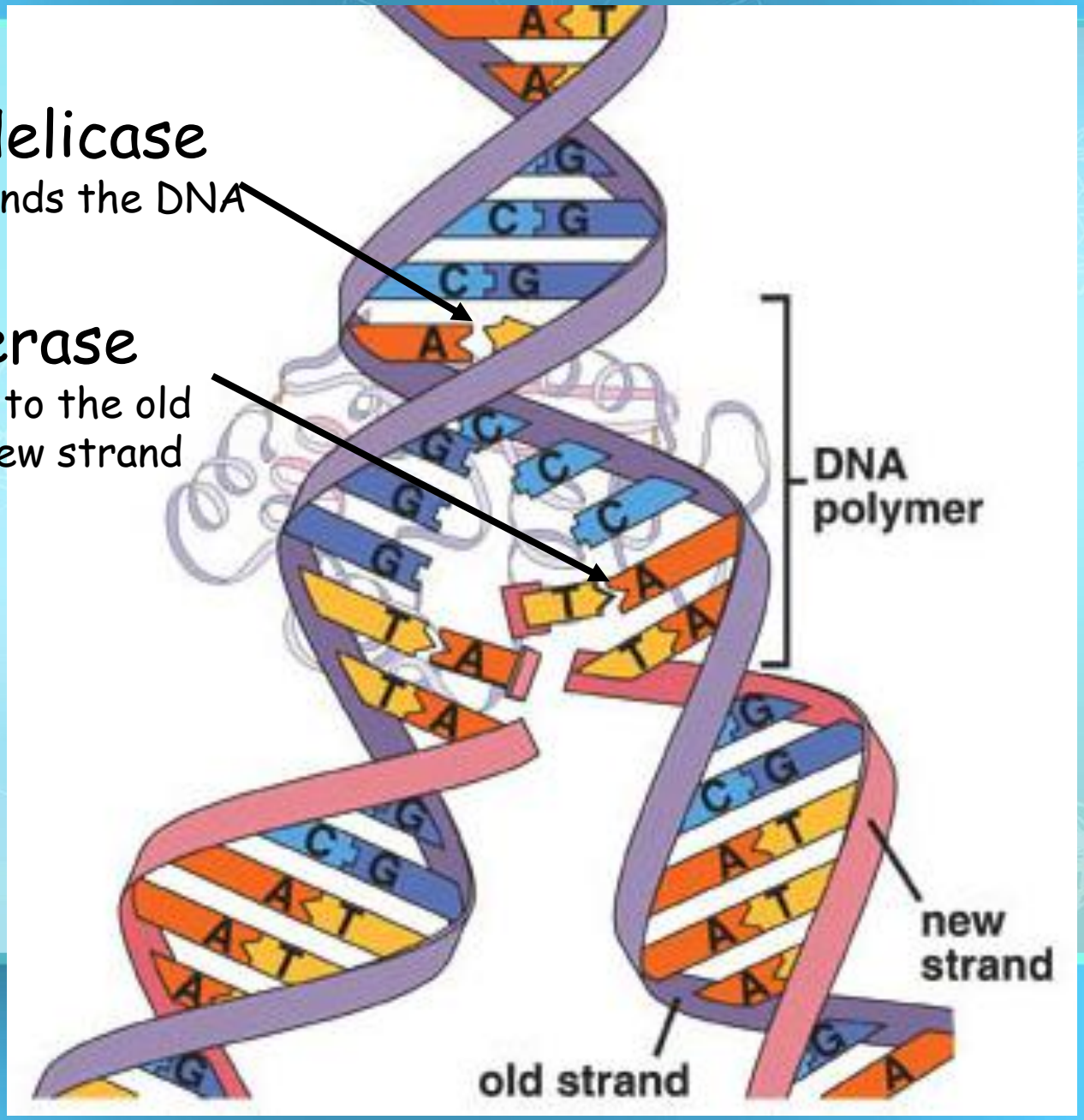


Helicase

unwinds the DNA

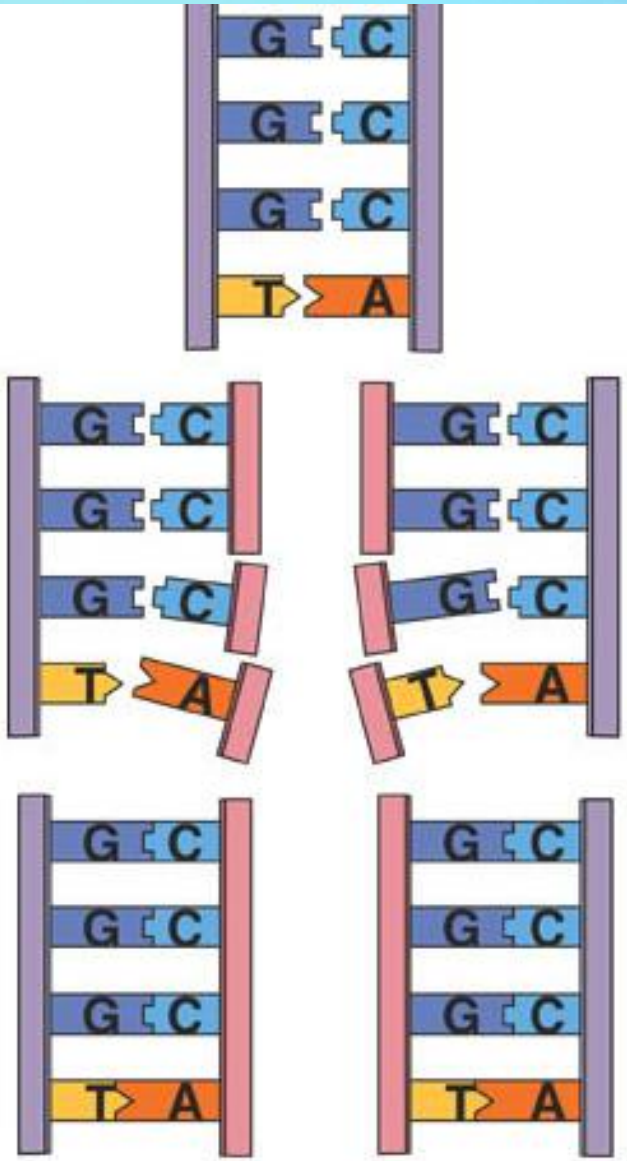
DNA Polymerase

adds new nucleotides to the old strand to form the new strand



Two New, Identical DNA Strands Result from Replication

Another View of Replication



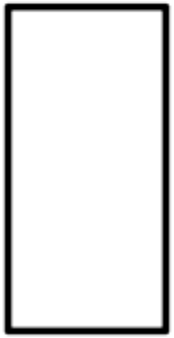
Parental DNA molecule contains so-called old strands hydrogen-bonded by complementary base pairing.

Region of replication. Parental DNA is unwound and unzipped. New nucleotides are pairing with those in old strands.

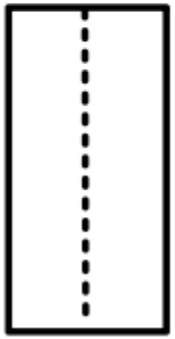
Replication is complete. Each double helix is composed of an old (parental) strand and a new (daughter) strand.

Modeling DNA Replication

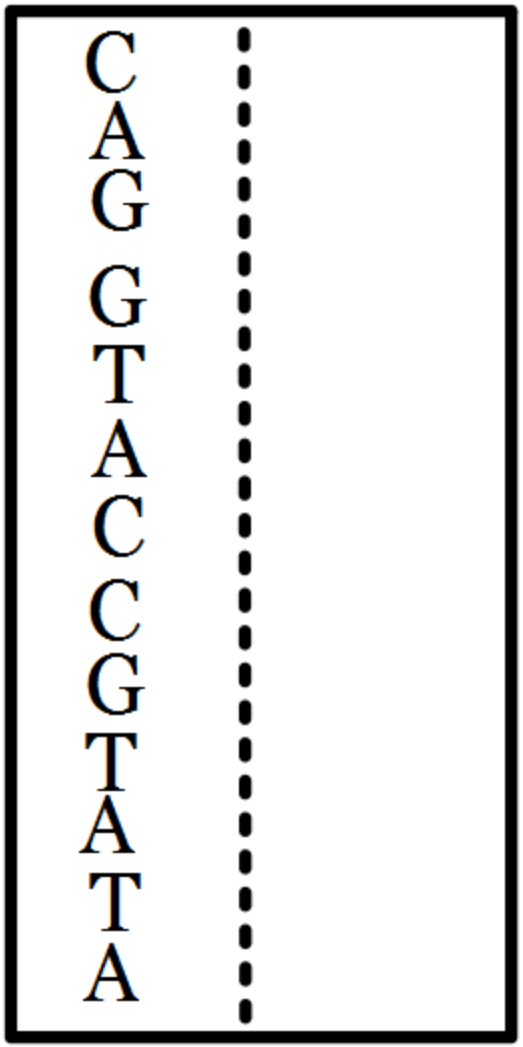
Step 1: Fold a sheet of paper in half lengthwise



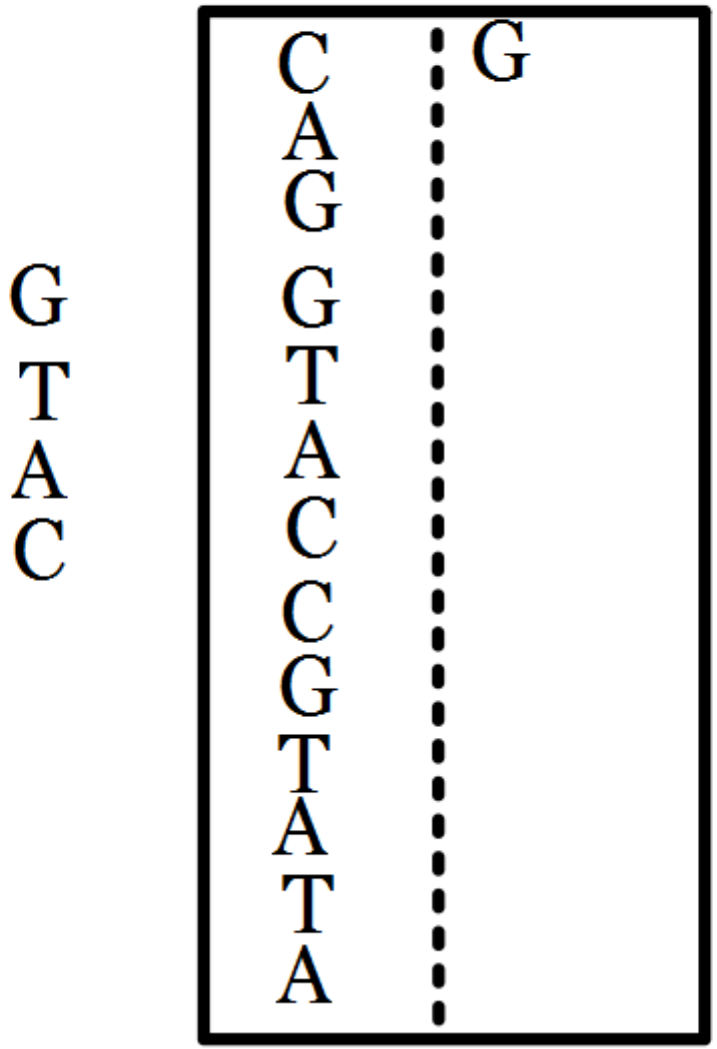
Step 2: Fold one half back again



Write the following sequence down left side of the paper next to the fold.

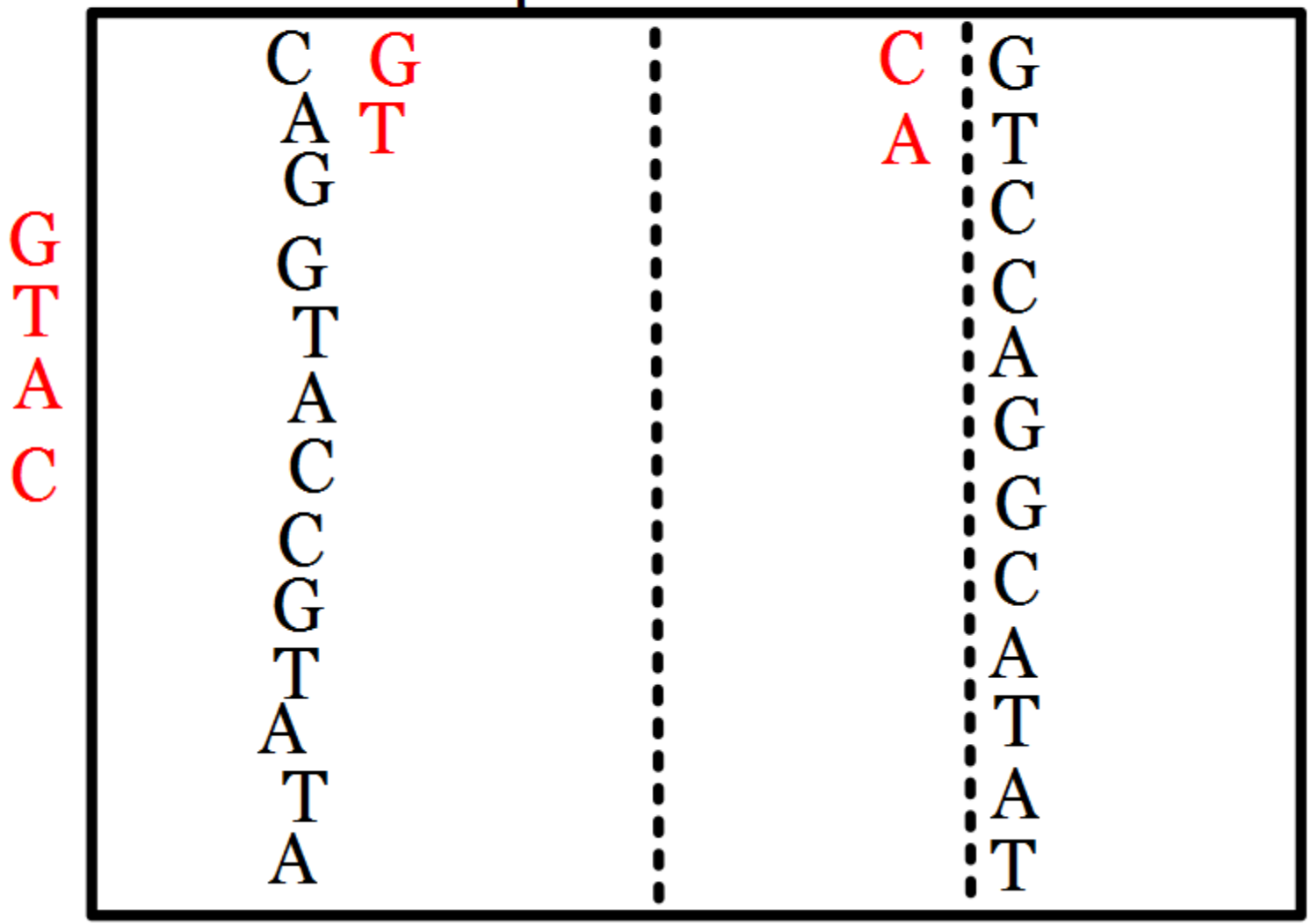


Write the complimentary sequence on the RIGHT side of the fold



Unfold the paper

Replicate each strand- the old strand has become the template for the new strand



Review:

How does the structure of the DNA molecule allow genetic information to be transferred from one generation to the next (or from one cell to the next) without changing the sequences of bases each time it is replicated?

Because DNA is made up of 2 strands that are connected by hydrogen bonds it can easily unwind. When it unwinds each strand is used as a template strand to build a new molecule of DNA. Because of complementary base pairing there is only one option for matching each nucleotide on the template strand A-T and C-G. This is the reason that DNA can replicate and make 2 identical copies of itself.