Nucleic Acids and Nucleotides

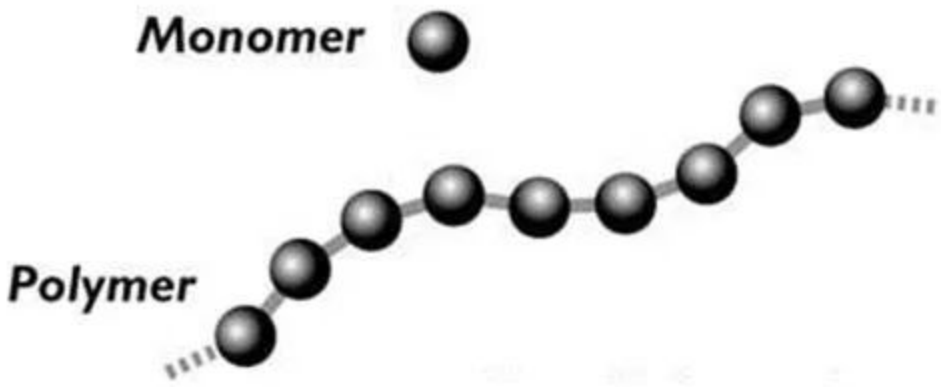
DNA = **D**eoxyribo**n**ucleic **A**cid

- DNA is a **nucleic acid**.

- Nucleic acids are made up of **nucleotide monomers**, linked together to form long **polymer chains**.

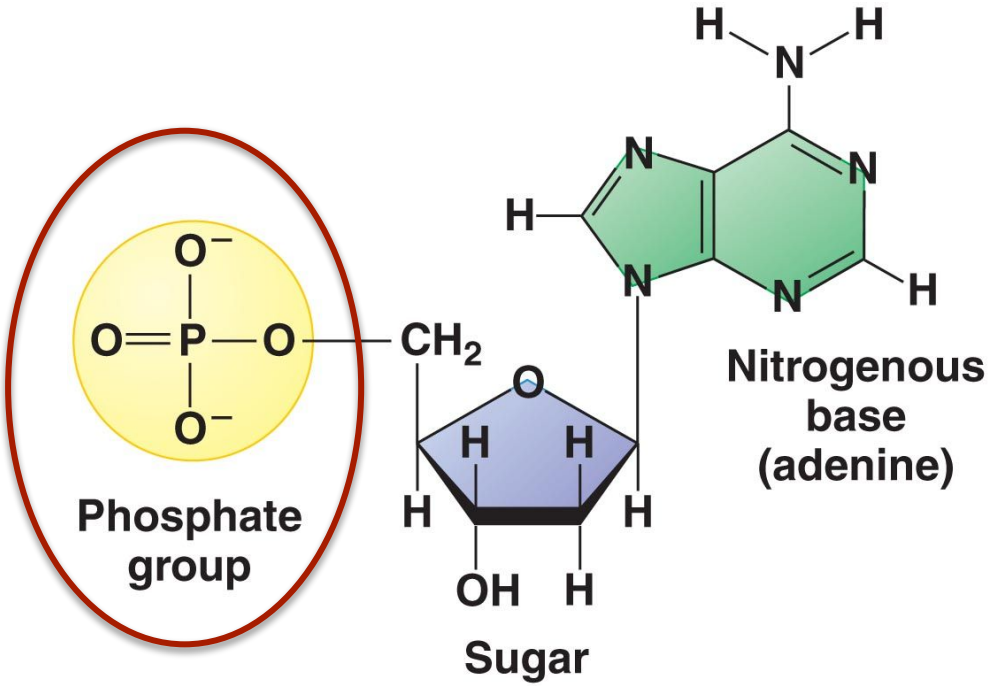
Monomer = **Nucleotide**

Polymer = **Nucleic Acid**



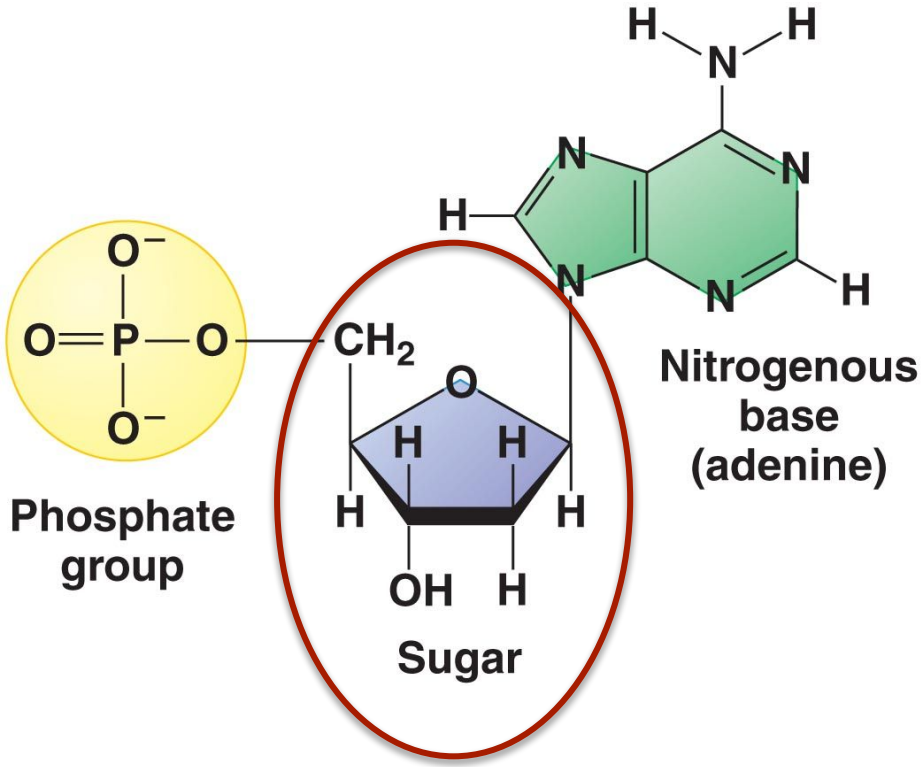
Nucleic Acids and Nucleotides

- DNA's nucleotides are made up of 3 basic components:
  - ✓ **phosphate group**



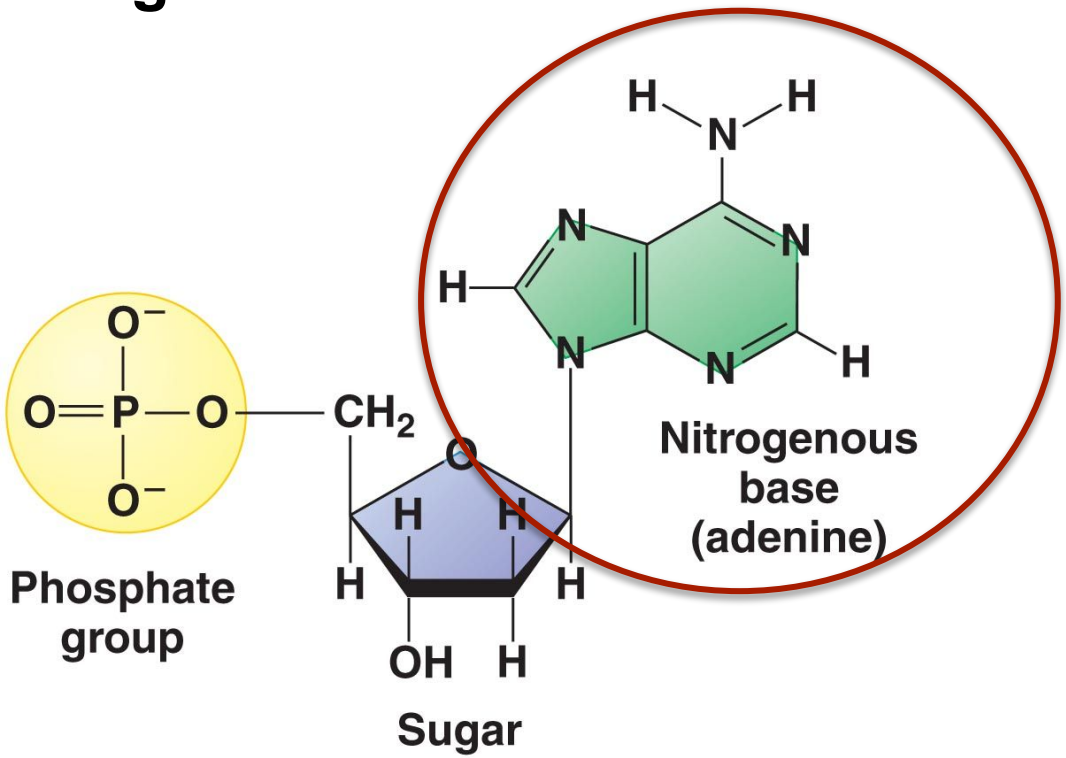
Nucleic Acids and Nucleotides

- DNA's nucleotides are made up of 3 basic components:
  - ✓ **phosphate group**
  - ✓ **5-carbon sugar called deoxyribose**



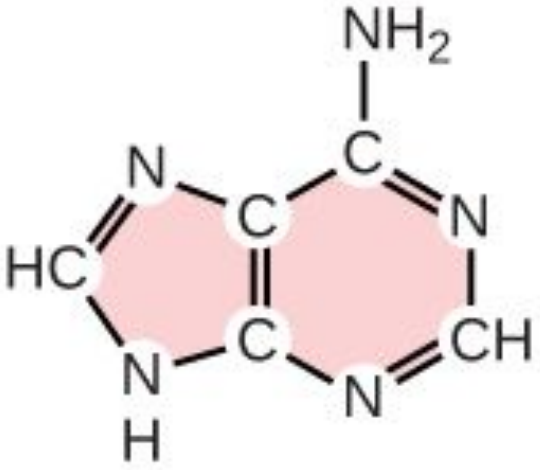
Nucleic Acids and Nucleotides

- DNA's nucleotides are made up of 3 basic components:
  - ✓ **phosphate group**
  - ✓ **5-carbon sugar called deoxyribose**
  - ✓ **nitrogenous base**



Nitrogenous Bases and Covalent Bonds

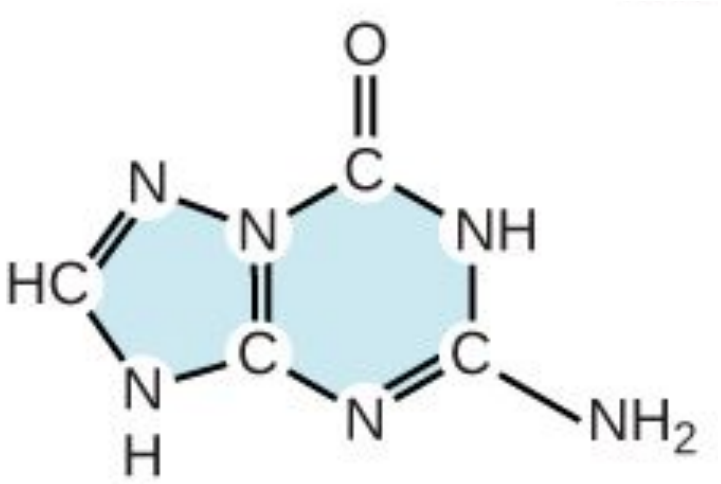
- DNA has 4 different nitrogenous bases:
  - ✓ **adenine (A)**



Nitrogenous Bases and Covalent Bonds

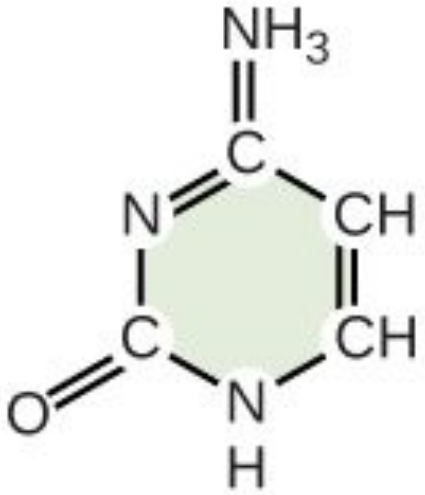
- DNA has 4 different nitrogenous bases:

✓
✓ **guanine (G)**



Nitrogenous Bases and Covalent Bonds

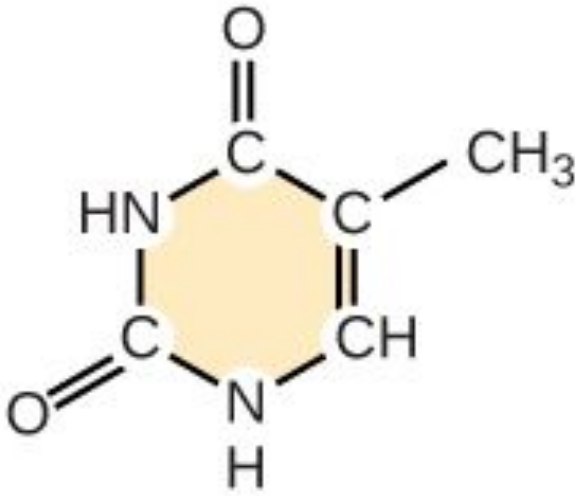
- DNA has 4 different nitrogenous bases:
  - ✓
  - ✓
  - ✓ **cytosine (C)**
  - ✓



Nitrogenous Bases and Covalent Bonds

- DNA has 4 different nitrogenous bases:

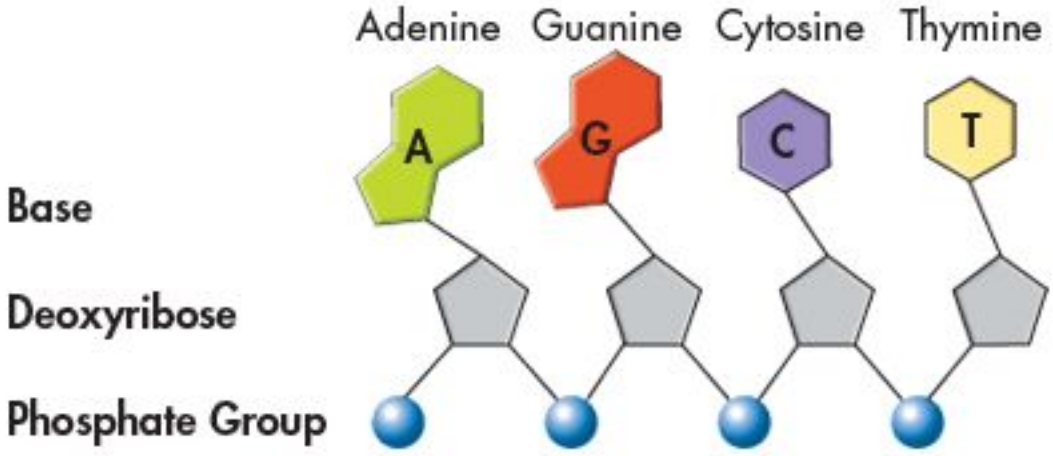
✓
✓
✓
✓ **thymine (T)**



Nitrogenous Bases and Covalent Bonds

- DNA has 4 different nitrogenous bases:
  - ✓ **adenine (A)**
  - ✓ **cytosine (C)**
  - ✓ **guanine (G)**
  - ✓ **thymine (T)**

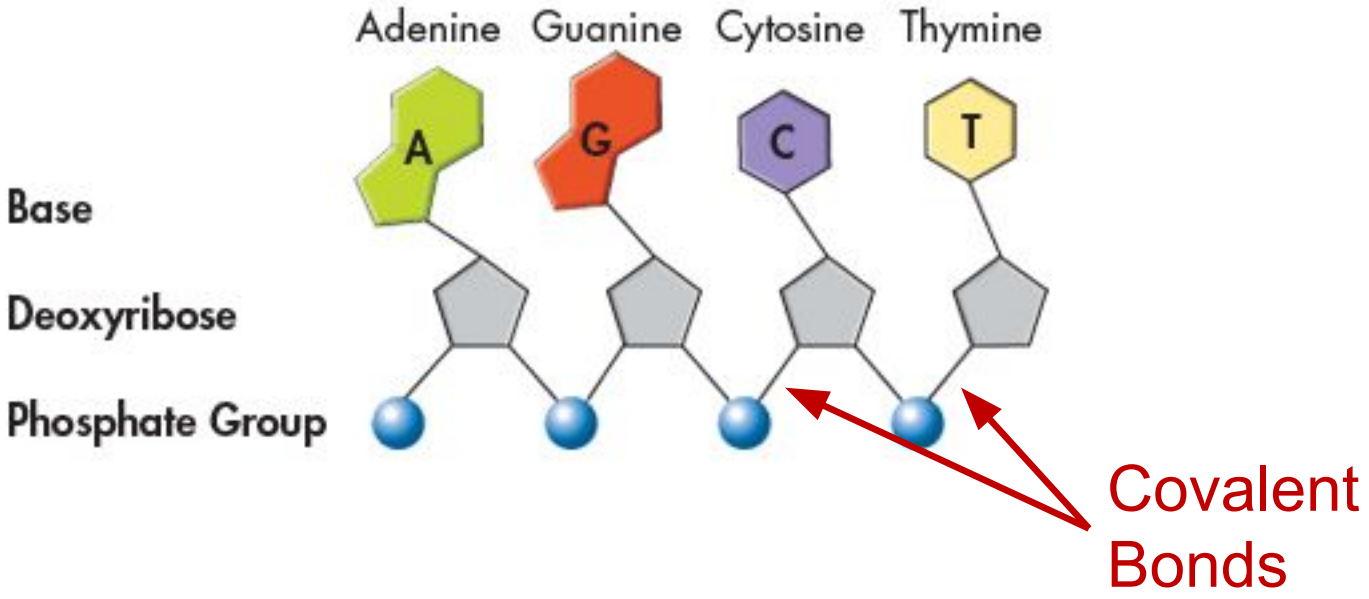
- The nitrogenous bases stick out sideways from the nucleotide chain.



Nitrogenous Bases and Covalent Bonds

- The nucleotides in a strand of DNA are joined by **covalent bonds** formed between the **sugar and phosphate groups**.

- The nucleotides can be joined together in any order, meaning that **any sequence of nitrogenous bases is possible**.

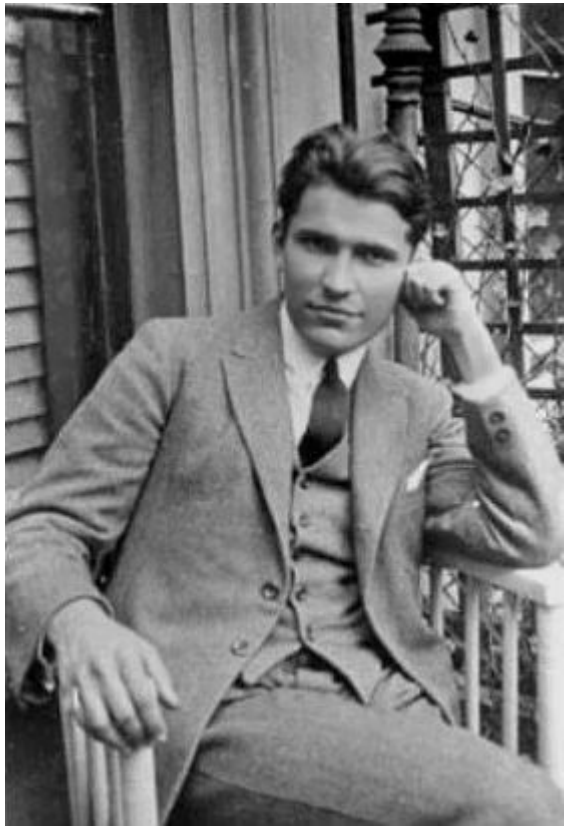


Chargaff's Rules

- **Erwin Chargaff** discovered that the percentages of adenine [A] and thymine [T] bases are almost equal in any sample of DNA.

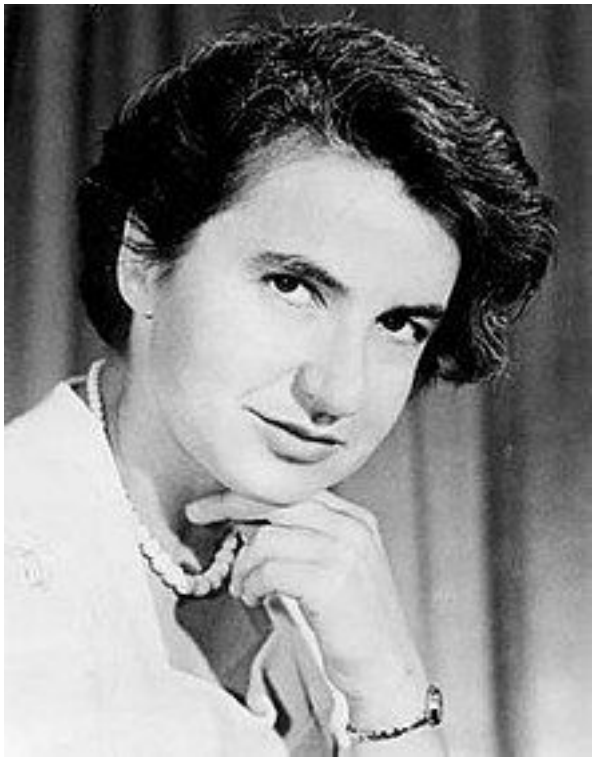
- The same thing is true for the other two nucleotides, guanine [G] and cytosine [C].

- The observation that **[A] = [T]** and **[G] = [C]** became known as "**Chargaff's rules**."



Franklin's X-Rays

- In the 1950s, British scientist **Rosalind Franklin** used a technique called **X-ray diffraction** to get information about the structure of the DNA molecule.

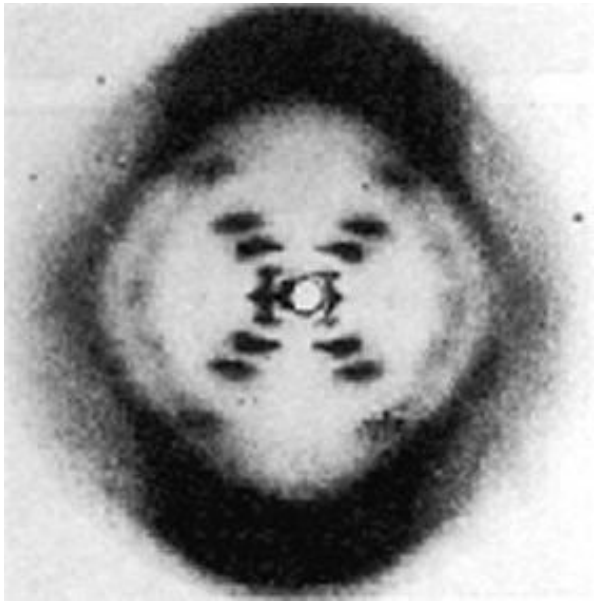


Franklin's X-Rays

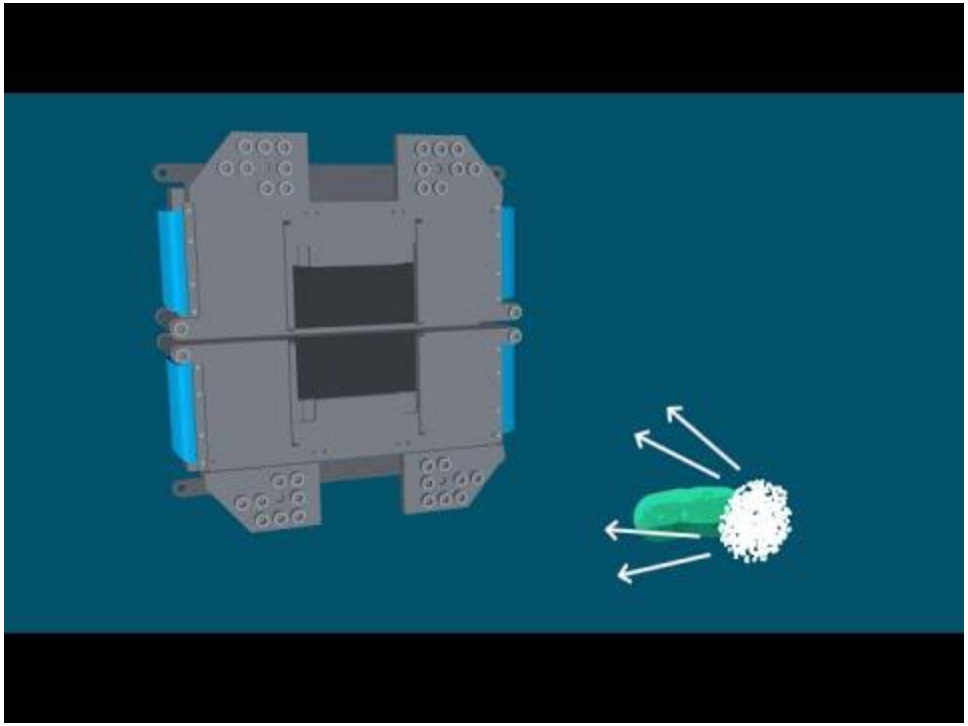
- X-ray diffraction revealed an **X-shaped pattern** showing that the **strands in DNA are twisted** around each other like the coils of a spring.

- The **angle** of the X-shaped pattern suggested that there are **two strands** in the structure.

- Other clues suggested that the **nitrogenous bases are near the center of the DNA molecule**.



X-Ray Diffraction Video



The Work of Watson and Crick

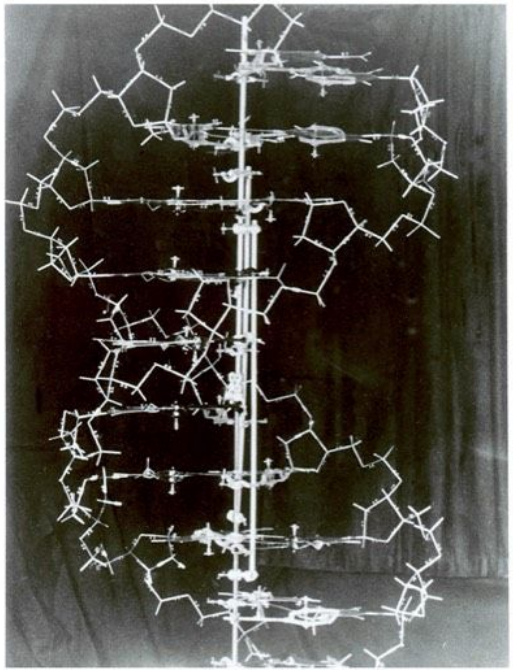
- At the same time, **James Watson**, an American biologist, and **Francis Crick**, a British physicist, were also trying to understand the structure of DNA.

The Work of Watson and Crick

- Early in 1953, Watson was shown a copy of Franklin's X-ray pattern.

- The clues in Franklin's X-ray pattern enabled Watson and Crick to build a **3D model** that explained the specific structure and properties of DNA.

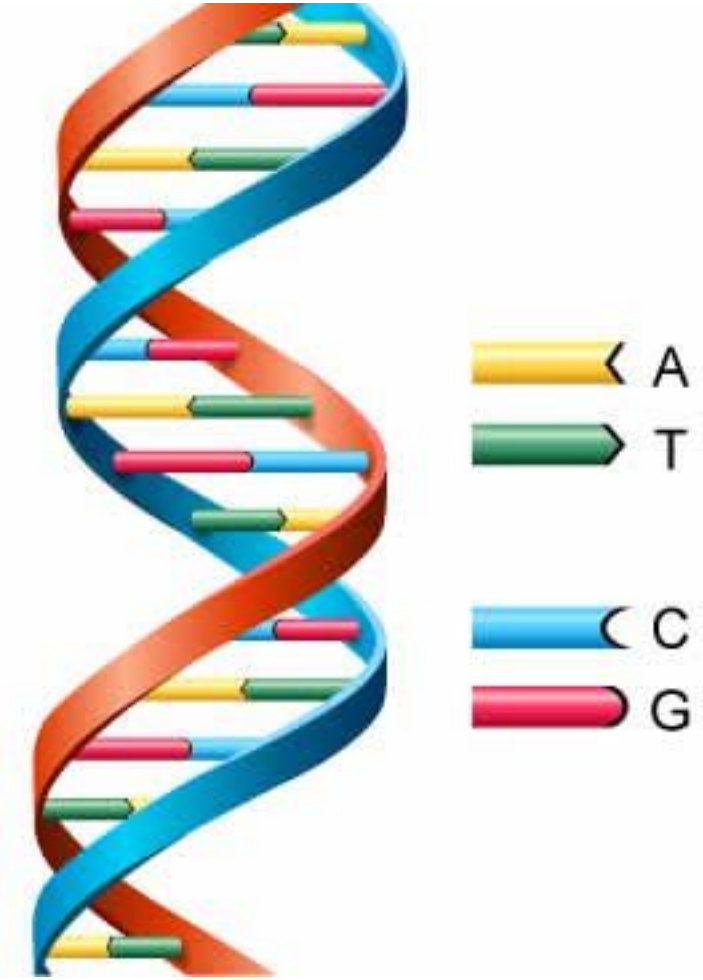
- Watson and Crick's breakthrough model of DNA was a **double helix**.



The Double-Helix Model

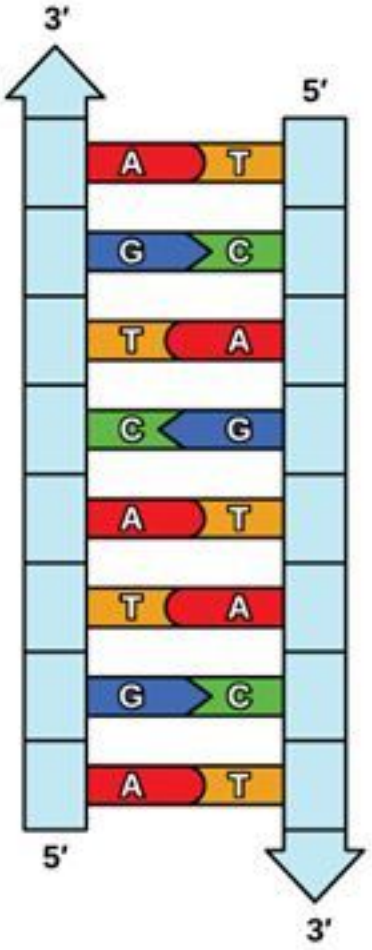
- A double helix looks like a **twisted ladder**.

- The double helix accounted for **Franklin's X-ray pattern** and explains **Chargaff's rule of base pairing** and how the two strands of DNA are held together.

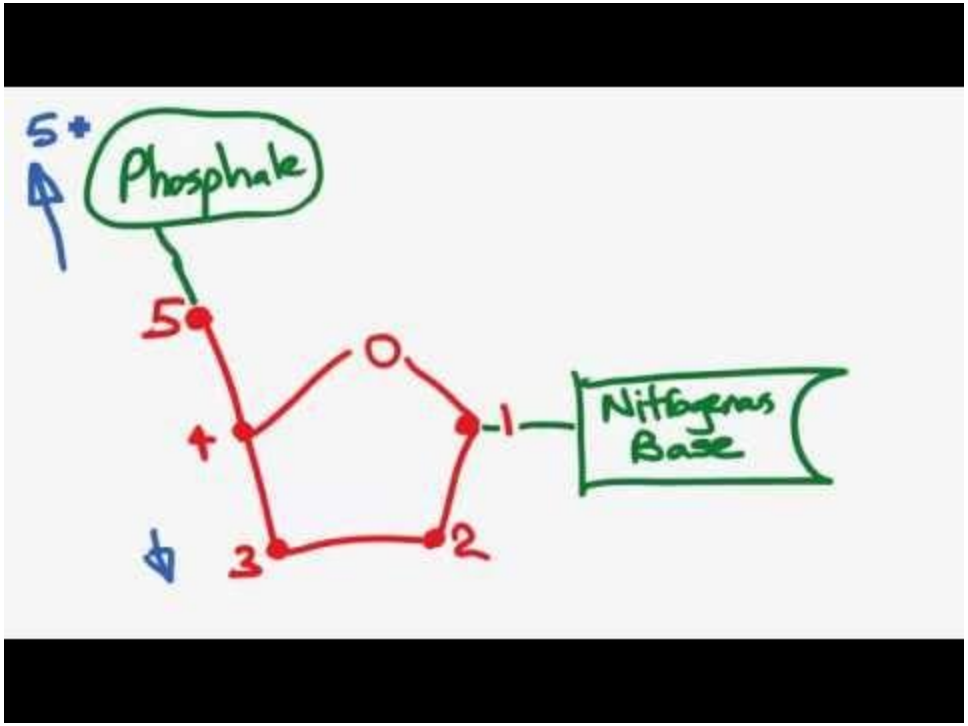


The Double-Helix Model

- In the double-helix model, the two strands of DNA are "**antiparallel**"—they run in **opposite directions**.



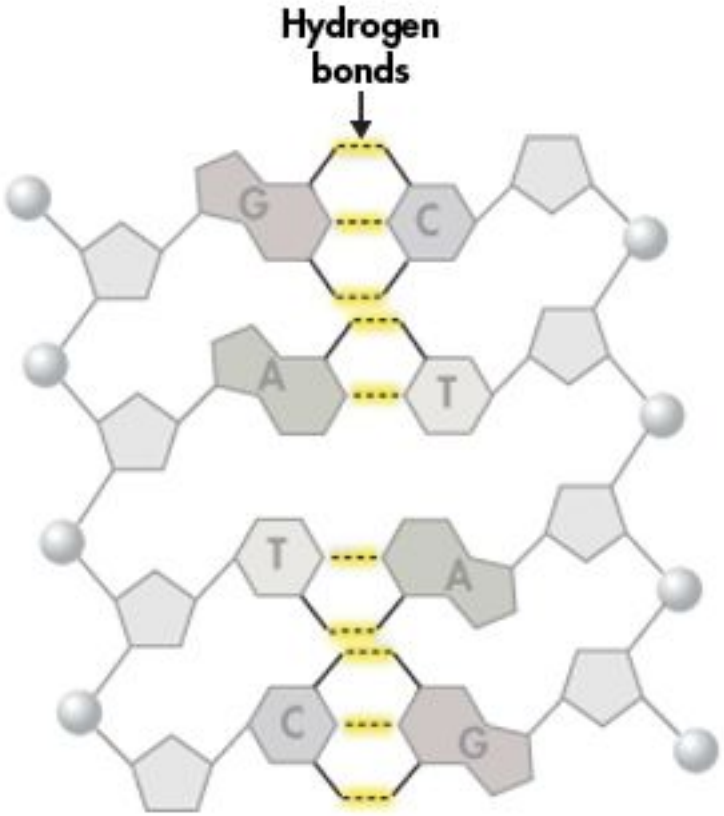
5’ - 3’ Video



Hydrogen Bonding

- Watson and Crick discovered that **hydrogen bonds** could form between certain nitrogenous bases, providing just enough force to hold the two DNA strands together.

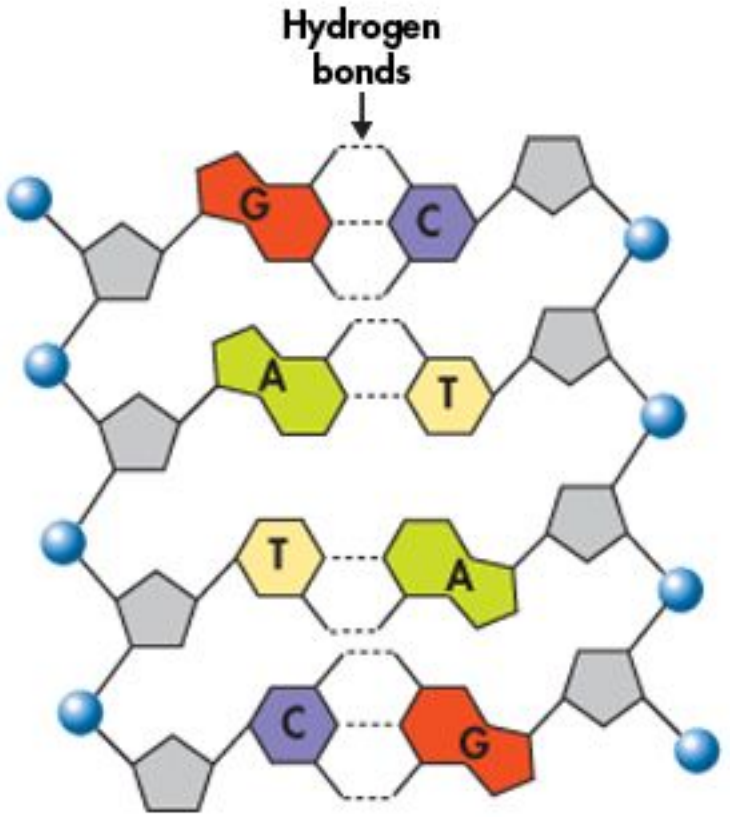
- Hydrogen bonds are relatively **weak chemical forces** that allow the two strands of the helix to separate during DNA replication.



Base Pairing

- Hydrogen bonds form only between certain base pairs - **adenine with thymine**, and **guanine with cytosine**.

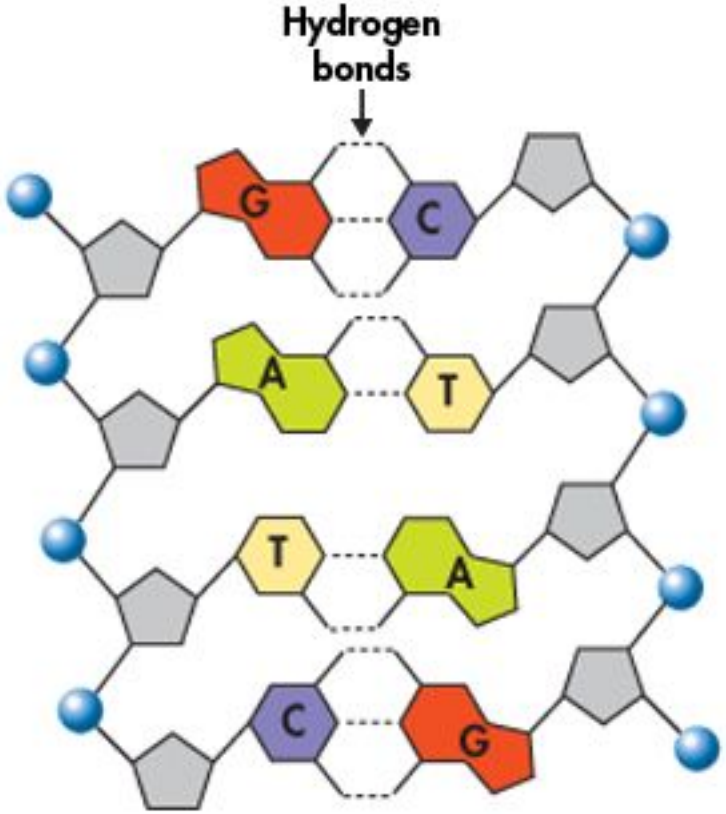
- This nearly perfect fit between A–T and G–C nucleotides is known as **base pairing**.



Base Pairing

- Watson and Crick realized that base pairing explained **Chargaff's rule**:

[A] = [T] and **[G] = [C]**.



Let’s Review

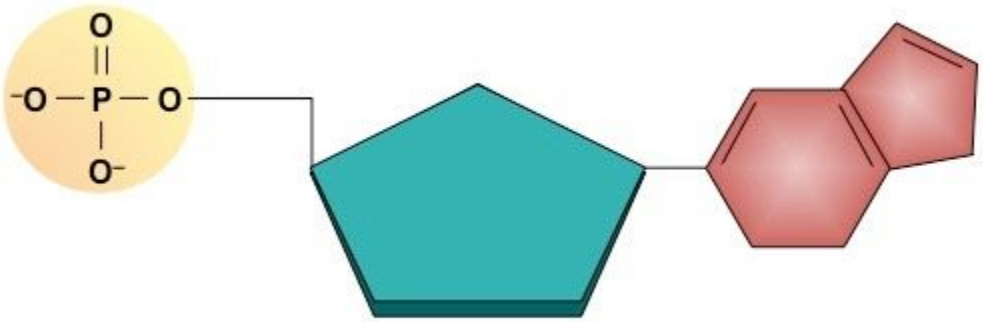
DNA is a long polymer _____.

Let’s Review

The monomer “building blocks” of DNA are _____.

Let's Review

Label the three basic components that make up a nucleotide of DNA.

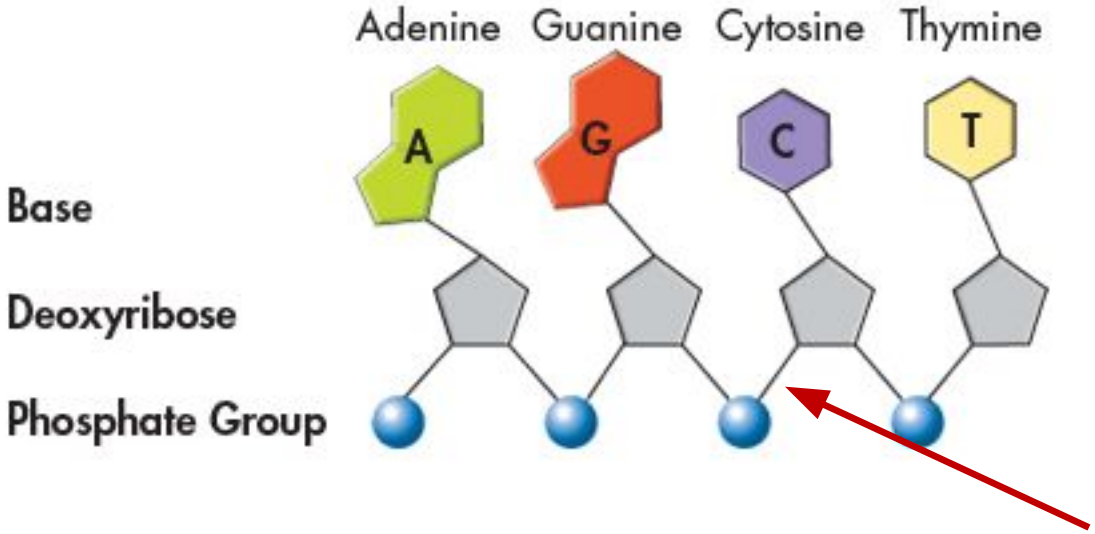


Let’s Review

Name the four kinds of nitrogenous bases.

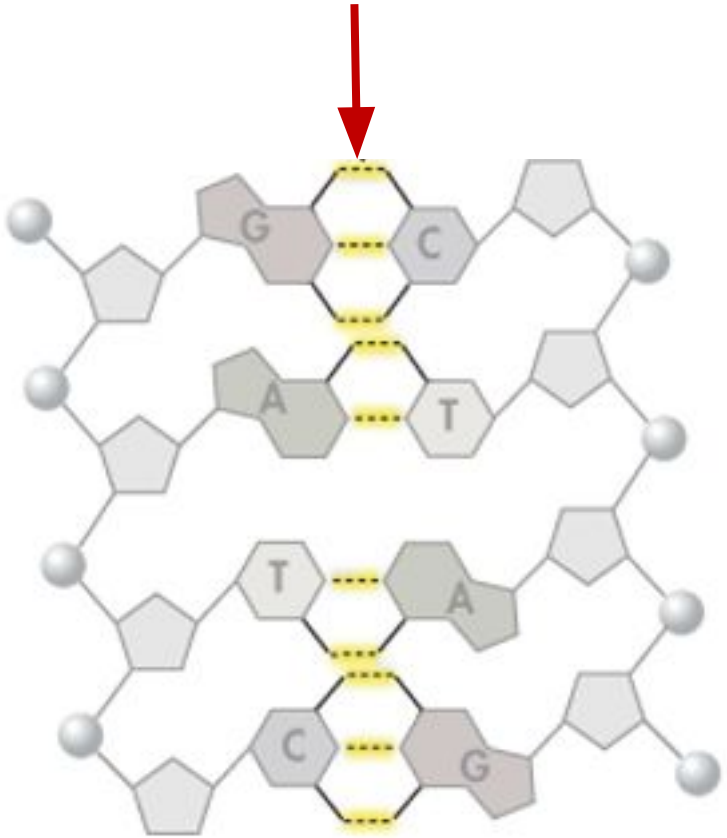
Let's Review

What type of bond joins the nucleotides in DNA?



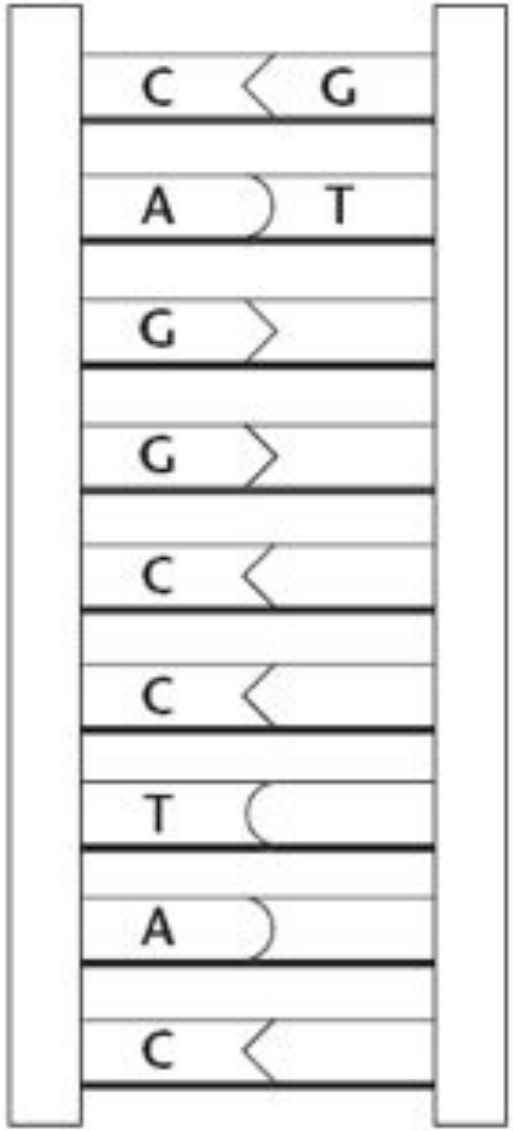
Let's Review

What type of bond joins the base pairs between the two stands in the DNA double helix?



Let's Review

Fill in the appropriate letters of the missing nitrogenous bases in the DNA double-helix molecule.



Key
A = Adenine
C = Cytosine
G = Guanine
T = Thymine

Let's Review

What percent of adenine is in the DNA sample based on Chargaff's rules?

DNA Sample	Percent of adenine	Percent of thymine	Percent of guanine	Percent of cytosine
#1		30	20	

Let's Review

What percent of cytosine is in the DNA sample based on Chargaff's rules?

DNA Sample	Percent of adenine	Percent of thymine	Percent of guanine	Percent of cytosine
#1		30	20	

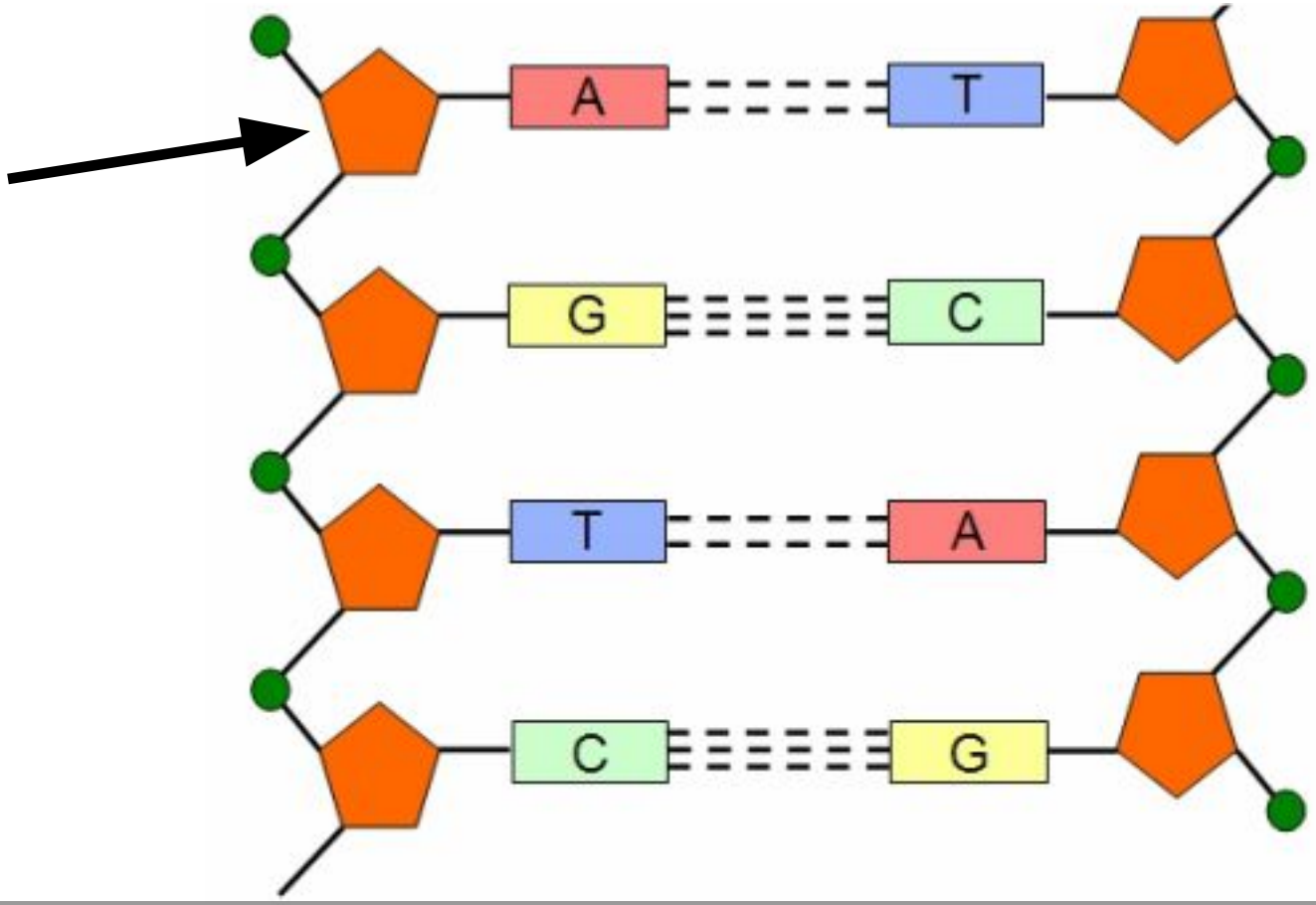
Let's Review

What percent of thymine is in the DNA sample based on Chargaff's rules?

DNA Sample	Percent of adenine	Percent of thymine	Percent of guanine	Percent of cytosine
#2				17

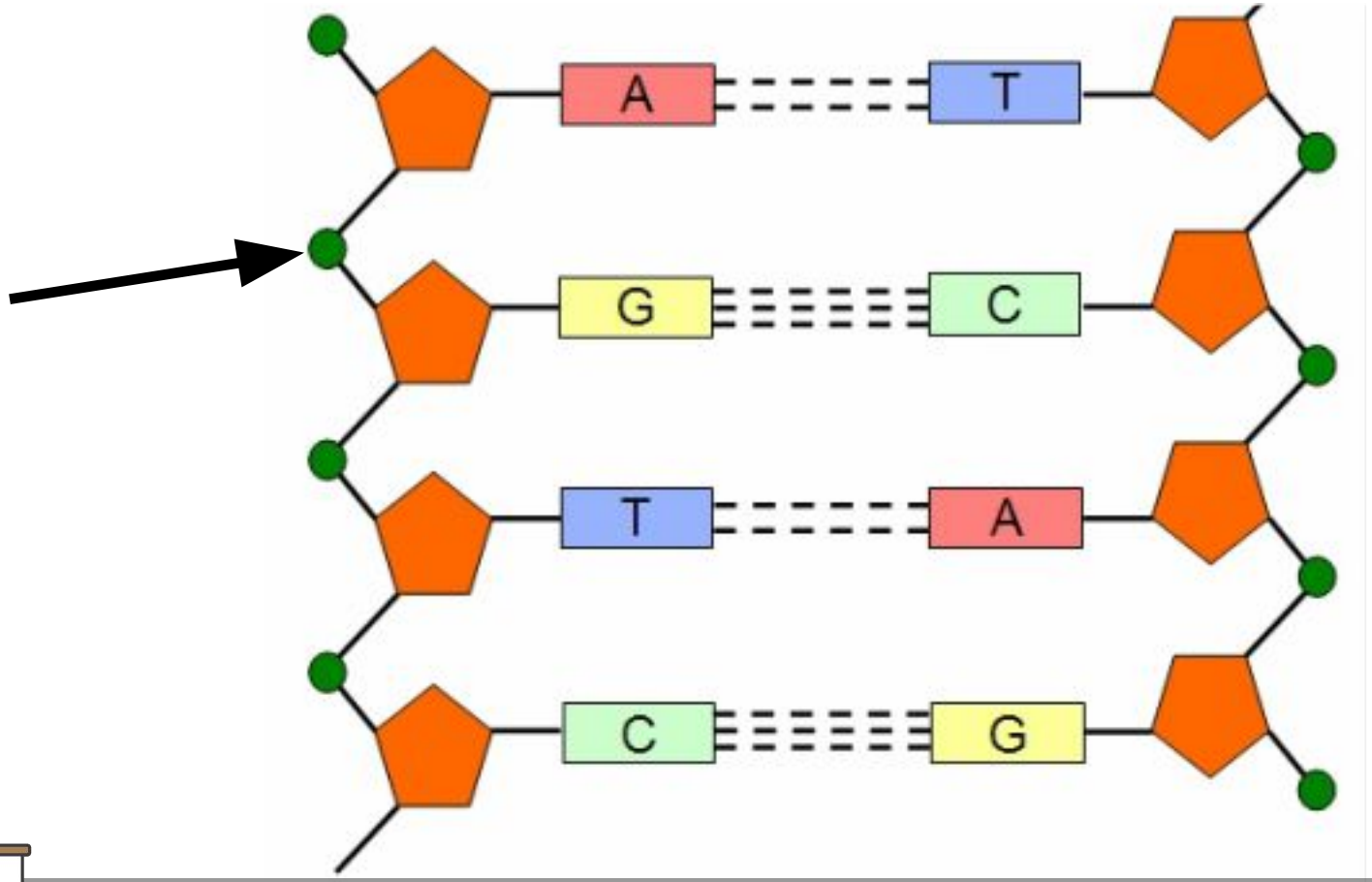
Let's Review

Name the part of the DNA molecule that the arrow is pointing at?



Let's Review

Name the part of the DNA molecule that the arrow is pointing at?



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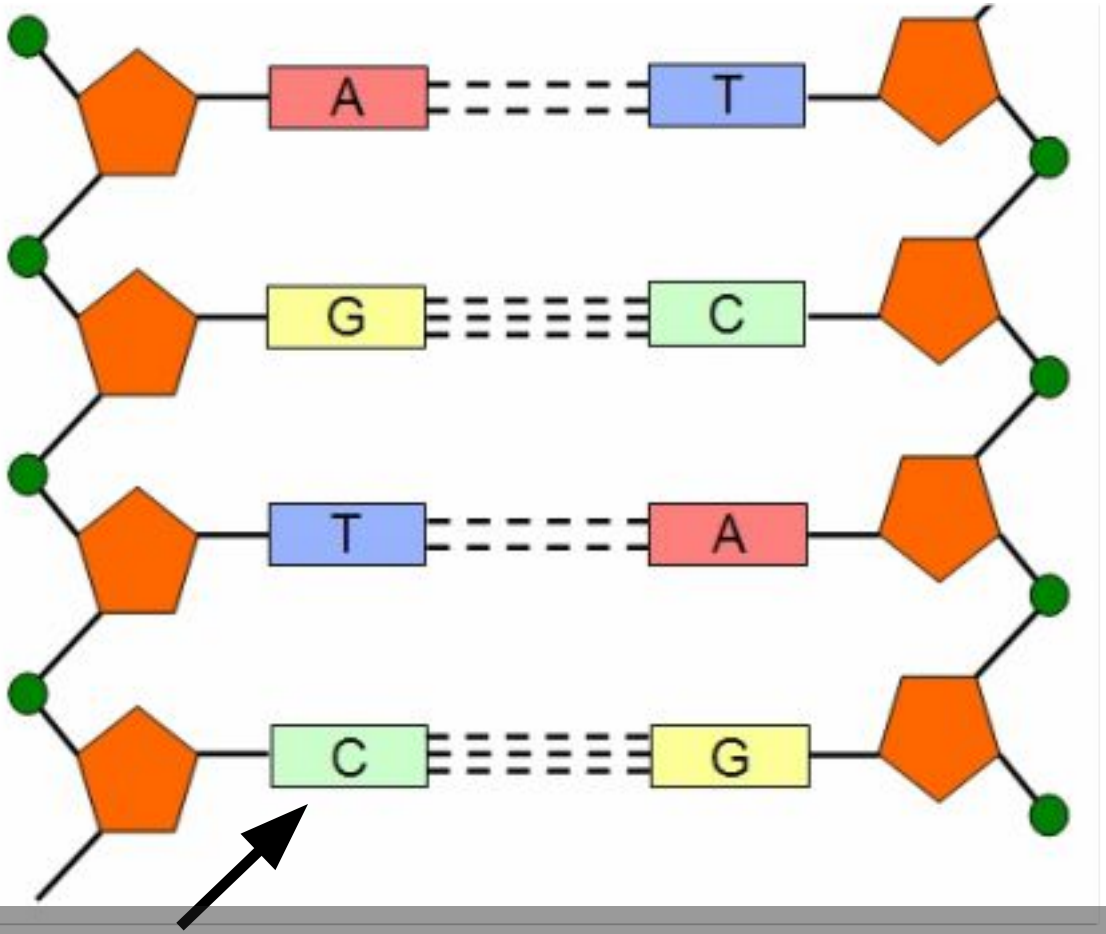

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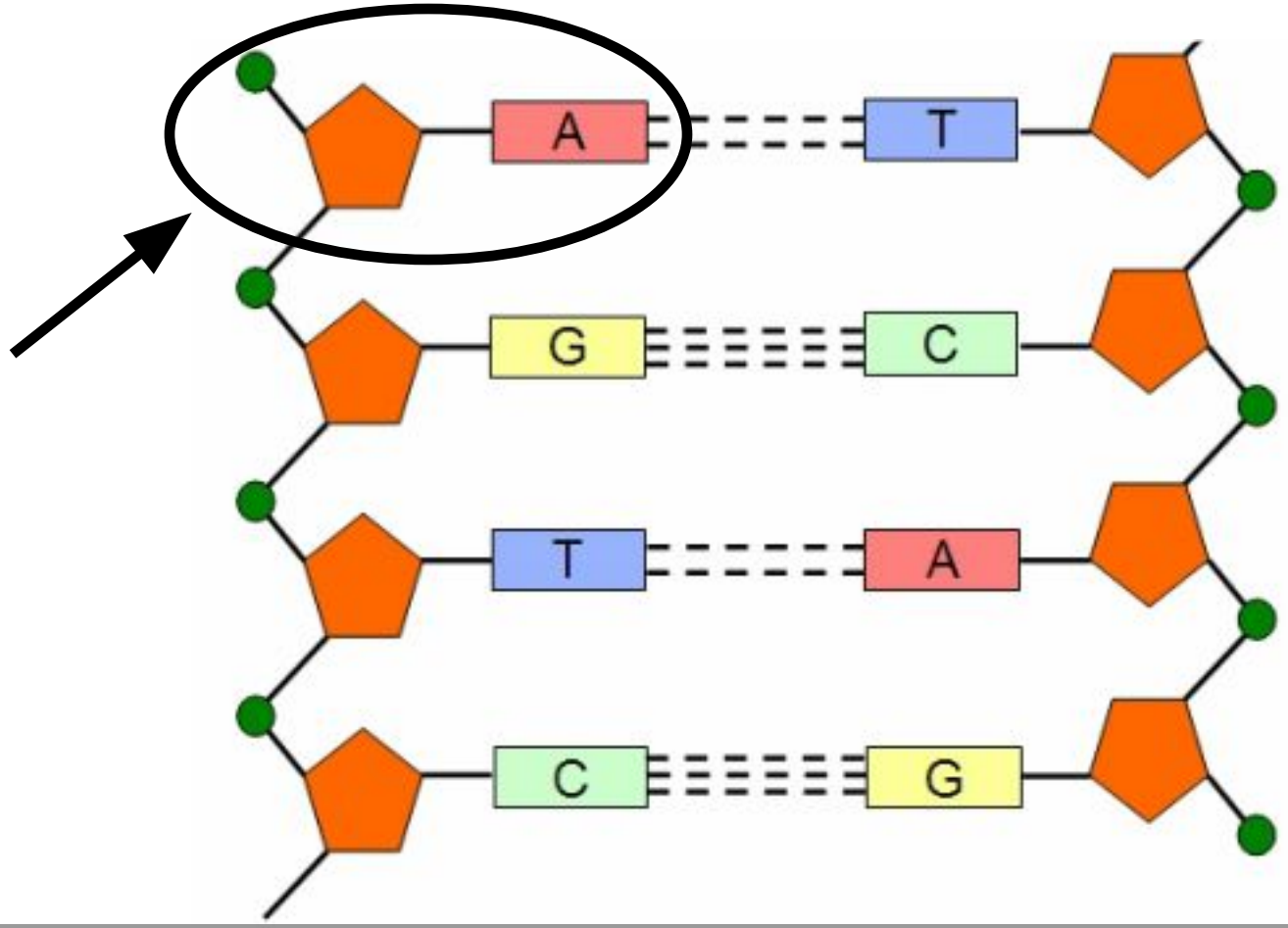
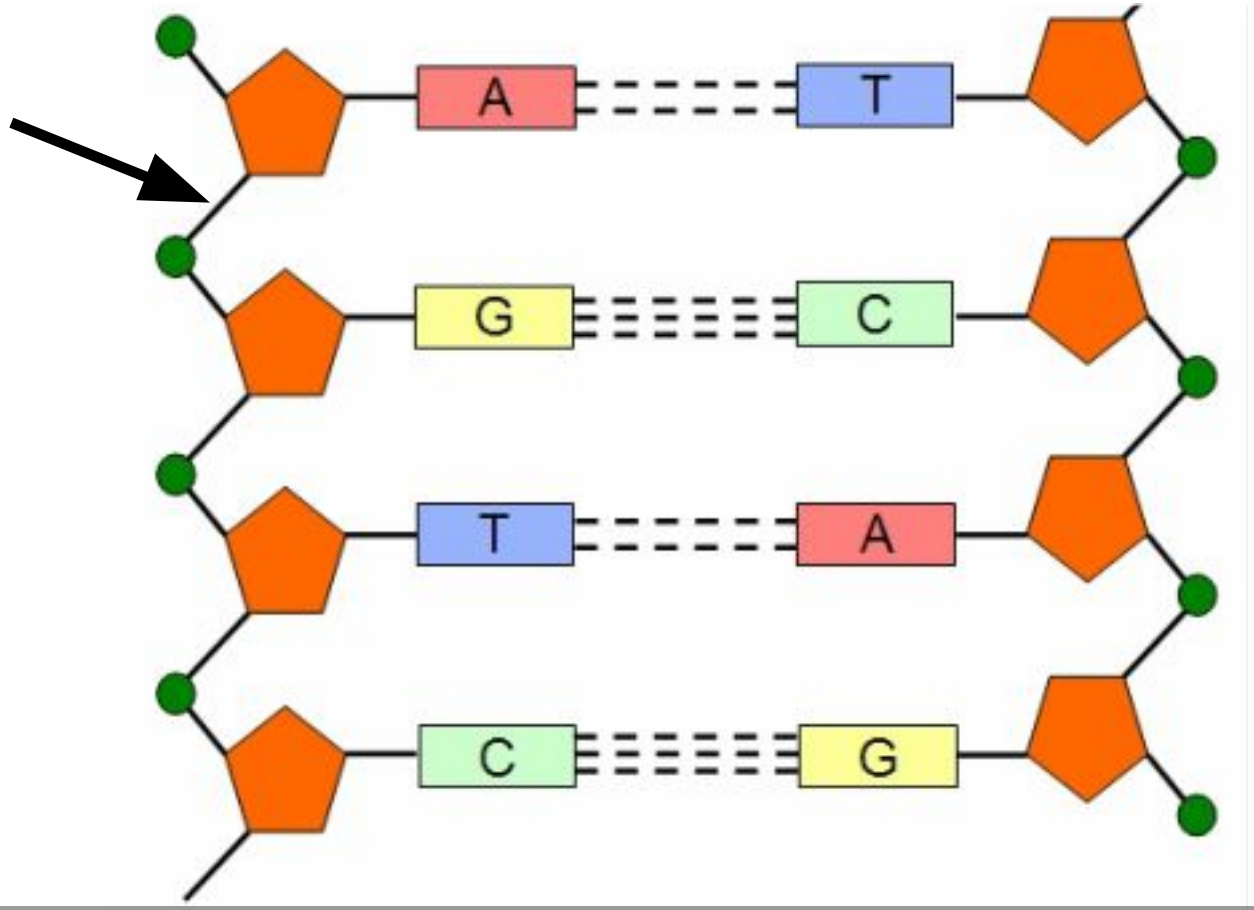


Let's Review

Name the type of bonds are found between consecutive nucleotides in a DNA molecule?



Let's Review

Name the type of bonds are found between base pairs of antiparallel strands of DNA?