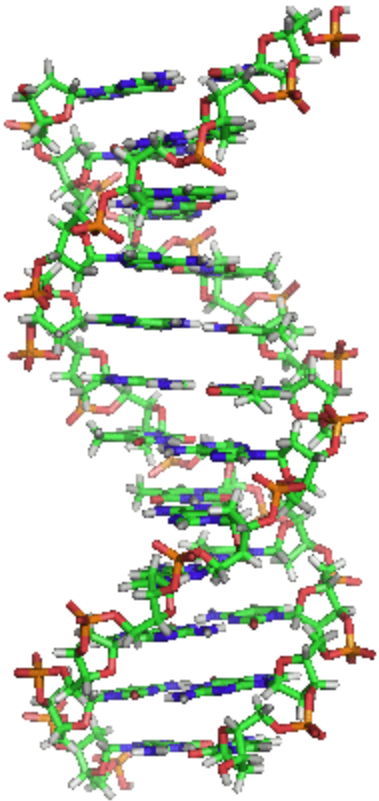


# Nucleic Acids:

## DNA



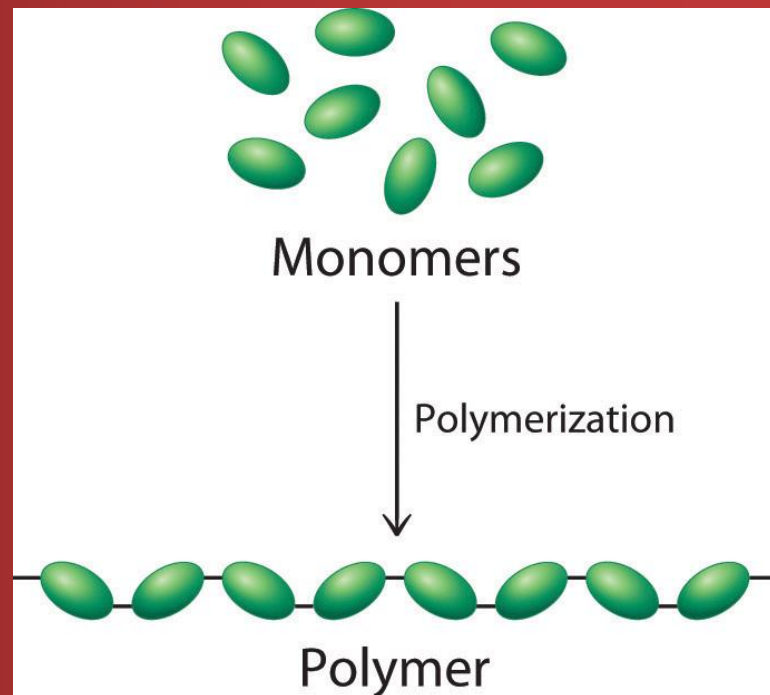
# Review of ORGANIC CHEMISTRY

## ■ Definition:

– Contains

- CARBON (C) and Hydrogen (H)
- Large polymers can be made of smaller individual monomers.

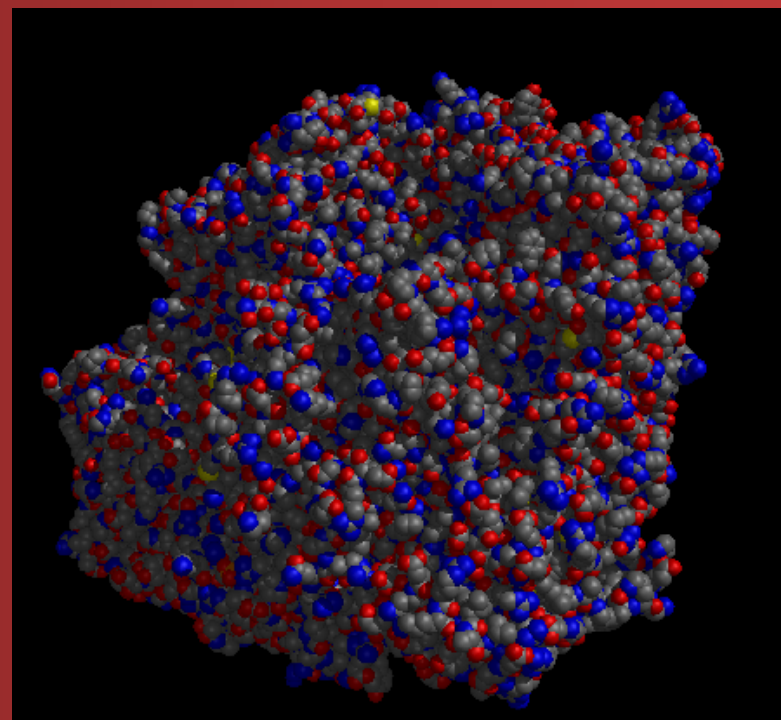
**Ex: For carbohydrates, polysaccharides are large chains of monosaccharides.**



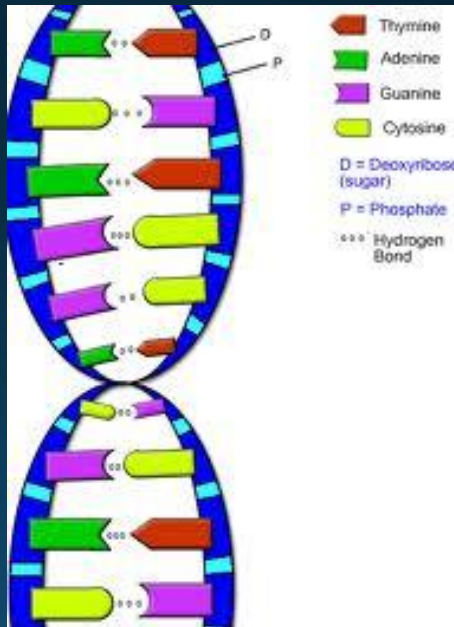
# Organic Chemistry

- 4 kinds of Organic Macromolecules

1. Carbohydrates
2. Lipids
3. Nucleic Acids
4. Proteins

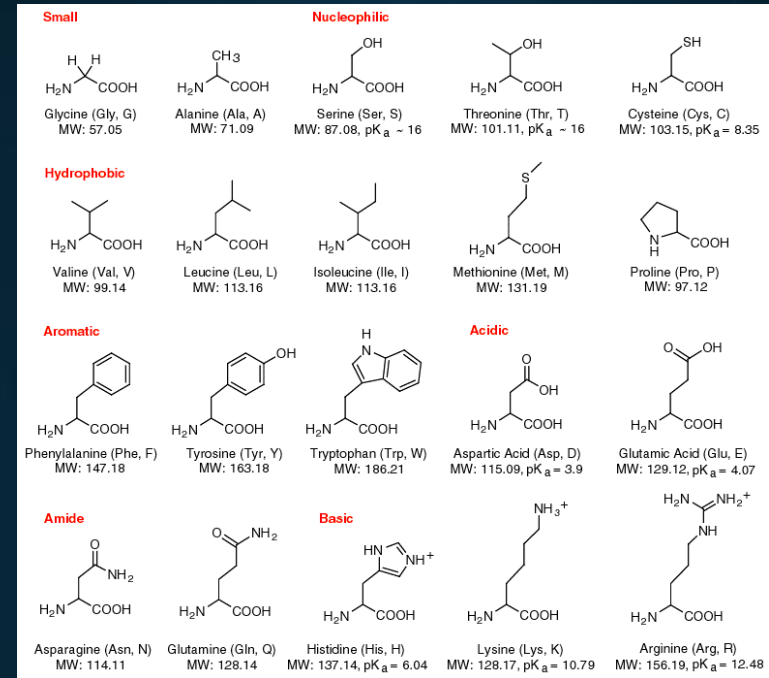
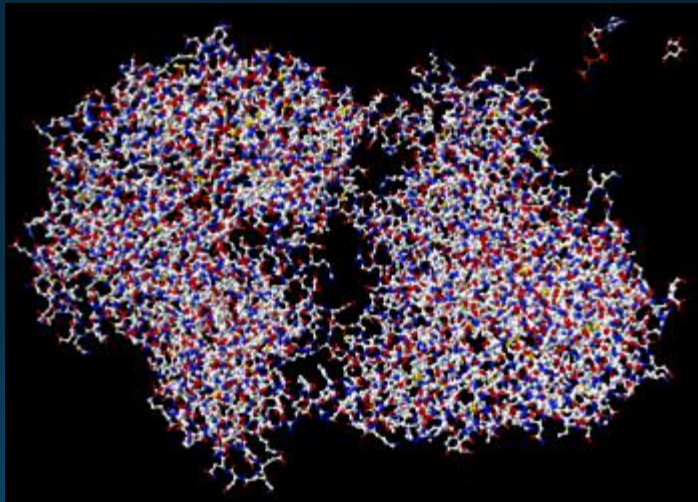


# Hershey and Chases' Experiments:



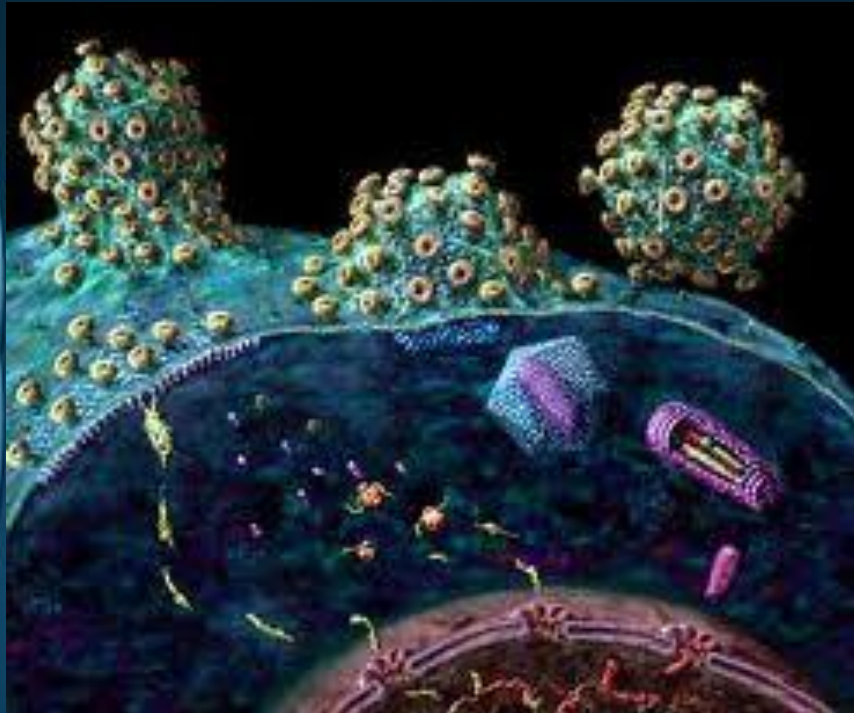
- Both DNA and proteins were made up of building blocks- different building blocks though.
- DNA is made up of nucleic acids- of which there are 4.
- Proteins are made up of 20 different amino acids.
- Everyone in the 50's was asking: do proteins or DNA carry genetic material?

# Hershey and Chases' Experiments:



- Proteins seemed like the better candidate for coding all the genetic diversity seen in living things.
- They had a larger alphabet (20 “letters” vs. 4), which meant they must be capable of storing larger and more varied amounts of information.

# Hershey and Chases' Experiments:

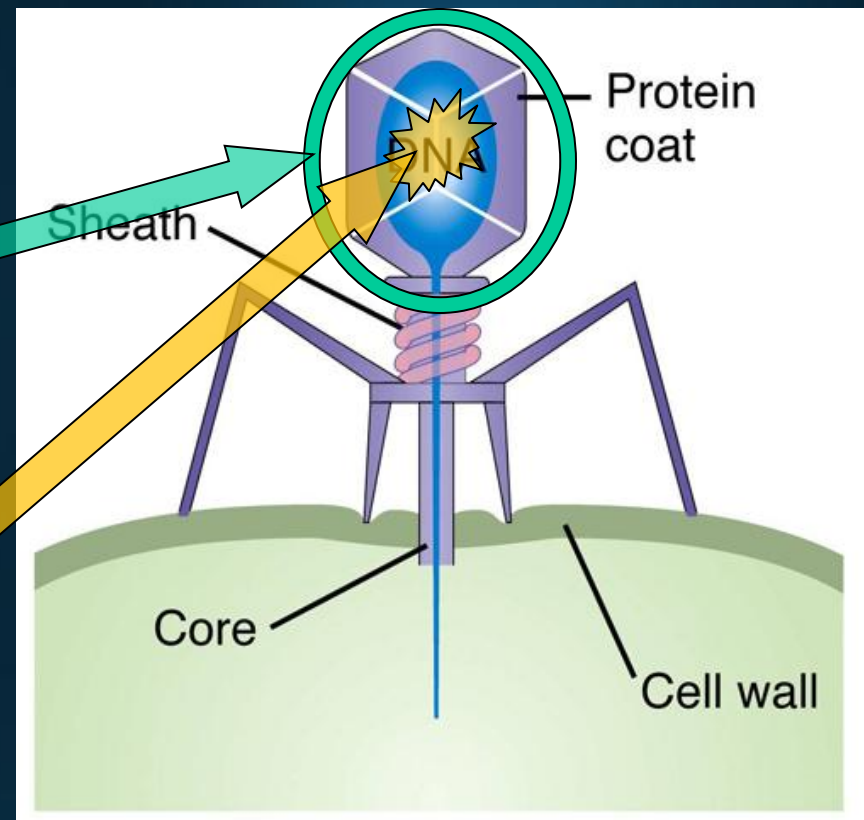


- Viruses were the perfect model organism for this experiment, because they inject their genetic material into host cells.
- Viruses are made up of both protein and DNA.
- If the genetic material could be tagged from the virus and then found later in the host cell, Hershey and Chase could tell if what the virus injected was protein or DNA.

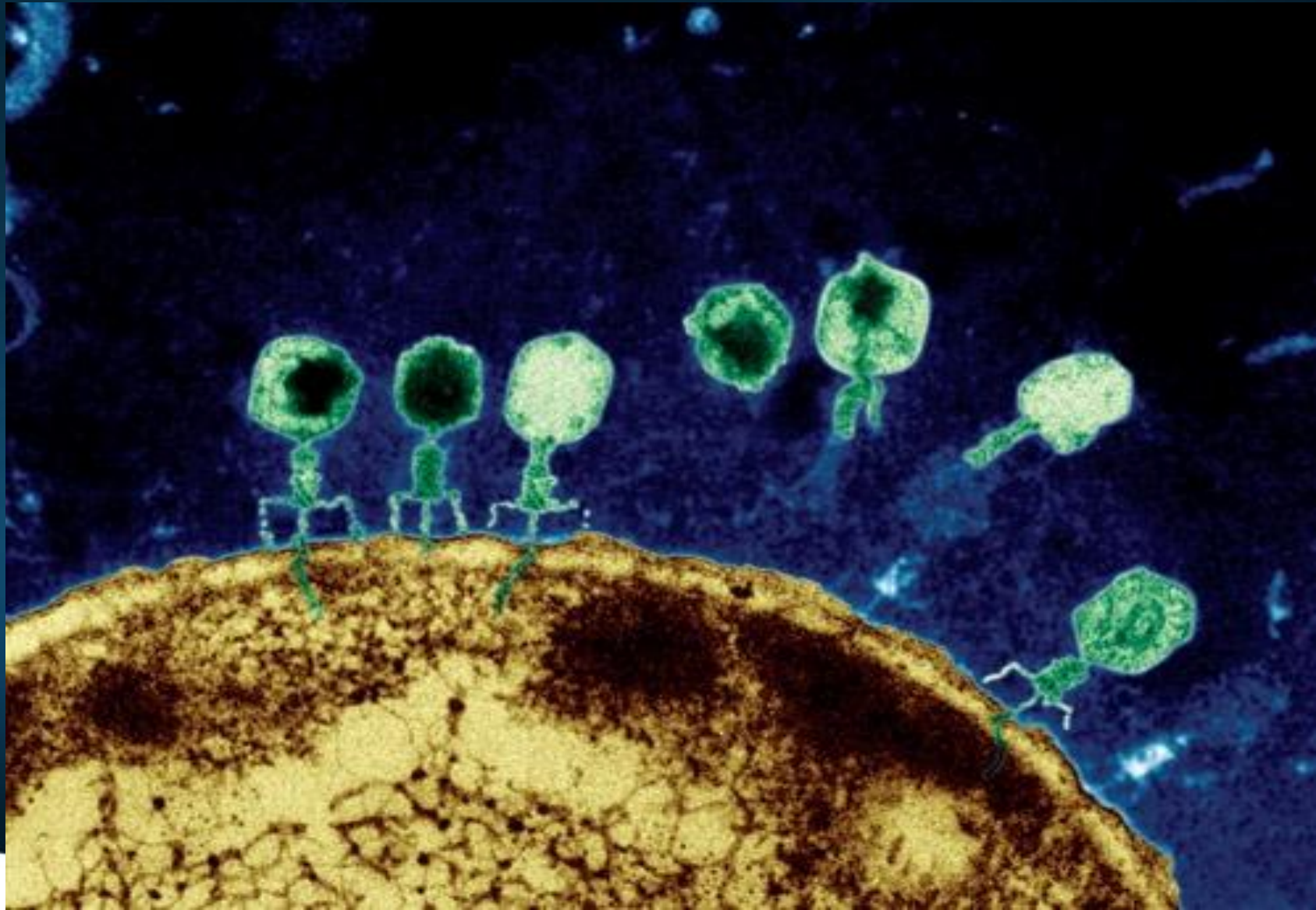
# Hershey and Chases' Experiments:

- Bacteriophages were perfect for this, because they have an outside protein coat, and DNA in the interior.
- Hershey and Chase **labeled the outside protein coat of the virus with Sulfur.**
- Then they labeled the viral DNA with **Phosphorous.**

## radioactively labeled virus



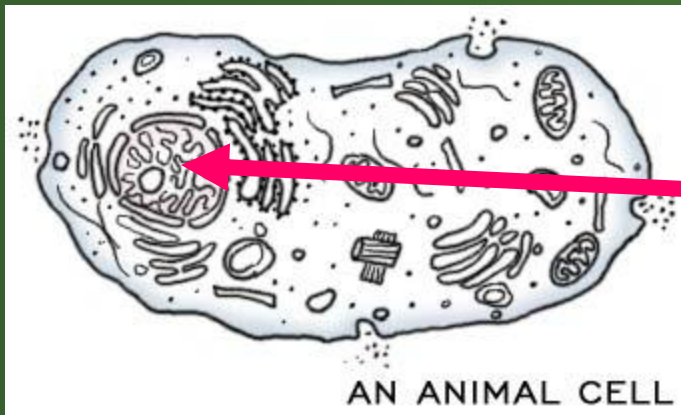
# More Bacteriophages:





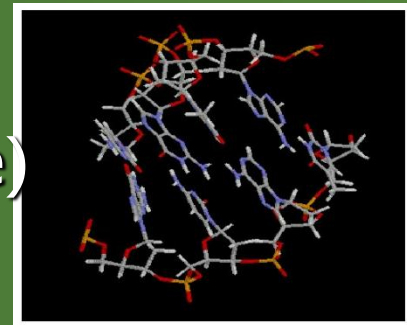
# NUCLEIC ACIDS

Named for where they were first found:



→ The Nucleus

- Three types that we will be studying
  1. DNA (Deoxyribonucleic Acid)
  2. RNA (Ribonucleic Acid)
  3. ATP (Adenosine Triphosphate)



# NUCLEIC ACIDS

- Contain the elements:

The periodic table is color-coded as follows:

- s-block:** Elements 1 (H) and 2 (He), and groups 1 (Li, Na, K, Rb, Cs, Fr) and 2 (Be, Mg, Ca, Sr, Ba, Ra).
- d-block:** Transition metals (groups 3-10).
- p-block:** Groups 13-18, including non-metals and noble gases.
- f-block:** Lanthanide and Actinide series.

Legend for Phases:

- Solid (White)
- Liquid (Light Blue)
- Gas (Light Green)

Note: (Mass Numbers in Parentheses are from the most stable of common isotopes.)

- Carbon
- Hydrogen
- Oxygen
- Nitrogen
- Phosphorous

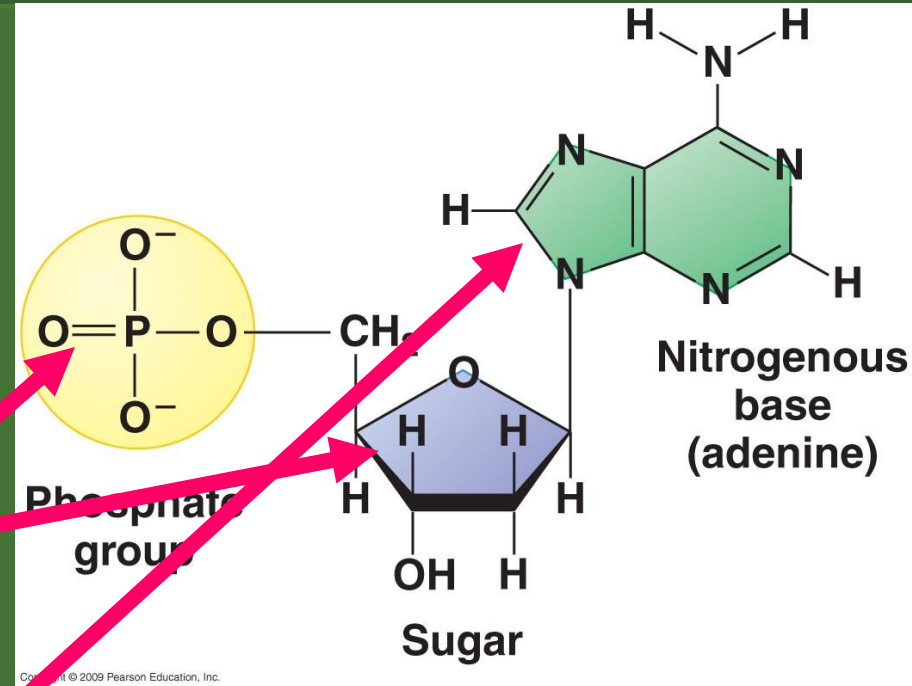
# NUCLEIC ACIDS

- How can you tell the difference between nucleic acids and lipids/carbohydrates?

Lipids and carbohydrates don't have phosphorous (except phospholipids) or nitrogen.

# Structure of Nucleic Acids:

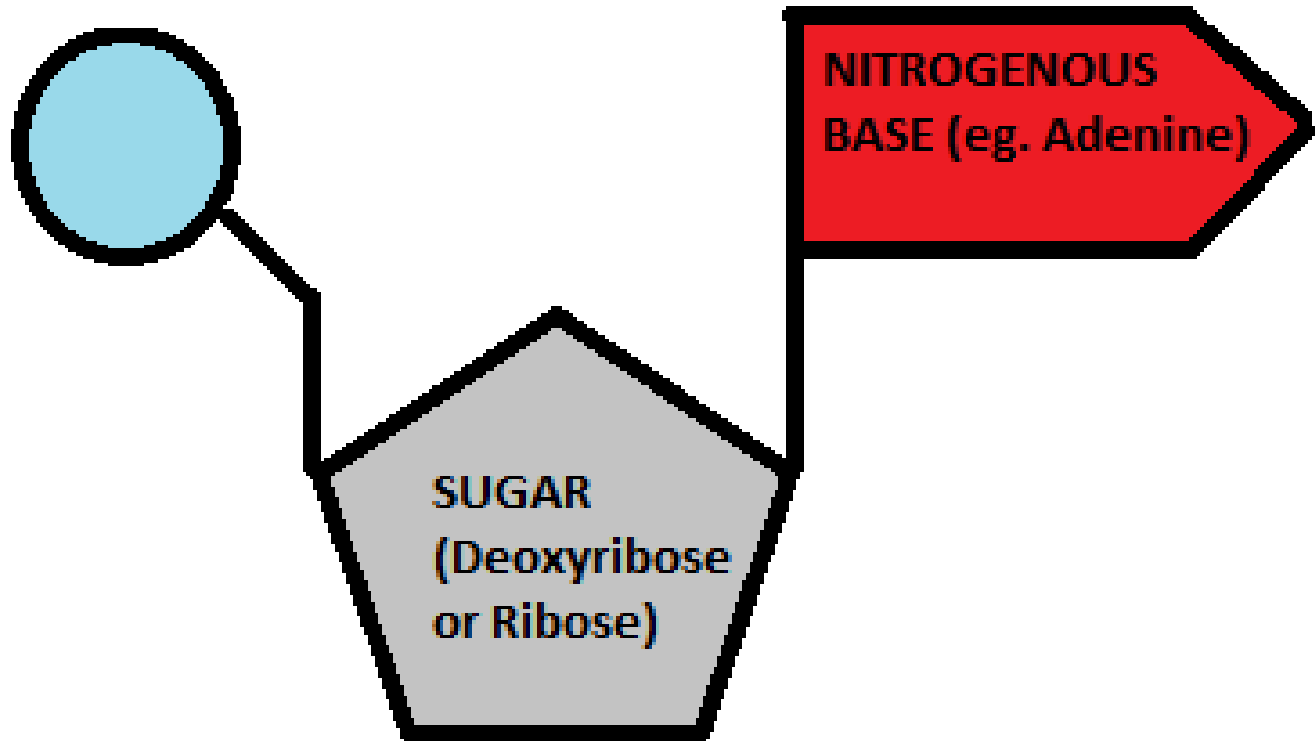
- **Definition:**
  - small, repeating chain of **nucleotides.**
- **Nucleotide:**
  - \* 5 carbon sugar
  - \* phosphate
  - \* nitrogenous base



Nucleic Acids are the polymer.  
Nucleotides are the monomers (building blocks).

# Generalized Nucleotide:

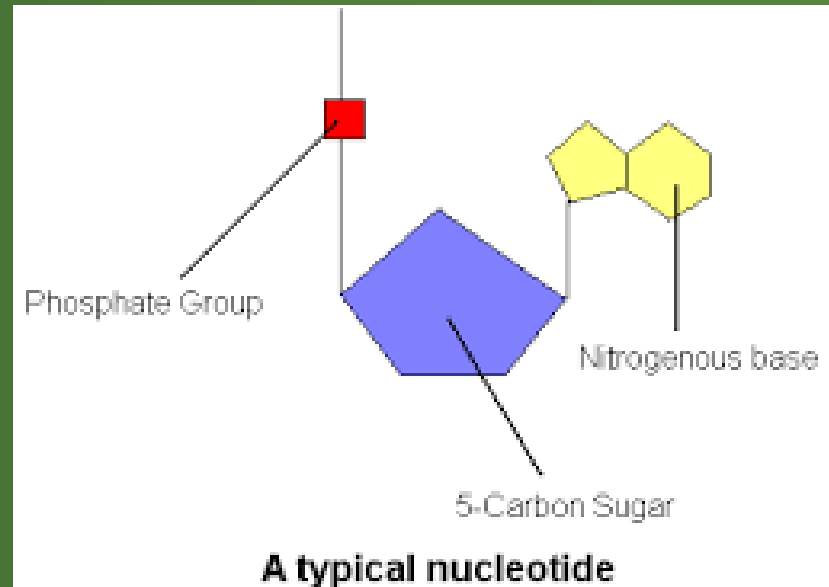
Phosphate group



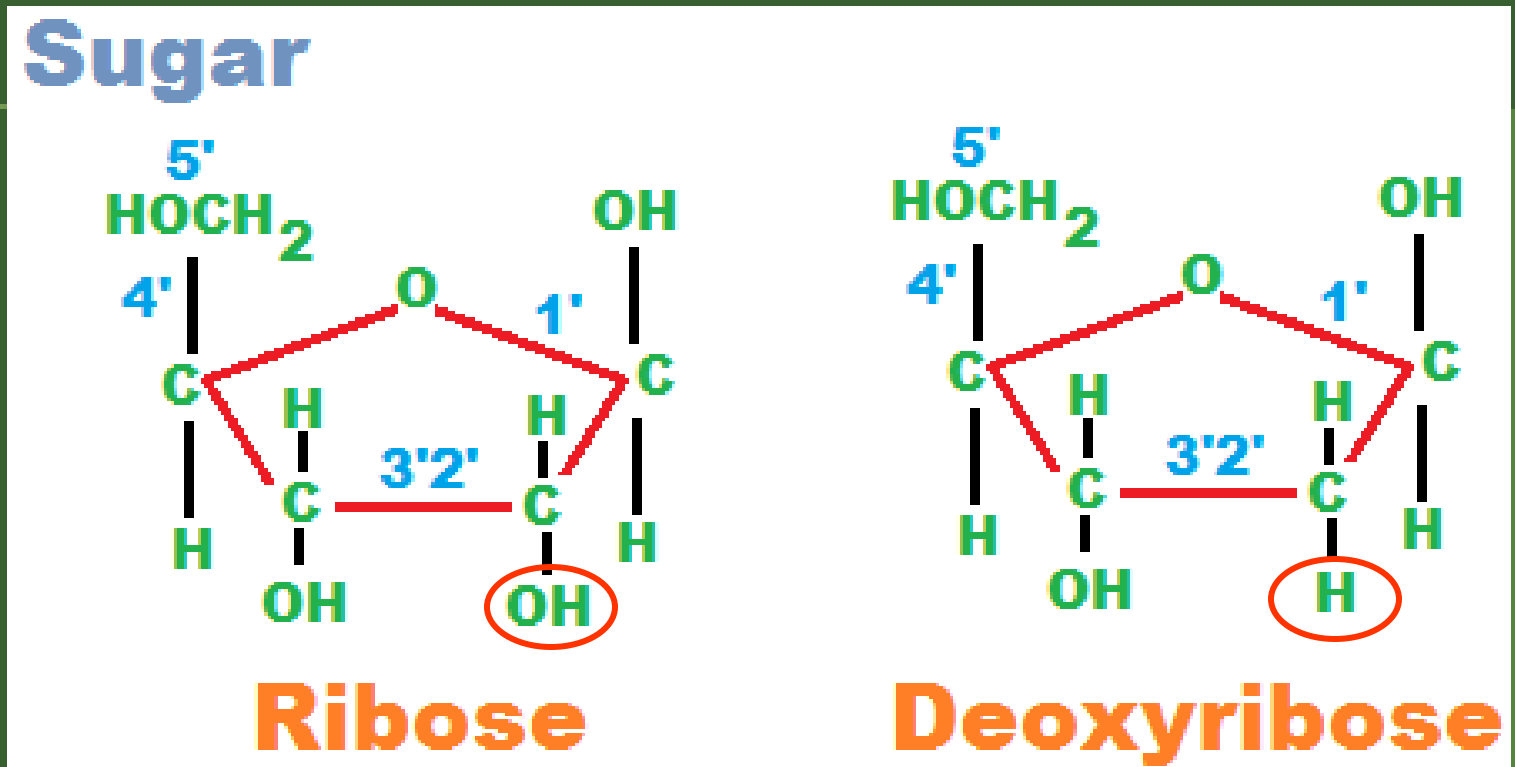
# Types of Nucleotides:

Nucleotides can differ from one another depending on the sugar and the base they are using.

There are two different types of sugar and five different types of base to choose from.

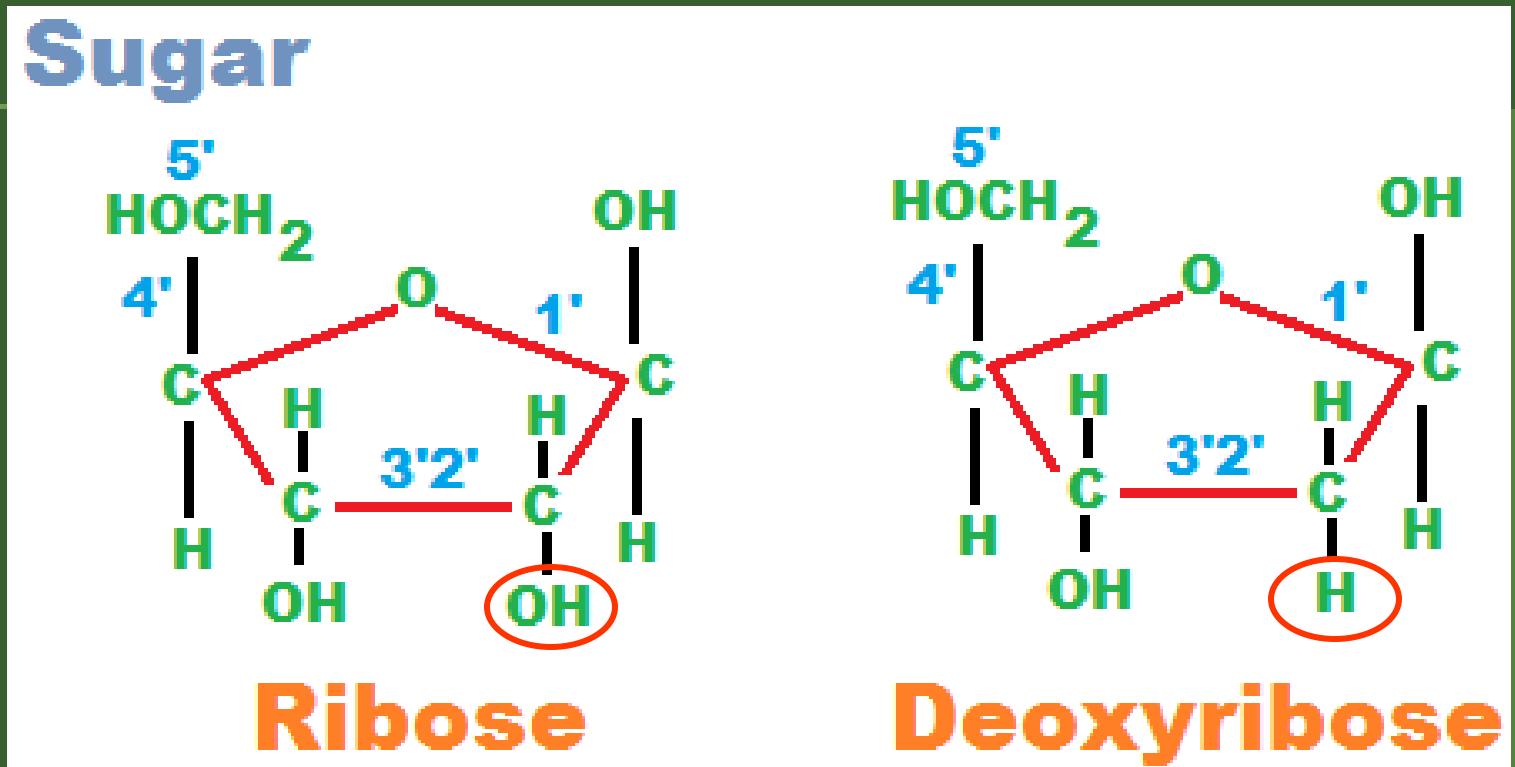


# Two types of sugars used:



Can you spot the difference?  
Look closely!

# Two types of sugars used:



Ribose is the sugar used in RNA.

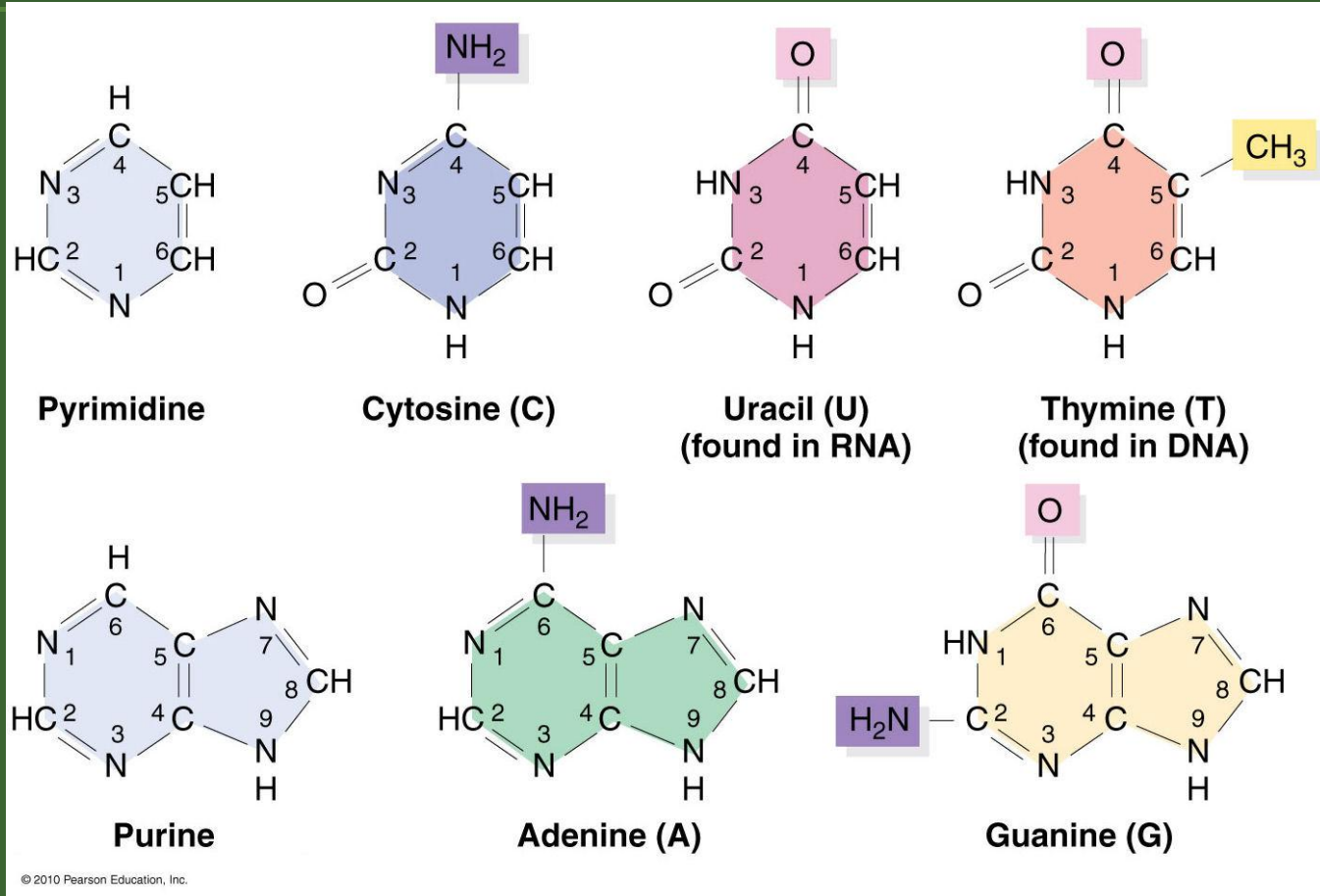
Deoxyribose is the sugar used in DNA



# Five types of nitrogenous bases:

Pyrimidine=  
1 ring  
structure  
(think:  
pyramid has  
one base)

Purine=  
2 ring  
structure

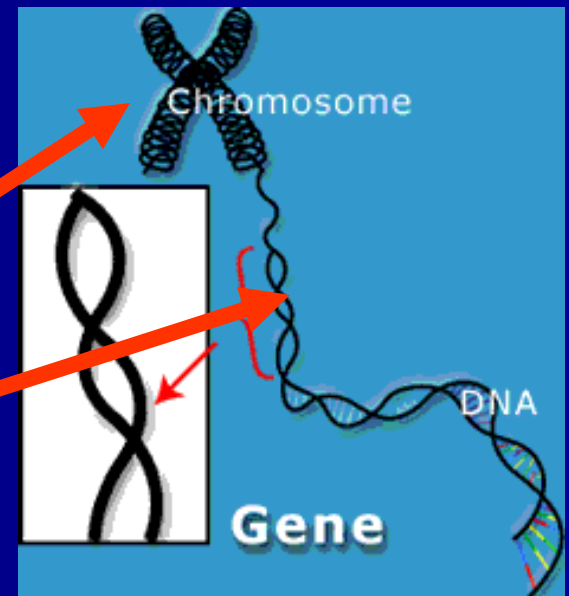


# DNA:

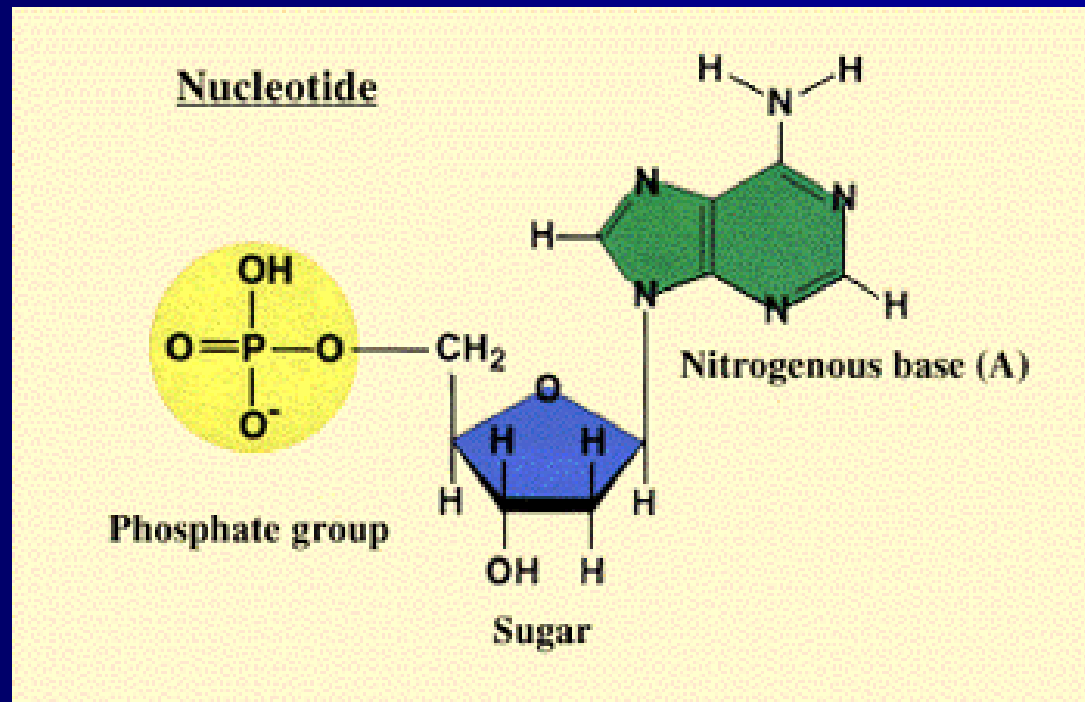
**Nucleic acid made using deoxyribose**

## Deoxyribonucleic Acid

- Stores **hereditary** information in the cell that directs the cell's activities and determines a cell's characteristics.
- Supercoiled into **chromosomes**
  - DNA makes up **GENES**



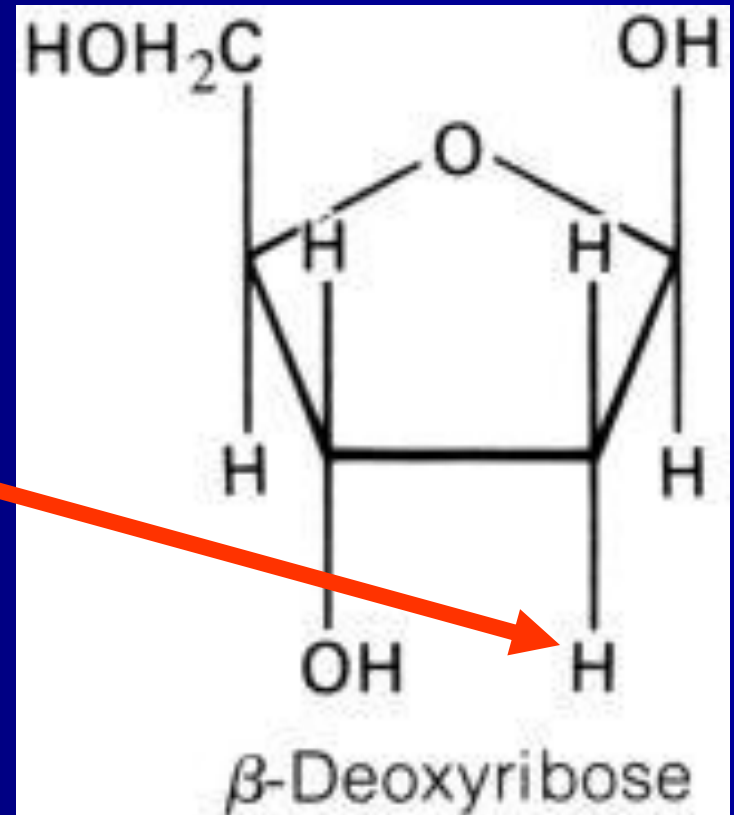
# DNA Nucleotide



**3** separate components

# DNA Nucleotide Structure: component #1

1. 5 carbon sugar  
Deoxyribose
  - “de” means without...
    - With one less oxygen than ribose sugar



# DNA Nucleotide Structure: component #2

## Phosphate



- Carries a negative charge.



# DNA Nucleotide Structure: component #3

## Nitrogenous Base

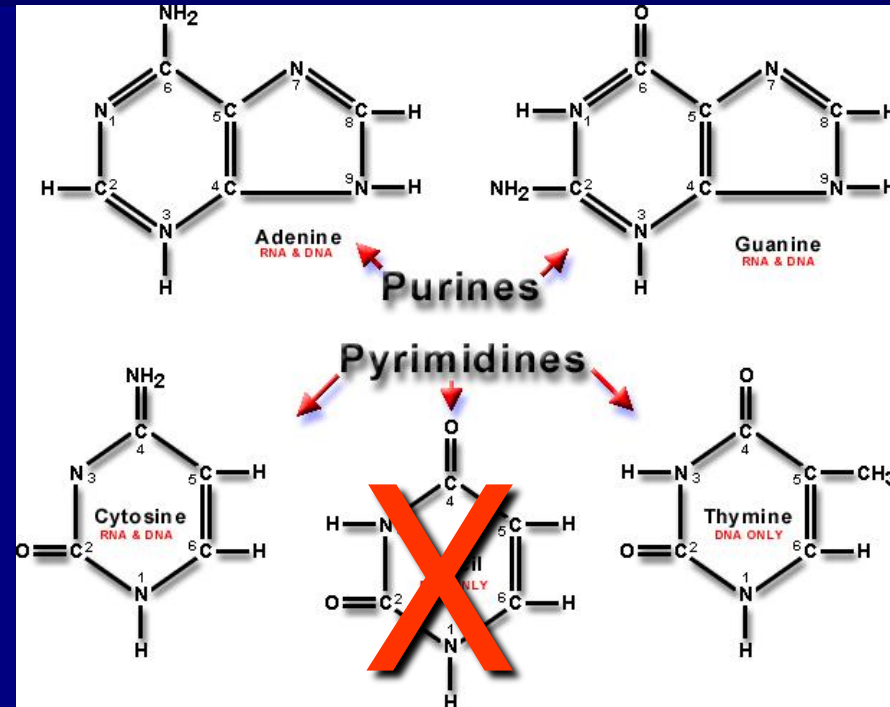
DNA uses 4 of the  
5 bases:

Adenine (A)

Guanine (G)

Cytosine (C)

Thymine (T)



DNA does not  
contain Uracil (U)

# DNA Nucleotide Structure: component #3

## Pyrimidines

Thymine

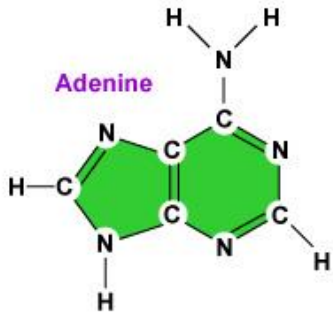


Cytosine

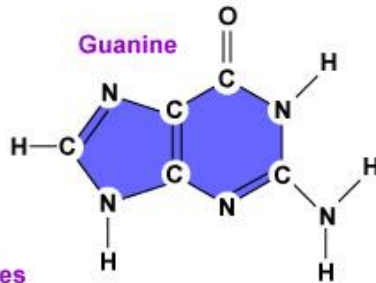


## Nitrogenous Bases of DNA

Adenine



Guanine



## Purines

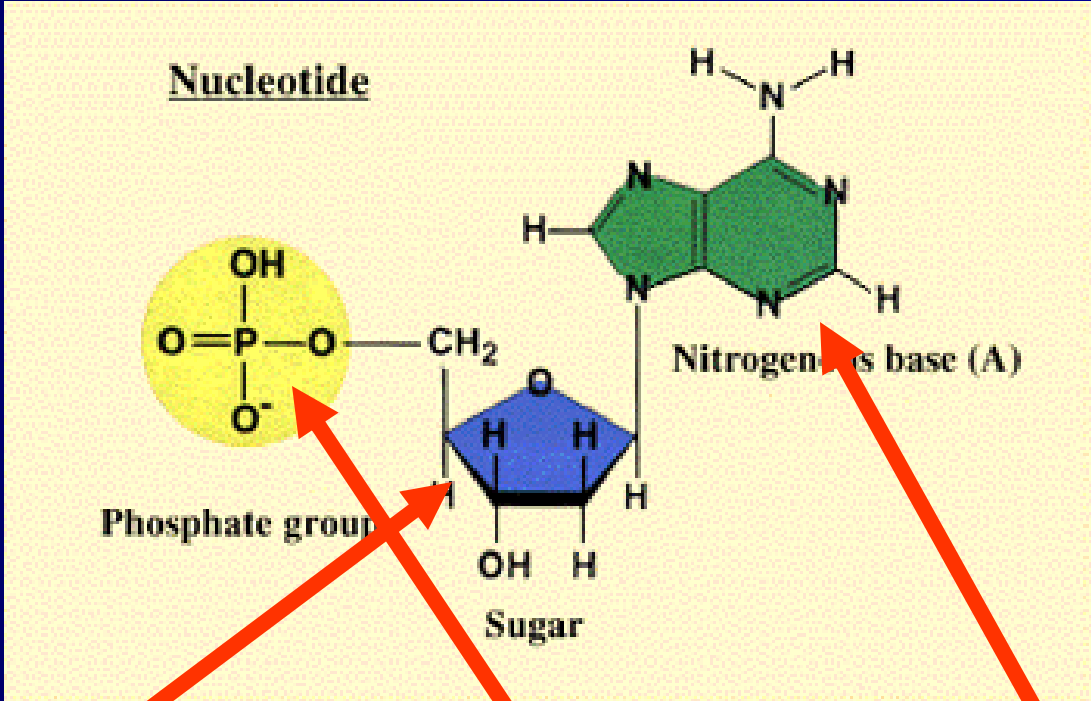
Nitrogenous Base:

For DNA, the  
pyrimidines are:  
Cytosine and Thymine

For DNA, the purines  
are: Guanine and  
Adenine

*I keep these straight by remembering that the pyrimidines both have a **y** in them, like the word **pyrimidine**.*

# DNA Nucleotide



**Sugar**

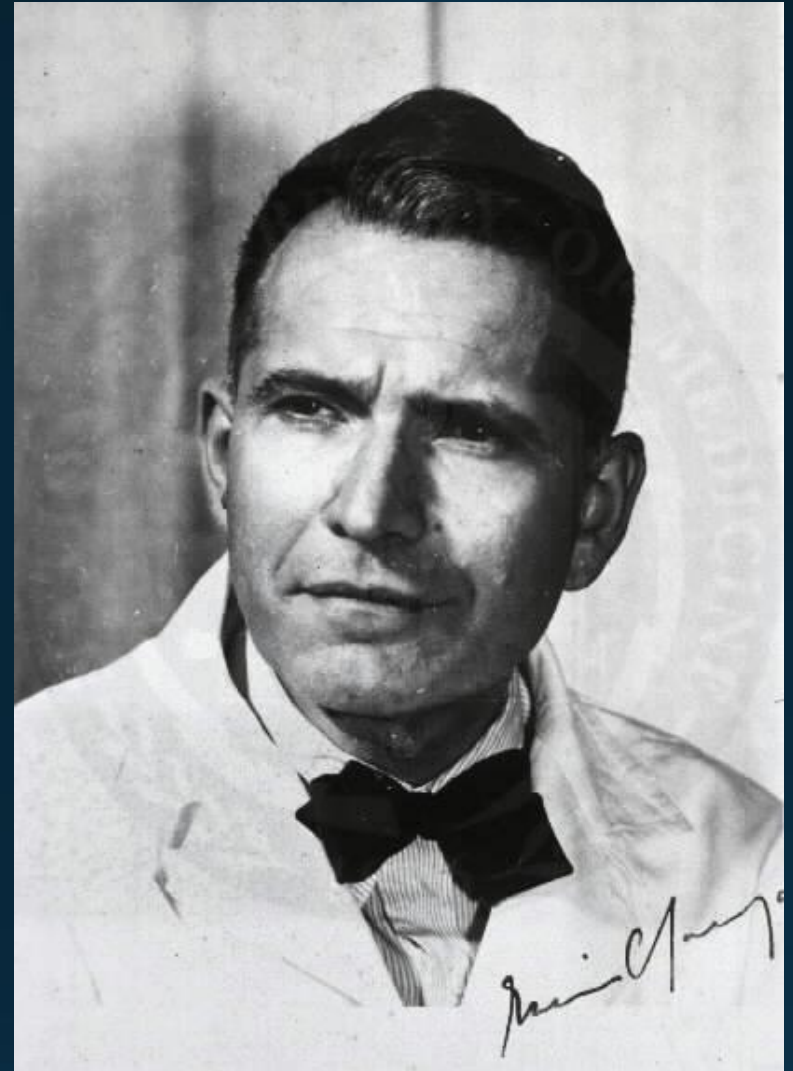
**Phosphate**

**Base**



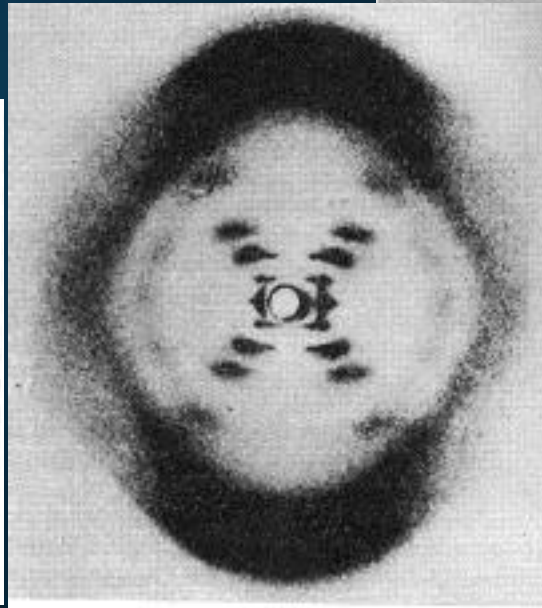
# Edwin Chargoff

- Determined that the ratio of **A:T** and the ratio of **G:C** was always the same in ALL organisms tested.
- A= Adenine
- T= Thymine
- G= Guanine
- C= Cytosine
- A, T, G, and C are nucleic acids.



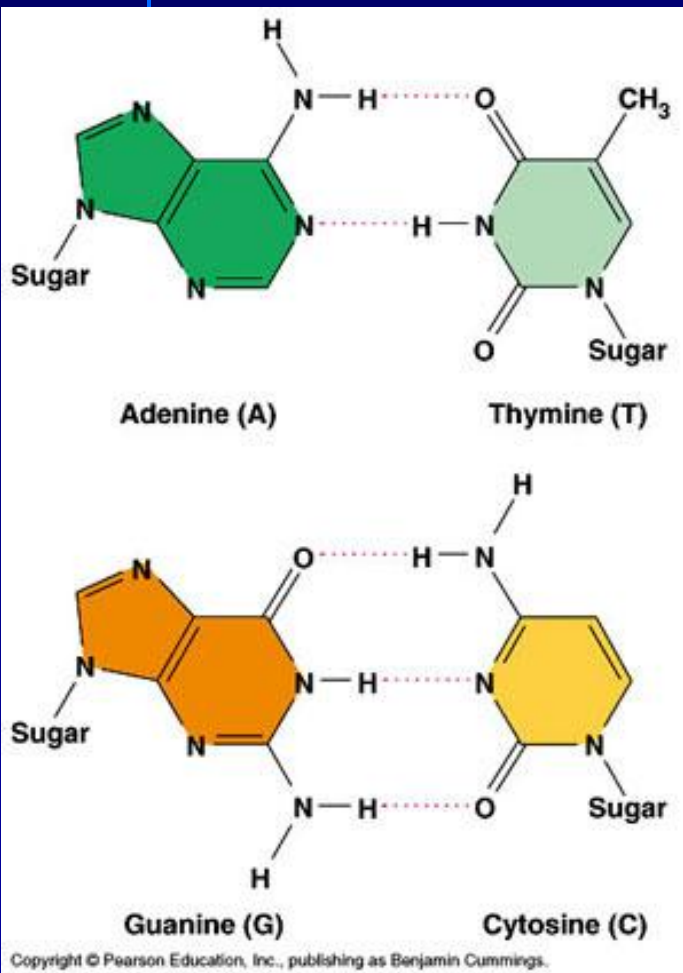
# Determining DNA's Structure

- **Rosalind Franklin** did X-Ray analysis on DNA
- The results showed that DNA was **helical** (spiral)
- She deduced that the molecules were **stacked like rungs on a ladder.**



# Complementary bonding

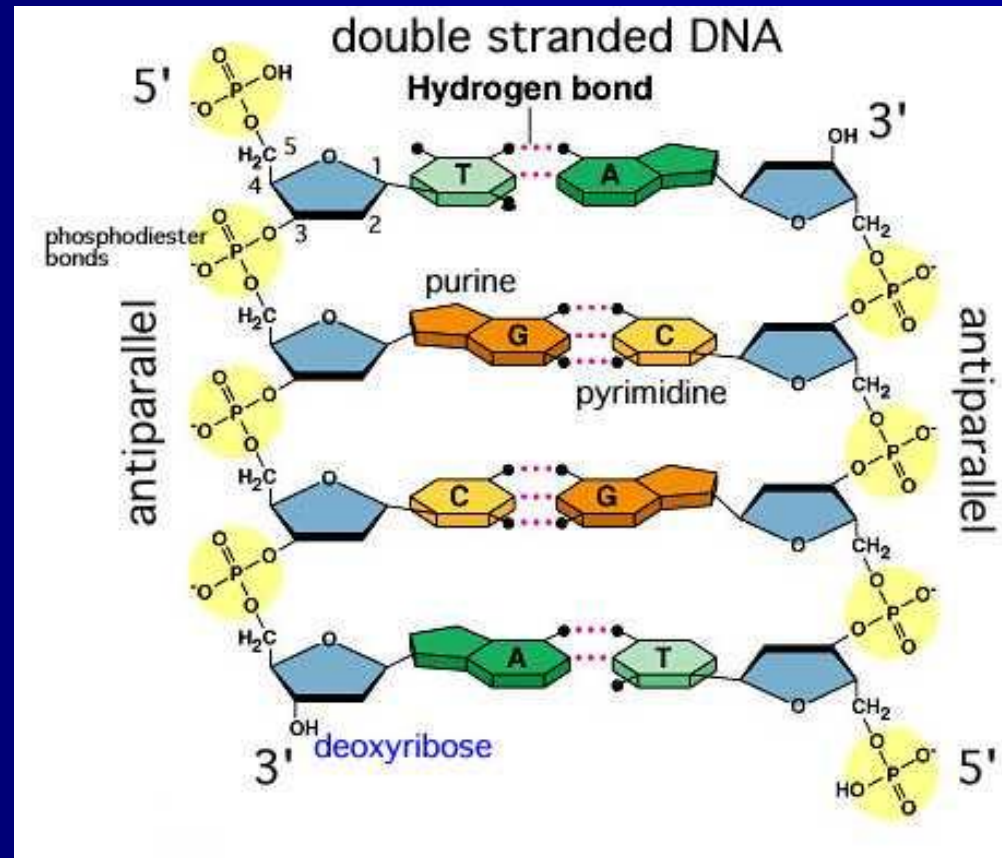
## Happens between the nitrogenous bases.



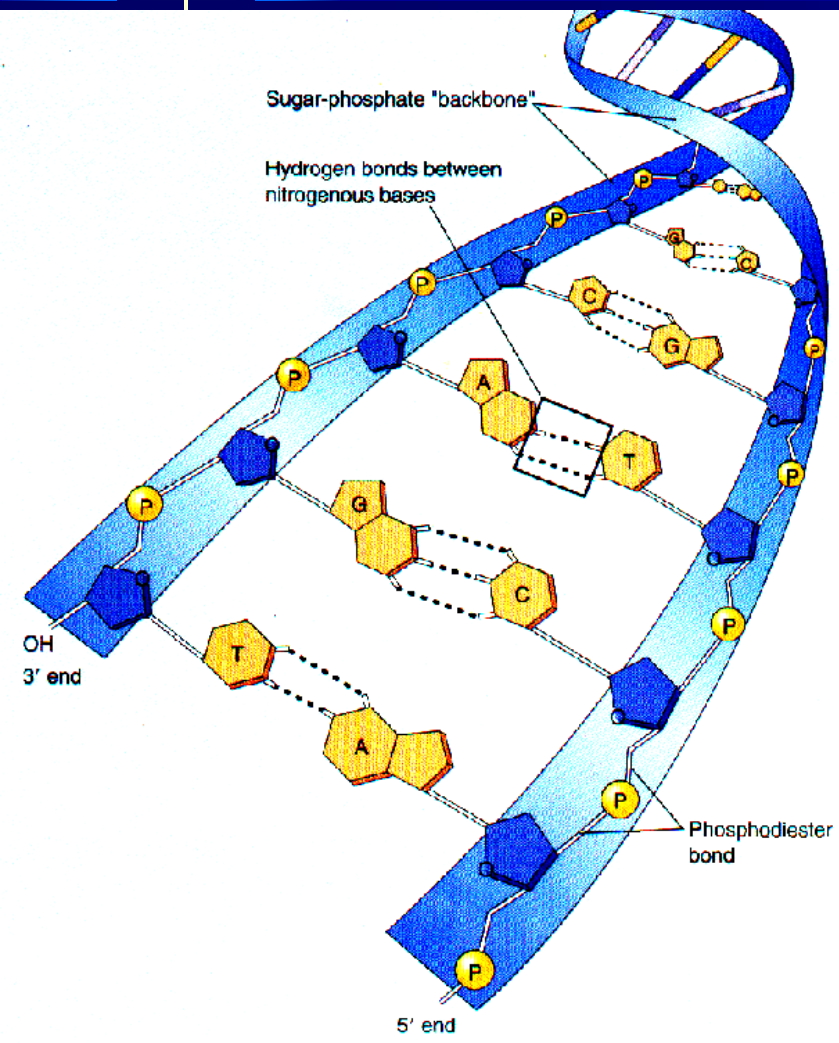
- Purines are always attracted to Pyrimidines.
- They will form weak hydrogen bonds.
- G bonds to C
- A bonds to T

# 3-D Structure of DNA

- The nucleotides are connected together into two long chains hooked together in the middle to create a ladder.



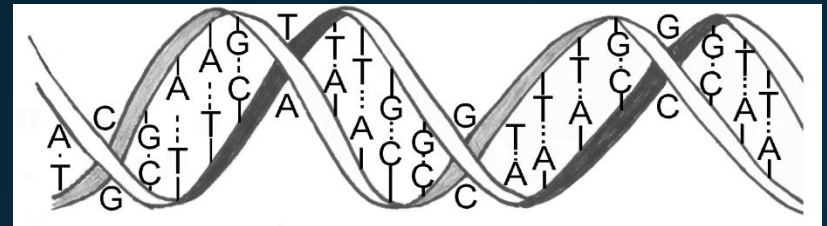
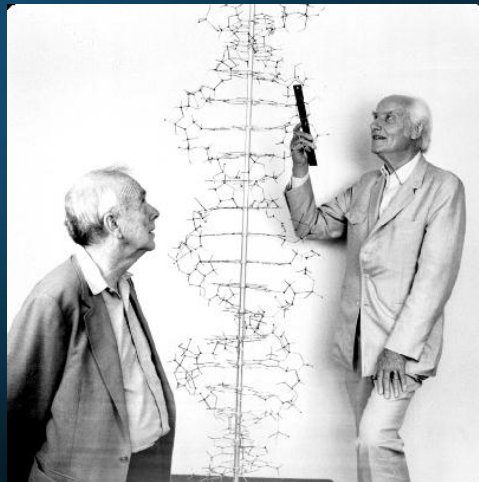
# 3-D Structure of DNA



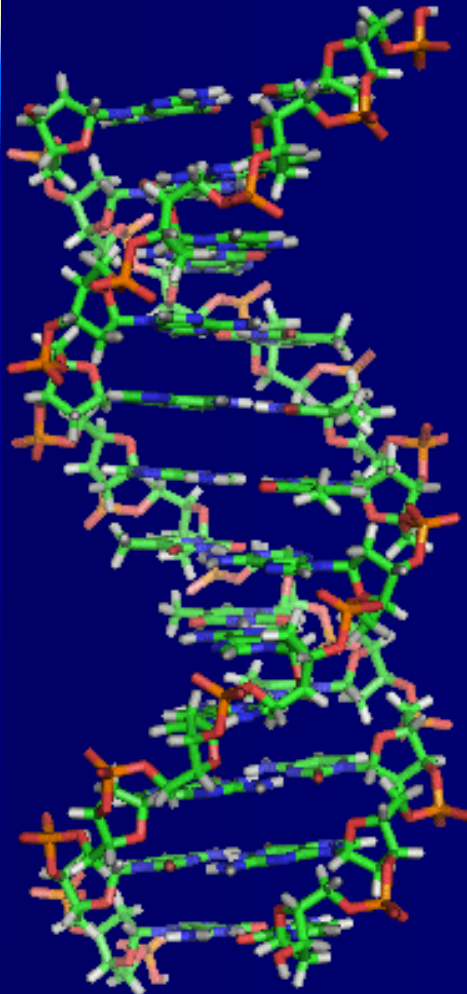
- Double Stranded (DNA when untwisted looks like a ladder).
  - Sides: alternating sugar and phosphate units
  - Rungs: Purine and pyrimidine held together by hydrogen bond.

# Determining Structure of DNA (cont.)

- James **Watson** and Francis **Crick** deduced the correct structure of DNA using all the above knowledge
- They won the **Nobel Prize** a decade later.
- The molecule is a **double helix** (anti-parallel) of strands that are made of a backbone containing **sugars** and **phosphates**.



# 3-D Structure of DNA



- When twisted, DNA looks like a:

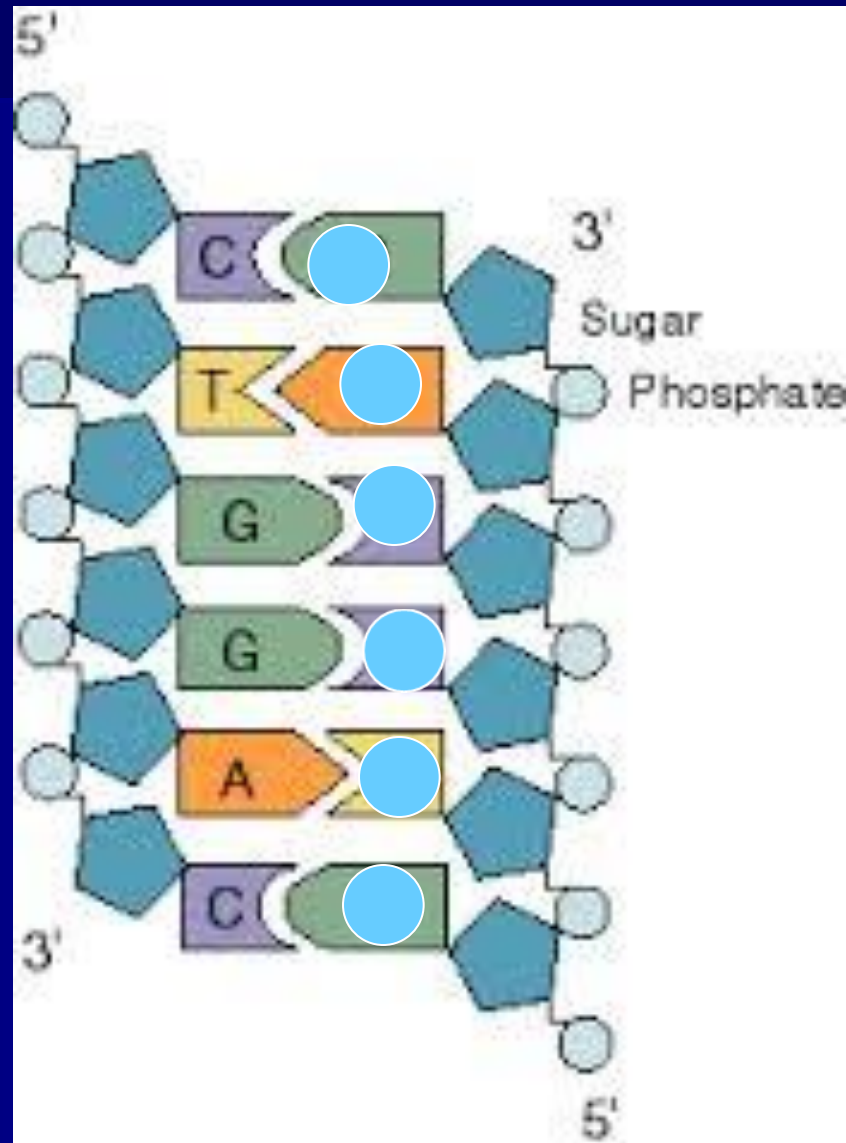
## **DOUBLE HELIX**

Could be described as:

- "Spiral Staircase"
- "Twisted Ladder"

# 3-D Structure of DNA

The sequence of bases on one strand determines the sequence of bases on the other strand: complementary





# Nucleic Acids

- We will cover RNA and ATP later!