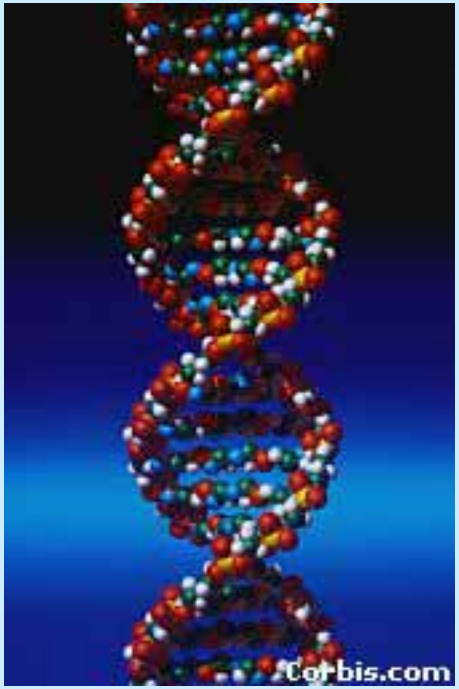
The Structure of DNA



Mr. Coleman
Biology

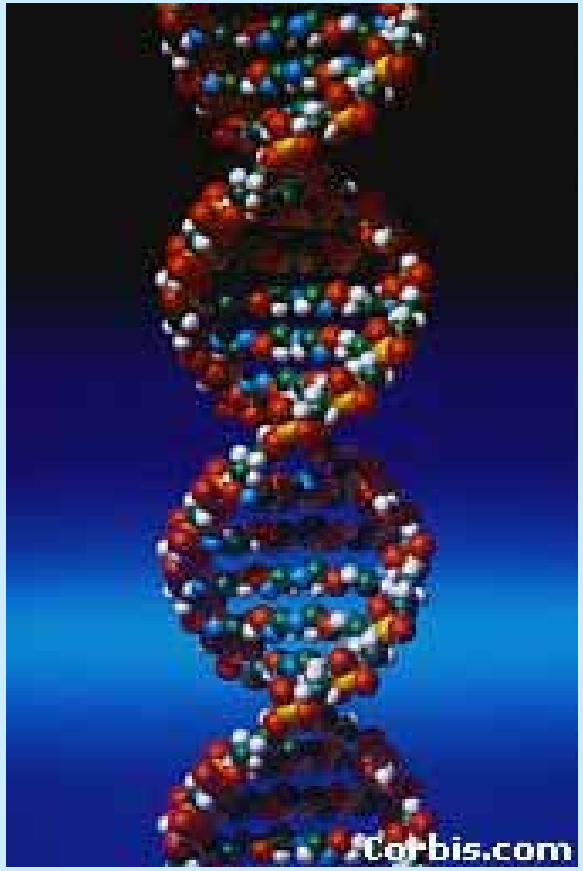
DNA

- **DNA** is often called the blueprint of life.
- In simple terms, **DNA** contains the instructions for making proteins within the cell.

Why do we study **DNA**?

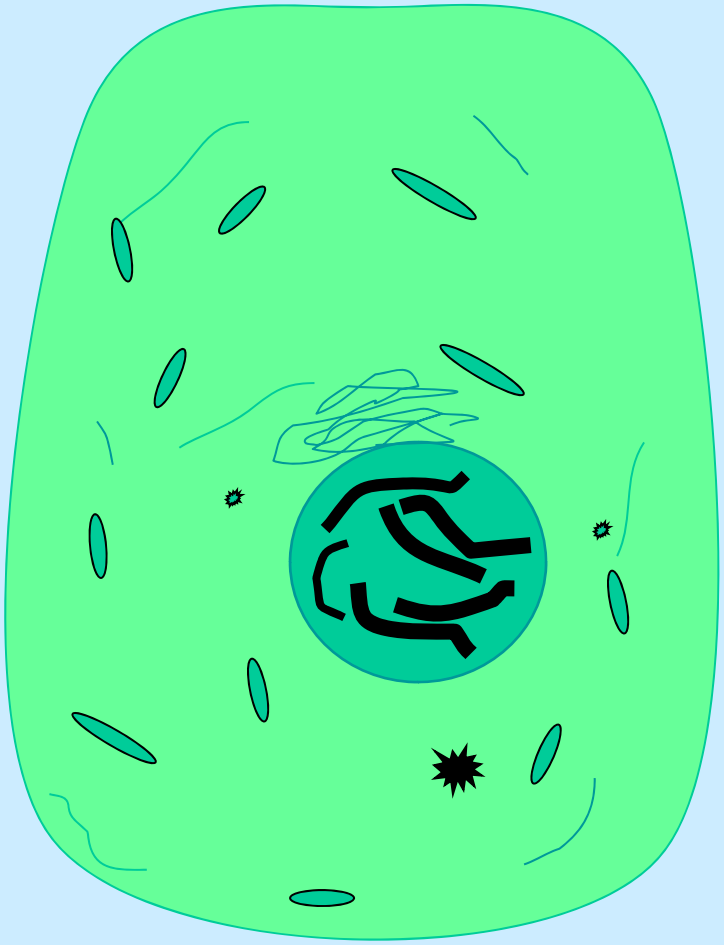
We study DNA for many reasons, e.g.,

- its central importance to all life on Earth,
- medical benefits such as cures for diseases,
- better food crops.



Chromosomes and DNA

- Our genes are on our chromosomes.
- Chromosomes are made up of a chemical called DNA.

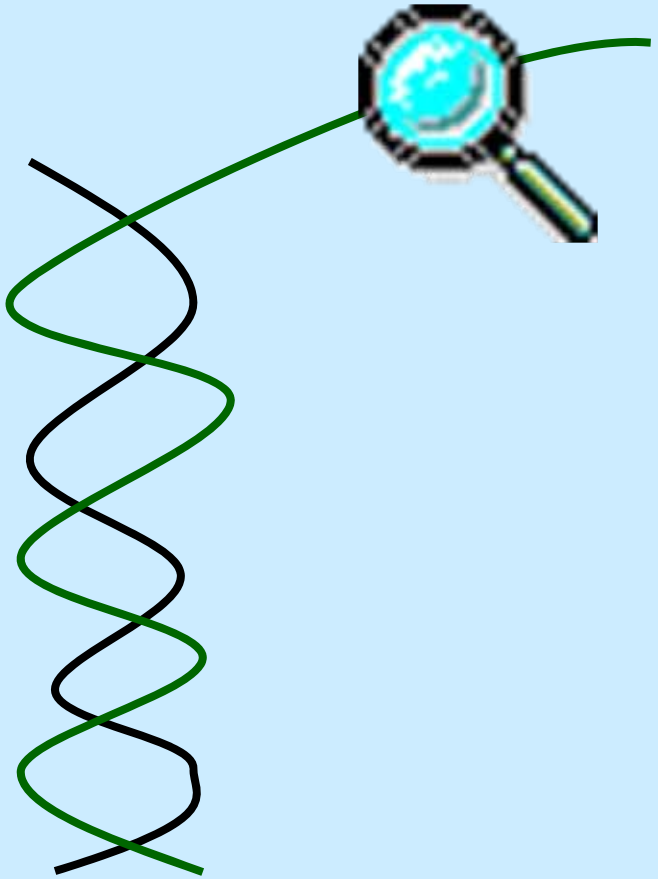


The Shape of the Molecule

- DNA is a very long polymer.
- The basic shape is like a twisted ladder or zipper.
- This is called a ***double helix.***

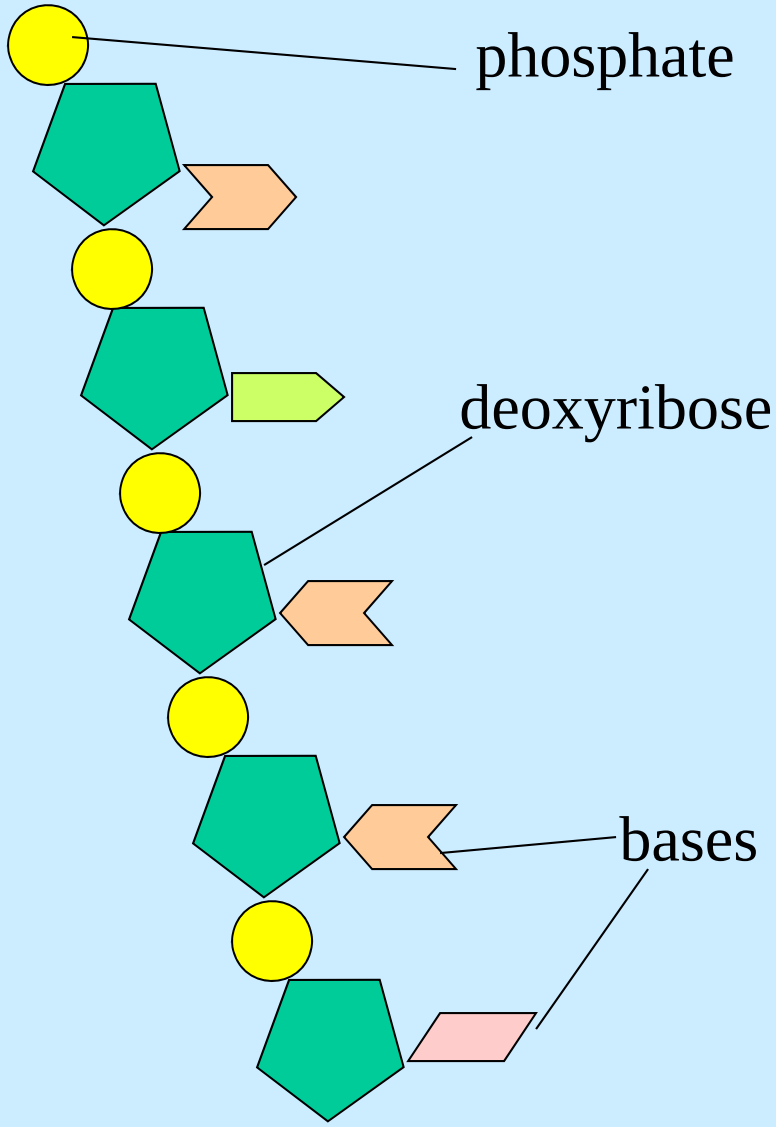
The Double Helix Molecule

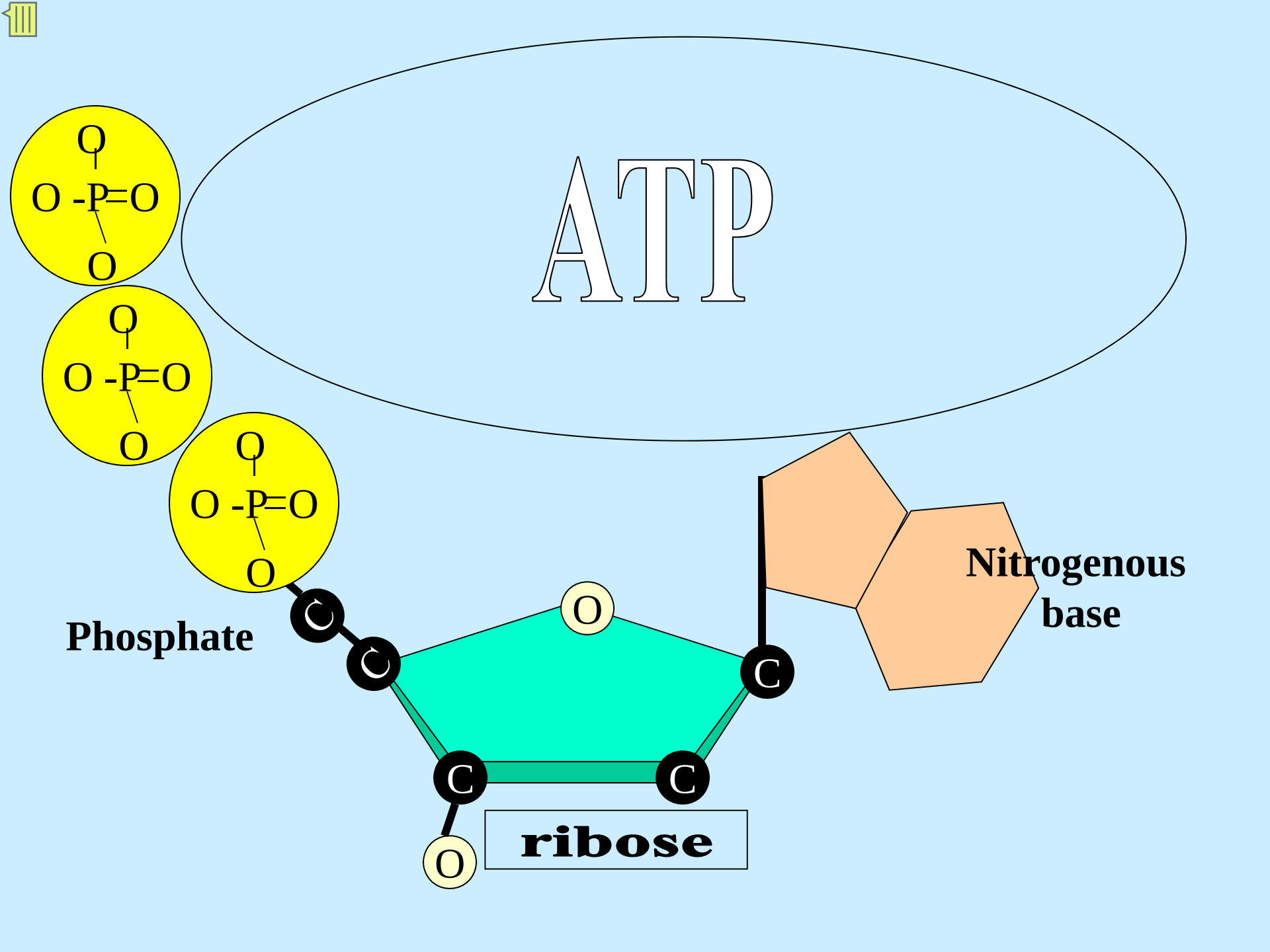
- The DNA double helix has two strands twisted together.
- *(In the rest of this unit we will look at the structure of one strand.)*



One Strand of DNA

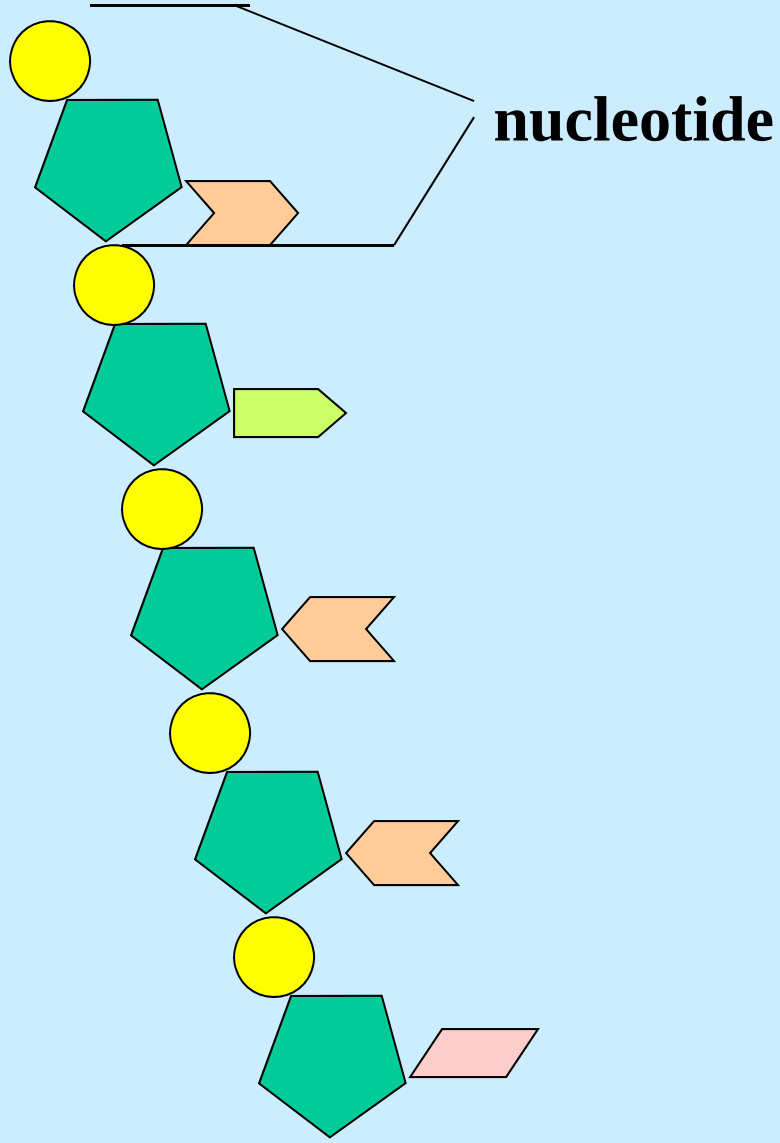
- The backbone of the molecule is alternating **phosphate** and **deoxyribose**, a sugar, parts.
- The teeth are nitrogenous **bases**.




ATP
O
O -P=O
O
O
O -P=O
O
O
O -P=O
O
Phosphate
C
C
O
C
C
C
O
ribose
Nitrogenous base

One Strand of DNA

- One strand of DNA is a polymer of nucleotides.
- One strand of DNA has many millions of nucleotides.



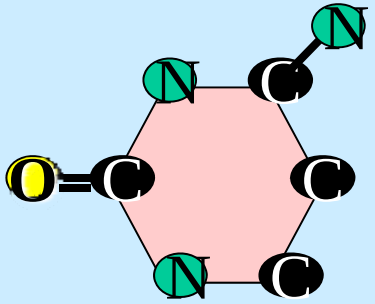
Four nitrogenous bases

DNA has four different bases:

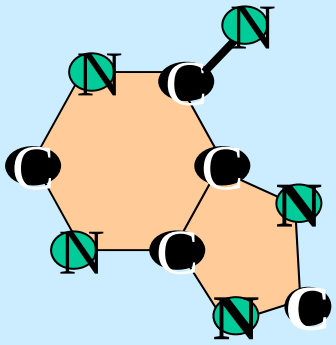
- Cytosine **C**
- Thymine **T**
- Adenine **A**
- Guanine **G**

Two Kinds of Bases in DNA

- Pyrimidines are single ring bases.

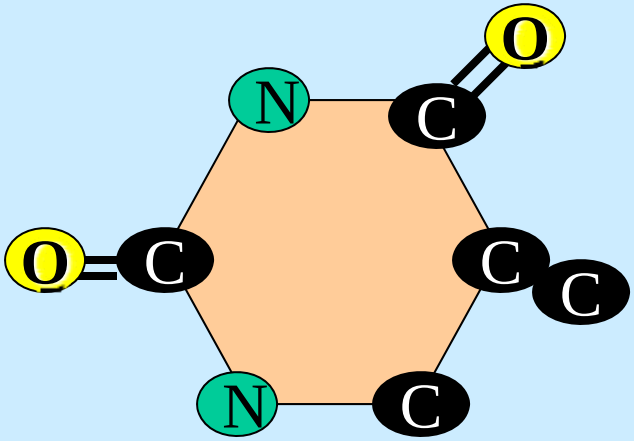


- Purines are double ring bases.

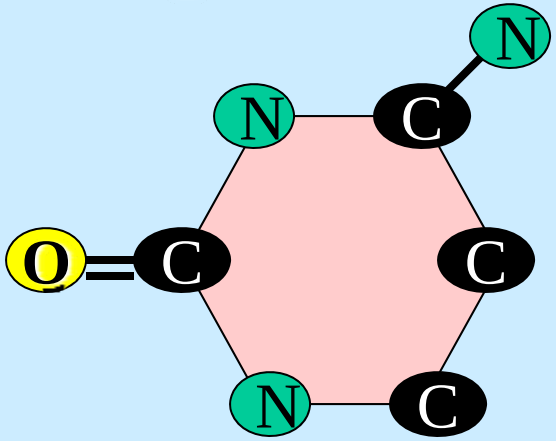


Thymine and Cytosine are pyrimidines

- Thymine and cytosine each have one ring of carbon and nitrogen atoms.



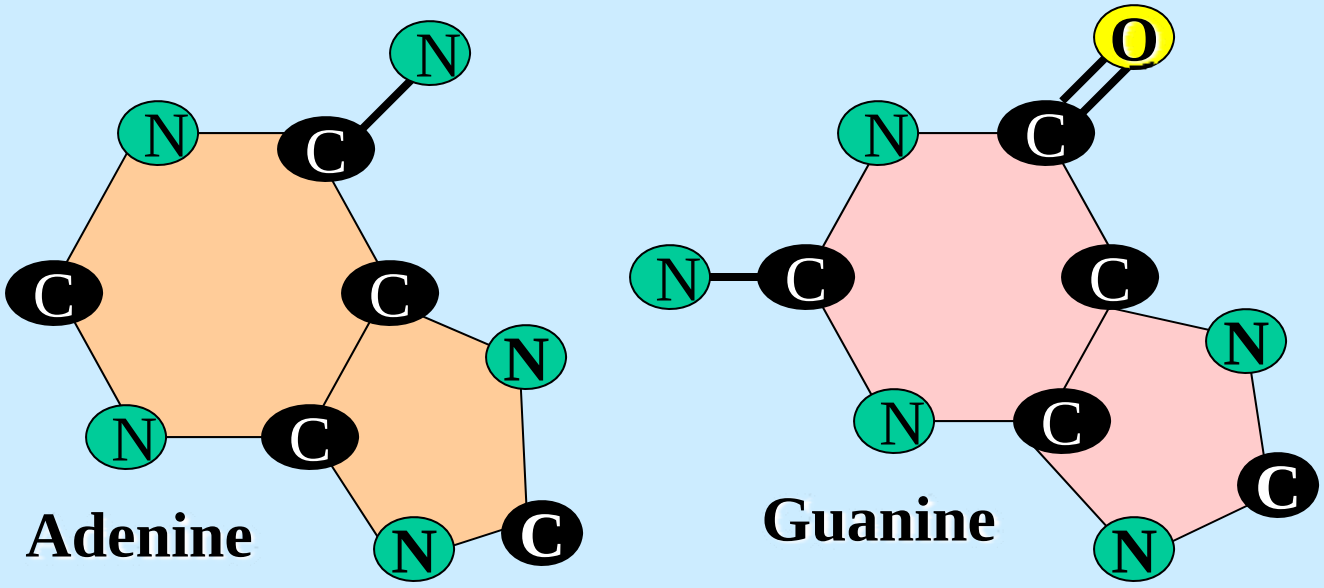
thymine



cytosine

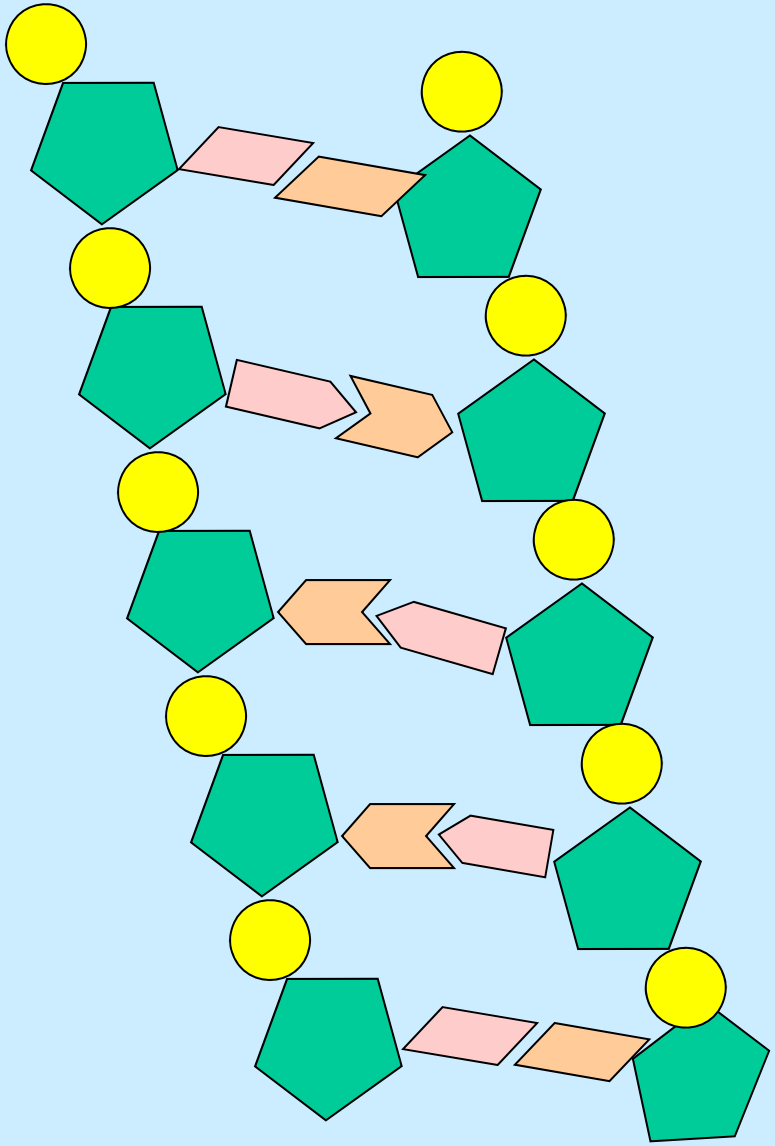
Adenine and Guanine are purines

- Adenine and guanine each have two rings of carbon and nitrogen atoms.



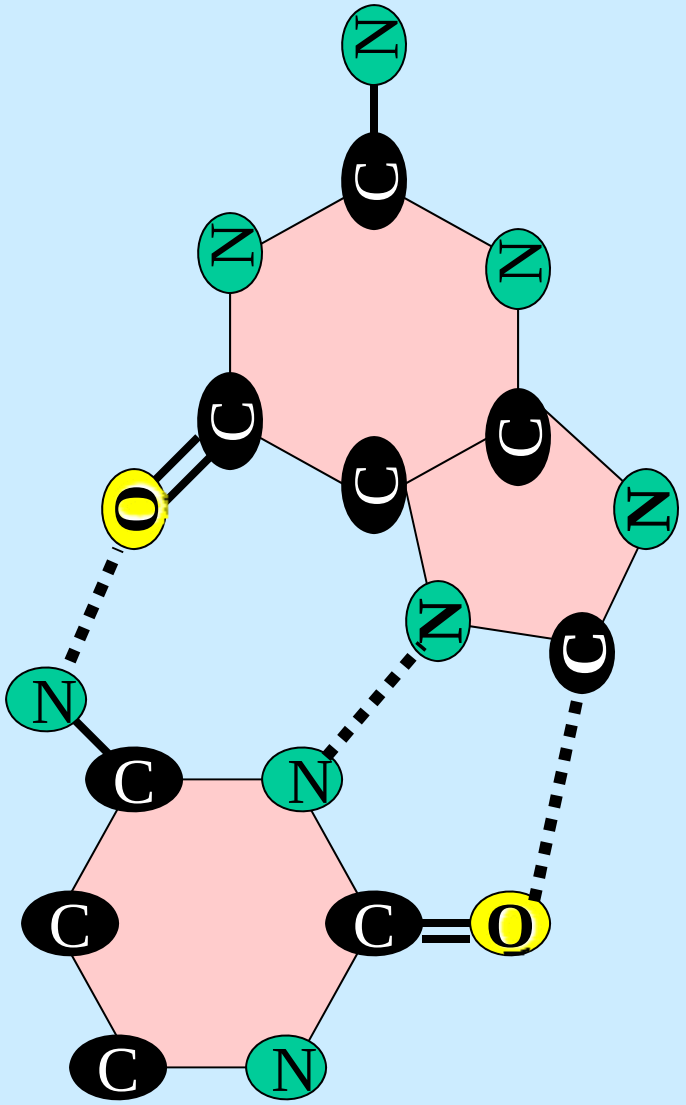
Two Stranded DNA

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



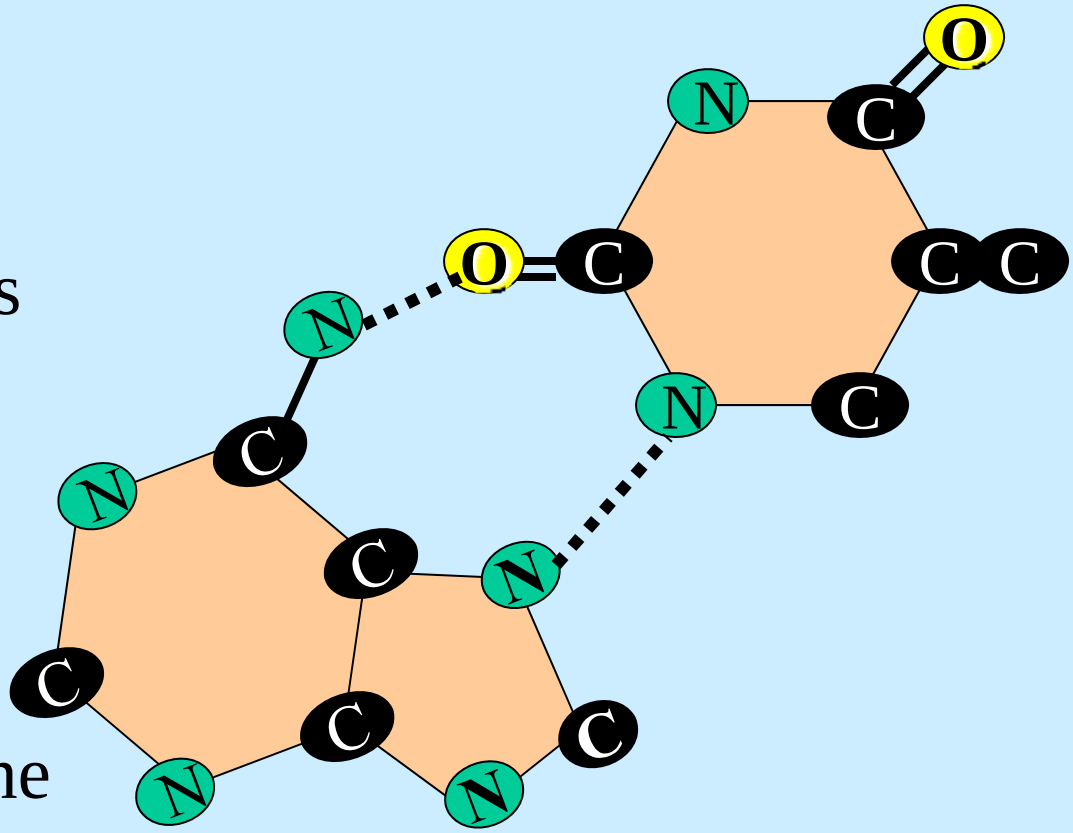
Hydrogen Bonds

- The bases attract each other because of hydrogen bonds.
- 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.)



Hydrogen Bonds, cont.

- When making hydrogen bonds, cytosine always pairs up with guanine,
- And adenine always pairs up with thymine.
- (Adenine and thymine are shown here.)



Important:

- Adenine and Thymine always join together

A ⇌ T

- Cytosine and Guanine always join together

C ⇌ G

DNA by the numbers

- **Each cell has about 2 m of DNA.**
- **The average human has 75 trillion cells.**
- **The average human has enough DNA to go from the earth to the sun more than 400 times.**
- **DNA has a diameter of only 0.000000002 m.**

The earth is 150 billion m or 93 million miles from the sun.