

# 01 – DNA AND PROTEINS

## 1.1 - DNA Structure

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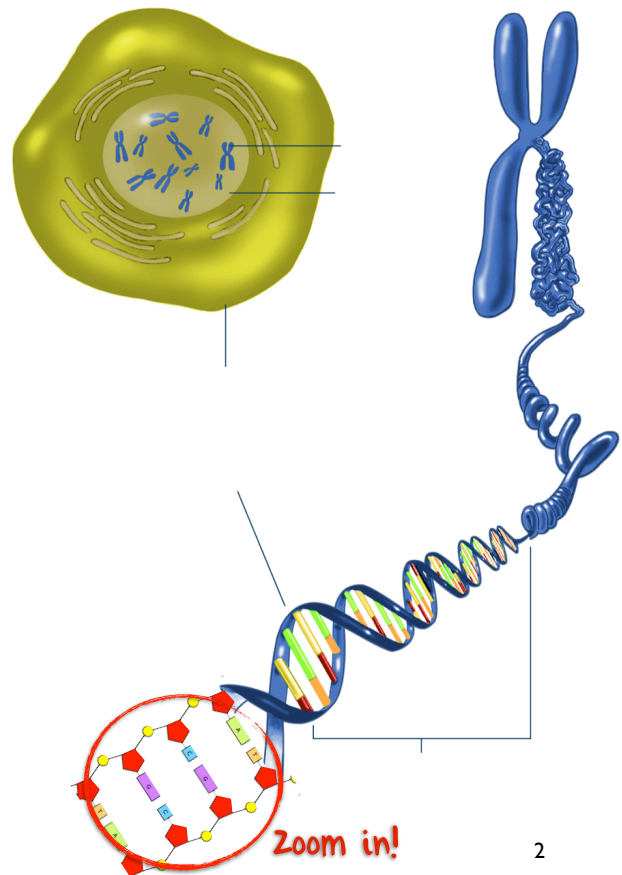


**1.1.1** DNA stores and transmits genetic information; it functions in the same way in all living things.

**1.1.2** DNA is a helical double-stranded molecule.

**Dexoy ribonucleic acid**

*\*In Cytosol of Prokaryotes*



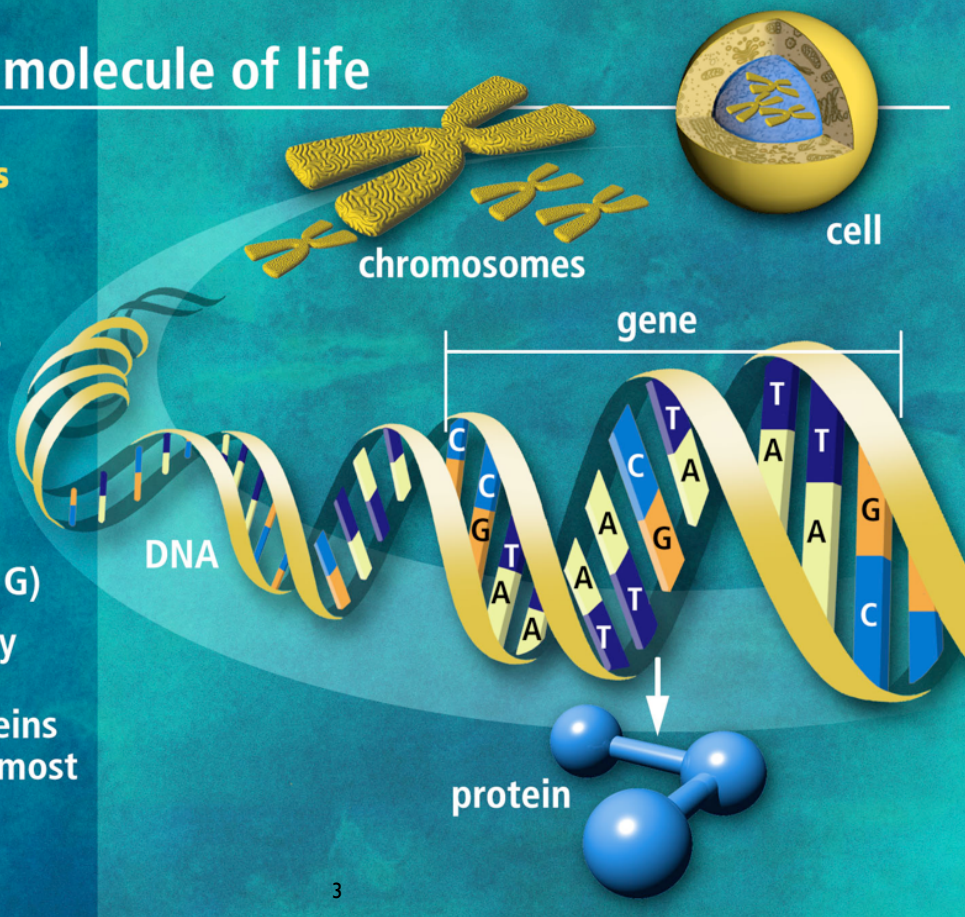
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# DNA the molecule of life

## Trillions of cells

Each cell:

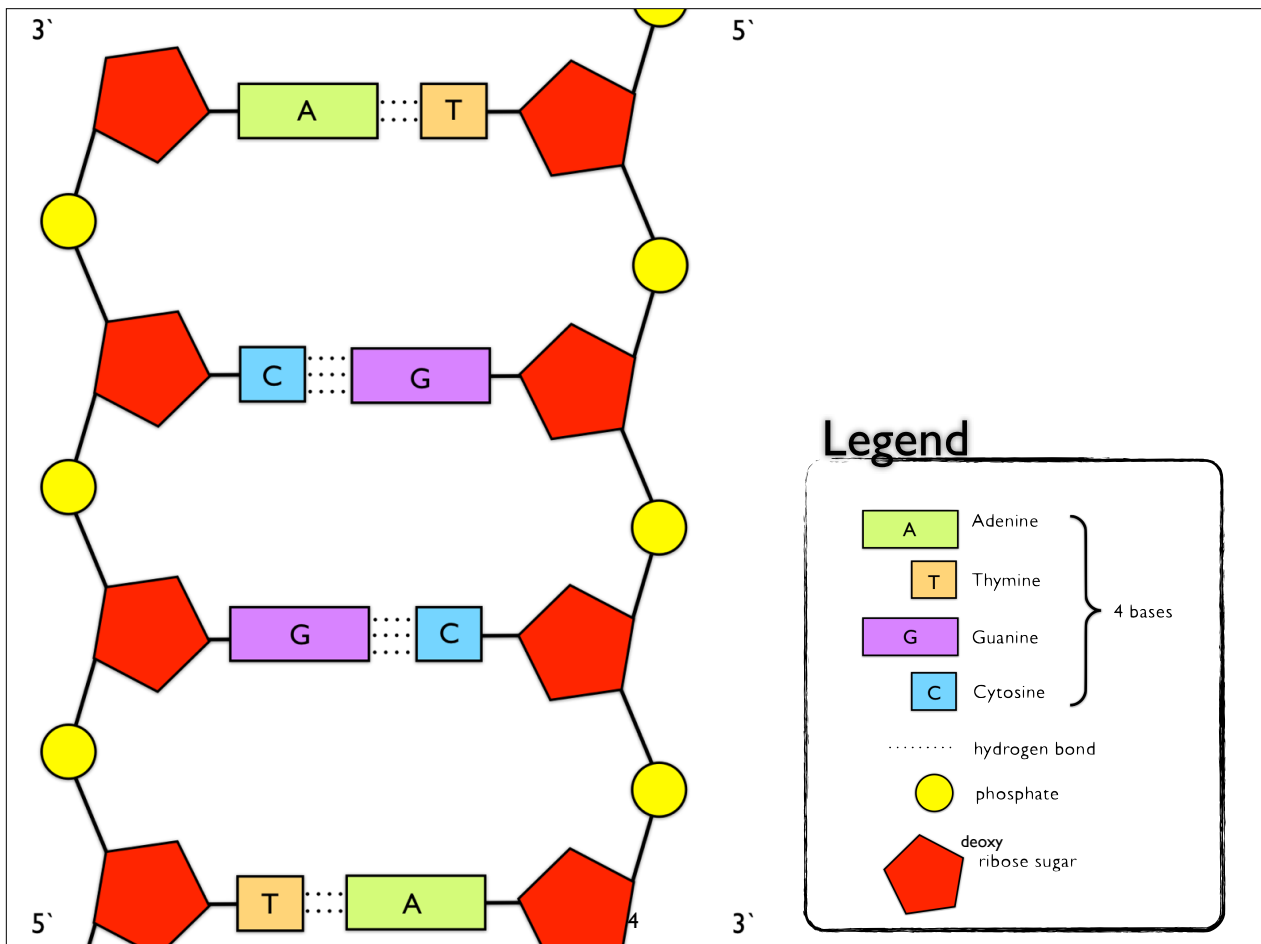
- 46 human chromosomes
- 2 meters of DNA
- 3 billion DNA subunits (the bases: A, T, C, G)
- Approximately 30,000 genes code for proteins that perform most life functions



Y-GG 01-0085

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Nucleic acids = built of nucleotides

DNA & RNA

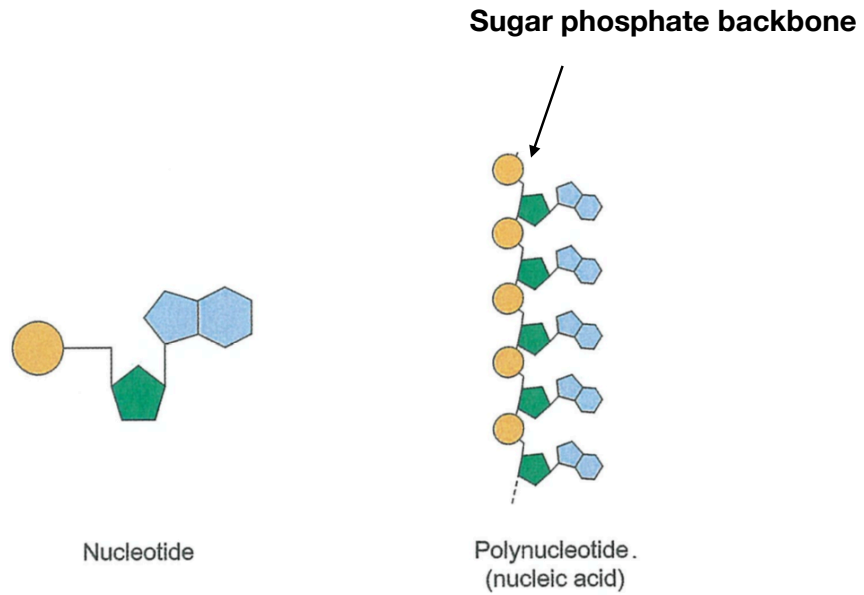


Figure 1.01: Structure of a nucleotide (left) and nucleic acid (right).

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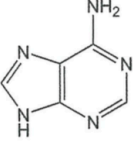
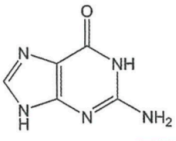
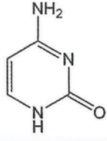
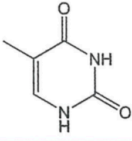
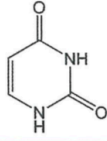
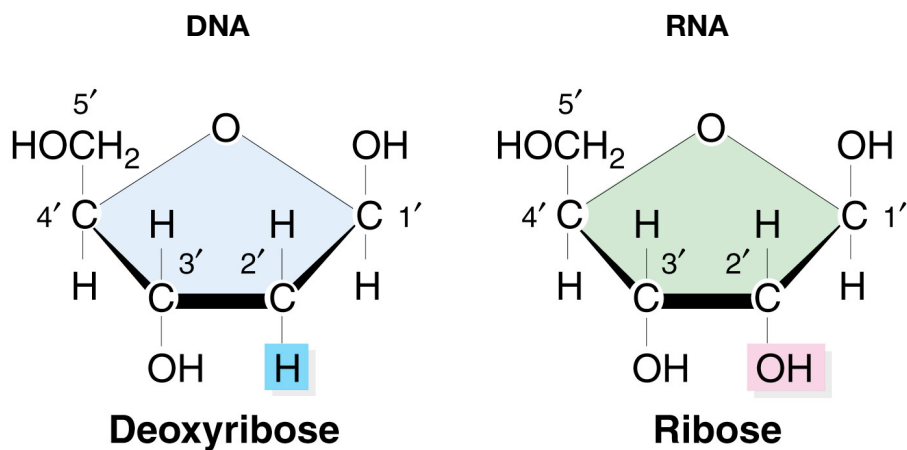
				
Adenine	Guanine	Cytosine	Thymine	Uracil
RNA and DNA			DNA only	RNA only

Figure 1.03: Bases present in RNA and DNA.



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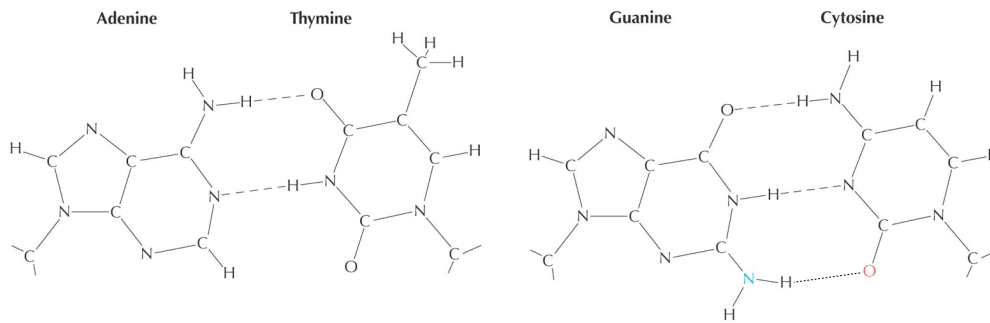
# The Four Bases in DNA

Purines = double ring

Pyrimidines = single ring

A & G

T & C



**FIGURE 2.19.** Pairing of bases in the DNA double helix based on the structures originally shown in Watson and Crick's 1953 paper. Hydrogen bonds are indicated by dashed lines. Pauling later showed that guanine and cytosine share a third hydrogen bond between the nitrogen (*blue*) and the oxygen (*red*).

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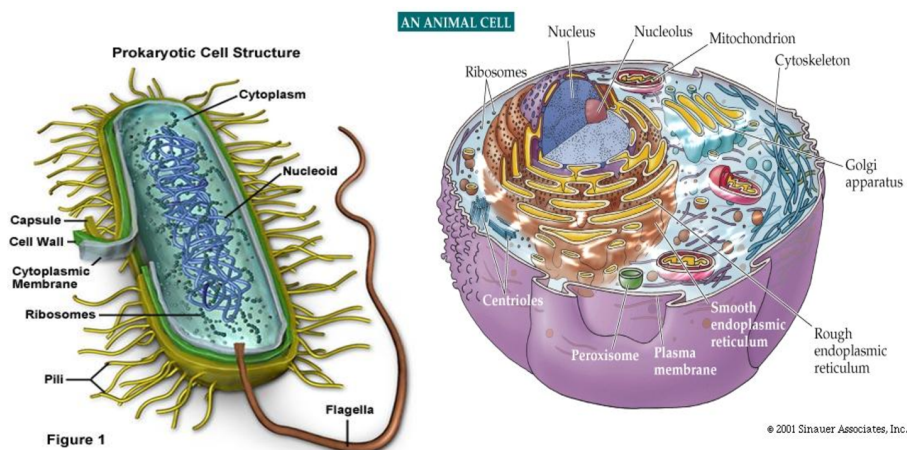


**1.1.3** In eukaryotes, DNA is bound to proteins in linear chromosomes, which are found in the nucleus.

**1.1.4** DNA is unbound and circular in the cytosol of prokaryotes and in the mitochondria and chloroplasts of eukaryotes.

Compare chromosomes in prokaryotes and eukaryotes.

## Prokaryotic vs Eukaryotic Cells



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### Prokaryotic

- Relatively simple, small cell ranging from 1 - 2µm.
- Possess rigid cell wall which prevents rupture of the cell.
- Membrane bound organelles are absent in Prokaryotic cell.
- Genetic material is not enclosed in nuclear membrane.
- Genetic material consists of single circular or endless double helical molecule of DNA.

### Eukaryotic

- Complex large cells, ranging from 10 - 100 µm.
- No rigid cell wall in vertebrates, but in plants, cell wall is present.
- Membrane bound organelles are present in Eukaryotic cell.
- Genetic material is enclosed in a well defined nuclear membrane.
- There are many chromosomes, formed of linear, open ended double helical molecules of DNA.

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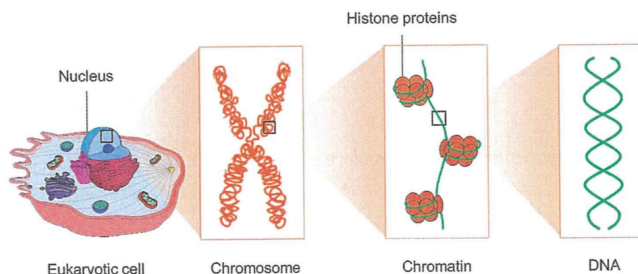


Figure 1.07: Location and arrangement of DNA in eukaryotes.

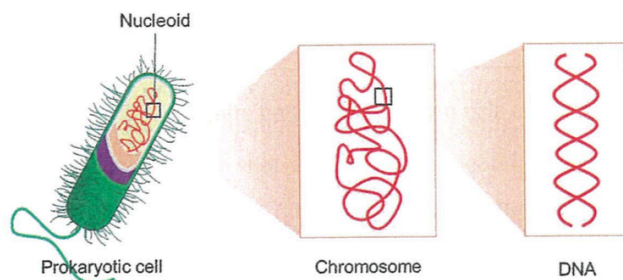


Figure 1.08: Location and arrangement of DNA in prokaryotes.

### Cytosol:

- the liquid inside cells around the organelles
- complex mix of substances dissolved in water

Prokaryotes - most of the chemical reactions take place here

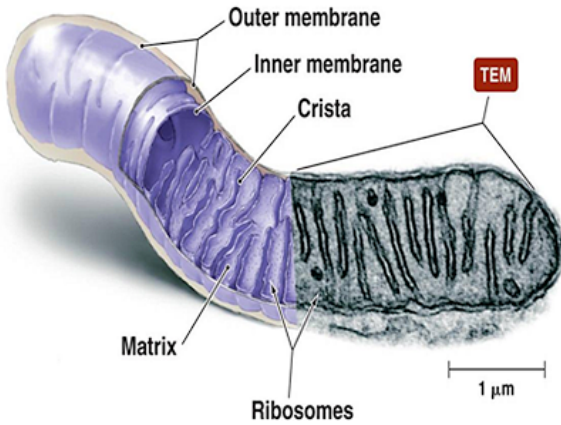
Eukaryotes - lots of chemical reactions here, but many in organelles as well

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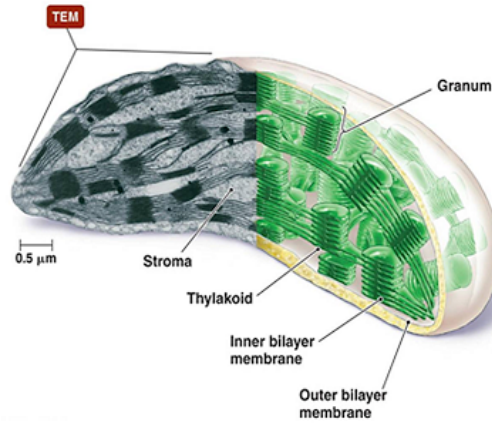
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## Small circular DNA found in Eukaryotic organelles

Mitochondria



Chloroplast



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# DNA REPLICATION

**1.1.5** Replication of DNA allows for genetic information to be inherited.

**1.1.6** Base-pairing rules and method of DNA replication are universal.

- Describe the structural properties of the DNA molecule, including:
  - nucleotide composition and pairing
  - the weak bonds between strands of DNA allow for replication
- Explain the importance of complementary base pairing (A-T and C-G).
- Describe and represent the process of semi-conservative replication of DNA.

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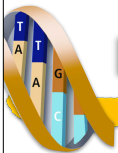


Key properties of DNA allow it to copy itself exactly and so pass on information to offspring!

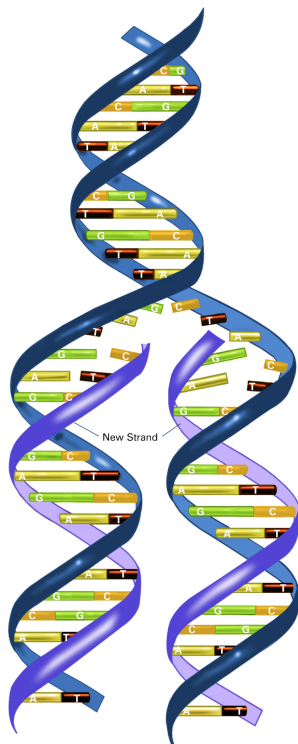
1. Nucleotide composition:
2. Nucleotide pairing:
3. Weak bonds between strands:

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## DNA Replication Fork



### Semi-conservative Replication

#### Results

- ➔ two new double strands that are identical
- ➔ each new DNA strand has half of the original DNA

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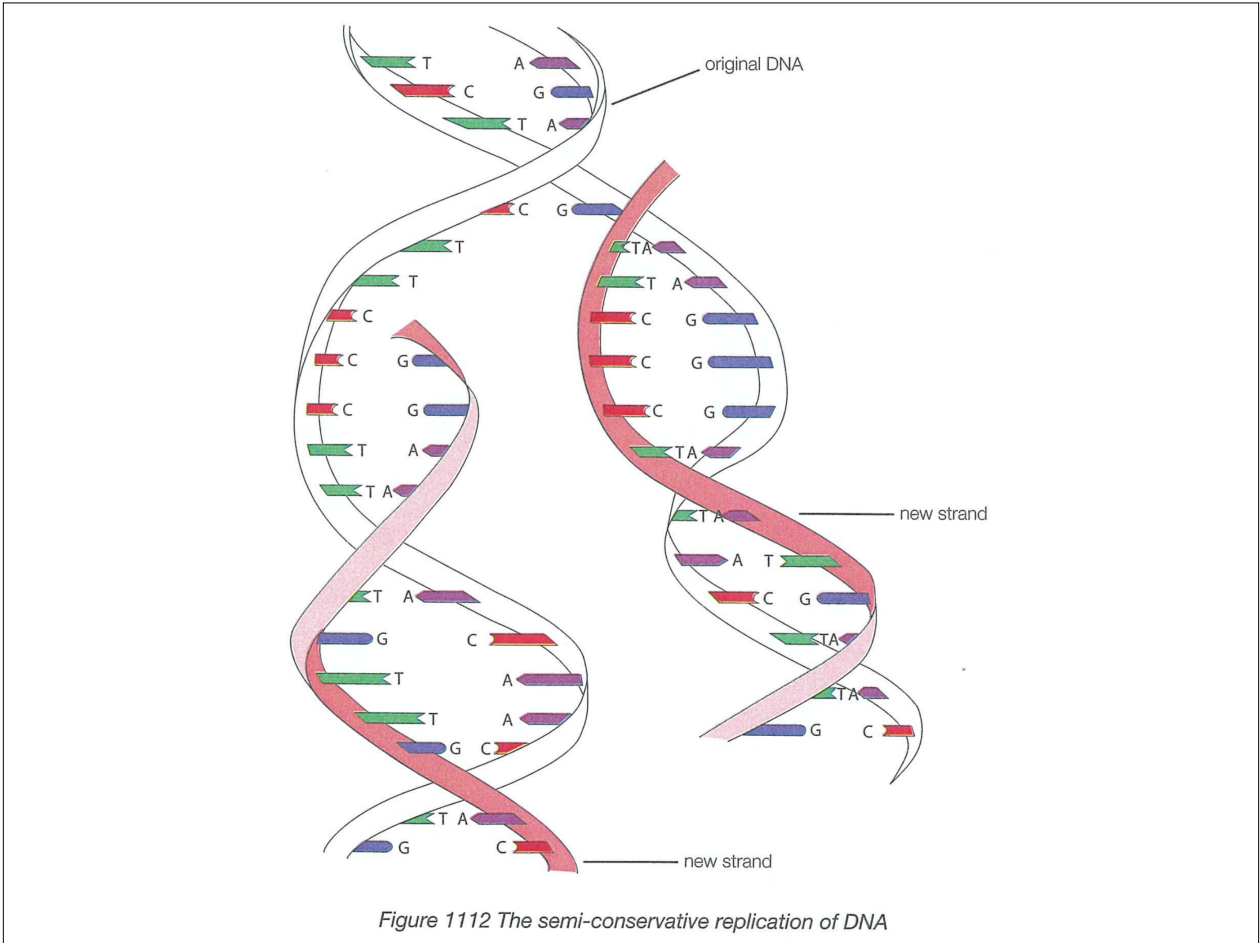
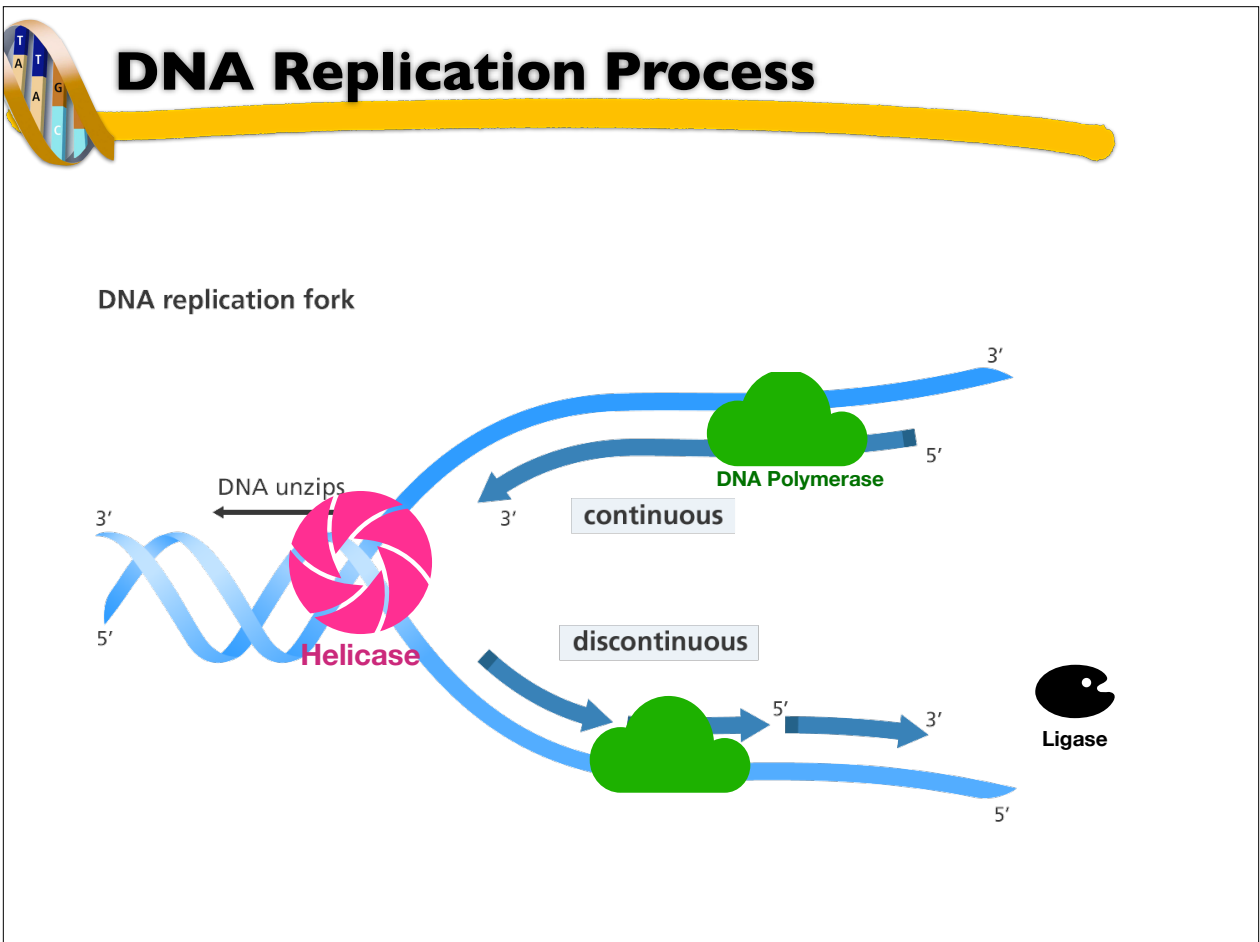
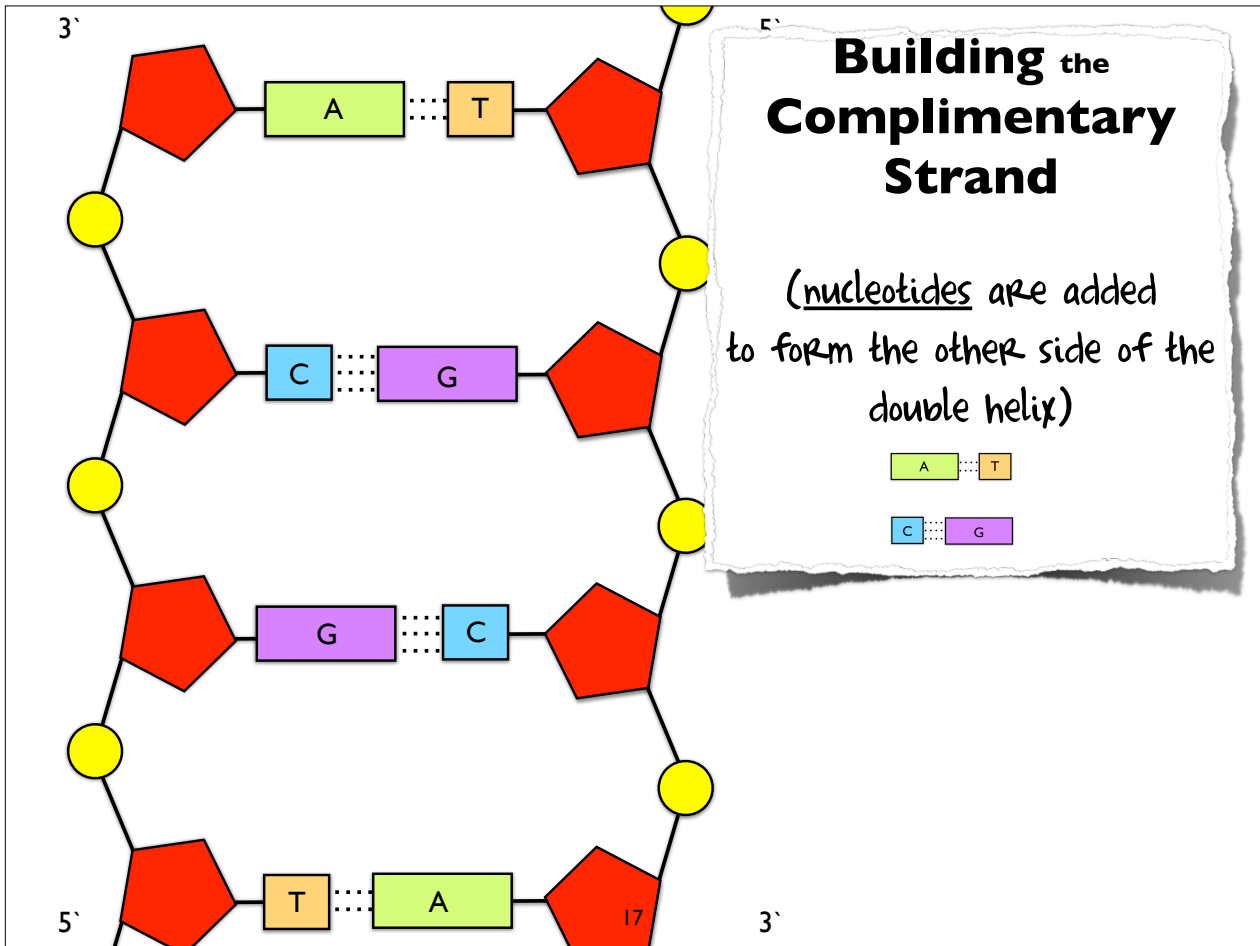


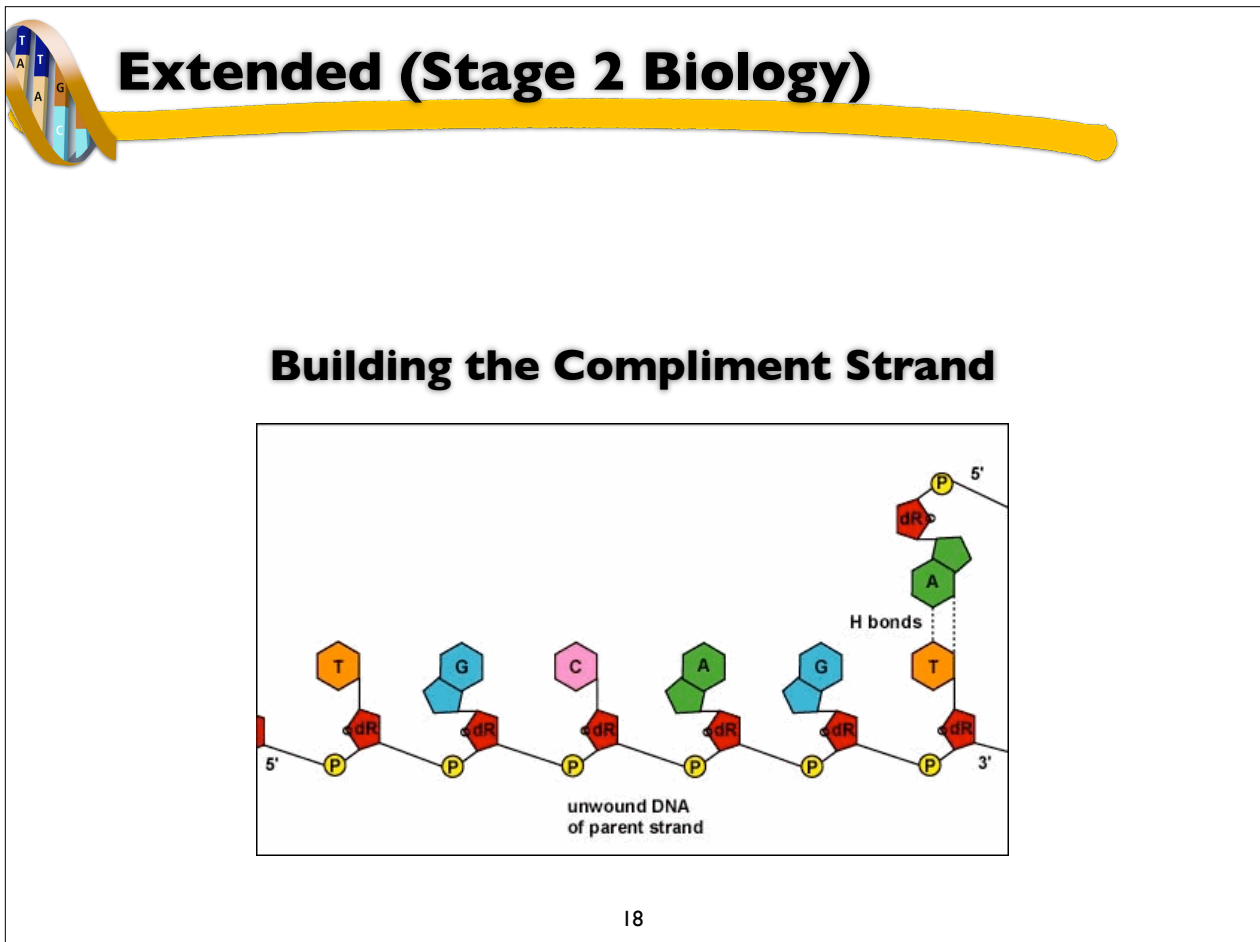
Figure 1112 The semi-conservative replication of DNA







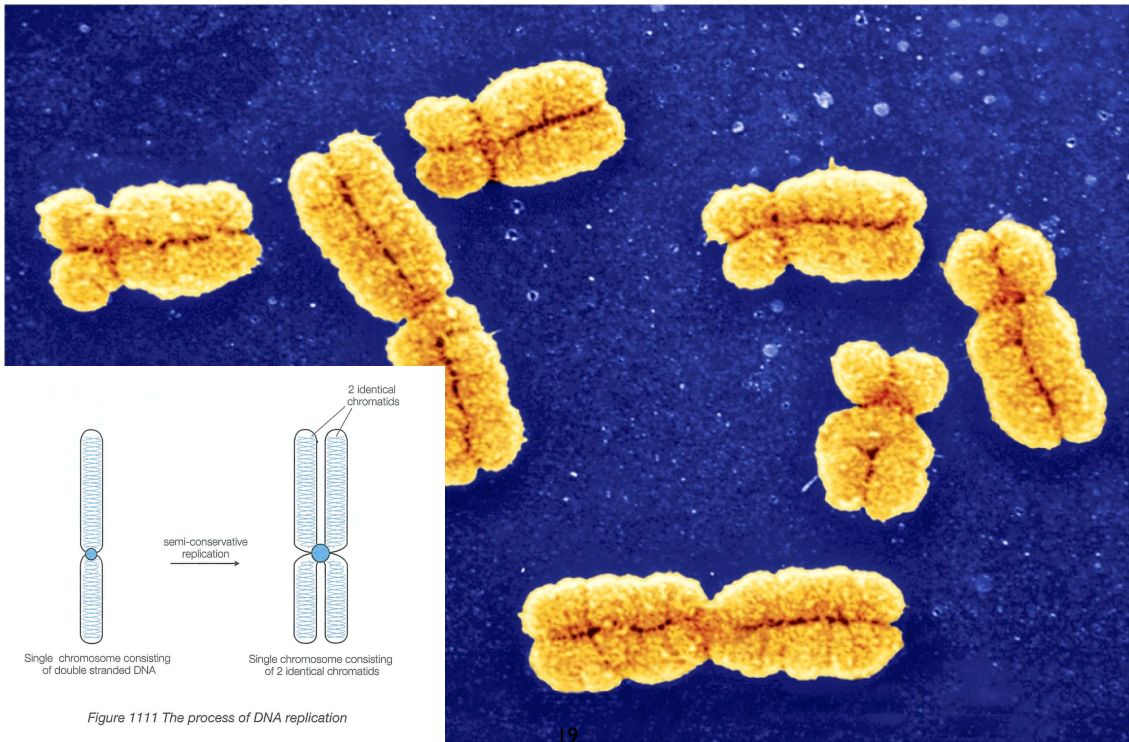
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# After Replication = sister chromatids



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# Human Karyotype



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