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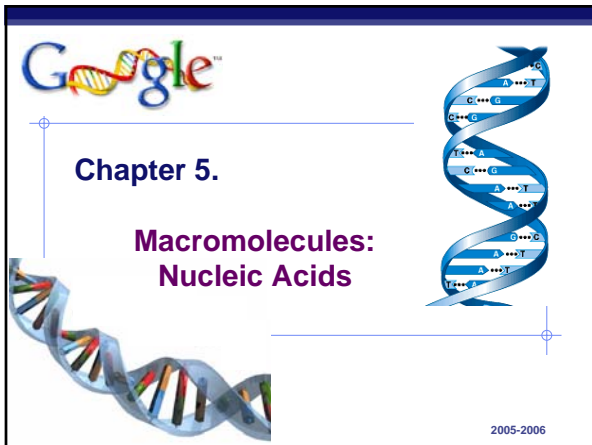
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**Nucleic Acids**

- **Function:**
  - ◆ store & transmit hereditary information
- **Examples:**
  - ◆ RNA (ribonucleic acid)
  - ◆ DNA (deoxyribonucleic acid)
- **Structure:**
  - ◆ monomers = nucleotides

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Based on work by K. Foglia  
www.kimunity.com

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### Nucleotides

- 3 parts
  - nitrogen base (C-N ring)
  - pentose sugar (5C)
    - ribose in RNA
    - deoxyribose in DNA
  - PO<sub>4</sub> group

The diagram shows a phosphate group (a phosphorus atom bonded to four oxygen atoms) connected to a pentose sugar (a five-membered ring with an oxygen atom at the top). The pentose sugar is further connected to a nitrogenous base (a six-membered ring with two nitrogen atoms). A callout box provides a detailed view of the phosphate group and its connection to the pentose sugar.

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### Types of nucleotides

- 2 types of nucleotides
  - different Nitrogen bases
    - purines
      - double ring N base
      - adenine (A)
      - guanine (G)
    - pyrimidines
      - single ring N base
      - cytosine (C)
      - thymine (T)
      - uracil (U)

The diagram shows the chemical structures of four nitrogenous bases. Purines are shown as double-ring structures: Adenine (A) and Guanine (G). Pyrimidines are shown as single-ring structures: Cytosine (C), Thymine (T), and Uracil (U). Thymine is noted as being in DNA, and Uracil is noted as being in RNA.

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### Building the polymer

The diagram illustrates the assembly of a polynucleotide. Part (a) shows the components: Deoxyribose (in DNA) and Ribose (in RNA) sugars, and the chemical structures of Cytosine, Thymine, Uracil, Adenine, and Guanine. Part (b) shows a single nucleotide consisting of a phosphate group, a pentose sugar, and a nitrogenous base. Part (c) shows a polynucleotide chain where nucleotides are linked together.

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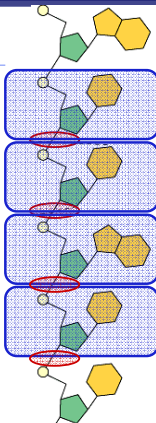
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### Nucleic polymer

- **Backbone**
  - ◆ sugar to  $PO_4$  bond
  - ◆ **phosphodiester bond**
    - new base added to sugar of previous base
    - polymer grows in one direction
  - ◆ N bases hang off the sugar-phosphate backbone

**Why is this important?**



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### RNA & DNA

- **RNA**
  - ◆ single nucleotide chain
- **DNA**
  - ◆ double nucleotide chain
    - N bases bond in pairs across chains
  - ◆ spiraled in a **double helix**
    - double helix 1<sup>st</sup> proposed as structure of DNA in 1953 by **James Watson & Francis Crick** (just celebrated 50th anniversary!)



Based on work by K. Foglia  
www.k12science.com

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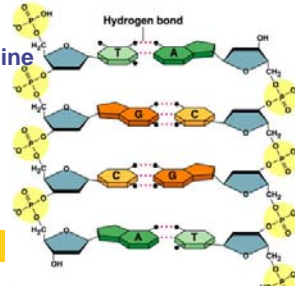
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### Pairing of nucleotides

- **Nucleotides bond between DNA strands**
  - ◆ H bonds
  - ◆ purine :: pyrimidine
  - ◆ A :: T
    - 2 H bonds
  - ◆ G :: C
    - 3 H bonds

**Why is this important?**



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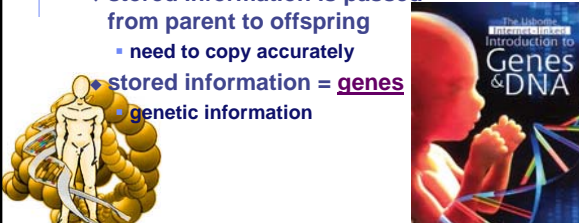
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### Information polymer

- Function
  - series of bases encodes information
    - like the letters of a book
  - stored information is passed from parent to offspring
    - need to copy accurately
  - stored information = **genes**
    - genetic information



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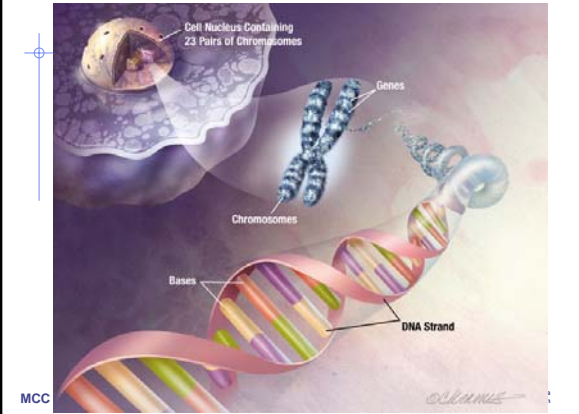
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Cell Nucleus Containing 23 Pairs of Chromosomes

Genes

Chromosomes

Bases

DNA Strand

MCC

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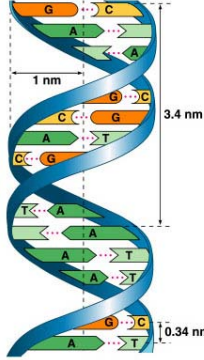
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### DNA molecule

- Double helix
  - H bonds** between bases join the 2 strands
    - A :: T
    - C :: G

Why is it important that the strands are bonded by H bonds?



1 nm

3.4 nm

0.34 nm

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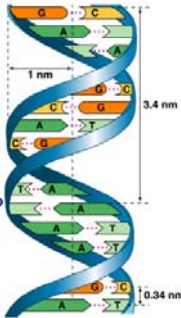
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### Copying DNA

- Replication
  - ◆ 2 strands of DNA helix are complementary
    - have one, can build other
    - have one, can rebuild the whole
  - ◆ why is this a good system?
  - ◆ when in the life of a cell does replication occur?
    - mitosis
    - meiosis



Based on work by K. Foglia  
www.kimunity.com

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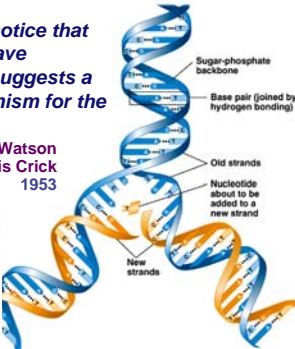

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### DNA replication

*"It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material."*

James Watson  
Francis Crick  
1953


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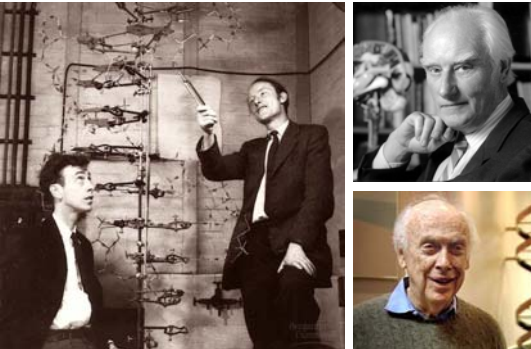
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### 1953 | 1962

### Watson and Crick ... and others...



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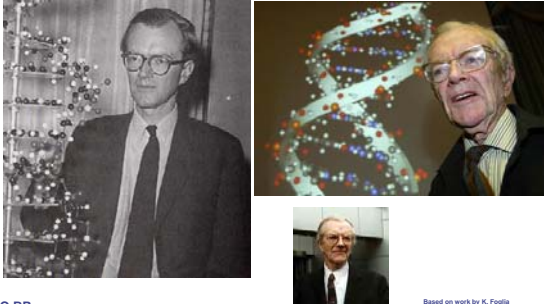
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**Maurice Wilkins... and...** 1953 | 1962



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**Rosalind Franklin (1920-1958)**



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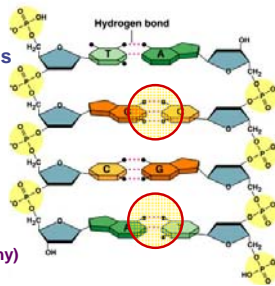
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**Interesting note...**

- Ratio of A-T::G-C affects stability of DNA molecule
  - 2 H bonds vs. 3 H bonds
  - biotech procedures
    - more G-C = need higher T° to separate strands
  - high T° organisms
    - many G-C
  - parasites
    - many A-T (don't know why)



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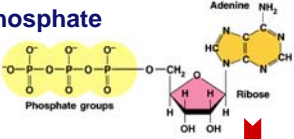
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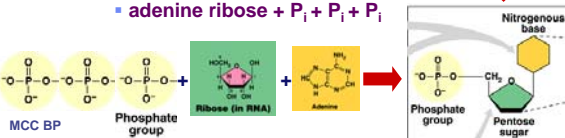
**Another interesting note...**

- **ATP**  
**Adenosine triphosphate**



◆ **modified nucleotide**

- **adenine ribose + P<sub>i</sub> + P<sub>i</sub> + P<sub>i</sub>**



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# Macromolecule Review

AP Biology 2005-2006

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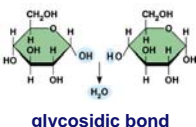
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**Carbohydrates**

- **Structure / monomer**
  - ◆ monosaccharide
- **Function**
  - ◆ energy
  - ◆ raw materials
  - ◆ energy storage
  - ◆ structural compounds
- **Examples**
  - ◆ glucose, starch, cellulose, glycogen



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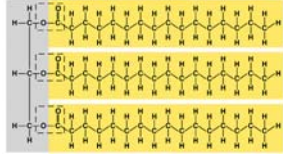
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### Lipids

- Structure / building block
  - glycerol, fatty acid, cholesterol, H-C chains
- Function
  - energy storage
  - membranes
  - hormones
- Examples
  - fat, phospholipids, steroids



ester bond (in a fat)

MCC BP Based on work by K. Foglia  
www.kimunity.com

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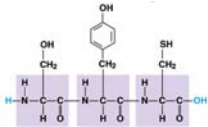
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### Proteins

- Structure / monomer
  - amino acids
  - levels of structure
- Function
  - enzymes
  - defense
  - transport
  - structure
  - signals
  - receptors
- Examples
  - digestive enzymes, membrane channels, insulin hormone, actin



peptide bond

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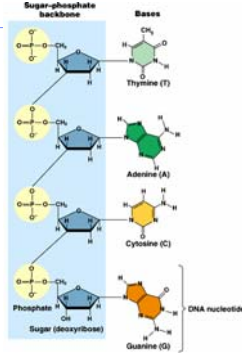
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### Nucleic acids

- Structure / monomer
  - nucleotide
- Function
  - information storage & transfer
- Examples
  - DNA, RNA



phosphodiester bond

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