

## NUCLEOTIDES AND NUCLEIC ACIDS

INFORMATION FLOW IN CELLS = "Central Dogma of Molecular Biology"

DNA → RNA → PROTEINS

### FUNCTION

DNA - genetic code contains info that controls cell activities (some viruses use RNA)  
RNA - carries message from DNA to cell; protein synthesis

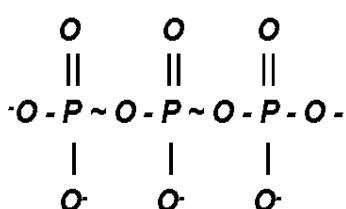
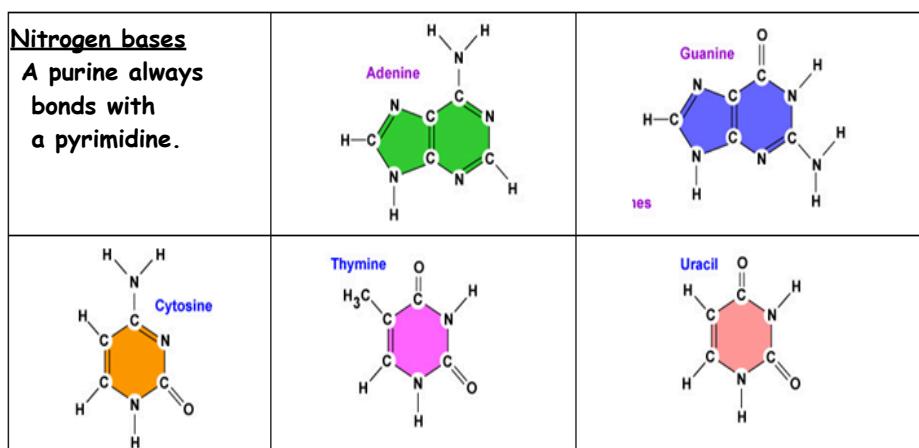
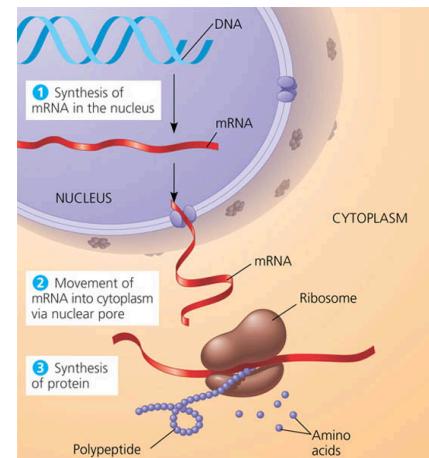
### BASIC STRUCTURE

NUCLEOSIDE = nitrogenous base + sugar

NUCLEOTIDE = nitrogenous base + sugar + phosphate group

PURINES = 2 rings; Adenine (A), Guanine (G)

PYRIMIDINES = 1 ring; Cytosine (C), Thymine (T), Uracil (U)

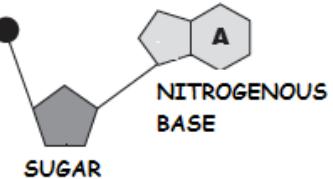


### NUCLEOTIDES

Can have one, two, or three phosphate groups (mono, di, tri-phosphates)

High energy bond between phosphate groups is important energy transport

### PHOSPHATE



Named for nitrogen base and number of phosphate groups

EX: adenosine triphosphate (ATP)  
cytosine diphosphate (CDP)  
guanosine monophosphate (GMP)

### IMPORTANT NUCLEOTIDES

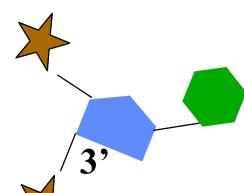
**ADENOSINE TRIPHOSPHATE (ATP)** = main energy currency in ALL living things  
(GTP & UTP also used)

**CYCLIC AMP (cAMP)** - "Second messenger"

Important in cell signaling and response to hormones

**COENZYMES** - Many coenzymes are nucleotides or their derivatives (vitamins)

EX: Flavin adenine dinucleotide (FAD) & nicotinamide adenine dinucleotide (NAD) used in cellular respiration  
nicotinamide adenine dinucleotide phosphate (NADP) used in photosynthesis



## NUCLEIC ACIDS (DNA & RNA)

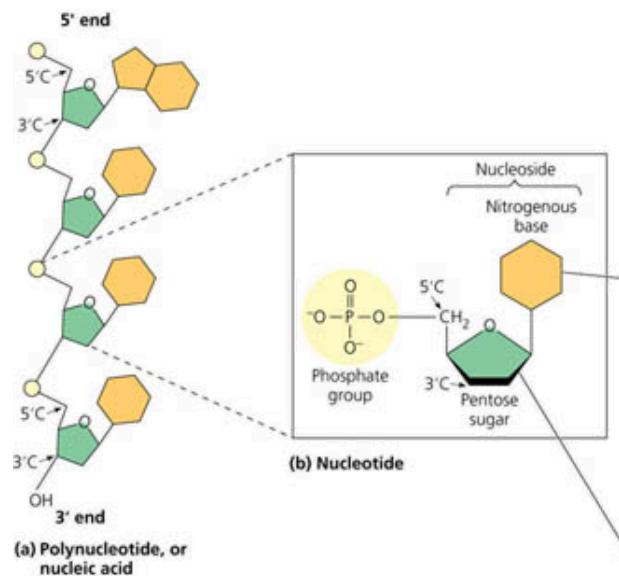
**DEHYDRATION SYNTHESIS** forms polymers of nucleotide building blocks  
**PHOSPHATES** and **SUGARS** form backbone

To distinguish sugar and nitrogen base carbon atoms when numbered, sugar atoms have a prime ( ' )  
 Phosphate group attached to 5' carbon on one sugar and the 3' carbon of next sugar

**PHOSPHATE LINKAGE** between carbon 3' of one sugar and carbon 5' of the next

### RIBONUCLEIC ACID (RNA)

- Single stranded
- Sugar = ribose
- Nitrogenous bases = A, U, G, C
- Can fold up in 3D shape



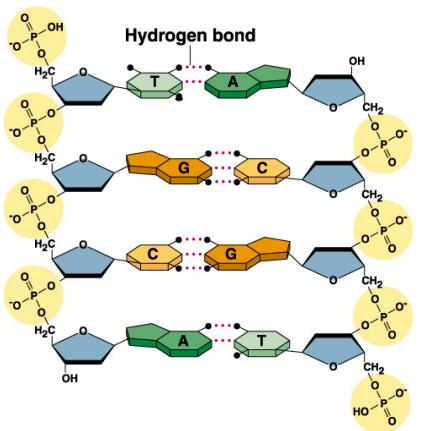
### DEOXYRIBONUCLEIC ACID (DNA)

- Double stranded
- Sugar = deoxyribose
- Nitrogenous bases = A, T, G, C
- Strands run in opposite directions (**ANTIPARALLEL**)
- Backbone = sugars and phosphates
- Rungs of ladder = nitrogenous bases
- Hydrogen bonds between nitrogenous bases

hold sides of ladder together

- Purine always bonds to a Pyrimidine

**CHARGAFF'S RULE:**  $A = T$ ;  $G \geq C$



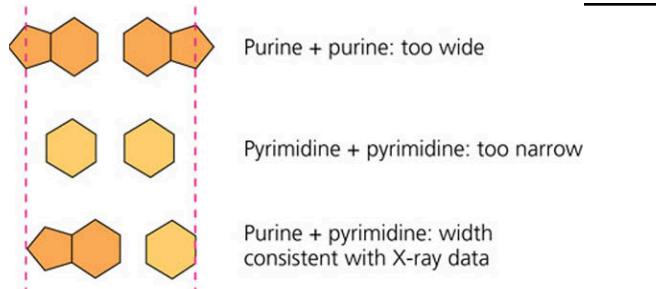
The double strand twists around its axis like a spiral staircase, forming a **DOUBLE HELIX**

### NUCLEOTIDE SUBUNITS

**SUGAR** = Ribose (RNA)  
 OR Deoxyribose (DNA)

### NITROGEN BASES:

DNA	RNA
Adenine	Adenine
Guanine	Guanine
Cytosine	Cytosine
Thymine	Uracil



DNA and protein sequences can be used as tape measures of evolution

- linear sequences of nucleotides in DNA molecules are passed from parents to offspring
- more distantly related species have chains that are less similar