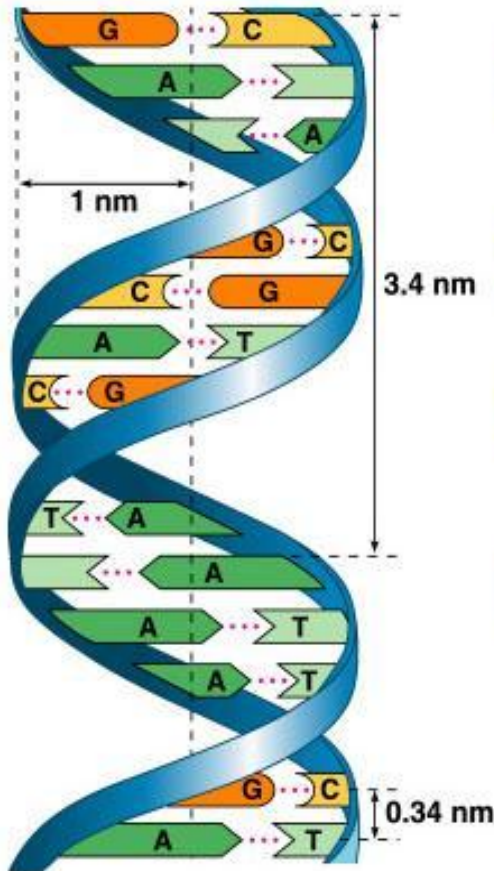
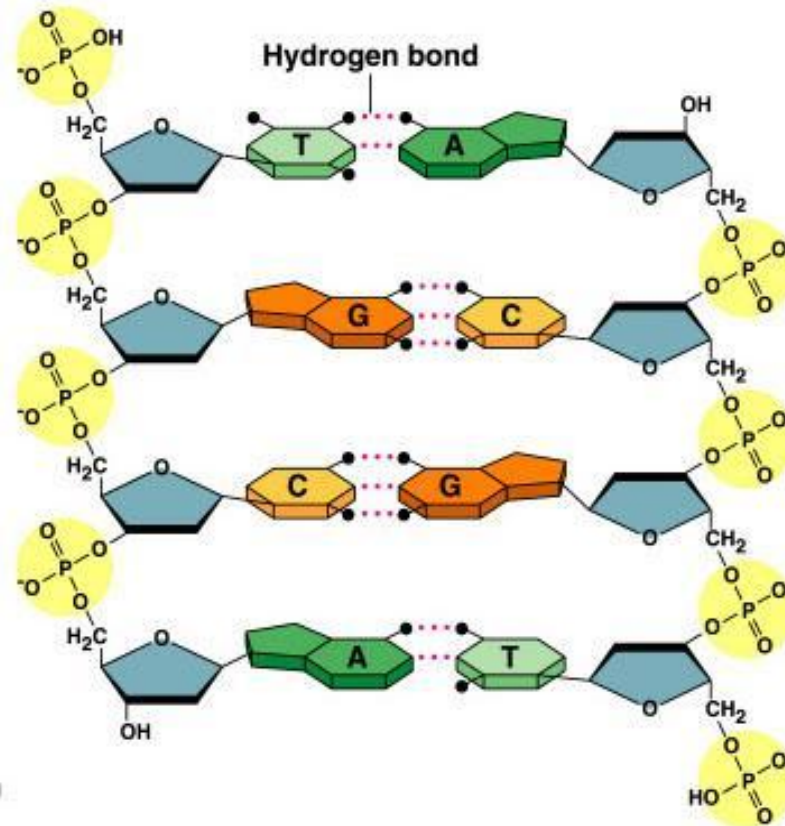


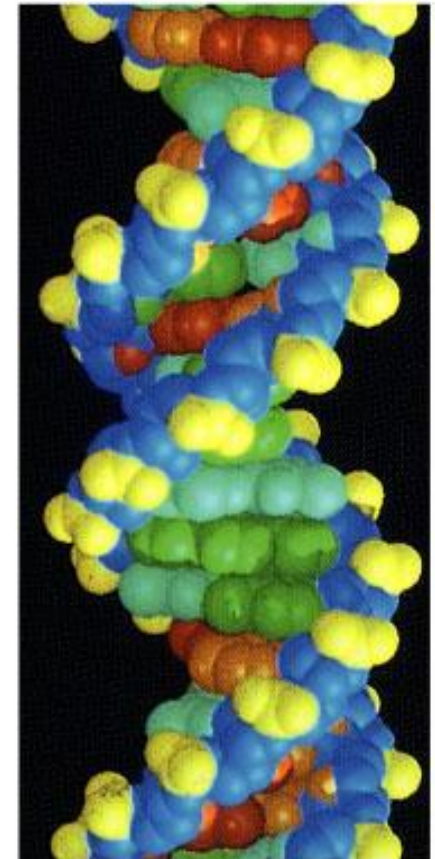
Nucleic acids (DNA & RNA)



(a) Key features of DNA structure

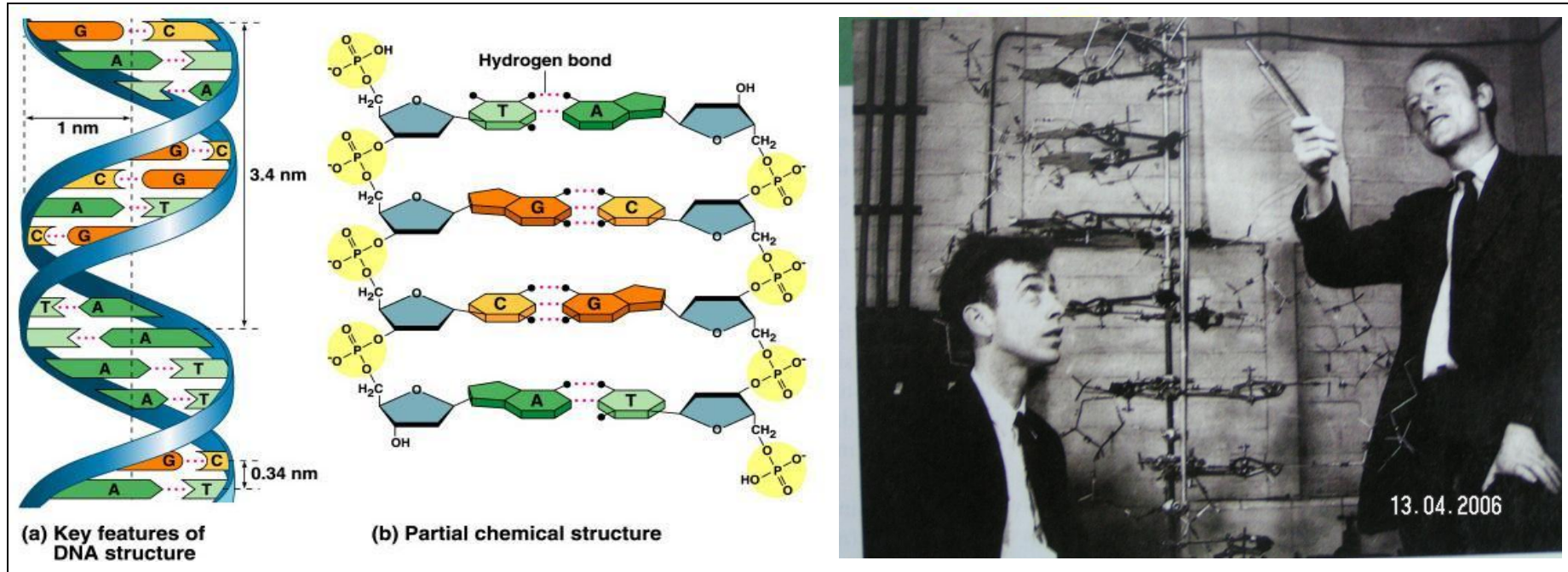


(b) Partial chemical structure



(c) Space-filling model

Watson and Crick discovered the double helix by building models to conform to X-ray data



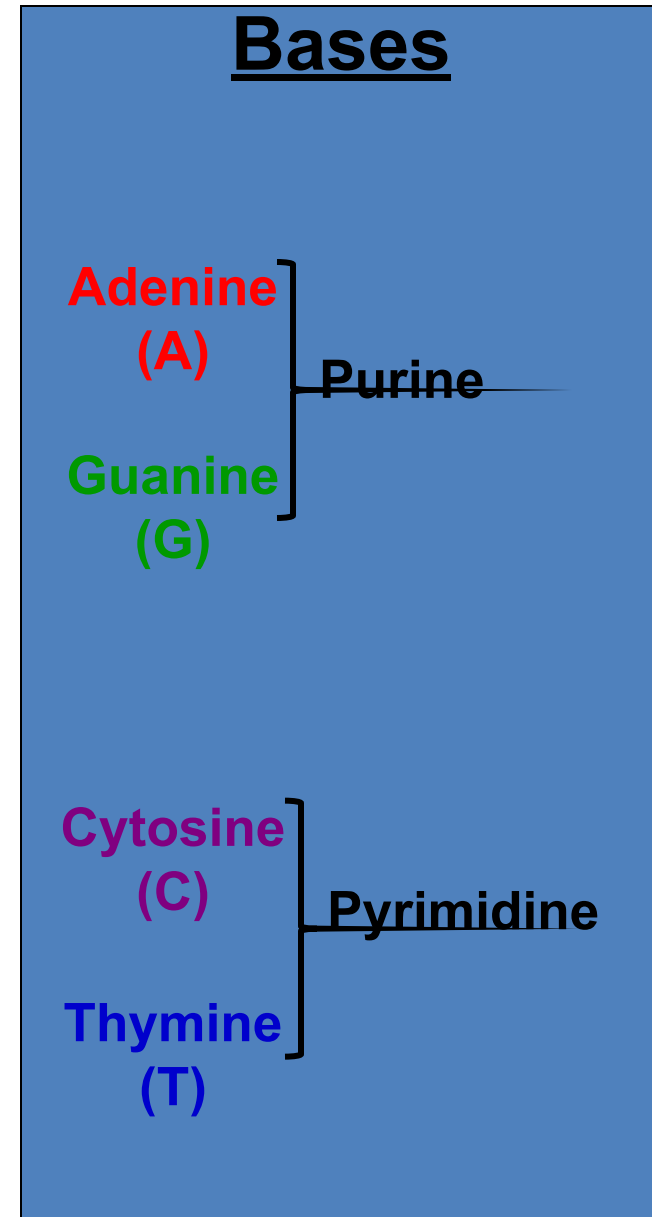
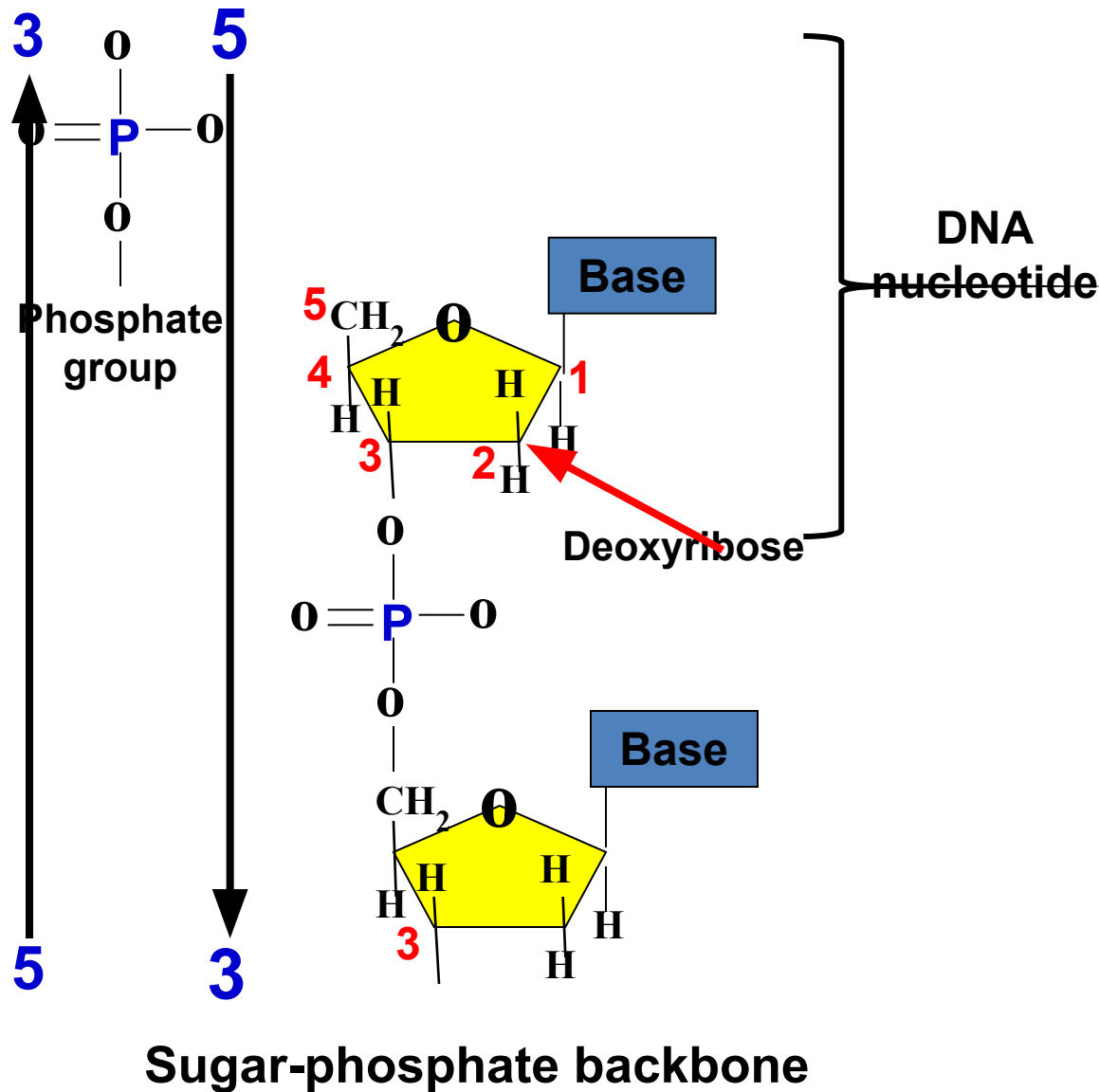
In April 1953, James **Watson** and Francis **Crick** shook the scientific world with an elegant double-helical model of the structure of deoxyribonucleic acid or DNA.

Watson and Crick began to work on a model of DNA with two strands, the **double helix**.

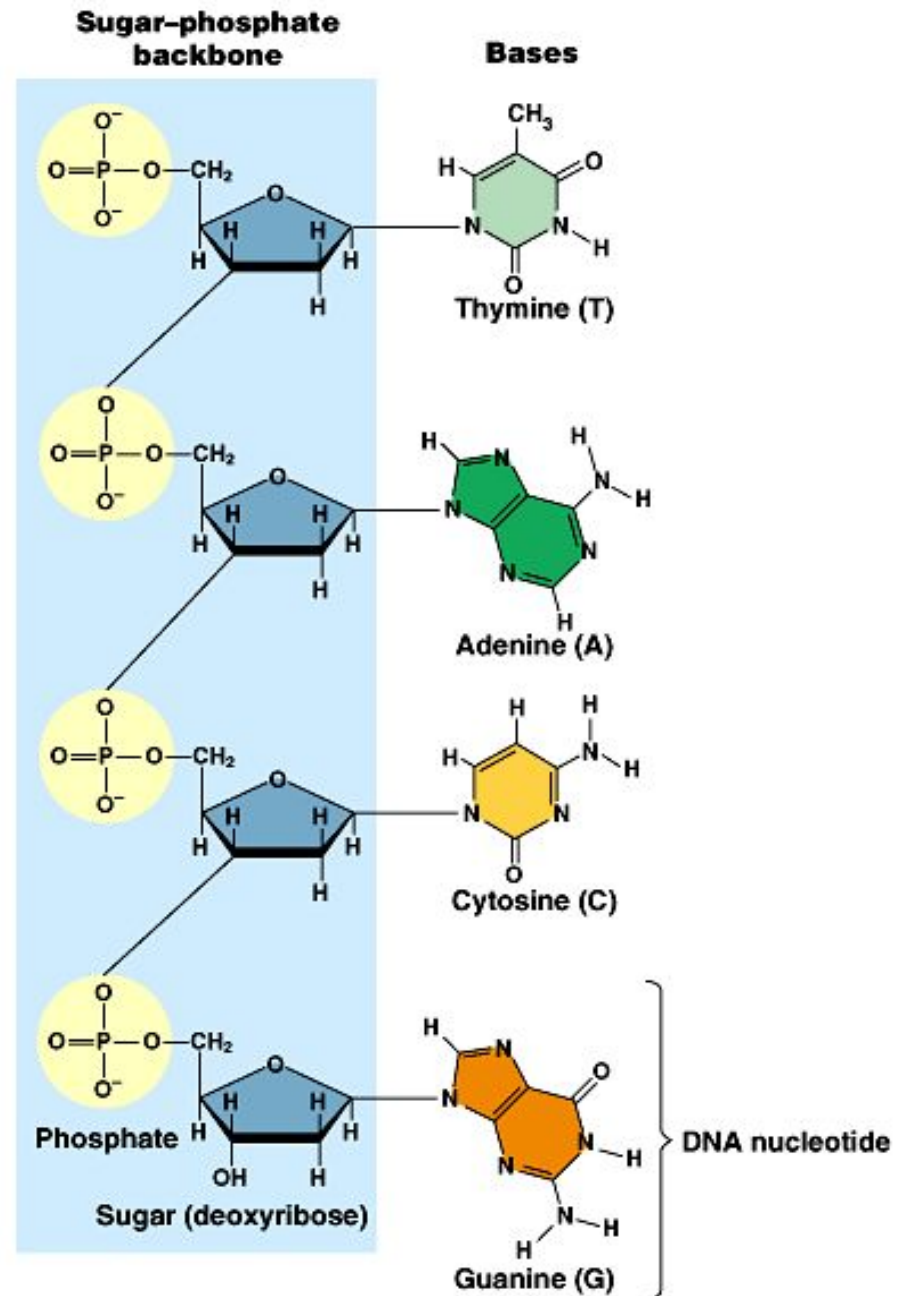
A gene is a small region in the DNA.

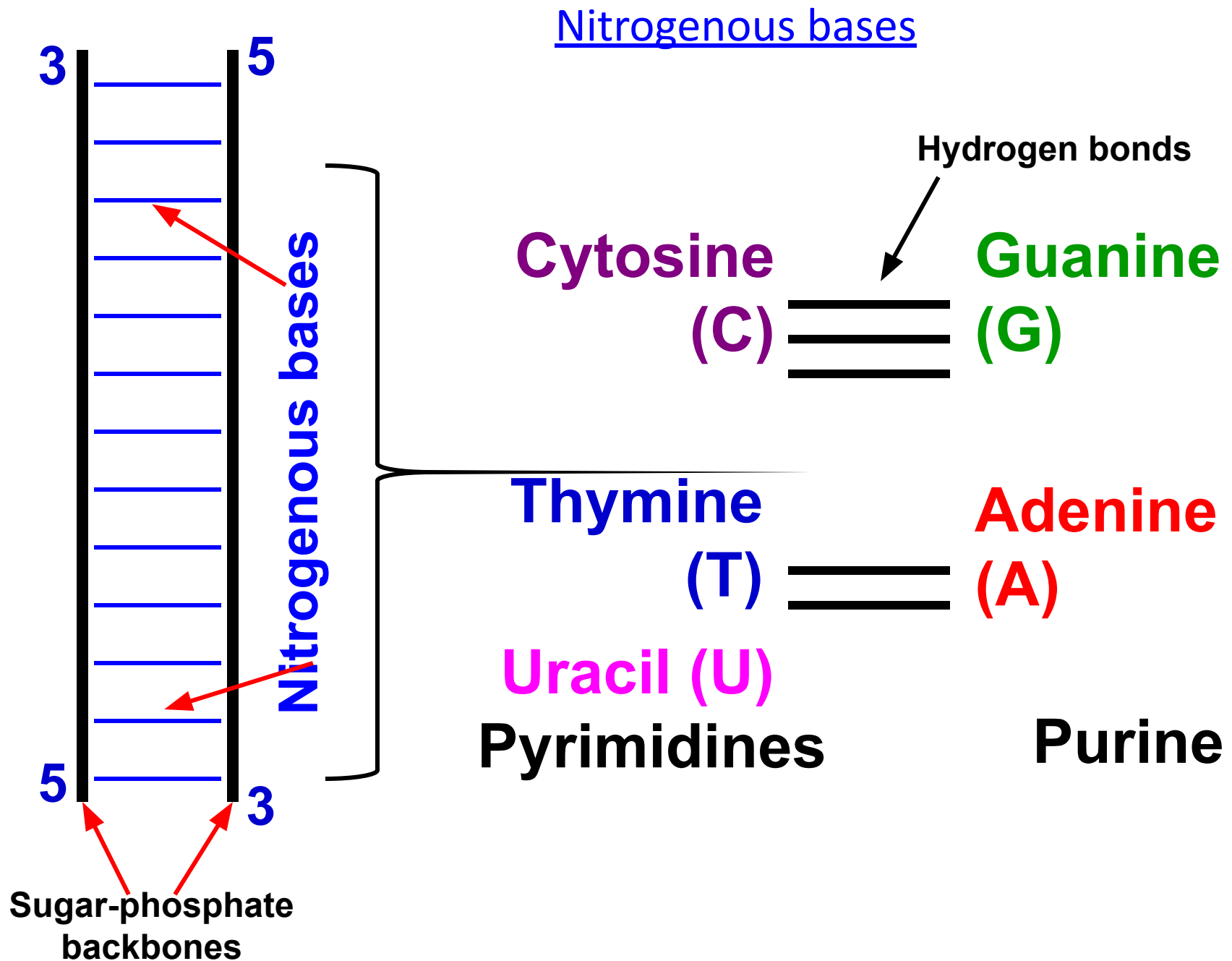
- Nucleic acids store and transmit hereditary information.
- There are two types of nucleic acids:
 - 1)- ribonucleic acid (RNA);
 - 2)- deoxyribonucleic acid (DNA).
- DNA also directs mRNA synthesis, thus, controls protein synthesis.
- Organisms inherit DNA from their parents.
 - Each DNA molecule is very long and usually consists of hundreds to thousands of genes.
 - When a cell divides, its DNA is copied and passed to the next generation of cells.
- The mRNA interacts with ribosomes to direct the synthesis of amino acids in a polypeptide (protein)

Structures of nucleic acids (DNA & RNA)



- The PO_4 group of one nucleotide is attached to the **sugar** of the next nucleotide in line.
- The result is a “**backbone**” of alternating phosphates and sugars, from which the bases start.



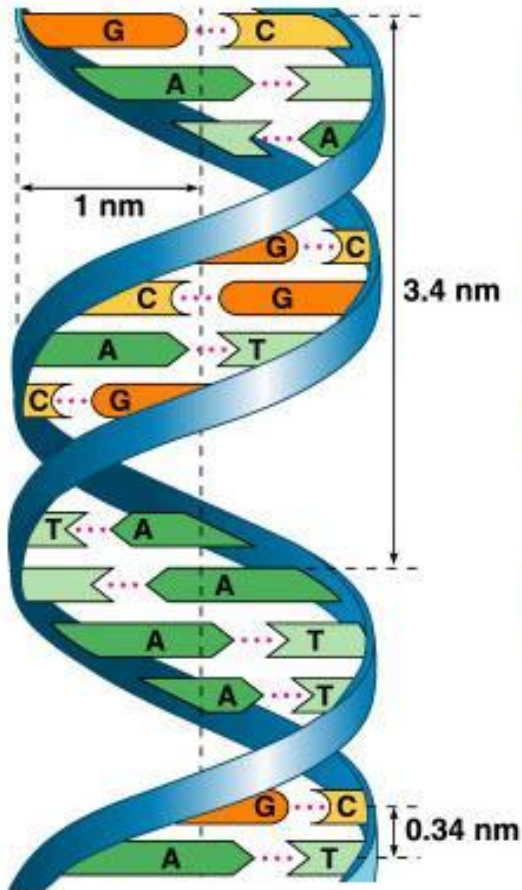


The nucleic acid strand is a polymer of nucleotides

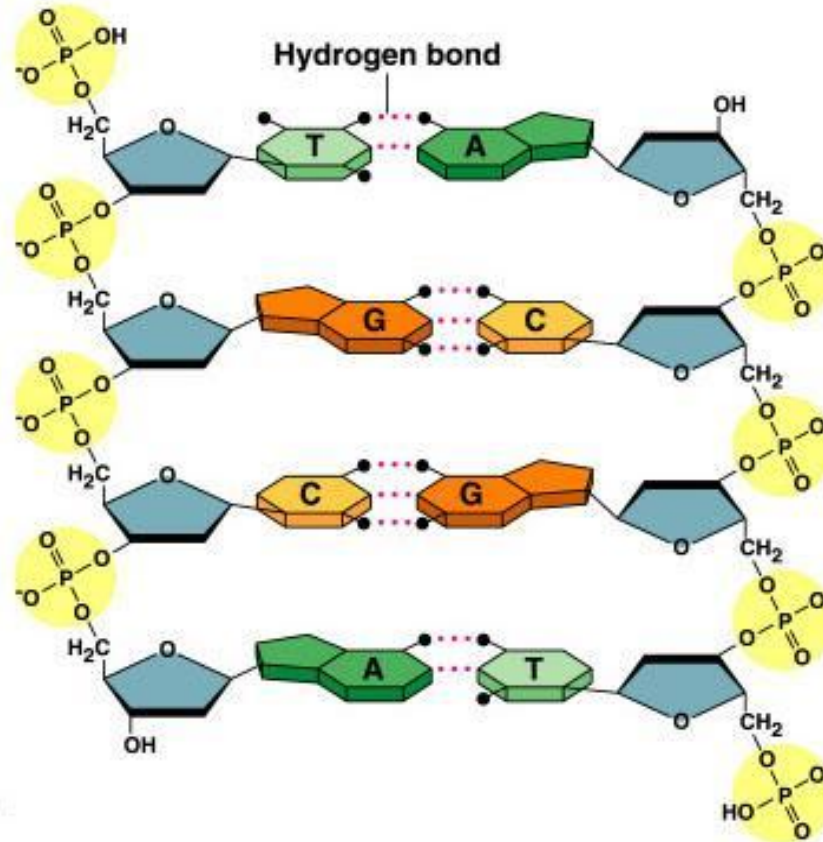
- Nucleic acids are polymers of monomers called **nucleotides**.
- Each nucleotide consists of three parts: a **nitrogen base**, a **pentose sugar**, and a **phosphate group**.
- The nitrogen bases (rings of carbon and nitrogen) come in two types: **Purines** and **Pyrimidines**.
- The pentose sugar joined to the nitrogen base is **ribose** in nucleotides of RNA and **deoxyribose** in DNA.
- The only difference between the sugars is the lack of an oxygen atom on carbon 2 in deoxyribose.

- Polynucleotides are synthesized by connecting the sugars of one nucleotide to the phosphate of the next with a **phosphodiester** link.
- This creates a repeating backbone of **sugar-phosphate** units with the nitrogen bases as appendages.
- The sequence of nitrogen bases along a DNA or mRNA polymer is unique for each gene.
- Genes are normally hundreds to thousands of nucleotides long.
- The linear order of bases in a gene specifies the order of amino acids (the monomers of a protein).

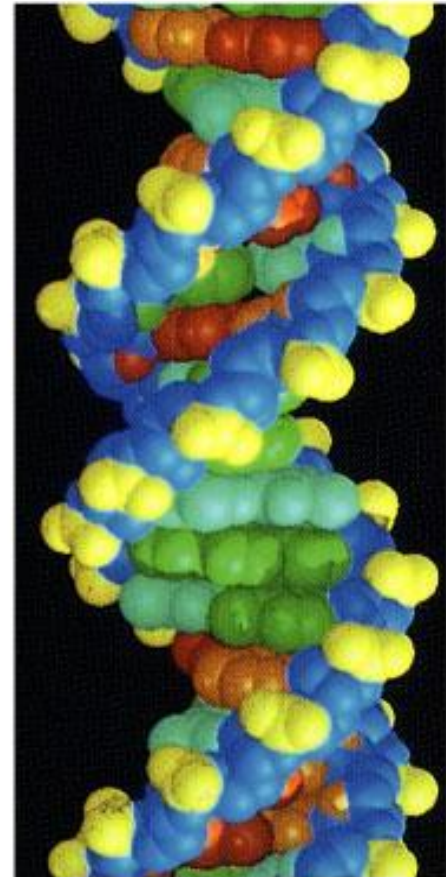
- An RNA molecule is single polynucleotide chain (**single strand**).
- DNA molecules have two polynucleotide strands (**double strand**) that spiral around to form a **double helix**.



(a) Key features of DNA structure

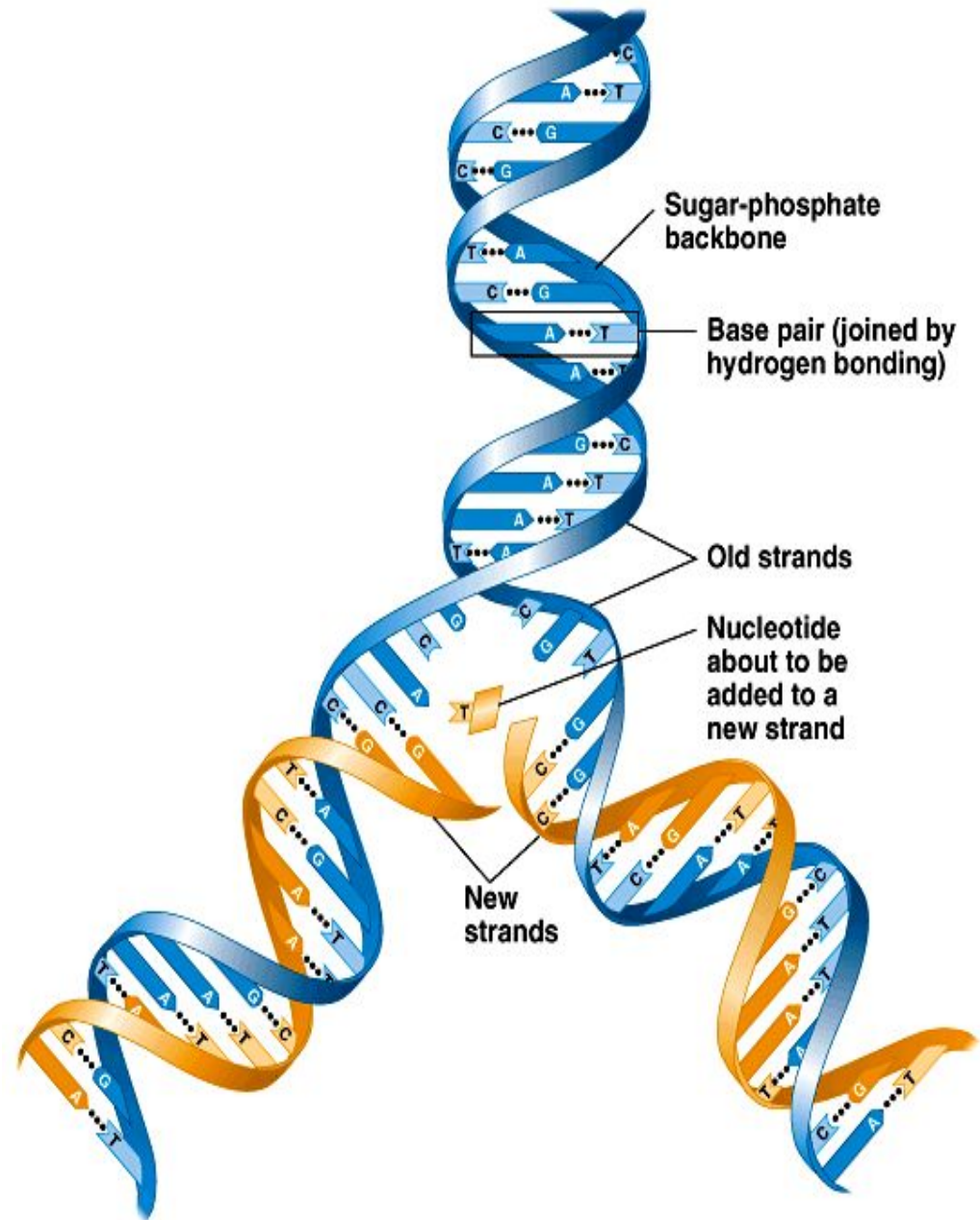


(b) Partial chemical structure



(c) Space-filling model

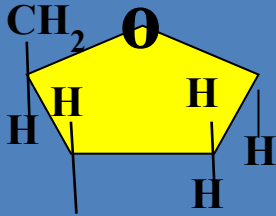
- The sugar-phosphate backbones of the two polynucleotides are on the outside of the helix.
- Pairs of nitrogenous bases (one from each strand) connect the polynucleotide chains with hydrogen bonds.
- Most DNA molecules have thousands to millions of base pairs (bP).



ribonucleic acid (RNA)

- a)- Messenger RNA (mRNA) is the blueprint for construction of a protein.
- b)- Ribosomal RNA (rRNA) is the construction site where the protein is made in the ribosome.
- c)- Transfer RNA (tRNA) is the truck delivering the proper amino acid to the site at the right time.

DNA



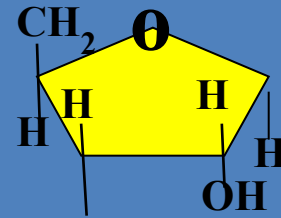
Deoxyribose sugar
(**O on C2 is missed**)

Deoxiribo-**N**ucleic-**A**cid

Double stranded nucleic acid

Bases: A, G, C, **T**

RNA



Ribose sugar
(**no missed O**)

Ribo-**N**ucleic-**A**cid

Single stranded nucleic acid

Bases: A, G, C, **U**

Repeated Sugar - Phosphate



DNA backbone

Sugar-Phosphate-Base



One nucleotide

Polynucleotide



DNA Molecule

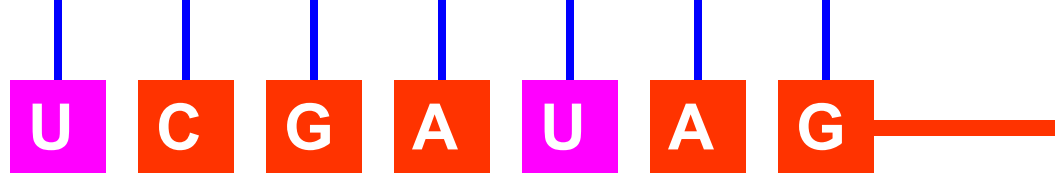
DNA Double stranded

RNA single stranded

DNA



mRNA



| Comparison | DNA | RNA |
|--|--|---|
| Name | DeoxyriboNucleic Acid | RiboNucleic Acid |
| Function | Long-term storage of genetic information; transmission of genetic information to make other cells and new organisms. | Used to transfer the genetic code from the nucleus to the ribosomes to make proteins. RNA is used to transmit genetic information in some organisms and may have been the molecule used to store genetic blueprints in primitive organisms. |
| Structural Features | B-form double helix. DNA is a double-stranded molecule consisting of a long chain of nucleotides. | A-form helix. RNA usually is a single-strand helix consisting of shorter chains of nucleotides. |
| Composition of Bases and Sugars | deoxyribose sugar phosphate backbone adenine, guanine, cytosine, thymine bases | ribose sugar phosphate backbone adenine, guanine, cytosine, uracil bases |
| Propagation | DNA is self-replicating. | RNA is synthesized from DNA on an as-needed basis. |
| Base Pairing | AT (adenine-thymine) GC (guanine-cytosine) | AU (adenine-uracil) GC (guanine-cytosine) |

Terminology

| English | Russian | Kazakh |
|-----------------------|--------------------------------|----------------------------|
| Nucleic acids | Нуклеиновая кислота | Нуклеин қышқылы |
| Deoxyribonucleic acid | Дезоксирибонуклеиновая кислота | Дезоксирибонуклеин қышқылы |
| Ribonucleic acid | Рибонуклениновая кислота | Рибонуклеин қышқылы |
| Nucleotide | Нуклеотид | Нуклеотид |
| Nitrogenous bases | Азотистые основания | Азоттық негіздер |
| Phosphate group | Фосфатная группа | Фосфат тобы |
| Pentose sugar | Сахар пентоза | Қант пентоза |
| Purines | Пурины | Пуриндер |
| Pyrimidines | Пиримидины | Пиримидиндер |
| Amino acids | Аминокислоты | Аминқышқылы |
| Protein | Белок | Ақуыз |