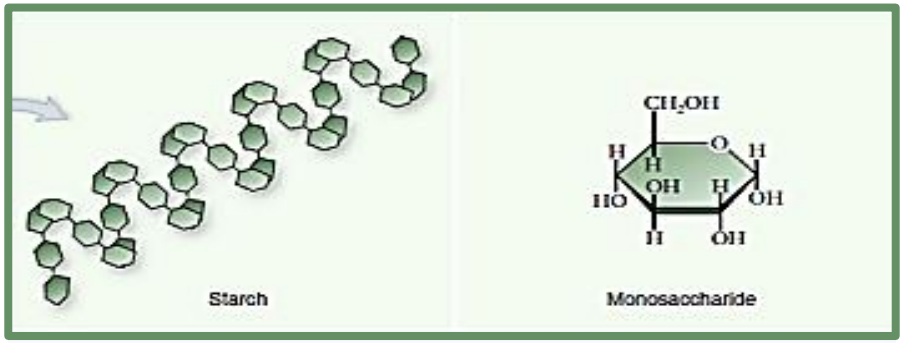
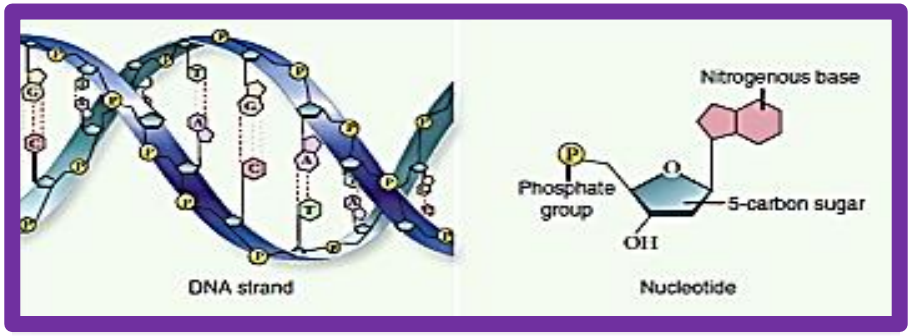
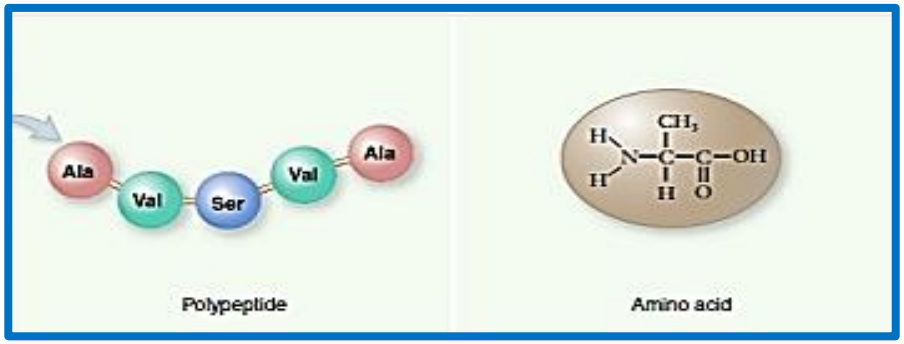
- Carbohydrates
- Nucleic acids- today

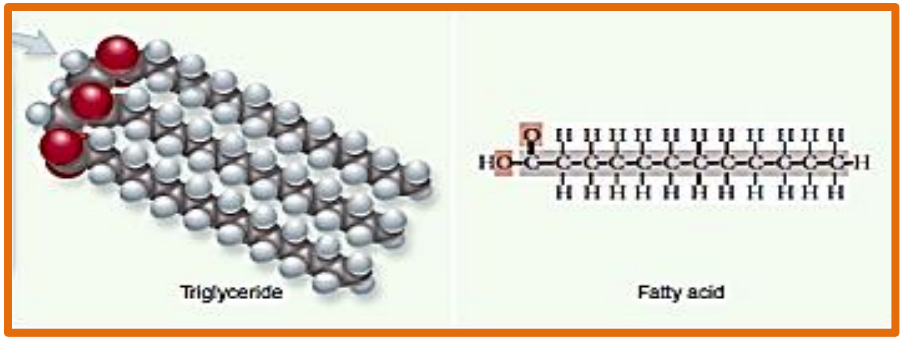
Four major classes of intracellular macromolecules (large biological molecules)

- Proteins
- Lipids



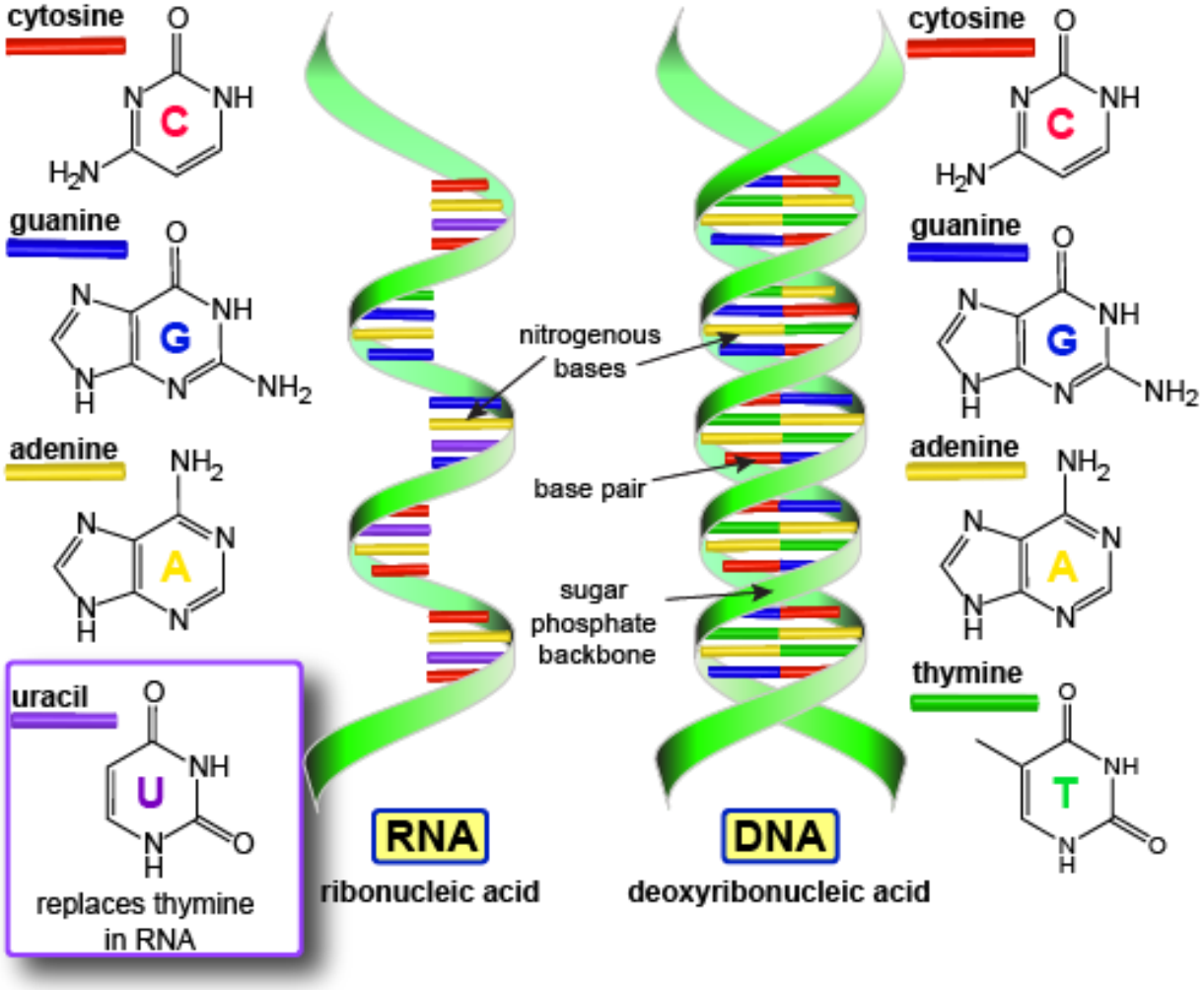






Nucleic Acids: Hereditary Material

All cells <u>store information</u> required to build and maintain the cell (*genetic information*) and <u>constantly use it</u>.



Nucleic acids are the molecules that

contain (Deoxyribonucleic acid, DNA)

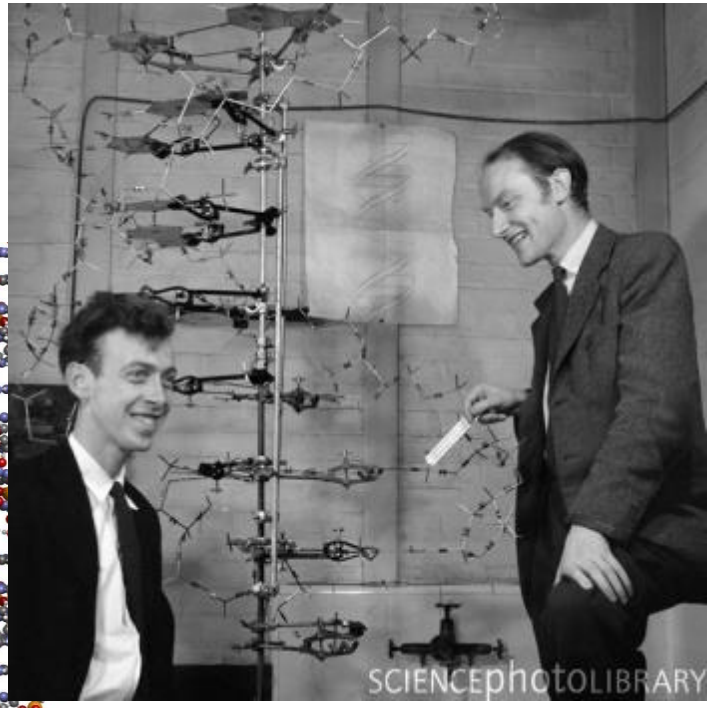
and

help express (ribonucleic acid, RNA)

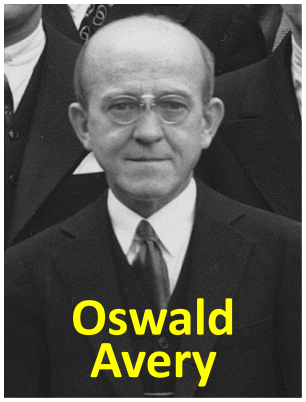
this information.

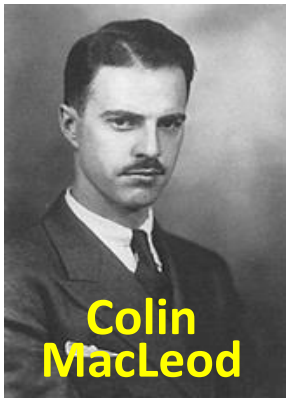
DNA Discovery

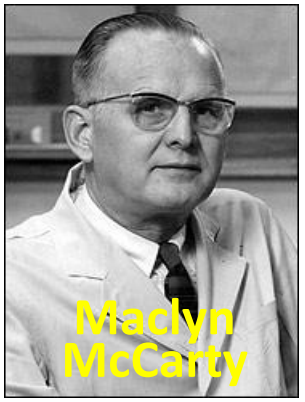
- Swiss physician Friedrich Miescher discovered DNA ("nuclein") in 1869, athough scientists did not understand what it was until…



James Watson and Francis Crick with their DNA model







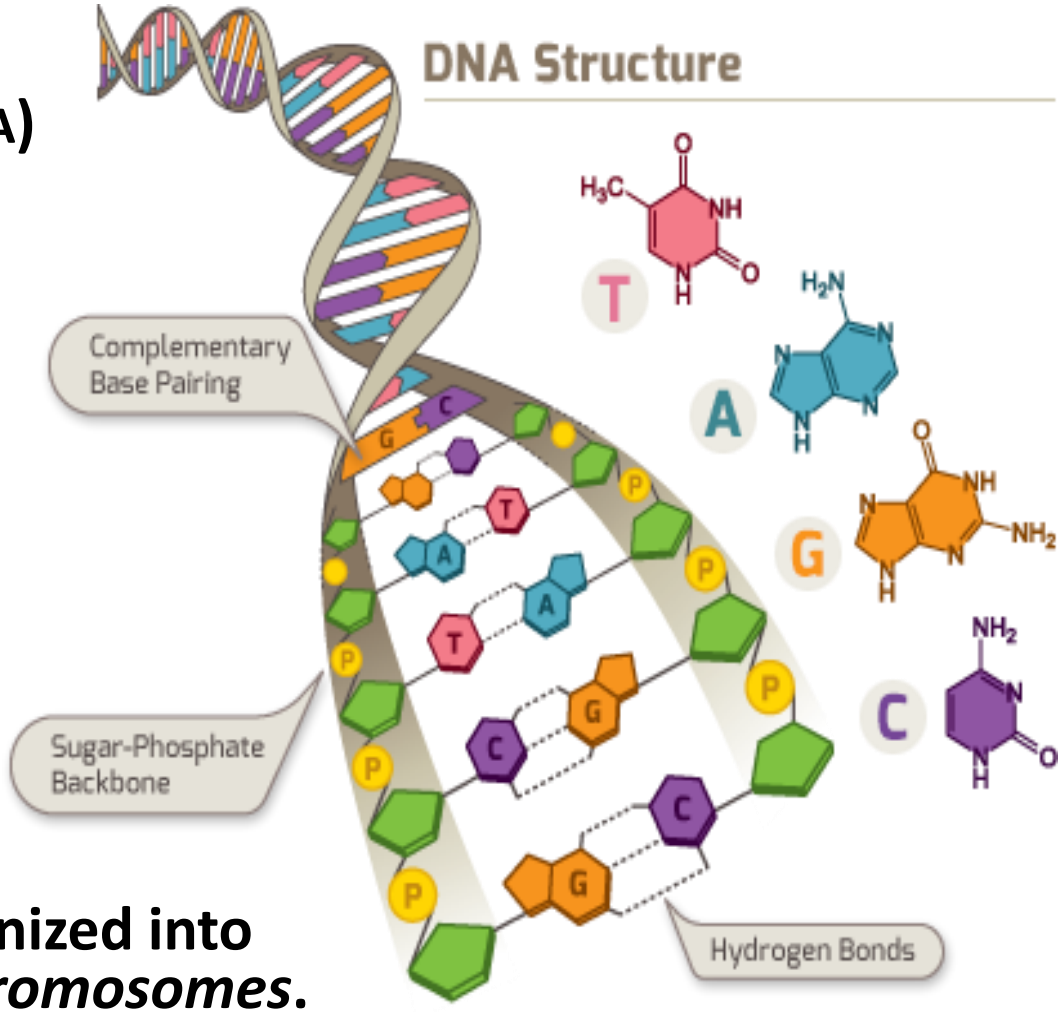
…1943: Avery-MacLeod-McCarty experiment showed that DNA is the hereditary material in bacteria.

- In 1953, James Watson and Francis Crick suggested the double-helix model of DNA structure based on a single X-ray diffraction image.

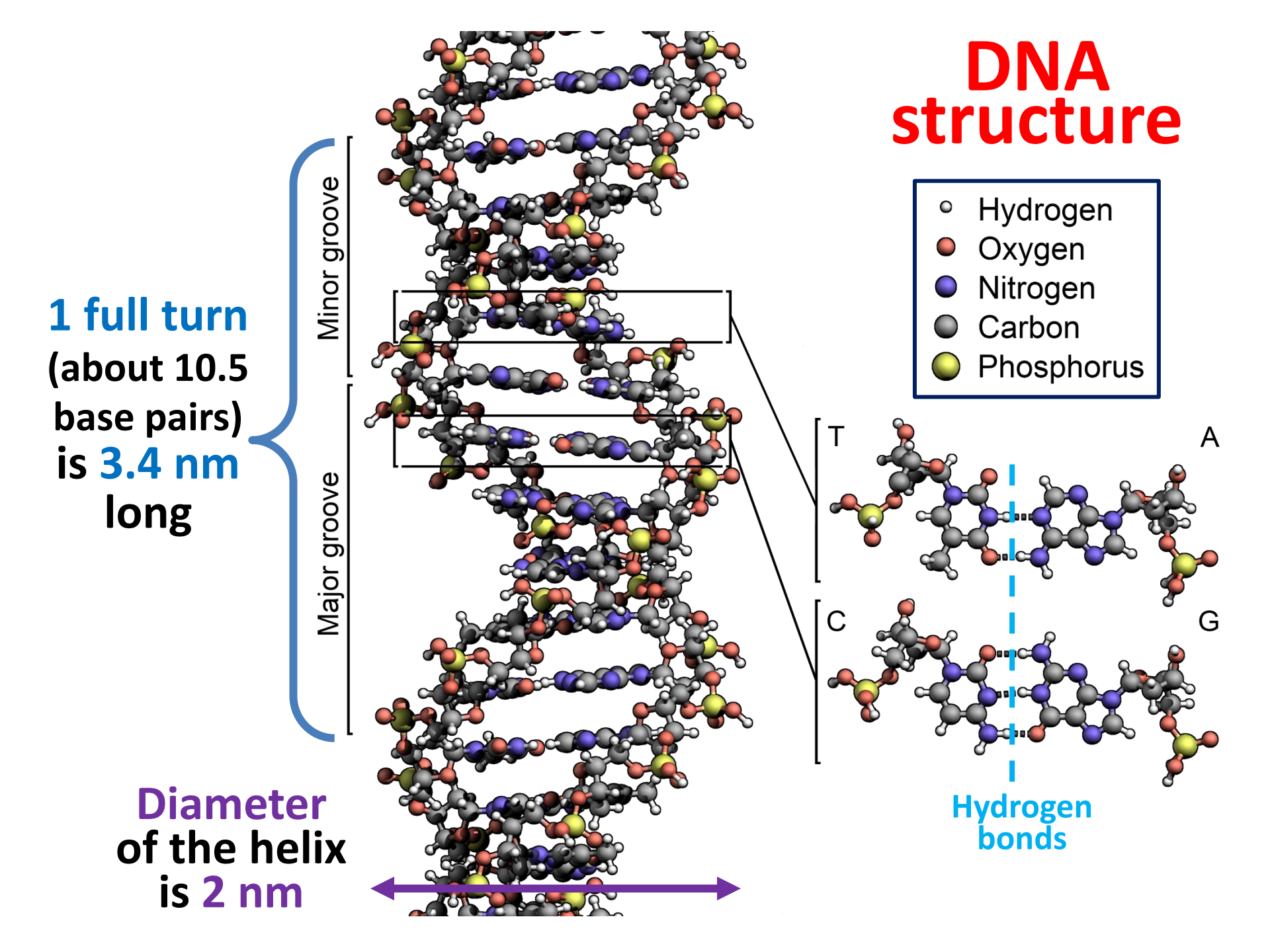
DNA is a long polymer

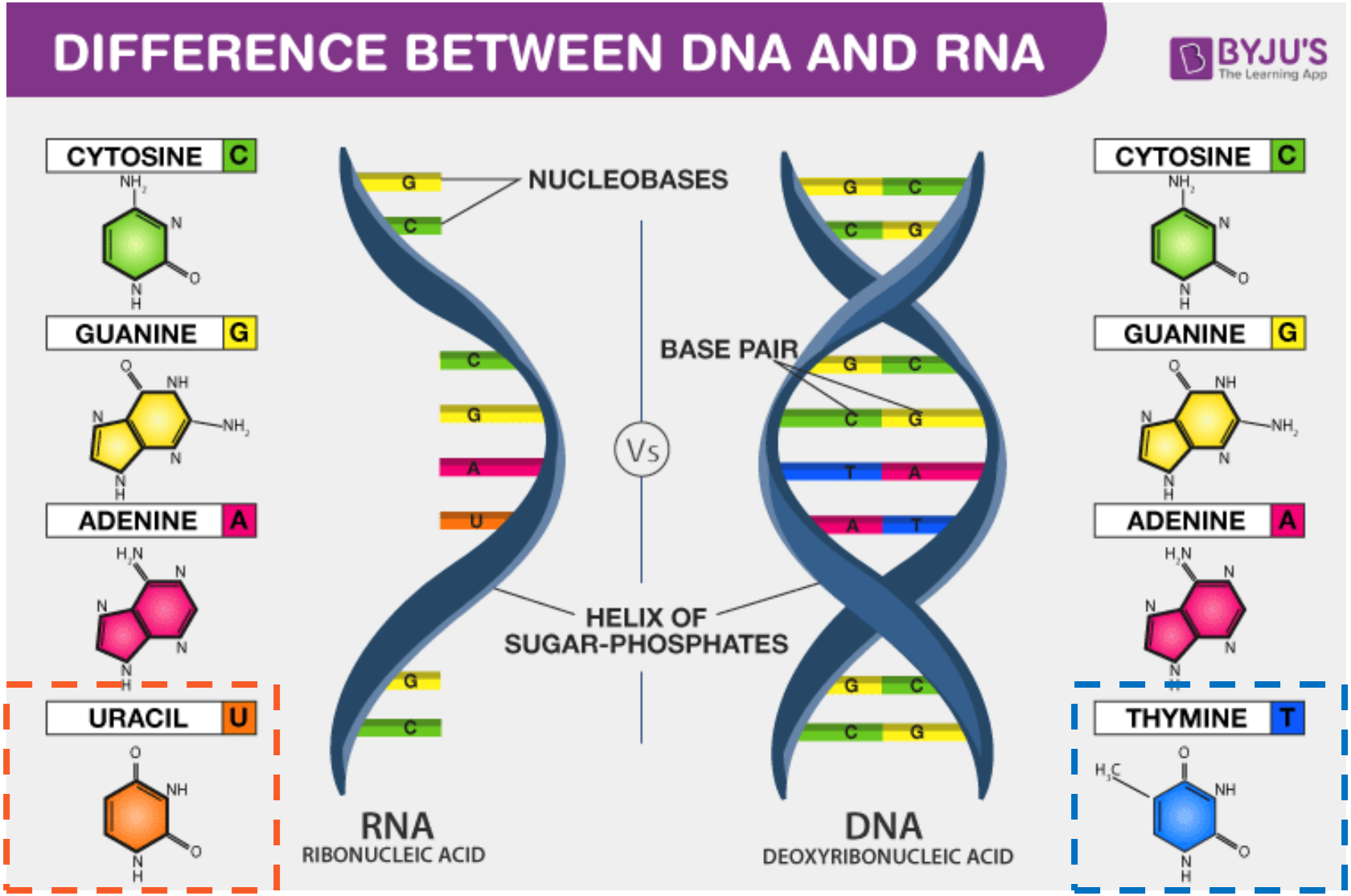
made from repeating units called nucleotides, or *bases*

- **Four types of bases:**
  - **T - Thymine (Uracil in RNA)**
  - **A - Adenine**
  - **G - Guanine**
  - **C - Cytosine**
- **In living organisms DNA does not usually exist as a single molecule, but instead as a pair of molecules that are held tightly together, entwined in the shape of a double helix.**
- **Within cells, DNA is organized into long structures called *chromosomes*.**



DNA structure





RNA is a shorter single strand, found in the cytoplasm, cannot self-replicate

DNA is a long double-helix, found mostly in the nucleus, can self-replicate

Gene, Genome and Genetic Code

What is Genome?

- Genetic material of an organism, essentially the instructions on making proteins and RNAs.
- Inscribed in DNA: complete DNA sequence.
- Includes both the *genes* and the non-coding regions.

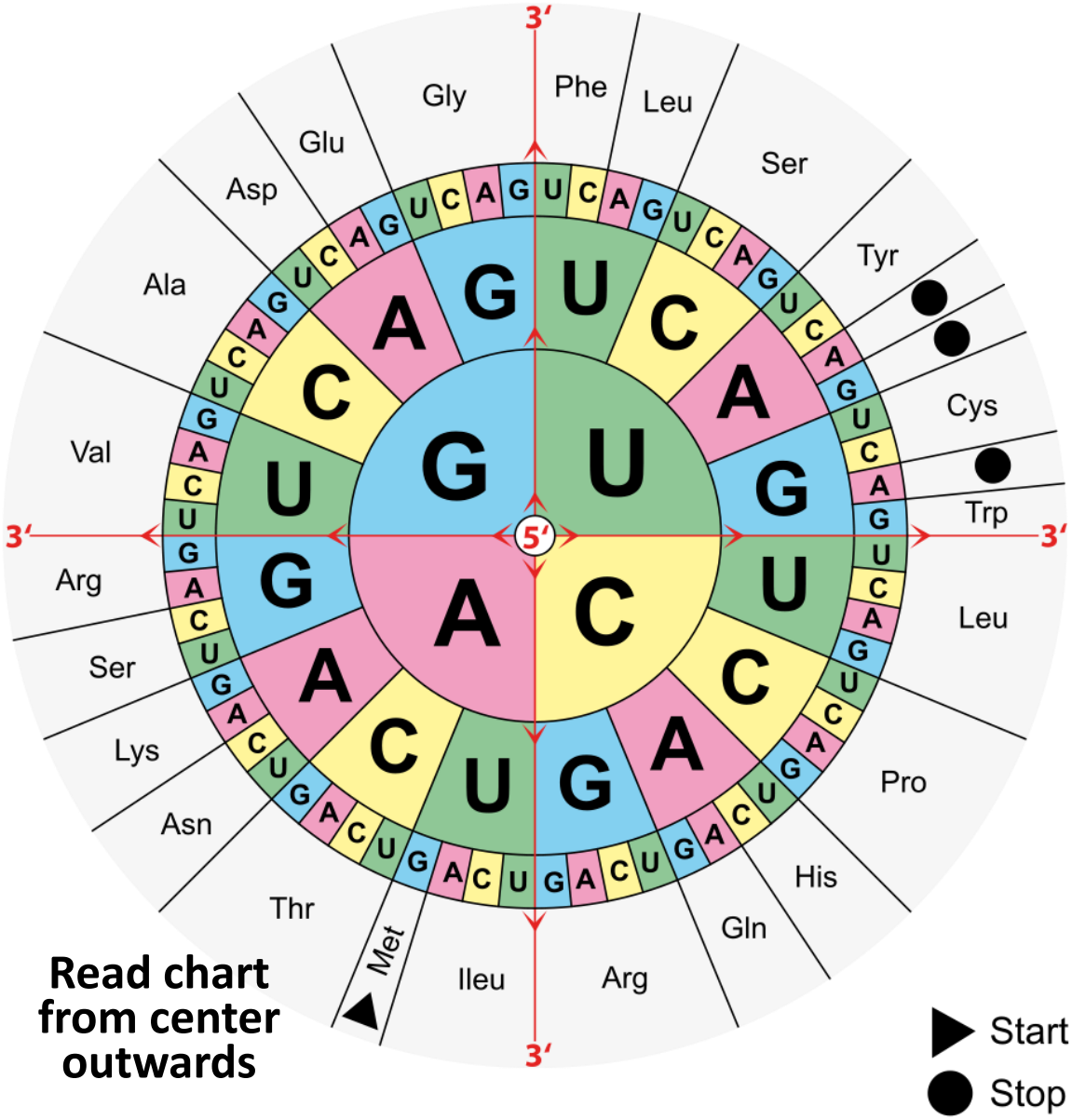
What is Gene?

- The portion of the genome that codes for a single protein or an RNA.
- The molecular unit of heredity of a living organism.
- The size of a single gene may vary greatly, ranging from ~1,000 bases to ~1 million bases in humans.

What is Genetic Code?

- The set of rules by which information encoded within DNA or RNA is translated into proteins.
- In general, the genetic code specifies 20 standard amino acids by means of triple nucleotide *codons* and is basically the same for all organisms on Earth.

Genetic Code



Read chart from center outwards

- 4-letter language.
- 3-letter words (*codons*).
- There are 64 words but only 20+2 unique “meanings” (20 amino acids and also “start” and “stop” codons).
- Some words have same meaning (*code redundancy*).
- All words have specific meaning (*no ambiguity*).