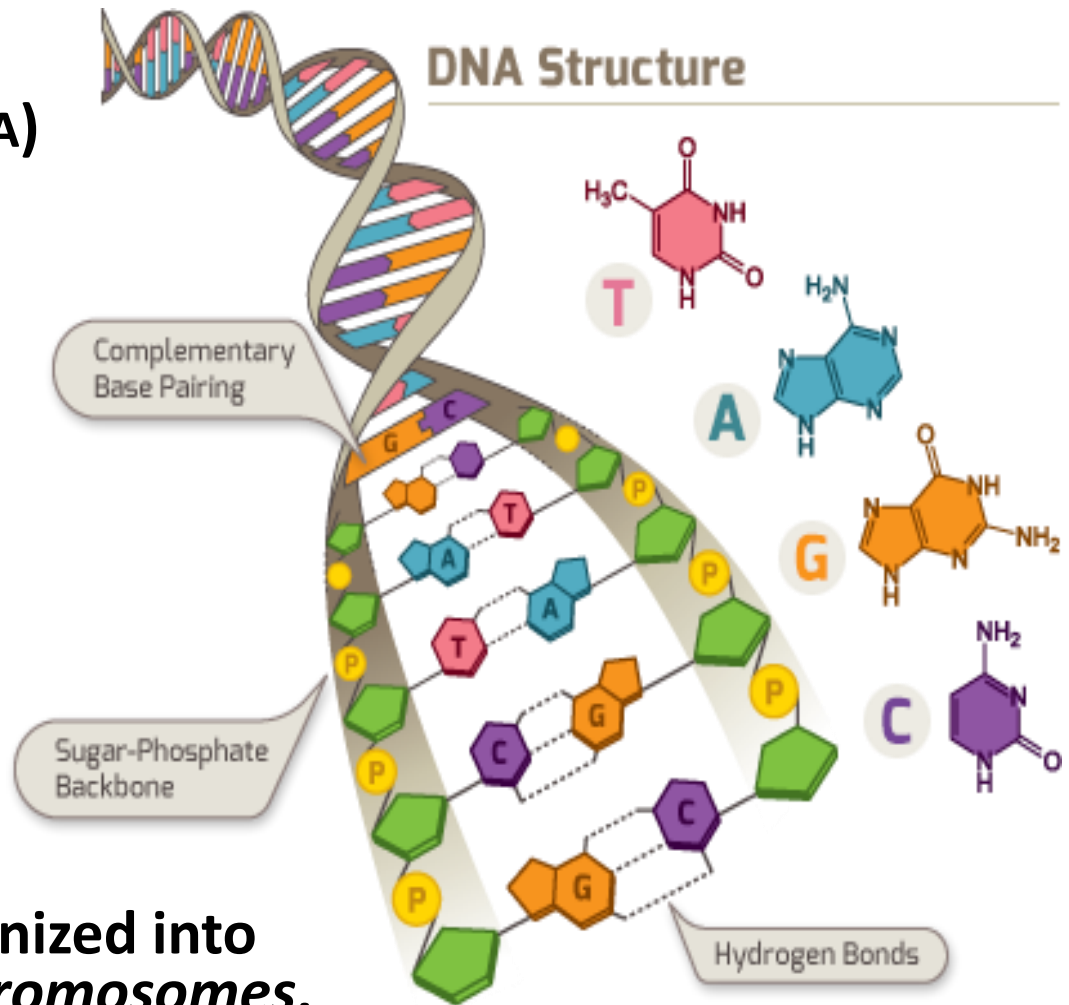


DNA is a long polymer made from repeating units called **nucleotides**, or *bases*

- 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*.



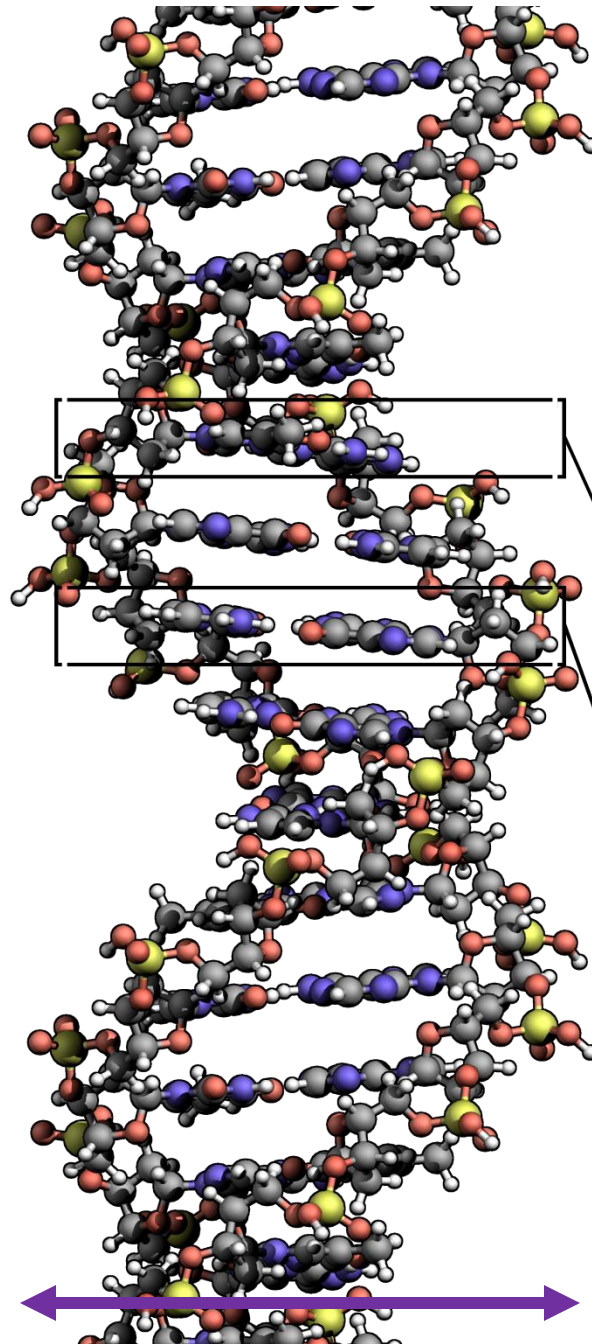
DNA structure

1 full turn
(about 10.5
base pairs)
is 3.4 nm
long

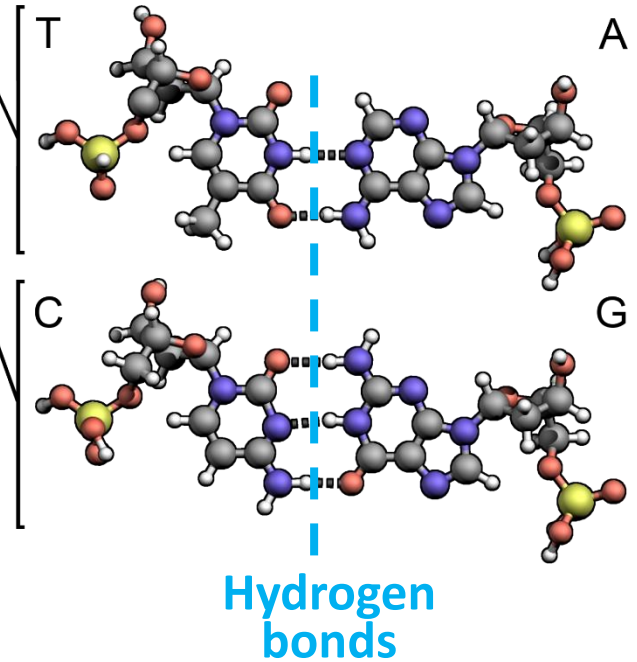
Minor groove

Major groove

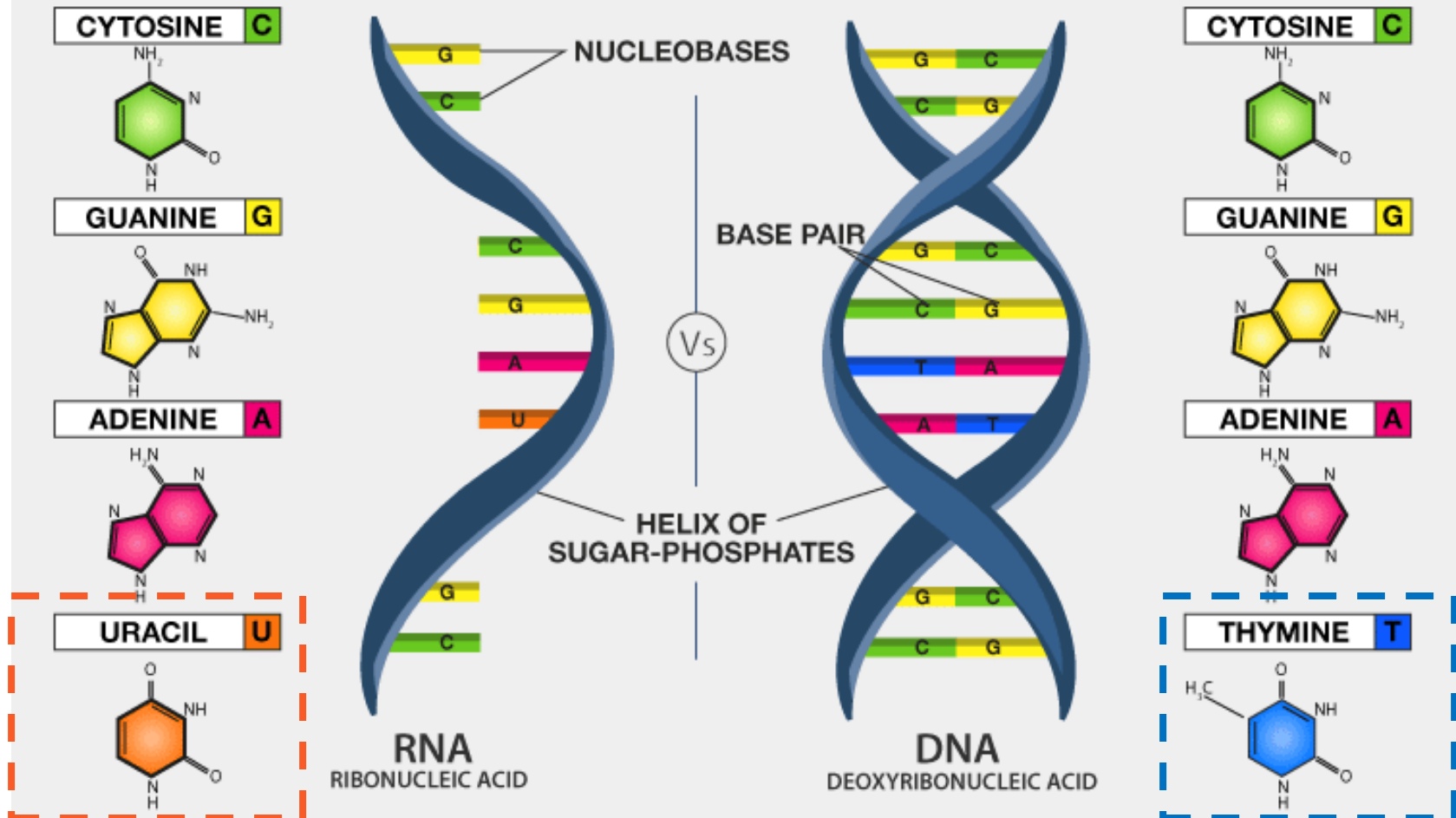
Diameter
of the helix
is 2 nm



- Hydrogen
- Oxygen
- Nitrogen
- Carbon
- Phosphorus



DIFFERENCE BETWEEN DNA AND RNA



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 **Genetic Code**?

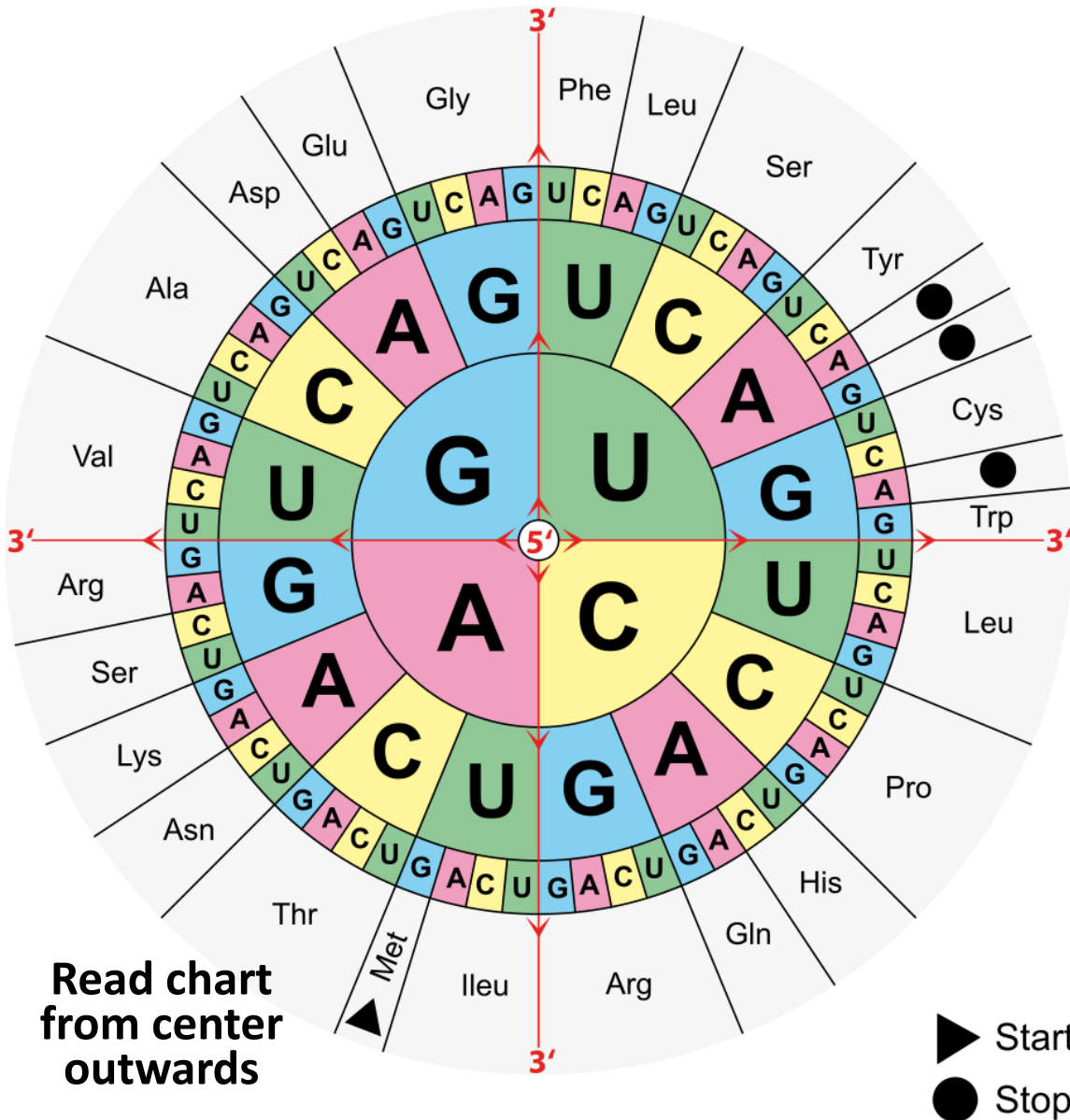
- The **set of rules** by which information encoded within DNA or RNA is translated into proteins.
- In general, the genetic code **specifies 20 standard amino acids by means of triple nucleotide *codons*** and is basically the same for all organisms on Earth.

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.



Genetic Code



- 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*).

DNA mutation: a change in sequence

THE CAT ATE THE RAT
THE **K**AT ATE THE RAT

THE CAT ATE THE RAT
THE **H**AT ATE THE RAT

THE **C**AT ATE THE RAT
THE CAA TET HER AT

THE CAT ATE THE RAT
THE **E**CA TAT ETH ERA T

- **Substitution:**

- Silent – the same meaning.

- Missense – the meaning is changed.

- **Deletion** – nonsense (the sentence makes no sense)

- **Insertion** – nonsense (the sentence makes no sense)

Substitutions are *point* mutations, while insertions and deletions are *frameshift* mutations.