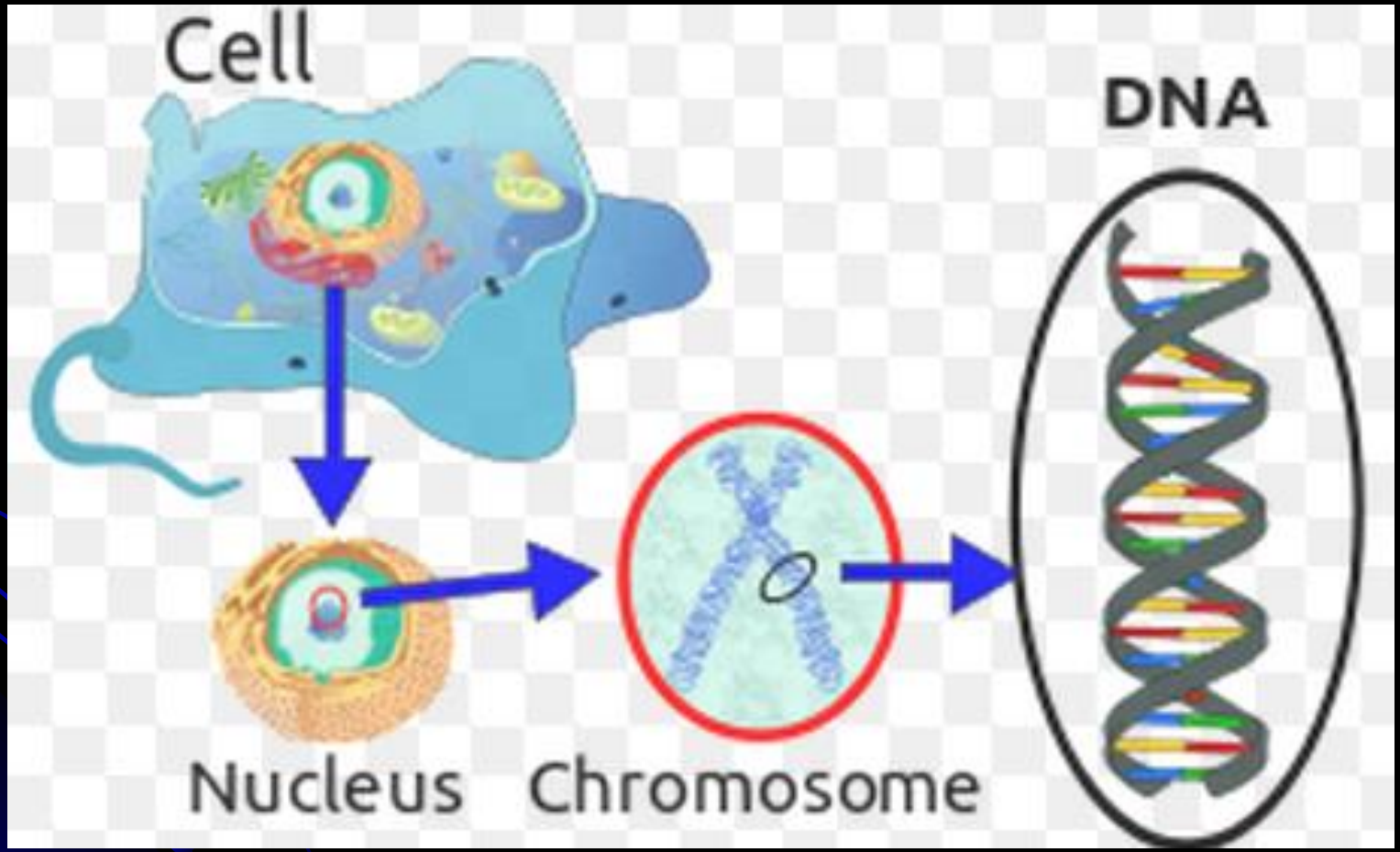
DNA Replication

12/15/14

DNA in a Cell



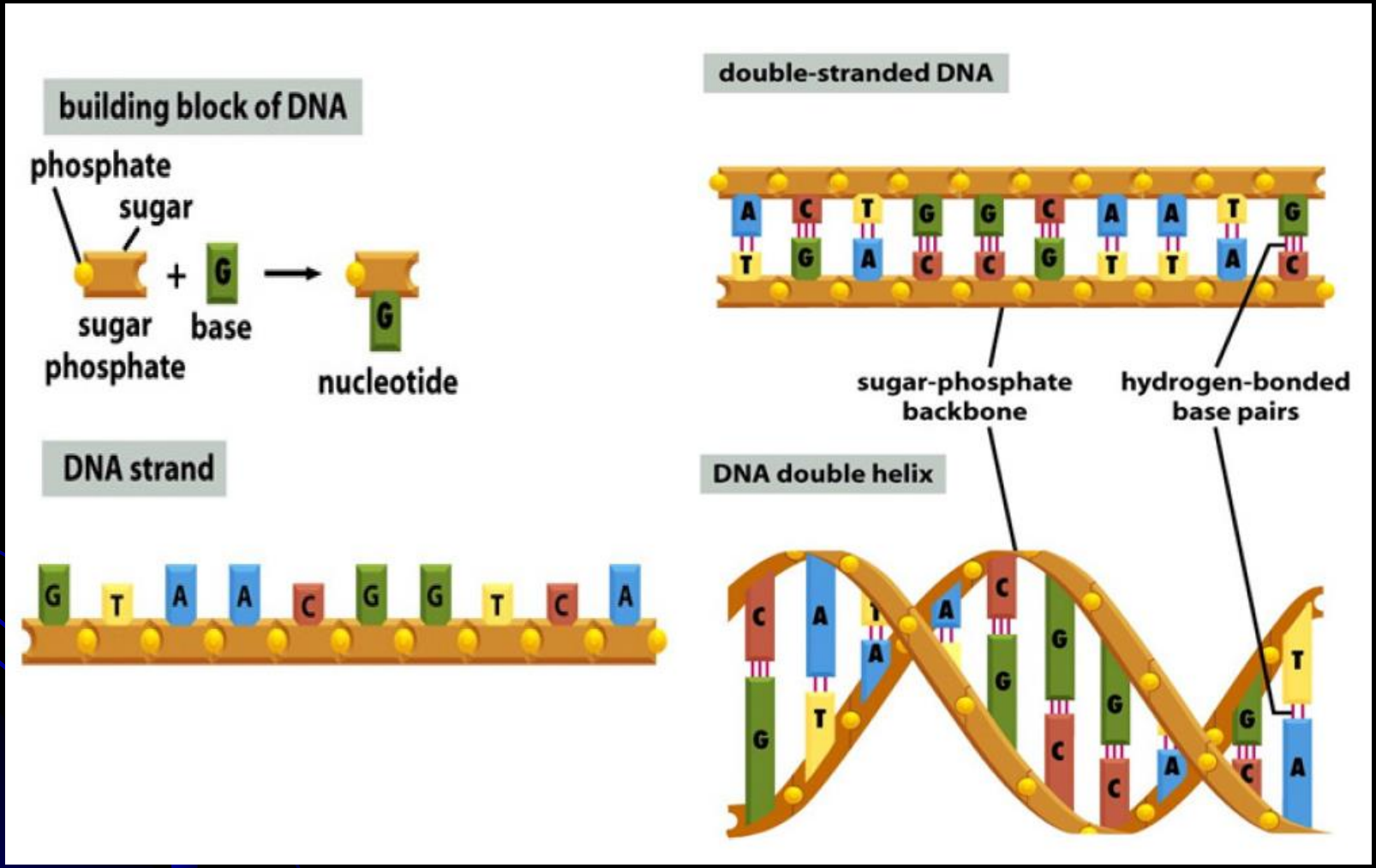
Prokaryotes and Eukaryotes

A **cell** is the fundamental working unit of every living organism.

There are two kinds of cells:

- **prokaryotes**, which are single-celled organisms with no cell nucleus: archea and bacteria.
- **eukaryotes**, which are higher level organisms, and their cells have nuclei: animals and plants.

DNA Double Helix



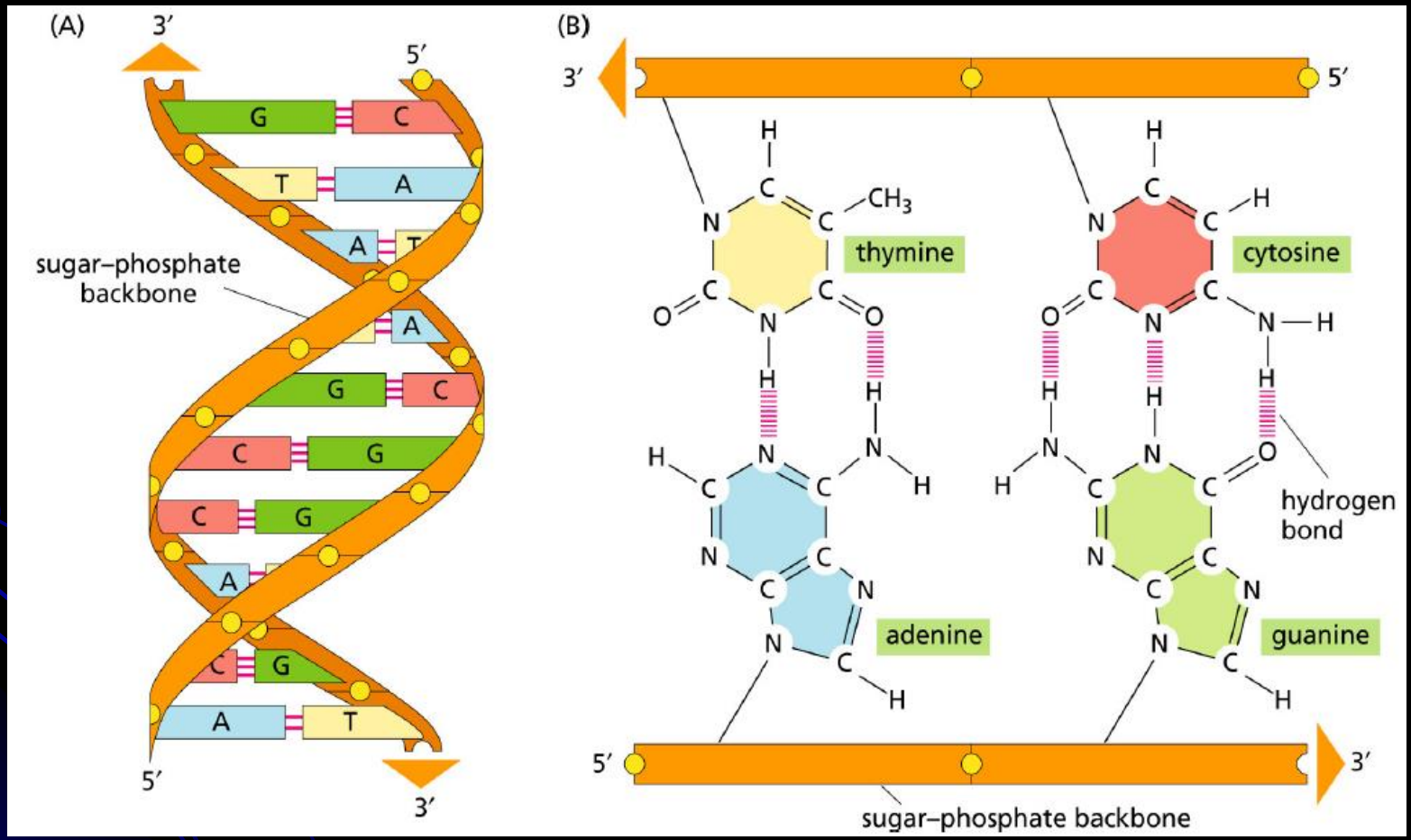
DNA Structure

- A **deoxyribonucleic acid** or **DNA** molecule is a double-stranded polymer composed of four basic molecular units called nucleotides.
- Each nucleotide comprises
  - a phosphate group
  - a deoxyribose sugar
  - one of four nitrogen bases:

    purines: **adenine** (**A**) and **guanine** (**G**)

    pyrimidines: **cytosine** (**C**) and **thymine** (**T**).

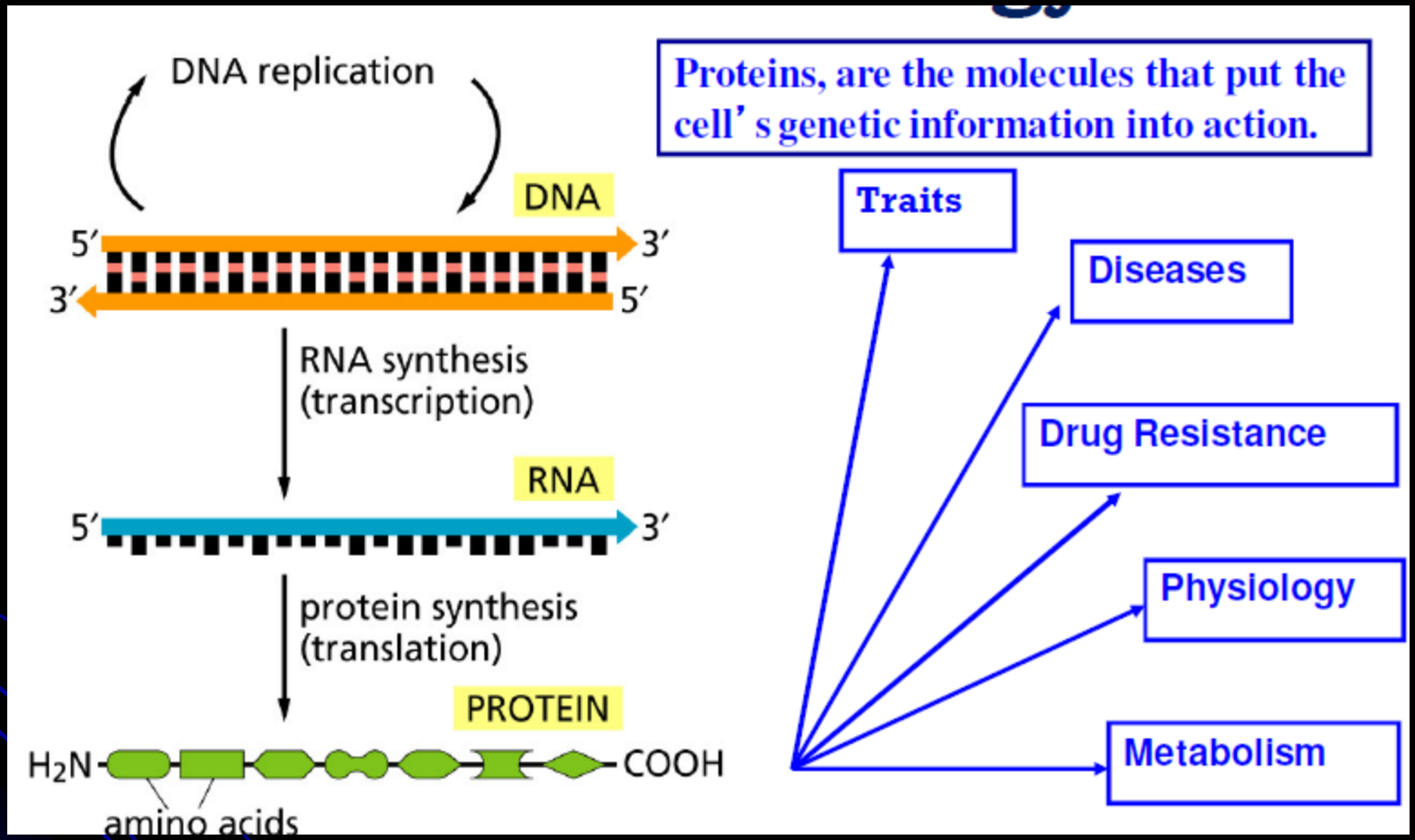
Double Helical Structure of DNA



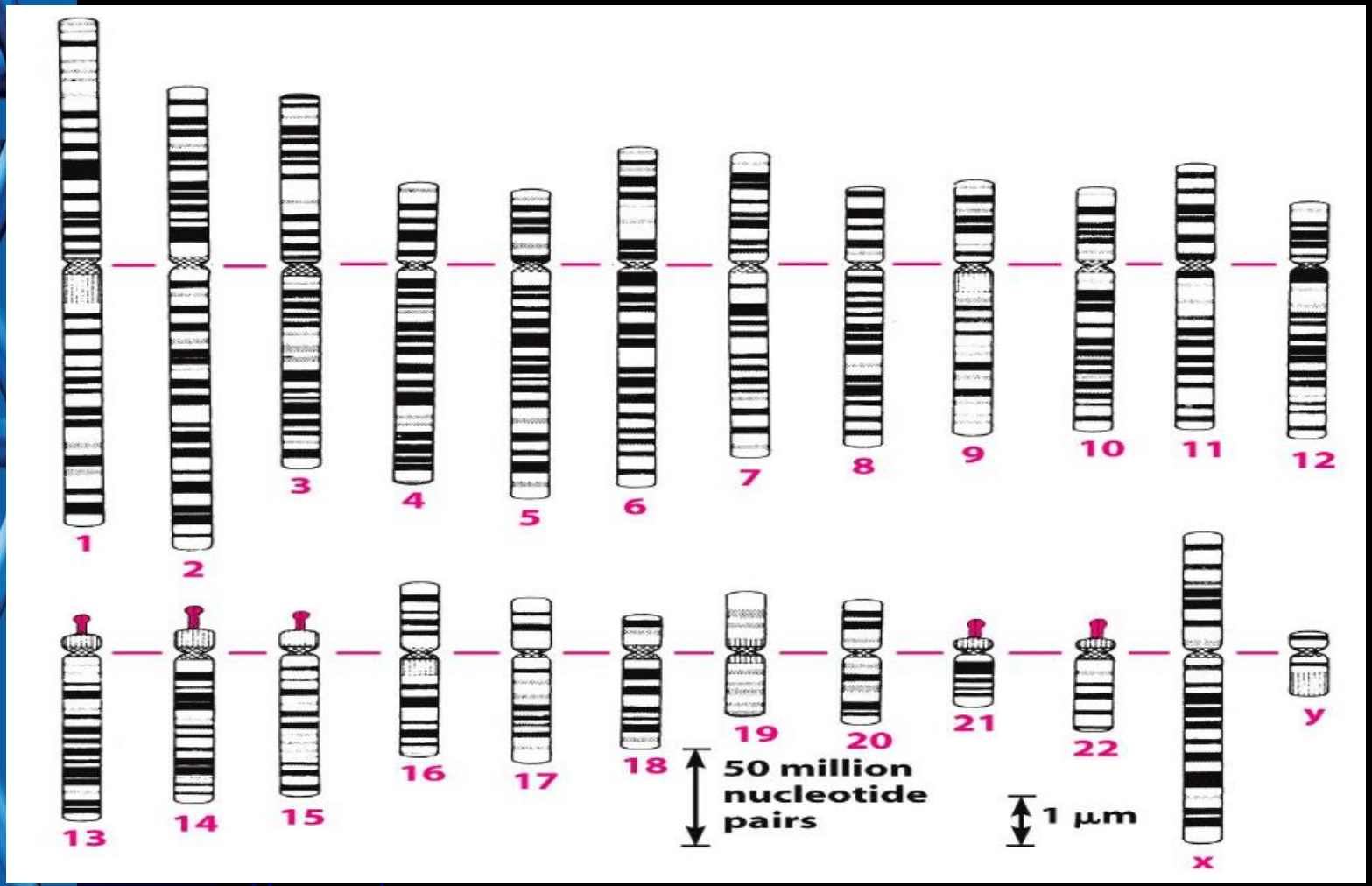
What is DNA?

- The complete collection of our DNA in one single copy is called a "genome".
- Double helix DNA is in fact two copies of your genome (sense and antisense).
- The double helix DNA in humans is divided in 23 chromosomes (so each chromosome is a part of your entire DNA collection and are thus not the same), which are present twice in each cell. Every gene is therefore present twice, once from your mother, once from your father.
- Every living cell in the body has exactly the same DNA sequence in the chromosomes (except red blood cells that don't have a nucleus). But every type of cell "knows" what to do and what not to do because it receives specific instructions from outside the cell, which sometimes results in an entire cascade of secondary instructions.

Central Dogma of Molecular Biology



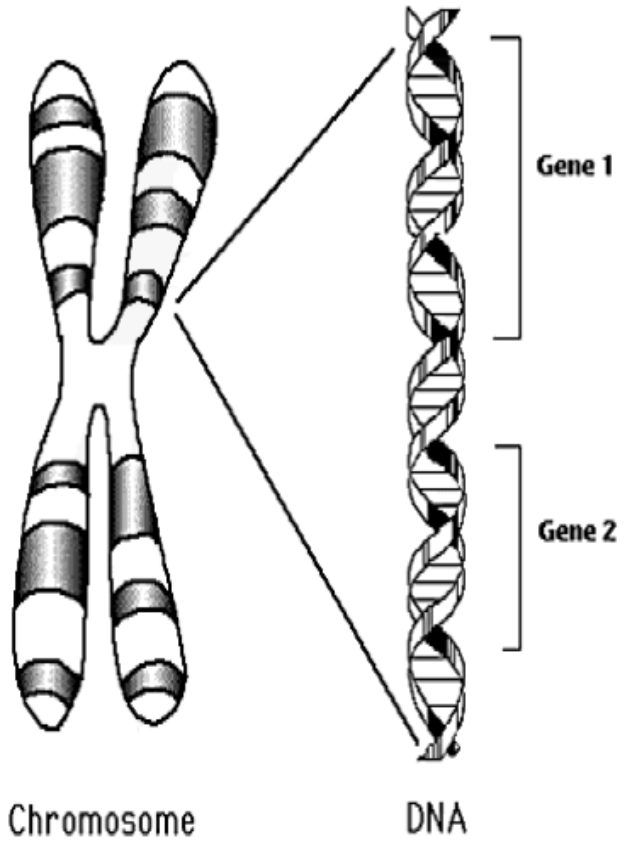
Human Chromosomes



Pairs of Chromosomes in Species

Common name	Scientific name	Number of chromosome pairs	Common name	Scientific name	Number of chromosome pairs
Mosquito	*Culex pipiens*	3	Wheat	*Triticum aestivum*	21
Housefly	*Musca domestica*	6	Human	*Homo sapiens*	23
Garden onion	*Allium cepa*	8	Potato	*Solanum tuberosum*	24
Toad	*Bufo americanus*	11	Cattle	*Bos taurus*	30
Rice	*Oryza sativa*	12	Donkey	*Equus asinus*	31
Frog	*Rana pipiens*	13	Horse	*Equus caballus*	32
Alligator	*Alligator mississipiensis*	16	Dog	*Canis familiaris*	39
Cat	*Felis domesticus*	19	Chicken	*Gallus domesticus*	39
House mouse	*Mus musculus*	20	Carp	*Cyprinus carpio*	52
Rhesus monkey	*Macaca mulatta*	21			

Genes



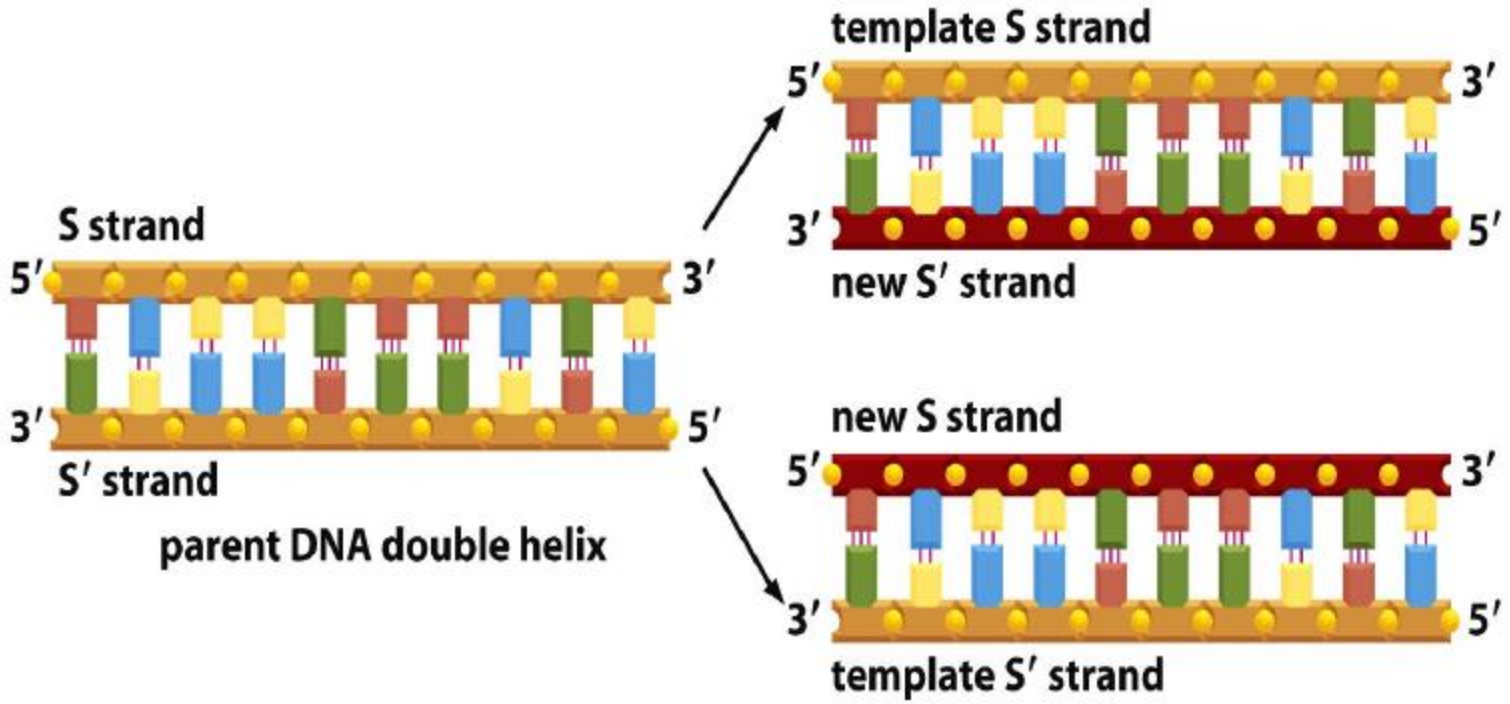
- A **gene** is a specific sequence of nucleotide bases along a chromosome carrying information for constructing a protein. A gene encodes a protein (or an RNA).
- The distance between **genes** is often much larger than the genes themselves.
- The human genome has around 23,500 genes.

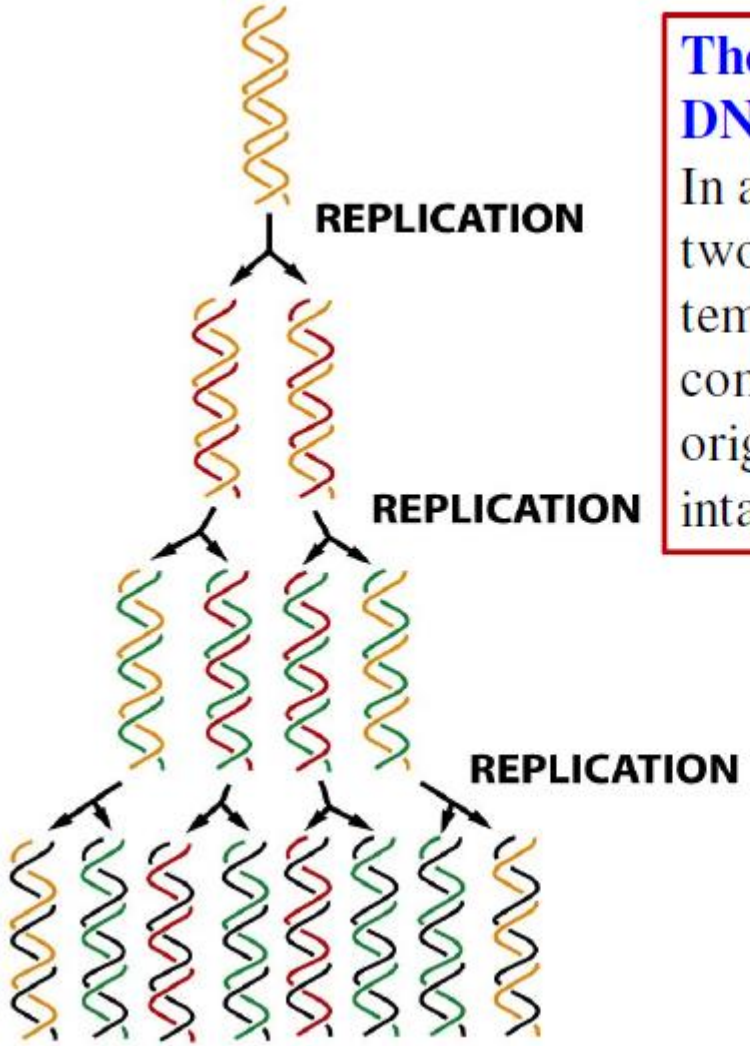
DNA Replication

- All organisms must duplicate their DNA with extraordinary accuracy before each cell division.
- During DNA replication inside a cell, each of the two original DNA strands serves as a template for the formation of an entire new strand.
- Because each of the two daughters of a dividing cell inherits a new DNA double helix containing one original and one new strand, the DNA double helix is said to be replicated "semiconservatively" by DNA polymerase.

The DNA double helix acts as a template for its own duplication

Because the nucleotide A will pair successfully only with T and G only with C, each strand of DNA can serve as a template to specify the sequence of nucleotides in its complementary strand by DNA basepairing. In this way, a double-helical DNA molecule can be copied precisely.

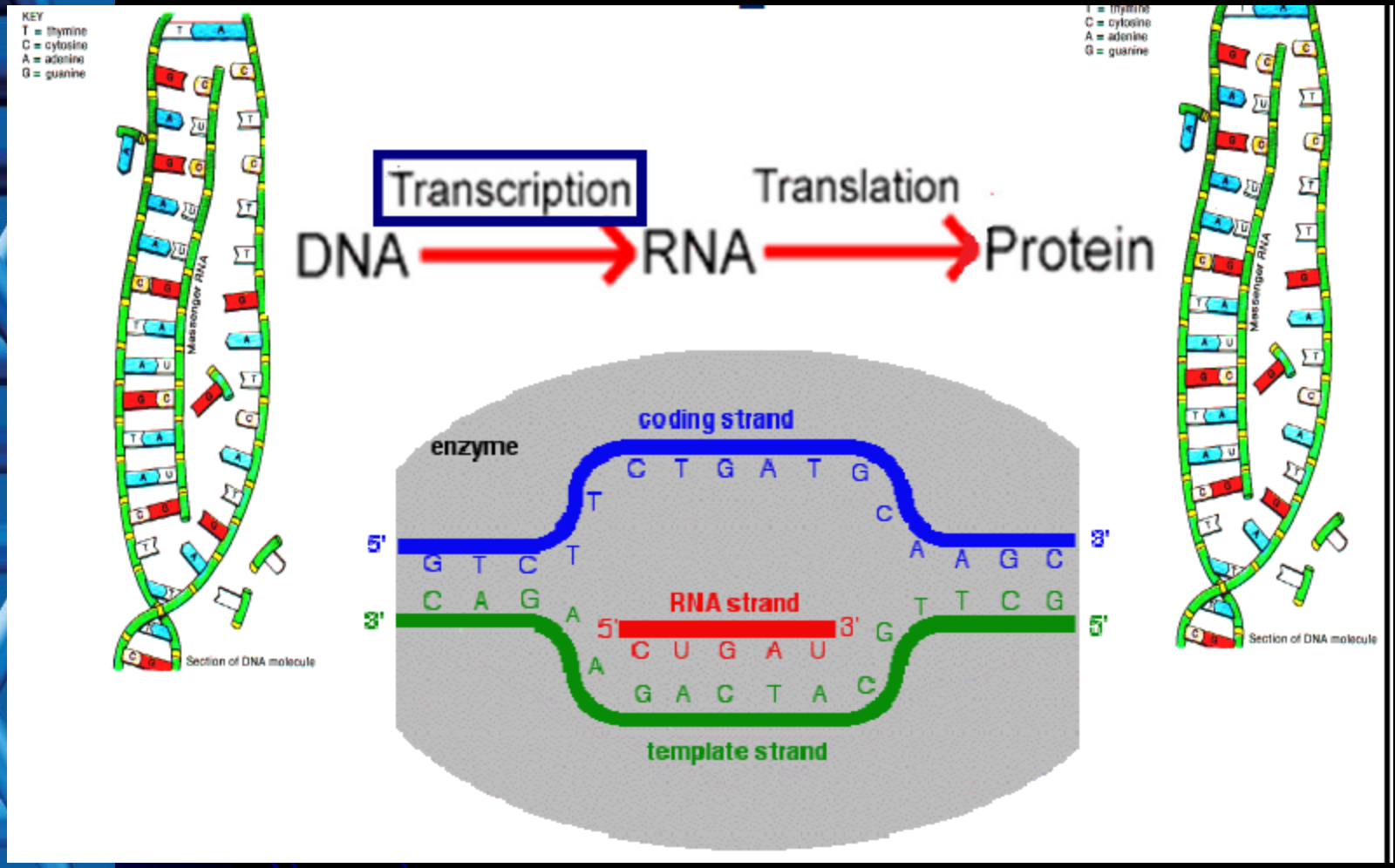




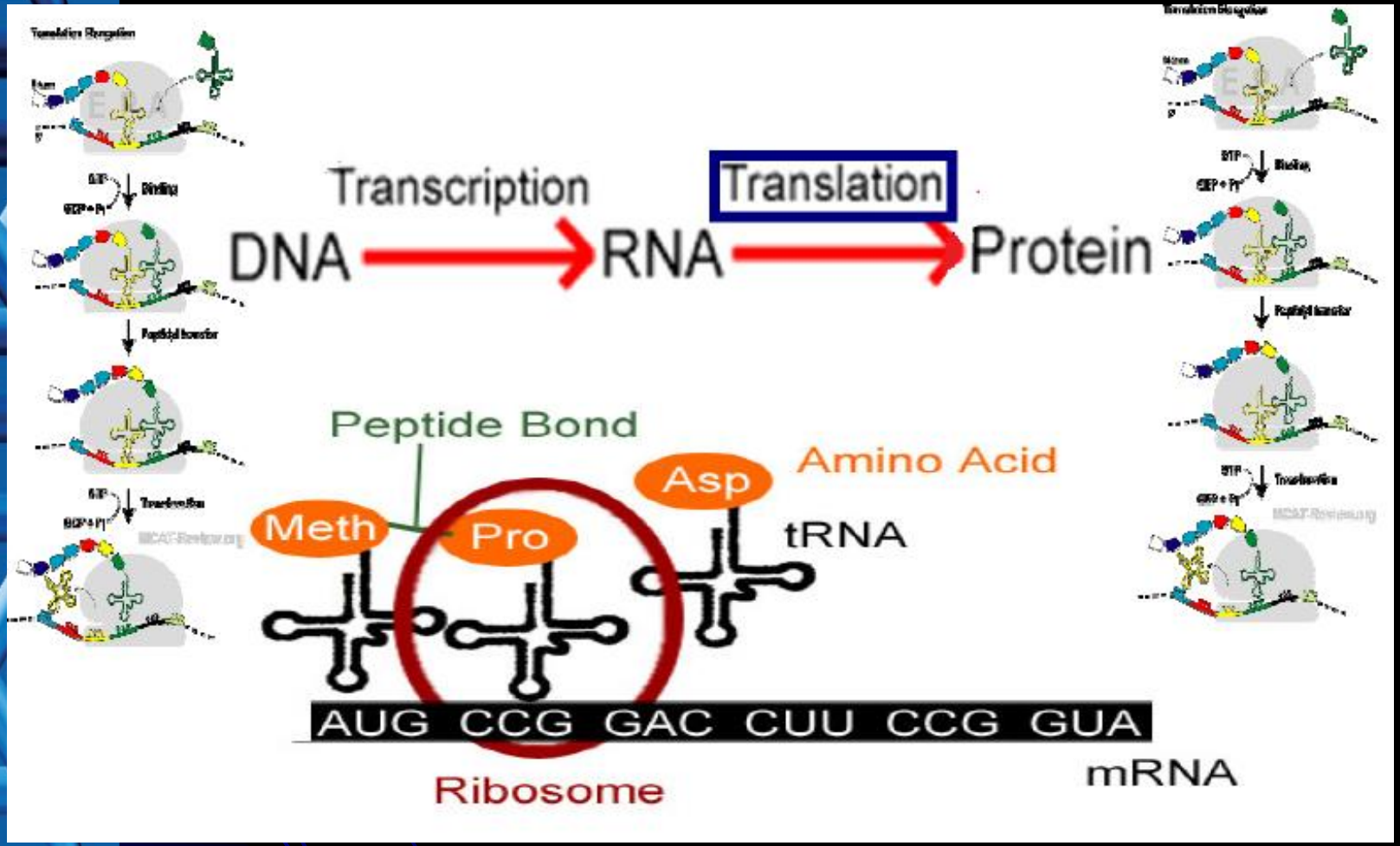
The semiconservativen ature of DNA replication

In a round of replication, each of the two strands of DNA is used as a template for the formation of a complementary DNA strand. The original strands therefore remain intact through many cell generations

Transcription



Translation



Video