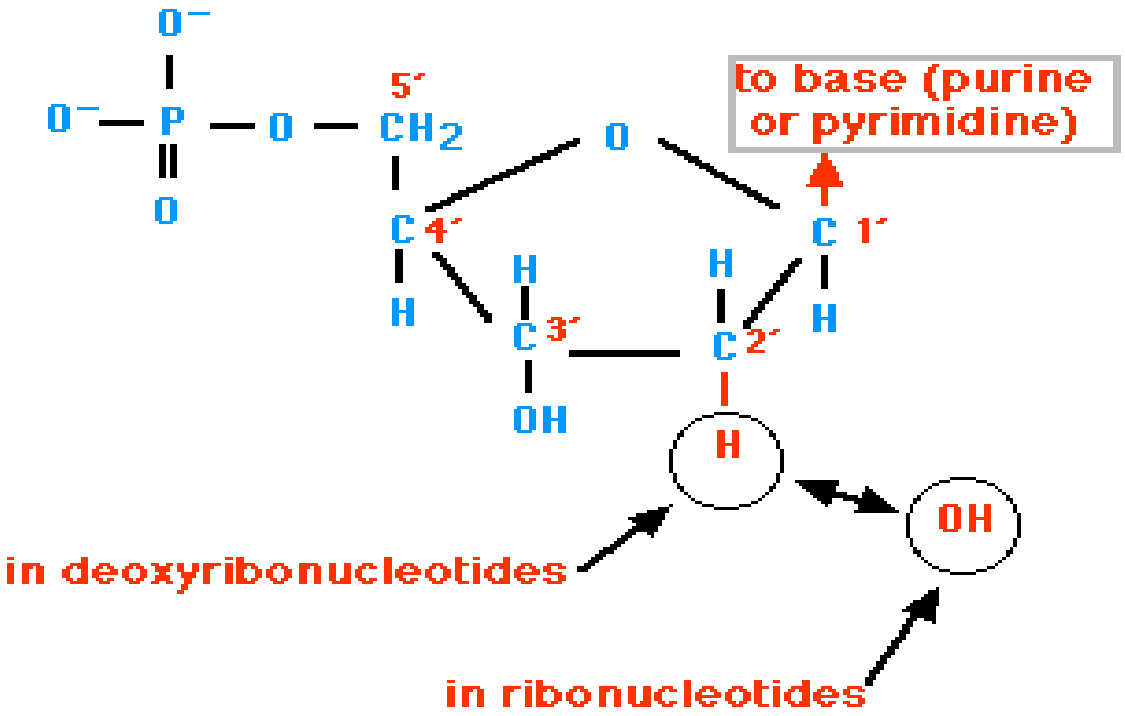
Nucleic acids

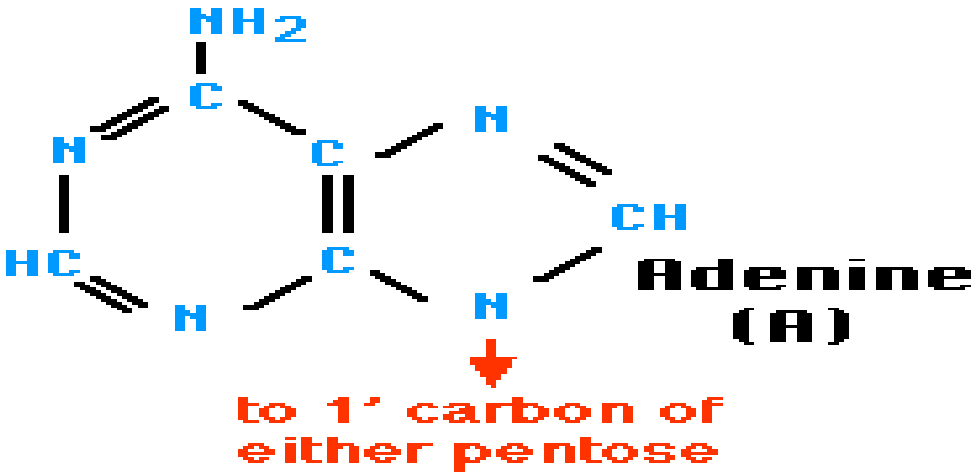
- Complex organic molecules that store and transfer genetic information within a cell
- DNA (deoxyribonucleic acid): genetic material
- RNA (ribonucleic acid): uses genetic information to manufacture proteins
- Nucleic acids are made of nucleotides (monomers)

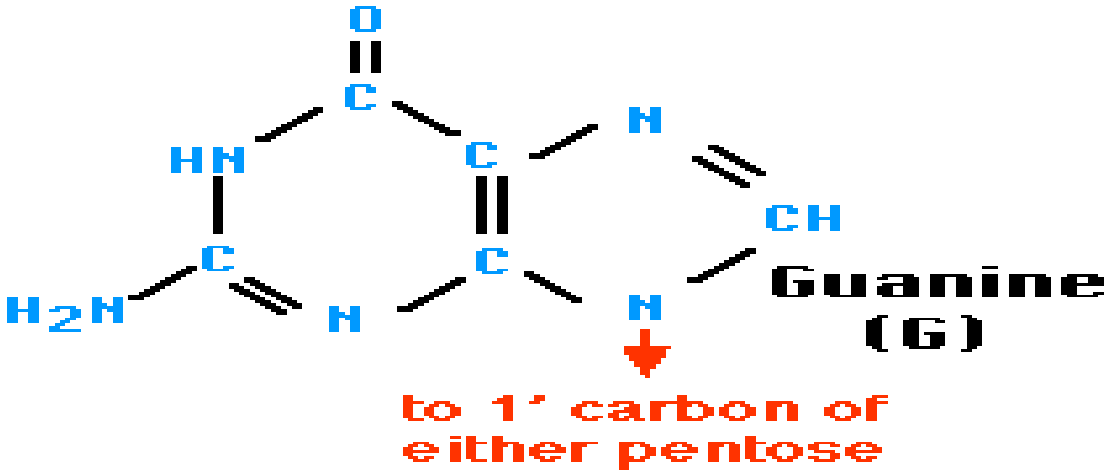
- Nucleotides: provide energy for cellular reaction

- Each nucleotide consists of 3 parts: **5-carbon simple sugar molecule (ribose or deoxyribose), phosphate group,** and **nitrogenous base**

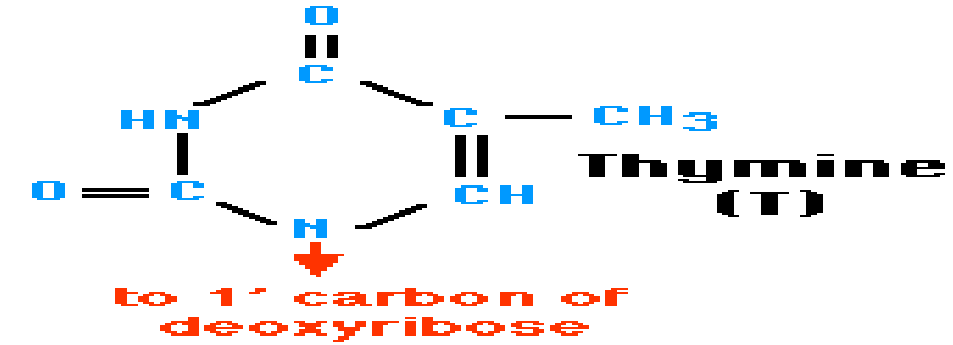


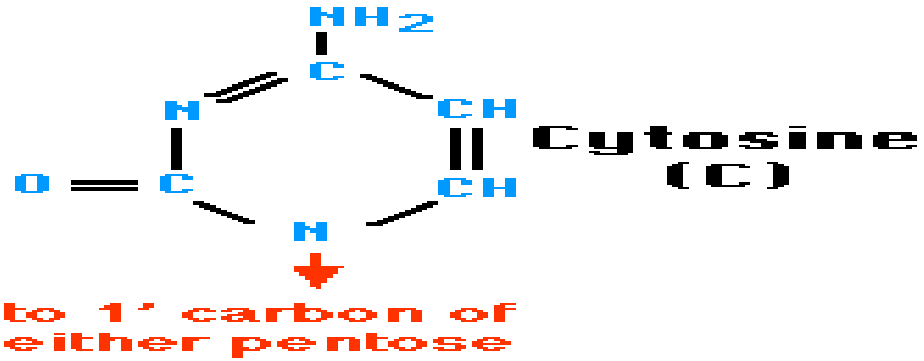
PURINE BASES: LARGE DOUBLE-RING MOLECULES

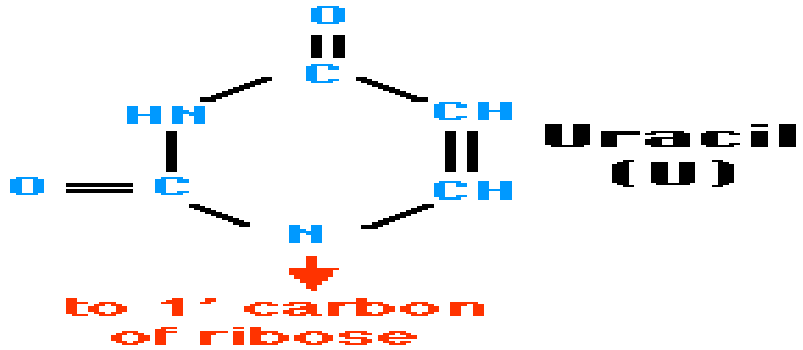




PYRIMIDINE: SMALLER SINGLE-RING BASES



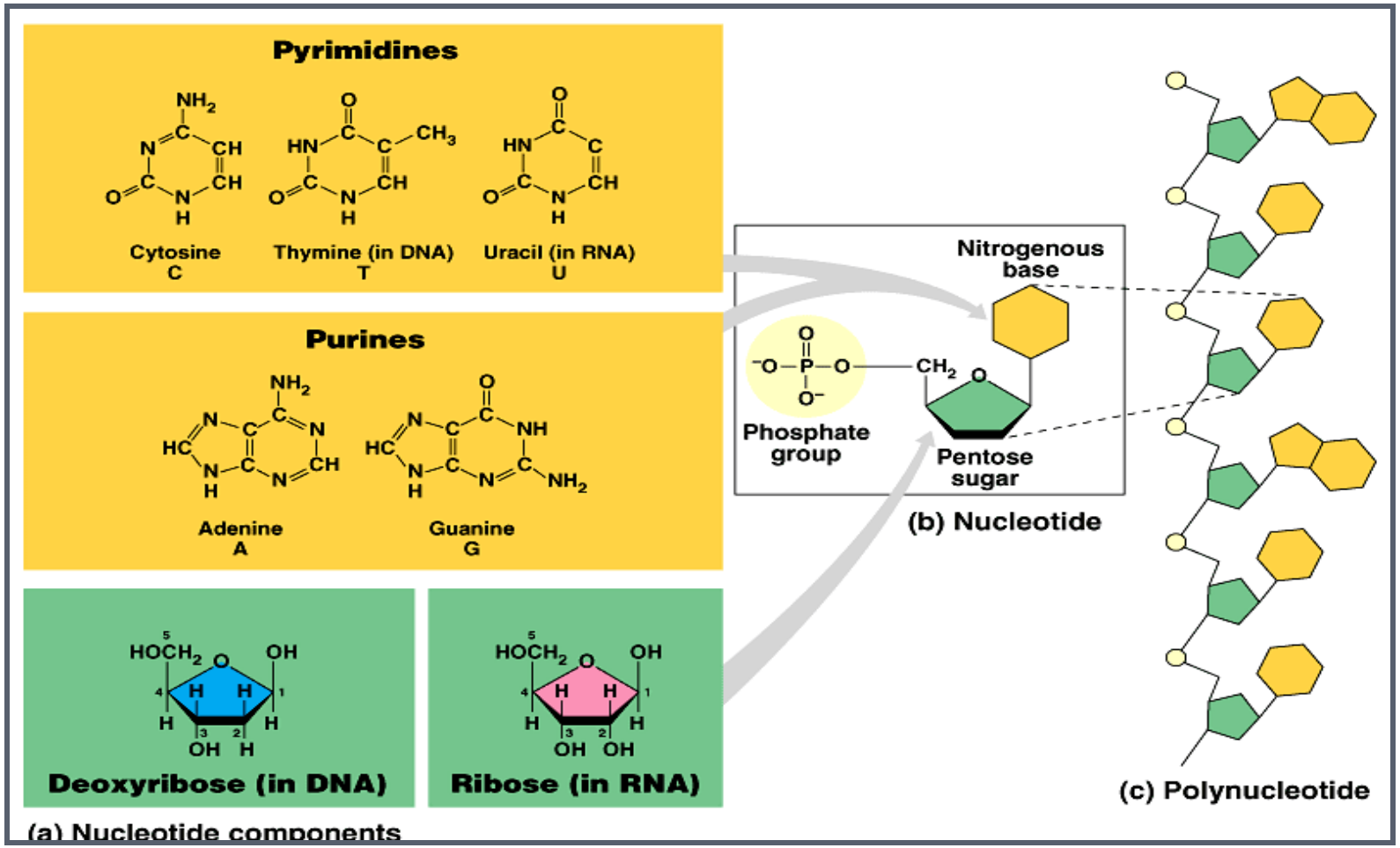


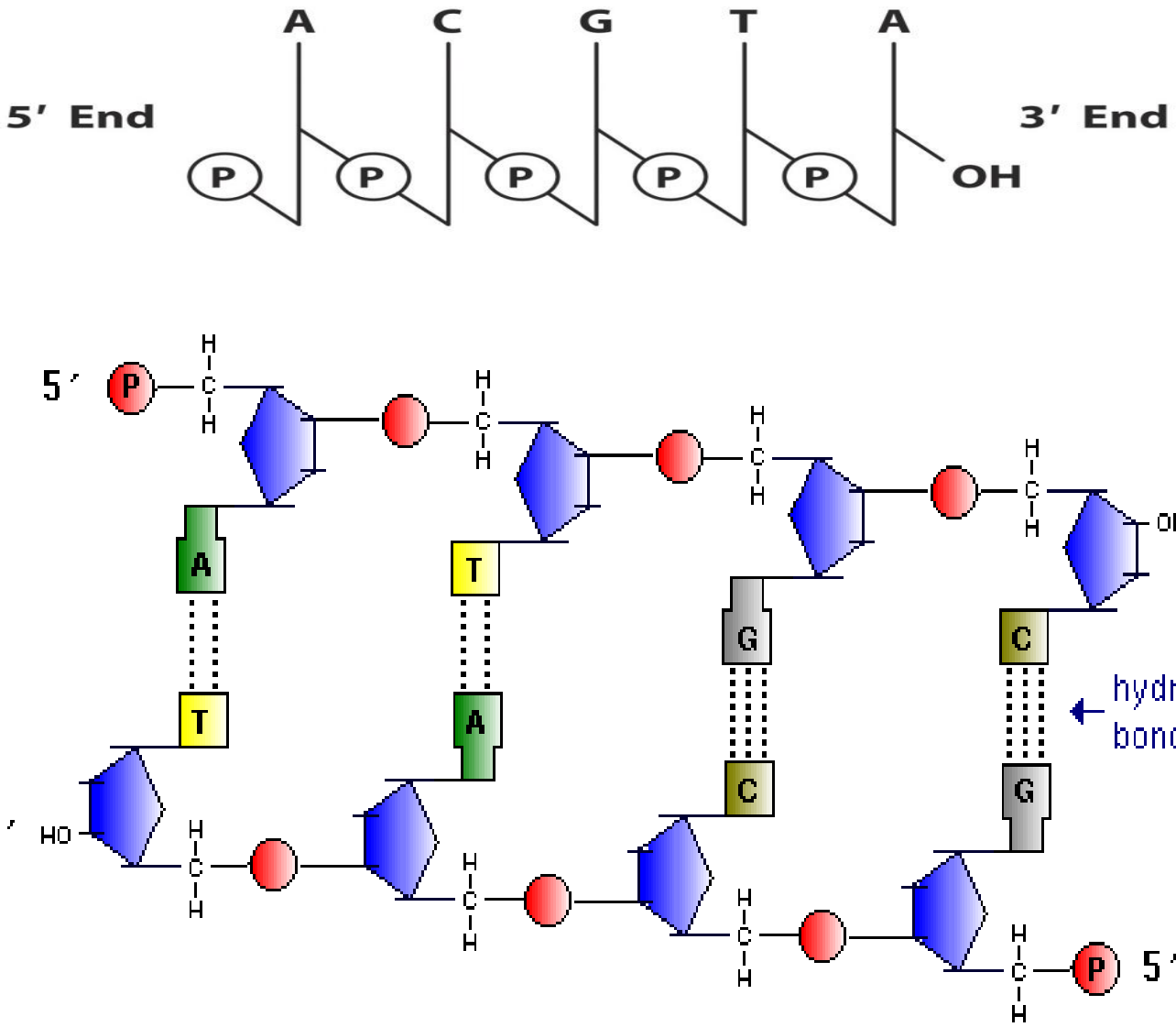


•Nucleotides are linked together to form polymer so that the sugar and phosphate form the backbone and the nitrogenous base stick out to the side

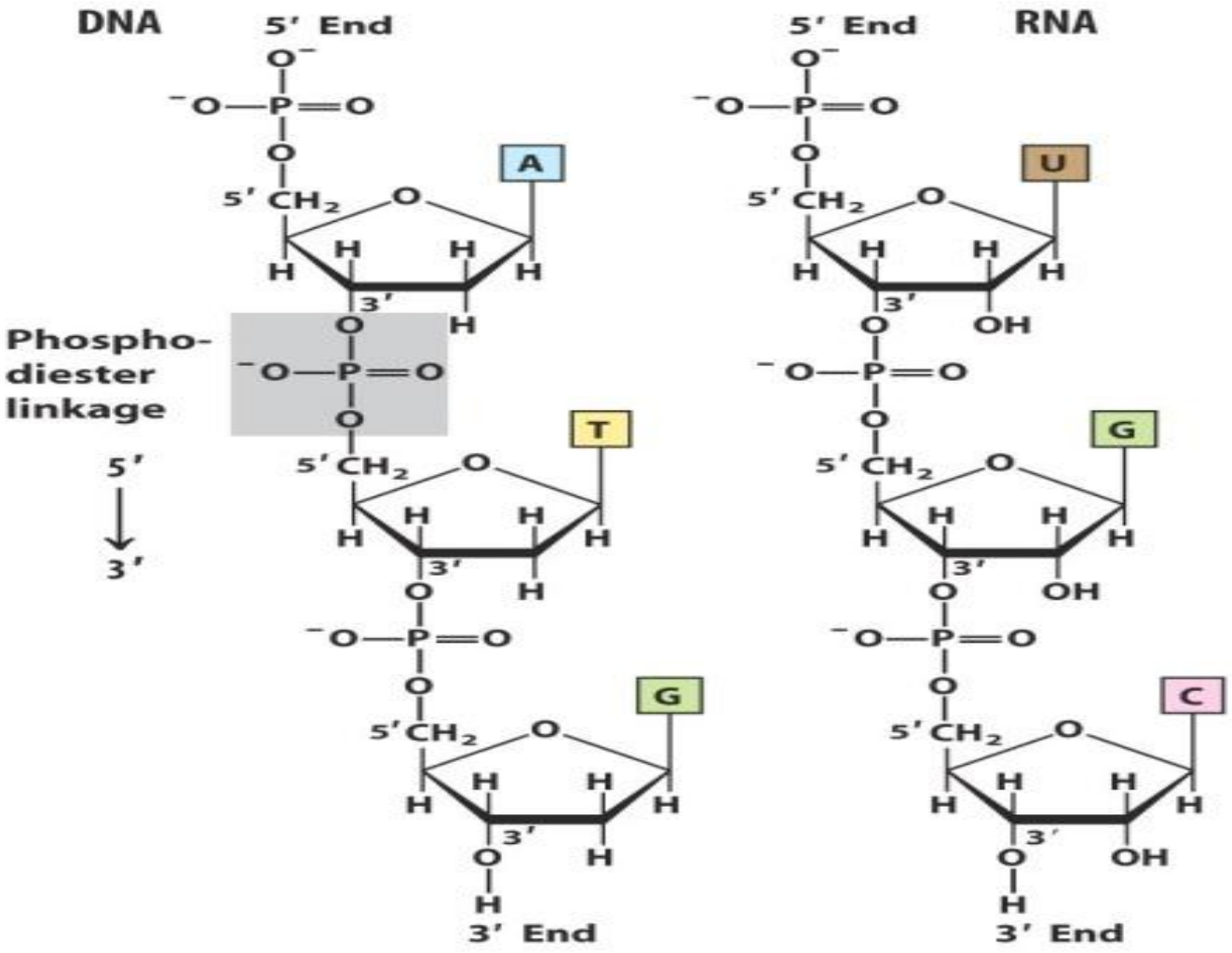
•A nucleotide with 3 phosphates has more energy than that of 1.

• All nucleotides transfer energy especially as ATP




A
C
G
T
A
5′ End
3′ End
P
OH
5′
3′
HO
hydrogen
bonds

DNA: A, T, G, C
RNA: A, U, G, C

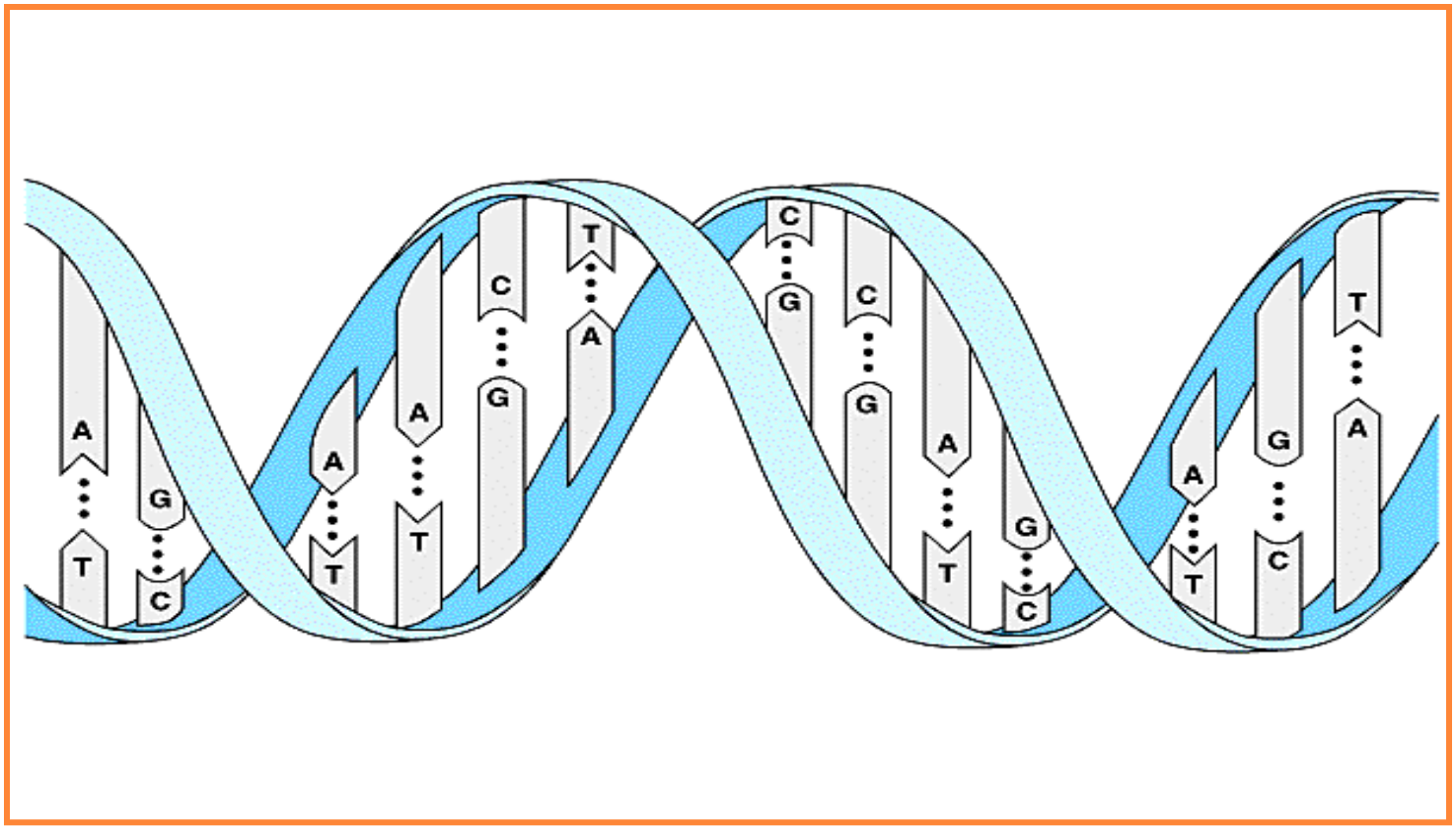


DNA

- Two strands which form twisted ladderlike structure with thousands of nucleotides along

- Two strands attached by hydrogen bonds between
  A binds with T (U in case of RNA) G binds with C

- One stand is called coding and the other is noncoding. Ex: ACTGAGCT; every 3 bases are read together. Noncoding is important in protecting the coding sequence from reactions


A
T
G
C
A
T
A
T
C
G
T
A
C
G
C
G
A
T
G
C
A
T
G
C
T
A
A
T
G
C

- Information carried by DNA could be compared to information in book.

- DNA is composed of nucleotides (letters in book), where every three nucleotides in specific sequence (words) are organized in genes (chapters) that carry information for protein synthesis (chapters in book relating to one idea)

- Order of nucleotides in gene is directly related to the order of a.a. in the protein for which it codes

- Different genes along a DNA strand have beginning and ending signals that tell when to start and stop reading the gene
- Human body cells contain 46 stands (books) of helical DNA each containing many genes (chapters)
- Strands are called chromosomes when they become supercoiled in preparation for cellular reproduction
- Before cellular reproduction, DNA makes copied of coding and non-coding strands to ensure that daughter cells will receive a full complement of genes required for their survival.

Gene: segment of DNA that is able to:

1. replicate by directing the manufacture of copies of itself
2. mutate or chemically change and transmit these changes to future generations
3. store information that determines the characteristics of cells and organisms. Use this information to direct synthesis of structural, carrier, and regulatory proteins

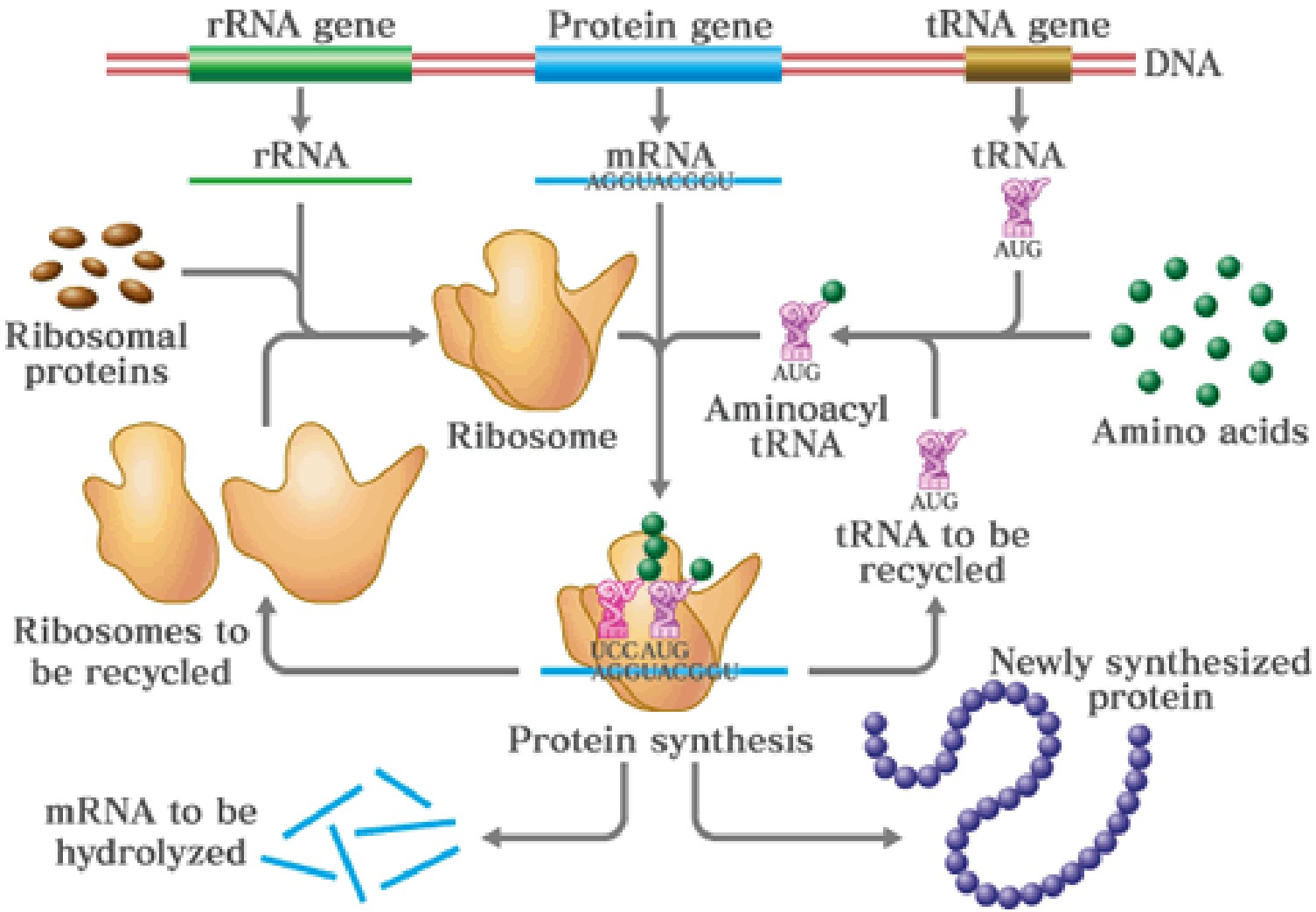
RNA

- Ribonucleic acid, found in three forms

1. **Messenger RNA** (mRNA): is a single- strand copy of a portion of the coding strand of DNA for a specific gene. When mRNA forms, it applies the base rule with DNA coding sequence (C with G; and U with A). After mRNA is formed and peeled off, it links with cellular structure, called ribosome, where the genetic message can be translated into protein.

2. **Ribosomal RNA** (rRNA): RNA copy of DNA but after being formed it becomes twisted and covered in protein to form a ribosome.

3. **Transfer RNA** (tRNA): also copy of different segments of DNA, but when peeled off the surface, each segment takes the form of cloverleaf. tRNA molecules are responsible for transferring specific a.a. to the ribosome where all three forms of RNA come together to help in protein manufacture


rRNA gene
Protein gene
tRNA gene
DNA
rRNA
mRNA
AGGUACGGU
tRNA
AUG
Ribosomal proteins
Ribosome
AUG
Aminoacyl tRNA
Amino acids
AUG
tRNA to be recycled
Ribosomes to be recycled
UCCAUG
AGGUACGGU
Newly synthesized protein
Protein synthesis
mRNA to be hydrolyzed

LIPIDS

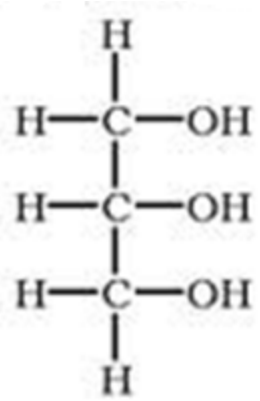
There are three main types of lipids:

1. True fats (ex. olive oil).
2. Phospholipids: primary component of cell membrane
3. Steroids (some hormones).

- Lipids are non-polar (not dissolve in water) organic molecules that are formed of carbon, hydrogen, and oxygen.Usually small amount of oxygen as compare to carbon. Simple lipids cant be broken down into smaller subunits, while complex lipids can be hydrolyzed in smaller units

True (neutral) fats

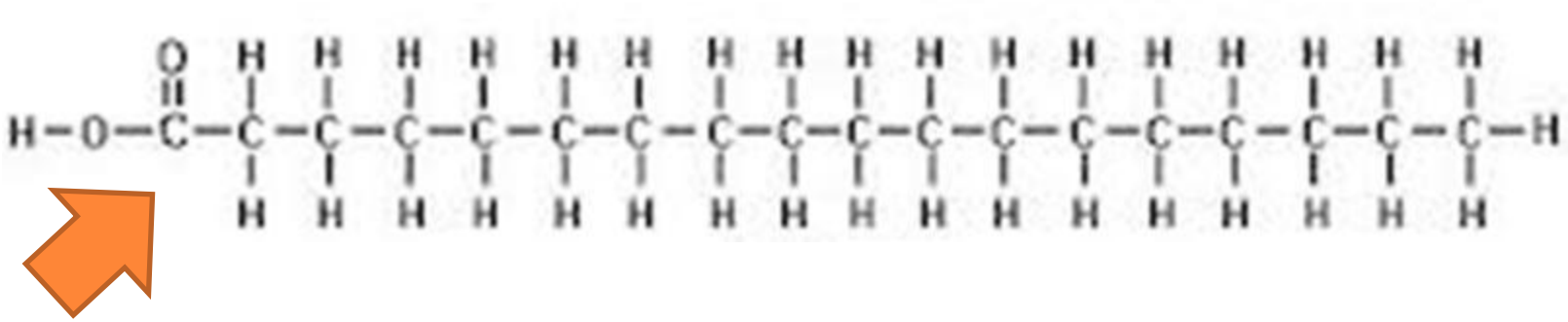
- Important in providing energy
- Building blocks: fatty acid and glycerol
- **Glycerol** ($C_3H_5(OH)_3$): has three alcohol groups attached to it. It is used under the name of glycerin as an additive to make them smooth and easy spread. At room temperature, it is clear lightweight oil.



Fatty acid

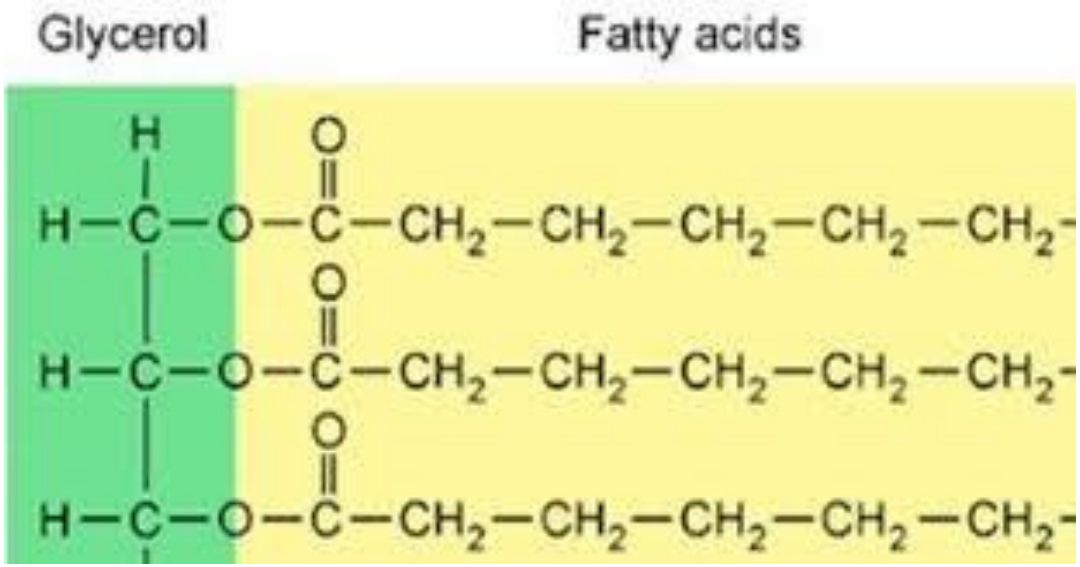
- Long chain carbon skeleton with carboxyl functional group

- Saturated fats have the maximum number of hydrogen. Found in animal tissue and tend to be solid at room temperature



- Triglycerides made of 1 glycerol molecule and 3 attached fatty acids. Account for 95% of fats stored in human tissue

- 3 fatty acid molecules combined with 3 glycerol molecules by dehydration reaction to form simple fat.

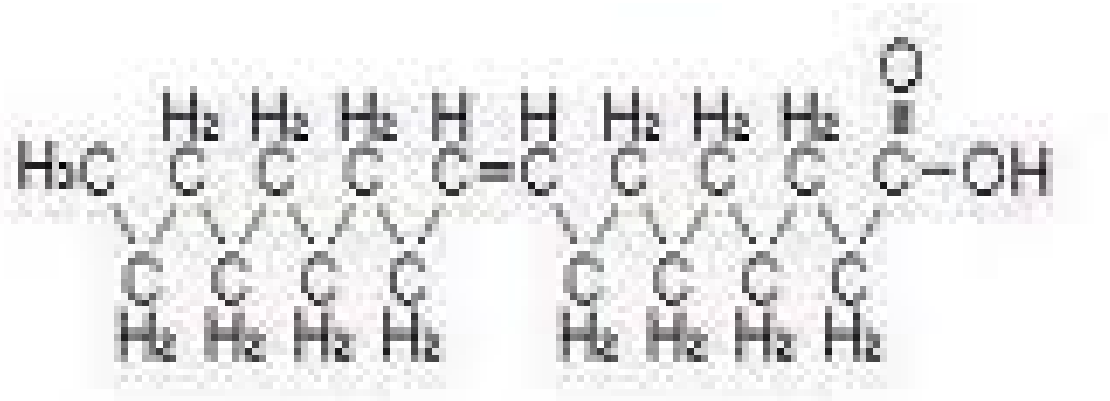


- Fatty acid is unsaturated if carbons are double-bonded to each other at one or more points

- The occurrence of double bond is indicated by omega (ω), followed by number indicating the location of the first double bond in the molecule

- Counting begins from the end farthest from the carboxylic functional group.

Oleic acid



Name: C18:Iω9

It is monounsaturated fatty acid. Found in olive oil. Commonly referred to as Omega9

- Essential fatty acids: is not made by the body, but should be taken in diet because it is involved in the synthesis of prostaglandin hormone that is important for cell growth and specialization (omega 3 and omega 6)

- Many foods are now adding omega 3 to the food because it may reduce cardiovascular diseases

- Many unsaturated fats are usually liquid at room temperature

- Fats are important for storing energy more than that of carbohydrate
- Fats can be stored in small space yet provide high amount of energy
- Fats also provide protection in animals from heat loss
- The fat layer around internal organs cushion the organs from physical damage
- 95% of fat stored in human tissue as triglyceride

PHOSPHOLIPIDS

- Class of complex water-insoluble organic molecules that resemble neutral fats but contain a charged phosphate group (PO_4)
- Phospholipids are important because they are major components of cell membranes
- Cells are separated from exterior environment by lipids
- Lecithins are phospholipids that help emulsification of fats by separating large portions into smaller units

STEROIDS

- Characterized by arrangement of interlocking rings of carbon. Steroid used by body as component of cell membranes

- Cholesterol is important in the manufacture of vitamin D, which assists in proper development of bones and teeth. Cholesterol in the skin reacts with UV light to produce vitamin D.By watching your diet, you can decrease cholesterol serum level by 20%. Disease associated with cholesterol is athersclerosis

- Testosterone and progesterone are steroids made by organism