ORGANIC MOLECULES

Organic molecules are chemicals that contain C, H, and O atoms in their structures.

TYPES OF ORGANIC MOLECULES

- There are 5 types of organic molecules in living things.These are:
- **Carbohydrates**
- **Lipids**
- **Proteins**
- **Vitamins**
- **Nucleic acids**

CARBOHYDRATES

PROPERTIES:

- They contain C, H and O .
- They are main source of energy for organisms.
- They participate structure of cell.

TYPES OF CARBOHYDRATES

- **Monosaccharides (single sugar)**
- **Disaccharides(double sugar)**
- **Polysaccharides (many sugar)**

MONOSACHARIDES

- Monosaccharides are the simplest carbohydrates.
- Monosacharides are classified according to their carbon atoms.
  1- Pentose sugar (5 C)
  2- Hexose sugar (6 C)

PENTOSE SUGAR

- **Pentose sugars have 5 carbon atoms.**
- **They participate structure of nucleic acids.**

EX:

Ribose and Deoxyribose

HEXOSE SUGAR

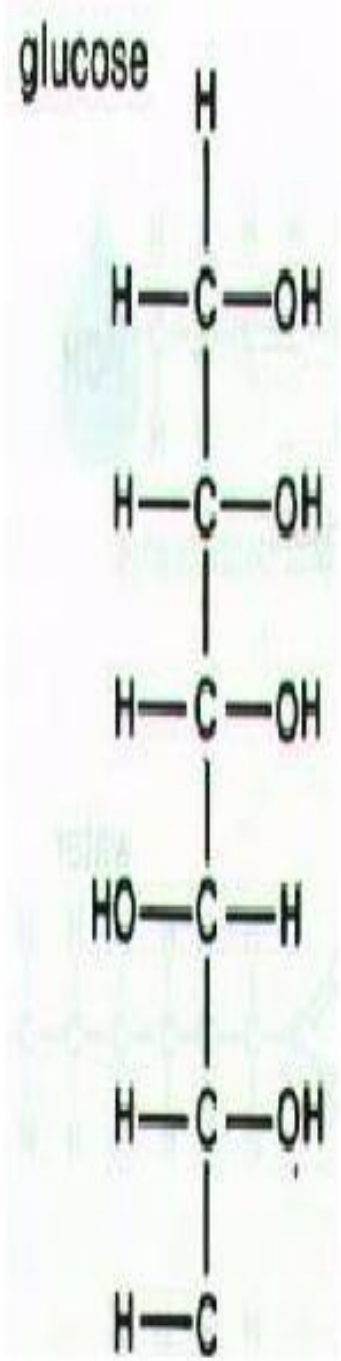
- Hexose sugars have 6 carbon atoms
- They are used in energy production.

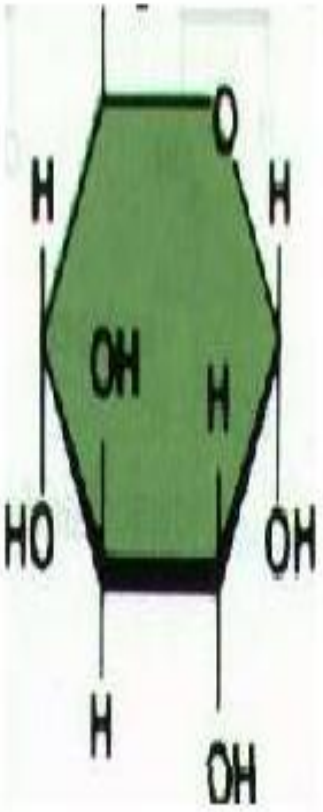
EX: Glucose, Fructose and Galactose

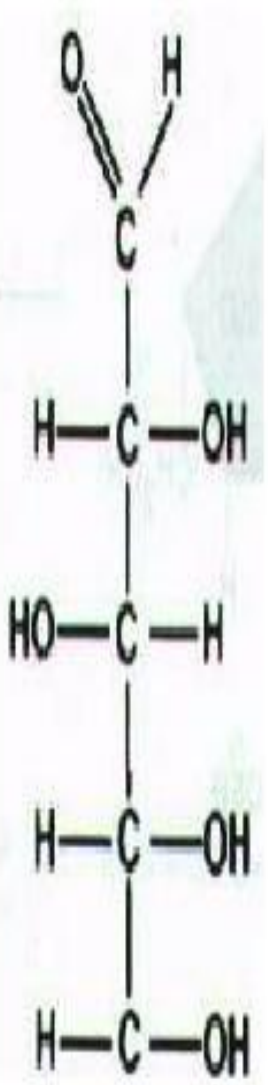
GLUCOSE

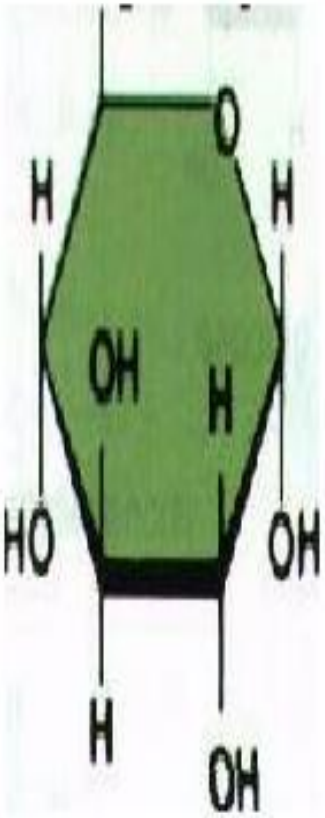
- Glucose is a monosaccharide with the formula $C_6H_{12}O_6$.
- Plants produce glucose during the photosynthesis.
- Amount of glucose is controlled by hormone in human blood.

glucose


H
H—C—OH
H—C—OH
H—C—OH
HO—C—H
H—C—OH
H—C—OH
H—C


O
H
H
OH
H
HO
OH
H
OH


O
H
C
H—C—OH
HO—C—H
H—C—OH
H—C—OH


O
H
H
OH
H
HO
OH
H
OH

DISACCHARIDES

- Disaccharide is double sugar.
- Two monosaccharides chemically combine to form disaccharide.
- There is glycosidic bond between two monosaccharides

TYPES OF DISACCHARIDES

There are 3 types of disaccharides. These are;

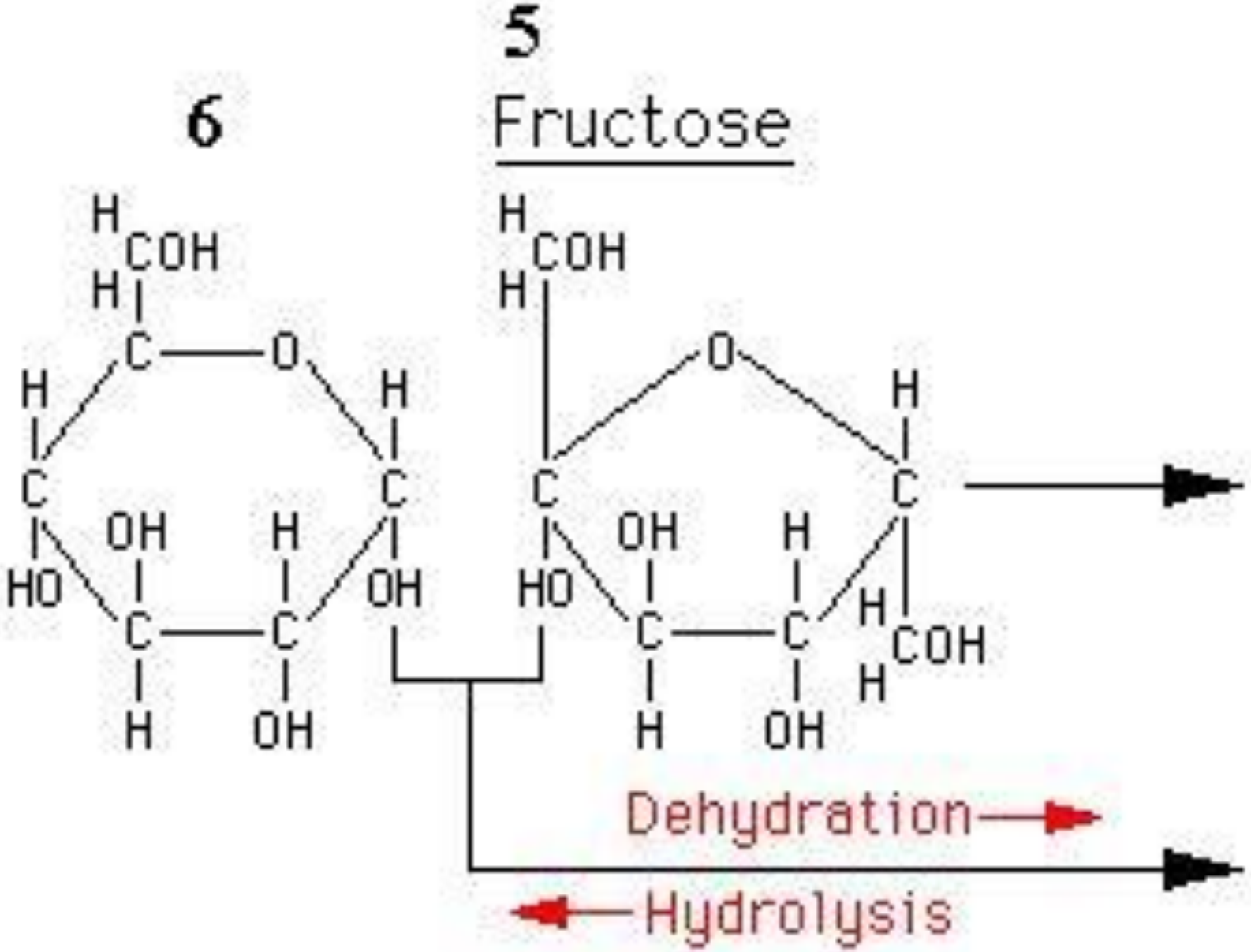
- Maltose
- Sucrose
- Lactose

GLUCOSE + GLUCOSE → MALTOSE + H_2O

GLUCOSE + GALACTOSE → LACTOSE + H_2O

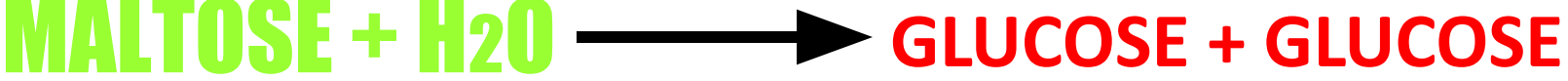
GLUCOSE + FRUCTOSE → SUCROSE + H_2O

Carbohydrates



- **During the formation of disaccharide one molecule water is released. This type of reaction is called dehydration.**

- The reverse of dehydration is hydrolysis. In this reaction water molecules are added to reaction.



POLYSACCHARIDES

- Simple sugars can be joined together by dehydration synthesis to form polysaccharides.

- Polysaccharides are long chain of glucose.

Starch, glycogen, cellulose and chitin are examples of polysaccharide.

- Starch: It is found only in plants.
- Glycogen: It is found certain animal cells. Glycogen is stored in the liver and muscle.
- Cellulose: It participates structure of plant cell.

LIPIDS

Properties :

- They are soluble in alcohol and ether but not in water.
- Lipids are secondary source of energy.
- Lipids take role in the conservation of body temperature.
- They give more energy than carbohyrates and proteins. .

- Lipid molecule contains 2 subunits. These are glycerol and 3 fatty acids.

GLYCEROL + 3 FATTY ACID → **LIPID** + $3H_2O$

- **Ester bonds link the glycerol and three fatty acids.**

TYPES OF LIPIDS

- SATURATED
- UNSATURATED

PROTEINS

- *Proteins contain C, H, O and N. Some also contain S.*
- *They are used in cell structure, regulation and control of cell functions.*
- *They are produced under the control of DNA.*
- *Aminoacid is monomer of protein.*

AMINO ACIDS

An aminoacid contains of a central carbon atom, which are bonded:

1-A carboxyl group (COOH)

2-An amino group (NH_2)

3-Radical group

4-A single hydrogen atom (H)

- Radical group makes each aminoacid different.
- There are 20 different aminoacids.
- There must be 20 types of radical groups.
- Two aminoacids are linked ***peptide bond*** and formed dipeptide.
- Peptid bond forms between COOH of first aminoacid and NH2 of second aminoacid.

AMINOACID+AMINOACID → ***DIPEPTIDE***

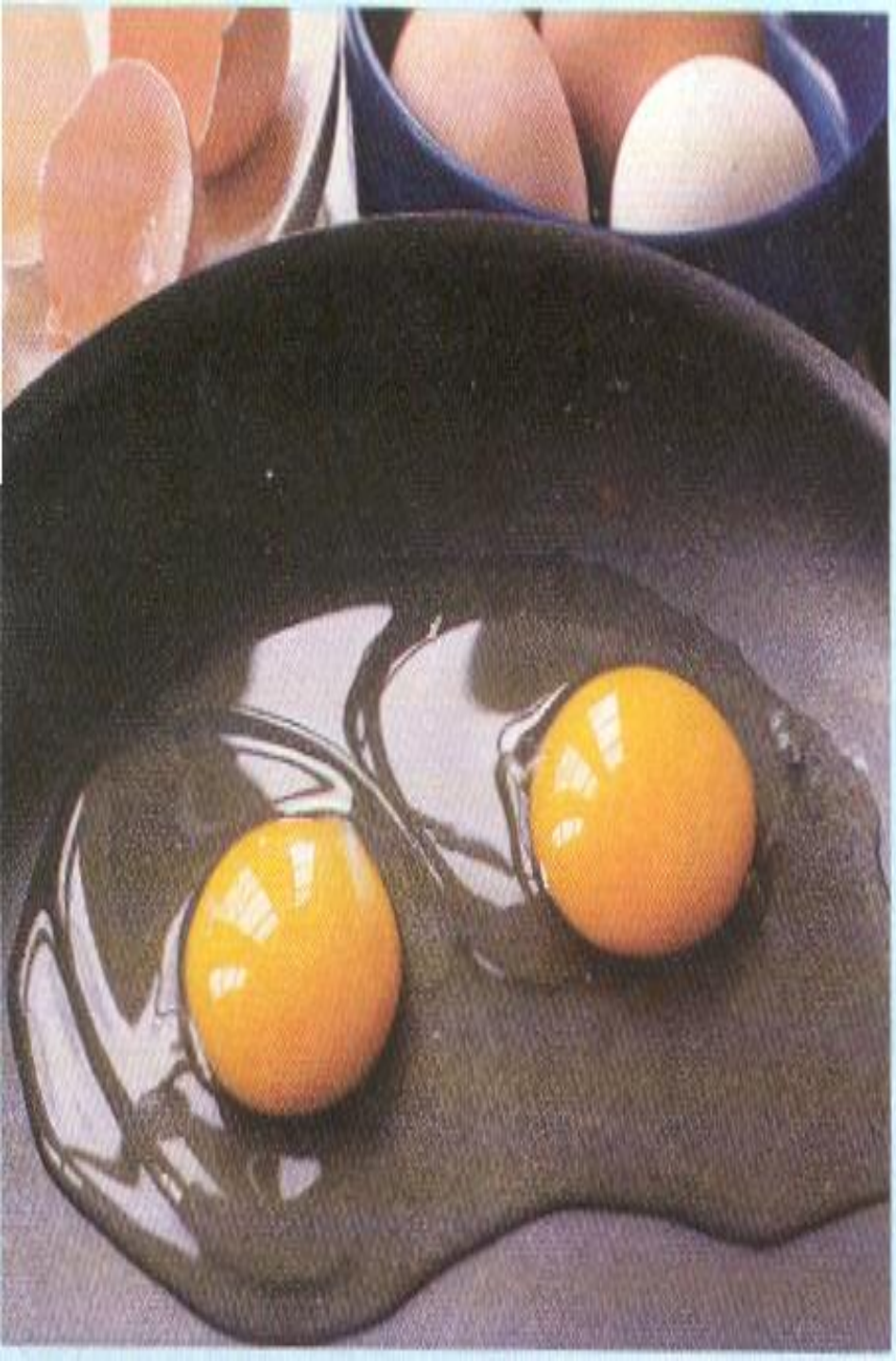
Protein molecules may have 70 aminoacids. There are many different proteins. Because;

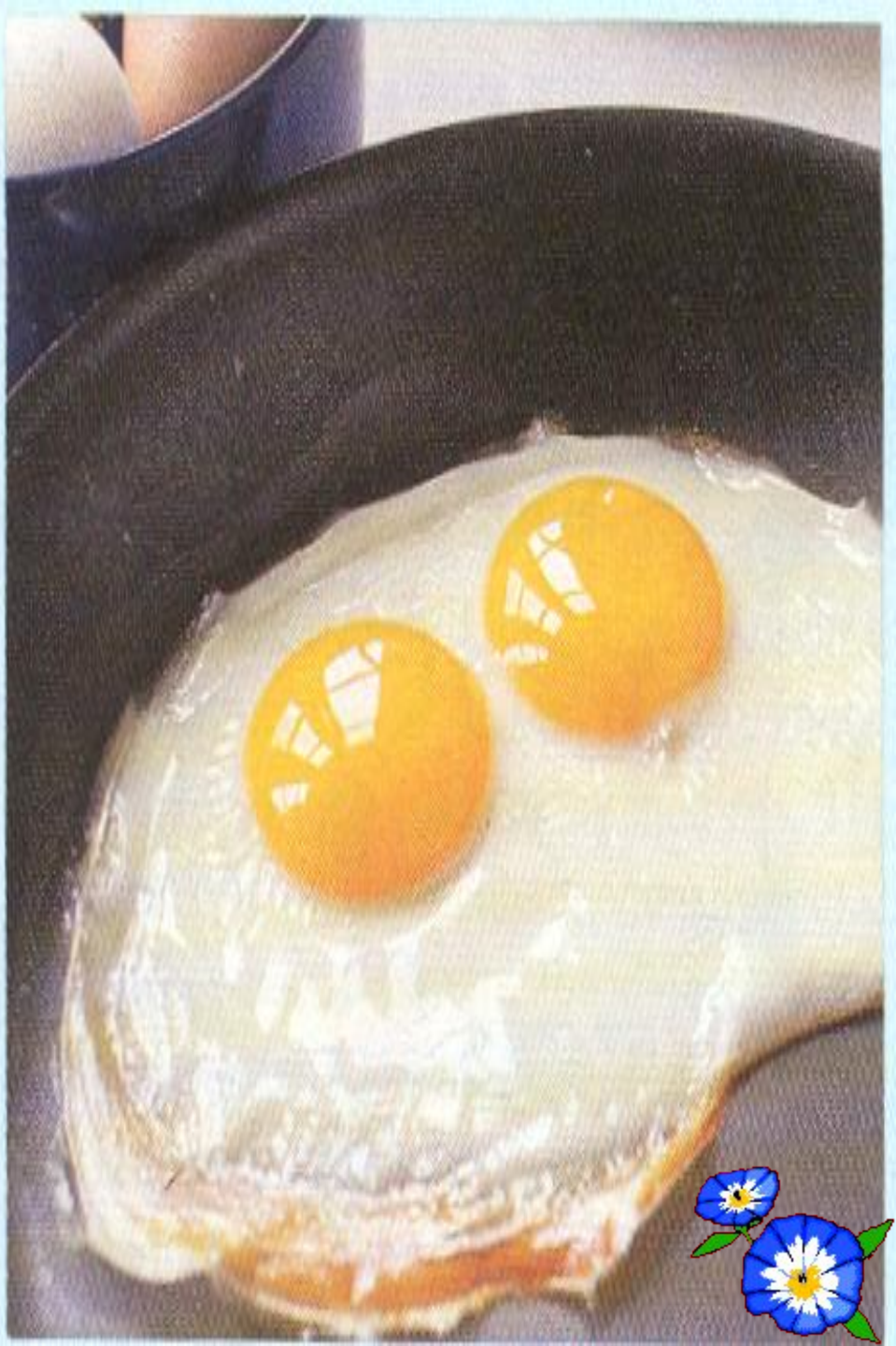
- ***1–Each different sequence makes a different protein.***
- ***2–Each different number of aminoacid makes a different protein***
- ***3–Each different kind of aminoacid makes a different protein.***

DENATURATION

- Proteins are heat sensitive. High temperature breaks certain bonds within protein molecules. This causes chance protein structure.

- **Such a change in shape of protein molecule is called *Denaturation*.**





- Proteins are not used energy source. Because protein participates cell structure.

Nitric acid is indicator of protein.

Our Metabolism chose carbohydres because they are;

1- Smaller and have less molecular weight (thats why easily transported in blood streem)

2- Mobilizing faster and easier than others,

3- Flexible and water meltible (thats why they're required small amount water in our body)

4- However fat molecules heavier and larger although they give 2,5 times more energy than carbohydrates

5- Even fatty acids require more water... Unless our body must be 8 times larger at least..

VITAMINS

Properties of vitamins

- They are used in regulation of body activities, growth and reproduction.
- They are produced by plants.
- They don’t supply energy.

TYPES OF VITAMINS

- Vitamins are divided into two major groups. These are water-soluble vitamins and lipid soluble vitamins.
- B and C are water soluble vitamins.
- A, D, E and K are lipid soluble vitamins.

C and B vitamins

VITAMIN C:Found in oranges, lemons, tomatoes and green vegetables.

- **It`s deficiency in body causes scurvy.**

VITAMIN B:They are obtained from liver, eggs and wheat.

- **It`s deficiency in body causes beriberi.**

A and D vitamins

Vitamin A: **It is found in cheese,milk, liver, green vegetables. It`s deficiency may cause night blindness.**

Vitamin D: **It is found fish, butter, milk, cheese and egg.It`s deficiency may cause rickets.**

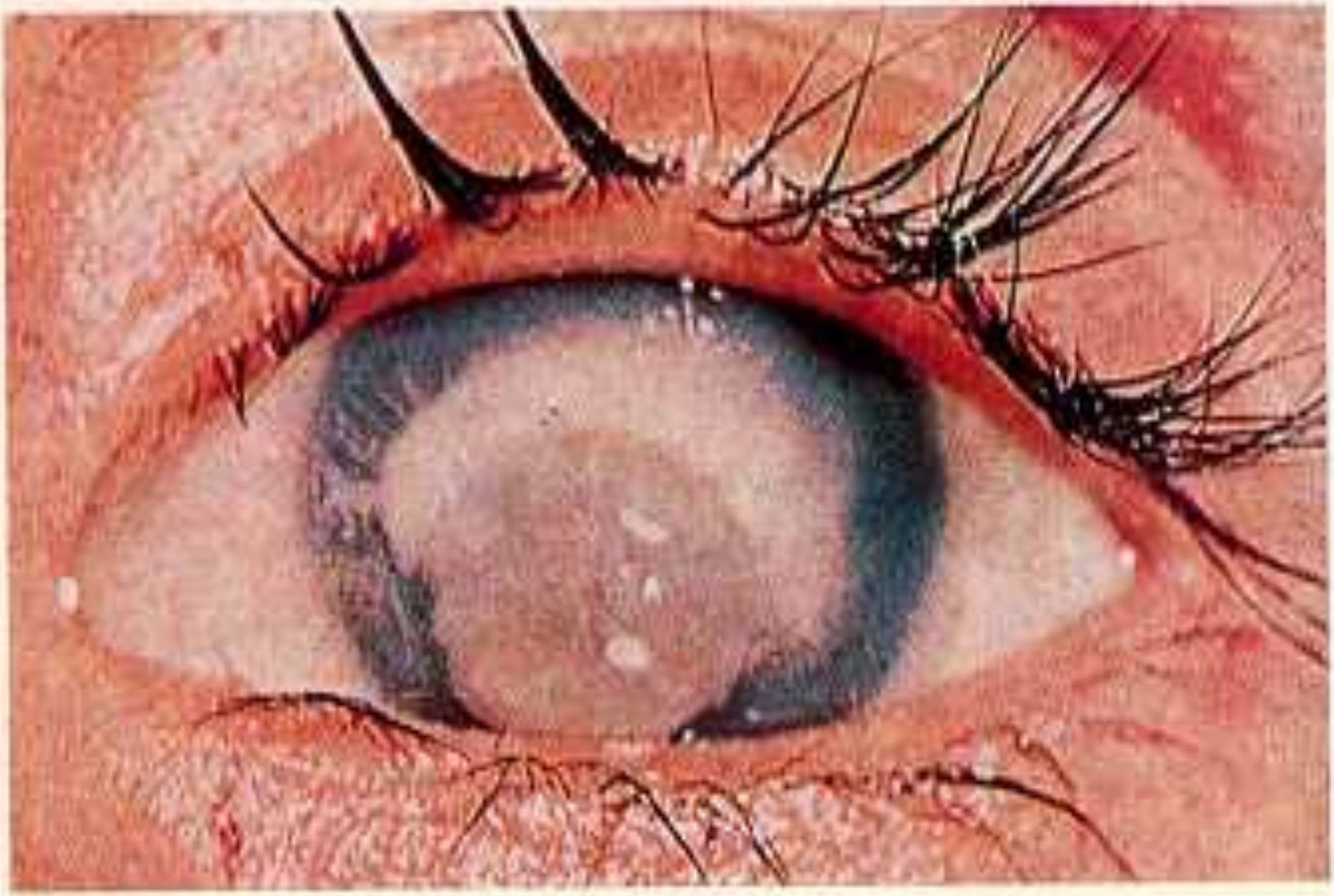
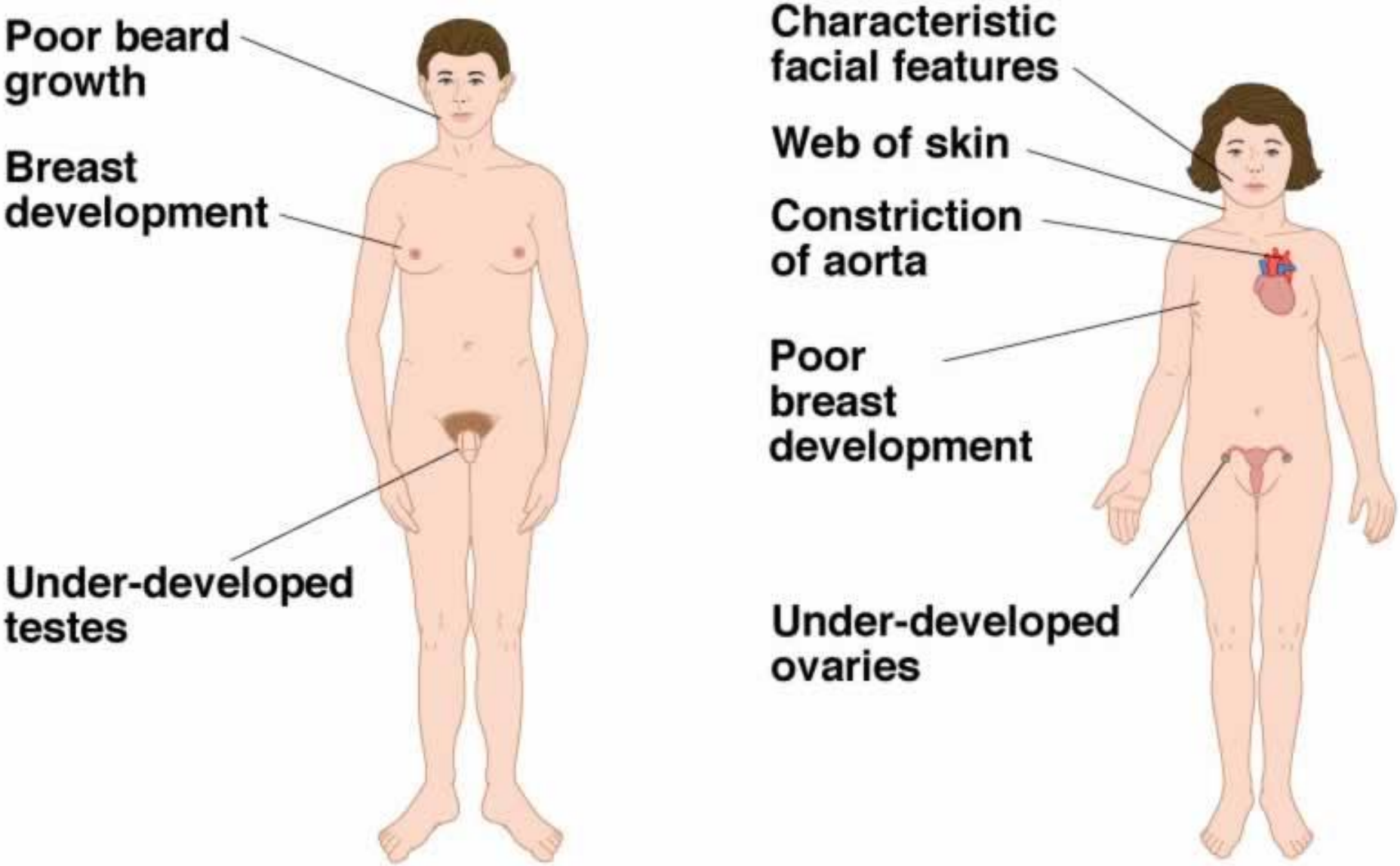


Fig. 3 Keratomalacia in a young child.

E and K vitamins

Vitamin E: ***It is found sun flower oil and meat.*** **It`s deficiency may cause sterility.**

Vitamin K: ***It is found in vegetables, liver and egg.*** **It`s deficiency prevents blood clotting.**



NUCLEIC ACIDS

- Nucleic acids differ from other organic molecules in their function.

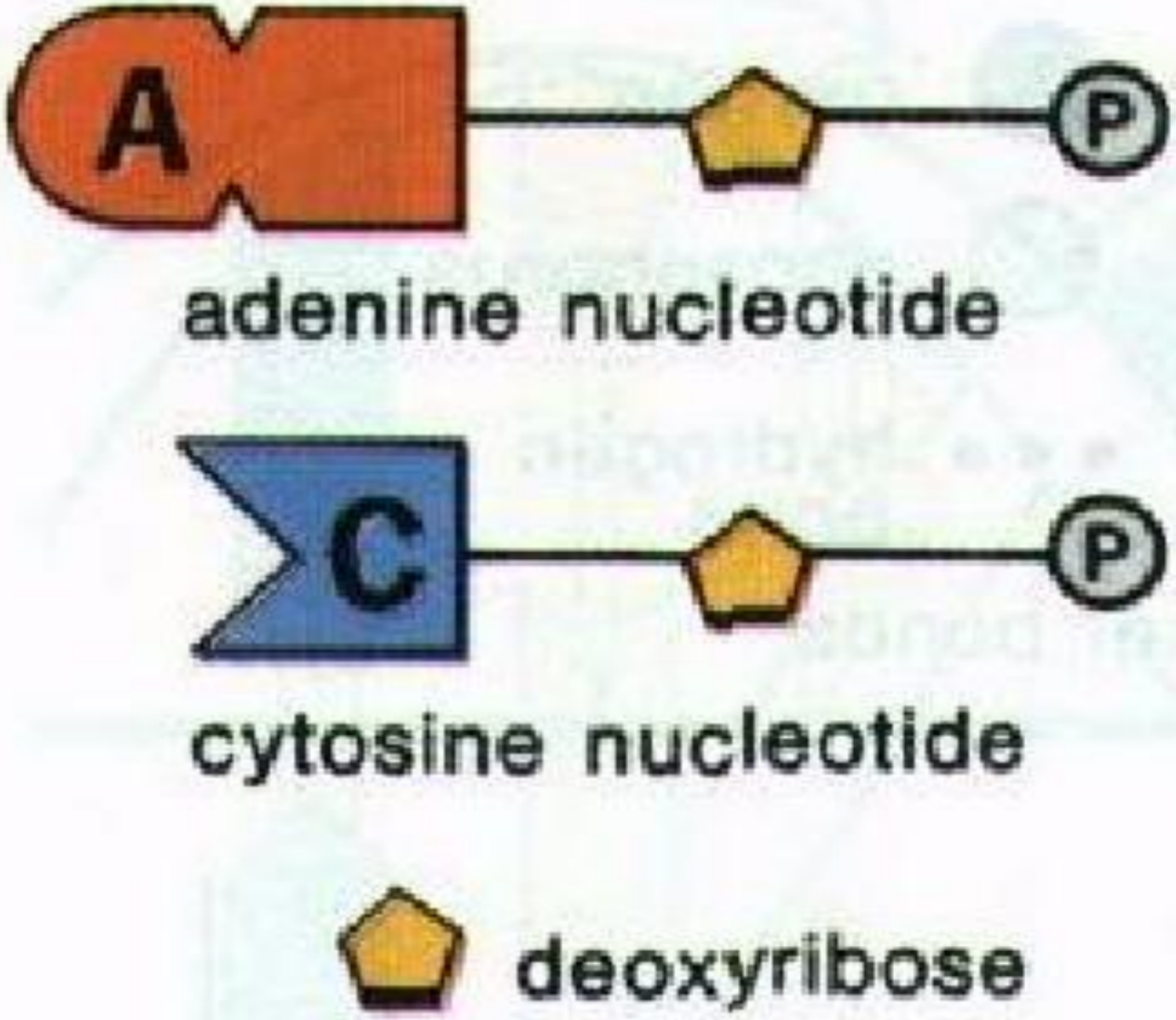
- Genetic information is stored in nucleic acids.

NUCLEOTIDE

- ***The unit of nucleic acids is nucleotide.***

A nucleotide contains;

- ***a pentose sugar,***
- ***a phosphate group***
- ***a nitrogenous base.***


A
P
adenine nucleotide
C
P
cytosine nucleotide
deoxyribose

PENTOSE SUGAR

Pentose sugars have 5 C atoms.There are 2 types of pentose. These are ribose and deoxyribose.

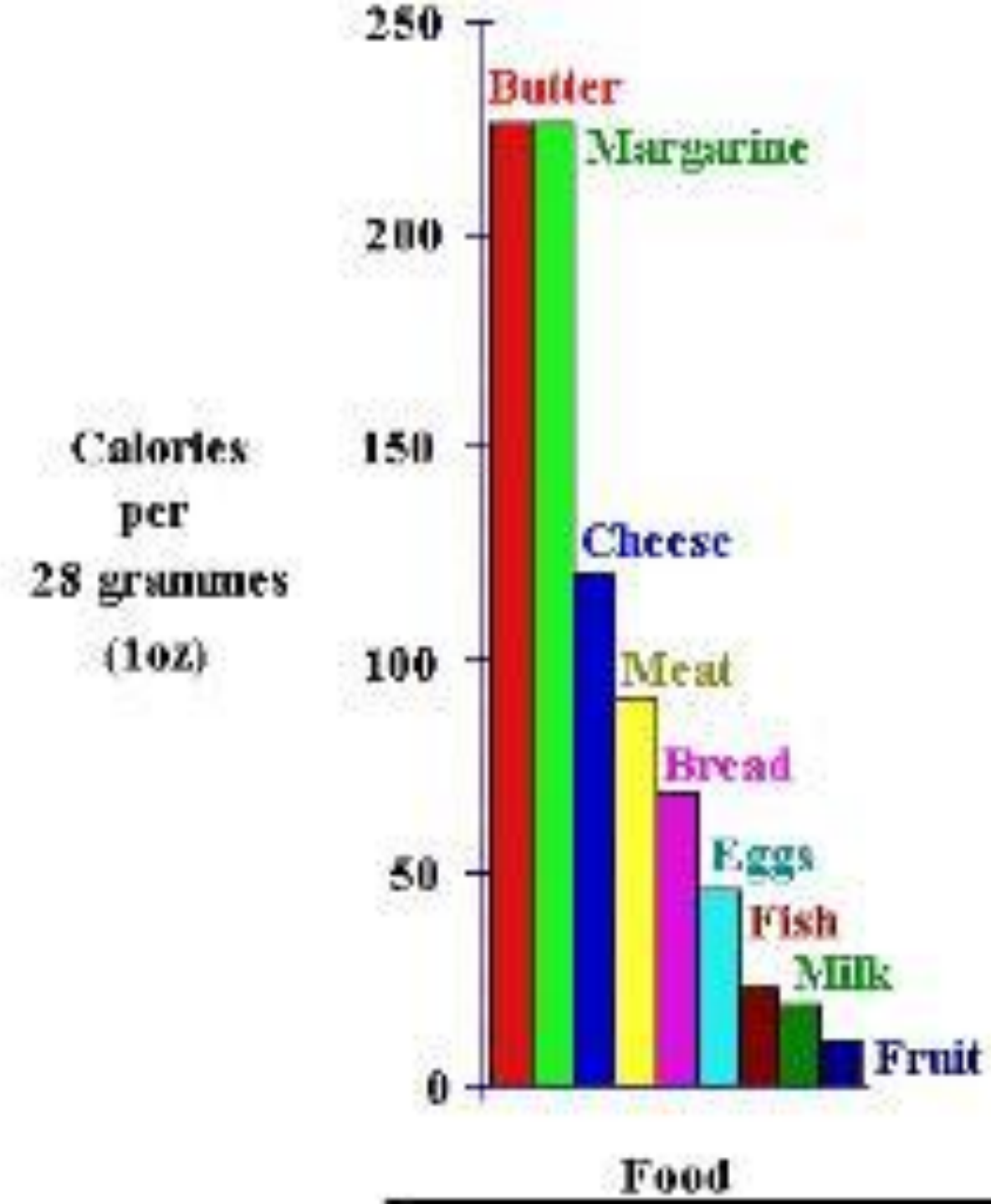
- **Nucleic acids which contain ribose sugar are called ribonucleic acid or RNA.**
- **Nucleic acids which contain deoxyribose sugar are called deoxyribonucleic acid or DNA.**

PHOSPHATE GROUP

- All kinds of nucleotides have a phosphate group.

- It is identical in all types of nucleotides.

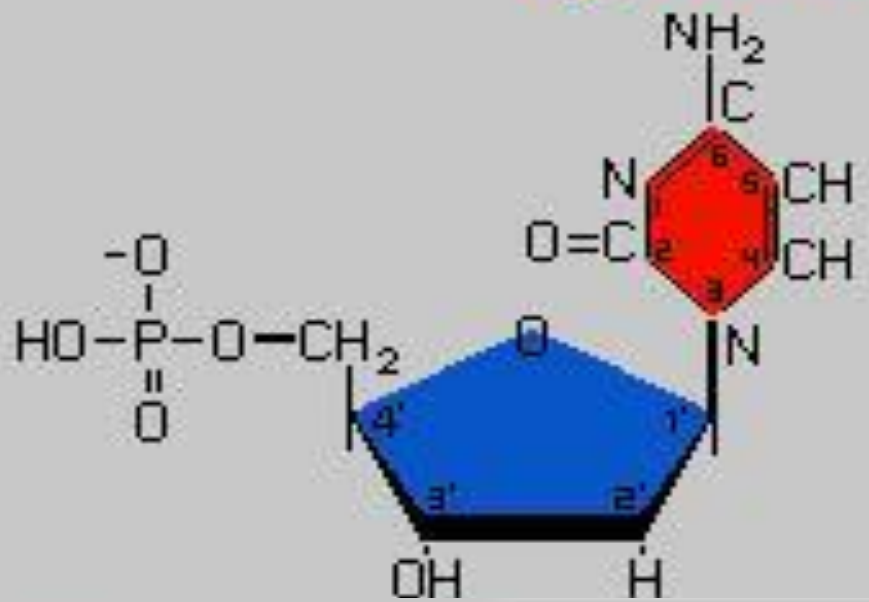
- Phosphate group gives an acidic character to nucleotide.


250
200
150
100
50
0
Calories
per
28 grammes
(1oz)
Butter
Margarine
Cheese
Meat
Bread
Eggs
Fish
Milk
Fruit
Food

ORGANIC BASE

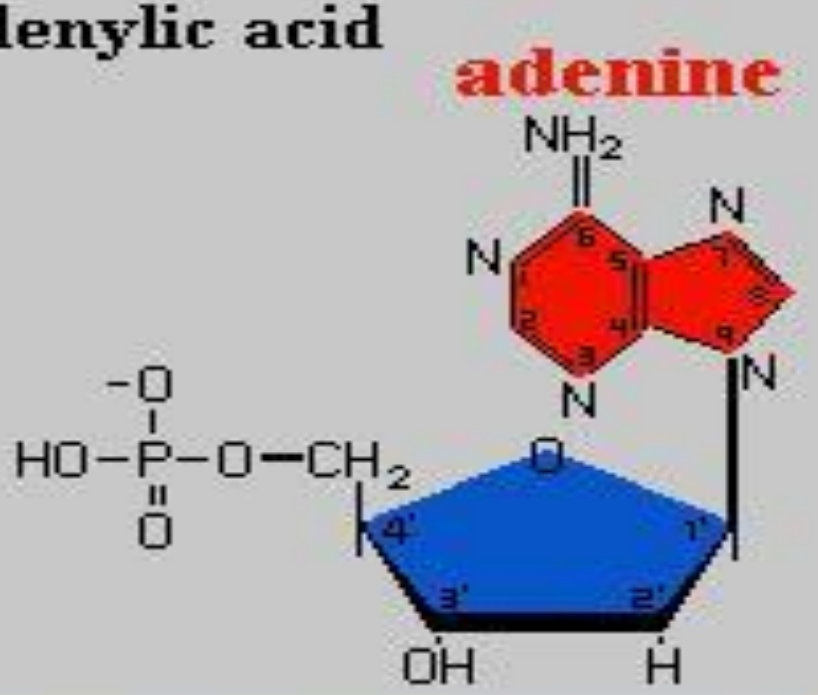
- Organic bases are nitrogen containing compounds. These are adenine (A), guanine (G), thymine (T), cytosine (C) and urasil (U).
- Nucleotides are classified according to its organic base. For example:
- Nucleotide which contains thymine is called thymine nucleotide.

cytosine



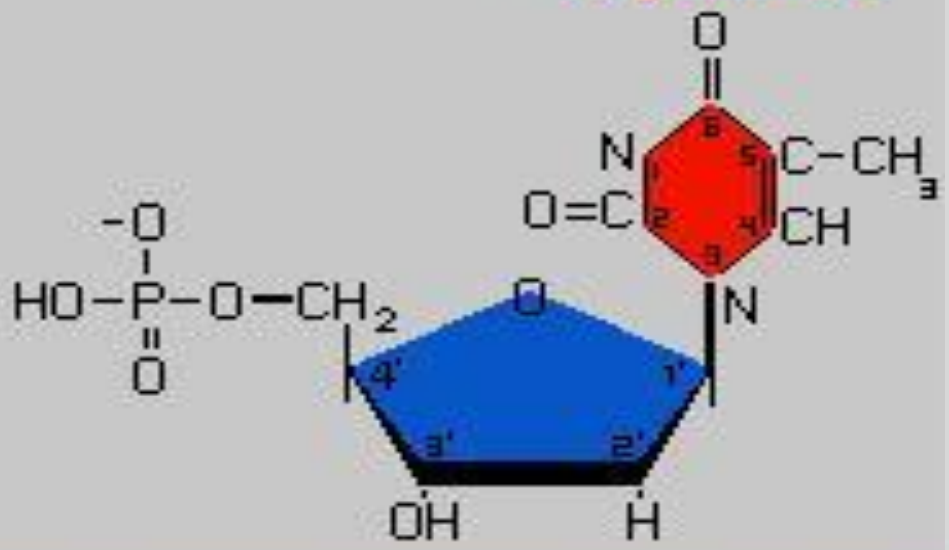
adenylic acid

adenine



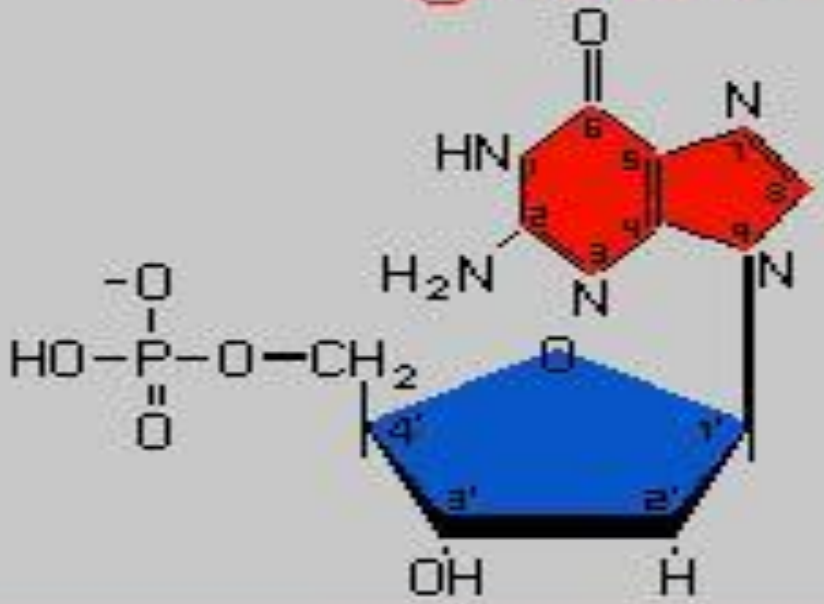
thymidylic acid

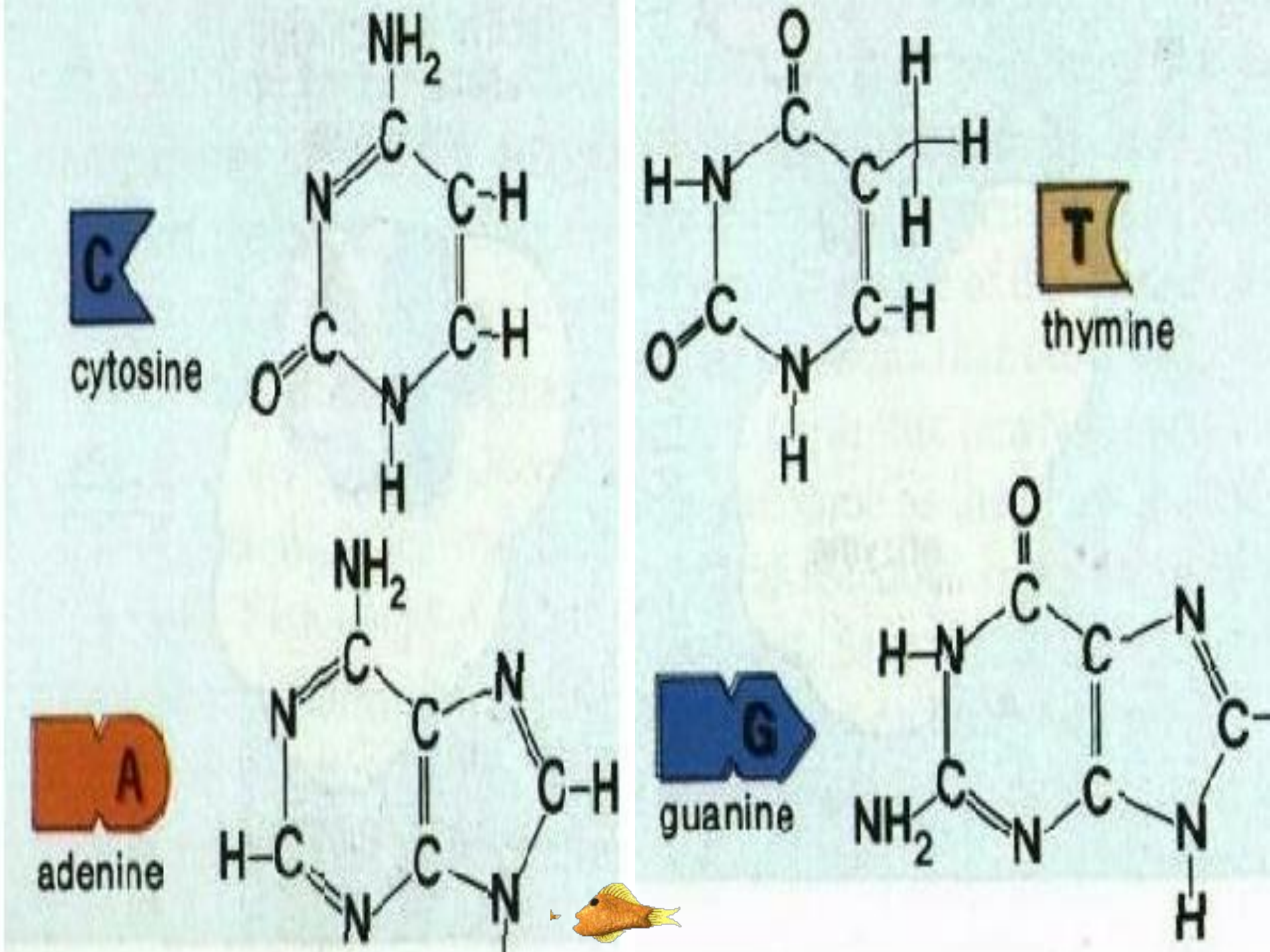
thymine



guanylic acid

guanine




C
cytosine
T
thymine
A
adenine
G
guanine

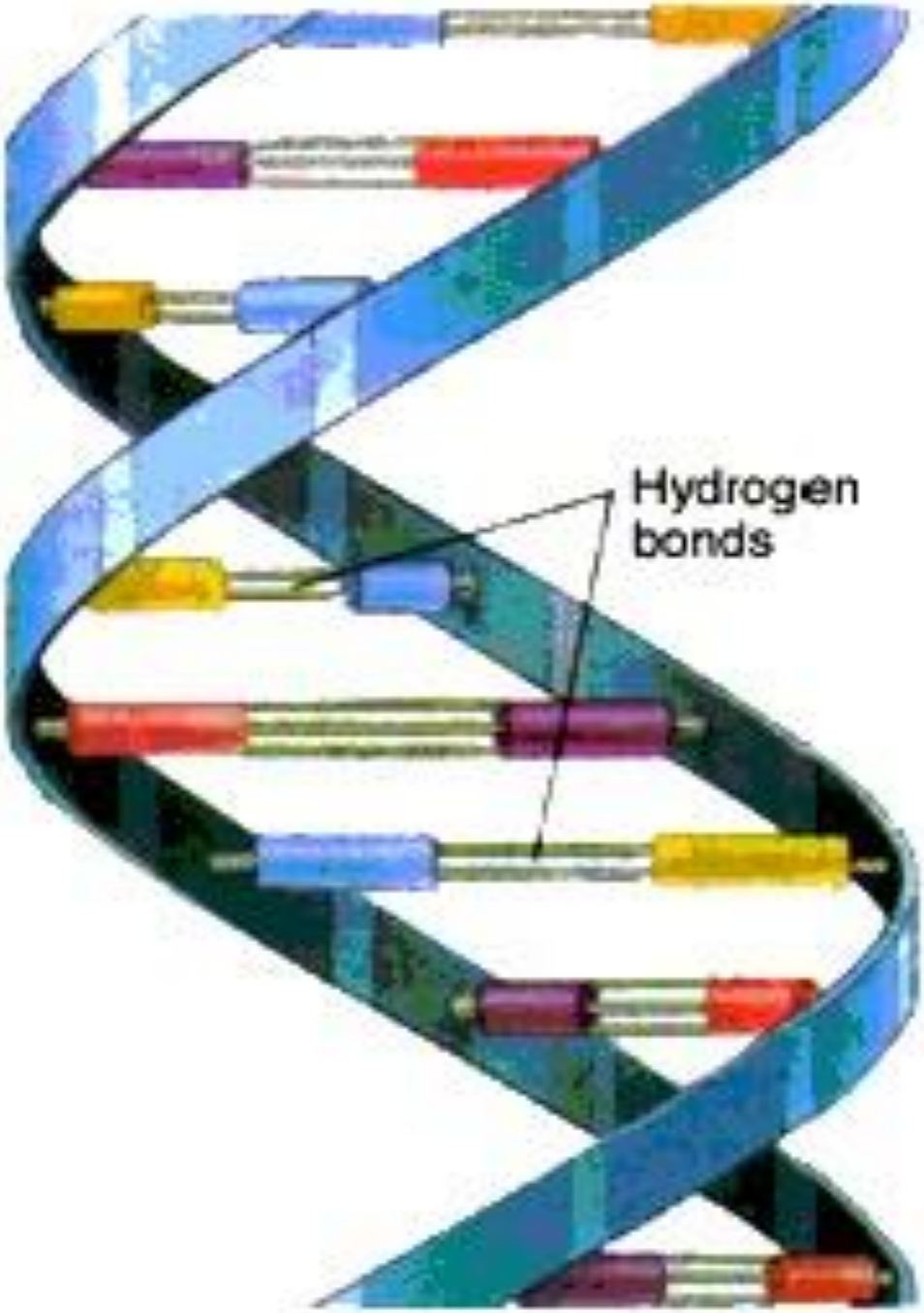
DNA

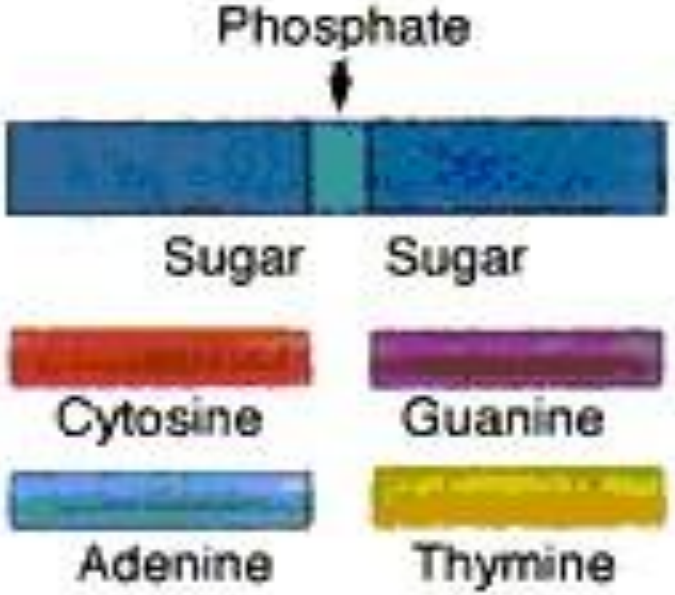
Functions

- Store genetic information by replication of itself and provides genetic continuity.
- Regulation of metabolic activity of cell by ordering the synthesis of all proteins and enzymes.

DNA molecule contains two long chains of nucleotides. The nucleotides of each chain are connected by phosphodiester bond.

In this way nucleotides are attach to each other to form one strand of DNA. The second strand is ordered according to the nucleotide order of the first strand.


Hydrogen
bonds


Phosphate
Sugar
Sugar
Cytosine
Guanine
Adenine
Thymine

- When bonding of two DNA strands an adenine is always bonded to a thymine. There are double hydrogen bond between adenine and thymine(A=T).

- Cytosine is always bonded to guanine. There are three hydrogen bonds between cytosine and guanine (C --- G).

- The number of adenine nucleotide in DNA is equal to the number of thymine nucleotide.

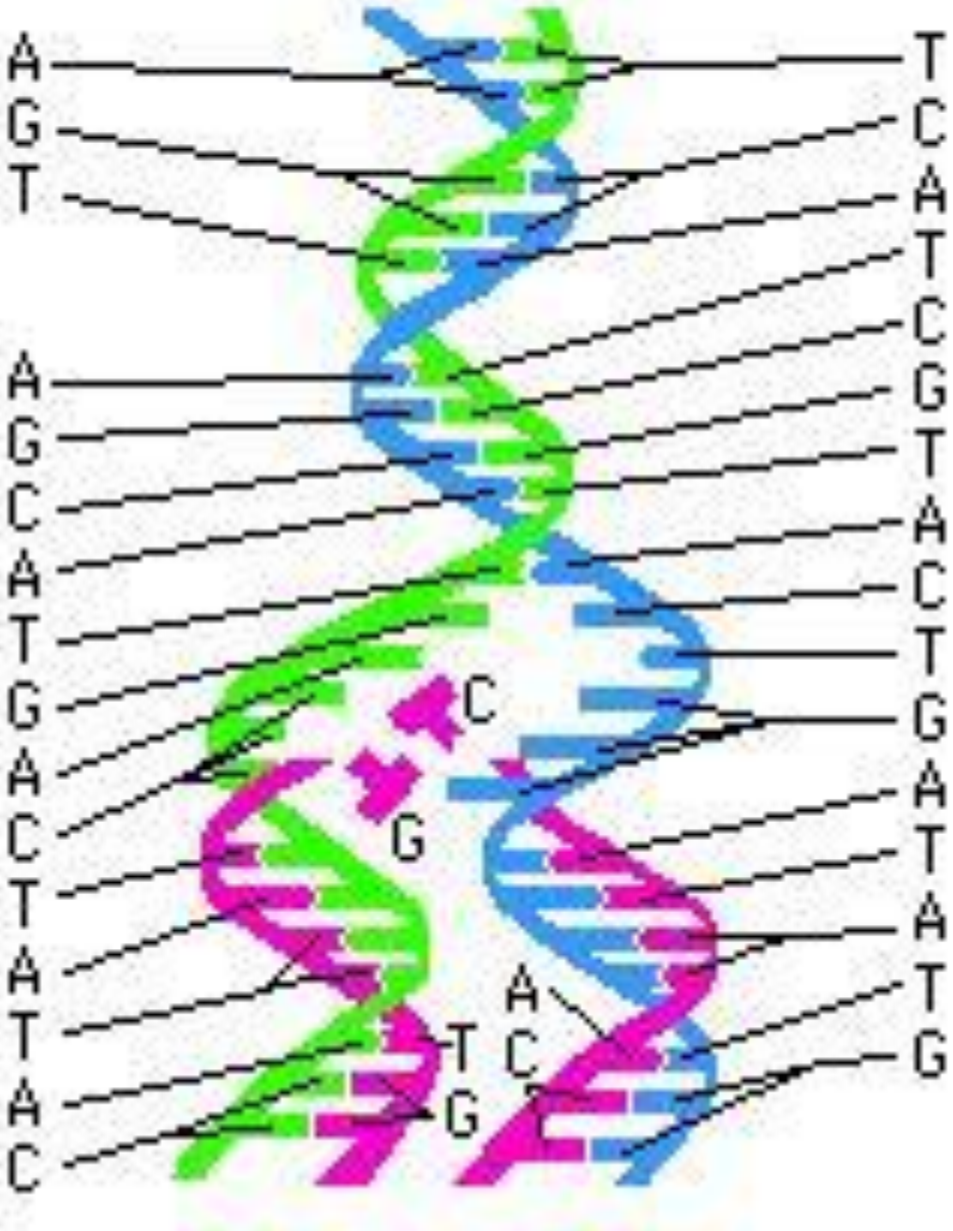
Therefore number of cytosine is equal to number of guanine nucleotide.

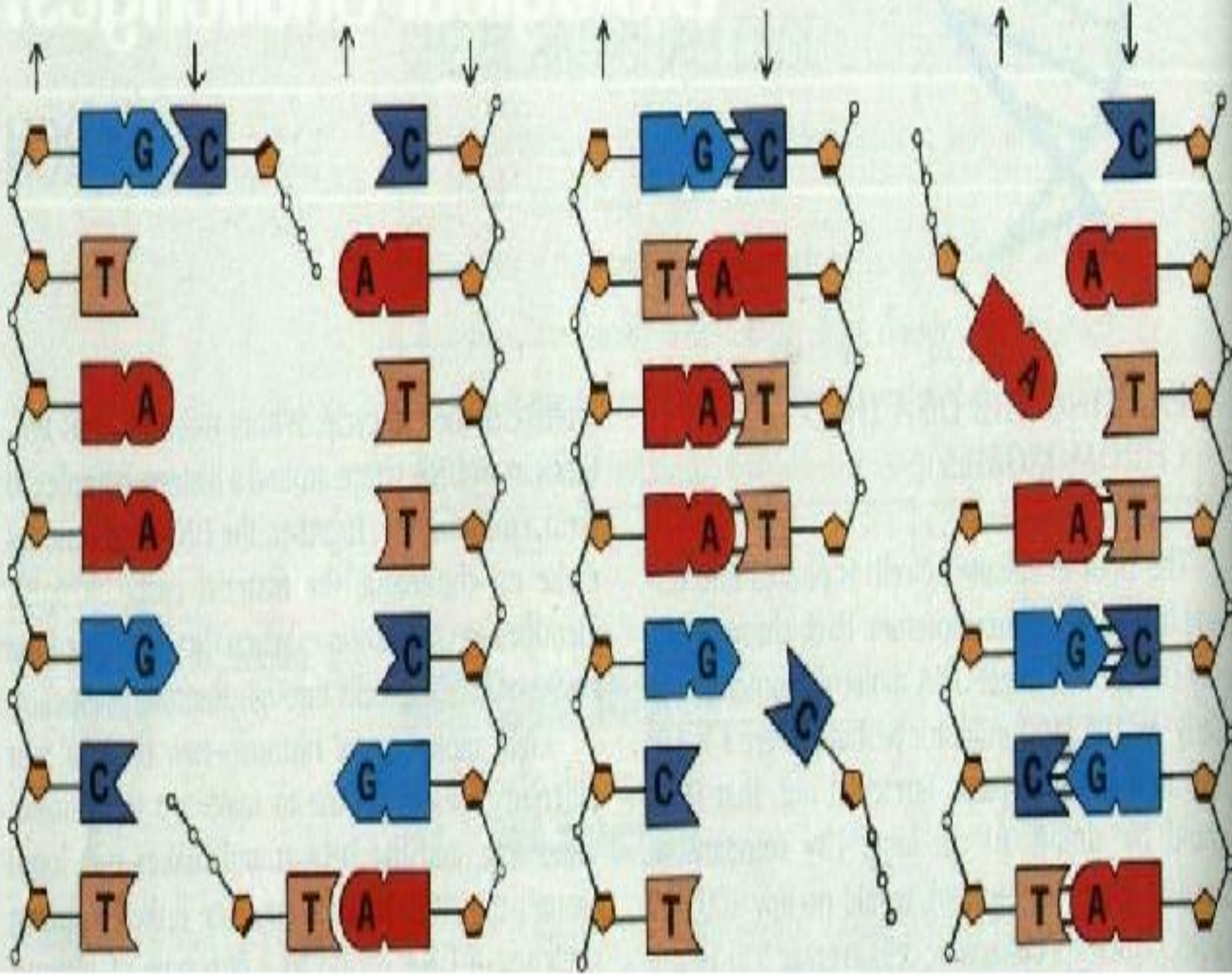
REPLICATION

- Before the cell division DNA make copy itself. This process is called duplication or replication.

- Two new DNA strands are formed semiconservatively.

DNA Replication





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

PROPERTIES OF DNA

1- It is double stranded.

2-In nucleus, mitochondria and chloroplast.

3-Replicates itself by DNA polymerase.

4-Nucleotides are A,T,G and C.

5- Sugar is deoxyribose.

6-It can replicate itself

RNA

1- It is single stranded.

2-In nucleus, mitochondria and chloroplast and cytoplasm.

3-Synthesized from DNA.

4-Nucleotides are A,U,G and C.

5- Sugar is ribose.

6-It transfers genetic information and synthesizing proteins.

Types of RNA

- mRNA
- tRNA
- rRNA

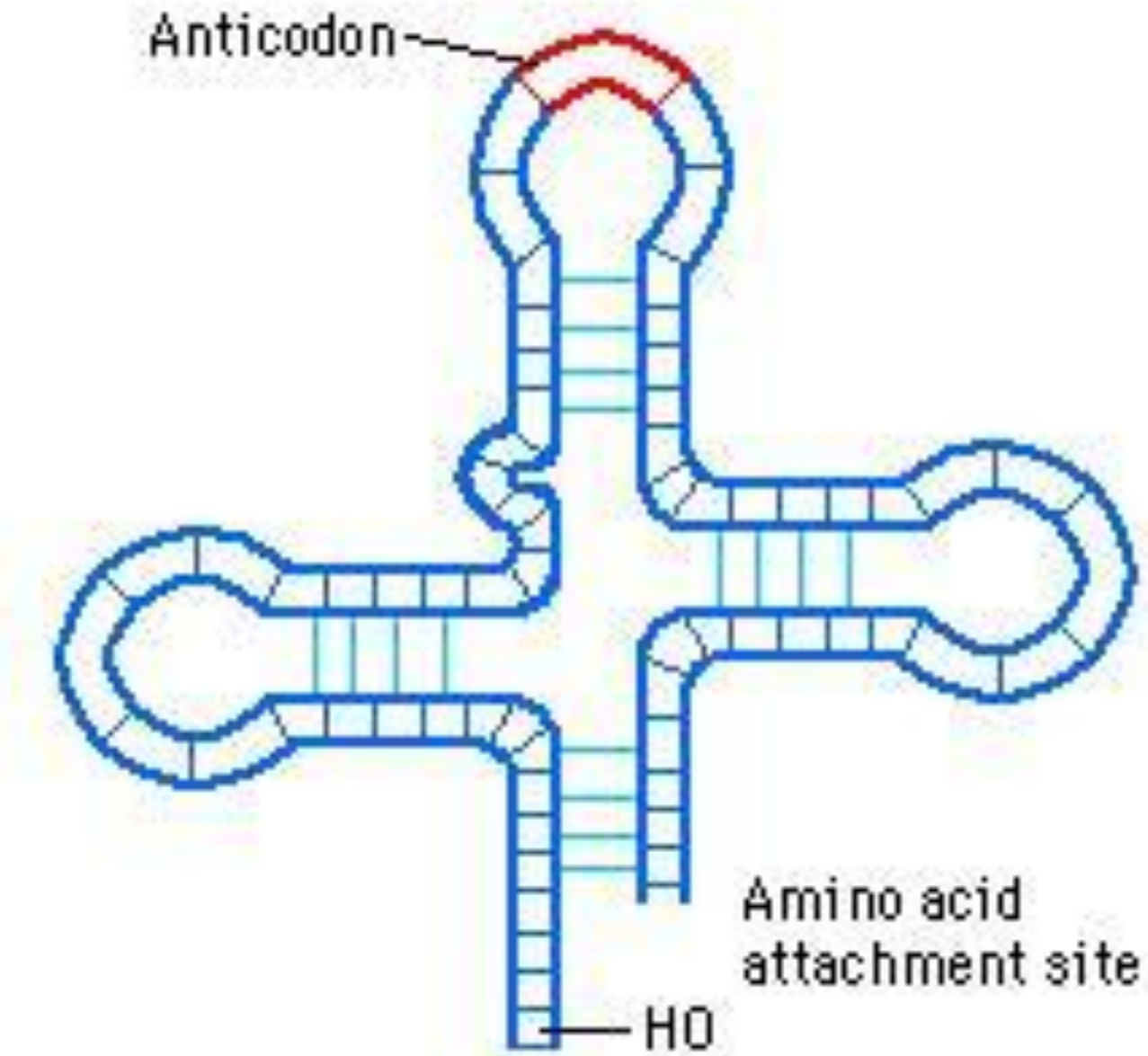
m RNA

- **All types of RNA are synthesized by DNA. Synthesizing of RNA from DNA is called transcription. Than m RNA moves to the cytoplasm.**
- Different m RNAs are transcripted from DNA for the synthesis of different proteins.

t RNA

- t RNA is synthesized in nucleus but than remains in cytoplasm.
- t RNA carries aminoacids from cytoplasm to ribosome.
- Each t RNA can transfer only one kind of aminoacid. There must be 20 types of t RNA because there are 20 types of aminoacid.

tRNA

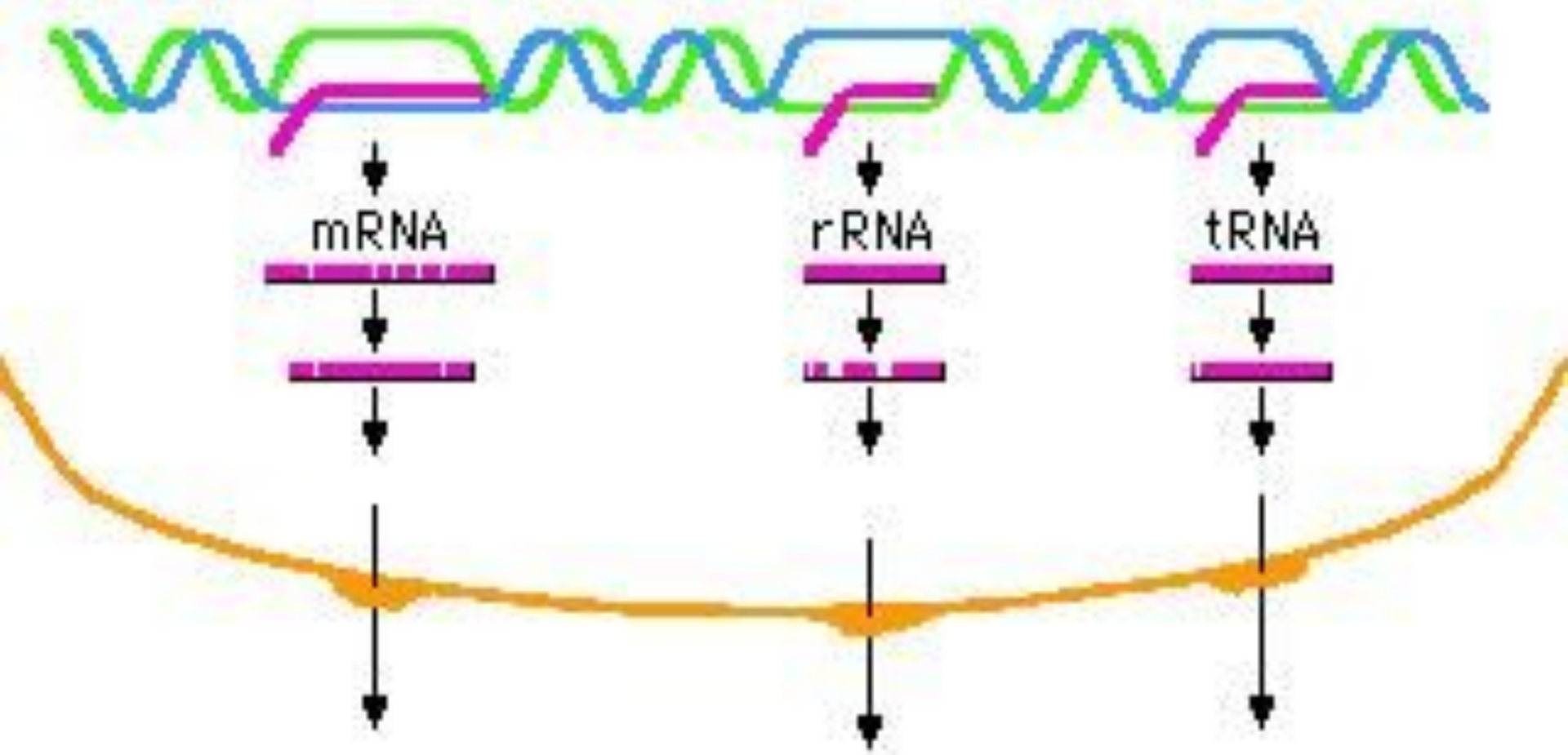


r RNA

- r RNA is formed by DNA in the nucleolus of the cell.
- r RNA takes roles in protein synthesis.
- r RNA participates structure of ribosome.

Transcription

Different gene regions of DNA:



THE GENETIC CODE

- It is a system of symbols used to store information carried by DNA chain.
- Only 4 bases in DNA serve to specify 20 aminoacids and all biological processes.
- 3 nucleotides code a single aminoacid.The triplet of nucleotides is called CODON.

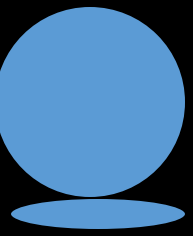
- There are 64 codons.One of them is start codon (AUG).It codes methionin
- 3 of them are stop codons(UAA,UAG and UGA)
- None of stop codons codes aminoacid.
- Except stop codons 61 codons code aminoacids.
- Some aminoacids are coded by more than one codons.For example; CAU and CAC code histidine.

PROTEIN SYNTHESIS

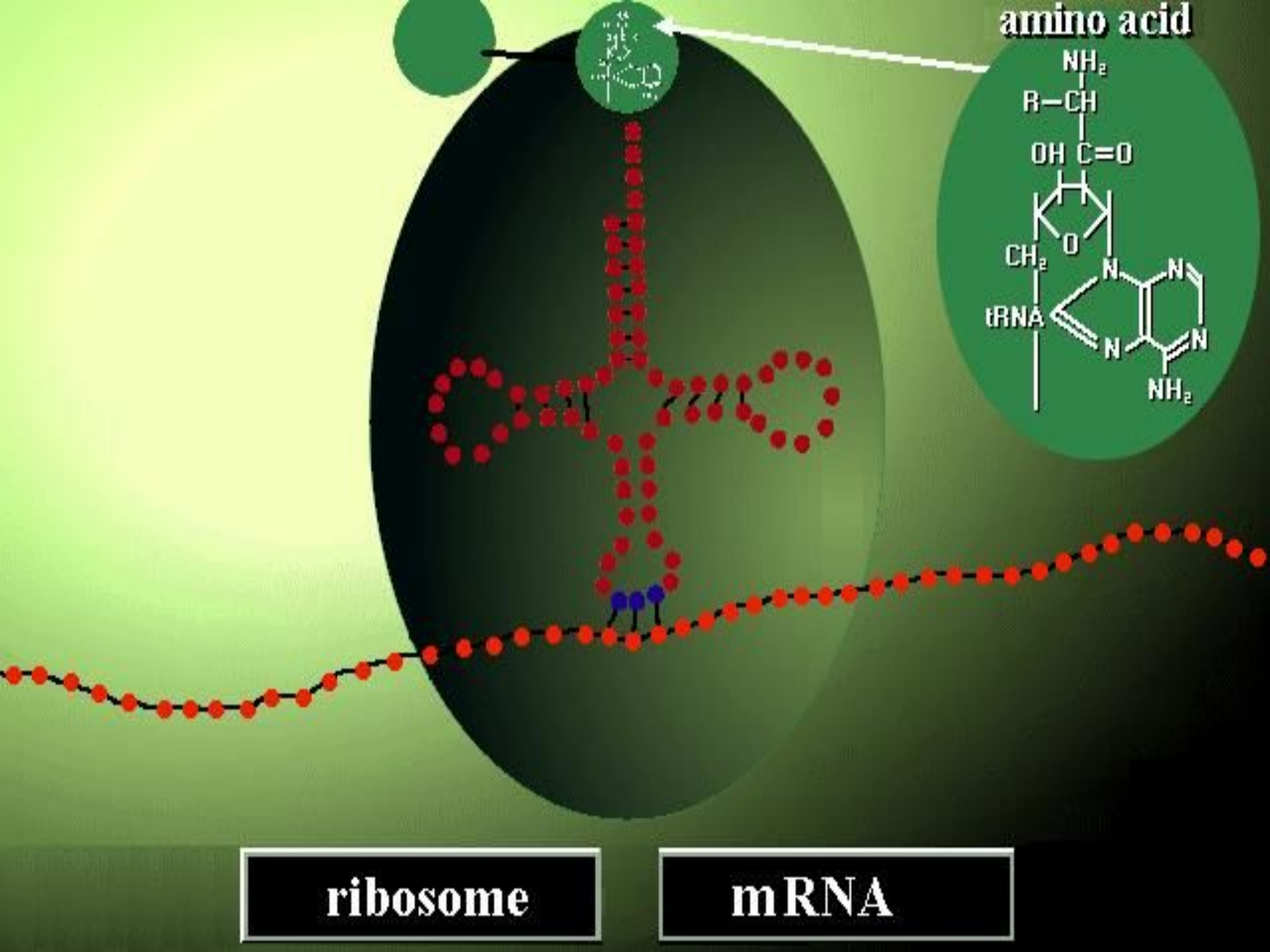
(TRANSLATION)

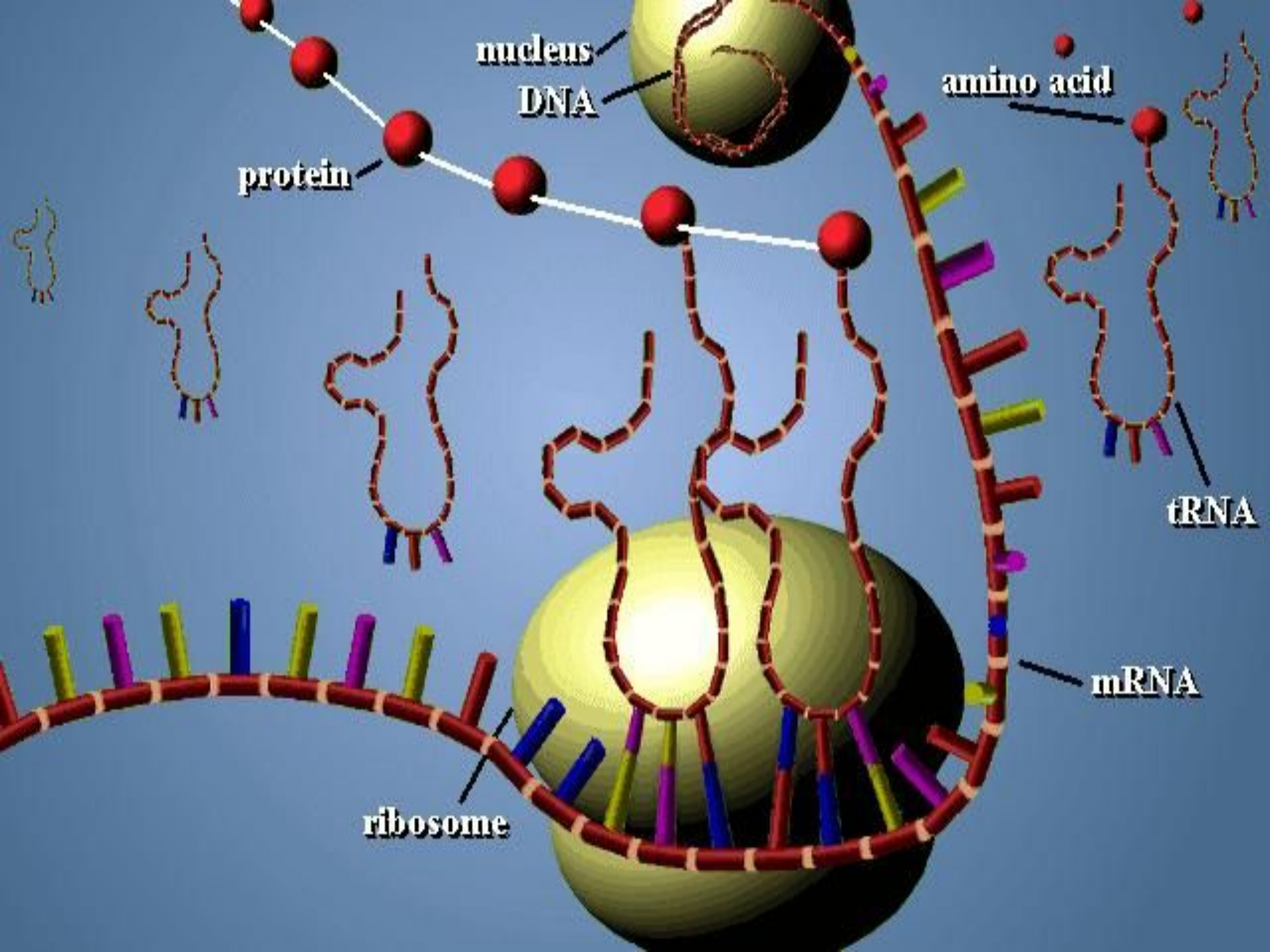
- Genetic material is translated into a protein.

1-INITIATION



polysome


amino acid
NH2
R–CH
OH C=O
O
CH2
tRNA
N
N
N
N
NH2
ribosome
mRNA

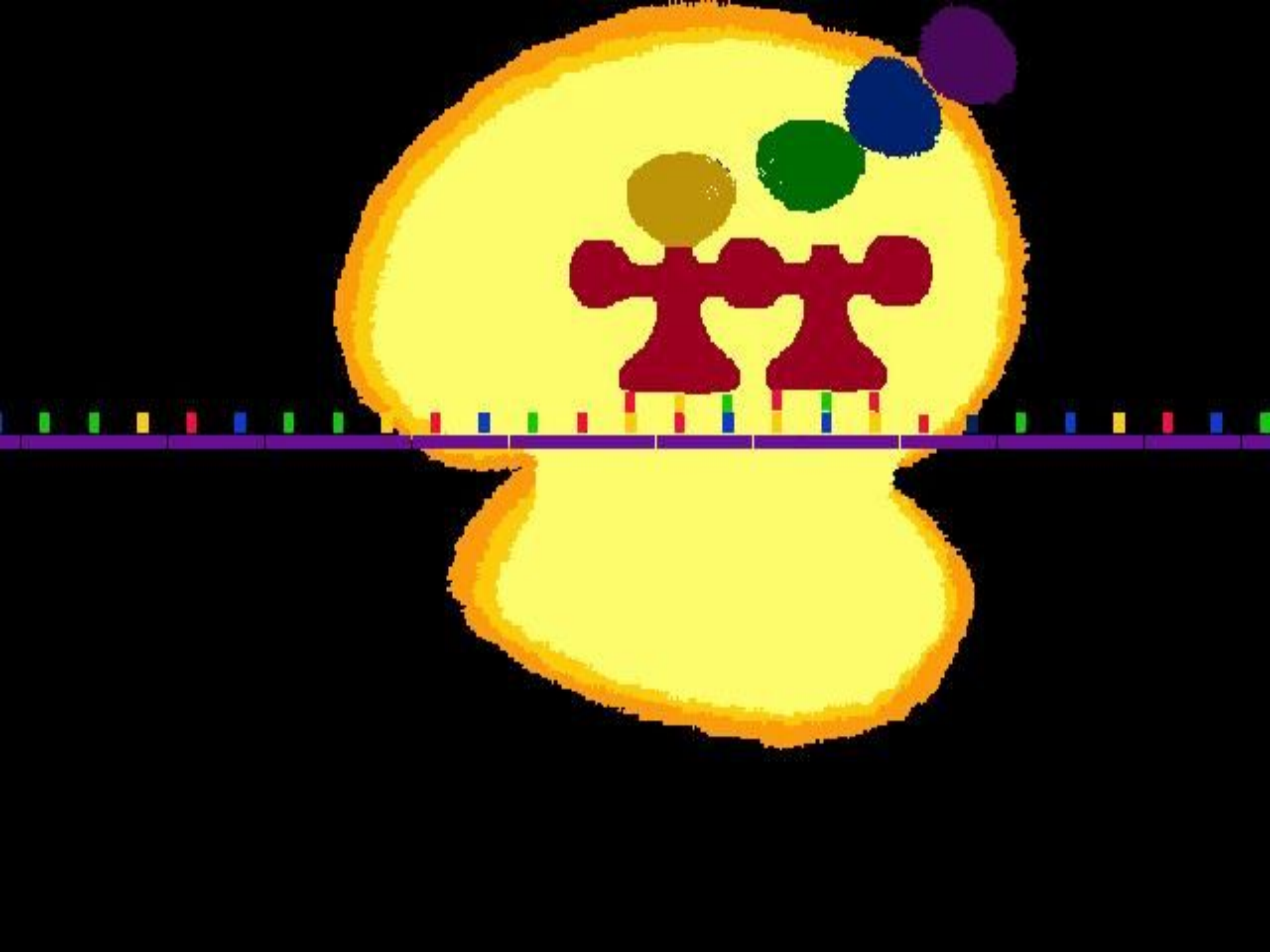

nucleus
DNA
amino acid
protein
tRNA
mRNA
ribosome

- Selection of initiation codon.(AUG)
- formation of hydrogen bond between codons on mRNA and naticodons on tRNA.

2-ELONGATION

- joining two aminoacids by peptide bond.
- First tRNA leaves A site while second one replaces P site.

This process repeates till synthesis is completed.



3-TERMINATION

- Begins when a stop codon is reached.
- A special protein binds to stop codon and causes peptidyl transferase to release the completed polypeptide.