Biotechnological Process:

Any biotechnological process can be separated into the following 5 major steps or operations:

(1) Strain (or culture) choice and improvement

(2) Mass culture (large-scale culture)

(3) Optimization of cell responses

(4) Process operation

(5) Product recovery or downstream processing.

1. Strain Choice:

The first step in such a biotechnological process is the identification of biological agent (microorganism/animal cell/plant cell) capable of producing the desired compound. This would generally involve the isolation of such a micro-organism from an appropriate habitat and its improvement through suitable strain development strategies.

2. Mass Culture:

It is necessary to culture the strain on a large scale, once a suitable strain has been developed; it needs to be maintained for as long as it is needed. Such strains can be used either to produce the biomass, (for example; SCP), or to recover some compounds from the biomass or the medium.

3. Optimization of Cell Responses:

In general, the conditions favoring rapid cell growth and biomass production are different from those of producing compound of interest, e.g., antibiotics. Therefore, in order to optimize the biochemical yields, the culture conditions have to be precisely regulated.

4. Process Operations:

The steps of a biotechnological process need to be fully optimized for safety, reproducibility, control and efficiency at all the scales of operation. In major part, this is the function of process engineering design developed with a full understanding of the biological, chemical and socioeconomic factors.

5. Product Recovery:

The goal of any biotechnological process is to recover (obtain) the needed product(s) in a useful form. The efficiency of product recovery is directly reflected in the product cost. The mode of this operation also determines the environmental friendliness of the process.

Some examples on applications of Biotechnology :

1- Medical applications:

1- The treatment of certain diseases such as cancer.

2- The production of vaccines and immunizations.

3- Diagnosis of diseases.

4- Gene therapy.

5- Stem cell research.

6- Production of proteins and genes.

Biotechnology has created more than 200 new biotherapeutics and vaccines, including products to treat cancer, diabetes, HIV/AIDS and autoimmune disorders. The majority of these products are therapeutic proteins.

2-Agricultural applications:

1- Food production, such as genetically modified foods.

2- Increased nutritional value

3- Resistance to herbicides, pesticides

4- Plants not required addition of fertilizer.

5- Stress – resistant plant (alkalinity, acidity, frost, drought)

6- Plant used to produce vaccine and medical products.

3- Industrial applications:

1- The enzymes are the most important outputs in this area and there are currently more than 450 enzymes work as a catalyst in various industrial applications, such as: carbohydrase's (e.g. Amylases), proteases, peptidases, lipases, oxi reductases and transferases.

2- Energy production.

4-Environmental applications:

1- The major environmental use is cleaning through bioremediation.

2- Bioremediation is the use of biotechnology to process or degrade a variety of natural and manmade products, especially those contributing to pollution.

Nucleic Acid Definition

Nucleic acids are essential large biological molecules for all forms of life. The nucleic acids include the DNA and the RNA. They are the hereditary determinants of living organisms. They are present in most living cells either in Free State or bound to proteins as nucleoproteins.

Naturally occurring chemical compound that is capable of being broken down to yield phosphoric acid, sugars, and a mixture of organic bases (purines and pyrimidines). Nucleic acids are the main information-carrying molecules of the cell, and, by directing the process of proteinsynthesis, they determine the inherited characteristics of every living thing. The two main classes of nucleic acids are deoxyribonucleic acid (DNA) and ribonucleic acid (RNA).

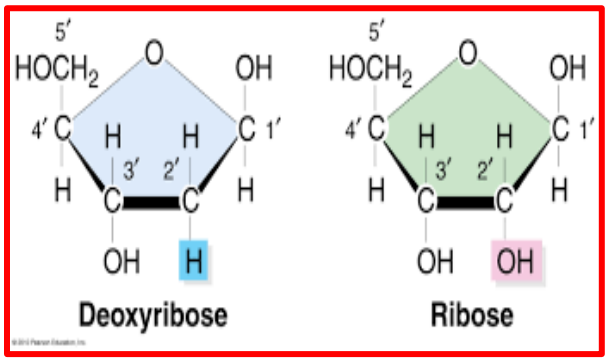
DNA structure

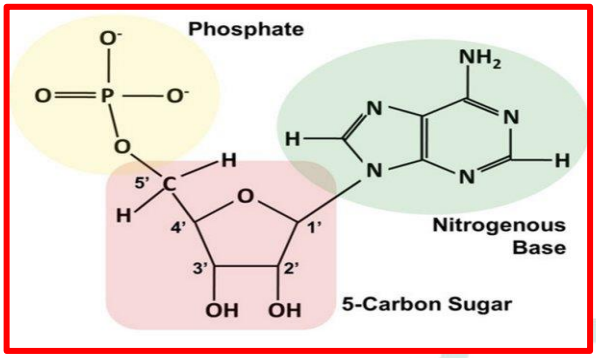
DNA Nucleotides:

The building blocks of nucleic acids are nucleotides. Nucleotides that compose DNA are called deoxyribonucleotides. The three components of a deoxyribonucleotide are a five-carbon sugar called deoxyribose, a phosphate group, and a nitrogenous base, a nitrogen-containing ring structure that is responsible for complementary base pairing between nucleic acid strands (Figure below). The carbon atoms of the five-carbon

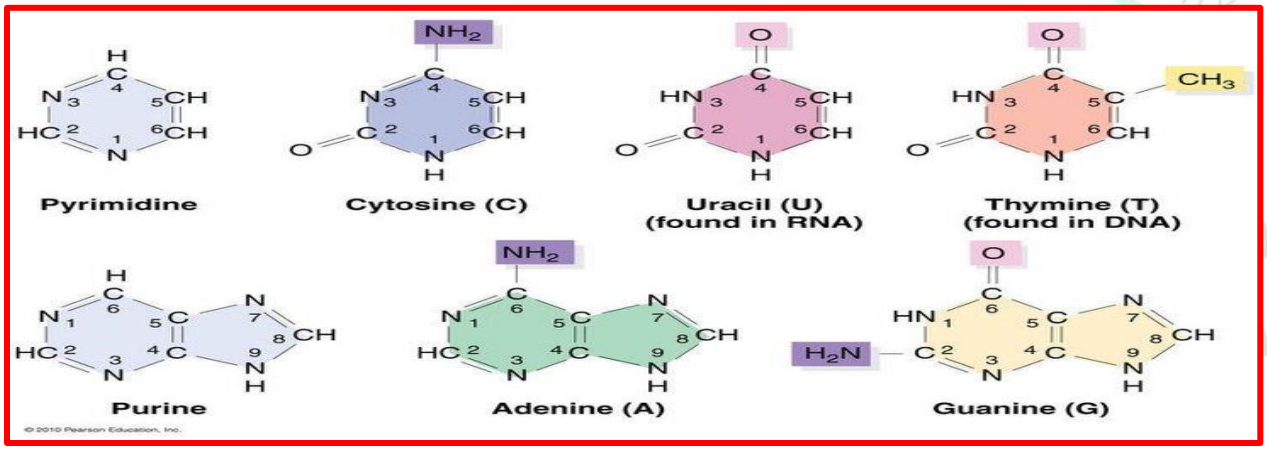
deoxyribose are numbered 1′, 2′, 3′, 4′, and 5′ (1′ is read as “one prime”).

A nucleoside comprises the five-carbon sugar and nitrogenous base.



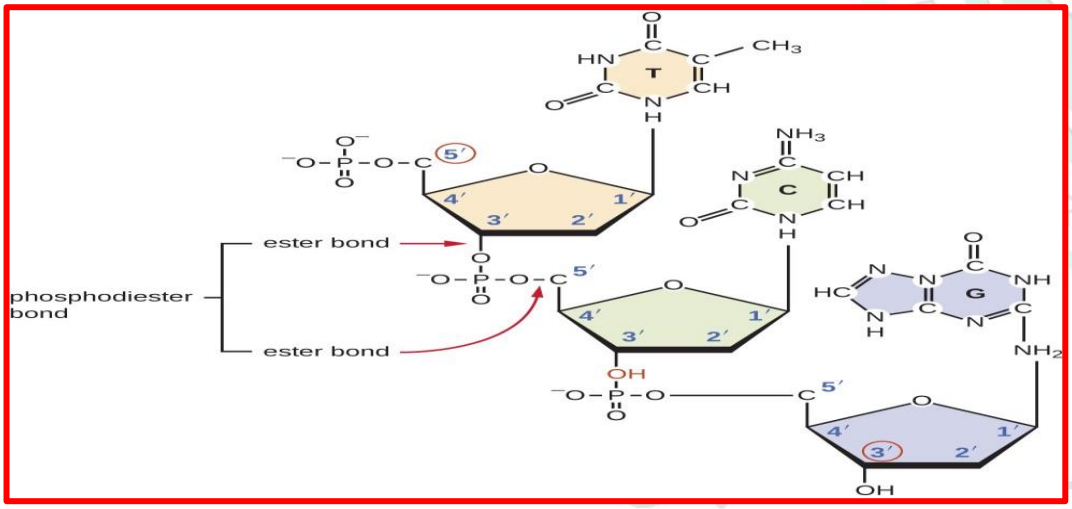


The deoxyribonucleotide is named according to the nitrogenous bases (Figure below). The nitrogenous bases adenine (A) and guanine (G) are the purines; they have a double-ring structure with a six-carbon ring fused to a five-carbon ring. The pyrimidines, cytosine (C) and thymine (T), are smaller nitrogenous bases that have only a six-carbon ring structure.



Individual nucleoside triphosphates combine with each other by covalent bonds known as 5′-3′ phosphodiester bonds, or linkages whereby the phosphate group attached to the 5′ carbon of the sugar of one nucleotide bonds to the hydroxyl group of the 3′ carbon of the sugar of the next nucleotide. Phosphodiester bonding between nucleotides forms the sugar- phosphate backbone, the alternating sugar-phosphate structure composing the framework of a nucleic acid strand (Figure below). During the polymerization process, deoxynucleotide triphosphates (dNTP) are used.

To construct the sugar-phosphate backbone, the two terminal phosphates are released from the dNTP as a pyrophosphate. The resulting strand of nucleic acid has a free phosphate group at the 5′ carbon end and a free hydroxyl group at the 3′ carbon end. The two unused phosphate groups from the nucleotide triphosphate are released as pyrophosphate during phosphodiester bond formation.



Watson and Crick proposed the double helix model for DNA.

(a) The sugar-phosphate backbones are on the outside of the double helix and purines and pyrimidines form the "rungs" of the DNA helix ladder.

(b) The two DNA strands are antiparallel to each other.

(c) The direction of each strand is identified by numbering the carbons (1through 5) in each sugar molecule. The 5′ end is the one where carbon #5 is not bound to another nucleotide; the 3′ end is the one where carbon #3 is not bound to another nucleotide.