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**BRIDGE COURSE 2020-21**

| S.NO | TOPIC | DATE |
|---|---|---|
| 1. | Introduction to prokaryotic and eukaryotic cell | 15-04-21 |
| 2. | Introduction to bio-molecules | 15-04-21 |
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| 6. | Introduction to microbiology and study of microorganisms | 17-04-21 |
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| 9. | Instrumentation in microbiology | 19-04-21 |

# TOPIC I - PROKARYOTIC CELL

**I. An Overview of Procaryotic Cell Structure**

A. Size, shape, and arrangement :

1. Procaryotes come in a variety of shapes including spheres (cocci), rods (bacilli), ovals (coccobacilli), curved rods (vibrios), rigid helices (spirilla), and flexible helices (spirochetes)

2. During the reproductive process, some cells remain attached to each other to form chains, clusters, square planar configurations (tetrads), or cubic configurations (sarcinae)

3. A few bacteria are flat and some lack a single, characteristic form and are called pleiomorphic

B. Procaryotic cells vary in size although they are generally smaller than most eucaryotic cells; recently, however, a large procaryote, *Epulopiscium fisheloni* was discovered that grows as large as 600Tm H 80Tm, a littler smaller than a printed hyphen

C. Procaryotic cells contain a variety of internal structures

D. Not all structures are found in every genus, but procaryotes are consistent in their fundamental structure and most important components

E. Procaryotic cell organizationCprocaryotes are morphologically distinct from eucaryotic cells and have fewer internal structures.

**II. Procaryotic Cell Membranes**

A. The plasma membrane

1. The plasma membrane consists of a phospholipid bilayer with hydrophilic surfaces (interact with water) and a hydrophobic interior (insoluble in water); such asymmetric molecules are said to be amphipathic

2. Archaeobacterial membranes have a monolayer instead of a bilayer structure

3. Proteins are associated with the membrane and may be either peripheral (loosely associated and easily removed) or integral (embedded within the membrane and not easily removed)

4. The membrane is highly organized, asymmetric, flexible, and dynamic

5. The plasma membrane serves several functions for the cell

2. Gas vacuoles are a type of inclusion body found in cyanobacteria and some other aquatic forms; they provide buoyancy for these organisms and keep them at or near the surface of their aqueous habitat

E. Ribosomes

1. Ribosomes are complex structures consisting of protein and RNA

2. They are responsible for the synthesis of cellular proteins

3. Procaryotic ribosomes are similar in structure to, but smaller and less complex than, eucaryotic ribosomes

F. Molecular Chaperones

1. These are Helper proteins that aid the folding of nascent polypeptides during protein synthesis

2. Many molecular chaperones are heat-shock proteins that increase in concentration after cells are subjected to environmental stress; they promote proper folding of new proteins that are replacing heat-damaged existing proteins

3. Molecular chaperones also function to keep secretory proteins in an export-competent state until they are translocated across the plasma membrane

**VI. The Nucleoid** is an irregularly shaped region in which the single circular chromosome of the procaryote will be found; in most procaryotes it is not bounded by a membrane, but is sometimes found to be associated with the plasma membrane or with mesosomes; two genera of planctomycete bacteria have been shown to have membrane-bounded DNA-containing regions

A. The bacterial chromosome is an efficiently packed, closed circular DNA molecule that is looped and coiled extensively

B. In actively growing bacteria, the nucleoid has projections that extend into the cytoplasmic matrix; these projections probably contain DNA being actively transcribed

C. Plasmids are small, closed circular DNA molecules that can exist and replicate independently of the bacterial chromosome; they are not required for bacterial growth and reproduction, but they may carry genes that give the bacterium a selective advantage (e.g., drug resistance, enhanced metabolic activities, etc.)

**VII. The Procaryotic Cell Wall** is a rigid structure that results in the characteristic shapes of the various procaryotes and protects them from osmotic lysis

## VIII. Components External to the Cell Wall

A. Capsules and slime layers are layers of polysaccharides lying outside the cell wall; they protect the bacteria from phagocytosis, viral infection, pH fluctuations, osmotic stress, hydrolytic enzymes, or the predacious bacterium *Bdellovibrio.*

1. Capsules are well organized

2. Slime layers are diffuse and unorganized

B. A glycocalyx is a network of polysaccharides extending from the surface of bacteria and other cells

C. S layers are regularly structured layers of protein or glycoprotein

D. S layers are common among the archeaobacteria where it may be the only structure outside the plasma membrane

E. Pili and fimbriae are short, thin, hairlike appendages that mediate bacterial attachment to surfaces (fimbriae) or to other bacteria during sexual mating (pili)

F. Flagella and motility

1. Flagella are threadlike locomotor appendages extending outward from the plasma membrane and cell wall

2. Flagella may be arranged in various patterns:

a. Monotrichous - Bacterium with single flagellum

b. Amphitrichous - Bacterium with single flagellum at each pole

c. Lophotrichous - Bacterium with cluster (tuft) of flagella at one or both ends

d. Peritrichous - Bacterium with relatively even distribution of flagella over the entire surface of the bacterium

3. Flagellar ultrastructure: The flagellum consists of a hollow filament composed of a single protein known as flagellin. The hook is a short curved segment that links the filament to the basal body, a series of rings that drives flagellar rotation.

4. Flagellar synthesis involves many genes for the hook and basal body, as well as the gene for flagellin. New molecules of flagellin are transported through the hollow filament so that the growth of the flagellum is from the tip, not from the base.

# TOPIC I – EUKARYOTIC CELL

## I. An Overview of Eucaryotic Cell Structure

A. Eucaryotic cells have membrane-delimited nuclei(nucleus separated by nuclear membrane)

B. Eucaryotic cells have membrane-bound organelles that perform specific functions within the cells; this allows simultaneous independent control

C. The large membrane surface area of eucaryotic cells allows greater respiratory and photosynthetic activity

## II. The Cytoplasmic Matrix, Microfilaments, Intermediate Filaments, and Microtubules

A. The cytoplasmic matrix, although superficially featureless, provides the complex environment required for many cellular activities

B. Microfilaments (4 to 7 nm) may be scattered throughout the matrix or organized into networks and parallel arrays; they play a major role in cell motion and cell shape changes

C. Microtubules are hollow cylinders (25 nm) that help maintain cell shape, that are involved (with microfilaments) in cellular movement, and that also participate in intracellular transport of substances

D. Microtubules also form the mitotic spindle during cell division and are present in cilia and flagella

E. Intermediate filaments (8 to 10 nm) are major components of the cytoskeleton, an intricate network of interconnected filaments that helps maintain cell shape and contributes to cellular movement

**III. The Endoplasmic Reticulum (ER)**-a complex set of internal membranes that may have ribosomes attached (rough or granular endoplasmic reticulum; RER or GER), or that may be devoid of ribosomes (smooth or agranular endoplasmic reticulum; SER or AER)

A. The ER transports proteins, lipids, and other materials within the cell

B. The ER is a major site of cell membrane synthesis

C. Lipids and many proteins are synthesized by ER-associated enzymes and ribosomes

D. New ER is produced through expansion of old ER

A. Ribosomes may be attached to the ER or they may be free

B. ER-associated ribosomes synthesize integral membrane proteins or proteins that are secreted out of the cell

C. Free ribosomes synthesize nonsecretory, nonmembrane proteins

D. Molecular chaperones aid the proper folding of proteins after synthesis and also assist the transport of proteins into eucaryotic organelles such as mitochondria

**VII. Mitochondria**-the site of tricarboxylic acid cycle activity and the generation of ATP by electron transport and oxidative phosphorylation

A. Mitochondria have both an inner membrane and an outer membrane enclosing a fluid matrix

B. The inner and outer membrane have different lipids and enzymes

C. The enzymes of the tricarboxylic acid cycle and the b-oxidation pathway for fatty acids are located within the matrix

D. Electron transport and oxidative phosphorylation occur only on the inner mitochondrial membrane

E. Mitochondria use their own DNA and their own ribosomes to synthesize some of their proteins

**VIII. Chloroplasts**-the site of both the light and the dark reactions of photosynthesis

A. Chloroplasts have an outer membrane and an inner membrane system of flattened sacs called thylakoids that often form stacks known as grana; the fluid matrix compartment is called the stroma

B. The formation of carbohydrate from carbon dioxide and water (dark reaction) occurs in the stroma

C. The trapping of light energy to generate ATP, NADPH, and oxygen (light reaction) occurs in the thylakoid membranes of the grana

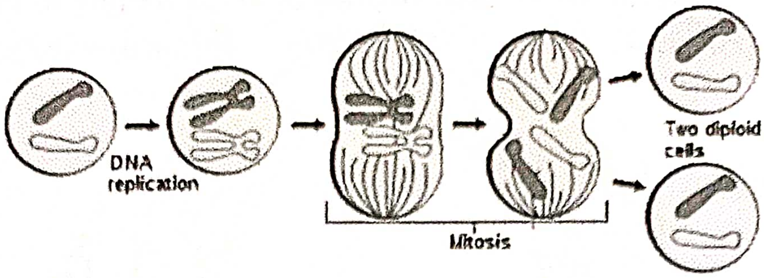
**IX. The Nucleus and Cell Division**

A. Nuclei are membrane-bound structures that house the chromatin (genetic material) of the cell

1. Euchromatin is loosely organized and genetically active

2. Heterochromatin is tightly coiled and contains dormant genes

# TOPIC III - CELL CYCLE




Each turn of the cell cycle divides the chromosomes in a cell nucleus.

The **cell cycle**, or **cell-division cycle**, is the series of events that takes place in a cell leading to its division and duplication (replication). In cells without a nucleus (prokaryotic), the cell cycle occurs via a process termed binary fission. In cells with a nucleus (eukaryotes), the cell cycle can be divided in two brief periods: interphase—during which the cell grows, accumulating nutrients needed for mitosis and duplicating its DNA—and the mitosis (M) phase, during which the cell splits itself into two distinct cells, often called "daughter cells". The cell-division cycle is a vital process by which a single-celled fertilized egg develops into a mature organism, as well as the process by which hair, skin, blood cells, and some internal organs are renewed.

Phases :

The cell cycle consists of four distinct phases: $G_1$ phase, S phase (synthesis), $G_2$ phase (collectively known as interphase) and M phase (mitosis). M phase is itself composed of two tightly coupled processes: mitosis, in which the cell's chromosomes are divided between the two daughter cells, and cytokinesis, in which the cell's cytoplasm divides in half forming distinct cells. Activation of each phase is dependent on the proper progression and completion of the previous one. Cells that have temporarily or reversibly stopped dividing are said to have entered a state of quiescence called $G_0$phase.

After cell division, each of the daughter cells begin the interphase of a new cycle. Although the various stages of interphase are not usually morphologically distinguishable, each phase of the cell cycle has a distinct set of specialized biochemical processes that prepare the cell for initiation of cell division.

**Mitosis (M Phase/Mitotic phase)**

The relatively brief M phase consists of nuclear division (karyokinesis). The M phase has been broken down into several distinct phases, sequentially known as:

- prophase,
- metaphase,
- anaphase,
- telophase
- cytokinesis (strictly speaking, cytokinesis is not part of mitosis but is an event that directly follows mitosis in which cytoplasm is divided into two daughter cells)

**Mitosis** is the process by which a eukaryotic cell separates the chromosomes in its cell nucleus into two identical sets in two nuclei. It is generally followed immediately by cytokinesis, which divides the nuclei, cytoplasm, organelles and cell membrane into two cells containing roughly equal shares of these cellular components. Mitosis and cytokinesis together define the **mitotic (M) phase** of the cell cycle - the division of the mother cell into two daughter cells, genetically identical to each other and to their parent cell. This accounts for approximately 10% of the cell cycle.

Mitosis occurs exclusively in eukaryotic cells, but occurs in different ways in different species. For example, animals undergo an "open" mitosis, where the nuclear envelope breaks down before the chromosomes separate, while fungi such as *Aspergillus nidulans* and *Saccharomyces cerevisiae* (yeast) undergo a "closed" mitosis, where chromosomes divide within an intact cell nucleus. Prokaryotic cells, which lack a nucleus, divide by a process called binary fission.

The process of mitosis is complex and highly regulated. The sequence of events is divided into phases, corresponding to the completion of one set of activities and the start of the next. These stages are prophase, prometaphase, metaphase, anaphase and telophase. During the process of mitosis the pairs of chromosomes condense and attach to fibers that pull the sister chromatids to opposite sides of the cell. The cell then divides in cytokinesis, to produce two identical daughter cells.

Because cytokinesis usually occurs in conjunction with mitosis, "mitosis" is often used interchangeably with "M phase". However, there are many cells where mitosis and cytokinesis occur separately, forming single cells with multiple nuclei. This occurs most notably among the fungi and slime moulds, but is found in various different groups. Even in animals, cytokinesis and mitosis may occur independently, for instance during certain stages of fruit fly embryonic development. Errors in mitosis can either kill a cell through apoptosis or cause mutations that may lead to cancer.

Regulation of eukaryotic cell cycle:

Regulation of the cell cycle involves processes crucial to the survival of a cell, including the detection and repair of genetic damage as well as the prevention of uncontrolled cell division. The molecular events that control the cell cycle are ordered and directional; that is, each process occurs in a sequential fashion and it is impossible to "reverse" the cycle.

# TOPIC IV - MOLECULAR BIOLOGY

## I. Nucleic Acid Structure

A. DNA Structure

1. DNA is composed of purine and pyrimidine nucleosides that contain the sugar 2¢-deoxyribose and are joined by phosphodiester bridges

2. DNA is usually a double helix consisting of two chains of DNA coiled around each other

3. The purine adenine (A) on one strand of DNA is always paired with the pyrimidine thymine (T) on the other strand, while the purine guanine (G) is always paired with the pyrimidine cytosine (C); thus, the two strands are said to be complementary

4. The two polynucleotide chains are antiparallel (i.e., their sugar-phosphate backbones are oriented in opposite directions)

5. The two strands are not positioned directly opposite one another; therefore, a major groove and a smaller minor groove are formed by the double helix backbone

B. RNA structure

1. RNA differs from DNA in that it is composed of the sugar ribose rather than 2¢-deoxyribose

2. RNA differs from DNA in that it contains the pyrimidine uracil (U) instead of thymine

3. RNA differs from DNA in that it usually consists of a single strand that can coil back on itself, rather than two strands coiled around each other

4. Three different kinds of RNA exist-ribosomal (rRNA), transfer (tRNA), and messenger (mRNA)-and differ from one another in function, site of synthesis in eucaryotic cells, and structure

C. The organization of DNA in cells

1. In procaryotes, the DNA exists as a closed circular, supercoiled molecule associated with basic (histonelike) proteins

2. In eucaryotes, the DNA is more highly organized

a. It is associated with basic (histone) proteins

7. DNA ligases join the discontinuous fragments to form a complete strand of DNA

8. DNA replication is extraordinarily complex; at least 30 proteins are required to replicate the *E. coli* chromosome

9. The rate of DNA synthesis is 750 to 1,000 base pairs per second in procaryotes, and 50 to 100 base pairs per second in eucaryotes

**III. DNA Transcription or RNA Synthesis**

A. Three types of RNA are produced by transcription

1. tRNA carries amino acids during protein synthesis

2. rRNA molecules are components of the ribosomes

3. mRNA carries the message that directs the synthesis of proteins; in addition to the translated regions of the mRNA, there are several untranslated regions that serve particular purposes

a. Leader sequences consist of 25 to 150 bases at the 5¢ end of the mRNA, and precede the initiation codon

b. Spacer regions separate the segments that code for individual polypeptides in polygenic mRNAs (i.e., those RNAs that encode more than one polypeptide chain)

c. Trailer regions are found at the 3¢ end of the mRNA after the last termination codon

B. RNA polymerase (a large multi-subunit enzyme) is the enzyme responsible for the synthesis of RNA

C. A gene is a DNA segment or sequence that codes for a polypeptide, rRNA, or tRNA

D. In a given segment, only one strand (sense or template strand) is copied

E. A promoter is the region of the DNA to which RNA polymerase binds in order to initiate transcription

F. Terminators are regions of the DNA that, when transcribed, result in the termination of the transcription process

G. In eucaryotes, transcription yields large RNA precursors (heterogeneous nuclear RNA; hnRNA) that must be processed by posttranscriptional modification to produce mRNA

c. After each amino acid is added to the chain, translocation occurs and thereby moves the ribosome to position the next codon appropriately

d. Several polypeptide elongation factors are required for this process

e. Hydrolysis of ATP and GTP provide the energy needed for this process

3. Termination takes place at any one of three special codons (UAA, UAG, or UGA)

a. Three polypeptide release factors aid in the recognition of these codons

b. No amino acids are incorporated into the growing polypeptide chain at these positions

c. The ribosome hydrolyzes the bond between the completed protein and the final tRNA, and the protein is released from the ribosome, which then dissociates into its two component subunits

d. As the protein leaves the ribosome it folds into its proper shape aided by molecular chaperones

F. Eucaryotic protein synthesis is similar, but may require more protein factors to mediate various parts of the process; and usually is less dependent on molecular chaperones for proper folding of the newly synthesized protein

G. Procaryotic proteins may undergo splicing after translation; such splicing removes intervening sequences (introns) from the sequences (extrons) that remain in the final product.

# Molecular Biology

**Molecular biology** is the branch of biology that deals with the molecular basis of biological activity. This field overlaps with other areas of biology and chemistry, particularly genetics and biochemistry. Molecular biology chiefly concerns itself with understanding and the interactions between the various systems of a cell, including the interactions between the different types of DNA, RNA and protein biosynthesis as well as learning how these interactions are regulated.

Molecular biology as an approach from the viewpoint of the so-called basic sciences with the leading idea of searching below the large-scale manifestations of classical biology for the corresponding molecular plan. It is concerned particularly with the *forms* of biological molecules and [...] is predominantly three-dimensional and structural—which does not mean, however, that it is merely a refinement of morphology. It must at the same time inquire into genesis and function.

**Relationship to other biological sciences**

Researchers in molecular biology use specific techniques native to molecular biology (see *Techniques* section later in article), but increasingly combine these with techniques and ideas from genetics and biochemistry. There is not a defined line between these disciplines. The figure above is a schematic that depicts one possible view of the relationship between the fields:

- *Biochemistry* is the study of the chemical substances and vital processes occurring in living organisms. Biochemists focus heavily on the role, function, and structure of biomolecules. The study of the chemistry behind biological processes and the synthesis of biologically active molecules are examples of biochemistry.
- *Genetics* is the study of the effect of genetic differences on organisms. Often this can be inferred by the absence of a normal component (e.g. one gene). The study of "mutants" – organisms which lack one or more functional components with respect to the so-called "wild type" or normal phenotype. Genetic interactions (epistasis) can often confound simple interpretations of such "knock-out" studies.
- *Molecular biology* is the study of molecular underpinnings of the processes of replication, transcription, translation, and cell function. The central dogma of molecular biology where genetic material is transcribed into RNA and then translated into protein, despite being an oversimplified picture of molecular biology, still provides a good starting point for understanding the field. This picture, however, is undergoing revision in light of emerging novel roles for RNA.

Much of the work in molecular biology is quantitative, and recently much work has been done at the interface of molecular biology and computer science in bioinformatics and computational biology. As of the early 2000s, the study of gene structure and function, molecular genetics, has been among the most prominent sub-field of molecular biology.

also be used to determine whether a particular DNA fragment is found in a cDNA library. PCR has many variations, like reverse transcription PCR (RT-PCR) for amplification of RNA, and, more recently, real-time PCR (QPCR) which allow for quantitative measurement of DNA or RNA molecules.

**Gel electrophoresis**

Gel electrophoresis is one of the principal tools of molecular biology. The basic principle is that DNA, RNA, and proteins can all be separated by means of an electric field. In agarose gel electrophoresis, DNA and RNA can be separated on the basis of size by running the DNA through an agarose gel. Proteins can be separated on the basis of size by using an SDS-PAGE gel, or on the basis of size and their electric charge by using what is known as a 2D gel electrophoresis.

**Macromolecule blotting and probing**

The terms *northern*, *western* and *eastern* blotting are derived from what initially was a molecular biology joke that played on the term *Southern blotting*, after the technique described by Edwin Southern for the hybridisation of blotted DNA. Patricia Thomas, developer of the RNA blot which then became known as the *northern blot* actually didn't use the term.[2] Further combinations of these techniques produced such terms as *southwesterns* (protein-DNA hybridizations), *northwesterns* (to detect protein-RNA interactions) and *farwesterns* (protein-protein interactions), all of which are presently found in the literature.

**Southern blotting :** Named after its inventor, biologist Edwin Southern, the Southern blot is a method for probing for the presence of a specific DNA sequence within a DNA sample. DNA samples before or after restriction enzyme digestion are separated by gel electrophoresis and then transferred to a membrane by blotting via capillary action. The membrane is then exposed to a labeled DNA probe that has a complement base sequence to the sequence on the DNA of interest. Most original protocols used radioactive labels, however non-radioactive alternatives are now available. Southern blotting is less commonly used in laboratory science due to the capacity of other techniques, such as PCR, to detect specific DNA sequences from DNA samples. These blots are still used for some applications, however, such as measuring transgene copy number in transgenic mice, or in the engineering of gene knockout embryonic stem cell lines.

**Northern blotting :** The northern blot is used to study the expression patterns of a specific type of RNA molecule as relative comparison among a set of different samples of RNA. It is essentially a combination of denaturing RNA gel electrophoresis, and a blot. In this process RNA is separated based on size and is then transferred to a membrane that is then probed with a labeled complement of a sequence of interest. The results may be visualized through a variety of ways depending on the label used; however, most result in the revelation of bands representing the sizes of the RNA detected in sample. The intensity of these bands is related to the amount of the target RNA in the samples analyzed. The procedure is commonly used to study when and how much gene expression is occurring by measuring how much of that RNA is

# Introduction to Immunity

A system functions in the body providing protection against the pathogenic organisms. This defensive system is known as immune system. This system furnishes the body to fight against the certain disease. This ability to resist against the disease is called immunity. The immune system possesses a remarkable quality of distinguishing between the self antigen and foreign antigen.

**Antibody:** Antibodies are certain specific proteins found in the blood plasma and lymph in the body, which fight against the viruses and bacteria invading the body and resist against their pathogenic effects. Viruses, bacteria, fungi and other foreign proteins which enter the blood, lymph or the body and which cause pathogenic effects are called antigens. The immune system produces antibodies to resist against antigens. In order to resist against the pathogenic effects of antigens and the causative organisms (antigens), the body possesses special type of cells. This type of cell system resists the organ or tissue transplantation and also resists those body cells which get themselves transformed into cancerous cells.

**Antigens:** As stated earlier, Viruses, Bacteria, Fungi and other foreign proteins which enter the blood, lymph or the body and which cause pathogenic effects are called antigens. Normally the antigens are macromolecules formed of proteins and conjugated protein. Thus any foreign protein that induces the production of antibody in the body is known as antigen. The following may act as antigen and induce the activity of immune system.

1. The cell wall of bacteria
2. Capsid of virus
3. Egg albumin
4. Pollen grain
5. Certain vegetables and fruits
6. Feathers
7. Animal tissue
8. Transplanted organ
9. Medicine
10. Drugs
11. Chemicals etc.

**Allergy and Inflammation :** Allergy is a specific type of antigen antibody reaction occurring in the body, in which the body shows high and unusual physiological response against certain substances. The substances which are causative for producing allergy are called allergens. An allergen is a kind of Antigen. The antibody binds with the allergen on the receptor surface of the mast cells. The mast cells are found in connective tissue in our body. All people are not sensitive to all type of allergens. The allergic reaction does not occur when a person comes in contact with a particular allergen for the first time. This is because the antibody is not yet produced against the allergen. Once the antibodies are produced against a particular allergen, the subsequent exposure to the allergen would enhance the antibody production. At this stage the antibody binds with the allergen on the surface of mast cells causing them to burst and release histamine. This release histamine causes skin irritation and inflammation in that part of the body. This phenomenon is known as Allergy. Allergy occurs quite fast.

Allergic Reactions results into.

(1) Irritation in the mucous membrane,

(2) Excessive secretion of nasal and ophthalmic fluids,

(3) Increased sensitivity and softness of the skin,

(4) Uticaria,

(5) Asphyxia etc.

In some case the patient is required to be given Oxygen. Sometimes a single penicillin injection or the sting of honeybee or Scorpion can cause death. Such cases of death are due to anaphylactic shock. To nullify the allergic effect of histamine, antihistamine drugs are given.

**Active Acquired Immunity :** The immunity attained by the production of antibodies in the body against any particular type of Antigen is known as Active Acquired Immunity. Acquired immunity can be developed in the body against polio and several other diseases. Pathogenic bacteria or virus made ineffective by killing or weakening them, are used in the vaccine in order to develop such acquired immunity in the person getting Vaccinated. The immune system of the body identifies such bacteria or virus, as the case may be, and produces suitable antibodies. It is sometimes essential to give a booster dose of the vaccine in order to develop sufficient immunity. The dreadful disease, small pox has been totally eradicated through the vaccination programme .

**Passive Acquired Immunity :** In order to develop antibodies in the body fluid of any vertebrate, inactivated pathogenic microbes are introduced in the body. Such antibodies are taken out from that animal and injected in the body of another animal or man. This animal or man who is also final recipient of the antibodies becomes immunized. This type of immunity is known as Passive Acquired Immunity. The person infected with hydrophobia virus is not able to produce sufficient antibodies so rapidly as is necessary . Thus the infected person has always dreadful

# Infection

An **infection** is the colonization of a host organism by parasite species. Infecting parasites seek to use the host's resources to reproduce, often resulting in disease. Colloquially, infections are usually considered to be caused by microscopic organisms or microparasites like viruses, prions, bacteria, and viroids, though larger organisms like macroparasites and fungi can also infect.Hosts normally fight infections themselves via their immune system. Mammalian hosts react to infections with an innate response, often involving inflammation, followed by an adaptive response. Pharmaceuticals can also help fight infections. The branch of medicine that focuses on infections and pathogens is infectious disease medicine.

## Diagnostic approach

Diagnosis of infections can be difficult as specific signs and symptoms are rare. If an infection is suspected, blood, urine and sputum cultures are usually the first step. Chest x-rays and stool analysis may also aid diagnosis. Spinal fluid can be tested to ensure that there is no brain infection.

In children the presence of cyanosis, rapid breathing, poor peripheral perfusion, or a petechial rash increases the risk of a serious infection by greater than 5 fold.[1] Other important indicators include parental concern, clinical instinct, and temperature greater than 40 °C.

## Signs and symptoms

- Extreme fatigue which may be ongoing for more than 2–3 months
- Continued weight loss
- Low grade or spiking fever
- Night sweats and chills
- Vague body aches and pain

## Bacterial or viral

Bacterial and viral infections can both cause symptoms such as malaise, fever, and chills. It can be difficult to distinguish which is the cause of a specific infection.[2] It's important to distinguish, because viral infections cannot be cured by antibiotics. Comparison of viral and bacterial infection

| Characteristic | Viral infection | Bacterial infection |
| --- | --- | --- |
| Typical symptoms | In general, viral infections are systemic. This means they involve many different parts of the body or more than one body system at the same time; i.e. a | The classic symptoms of a bacterial infection are localized redness, heat, swelling and pain. One of the hallmarks of a bacterial infection is local pain, pain |

certain circumstances to cause a compromising infection. Some colonizing bacteria, such as *Corynebacteria sp.* and *viridans streptococci*, prevent the adhesion and colonization of pathogenic bacteria and thus have a symbiotic relationship with the host, preventing infection and speeding wound healing.

The variables involved in the outcome of a host becoming inoculated by a pathogen and the ultimate outcome include:

- the route of entry of the pathogen and the access to host regions that it gains
- the intrinsic virulence of the particular organism
- the quantity or load of the initial inoculant
- the immune status of the host being colonized

As an example, the staphylococcus species present on skin remain harmless on the skin, but, when present in a normally sterile space, such as in the capsule of a joint or the peritoneum, will multiply without resistance and create a huge burden on the host.

**Disease :** Disease can arise if the host's protective immune mechanisms are compromised and the organism inflicts damage on the host. Microrganisms can cause tissue damage by releasing a variety of toxins or destructive enzymes. For example, *Clostridium tetani* releases a toxin which can paralyze muscles, or staphylococcus releases toxins which can produce shock and sepsis. Not all infectious agents cause disease in all hosts. For example less than 5% of individuals infected with polio develop disease. On the other hand, some infectious agents are highly virulent. The prion causing mad cow disease and Creutzfeldt–Jakob disease kills almost all animals and people that are infected. Persistent infections occur because the body is unable to clear the organism after the initial infection. Persistent infections are characterized by the continual presence of the infectious organism often as latent infection with occasional recurrent relapses of active infection. There are some viruses that can maintain a persistent infection by infecting different cells of the body. Some viruses once acquired never leave the body. A typical example is the herpes virus which tends to hide in nerves and become reactivated when specific circumstances arise. Persistent infections cause millions of deaths globally each year.[5] Chronic infections by parasites account for a high morbidity and mortality in many underdeveloped countries.

## Primary and secondary infections

**Primary** and **secondary infection** may either refer to succeeding infections or different stages of one and the same infection such as in acute herpes labialis infection. In the latter case, **acute infection** may also be used, as in acute HIV infection.

**Transmission :** In order for infecting organisms to survive and repeat the cycle of infection in other hosts, they (or their progeny) must leave an existing reservoir and cause infection

# Drugs

Coffee is the most widely used psychoactive drug beverage in the world. In 1999 the average consumption of coffee was 3.5 cups per day per U.S. citizen. Wine is a common alcoholic beverage. A **drug**, broadly speaking, is any substance that, when absorbed into the body of a living organism, alters normal bodily function.[3] There is no single, precise definition, as there are different meanings in drug control law, government regulations, medicine, and colloquial usage. In pharmacology, a drug is "a chemical substance used in the treatment, cure, prevention, or diagnosis of disease or used to otherwise enhance physical or mental well-being."[4] Drugs may be prescribed for a limited duration, or on a regular basis for chronic disorders. Recreational drugs are chemical substances that affect the central nervous system, such as opioids or hallucinogens. They may be used for perceived beneficial effects on perception, consciousness, personality, and behavior.

Some drugs can cause addiction and/or habituation. Drugs are usually distinguished from endogenous biochemicals by being introduced from outside the organism. For example, insulin is a hormone that is synthesized in the body; it is called a hormone when it is synthesized by the pancreas inside the body, but if it is introduced into the body from outside, it is called a drug.] Many natural substances, such as beers, wines, and psychoactive mushrooms, blur the line between food and recreational drugs, as when ingested they affect the functioning of both mind and body and some substances normally considered drugs such as DMT (Dimethyltryptamine) are actually produced by the human body in trace amounts.

**Medication :** A *medication* or *medicine* is a drug taken to cure and/or ameliorate any symptoms of an illness or medical condition, or may be used as preventive medicine that has future benefits but does not treat any existing or pre-existing diseases or symptoms.Dispensing of medication is often regulated by governments into three categories—*over-the-counter* (OTC) medications, which are available in pharmacies and supermarkets without special restrictions, *behind-the-counter* (BTC), which are dispensed by a pharmacist without needing a doctor's recreational drug use is controversial, with many governments not recognising spiritual or other perceived uses for drugs and classing them under illegal recreational use.

**Administering drugs :** Drugs, both medicinal and recreational, can be administered in a number of ways. Many drugs can be administered in a variety of ways rather than just one.

- Inhaled, (breathed into the lungs), as an aerosol or dry powder. (This includes smoking a substance)
- Injected as a solution, suspension or emulsion either: intramuscular, intravenous, intraperitoneal, intraosseous.
- Insufflation, or snorted into the nose.
- Orally, as a liquid or solid, that is absorbed through the intestines.
- Rectally as a suppository, that is absorbed by the rectum or colon.
- Sublingually, diffusing into the blood through tissues under the tongue.
- Topically, usually as a cream or ointment. A drug administered in this manner may be given to act locally or systemically.[11]

**Legal definition of drugs:** Some governments define the term drug by law. In the United States, the Federal Food, Drug, and Cosmetic Act definition of "drug" includes "articles intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease in man or other animals" and "articles (other than food) intended to affect the structure or any function of the body of man or other animals." Consistent with that definition, the U.S. separately defines narcotic drugs and controlled substances, which may include non-drugs, and explicitly excludes tobacco, caffeine and alcoholic beverages.

# TOOLS IN MICROBIOLOGY LABORATORY

1. INOCULATION LOOP:

- It is made up of metallic rod to which a platinum or nichrome wire fitted.
- It is used to transfer the inoculum because it is easy to sterilize.
- When it is placed in a blue flame it becomes red hot immediately and then it is cooled for the purpose of transfer.
- During the heating process whatever the microorganism or dust particles that are attached to the wire will be destroyed by heat.

2. AUTOCLAVE :

- Autoclave is an electronic device used for the moist heat sterilization of culture media, glassware, cotton, plastic ware, syringes etc.,
- It works similar to pressure cooker. It is made up of gun metal sheets which are supported in an iron case.
- It contains a heating coil to boil the water from which steam is generated.
- A complete arrest of steam without escaping it from Autoclave develops the pressure and results in increase of the temperature.
- In this manner if the pressure reaches 15psi, then the temperature will be 121$^{0}$C.
- At this temperature the autoclaving is done for 15 –20 min, then the all the objects placed in the autoclave will become sterilized i.e., the sterilized objects will be free from vegetative cells,spores,acellular entities and other organisms.
- Thus the autoclave works under the principles of steam under regulated pressure i.e., Boyel's Law.

3. LAMINAR AIR FLOW CABINET :

- It is an apparatus which provides an aseptic area to transfer the microbial cultures.
- One can sit near the chamber and the transfer methods can be done inside the chamber.
- It consists of an air blower inside the chamber which can produce air current with uniform velocity along with parallel flow lines.
- There is a special filter system made up of High Efficiency Particulate Air filters (HEPA) which can remove particles as small as 0.3μm.
- It does not allow microbes to enter into the system.
- Inside the chamber fluorescent tube and UV tube are fitted.
- UV Light kills germs when it is set for 30 min and other dust particles are removed by wiping with alcohol.
- Works like pouring, plating, streaking etc., are to be carried out in the flame zone of the burner or spirit lamp.

4. INCUBATOR :

- An incubator is an instrument that consists of copper (or) steel chamber around which warm air is circulated by means of electric current.
- The temperature of the incubator is kept constant due to its control by using thermostat.
- In an incubator proper temperature is maintained which is set for the growth of desired organism. For example, most of the bacteria that are used in the lab can grow well at $37^0$C.

5. HOT AIR OVEN :

- It is generally used for the sterilization of glassware, metal devices and other articles which are spoiled by autoclaving. It is a process of dry heat sterilization.
- It is less effective when compared to moist heat the oven consists of double walled chamber and the gaps between two walls is insulated.
- It is heated from below by using electric current.
- An in built thermo stat is present to regulate the temperature.
- If the temperature is set to 160°C the holding time should be one hour but at 180° C it should be 30 minutes.
- For better sterilization the holding time should be more.
- Inside the oven a fan is present to circulate the hot air.