PAVENDAR BHARATHIDASAN COLLEGE OF ARTS AND SCIENCE

Unit 1 **2 Marks**

What is Cytoskeleton?

- Cytoskeleton, a system of filaments or fibres that is present in the cytoplasm of eukaryotic cells (cells containing a nucleus).
- The cytoskeleton organizes other constituents of the cell, maintains the cell's shape, and is responsible for the locomotion of the cell itself and the movement of the various organelles within it.
- The filaments that comprise the cytoskeleton are so small that their existence was only discovered because of the greater resolving power of the electron microscope
- The primary filament systems comprising the cytoskeleton are **microtubules, actin filaments, and intermediate filaments**.

Define Nucleus?

- This is a prominent, spherical or oval structure found at the centre of the cell.
- It is the controlling centre of all cell activities and has been described as the brain of the cell or controlling unit of the cell.
- It was first discovered by Robert Brown in 1831 in flowering plants. The study of nucleus is termed as karyology. It regulates all metabolic and hereditary activities of the cell.
- The nucleus is present in all eukaryotic cells.

Define Nucleolus?

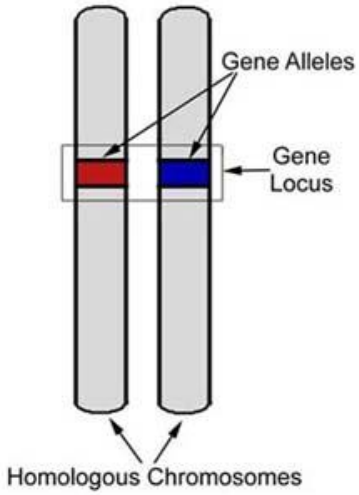
- This dense, spherical granule found in the nucleus contains RNA (ribonucleic acid) which is responsible for protein synthesis in the cytoplasm.
- The nucleolus is a round body located inside the nucleus of a eukaryotic cell.
- Nucleolus usually present in interphase cells. It is absent during division phase.

A note on Nuclear envelops?

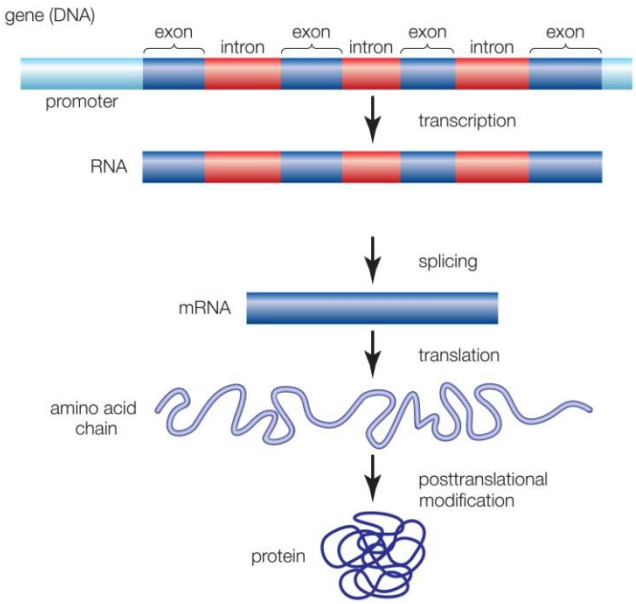
- The nuclear membrane, also called the nuclear envelope, is a double membrane layer that separates the contents of the nucleus from the rest of the cell.
- It is found in both animal and plant cells. A cell has many jobs, such as building proteins, converting molecules into energy, and removing waste products.
- The nuclear envelope protects the cell's genetic material from the chemical reactions that take place outside the nucleus.
- It also contains many proteins that are used in organizing DNA and regulating genes.

5 Marks

Define: Allele, Loci, and gene?

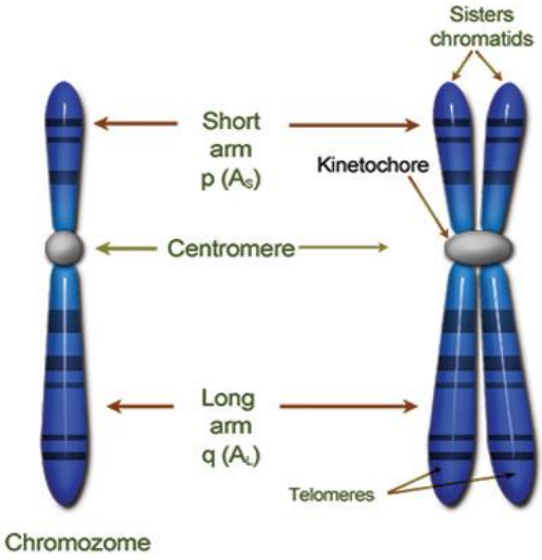


- **An allele** is a variant form of a given gene, meaning that it is one of two or more versions of a known mutation at the same place on a chromosome. It can also refer to different sequence variations for a several-hundred base-pair or more region of the genome that code for a protein. Alleles can come in different extremes of size. At the lowest possible end one can be the single base choice of a single nucleotide polymorphism (SNP).
- Sometimes, different alleles can result in different observable phenotypic traits, such as different pigmentation.
- In genetics, a **locus (plural loci)** is a specific, fixed position on a chromosome where a particular gene or genetic marker is located. Each chromosome carries many genes, with each gene occupying a different position or locus.
- Genes may possess multiple variants known as alleles, and an allele may also be said to reside at a particular locus. Diploid and polyploid cells whose chromosomes have the same allele at a given locus are called homozygous with respect to that locus, while those that have different alleles at a given locus are called heterozygous. The ordered list of loci known for a particular genome is called a gene map. Gene mapping is the process of determining the specific locus or loci responsible for producing a particular phenotype or biological trait.
- **Gene**, unit of hereditary information that occupies a fixed position (locus) on a chromosome. Genes achieve their effects by directing the synthesis of proteins.
- A unit of DNA that is usually located on a chromosome and that controls the development of one or more traits and is the basic unit by which genetic information is passed from parent to offspring.



Chromosomes and its types?

- Chromosomes are thread-like structures present in the nucleus. They are important because they contain the basic genetic material DNA. These are present inside the nucleus of plants as well as animal cells.
- Chromosomes were first discovered by Strasburger in 1815 and the term 'chromosome' was first used by Waldeyer in 1888. Human beings have 46 chromosomes in their body. These are arranged into 23 pairs.

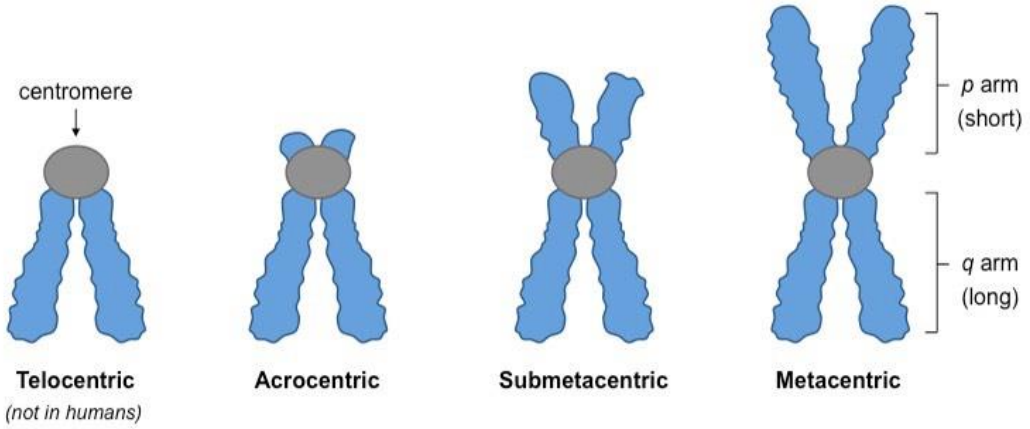


Metacentric Chromosomes: Metacentric chromosomes have the centromere present exactly in the center. Both the sections are metacentric chromosomes are therefore of equal length. Example: Human chromosome 1 and 3 are metacentric.

Submetacentric Chromosomes: In Submetacentric chromosomes, the centromere is not present exactly at the center. The centromere is slightly offset from the center. Both the sections are therefore not of equal length or are asymmetrical. Example: Human chromosomes 4 to 12 are submetacentric.

Acrocentric Chromosomes: Acrocentric chromosomes have a centromere which is highly offset from the center. Therefore, one of the strands is very long and one very short. Example: Human chromosomes 13,15, 21, and 22 are acrocentric.

Telocentric Chromosomes: In telocentric chromosomes, the centromere is present at the very end of the chromosome. Telocentric chromosomes are present in species such as mice. Humans do not possess telocentric chromosomes.

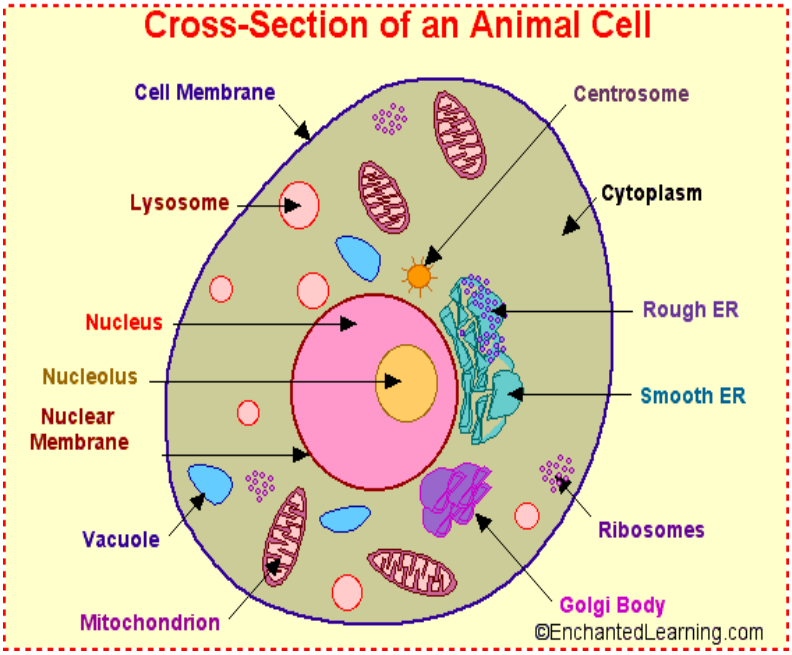


10 Marks

Explain in detail the structure and function of nucleus?

Nucleus

This is a prominent, spherical or oval structure found at the centre of the cell. It is the controlling centre of all cell activities and has been described as the brain of the cell or controlling unit of the cell.



Occurrence:

The nucleus is present in all eukaryotic cells. However, it is absent in erythrocytes and some lens cells.

In eukaryotes, the nucleus is surrounded by a nuclear membrane whereas in prokaryotes, the nuclear material is not surrounded by a nuclear membrane. Such a nuclear material is called as nucleoid.

Number:

Generally a cell contains only one nucleus. But sometimes tow or more nuclei are present. Based on the number of nucleus, the cells are classified into the following types:

- Anucleate cell – In anucleate cells the nucleus is absent eg. Erythrocytes of human
- Mononucleate cell – In mononucleate cells a single nucleus is present ef. Amoeba
- Binucleate cell – In binucleate cell, two nuclei are present. Of these nucleus is small called micronucleus and the other nucleus is large called macronucleus. Eg. Paramecium
- Multinucleate cell – It contains many nuclei. Eg. Opalina

Position:

The position of the nucleus in a cell is variable. Usually it is situated in the centre of the cell. But in adipose cells or in egg rich in yolk, the nucleus is forced to lie on the periphery. In glandular cells and in Acetabularia it lies in the basal region.

Shape:

The shape of the nucleus varies considerably. In most of the cells it is spherical in shape. In cylindrical cells it is elliptical. In human neutrophils it is trilobed. In paramecium, the macronucleus is kidney shaped. The nucleus of spinning gland cells of insects is highly branched. In vorticella it is horse-shoe shaped.

Size:

Size of the nucleus is variable. The size of the nucleus is directly proportional to the cytoplasm. The more the volume of the cytoplasm the larger is the size of the nucleus. R.Hertwig has formulated a relationship between the nuclear volume and the cytoplasmic volume which is called the nucleoplasmic index (NP). The NP ratio acts as a stimulus to the cell division.

The nucleus is composed of the following structures:

- Nuclear Membrane (Karyotheca)
- Nucleoplasm (karyolymph)
- Nucleolus
- Chromatin network (nuclear reticulum)

Functions of Nucleus:

- **Metabolism**: Nucleus controls manority of the activities of cells. It is regulatory organelle in cell metabolism.
- **Heredity**: Since the nucleus contains DNA molecules in its chromosomes, it plays a significant role in heredity.
- **Differentiation**: It controls cell differentiation during the embryonic development.
- **Exchange of materials**: Nuclear membrane is concerned with the exchange of materials between the cytoplasm and nucleoplasm.
- **Support**: Nuclear membrane provides a surface for the attachment of structural elements of the cytoplasm such microtubules and microfilaments.
- **RNA Synthesis**: The synthesis of RNA occurs with in nucleus. From these RNAs ribosome, tRNA and various proteins are formed.

Write essay on Microtubules, microfilaments and Intermediate filaments?

Cytoskeleton, a system of filaments or fibres that is present in the cytoplasm of eukaryotic cells (cells containing a nucleus). The cytoskeleton organizes other constituents of the cell, maintains the cell's shape, and is responsible for the locomotion of the cell itself and the movement of the various organelles within it.

Three major types of filaments make up the cytoskeleton: **actin filaments, microtubules, and intermediate filaments**.

- **Actin filaments** occur in a cell in the form of meshworks or bundles of parallel fibres; they help determine the shape of the cell and also help it adhere to the substrate. The constantly changing arrays of actin filaments help move the cell and mediate specific activities within it, such as cell cleavage during mitosis.

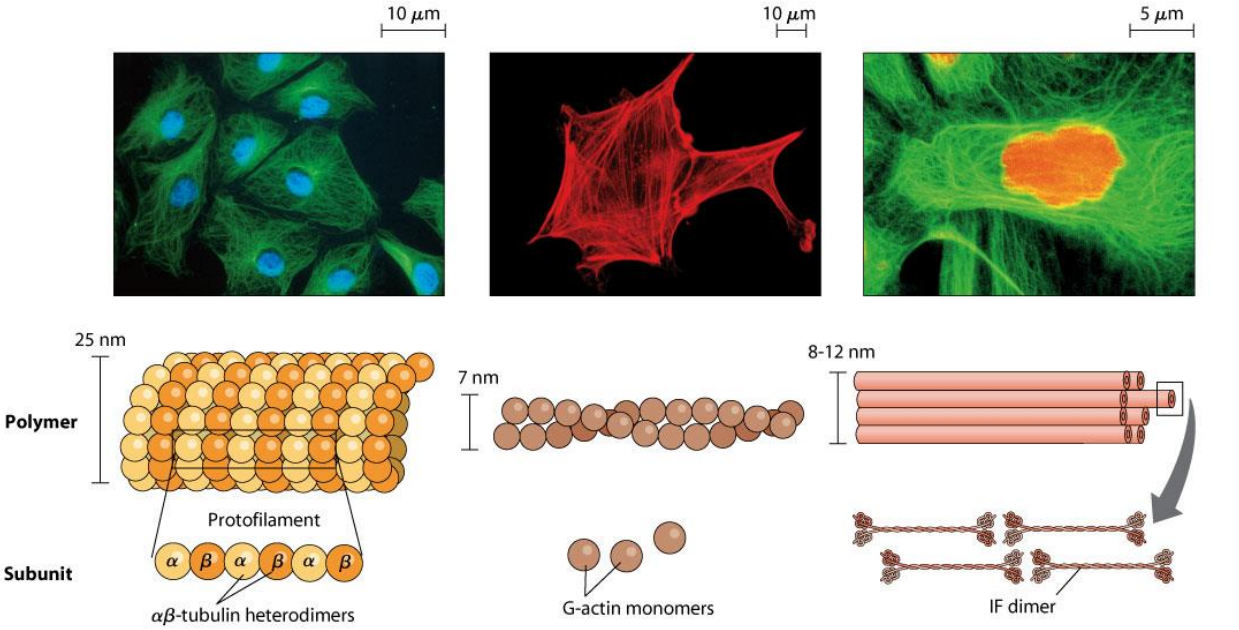
- **Microtubules** are longer filaments that are constantly assembling and disassembling; they play a crucial role in moving the daughter chromosomes to the newly forming daughter cells during mitosis, and bundles of microtubules form the cilia and flagella found in protozoans and in the cells of some multicellular animals.

- **Intermediate filaments**, in contrast to actin filaments and microtubules, are very stable structures that form the true skeleton of the cell. They anchor the nucleus and position it within the cell, and they give the cell its elastic properties and its ability to withstand tension.

In some instances, other proteins may also be considered part of the cytoskeleton.

Examples include septins, which can assemble into filaments and form attachment sites for certain types of proteins, and spectrin, which assembles along the intracellular surface of the cell membrane and helps maintain cell structure.

Table 15-1 **Properties of Microtubules, Microfilaments, and Intermediate Filaments**



	Microtubules	Microfilaments	Intermediate Filaments
Structure	Hollow tube with a wall consisting of 13 protofilaments	Two intertwined chains of F-actin	Eight protofilaments joined end to end with staggered overlaps
Diameter	Outer: 25 nm Inner: 15 nm	7 nm	8–12 nm
Monomers	α-tubulin β-tubulin	G-actin	Several proteins; see Table 15-4
Polarity	(+), (−) ends	(+), (−) ends	No known polarity
Functions	Cytoplasmic: Organization and maintenance of animal cell shape and polarity Chromosome movements Intracellular transport/ trafficking, and movement of organelles Axonemal: Cell motility	Muscle contraction Cell locomotion Cytoplasmic streaming Cytokinesis Maintenance of animal cell shape Intracellular transport/trafficking	Structural support Maintenance of animal cell shape Formation of nuclear lamina and scaffolding Strengthening of nerve cell axons (neurofilament protein) Keeping muscle fibers in register (desmin)

Unit 2

What is qualitative inheritance? **2 Marks**

- Quantitative inheritance is a genetic term which is defined as the combined result when many factors combine to result in a distinctive trait.
- An example of a result of quantitative inheritance is height.
- Qualitative inheritance An inheritance of a character that differs markedly in its expression among individuals of a species, variation in that species is discontinuous.
- Such characters are usually under the control of major genes.

Explain the Population genetics?

- Population genetics is the study of genetic variation within populations, and involves the examination and modelling of changes in the frequencies of genes and alleles in populations over space and time.
- Many of the genes found within a population will be polymorphic - that is, they will occur in a number of different forms (or alleles).
- Population genetics is a subfield of genetics that deals with genetic differences within and between populations, and is a part of evolutionary biology.

Specialized chromosomes?

- People had long philosophized about the observed differences between males and females of a species.
- If one considers sex a trait, or set of traits, then it followed that sex is inherited. In 1905, closer study of meiosis revealed the chromosomal basis of gender.
- Scientists noticed an oddball pair among the homologous chromosomes lined up at the cell equator during reduction division.
- One chromosome (X) was much bigger than the other (Y). In human beings, this mismatched pair of one X and one Y chromosome is seen exclusively in male cells. A matched pair of X chromosomes is found in female cells.
- Thus, XX chromosomes determine femaleness, and XY chromosomes determine maleness. Females produce only eggs with X chromosomes; males produce sperm with an X or a Y chromosome

5 Marks

Give a brief account on qualitative inheritance?

- It is the type of inheritance in which a single dominant gene influences a complete trait.
- Presence of two such dominant genes does not alter the phenotype.
- The genes in which dominant allele expresses the complete trait are called monogenes, e.g., TT or Tt for tallness in Pea.
- Qualitative inheritance produces a sort of discontinuous trait variations in the progeny, e.g., either tallness or dwarfness.
- Intermediate forms or continuous trait variations are not produced.

Explain the Chromosome abnormalities?

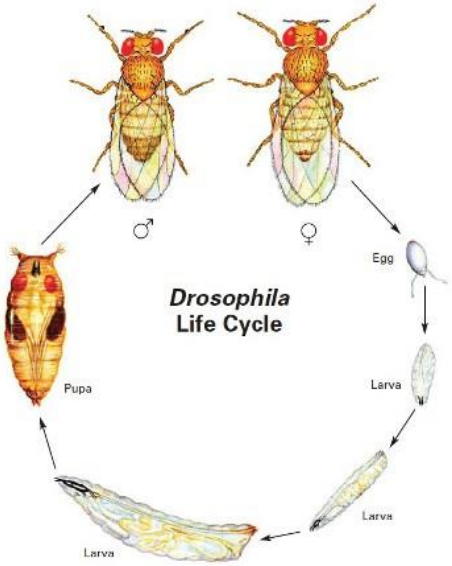
- Heredity plays a part in almost all diseases. Recent advances in gene research have allowed a steadily increasing number of specific genes and genetic factors to be linked to a wide variety of medical complaints.
- There are currently approximately 6,000 known genetic diseases. Those that result from simple mutations of single genes are often referred to as hereditary diseases, and they exhibit distinctive patterns of inheritance in families.
- Inherited diseases result primarily or exclusively from genetic mutations or genetic imbalance passed on from parent to child at conception. These include Mendelian genetic conditions as well as chromosomal abnormalities.
- A third group of disorders exists wherein both the environment and genetic factors interact to produce—or influence the course of—a disease. These conditions are often referred to as having multifactorial or complex inheritance patterns.
- Examples of autosomal recessive disease include sickle cell anemia, cystic fibrosis, Tay-Sachs disease, and phenylketonuria

Short notes on Mundelein inheritance?

- Mendel postulated that genes (characteristics) are inherited as pairs of alleles (traits) that behave in a dominant and recessive pattern.
- Alleles segregate into gametes such that each gamete is equally likely to receive either one of the two alleles present in a diploid individual.
- The key principles of Mendelian inheritance are summed up by Mendel's three laws, the Law of Independent Assortment, Law of Dominance, and Law of Segregation.

10 Marks

Write a detailed account on developmental genetics using Drosophila melanogaster?



- The fruit fly *Drosophila melanogaster* has been extensively studied for over a century as a model organism for genetic investigations.
- It also has many characteristics which make it an ideal organism for the study of animal development and behavior, neurobiology, and human genetic diseases and conditions.
- The genetic information (DNA) in all cells is carried in the chromosomes (literally "colored bodies") -- a complex of DNA plus specialized proteins (histones) packed in the cell's nucleus.
- As with humans, the chromosomes of Drosophila melanogaster come in pairs -- but unlike humans, which have 23 pairs of chromosomes, the fruit fly has only four: a pair of sex chromosomes (two X chromosomes for females, one X and one Y for males), together designated Chromosome 1, along with three pairs of autosomes (non-sex chromosomes) labeled 2 through 4.
- Chromosome 4 is the smallest and is also called the dot chromosome. It represents just ~2% of the fly genome.

Write essay on Law's of inheritance – single & dihybrid ratio?

- A dihybrid cross describes a mating experiment between two organisms that are identically hybrid for two traits. A hybrid organism is one that is heterozygous, which means that is carries two different alleles at a particular genetic position, or locus. Therefore, a dihybrid organism is one that is heterozygous at two different genetic loci.
- Mendel began his experiments by first crossing two homozygous parental organisms that differed with respect to two traits. An organism that is homozygous for a specific trait carries two identical alleles at a particular genetic locus.
- Mendel chose to cross a pea plant that was homozygous and dominant for round (RR), yellow (YY) seeds with a pea plant that was homozygous and recessive for wrinkled (rr), green (yy) seeds.
- Mendel observed that the pairs of traits in the parental generation sorted independently from one another, from one generation to the next.

Unit 3

2 Marks

Genetic code?

- The genetic code is a set of rules defining how the four-letter code of DNA is translated into the 20-letter code of amino acids, which are the building blocks of proteins.
- The genetic code is a set of three-letter combinations of nucleotides called codons, each of which corresponds to a specific amino acid or stop signal.

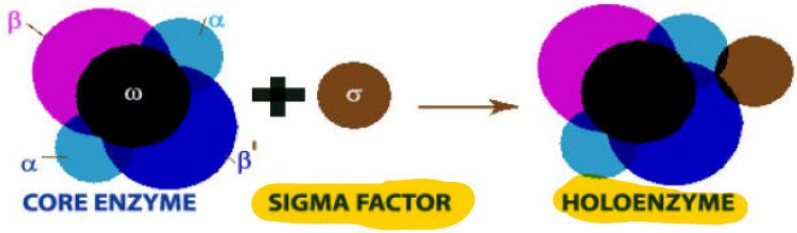
What is DNA Transcription?

- Transcription is the process by which an RNA copy of a gene made from DNA or Transcription is the process by which stored information is taken from the genetic material and ultimately made available to the cell in the form of protein or RNA.

- The DNA strand that is transcribed for a given mRNA is termed the template strand or Non-coding strand or Non-sense strand.

Note on Holoenzyme?

- E.Coli RNA polymerase is a complex enzyme consisting of six subunits.
- The complex RNA polymerase enzyme of E.Coli, the holoenzyme, is composed of a core enzyme and a sigma factor.
- The core enzyme is composed of five subunits. Core enzyme can continue transcription after initiation but holoenzyme is necessary for correct initiation of transcription.



S.No	Factors	Functions
1.	σ	Recognition of Promoter sequence and aids the proper binding of RNA Polymerase to DNA initiation site.
2.	β'	Binding of RNA Polymerase to template
3.	β	Polymerization function
4.	α, ω	Structural component of RNA Polymerase

5 Marks

List the characteristics of splicing?

- The most striking differences between eukaryotic and prokaryotic structural genes are that the coding sequences of most eukaryotic genes are interspersed with unexpressed regions. Because of this eukaryotic genes known as split genes.
- Splicing reaction involves the removal of nonfunctional or non-coding introns and joining of functional or coding exons.
- Exons: They are the coding or functional sequences (or) expressed sequences of gene which gets transcribed in the primary RNA transcript and is retained in the final mature m-RNA.
- Introns: They are the noncoding or nonfunctional intervening sequences (IVs) of gene which gets transcribed in the primary RNA transcript but are not retained in the mature m-RNA as a result of splicing reactions.

Post transcriptional processing in mRNA (5' cap), 3' – end polyadenylation, splicing?

- In eukaryotes m-RNAs are synthesized in nucleus while translation occurs in the cytosol.
- It thereafter undergoes extensive post transcriptional processing while still in the nucleus, to form mature m-RNA which then gets transported to cytosol to get associated with ribosomes for the translation process to commence. Processing of m-RNA involves the following stages,

Capping

All eukaryotic m-RNAs have a cap structure at the 5'end consisting of a 7-methyl guanosine residue join to the transcript via 5'-5' triphosphates bridge. The cap structure is attached to the 5'-end of the growing transcript by guanylyl transferase before it is greater than 20 nucleotides long.

Tailing

Tailing is a process in which poly A tail with around 200 adenosine residues attached to 3'-end of hnRNA.

Splicing

The most striking differences between eukaryotic and prokaryotic structural genes are that the coding sequences of most eukaryotic genes are interspersed with unexpressed regions. Because of this eukaryotic genes known as split genes.

Splicing reaction involves the removal of nonfunctional or non-coding introns and joining of functional or coding exons.

List of inhibitors of translation?

INHIBITORS: PROKARYOTIC INHIBITORS:

S.No	Name	Mechanism of Action
1.	Streptomycin, Neomycin and Kanamycin	Binds to 30S subunit to cause misreading and inhibition of initiation.
2.	Paromomycin	Inhibit initiation. Resistant mitochondria have altered small r-RNA.
3.	Tetracycline	Inhibits elongation by blocking binding of aminoacyl t-RNA to the A site on the 30S subunit.
4.	Chloramphenicol	Inhibits elongation at Peptidyl transferease activity.
5.	Erythromycin	Inhibits elongation at Transpeptidation step.
6.	Spectinoycin	Inhibits elongation at transpeptidation. Resistant ribosomes have altered potein S5.
7.	Thiostrepton	Inhibits elongation, preventing binding of EF-G-GTP complex to ribosome.
8.	Kirromycin	Inhibits elongation, preventing release of EF-TU-GDP complex from ribosome.
9.	Colicin E3	Specific nuclease for site on 16S r-RNA.
10	Trimethoprin	Prevents formation of fmet-t-RNA by inhibition of synthesis of N10-formyl THF.
11.	Linomycin	Inhibit peptidyl transferase complex
12.	Kasugamycin	Inhibit binding of aminoacylt-RNA^{fmet} .

EUKARYOTIC INHIBITORS:

S.No	Name	Mechanism of Action
1.	Cycloheximide (actidione)	Inhibits elongation and initiation, freezing ribosomes on polysomes (peptidyl transferase).
2.	Emetine	Inhibits elongation at translocation step. Resistant hamster cells have altered protein S14.
3.	Diphtheria toxin	Inhibits elongation by inactivating EF-2 by ADP ribosylation.
4.	Ricin and abrin	Inhibits elongation, affecting 60S subunit.

10 marks

Explain the process of Prokaryotic Transcription?

Initiation: Transcription begins when the DNA directed RNA Polymerase associates with the sigma factor to produce holoenzyme. The sigma factors allows the polymerase to bind specifically at the genes promoter sequence. There are two important promoter regions present. They are Pribnow box and -35 sequence.

Elongation: After several nucleotides (mostly eight) are added to the growing chain, RNA Polymerase undergoes a conformational change and the s subunit dissociates. Therefore, the chain elongation process is carried out by the core enzyme.

- Core enzyme continues reading the template strand and joining ribonucleotides by addition to the 3'-end of the growing chain synthesis of m-RNA is therefore in the 5'…>3' direction as the template is decoded in 3'….>5' direction.
- The strands of double stranded nucleic acids, even in temporary hybrids such as DNA-RNA molecules, must be antiparallel if hydrogen bonding across the strand is to takes place. The energy required for synthesis is provided by the triphosphates ribonucleosides. These ribonucleotides are the energy sources, building blocks and the information components for m-RNA synthesis.

Termination: The last stage in m-RNA synthesis is chain growth termination. Synthesis of m-RNA is ended by any one of the following ways namely a) Rho – independent termination, b) Rho - dependent termination. The DNA sequences, often referred to as transcription terminators are either rho-dependent or rho-independednt.

Give a detailed account on the mechanism of translation in eukaryotes?

I) Activation of Aminoacids: As in prokaryotes, aminoacids are activated by binding to t-RNA. The initiating aminoacyl t-RNA is met-t-RNAi met instead of met-t-RNAi fmet.

II) Initiation: It occurs in five steps. In first step, eIF2, GTP and met-t-RNAi met bind to form ternary complex. In the second step, ternary complex bind to 40S-eIF1-eIF3-eIF4C complex to form 40S-t-RNA complex. In the third step, m-RNA-4f-4a-4b complex bound to the above complex along with the release of eIF4a, 4b and 4f. This reaction is derived by ATP hydrolysis. In the fourth step, t-RNA recognizes initiation codon and bound to it. In the final step, 60S subunit of 80S ribosome bound along with the release of eIF1, 3, 4C and 2. eIF-5 catalyzes this step. Hydrolysis of GTP occurs in this step. Initiation complex 80S-m-RNA- met-t-RNAi met formed.

III) Elongation:

Elongation occurs in three steps as in prokaryotes namely

a) Binding of aminoacyl t-RNA to A site

b) Peptide bond formation and c) Translocation

The main difference between prokaryotes and eukaryotes is that the elongation factors. In eukaryotes the elongation factors are eEF1a, eEF1bg and eEF2.

IV) Termination: A Single factor eRF-1 or eTF-1, was found to catalyze the release of the completed polypeptide chain from eukaryotic ribosomes. This appears to recognize all three termination codons UAA, UAG and UGA. GTP hydrolysis is required for termination.

Post-translational modification of Proteins. Importance of Glycosylation and Phosphorylation?

- Many proteins that function excellulary, secretary protein ment for extracellular transport are glycosylated. For example, some of the digestive enzyme peptide hormones, membrane proteins, antibodies are glycosylated. The carbohydrate is linked mostly to aspargine and more rarely to serine or threonine residue. Glycosylation helps in targeting and protection of proteins. For example thyroglobulin secreted by thyroid cells is glycosylated. Many proteins that lubricate mucous membrane are also glycosylated.
- This is done by mainly by phosphorylation which is reversible and one of the most common post translational modifications. In phosphorylation the amino acids which are most commonly phosphorylated are serine, threonine and tyrosine, lysine, arginine, and histidine group of protein are also phosphorylated, but are less common. These aminoacids are enzymatically phosphorylated by ATP.

Unit 4

2 Marks

DNA replication?

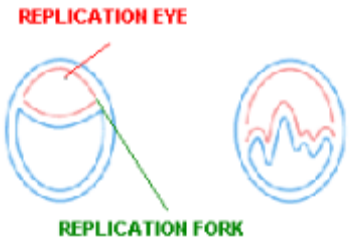
- Replication is an enzymatic process in which **synthesis of a daughter or progeny duplex DNA molecule**, identical to the parental duplex DNA occurs.
- Prokaryotes: Rate of replication in E.Coli (prokaryotic cell) is 1500 nucleotides per second. To complete replication of whole E.Coli genome it takes 40 minutes.
- Eukaryotes: Rate of replication in eukaryotes is about 10 - 100 nucleotides per second. To complete replication of simple eukaryotic genome 6 – 8 hours required.

DNA repair?

- When there is an damage occurs to DNA then it should be repaired otherwise it will affect the present and future generations. DNA, like any other molecule, can undergo a variety of chemical reactions.
- Base Excision Repair System and Nucleotide Excision Repair System

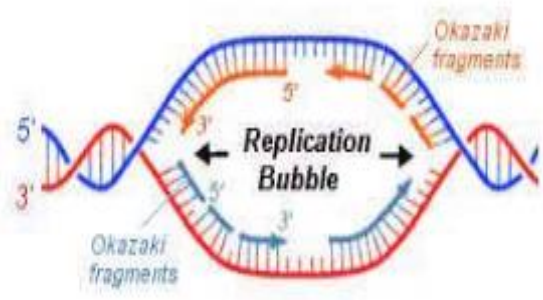
Replication eye?

- It is formed during replication in **both eukaryotic and prokaryotic DNA**.
- It is the place where replication occurs actively. It is otherwise **known as replication bubble**.
- Formation of the replication eye **provides the theta like structure to the circular DNA during replication in prokaryotes**.
- Each replication bubble found to **have two replication forks**, each at the **corner of an eye**.



Okazaki fragments?

- Fragments synthesized during lagging strand formation of replication was identified and proved by Rejis Okazaki.
- Hence, by his name these fragments are called as Okazaki's fragments. They are short polynucleotides with 1000-2000 base pairs in length.
- These fragments are synthesized by DNA polymerases.
- Even though they are formed during replication, they are joined to form larger DNA at the completion of replication by the action of DNA ligase.
- The invention of Okazaki fragments lead to the proposal of semidiscontinuous replication concept.



5 Marks

Details notes on Enzymes involved in replication?

In prokaryotes, there are three kinds of DNA polymerases. They are

DNA directed DNA polymerase – I: Its Molecular weight is 109kd and the concentration is around 400 molecules per cell. When treated with proteases like Trypsin, it gets cleaved into two fragments possessing different function. The large fragment called klenow fragment posses both polymerase and 3'-->5' exonuclease activity. The small fragment possesses only 5'-->3' exonuclease activity. Overall, three activities are possessed by DNA Pol-I.

DNA directed DNA polymerase – II: Structure and function are not completely elucidated. It has polymerase activity along with proof reading function, but it does not have 5'-->3' exonuclease activity.

DNA directed DNA polymerase – III: Holoenzyme of DNA pol-III consists of ten subunits. Core enzyme of DNA poly-III contain three subunit aeq. of three subunits alpha subunit posses polymerizing activity and epsilon posses proof reading activity. These are the two function of the enzyme. It does not have 5'-->3' exonuclease activity.

S.No	SUBUNITS	FUNCTION
1.	α	Polymerization
2.	ε	Repair and Proof reading function
3.	θ	Assembly of DNA pol-III
4.	β	Processivity - It holds the template
5.	γδδ'	Lagging strand synthesis - They aid the formation of loop.
6.	χφ	Normal function of DNA pol-III
7.	τ	Dimerization

Inhibitors of DNA replication?

Dauromycin and Adriamycin

- They are synthetic chemotherapeutic agents and are inhibitors of both DNA replication and transcription in prokaryotes.
- These are presumably act by interfering with the passage of both DNA and RNA polymerase.
- They have planar aromatic ring system which gets intercalated between GC pairs of the double helical structure. Thus, they prevent its replication and transcription.

Actinomycin - D

- It is an antibiotic produced by streptomyces and inhibits replication and transcription.
- It acts by intercalating its phenoxazone ring between two successive GC pairs in duplex DNA.
- Actinomycin D has two identical pentapeptides which have unusual composition of D-Valine and Sarcosine which stabilizes this intercalating interaction.

10 Marks

Mechanism of DNA replication?

Eukaryotic replication occurs during s-phase of cell cycle. Replication usually occurs only one time in a cell. Replication in eukaryotes occur in five stages namely,

1. Pre-initiation
    - Origin activation only occurs after cells enter S phase and triggers the Replicator Replicator selection is mediated by the formation of prereplicative complexes (pre-RCs).
    - The first step in the formation of the pre-RC is the recognition of the replicator by the eukaryotic initiator, ORC (Origin recognition Complex).
2. Initiation
    - Pre-RCs are activated to initiate replication by two protein kinases namely Cdk (Cyclin Dependant Kinase) and Ddk (Ddt4 Dependant Kinase).
    - Kinases are proteins that covalently attach phosphate groups to target proteins.
    - Each of these kinases is inactive in Gl and is activated only when cells enter S phase.
    - Once activated, these kinases target the pre-RC and other replication proteins.
3. Elongation
    - After Perid of DNA unwinding, DNA pol alpha/primase synthesizes additional primers, which allow the initiation of lagging strand DNA synthesis, Elongation process continued.
4. Termination
    - When the replication forks meet each other, then termination occurs. It will result in the formation of two duplex DNA.
    - Eventhough replication terminated, 5’ end of telomeric part of the newly synthesized DNA found to have shorter DNA strand than the template parent strand. This shortage corrected by the action of telomerase enzyme and then only the actual replication completed.

5. Telomerase function

- In Linear eukaryotic chromosome, once the first primer on each strand is remove, then it appears that there is no way to fill in the gaps, since DNA cannot be extended in the 3'-->5' direction and there is no 3' end upstream available as there would be in a circle DNA.
- Telomerase is a ribonucleoprotein (RNP) *Telomerase otherwise known as* modified Reverse Transcriptase.

Give a detailed account on models of DNA replication?

MODES OF REPLICATION

There are three modes are proposed for replication by Crick namely Conservative mode, Semiconservative mode and Dispersive mode. Of the three, Semiconservative mode of replication in prokaryotes proved by Meselson-Stahl experiment.

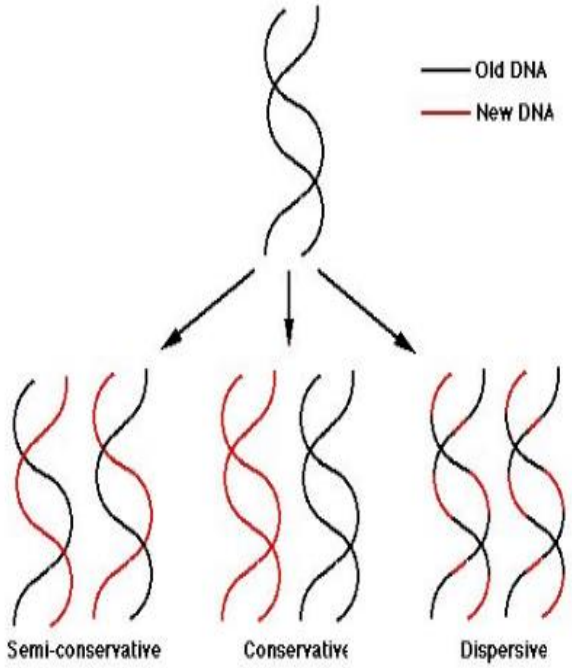
Watson And Crick Model or Hypothesis On Replication:

The Watson and Crick model for DNA replication assumes that as new strands of DNA are made, they follows the usual base pairing rules of A with T and G with C. This is essential because the DNA replicating machinery must be capable of discerning a good pair from a bad one, and the Watson - Crick base pairs give the best fit. Three hypothesis available for DNA replication. They are

Conservative replication: It yields two daughter duplexes, one of which has two old strands and one of which has two new strands.

Semiconservative replication: It gives two daughter duplex DNAs, each of which contains one old strand and one new strand.

Dispersive replication: It yields two daughter duplexes, each of which contains strands that are mixture of old and new DNA.



Unit 5

2 Marks

Lac operon?

- The lac operon is an operon, or group of genes with a single promoter (transcribed as a single mRNA).
- The genes in the operon encode proteins that allow the bacteria to use lactose as an energy source

trp operon?

- The trp operon is an operon—a group of genes that is used, or transcribed, together—that codes for the components for production of tryptophan.
- The trp operon is present in many bacteria, but was first characterized in Escherichia coli.

5 Marks

Details on lac genes?

Lac operon consists of lacZ, lacY, lacA genes as structural genes and operator, promoter and suppressor genes as regulatory genes.

A regulatory gene

- The regulatory gene codes for a regulatory protein. The lac repressor, encoded by the lacI gene, is the regulatory protein of the lac operon.

An operator

- The operator is the region of DNA of the operon that is the binding site for the regulatory protein.

A promoter

- The promoter is the DNA sequence of the operon recognized by DNA-dependent RNA polymerase.
- The initiation site for RNA synthesis is immediately downstream of the promoter. The gene for DNA-dependent RNA polymerase is not part of the operon, since the RNA polymerase enzyme transcribes all bacterial operons.

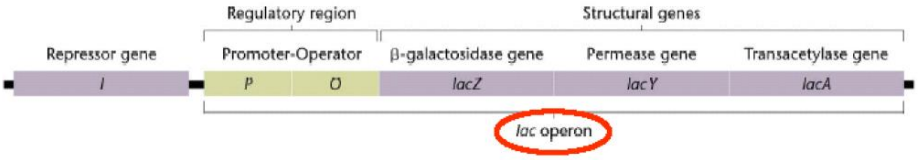
Structural Genes

- The operon encodes one or more genes for inducible enzymes. The lac operon encodes enzymes necessary for lactose metabolism, including ß-galactosidase, ß-galactoside permease, and ßgalactoside transacetylase

10 Marks

Describe Lac operon?

- An operon is a coordinately regulated unit of transcription in bacteria. The operon model was proposed by Jacob, Monod, and Wollman based on their genetic and biochemical studies on lactose-requiring mutations of E. coli.
- Some genes are always"on" i.e. transcribed and translated are termed as constitutive genes. Some genes are "off" but can be turned on are referred as inducible genes. They are in positive control. Some genes are usually "on" but can be turned off.
- They are referred as repressible genes. They are in negative control.An operon is a unit of the bacterial chromosome consisting of the following components:



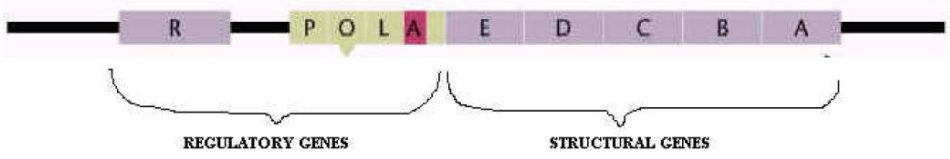
- Operon generally are of two types namely anabolic operon and catabolic operon. Those operon directing the synthesis of enzymes responsible for catabolic reactions then they are known as catabolic operon where as operon coding enzymes for synthetic reactions are known as anabolic operons.
- Lac operon is an fine example for catabolic operon because it codes for the enzymes which are responsible for degradation of lactose. Lac operon consists of lacZ,lacY,lacA genes as structural genes and operator,promoter and suppressor genes as regulatory genes.

Writes Essay on TRP operon?

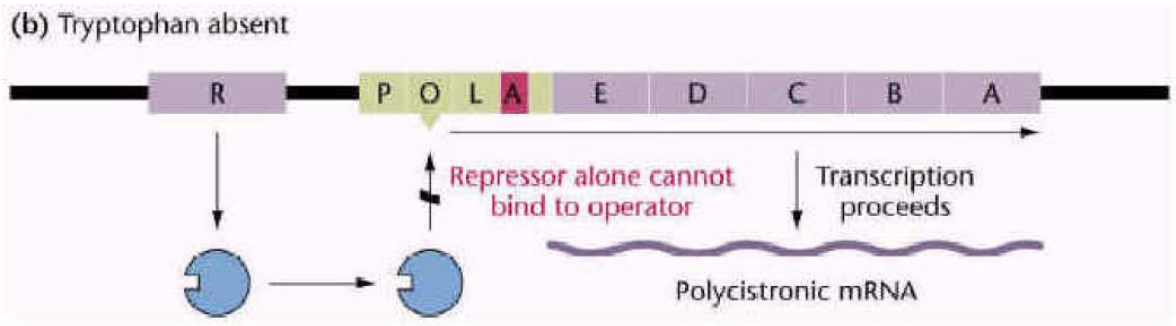
Trp operon is an example for anabolic operon. It generally codes for enzymes responsible for the synthesis of tryptophan, an essential aminoacid. trp operon consists of five genes a,b,c,d,e for five enzymes and regulatory genes.

a)trp operon structure:

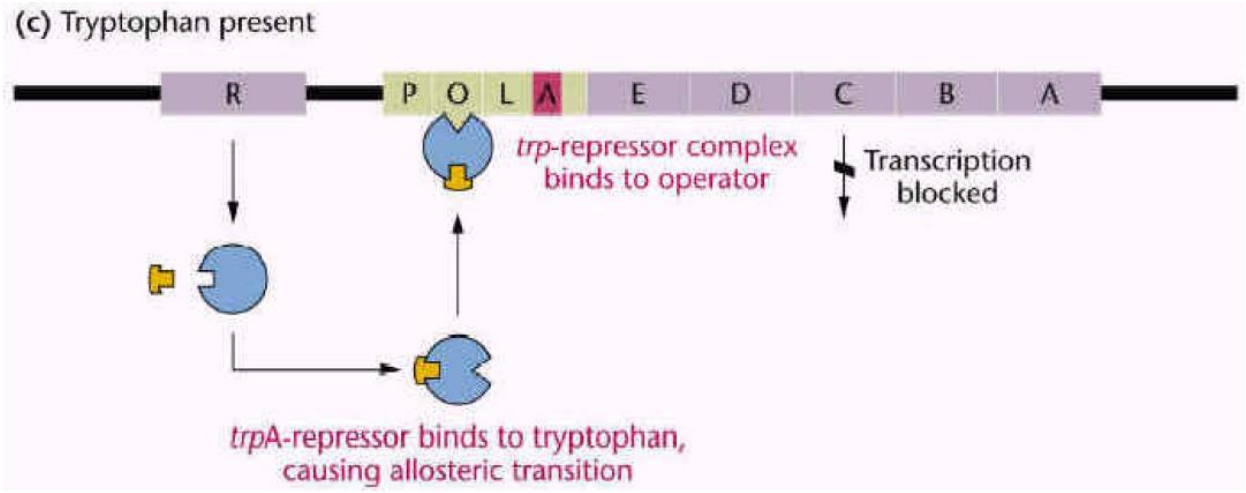
trp operon usually in cell found to be expressed normally but the excess of tryptophan suppress the expression of trp operon which is referred as negative control.



At lower levels or absence of tryptophan, repressor itself without tryptophan unable to bind with operator region and inhibit the binding of RNA polymerase and inturn transcription and translation of trp operon genes occurs. This inturn leads to the synthesis of tryptophan



When tryptophan present at higher levels, tryptophan can bind with repressor and the complex inturn bind with operator region and inturn inhibit binding of RNA Polymerase enzyme. This leads to inhibition of trp operon. Since tryptophan availability makes the difference for the expression and suppression, it is referred as corepressor



xpression of trp operon was also controlled by an another mechanism known as attenuation.