GURU GOBIND SINGH PUBLIC SCHOOL, CHAS

CLASS XII BIOLOGY

ASSIGNMENT

Central Dogma of Molecular Biology

Proposed by Francis Crick.

Talks about the direction of flow of genetic information.

DNA→ RNA→ Protein

Packaging of DNA Helix

There is 6.6×109 bp per cell in mammals. Taking 0.34 nm as the distance between consecutive bp, the total length of DNA happens to be 2.2 meters. (6.6 X109 bp X 0.34 X10-9m=2.2 meters)

2 m of DNA is too large to be accommodated in the nucleus with a dimension of 10−6m.

Packaging of DNA in Prokaryotes (E.g. E. coli)

Prokaryotes lack a well-defined nucleus.

Genetic material is scattered in the cytoplasm.

Nucleoid: The region where DNA being negatively charged (due to phosphate moiety) is associated with proteins that are positively charged.

Packaging of DNA in Eukaryotes

Histones: Positively charged, basic protein.

Histones are rich in basic amino acids like Lysine and arginine that give it a positive charge.

Histone octamer: Unit of eight molecules of histone.

DNA (negatively charged) wraps around histone (positively charged) to form nucleosomes.

1 nucleosome has approximately 200 bp of DNA.

Nucleosomes in a chromatin resemble beads present on strings.

Beads on string structure in chromatin are further packaged to form chromatin fibres, which further coil and condense to form chromosomes during metaphase.

Non-histone chromosomal (NHC) proteins – Additional set of proteins required for packaging of chromatin at higher level

Chromatin Types

Euchromatin:

Lightly Stained.

The loosely coiled region of chromatin.

Transcriptionally active.

Heterochromatin:

Darkly Stained.

The tightly coiled region of chromatin.

Transcriptionally inactive.

THE SEARCH FOR GENETIC MATERIAL

Transforming Principle

Experiments performed by Griffith on Streptococcus pneumonia.

pneumonia has two strains: R strain and S strain.

S Strain	R Strain
ü Produces a smooth colony on a culture plate.	ü Produces a rough colony on a culture plate.
ü Produces a polysaccharide coat.	ü Polysaccharide coat absent.
ü Virulent	ü Non-Virulent

Experiment performed by Griffith

Live R strain in the presence of heat-killed S strain should not have killed the mouse.

Somehow the bacteria produce virulence.

This is because somehow the R strain bacteria are transformed by heat-killed S strain bacteria.

The transformation must be due to the transfer of genetic material.

Biochemical Nature of Transforming Material

Avery, McLeod and McCarty worked to determine the biochemical nature of 'transforming principle' in Griffith's experiment.

They tried transforming the R cells to S cells by using biochemical (proteins, DNA, RNA, etc.) extracted from the S cell.

They concluded that DNA is the genetic material, as only it could transform the bacterial strain.

DNA as the Genetic Material

The proof came from the experiment performed by Hersey and Chase.

They used bacteriophage-Virus that infects bacteria.

Upon infection, the bacteriophage injects its DNA into the host cell and gets integrated into the host genome and subsequently produces more viral particles using the host machinery.

They experimented to find out whether protein or the DNA that entered the bacterial cell.

Hersey and Chase Experiment

They grew some viruses on a medium that contained radioactive phosphorus (32P) and some others on a medium that contained radioactive sulfur (35S).

Media containing radioactive Phosphorous had radioactive DNA.

Media containing radioactive sulfur had radioactive protein.

Infection: These radioactive bacteriophages were used to infect E. coli. Phage transfers the genetic material to the bacterial cell.

Blending: Viral coat were separated from the bacterial cell by agitating them in a blender.

Centrifugation: Viral particles were separated from the bacterial cell by spinning them in a centrifuge machine.

OBSERVATION:

Bacteria infected with phage with radioactive protein (35S)

No radioactivity detected in cell

Radioactivity detected in the supernatant.

Bacteria infected with phage with radioactive DNA (32P)

Radioactivity detected in cell

No-radioactivity detected in the supernatant.

CONCLUSION:

The above observation concluded that it is the DNA that entered the bacteria from phage and not proteins.

Hence, it was concluded that DNA is the genetic material and not the protein.

Properties of Genetic Material (DNA and RNA)

Criteria for a biomolecule to be genetic material:

It should be able to make a copy of itself (Replicate).

It should be structurally and chemically stable.

It should all the scope for mutations (essential for the process of evolution).

It should express itself following the Mendelian principles of inheritance.

STABILITY OF RNA

The 2′ OH group in RNA is present at every nucleotide makes RNA unstable and degradable.

RNA also acts as a catalyst (ribozyme), hence reactive.

RNA mutates faster compared to DNA, as it is unstable.

STABILITY OF DNA

The complementarity of the two DNA strands provides stability to the molecule.

Thymine instead of uracil in DNA provides additional stability.

DNA is more stable chemically and structurally is the preferred nucleic acid for storage of genetic material.

RNA WORLD

RNA was the first genetic material and essential life processes evolved around it.

DNA has evolved from RNA with chemical modifications that make it more stable.

DNA REPLICATION

During replication two strands of DNA separate and act as the template for the synthesis of new DNA strand that is complementary.

Semiconservative DNA replication: After one complete replication cycle, each DNA molecule consists of a parental DNA strand and a newly synthesised strand.

Note : Write these notes in your biology copy and do the NCERT questions accordingly.