

02 : GENE : IT'S NATURE, EXPRESSION AND REGULATION

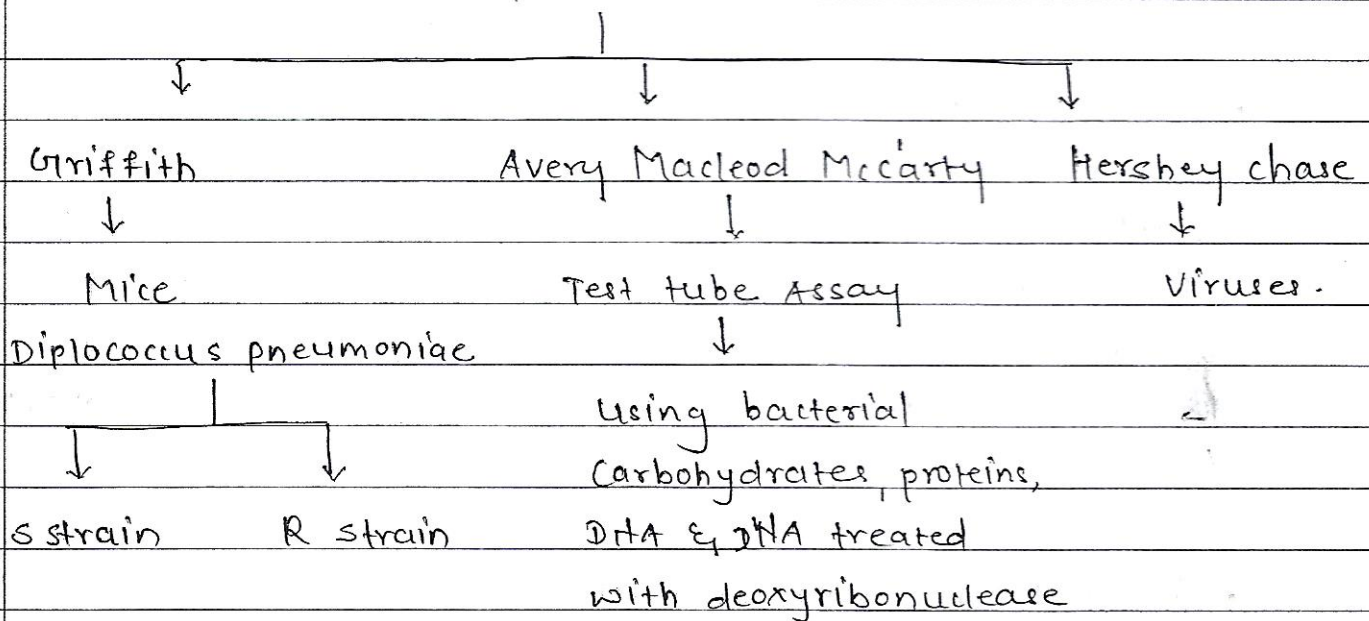
Hsc wt : chapter 02 + 03 + 04 = 07 MK.

• DNA :

DNA is a genetic material of all living organisms.

- Griffith demonstrated the bacterial transformation by using *Diplococcus pneumoniae*.
- Avery, Macleod & McCarty further supported that the transforming principle is nothing but DNA.
- Hershey & Chase proved that DNA is the genetic material.

Experiments -

• Modern concept of gene :

- Gene is defined as a segment of DNA which is responsible for inheritance & expression of a particular character.
- Seymour Benzer gave the terms, cistron, muton & recon

While describing a gene.

- Cistron : (unit of function)

It is responsible for expression of trait. It is a segment of DNA having information for synthesis of a particular protein or RNA.

- Muton : (unit of mutation)

It is segment of DNA that can undergo mutation.

- Recon : (unit of recombination)

It is segment of DNA that participates in recombination through crossing over during meiosis.

- DNA : Structure of eukaryotic DNA.

In 1869, Friedrich Miescher separated a cellular substance from the nuclei of pus cells & called it 'nuclein'. Because of acidic properties it was renamed as "nucleic acid".

- nucleic acids
- 1) Deoxyribo nucleic acid (DNA)
 - 2) Ribonucleic acid (RNA)

- chemical components of nucleic acid :-

→ Nucleic acids are made up of nucleotides. Each nucleotide is composed of sugar, phosphate & a nitrogen base.

1) Sugar : sugar in the nucleotide is deoxyribose ($C_5H_{10}O_4$) or ribose ($C_5H_{10}O_5$). These are pentose sugars having five carbon atoms & a pentagonal ring structure.

2) phosphate group :

phosphate group occurs in the form of phosphonic acid (H_3PO_4). There are three active $-OH$ groups in phosphonic acid.

3) Nitrogen bases :-

Nitrogen bases are of two types -

1) purines : Adenine, guanine (G)

2) pyrimidines : uracil (U), cytosine (C), thymine (T).

• Nucleoside :-

When a nucleotide does not contain a phosphate group then it is called nucleoside. It has only pentose sugar & a nitrogen base.

• Between sugar and nitrogen base there is glycosidic bond. The bond is present between the 1st carbon of sugar molecule & a nitrogen base.

• Between phosphate group & the sugar there is sugar-phosphate bond (phospho-diester bond).

phosphate group attached to sugar molecule at 5th carbon position.

• Nucleotide = pentose sugar + nitrogen base + phosphate group

• Nucleoside = pentose sugar + nitrogen base

- RNA plays an important role in protein synthesis.
- Components of RNA :-
 - RNA is made up of nucleotide having sugar, phosphate group & nitrogen base.
 - 1) sugar : RNA has ribose ($C_5H_{10}O_5$) sugar which is pentose in nature.
 - 2) phosphate group : phosphate gr. has three -OH groups.
 - 3) Nitrogen base : Nitrogen bases of RNA molecule are purines (Adenine & guanine) & pyrimidines (cytosine & uracil).
- Types of nongenetic RNA :-
 - 1) m-RNA : Messenger RNA
 - 2) r-RNA : ribosomal RNA
 - 3) t-RNA : transfer RNA
- They are produced by the process of transcription from DNA molecule. These RNA types play an important role in protein synthesis. & are present both in eukaryotic & prokaryotic cells.
- Codogen : Smallest triplet of nucleotides present on the DNA strand which can specify one amino acid.
- Codon : Smallest triplet of nucleotides present on the m-RNA strand which can specify one amino acid.
- Anticodon : Triplet of nucleotides present on the anticodon loop of t-RNA which is complementary to the codon of m-RNA.

Nucleic acids.

Nucleus.

Nucleus & cytoplasm.

deoxyribonucleic acid

Ribonucleic acid.

Made up of nucleotides

m-RNA

t-RNA

r-RNA

nucleotide → Gene.

phosphoric acid.

Deoxyribose sugar

Nitrogen bases.

Hair-pin model.

clover leaf model

phospho-diester bonds.

glycosidic bonds.

A = U

Adenine = uracil.

purines

pyrimidines

Adenine

Guanine.

Thymine

Cytosine

double hydrogen bond.

i.e. $A \equiv T$

Triple hydrogen bond

i.e. $G \equiv C$.

- polysomes / polyribosomes :-

- The structure made by binding of m-RNA strand with many ribosomes is called a polysome / polyribosome.
- polyribosomes increase the cellular efficiency of protein synthesis.

- Gene expression & gene regulation :

- Gene expression is controlled at transcriptional / post transcriptional level.
- For this purpose a cluster of genes called operons perform a regulatory function.
- operons include structural genes & their control elements called promoters and operators.

- The Lac operon :-

- The metabolism of lactose is dependent on three enzymes

- 1) permease
- 2) β -galactosidase
- 3) transacetylase

These enzymes synthesized according to lac operon system

- Lac operon has, promoter site (P), regulatory site (i), operator site (O).

- There are three structural genes i.e. Z, Y & A.

- Z = β galactosidase
- Y = permease
- A = transacetylase.