# Class - 4th Semester (Botany Hons)

## CC-8:- Molecular Biology

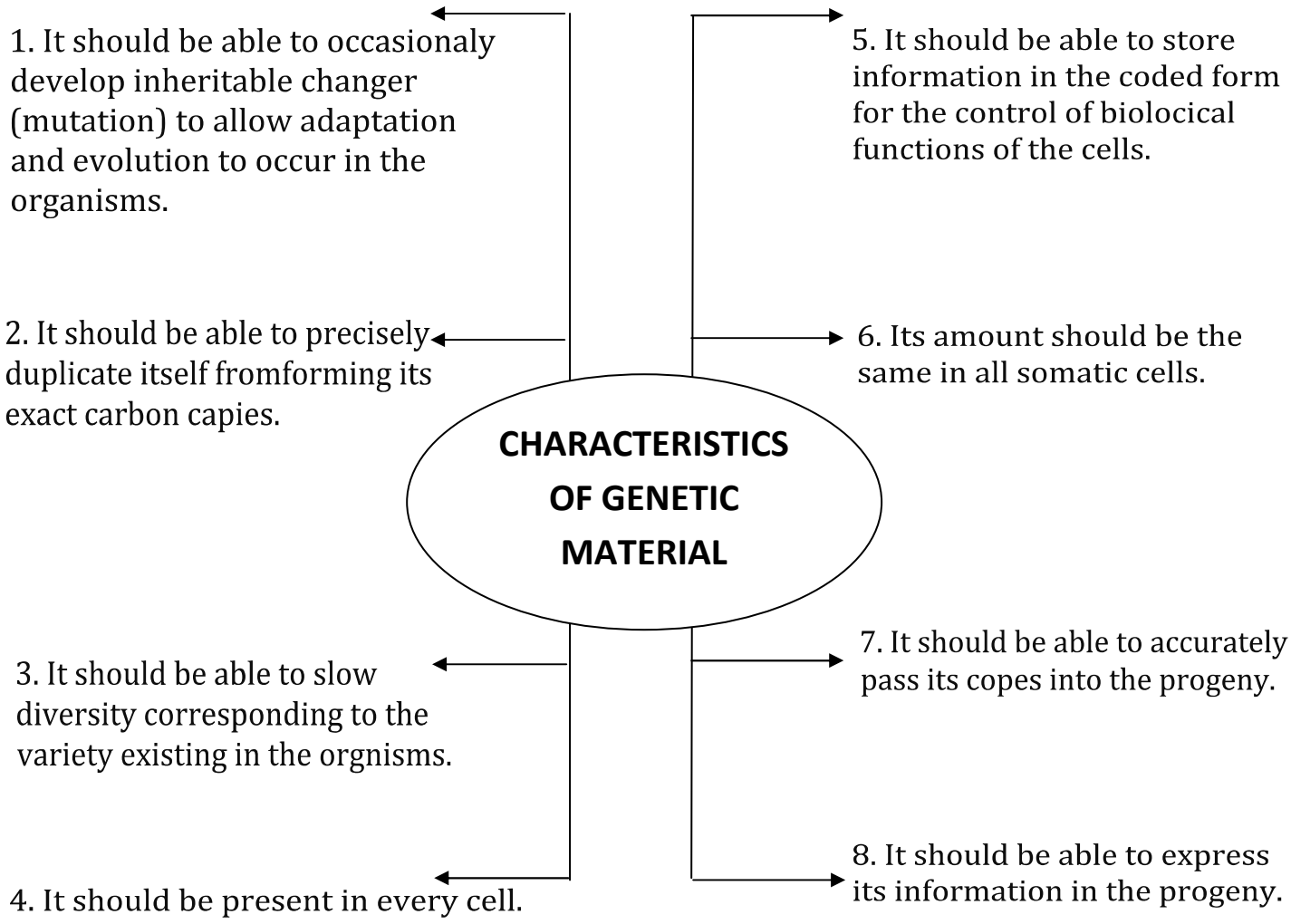
## Unit-1: Nucleic Acids:- Carriers of Genetic Information

### DNA as the carrier of genetic information

**Genetic Material:-**

The substance which not only controls the formation and expression of traits in an organism but can also replicate and pass on from a cell to its daughter or from one generation to next is called genetic material.

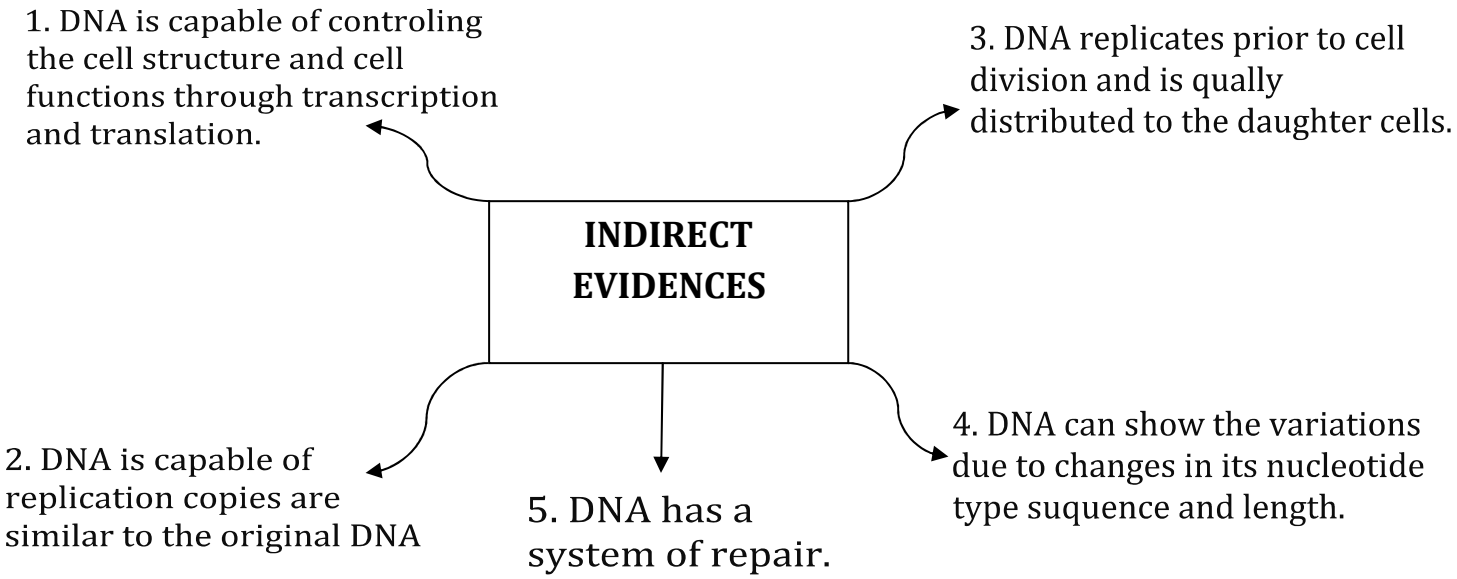
**Characteristics of genetic material:-**



**DNA AS GENETIC MATERIAL:-**

Various indirect as well as direct evidences indicate DNA is the genetic material.

**Indirect evidences:-**




Evidences favouring DNA as genetic material.

The concept of DNA as the genetic material of most organisms has been developed and supported by following direct and indirect evidences.

**Direct Evidences:-**

The most convincing evidences in support of DNA as genetic material came from the three approaches on micro organisms.

a) Transformation of Bacteria :- Griffith's experiment.
b) Mode of infection of Bacteriophages :- (Transduction) Hershey and chase experiment.
c) Conjugation of bacteria.

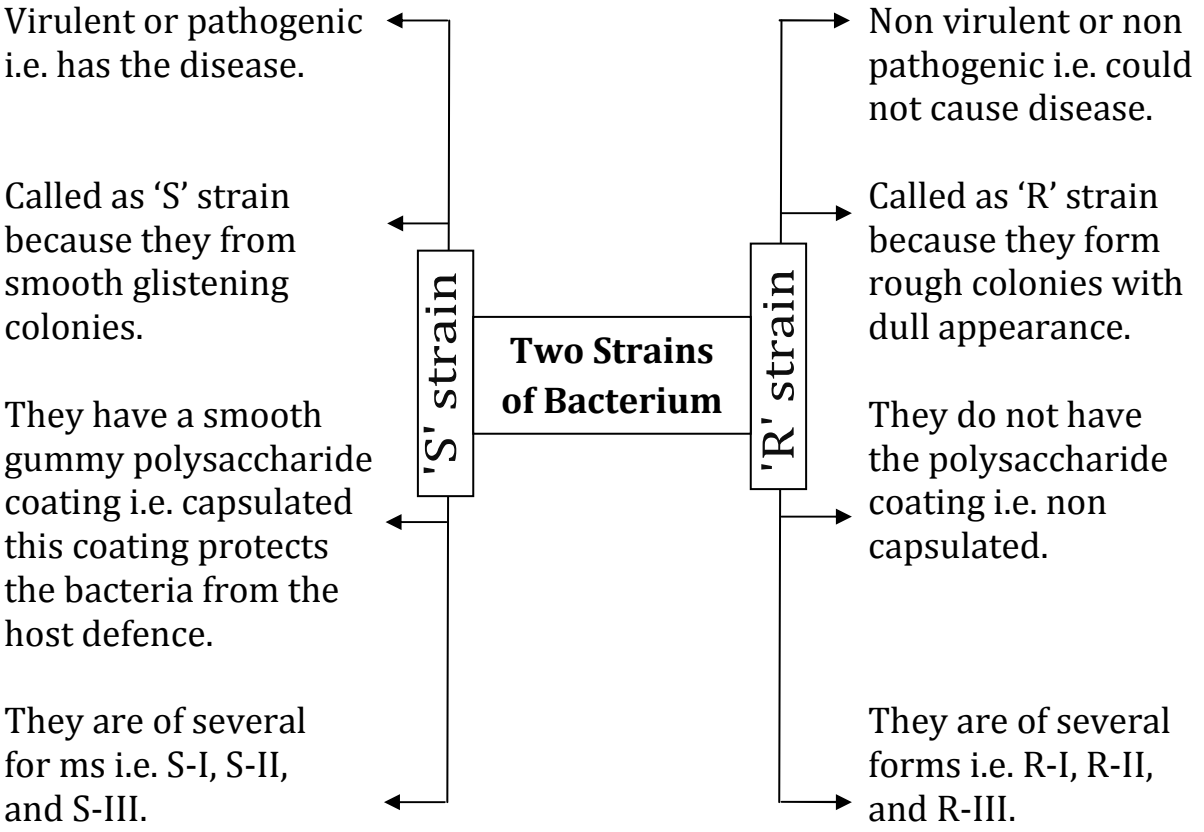
**a) Transformation of Bacteria :- (Griffith's experiment)**

**Transformation:-**

Transformation is the mode of exchange or transfer of genetic information from one strain of bacterium to another strain of bacterium without involving any direct contact between them.

Griffith in 1928 found that extracts of dead pathogenic strains of the bacterium streptococcus pneumonia can transform live harmless strains into live pathogenic strains.

Griffith observed two strains of bacterium these are as follows:-




**1. Experiment of Griffith:-**

In 1928 Frederic Griffith conducted an experiment on bacteria streptococcus pneumonia.

The experiment can be described in following four steps:-

a) Smooth type S-III bacteria were injected into mice. The mice died as a result of pneumonia caused by bacteria.
   S-III strain ⟶ Injected into the mice ⟶ Mice died.
   So, S-III strain was virulent.

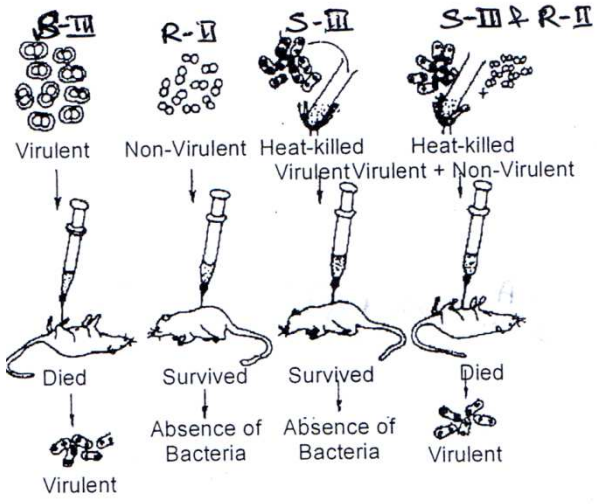
b) Rough type R-II bacteria were injected into mice. The mice remained healthy and pneumonia did not occur.
   R-II strain ⟶ Injected into mice ⟶ Mice lived.
   So, R-II strain was avirulent.

c) Smooth type S-III bacteria which normally cause disease were heat killed and then injected into mice. The mice lived and pneumonia was not caused.
   S-III strain (heat killed) ⟶ Injected into mice ⟶ Mice lived.
   So, S-III strain was avirulent.

d) Rough type bacteria R-II (living) and smooth type S-III heat killed bacteria were injected together into mice. The mice died due to pneumonia and virulent smooth type living bacteria could also be recovered from their dead bodies.
S-III strain (heat killed) + R-II strain (living) ⟶ Injected into mice ⟶ Mice died.
So, S-III strain (heat killed) + R-II strain (living) together was virulent.

**Conclusion:-**

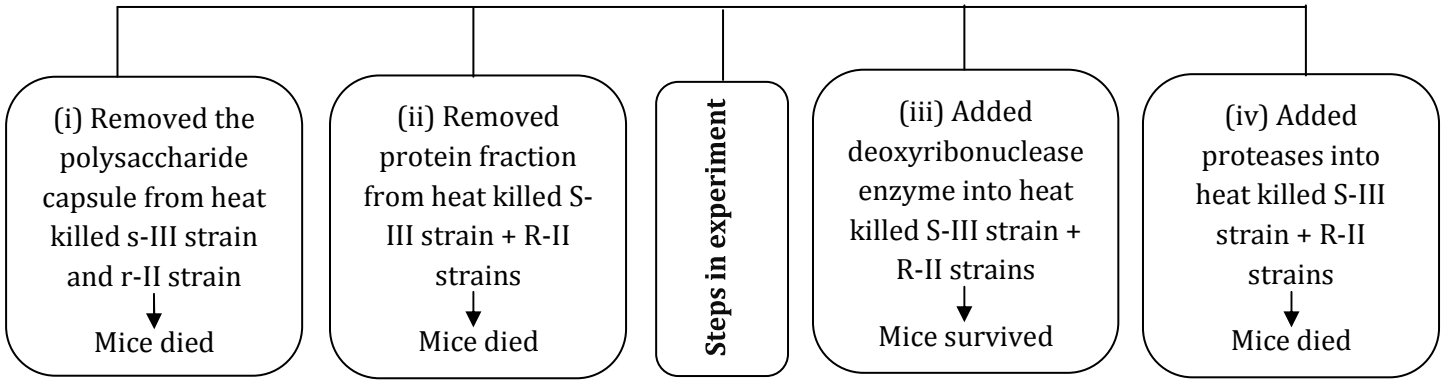
Griffith concluded that there was something in heat killed S-III strain bacteria that transform live R-II strains into live S-III strains, the R-II strains that were transformed into S-III strains continued thereafter producing S-III strains continued thereafter producing S-III strains only.




**Bacterial transformation experiments conducted by Griffith**

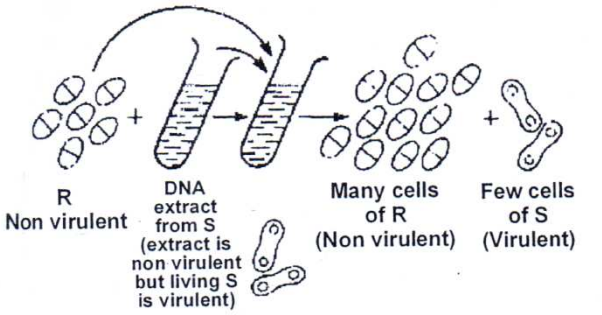
**2. Avery, Mc Leod and Mc Carty experiment:-**

Three scientists Avery, Mc Leod and Mc Carty in 1944 repeated the Griffith's experiment in vitro to identify the biochemical nature of transforming substance. They fractioned the heat killed S-II strain bacteria into three components – i) DNA, ii) Carbohydrate and protein and performed following experiment.



**Conclusion:-**

- In experiments (i), (ii) and (iv) , DNA of heat killed S-III strains was intact and so it transformed live R-II strains into S-III types, but in experiment (iii) the enzyme disintegrated the DNA and so R-II strains were not transformed.
- It clearly showed that the DNA component of heat killed S-III strains transformed live R-II strains into live S-II strains and thus, DNA forms molecular basic of heredity. This clearly shows that DNA is the genetic material.




Invitro experiment of Avery and others demonstrating that DNA is genetic material

**3. Transduction:** The Hershey-Chase experiment:-

The process in which bacterium infecting virus (bacteriophage) serves as a vector transferring DNA from one bacterium cell to another bacterium cell is called transduction, e.g. $T_2$ bacteriophase.

Scientists Hershey and Martha Chase (1952) performed an experiment to confirm that DNA of Bacteriophase enters into host (bacterial) cell and carries the necessary information for formation of new phages. Their experiment was based on the fact that DNA contains phosphorus but no sulphur where as proteins contains sulphur but no phosphorus.

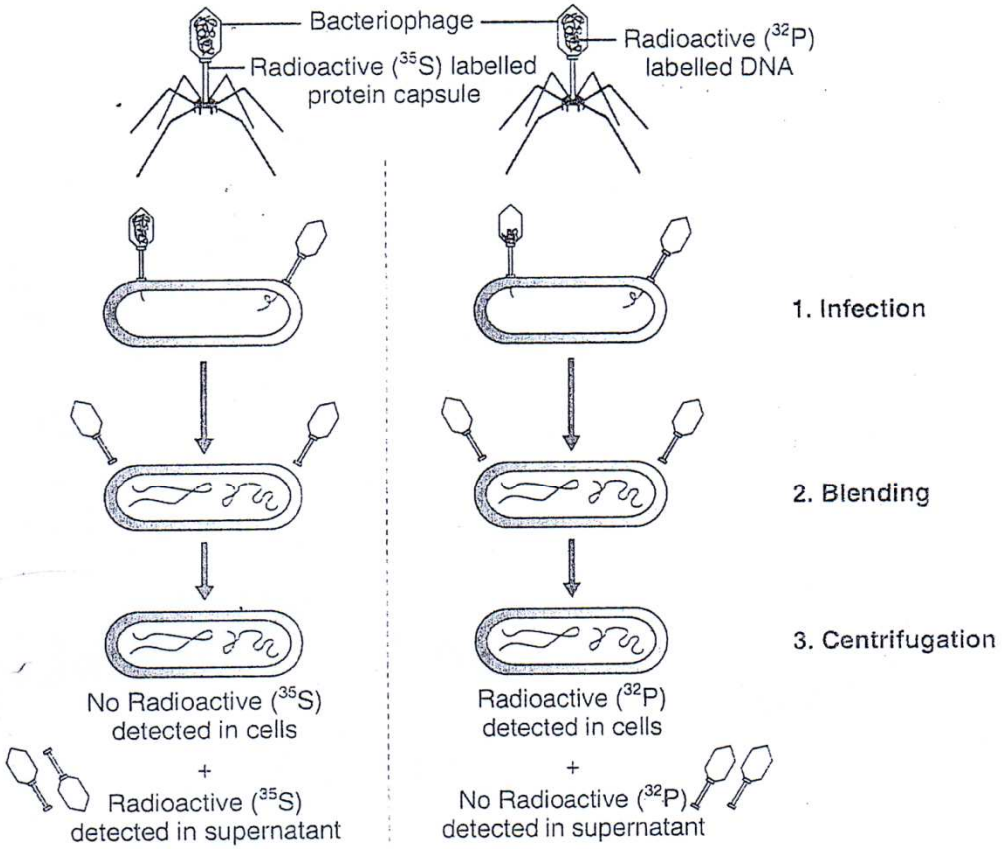
Therefore, phage DNA was labelled with $^{32}P$ by growing bacteria infected with phages contains sulphur but no phosphorus. Thus, the phage protein coat was labelled with $S^{35}$ by growing bacteria infected with phases in another culture medium containing $^{35}S$. After the formation of labelled phases. Three steps were followed, i.e., infection, blending, centrifugation.

i) **Infection :** These types of labelled phases were allowed to infect normally cultured bacteria in separate experiments.

ii) **Blending :** These bacterial cells were agitated in a blender to break the contact between virus and bacteria.

iii) **Centrifugation :** The virus particles were separated from the bacteria by spinning them in a centrifuge.

After the centrifugation the bacterial cells showed the presence of radioactive DNA labelled with P32 while radioactive protein labelled with S35 appeared on the outside of bacteria cells (i.e., in the medium). Labelled DNA was also found in the next generation of phage. This clearly showed that only DNA enters the bacterial host and not the protein. DNA, therefore, is the infective part of virus and also carries all the genetic information. This provided the unequivocal proof that DNA is the genetic material.




**Hershey and Chase's experiments with bacteriophages showing that DNA is genetic material or DNA is infective part of virus**

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