RAMA UNIVERSITY

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FACULTY OF ENGINEERING &TECHNOLOGY

DEPARTMENT OF BIOTECHNOLOGY

DNA as genetic material

Topic

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Before we discuss the evidence gathered from experiments to prove that the genetic material of most living organisms and many viruses is double-stranded DNA, let's review what was known about genes and DNA at the time James Watson and Francis Crick elucidated the structure of DNA in 1953:

2.Genes—the hereditary "factors" described by Mendel

—were known to be associated with specific character traits, but their physical nature was not understood.

3.The one-gene–one-enzyme theory postulated that genes control the structure of proteins.

4.Genes were known to be carried on chromosomes.

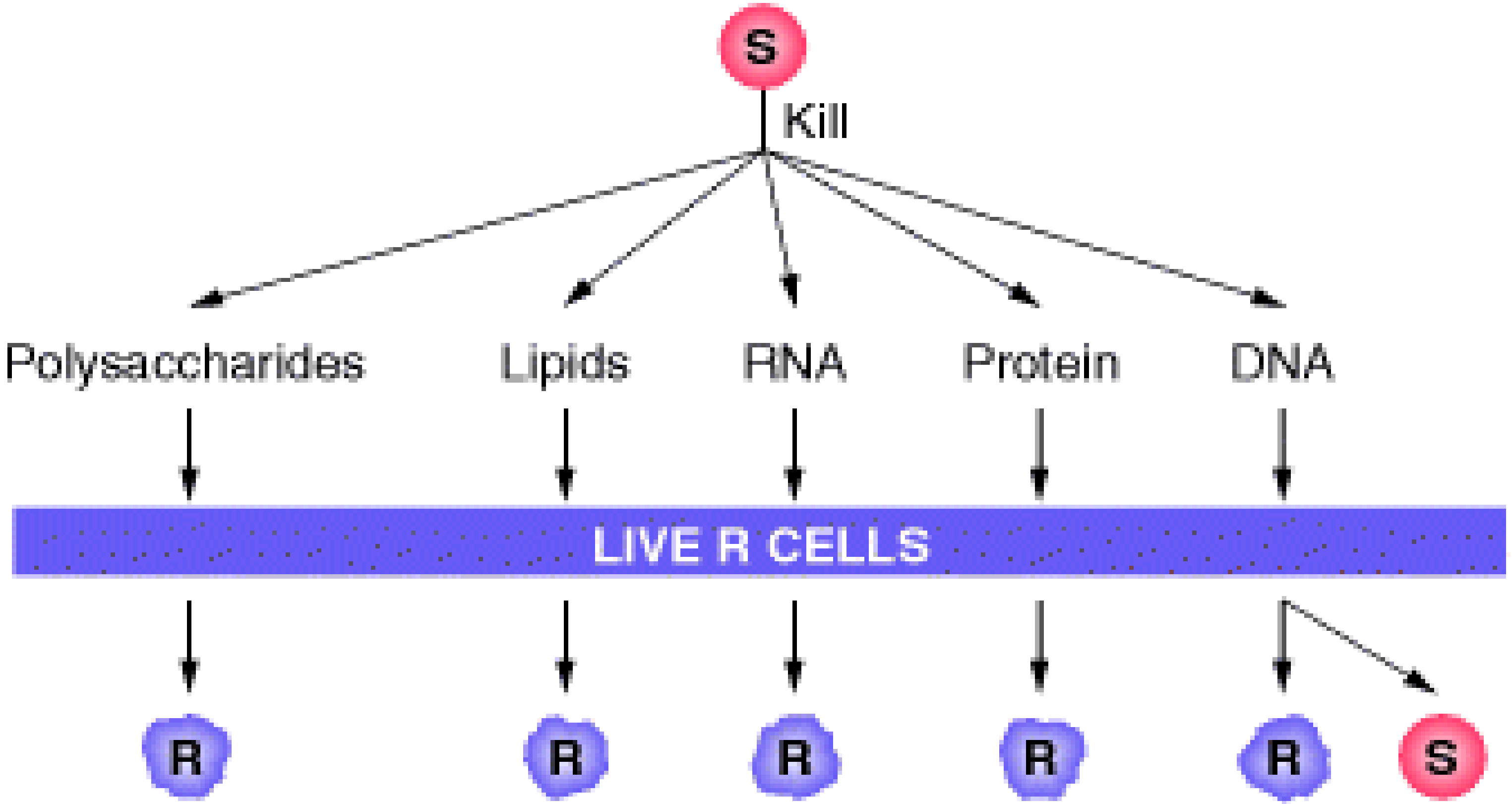
5.The chromosomes were found to consist of DNA

The discovery of DNA as genetic

- One of the first study that ultimately led to the identification of DNA as genetic material was done by Frederick Griffith involving the bacterium *Streptococcus pneumoniae* in 1928.
- This bacterium, which causes pneumonia in humans, is normally lethal in mice.
- Griffith used two strains that are distinguishable by the appearance of their colonies when grown in laboratory cultures. In one strain, a normal virulent type, the cells are enclosed in a polysaccharide capsule, giving colonies a smooth appearance; this strain is labelled *S*. In the other strain, a mutant nonvirulent type that is not lethal, the polysaccharide coat is absent, giving colonies a rough appearance; this strain is called *R*.

- Griffith injected mice with living R type bacteria. The mice were not affected and after a while the bacteria disappeared from the animal's blood stream.
- He also injected mice with living S type bacteria. The mice died, and S type bacteria could be isolated from their blood.
- Griffith killed some virulent cells by boiling them and injected the heat-killed cells into mice. The mice survived, showing that the carcasses of the cells do not cause death.
- However, mice injected with a mixture of heat-killed virulent cells and live nonvirulent cells did die. Live cells could be recovered from the dead mice; these cells gave smooth colonies and were virulent on subsequent injection. Somehow, the cell debris of the boiled S cells had converted the live R cells into liv$_3$ e S cells. The process is called transformation.

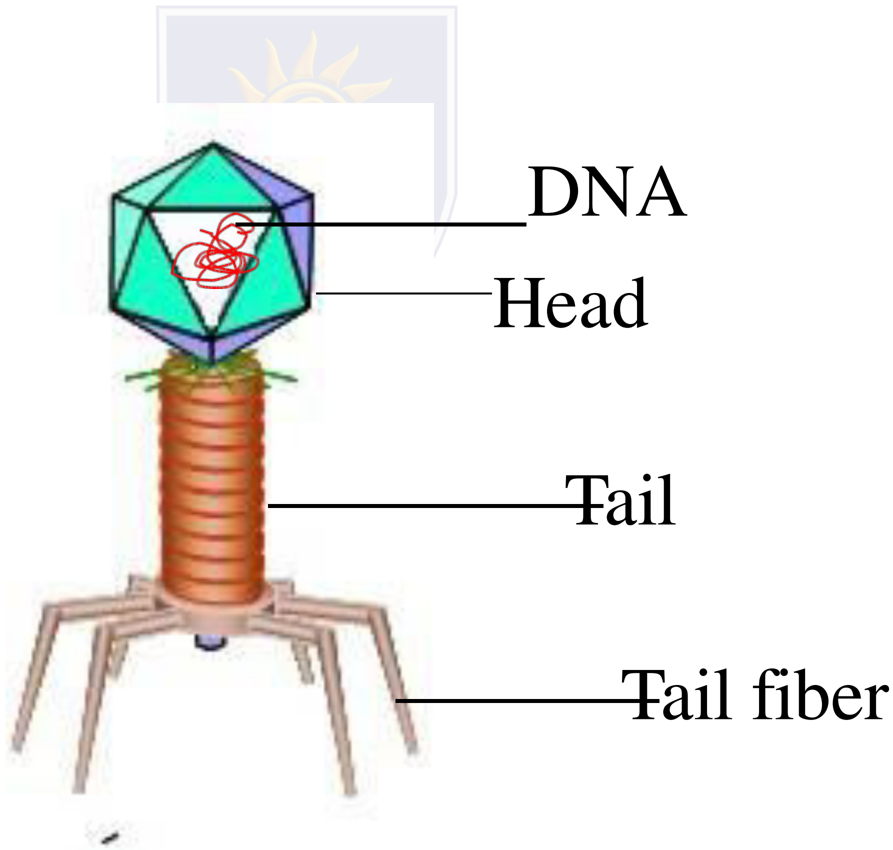
- In 1944, Oswald Avery, C. M. MacLeod, and M. McCarty separated the classes of molecules found in the debris of the dead S cells and tested them for transforming ability, one at a time. These tests showed that the polysaccharides themselves do not transform the rough cells.
- In screening the different groups, it was found that only one class of molecules, DNA, induced the transformation of R cells. DNA is the agent that determines the polysaccharide character and hence the pathogenic character. It seemed that providing R cells with S DNA was equivalent to providing these cells with S genes.
- The demonstration that DNA is the transforming principle was the first demonstration that genes are composed of DNA.


S
Kill
Polysaccharides
Lipids
RNA
Protein
DNA
LIVE R CELLS
R
R
R
R
R
S

Hershey-Chase experiment

- In 1952 Alfred Hershey and Martha Chase used bacteriophage (virus) T_2 to show that DNA is the genetic material. Most of the phage structure is protein, with DNA contained inside the protein sheath of its "head."
- They reasoned that phage infection must entail the introduction (injection) into the bacterium of the specific information that dictates viral reproduction.
- Hershey and Chase incorporated the radioisotope of phosphorus (^{32}P) into phage DNA and that of sulfur (^{35}S) into the proteins of a separate phage culture. P is not found in proteins but is an integral part of DNA; S is present in proteins but never in DNA.

Bacteriophage



- When the ^{32}P-labelled phages were used, most of the radioactivity ended up inside the bacterial cells, indicating that the phage DNA entered the cells. ^{32}P can also be recovered from phage progeny.
- When the ^{35}S-labelled phages were used, most of the radioactive material ended up in the phage ghosts, indicating that the phage protein never entered the bacterial cell.
- They concluded that DNA is the hereditary material; the phage proteins are mere structural packaging that is discarded after delivering the

The Hershey-Chase experiment, which demonstrated that the genetic material of phage is DNA, not protein.