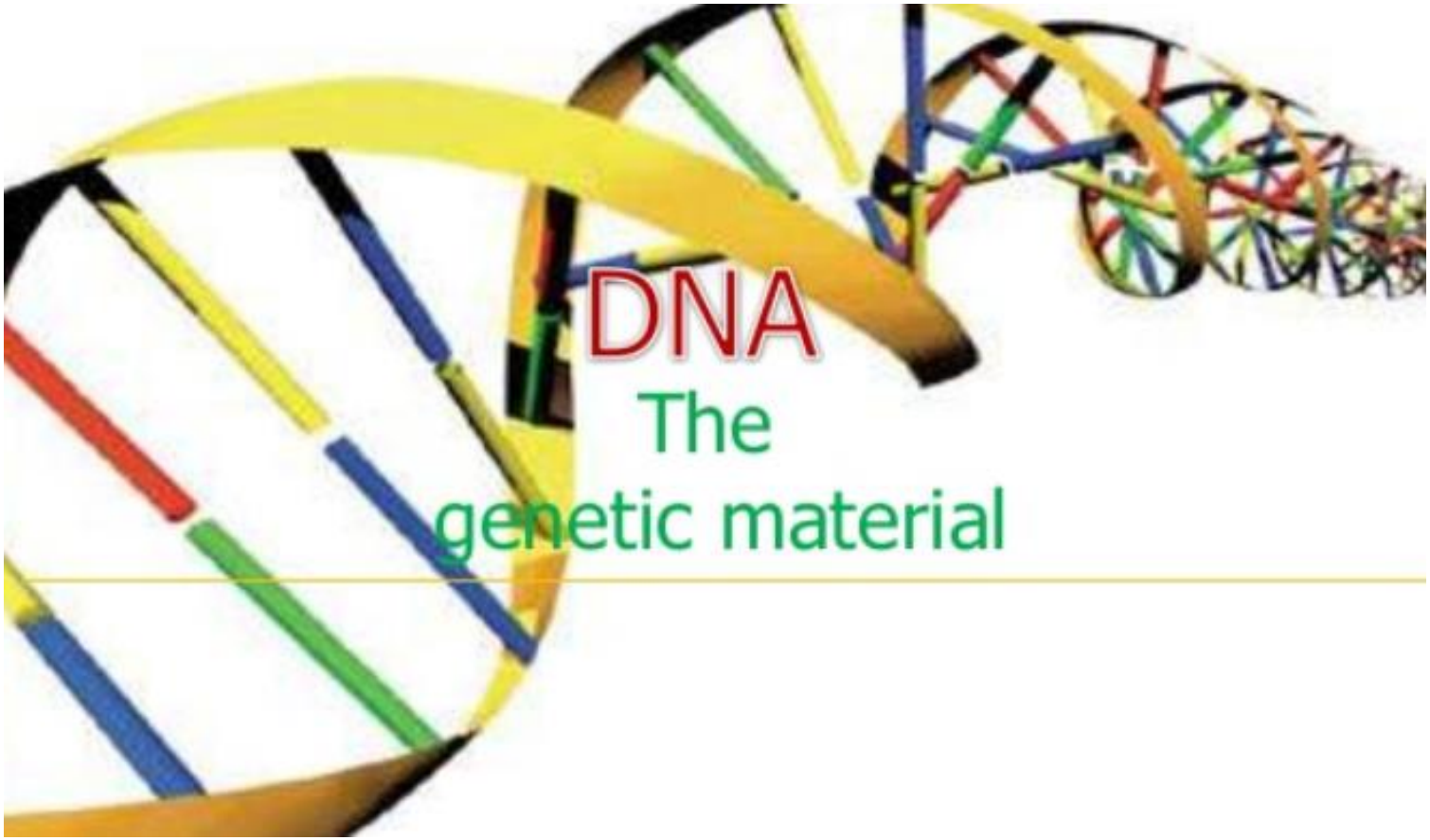
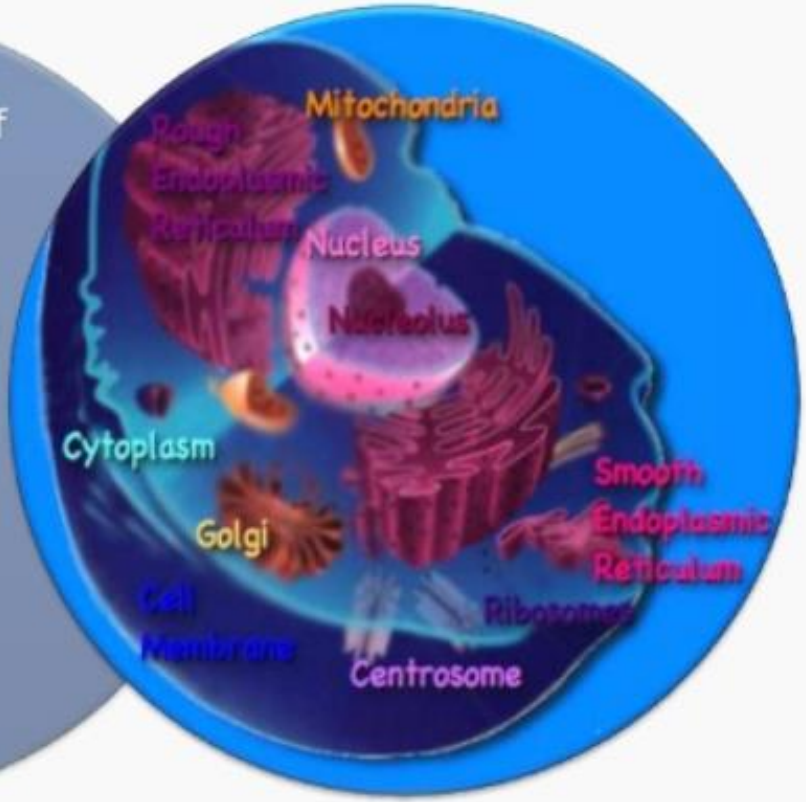


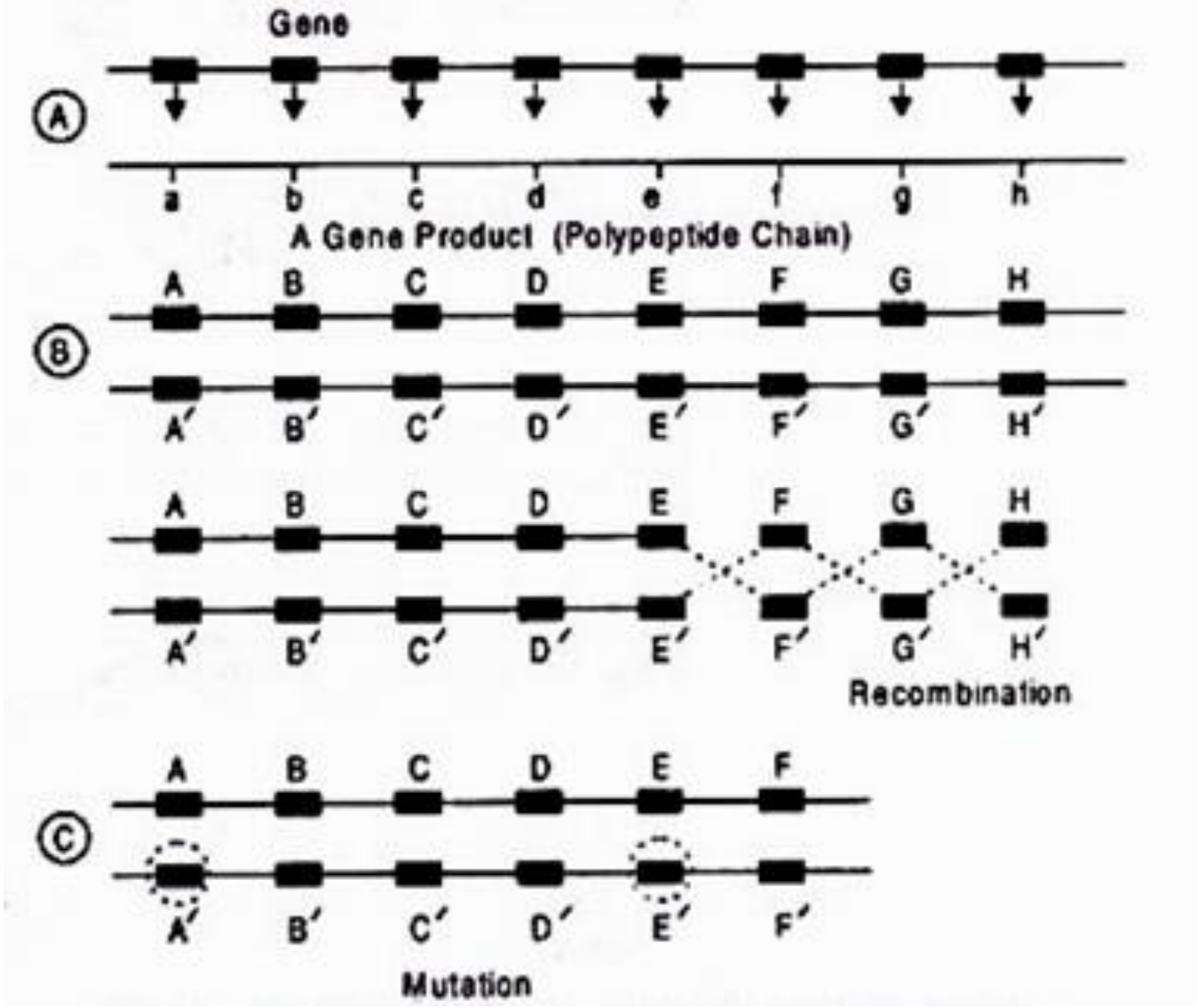
DNA

The genetic material

What is genetic material?

The genetic material of a cell or an organism refers to those materials found in the nucleus, mitochondria and cytoplasm, which play a fundamental role in determining the structure and nature of cell substances, and capable of self-propagating and variation.

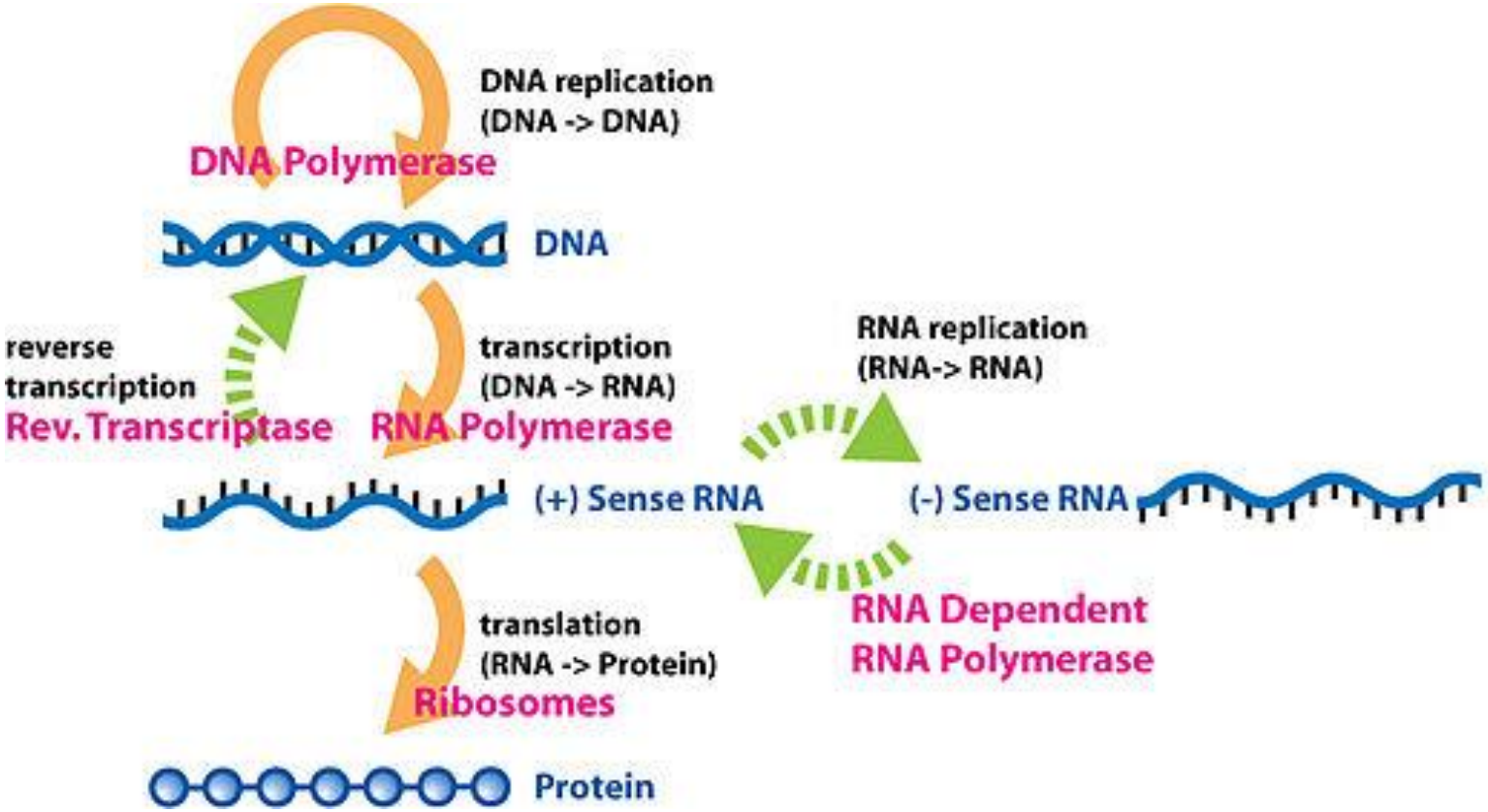



Gene
A
a
b
c
d
e
f
g
h
A Gene Product (Polypeptide Chain)
B
A
B
C
D
E
F
G
H
A′
B′
C′
D′
E′
F′
G′
H′
Recombination
C
Mutation

Cistrons,Mutons and Recons

They are functional units of DNA recognized by **Benzer (1955).**

Cistron. It is a unit of a gene or genetic material which is equivalent to a gene. A cistron is a structural gene which takes part is synthesis of one polypeptide.



Cistrons,Mutons and Recons

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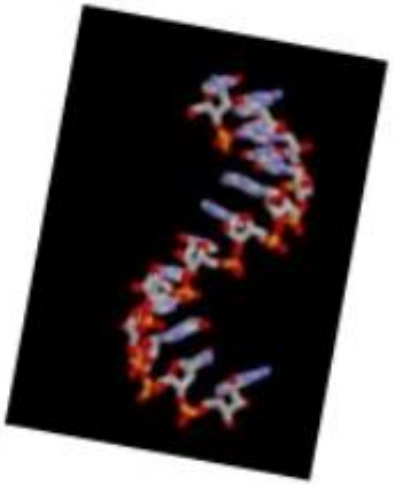
Cistron. It is a unit of a gene or genetic material which is equivalent to a gene. A cistron is a structural gene which takes part is synthesis of one polypeptide.

Muton. It is a unit of mutation.A muton may be as small as a nucleotide pair.Gene mutation is caused by replacement of one purine or pyrimidine, or vice versa,addition or deletion of nucleotides. Mutations bring about change in structure and expression of cistron.

Recon. It is a unit of recombination or rearrangement due to crossing over.Usually recon is a large segment of cistron but it can be as small as a single nucleotide pair.

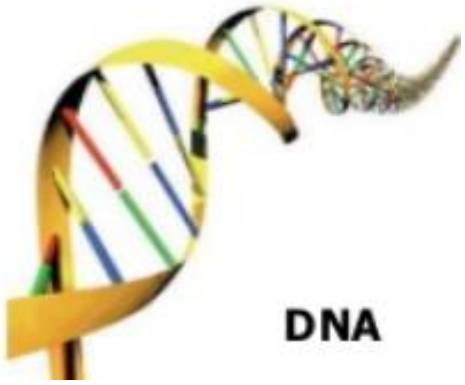
What's the point ????

RNA



Protein,RNA and DNA were thought as genetic material. But many experiments suggest DNA as genetic material rather than protein and RNA

Protein



DNA

It is well known fact that transmission of traits takes place from one generation to other. The offsprings are similar to both the parents in some traits

Gregor Johann Mendel (1866) on the basis of his hybridization experiments on Sweet pea gave the idea that transmission of traits over generations take place through Factor or Determiner or Gene which carries information for expression of trait or phenotype.

Genes are present on the chromosomes which are distributed equally into the two daughter cells during cell division. The biochemical studies reveal that chromosomes are composed of proteins (60%) and DNA (40%)

Genetic material must be capable of

- Replication (Make its copy)
- Storage of information for expression of trait
- Control expression of traits
- Change in controlled way (undergo mutation)
- Must be stable

Question: **List of 5 important features of a molecule to be considered as a genetic material**

Is the Genetic Material Protein or DNA

Topic of Discussion till 1944 was which chromosomal component DNA or Protein carries hereditary information or is the genetic material

Untill 1940 Proteins were considered as genetic material as Proteins are polymer of 20 protein amino acids and present in larger quantity, encode more and variety of information.

DNA is polymer of only 4 different deoxyribonucleotides ( ) and is present in smaller quantity

Most geneticists focused on "transmission genetics" and passively accepted proteins as the genetic material

But On the basis of certain experiments conducted from time to time ,it was ultimately demonstrated that DNA carries genetic information and not the proteins

There are some direct evidences and some indirect evidences which prove DNA as Genetic Material

Direct evidences come from :

- Frederick Griffith's (1928) experiment on Bacterial Transformation
- Oswald Avery, Colin Macleod and Maclyn McCarty's (1944) experiment on Transformation
- Alfred D. Hershey and Martha Chase (1952) experiment on T- Even (2,4) Bacteriophage

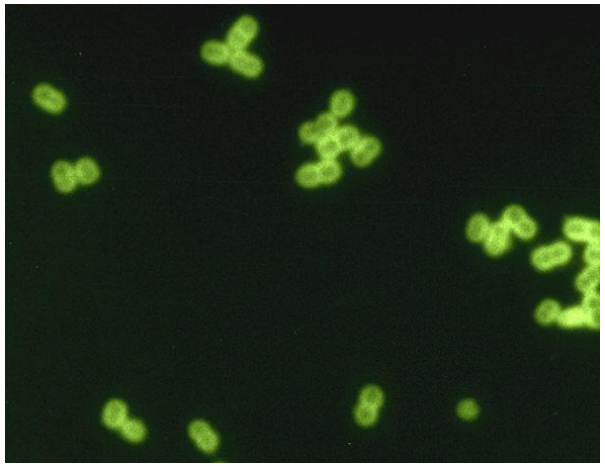
Remember This sequence of Experiments in detail

Frederick Griffith (1928) Studied *Diplococcus pneumoniae*, having Two strains

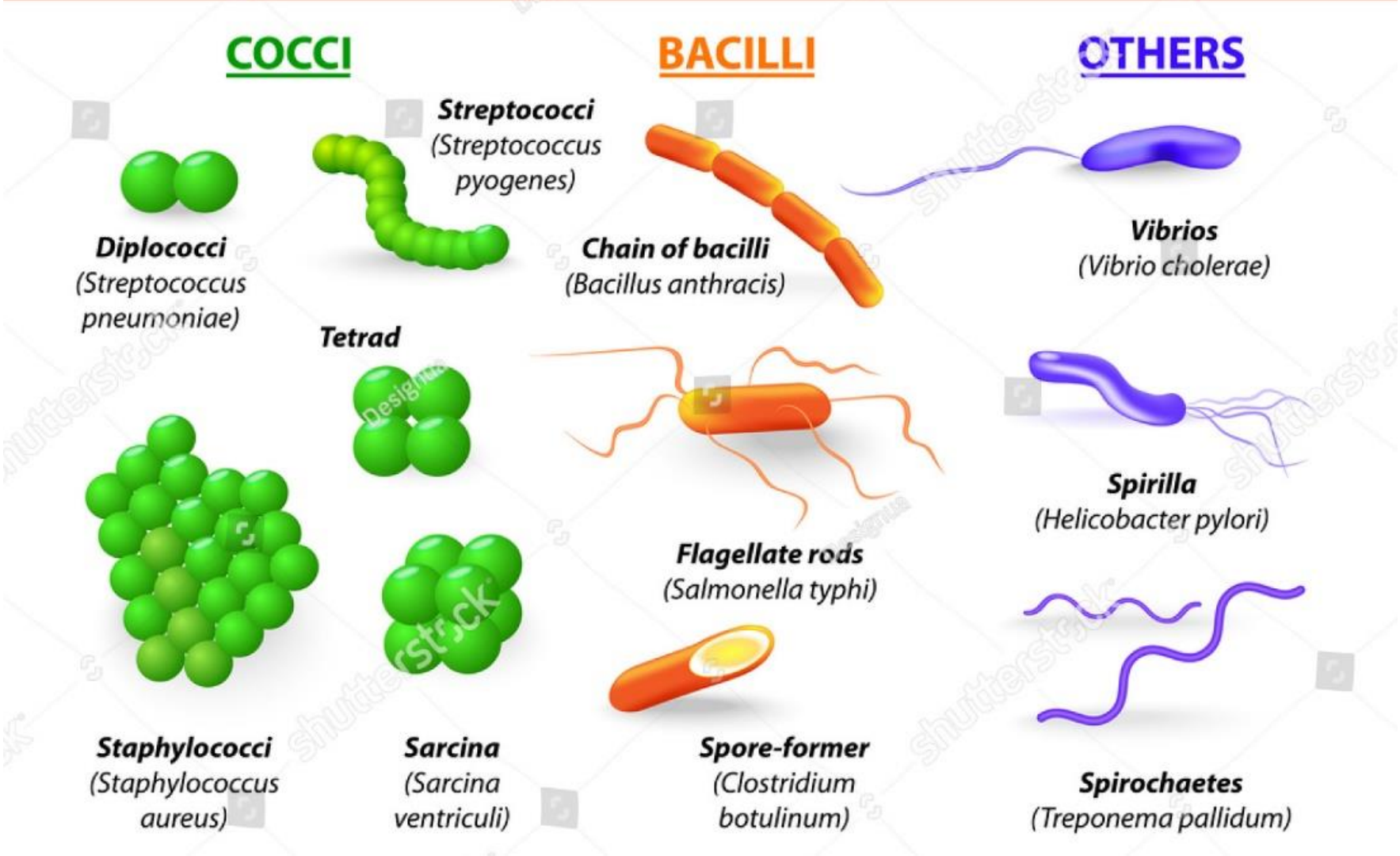
SIII strain was virulent, possessed a lipopolysaccharide capsule and could kill mice by causing disease Pneumonia and made round colonies on a culture plate

RII strain was avirulent and lacked a Lipopolysaccharide (LPS) capsule, growing in rough–shaped colonies on a culture plate

Remember terms:
Culture, culture media, culture plate,



SHAPES OF BACTERIA



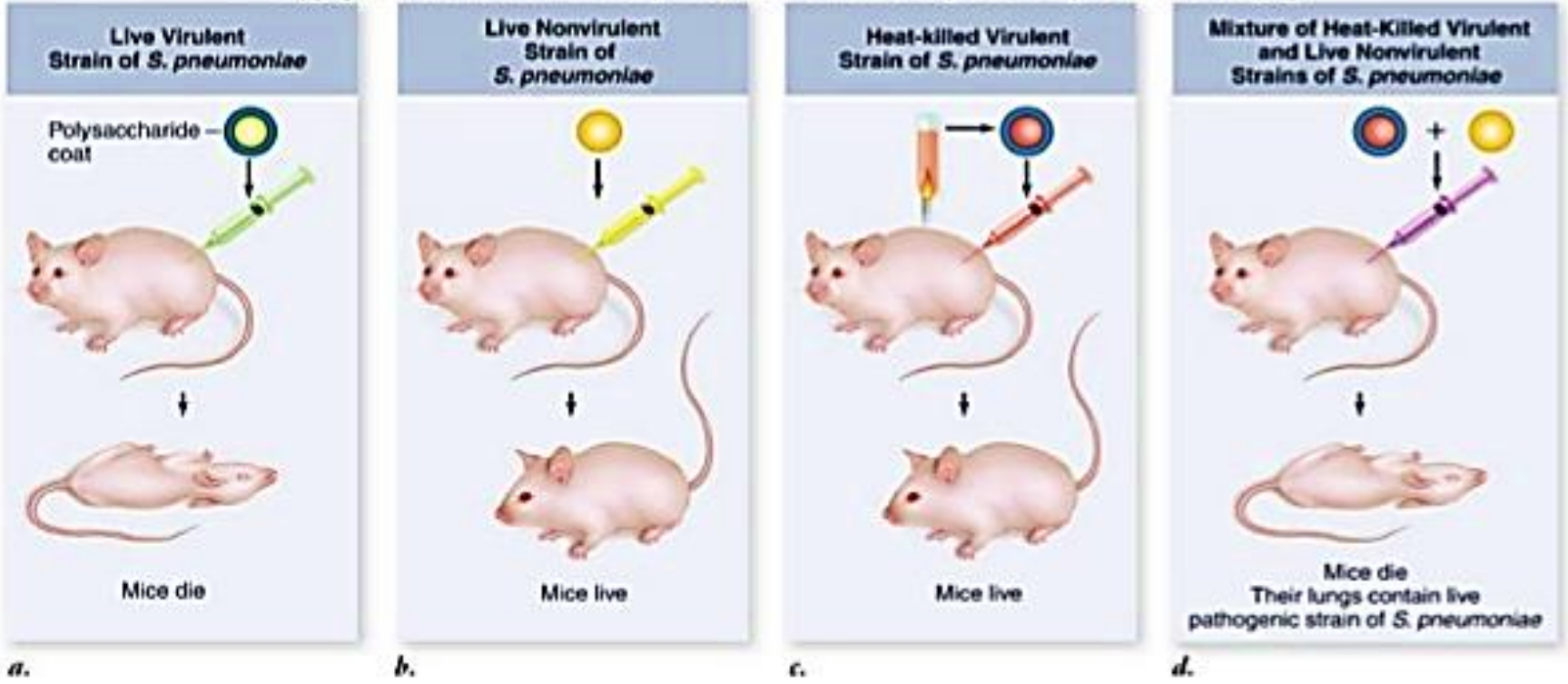
IMPORTANT

REMEMBER THE SEROTYPE TO UNDERSTAND THE UPCOMING SLIDES

STRAINS OF *DIPLOCOCCUS PNEUMONIAE* USED BY FREDERICK GRIFFITH IN HIS ORIGINAL TRANSFORMATION EXPERIMENTS

Serotype	Colony Morphology	Capsule	Virulence
II*R*	Rough	Absent	Avirulent
III*S*	Smooth	Present	Virulent

STEPS IN THE EXPERIMENT



1 LIVE SIII

2 LIVE RII

3 H K S III

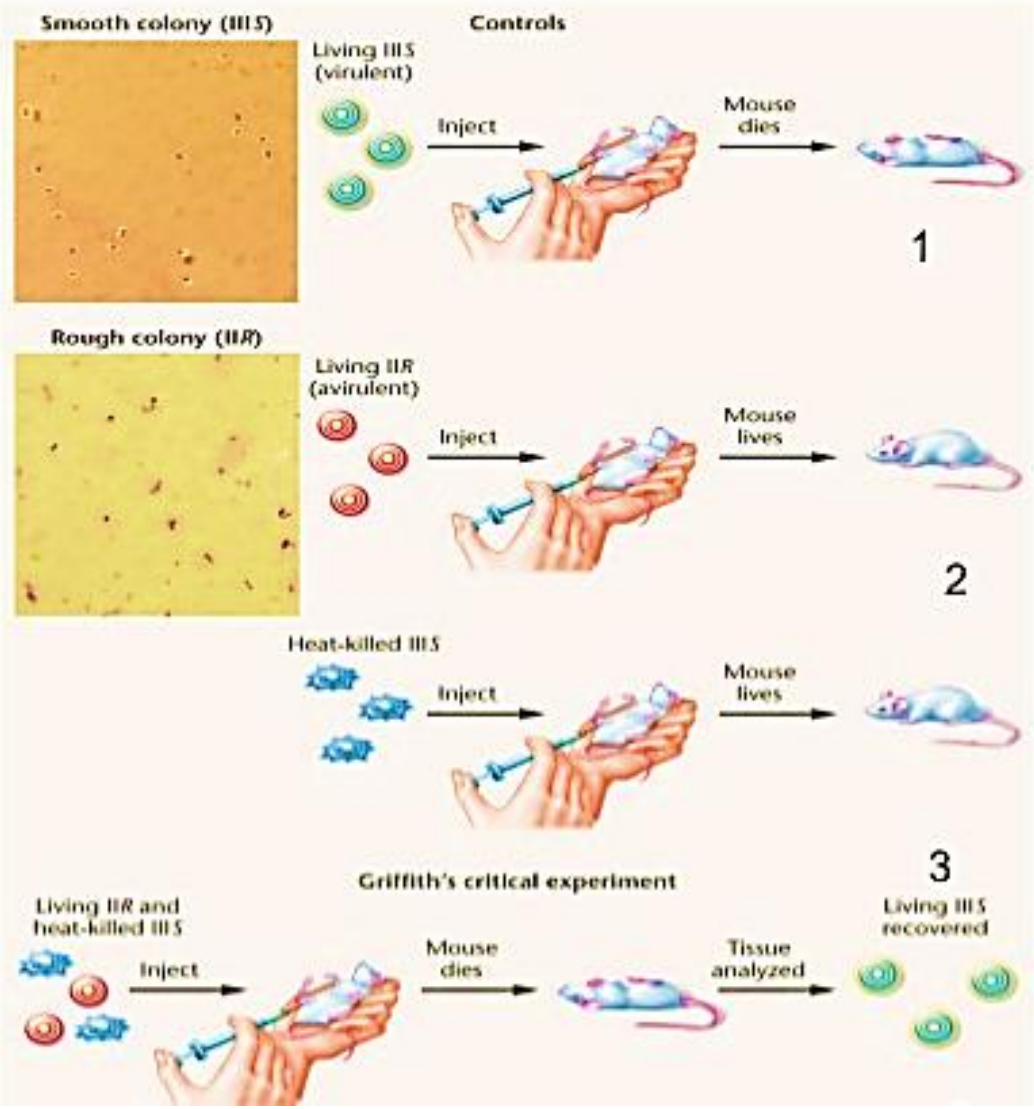
4 H K S III & LIVE RII

Strains of Diplococcus pneumoniae injected to mice

Griffith's Experiment

RII → SIII

transformation takes place in step 4 give clue for DNA as genetic material



STEPS AND RESULTS OF GRIFFITH'S EXPERIMENT

S N	STEPS	RESULT
I	Mouse injected with SIII strain	Mouse died √
II	Mouse injected with RII strain	Mouse survived
III	Mouse injected with Heat Killed SIII strain	Mouse survived
IV	Mouse injected with Heat Killed SIII & living R II strain	Mouse died & from its blood live SIII √ strain bacteria recovered
V	Mouse injected with Heat Killed SIII+ living RII strain + DNase enzyme	Mouse survived
VI	Mouse injected with Heat Killed SIII+ living RII strain + Protease enzyme	Mouse died of √ Pneumonia

GRIFFITH'S CONCLUSION

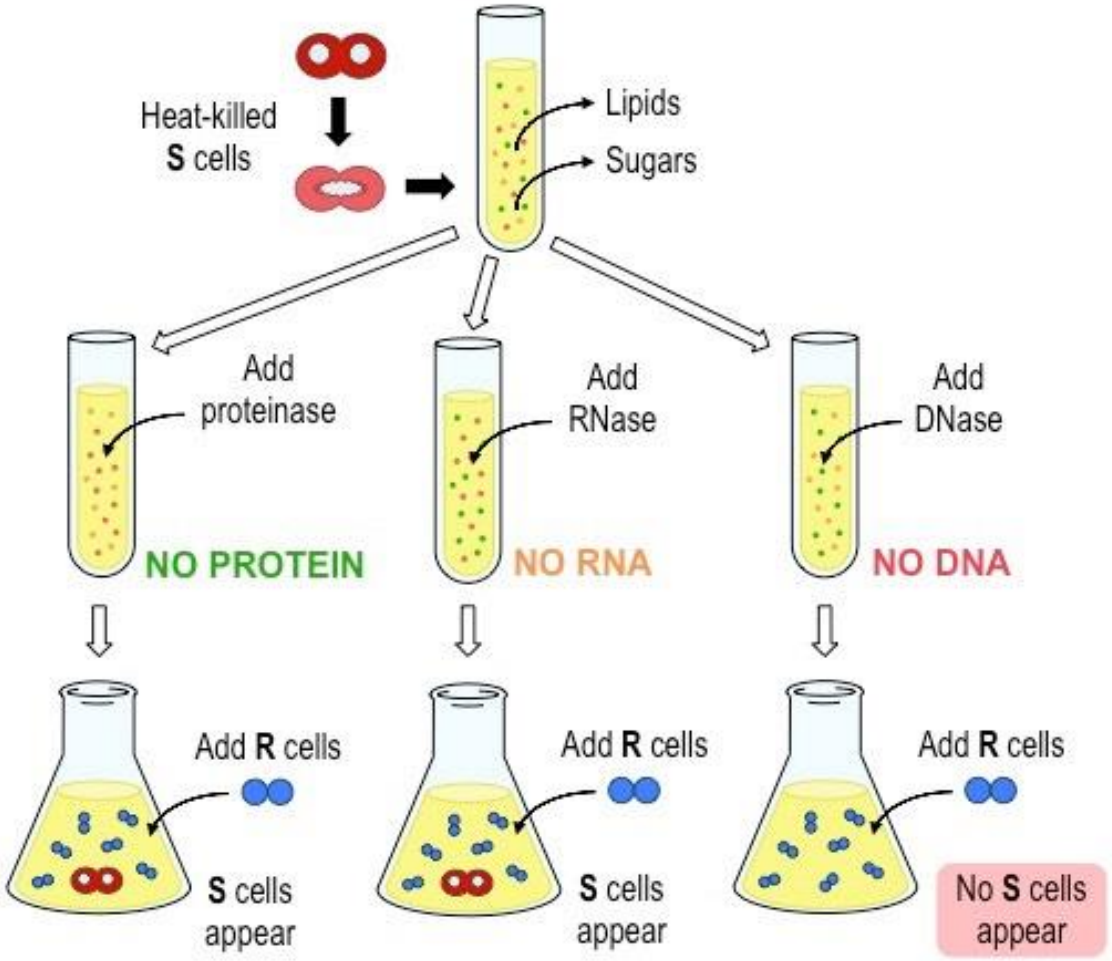
On the basis of Result of step IV Griffith concluded that there was transformation of Avirulent RII type to Virulent SIII type by picking up the genetic material encoding the LPS capsule from the Heat Killed S III .

This bacterial transformation clearly shows the role of DNA as Genetic Material and is further confirmed by results of step V which shows no transformation as DNase digests DNA and step VI again shows transformation as protease only digests protein

Further confirmation

Avery, MacLeod, & McCarty, 1944 repeated Griffith's experiment of transformation using purified cell extracts and concluded

Hypothesis: The genetic material of the cell is either protein or nucleic acid (DNA or RNA)



Remove lipids and sugars from a solution of heat-killed **S** cells.

Proteins, RNA and DNA remain

Treat solutions with enzymes to destroy protein, RNA or DNA

Add to culture containing living **R** cells.

Observe for transformation by testing for the presence of virulent **S** cells

Conclusion: Transformation requires DNA, therefore it is the genetic material of the cell

Avery, MacLeod AND McCarty EXPERIMENT

- Is based on transformation
- Cell free extract of SIII strain Bacterium was subjected to DNase,RNase and Protease
- Each treated extract was mixed with RII and mixture injected to mouse to see transformation.
- In case of Protease and RNase transformation was recorded
- In case of DNase no transformation was recorded

Hershey AND Chase Experiment

Alfred Hershey and Martha Chase, 1952 investigated

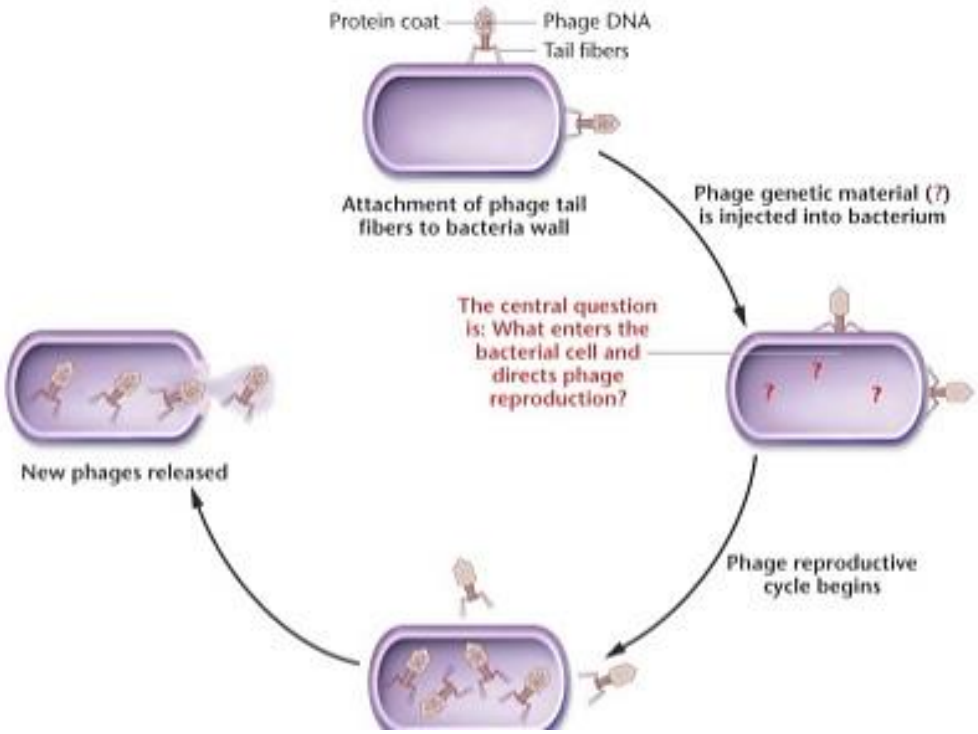
bacteriophages: viruses that infect bacteria

- the bacteriophage was composed of only DNA and protein
- they wanted to determine which of these molecules is the genetic material that enters into the bacteria

Life Cycle of T-2 Phage

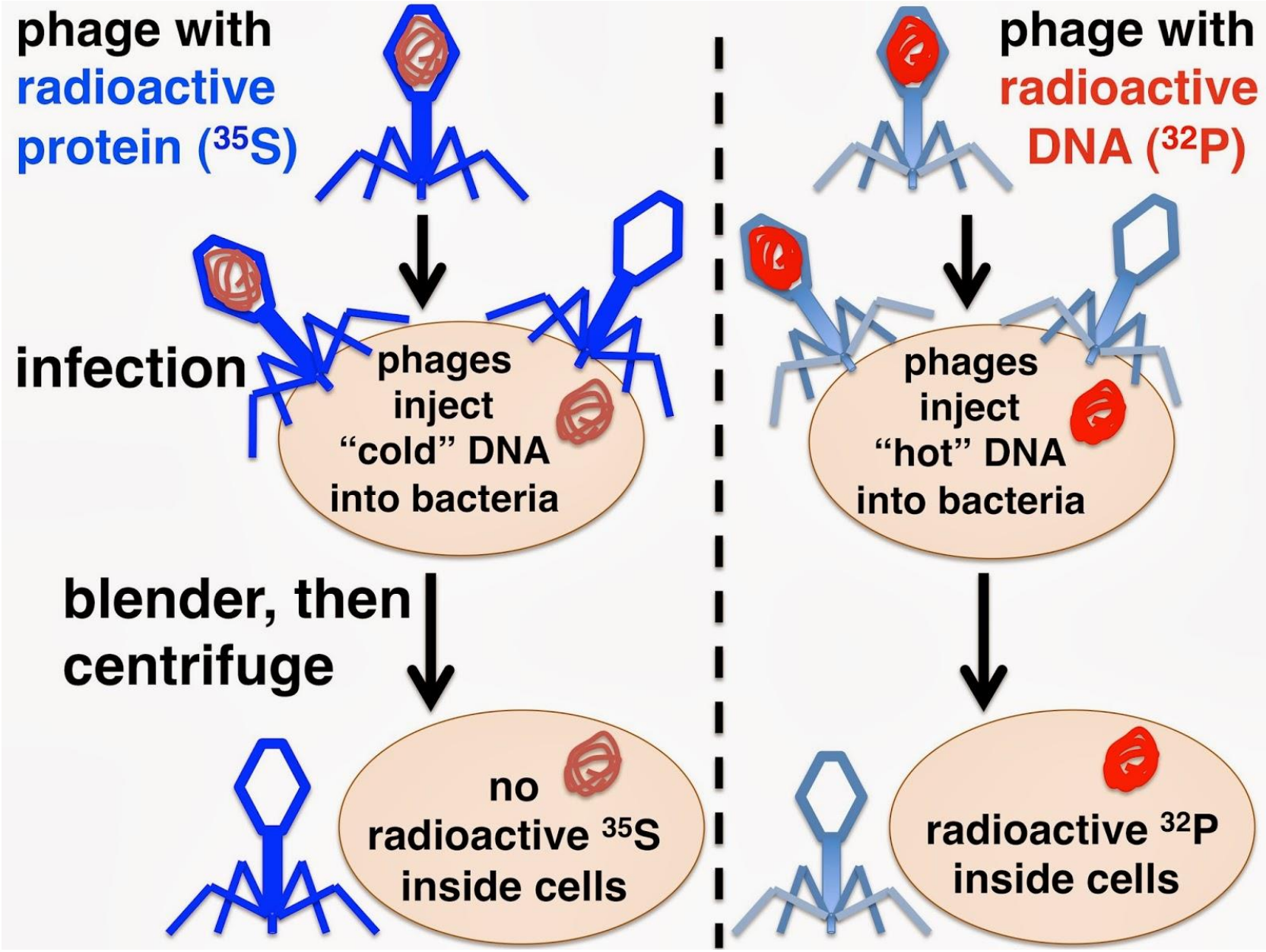
- Phage is made of DNA and protein coat

  Only DNA enters in the Bacterial cell and protein coat is left out side



EVENTS WHICH TAKE PLACE IN LIFE CYCLE OF BACTERIOPHAGE

- Attachment of Bacteriophage to receptor site on bacterial cell wall by its tail
- Bacterial cell wall dissolves at the point of contact
- Phage DNA enters into Bacterial cell, protein coat remains outside
- Phage DNA replicates forming many copies
- Assembly of phage DNA into new protein shells
- Lysis or breakdown of host cell and release of infective phage particle.


phage with
radioactive
protein (^{35}S)
phage with
radioactive
DNA (^{32}P)
infection
phages
inject
"cold" DNA
into bacteria
phages
inject
"hot" DNA
into bacteria
blender, then
centrifuge
no
radioactive ^{35}S
inside cells
radioactive ^{32}P
inside cells

HERSHEY & CHASE (1952) EXPERIMENT WITH T2 BACTERIOPHAGE

In culture I Bacteriophage was grown in medium containing Radioactive Phosphorus (^{32}P))To make DNA Radioactive

In culture II Bacteriophage was grown in medium containing radioactive Sulphur (^{35}S) To make proteins Radioactive

Both kinds of Bacteriophage particles were allowed to infect Bacteria

The infected bacteria were observed for radioactivity

Radioactive Phosphorus was found with bacterial cells

Radioactive Sulphur was not traced in bacterial cells (Only in Ghosts)

Bacteriophage progeny carried only radioactive phosphorus and not radioactive sulphur

Important for writing purpose

HERSHAY & CHASE CONCLUSION

As ghosts or coat of Bacteriophage were not labelled with 32P and only with 35S. The results of experiment clearly indicate that only DNA and not the proteins enter the bacterial cell. Protein coat is left outside. The DNA entering the host cell carries all the genetic information for synthesis of new phage particle. This certainly proves that DNA is the genetic material in Bacteriophage and not proteins