

# THE SEARCH FOR GENETIC MATERIAL

*Experiments to prove which is the genetic material...*

# THE SEARCH FOR GENETIC MATERIAL

1

## GRIFFITH'S TRANSFORMING PRINCIPLE EXPERIMENT

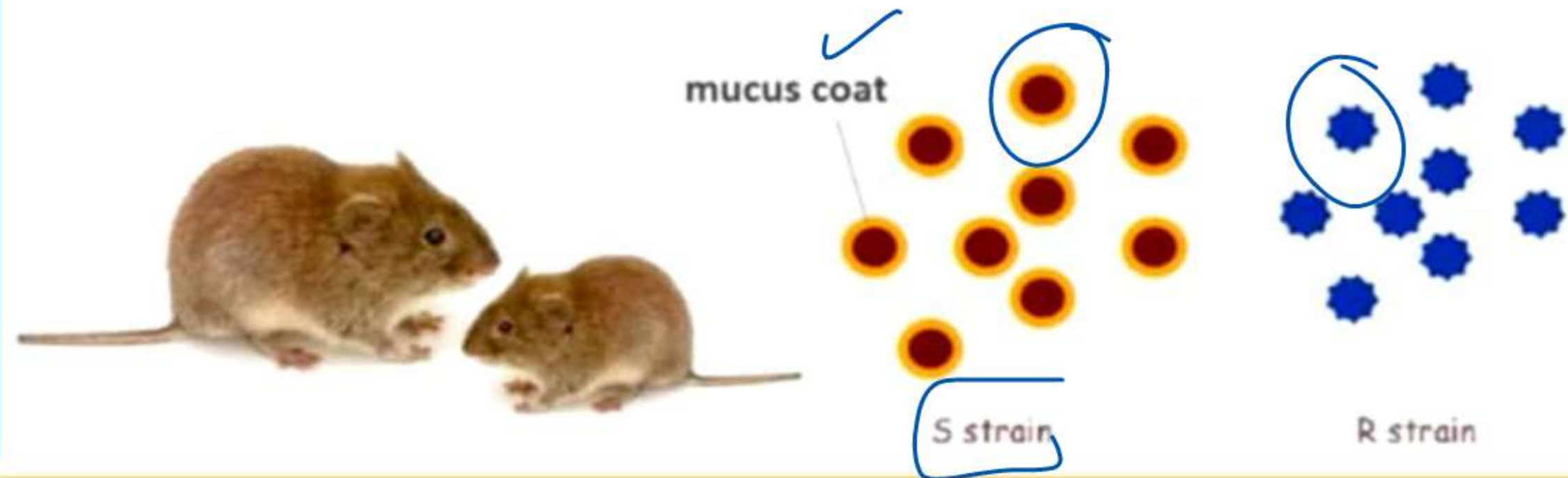


▶ Frederick Griffith (1928) used mice & Streptococcus pneumoniae.

▶ Streptococcus pneumoniae has 2 strains:

➤ **Smooth (S) strain (Virulent):** Has polysaccharide mucus coat. Cause pneumonia.

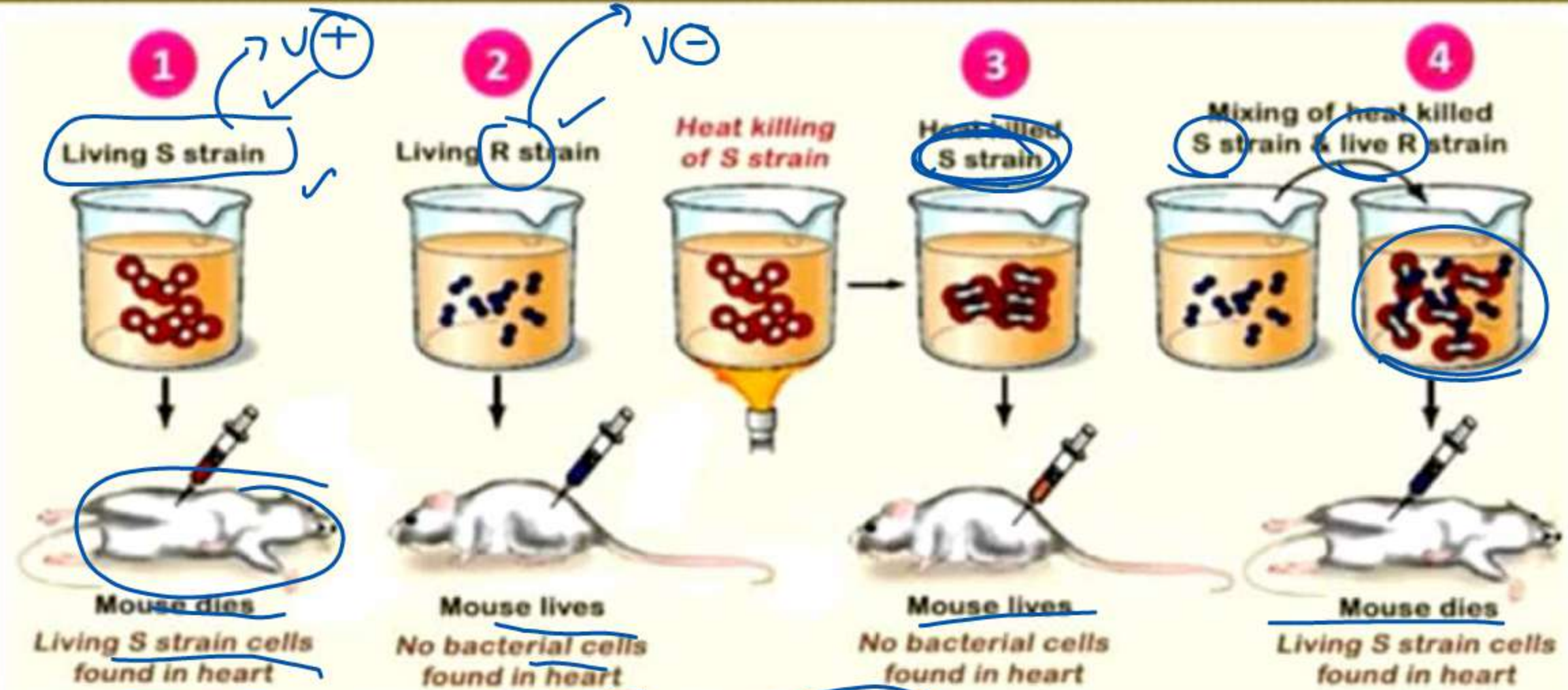
➤ **Rough (R) strain (Non-virulent):** No mucus coat. Do not cause Pneumonia.



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## GRIFFITH'S TRANSFORMING PRINCIPLE EXPERIMENT

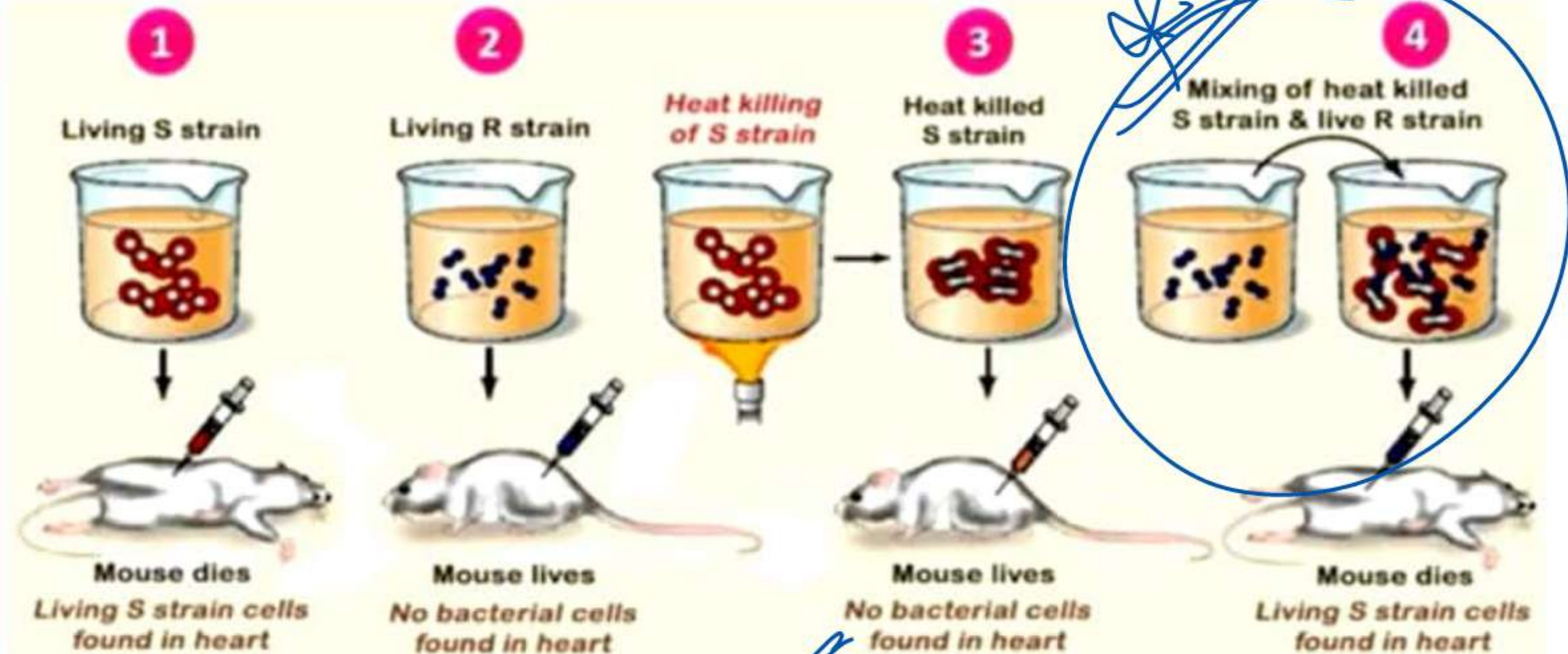


1. S-strain → Inject into mice → Mice die
2. R-strain → Inject into mice → Mice live
3. S-strain (Heat killed) → Inject into mice → Mice live
4. S-strain (Heat killed) + R-strain (live) → Inject into mice → Mice die

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## GRIFFITH'S TRANSFORMING PRINCIPLE EXPERIMENT



He concluded that some **'transforming principle'** transferred from heat-killed S-strain to R-strain. It enabled R-strain to synthesize smooth polysaccharide coat and become virulent. This is due to the transfer of genetic material.

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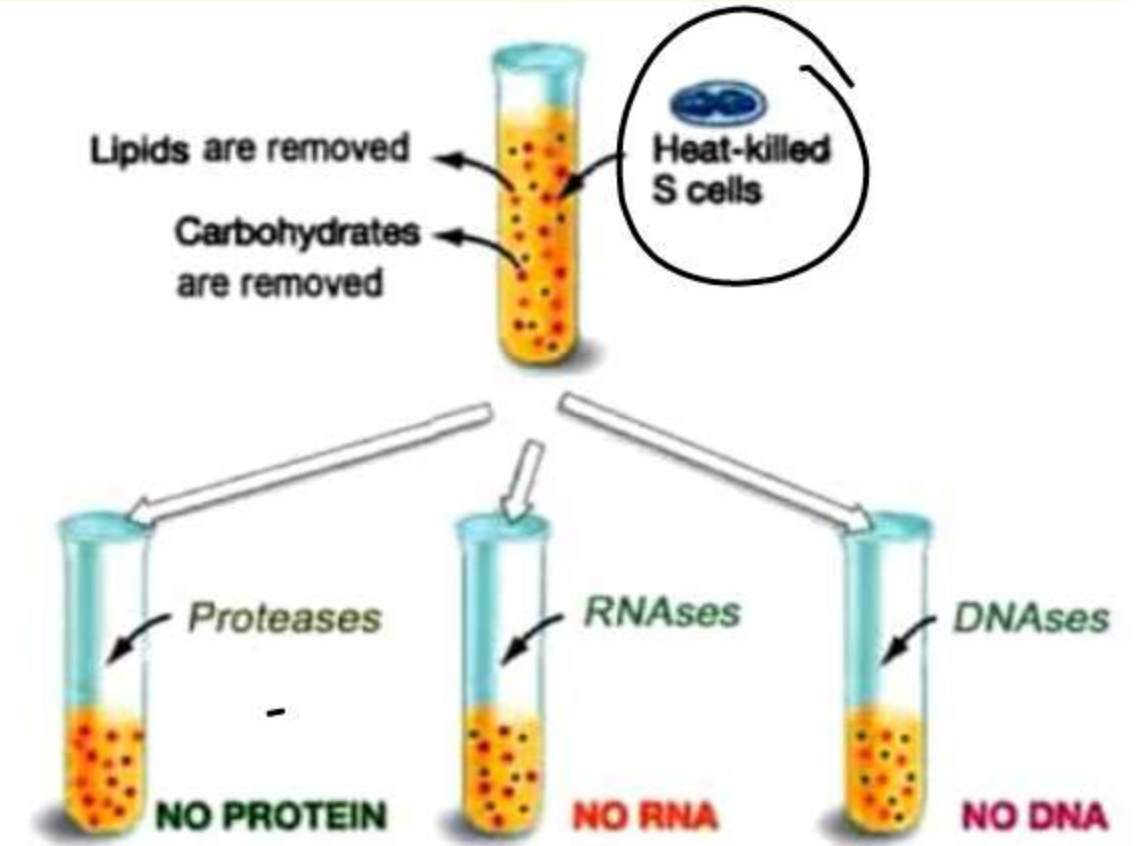
Chemical nature detect.

2

## BIOCHEMICAL CHARACTERIZATION OF TRANSFORMING PRINCIPLE



- ▶ **Oswald Avery, Colin MacLeod & Maclyn McCarty** worked to determine the biochemical nature of 'transforming principle' in Griffith's experiment.
- ▶ They purified biochemicals (proteins, DNA, RNA etc.) from heat killed S cells using suitable enzymes.



(Heat killed)  
↓  
lipid, carb go away

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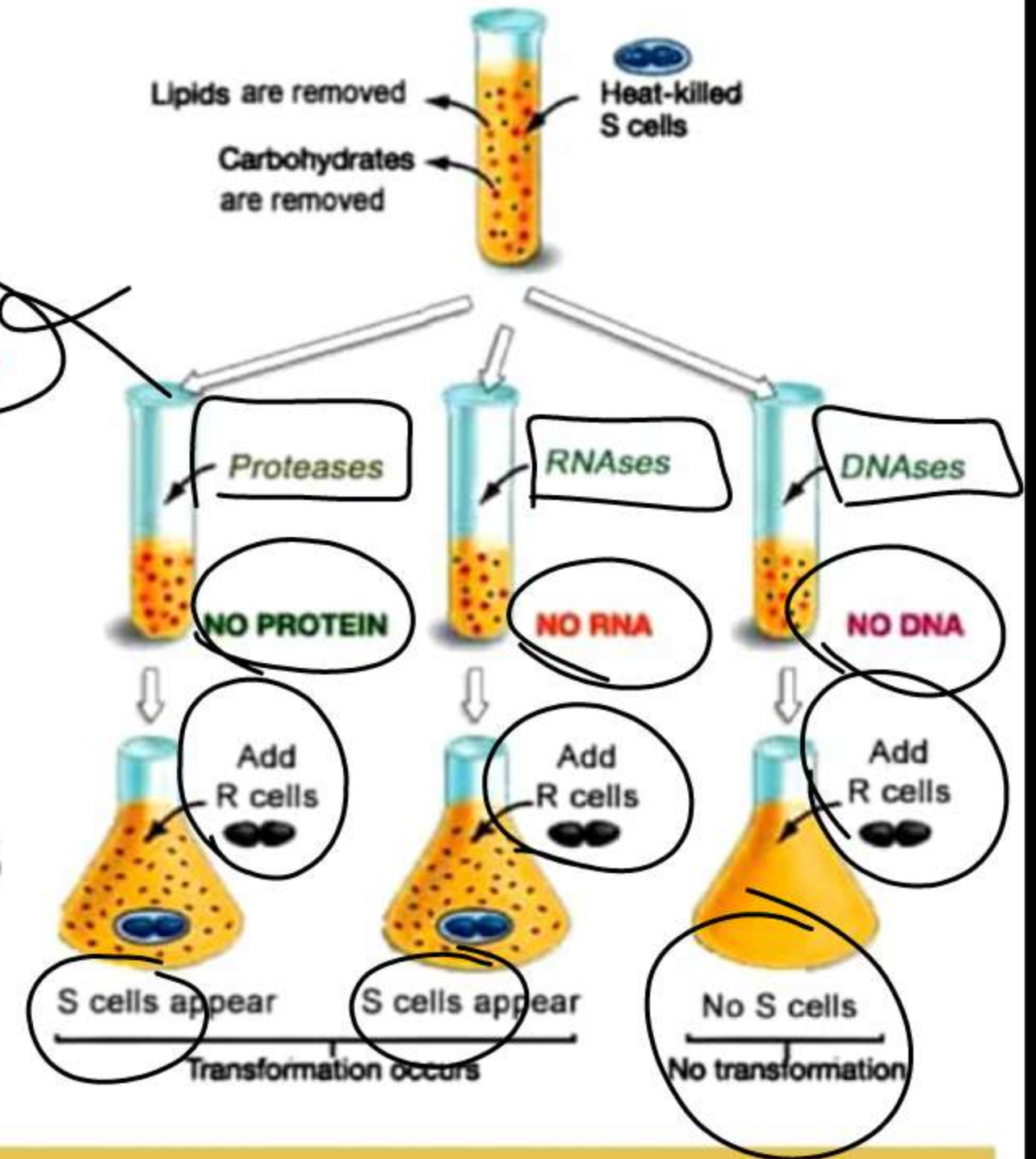
2

## BIOCHEMICAL CHARACTERIZATION OF TRANSFORMING PRINCIPLE



They discovered that

- ✓ **Digestion of protein & RNA** (using *Proteases* & *RNases*) **did not affect transformation.** So, transforming substance was not a protein or RNA.
- ✓ **Digestion of DNA** with *DNase* **inhibited transformation.** It means that DNA caused transformation of R cells to S cells, i.e. **DNA was the transforming principle.**



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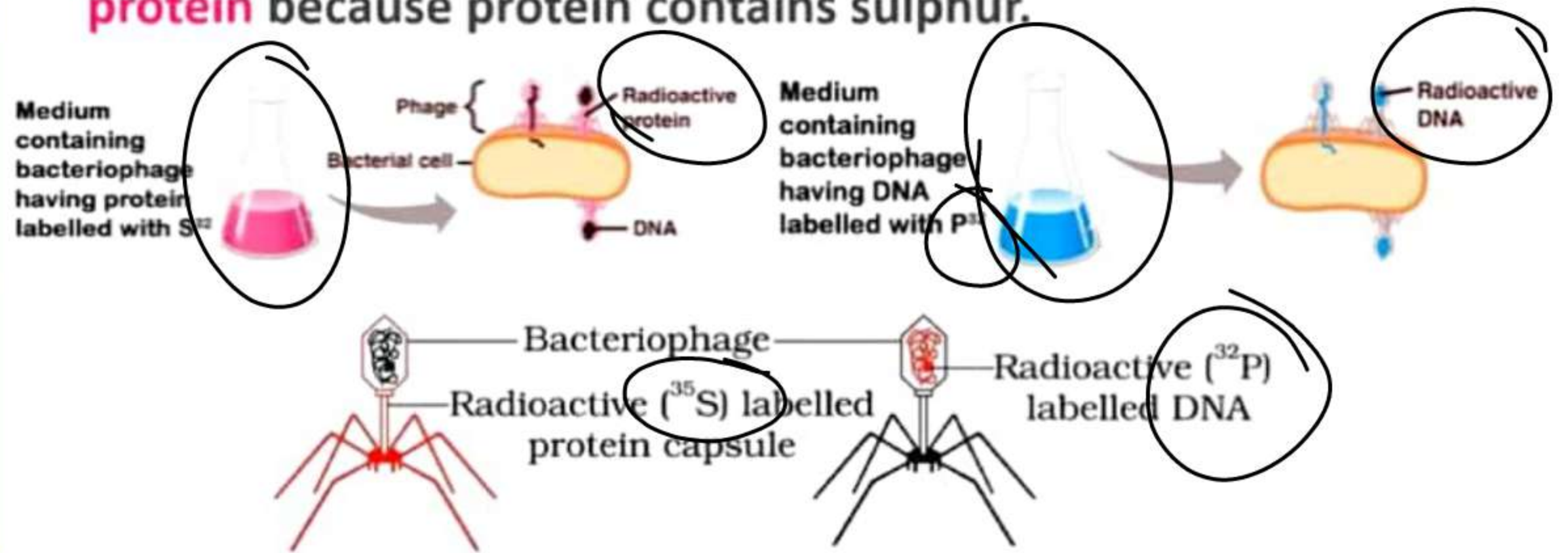
3

Tag

## HERSHEY-CHASE EXPERIMENT (BLENDER EXPERIMENT)



- ▶ **Hershey & Chase** grew some **bacteriophage** viruses on a medium containing **radioactive phosphorus ( $P^{32}$ )** and some others on medium containing **radioactive sulphur ( $S^{35}$ )**.
- ▶ Viruses grown in  $P^{32}$  got **radioactive DNA** because only DNA contains phosphorus. Viruses grown in  $S^{35}$  got **radioactive protein** because protein contains sulphur.



# THE SEARCH FOR GENETIC MATERIAL

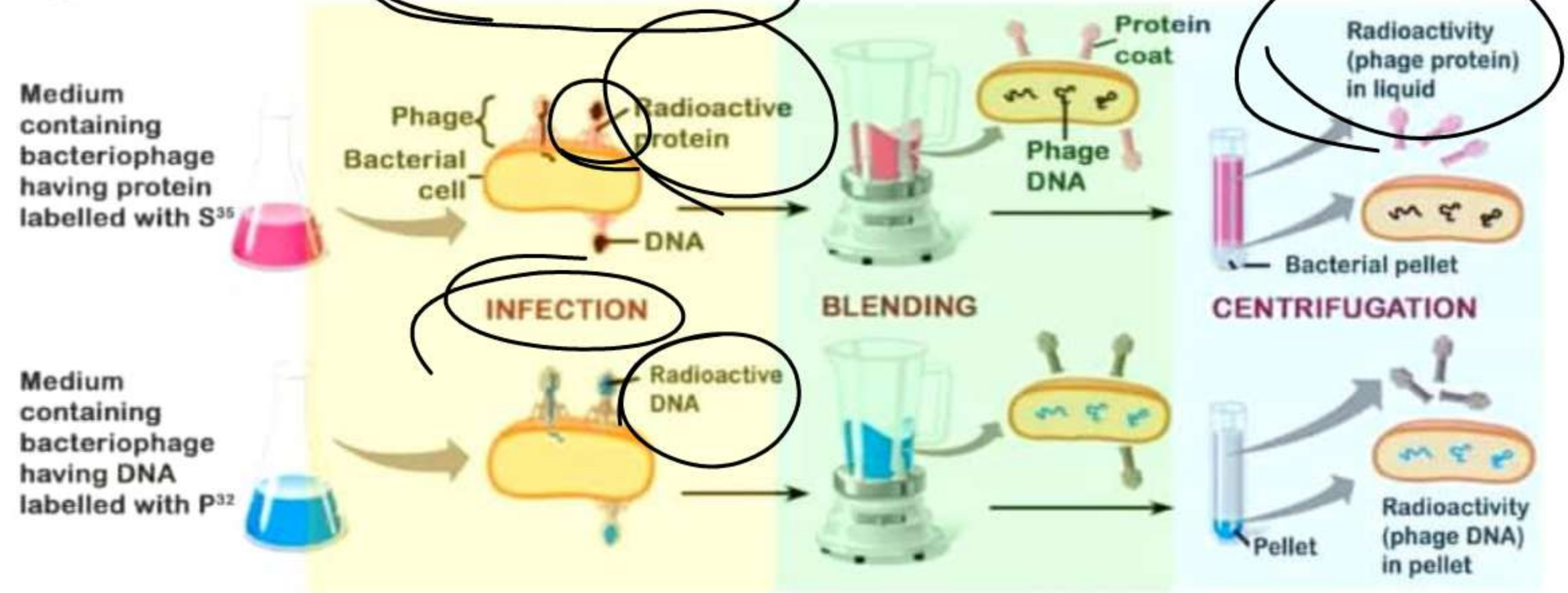
→ *Escherichia*

3

## HERSHEY-CHASE EXPERIMENT (BLENDER EXPERIMENT)



- ▶ These preparations were used separately to infect *E. coli*.
- ▶ After infection, the *E. coli* cells were gently agitated in a blender to remove the virus particles from the bacteria.
- ▶ Then the culture was centrifuged to separate lighter virus particles from heavier bacterial cells.





# THE SEARCH FOR GENETIC MATERIAL

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## HERSHEY-CHASE EXPERIMENT (BLENDER EXPERIMENT)



- ▶ Bacteria infected with viruses having radioactive DNA were radioactive. i.e., **DNA had passed from virus to bacteria.**
- ▶ Bacteria infected with viruses having radioactive proteins were not radioactive. i.e., **proteins did not enter the bacteria** from the viruses.



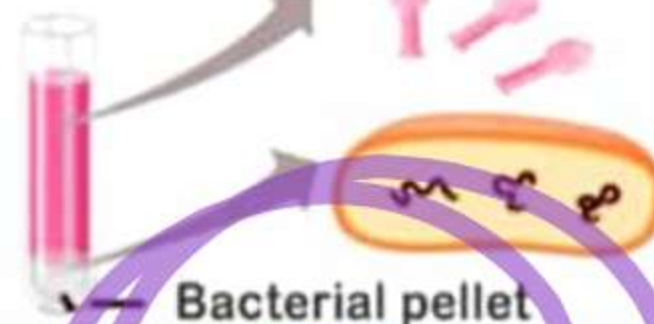
No Radioactive ( $^{35}\text{S}$ ) detected in cells

+

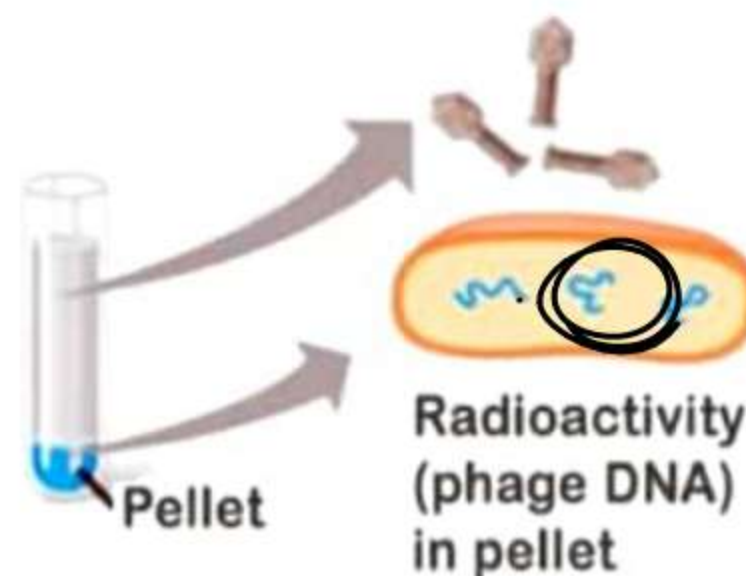
Radioactive ( $^{35}\text{S}$ ) in supernatant



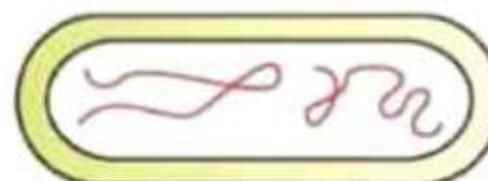
Radioactivity (phage protein) in liquid



Bacterial pellet



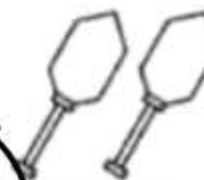
Radioactivity (phage DNA) in pellet



Radioactive ( $^{32}\text{P}$ ) detected in cells

+

No Radioactivity in supernatant

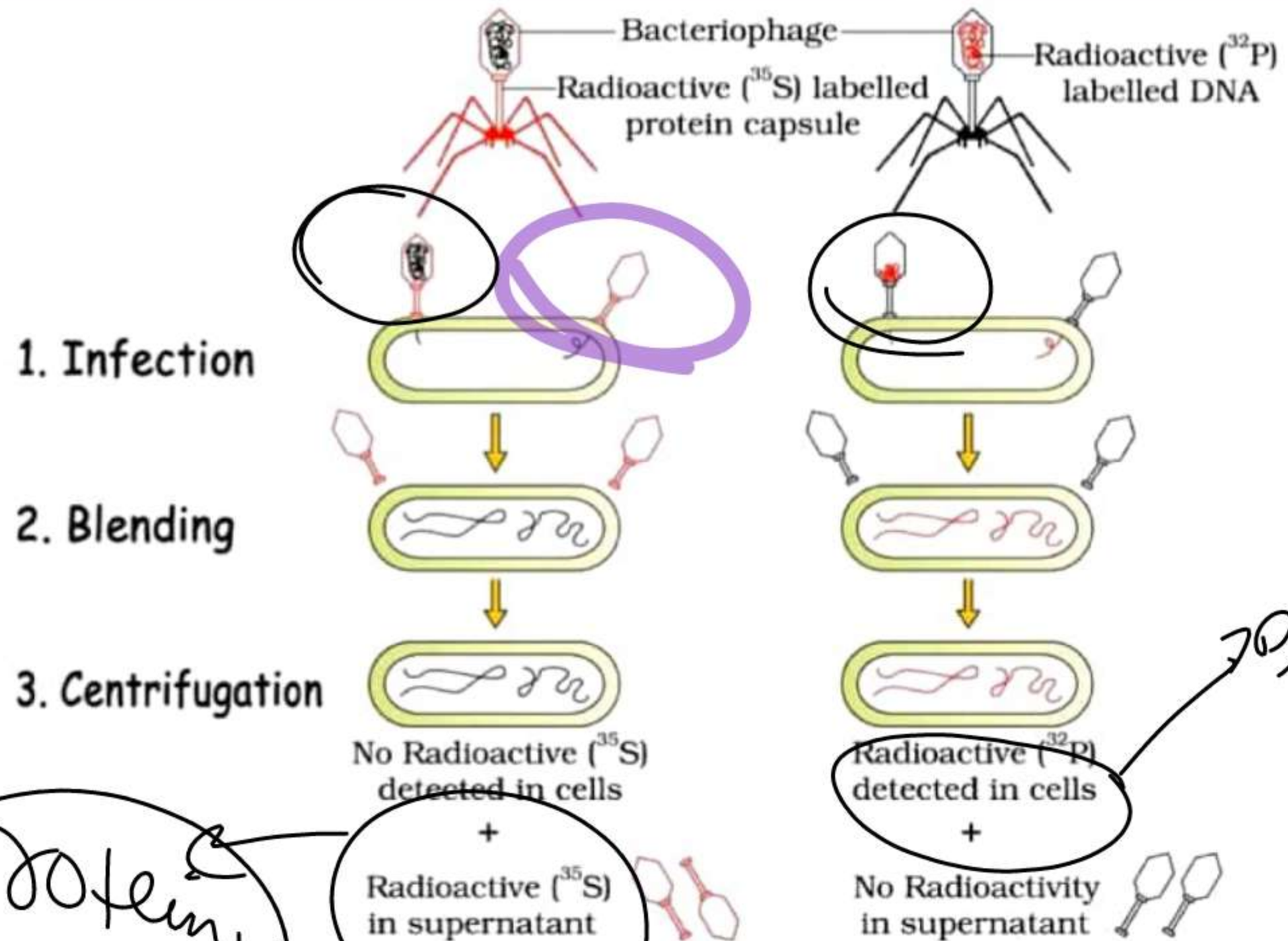


This proves that **DNA is the genetic material.**

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## HERSHEY-CHASE EXPERIMENT (BLENDER EXPERIMENT)



Protein

+

DNA

# PROPERTIES OF GENETIC MATERIAL

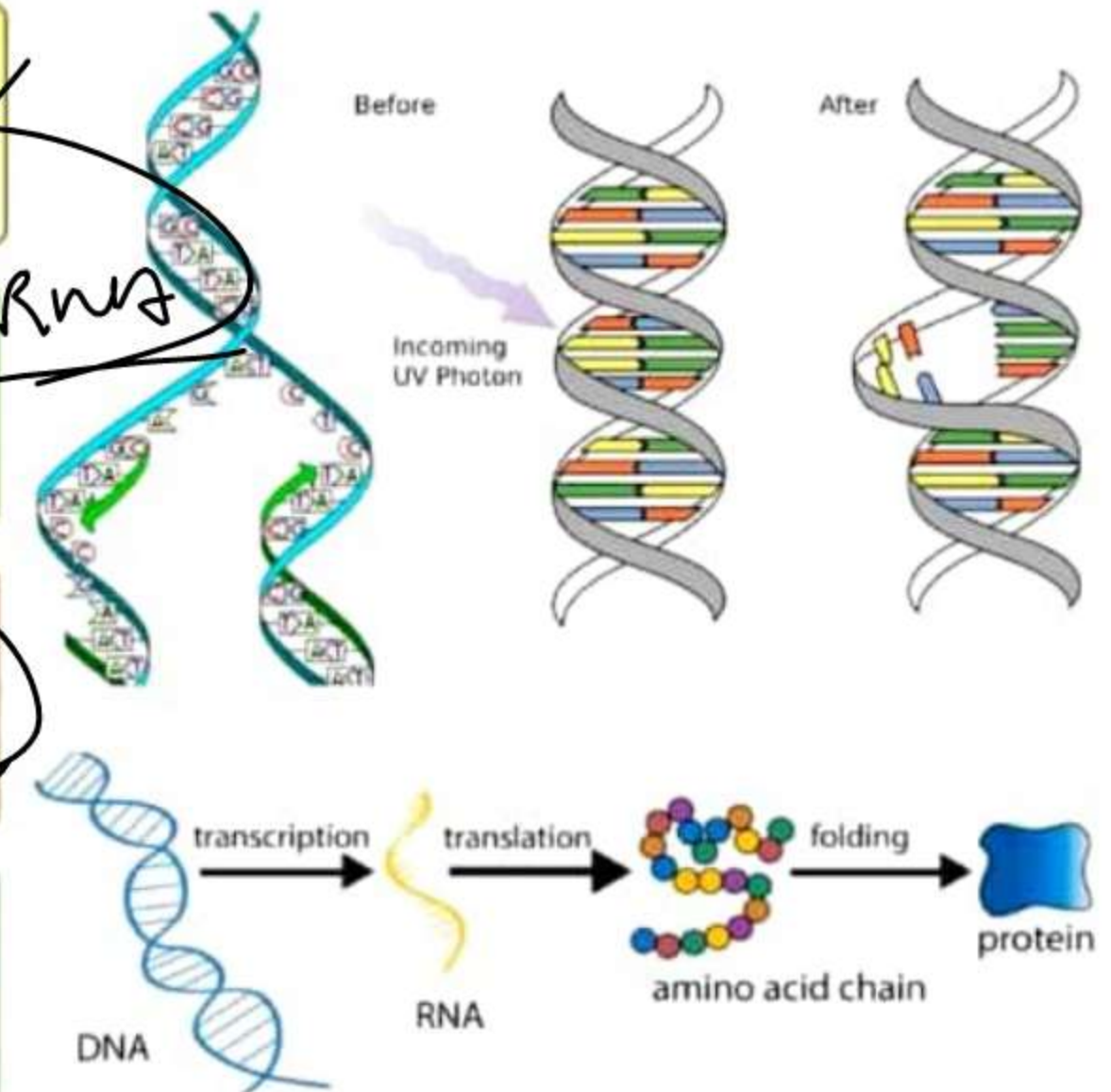
A genetic material must have the following properties:

✓ Ability to generate its replica (Replication).

✓ Chemical and structural stability.

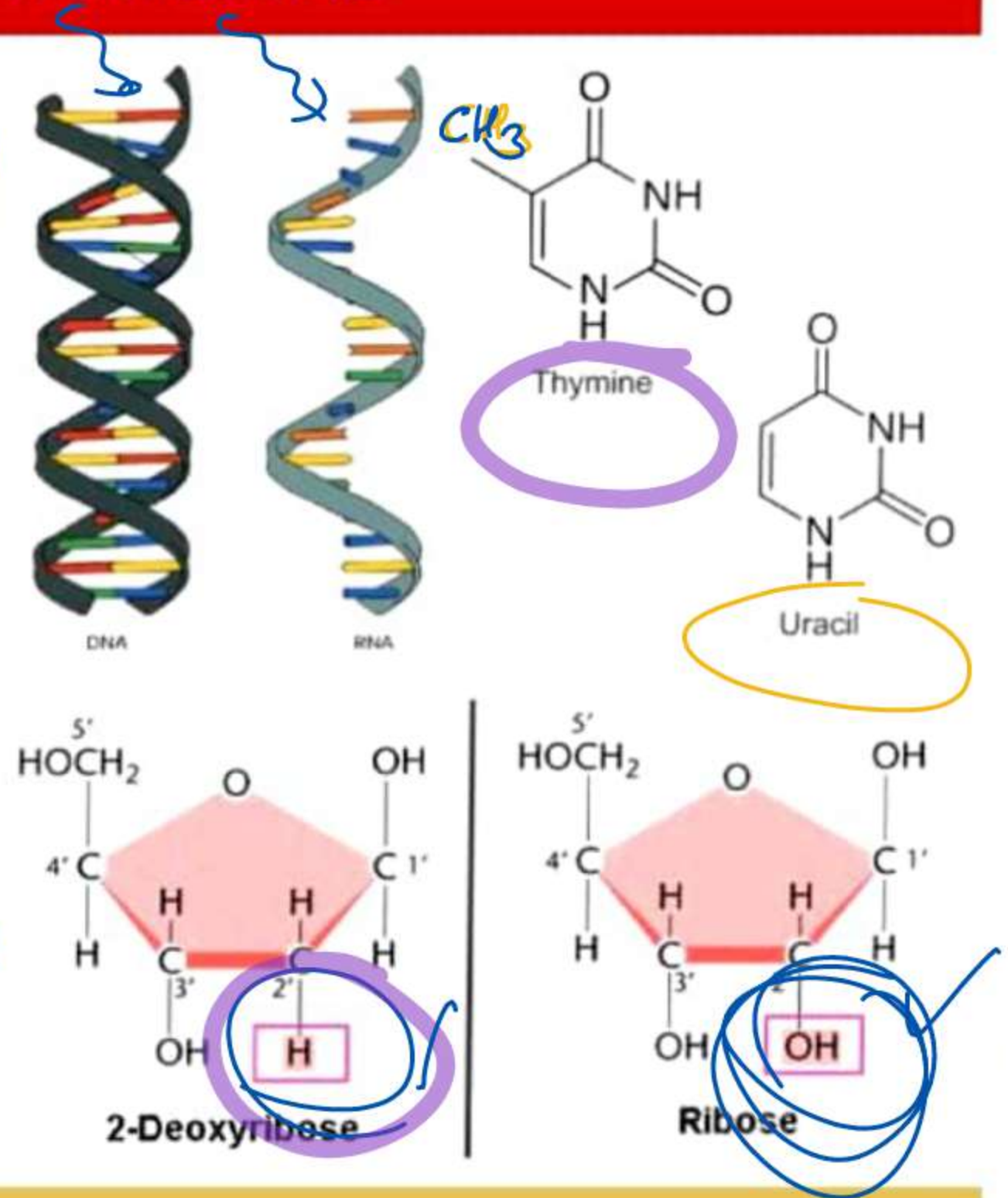
✓ Provide the *(small changes)* mutations needed for evolution.

✓ Ability to express as 'Mendelian Characters'.



# PROPERTIES OF GENETIC MATERIAL

Reasons for stability (less reactivity) of DNA	Reasons for mutability (high reactivity) of RNA
<ul style="list-style-type: none"> <li>• Double stranded</li> </ul>	<ul style="list-style-type: none"> <li>• Single stranded</li> </ul>
<ul style="list-style-type: none"> <li>• Presence of thymine</li> </ul>	<ul style="list-style-type: none"> <li>• Presence of Uracil</li> </ul>
<ul style="list-style-type: none"> <li>• Absence of 2'-OH in sugar</li> </ul>	<ul style="list-style-type: none"> <li>• Presence of 2'-OH in sugar</li> </ul>



• Streptococcus pneumoniae (Pneumonia)

R-Strain

— Rough

(Non-pathogen) → Non-virulent.

→ Polysaccharide

S-Strain

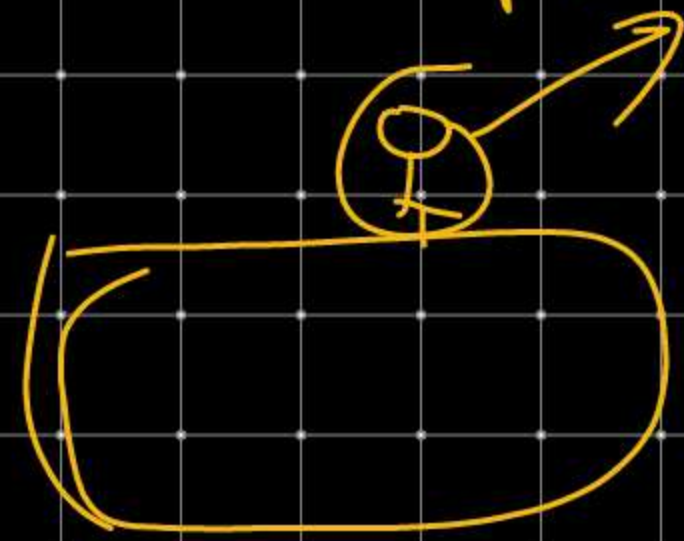
— Smooth.

→ Polysaccharide coat  
+ H<sub>2</sub>O.

→ Virulent form.

# 1. Teesly & Ware (Blender's exp)

→ ① Infection



② Blending

③ Centrifugation