

## Lecture 10:

# Viral Genome: Replication strategies-1

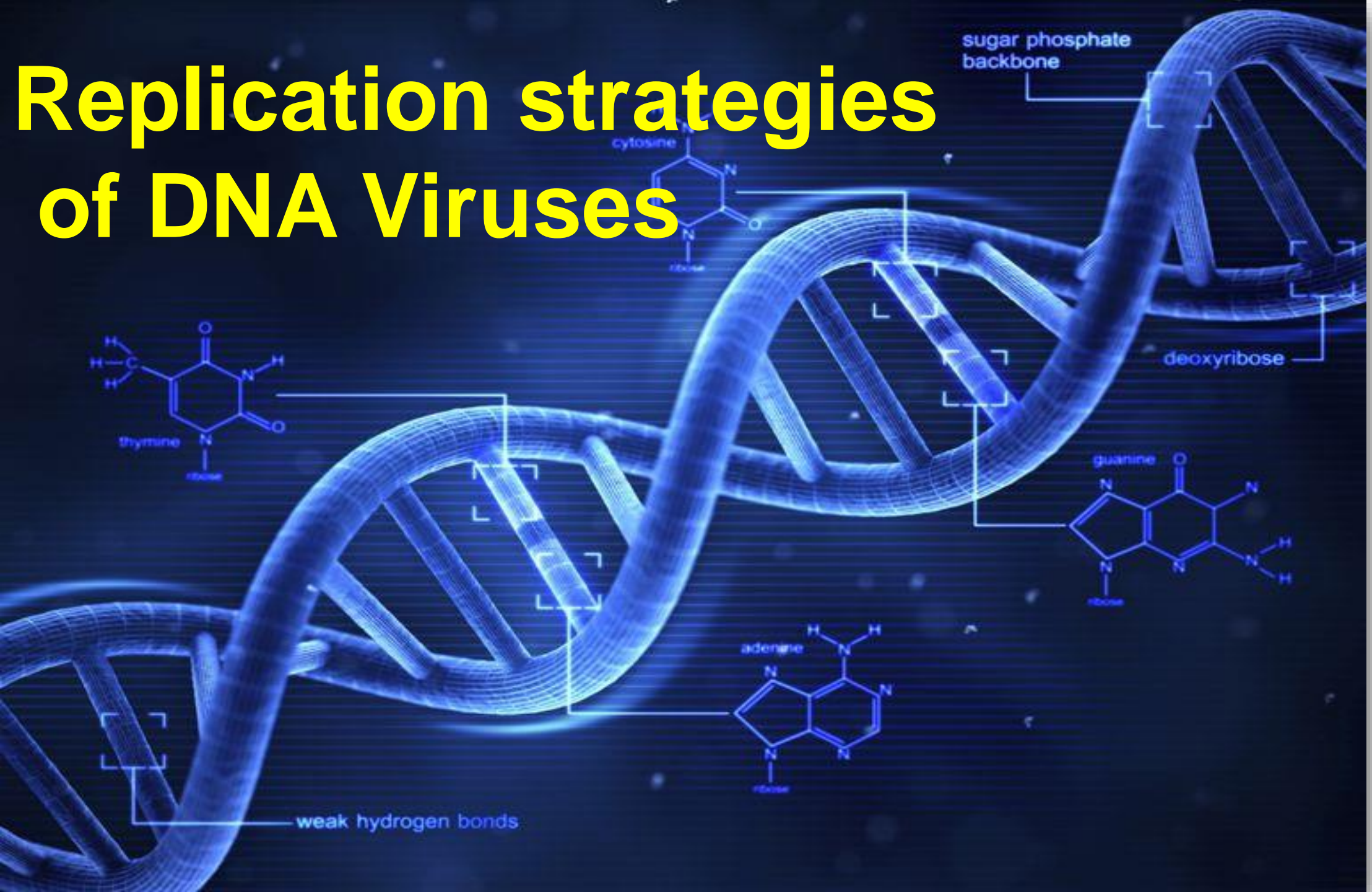
By

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# Replication strategies of DNA Viruses



# Important Notes

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- Replication of DNA viruses involves mechanisms that are familiar in cell biology (mostly by using the cellular enzymes):
    - Transcription of mRNA from dsDNA.
    - DNA replication.
  - Eukaryotic cells are not equipped to translate polycistronic mRNA into several individual proteins.
  - DNA viruses overcome this limitation by using the cellular mechanism of cleavage (splicing) of their polycistronic mRNA to yield monocistronic mRNA.


# Replication strategies

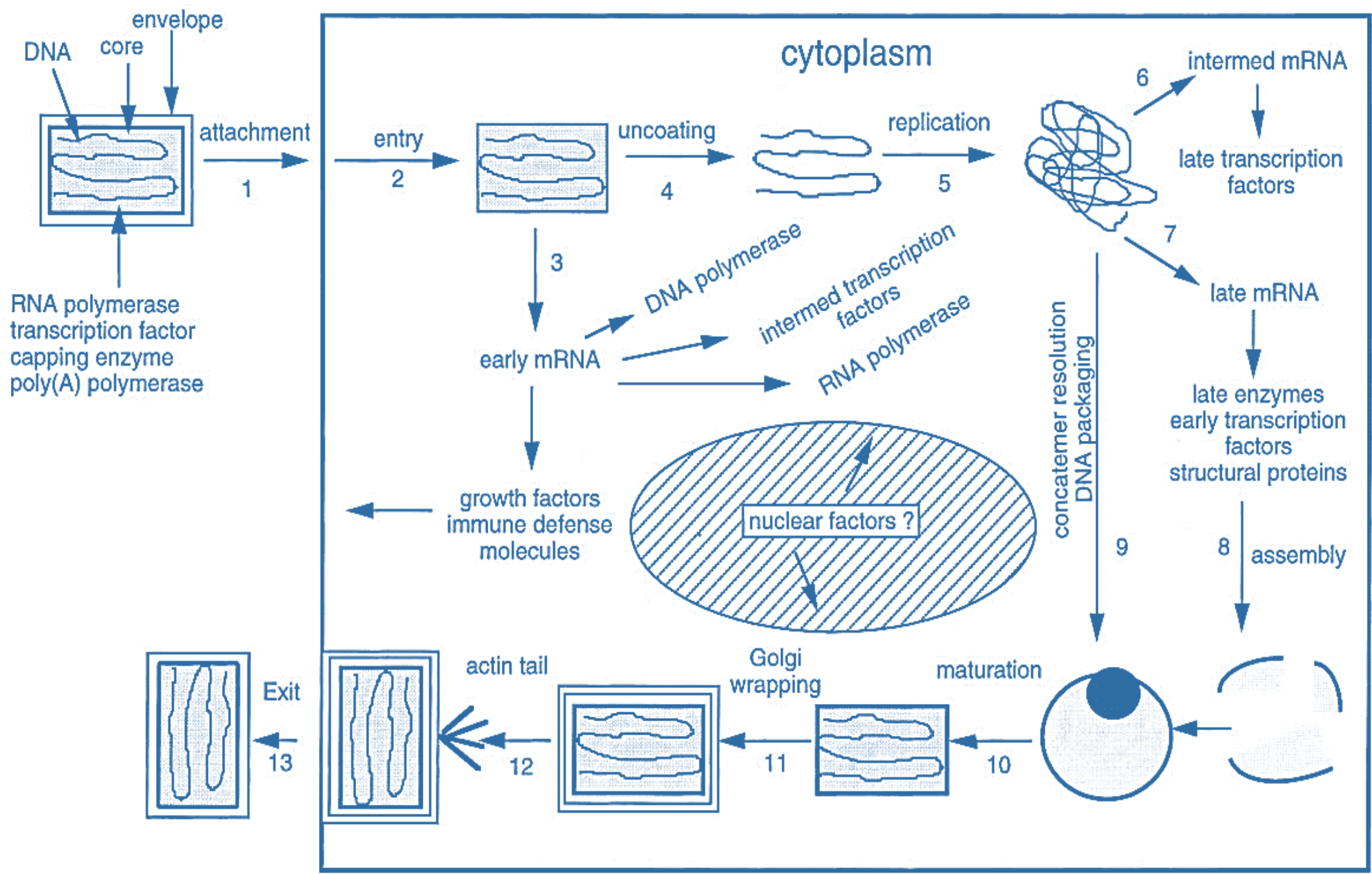
- dsDNA viruses replicate in cytoplasm  
(e.g. Poxviridae)
- dsDNA viruses replicate in nucleus  
(e.g. Herpesviridae, Adenoviridae)
- ssDNA viruses replicate in nucleus  
(e.g. Parvoviridae and Circoviridae)
- Reverse transcribing (RT) DNA viruses  
(e.g. Hepadnaviridae)



# 1- dsDNA viruses (Cytoplasm) Poxviridae

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- Replicate in the cytoplasm.
  - Carry their own **DNA dependent RNA polymerase**.
  - Their large genome encodes for many enzymes that make them independent on cell in their replication.
  - Their transcripts (mRNA) are monocistronic
  - Gene expression takes place in three steps:
    - **Early genes** (DNA and RNA polymerase, intermediate transcription factors, immune defense molecules... etc).
    - **Intermediate genes** (late transcription factors).
    - **Late genes** (structural proteins, late enzymes and early transcription factors).



# 1- dsDNA viruses (Nucleus) Herpesviridae

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- Replicates in the nucleus.
- Utilized the cellular DNA dependent RNA polymerase and other replication enzymes.
- There are different transcription units (groups of genes under the control of a single promoter) within the viral genome.
- Each unit is transcribed to give a polycistronic, but subgenomic, mRNA molecules.
- The polycistronic mRNA molecules undergo cleavage to produce monocistronic mRNAs that is translated to the structural proteins.



### 3- ssDNA viruses (Nucleus)

### Parvoviridae

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- Replicates in the nucleus.
- Initially, it utilizes the cellular DNA polymerase to synthesize dsDNA.
- dsDNA is then transcribed using the cellular **DNA-dependent RNA polymerase** to produce polycistronic subgenomic mRNAs.
- The polycistronic mRNA molecules undergo cleavage to produce monocistronic mRNAs that is translated to the structural proteins.





## 4- RT-DNA viruses *Hepadnaviridae*

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- Replicates in the nucleus.
- The virus genome is a circular partially dsDNA.
- Initially, the viral DNA polymerase completes the ssDNA portion of the viral genome to dsDNA.
- dsDNA is then transcribed using the cellular **DNA-dependent RNA polymerase** to produce monocistronic mRNA molecules for translation.
- Full-length, +ve RNA serves as a template for a viral reverse transcriptase to synthesize a -ve DNA strand for generation of the partially dsDNA genome.



## 4- RT-DNA viruses *Hepadnaviridae*

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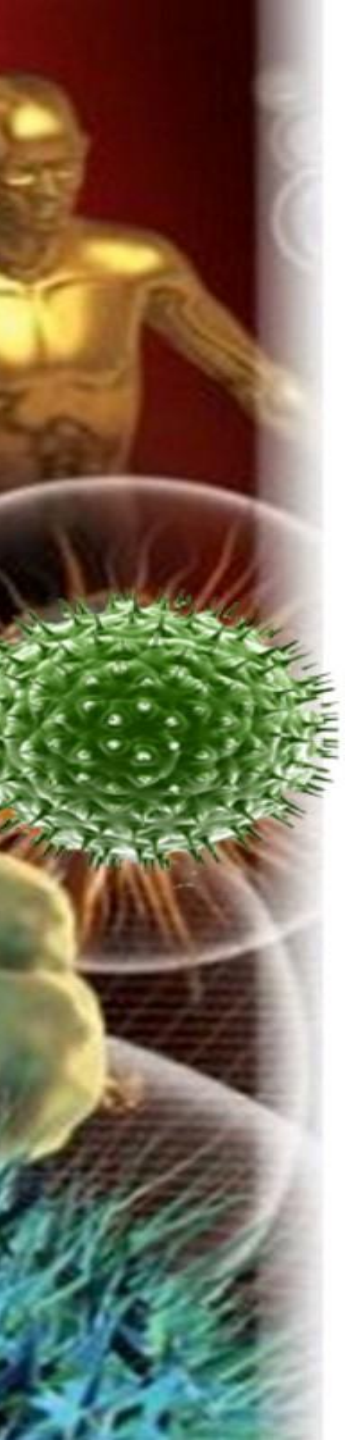
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- Full-length, +ve RNA serves as a template for a viral reverse transcriptase to synthesize a -ve DNA strand for generation of the partially dsDNA genome.



# Question

Eukaryotic cells are not equipped to translate polycistronic mRNA into several individual proteins how DNA viruses overcome this limitation during viral replication?





**TAKE HOME MESSAGES**

**Thanks for keeping your social distance during this COVID-19 Pandemic**



Thank  
You