Replication Strategies

ds DNA (cyt/nuc.)

- Steps: Rep.

1) Helicase: seperates strands

2) Topoisomerase: binds to DNA at backbone → untangles and unwinds DNA

3) Leading Strand template: 5' → 3' (new strand) by DNA Polymerase

Lagging Strand
- non continuous
- must also form in 5' → 3' direction
- Okazaki fragments
- RNA primer attaches (RNA sequence which matches bases on beginning of fork)
- Polymerase lays out new DNA after primer ⇒ repeated
- RNA primers are replaced by DNA

4) DNA Ligase: links okazaki fragments (1000 nuc.) (fills gaps)

5) Telomerase: adds DNA sequence repeats to 3' end of DNA strands (at ends of chromosomes)
- non coding DNA
- protective function
- only in eukaryotes

- Transcription:

Cellular Transcriptase: produces RNA chains (mRNA) using DNA as a template

SS(+) DNA (nuc.)

- Steps:
- Virus enters nucleus
- an intermediate forms: ds DNA

a. Transcription → mRNA → Synthesis of late and early Proteins

b. Replication → ds DNA converted back into SS DNA → assembled and packaged into a complete virion

ds RNA (cyt)

- Replication Strategy:
- These viruses are segmented → Replication is monocistronic
- each genome segment is transcribed seperately to produce monocistronic mRNAs.

- Steps: (trans.)

a. +ve sense strand:
- behaves like (+) ss RNA → directly goes to ribosomes → synthesizes proteins

b. -ve sense strand:
- behaves like (-) ssRNA
- uses RNA dependent RNA polymerase which must be packed with all viruses (RNA).
→ complementary (+) strand produced → ribosomes → proteins

- Notes:
- For some viruses, (picornav.) translation and transcription occur at the same time, in others they are two seperate steps
- This is since there are some functionally distinct RNA dep. RNA polymerases for each process.
- Some viruses undergo complex transcription, where 2 or more translation rounds are needed.

SS(+) RNA (cyt)

- Replication Strategy:
- These viruses have polycistronic mRNA (carries information of several genes/proteins)
- translated monocistronically as one whole unit to form a polyprotein product
- this is subsequently cleaved to form the distinct, mature proteins

- Steps: (trans.)
- directly goes to ribosomes in cytoplasm → synthesizes proteins
- replicated through formation of a (-) Sense intermediate by RNA dependant RNA Polymerase → new copies of (+) sense RNA are produced by using the (-) strand as a template

SS(-) RNA (cyt)

- Replication Strategy:

a. Segmented ⇒
- the (-) sense RNA genome is transcribed by RNA Dependant RNA Polymerase → monocistronic mRNA → serves as a template for replication
- Part of the mRNA ⇒ remains in cytoplasm → Produces proteins
- Other part of mRNA ⇒ used as a template → Produces more (-) Sense strands (to form new viruses)

b. Non Segmented ⇒
- Virion transcribed to yield monocistronic mRNAs by initiating transcription at different sites.

SS (+) RNA with DNA IM (Cyt + nuc.) (HIV)

- Diploid: have two seperate copies of the ss(+) RNA Strand.
- Do not serve directly as mRNA templates for proteins
- instead, they use DNA to create the templates

- Steps:
- Virus enters cytoplasm → Reverse Transcriptase transcribes RNA → DNA
- moves into nucleus as ds DNA
- Spliced into the host genome by Integrase (integrase viral genome into hosts' genome)
- This is called a provirus
- Cellular machinery transcribe and translate mRNA generating new viral proteins
- when the cellular genome replicates, the viral genome replicates as well.

- Note: some of the (+) sense RNA is used for viral replication

partial ds DNA with RNA IM (Cyt. + nuc) (Hep B)

- Gapped genome:
- partial ds DNA, with the two strands being incomplete
- they complement each other at certain sites and there are gaps within the genome.

- Steps:
- Virus enters cell → DNA Polymerase completes gaps → repaired → form a covalently closed circle DNA
- This ccc DNA enters nucleus → serves as a template for the production of viral mRNAs
- This mRNA goes to the cytoplasm → ribosomes → synthesis
- Some of this mRNA (+) sense is used as a template acted on by Reverse Transcriptase → RNA is transformed to DNA → becomes partial DNA.