

# DNA Virus Replication

Tuesday, October 28, 2014 10:43 PM

## Common features of DNA viruses

- Nearly all replicate in nucleus
- dsDNA → viral mRNA
  - Using cell's DNA dep. RNA poly
- dsDNA → more genomes
  - Using DNA dep. DNA poly
- Encode at least one regulatory protein (directs cell)

### Small DNA Virus

- < 10 kb
- Few genes → More dependent
- Host + 1 viral factor regulate gene expression
- Uses cell's DNA poly

### Large DNA Virus

- > 30 kb
- More genes → Less dependent
- Host + Multiple viral factors regulate gene expression
- Encodes DNA poly

## Challenges to overcome

- Gene efficiency (Size & Coding)
- Regulation of steps
- Ensure DNA replication
  - DNA poly reg.
  - Primers
  - End of DNA dilemma

## dsDNA Viruses - Group I

### Small viruses (< 10 kb)

- Papillomaviridae / Papillomavirus (HPV)
- Polyomaviridae / Polyomavirus (SV40)

## Circular dsDNA Replication

- Reg. **T antigen** (SV40)
  - Activate DNA Synthesis
    - DNA binding at origin
    - Recruits DNA poly to origin
    - ATPase and helicase function
  - Down regulates early, activates late
  - Intx. with host cell
    - Binds p53 & pRB → Promotes S phase
- Tropism for non-dividing cells
  - Reg. cell to be in S-phase but not pass it

## Efficient coding capacity

- Alt. processing
- Overlapping reading frames

## Herpesviridae (HHV-1)

- Efficient control over expression
  - $\alpha$  mRNAs: Immediate early → Transcriptional activation
  - $\beta$  mRNAs: Early → DNA replication proteins
    - Polymerase, helicase, endonuclease, etc.
  - $\gamma$  mRNAs: Late → Structural

## Rolling circle replication

- Endonuclease nick on one strand, other strand can be peeled away



Replicates in both directions

No need for a primer, no 3' end cut off

- Circle replicated multiple times to form **Concoctomer**
- Concoctomer cleaved to form single genomes





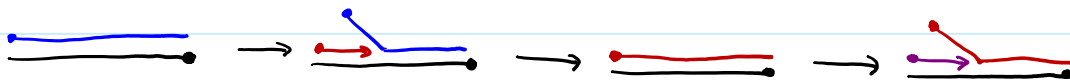
Why duplicate cellular enzymes?

- Not dependent on cell dividing enzymes

Adenovirus (Human adenovirus)

**Terminal protein (TP)** Replication initiation

- 5' ends contain protein with serine (-OH group)
  - No need for primer
  - Replicates from beginning to end of genome w/o gaps
- Strand displacement
  - Nascent strand pushes old strand off



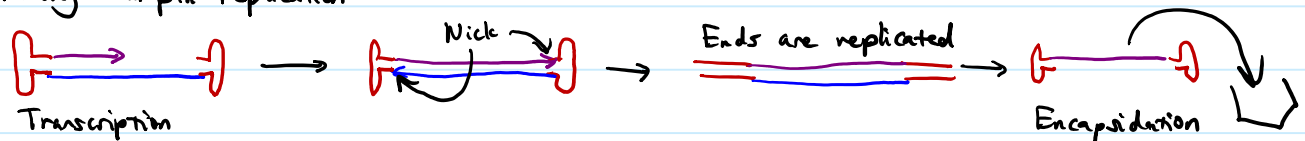
Poxviridae (Variola & Vaccinia) - Same TP replication

- Replicase in cytoplasm: Encode all their machinery

**ssDNA Virus - Group II**

Paroviridae (Human parovirus B19)

- Must become dsDNA (DNA sense does not matter)
- Genome folds forming hairpin ends
- Rolling hairpin replication



- Since DNA rep. is first step, reqs. replicating cells

**Summary of Advantages**

- Genome resembles host cell
- dsDNA very stable

- Can persist in non-permissive cells