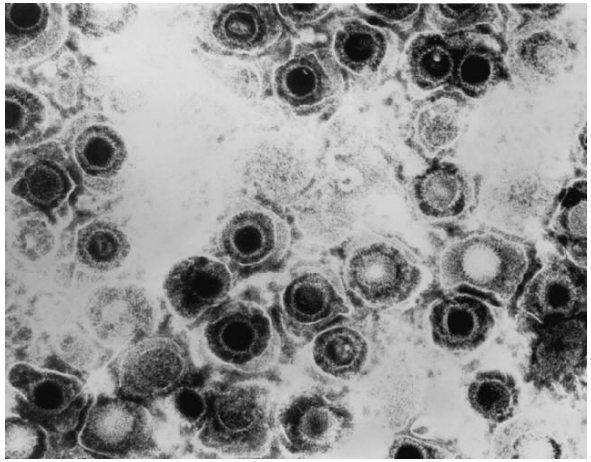
Viruses with dsDNA genomes (2):

Order *Herpesvirales*



More than 100 viruses of

mammals, birds, fishes, reptiles, amphibians and shellfish.

Commonalities: genome type and size, virion type, viral cycle (infection types)

Herpesviridae - mammals, birds, reptiles

Subfamilies: *α-, β-, γ-herpesvirinae*

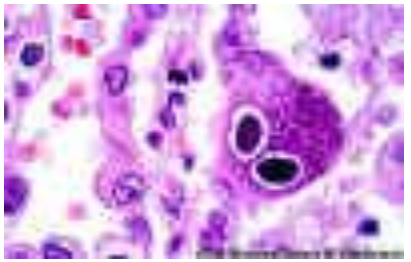
Eight human viruses from three subfamilies.

•HHV-1 (*Human herpesvirus 1*) = HSV-1 (Herpes simplex virus), contact transmission, mucosa, skin, cornea infections (epithelial cells), transport to the neuron nuclei.
Persistent , latent infection, symptoms during productive (acute) infection.
HHV-2 = HSV-2, genital herpes, sexually transmitted, epithelial cells, infant mortality is 54%!

HHV-3 = VZV (varicella-zoster), chickenpox and shingles, aerosol (droplet) transmission usually in childhood, latent in neurons of head and torso.

HHV-4 = EBV (Epstein-Barr), infects epithelial and B-cells (latent in B-cells), infectious mononucleosis (a kissing disease – transmitted by saliva), Burkitt's lymphomas (endemic, sporadic, AIDS related), nasopharynx carcinoma, Hodgkin lymphoma, non-Hodgkin lymphoma in AIDS patients, lympho-proliferative disturbance in transplanted patients.

- HHV-5 = (h)CMV (Human cytomegalovirus) – mild or symptomless infections in monocytes and epithelia, dangerous for fetus, newborn children (brain, liver, spleen, mental illness, deafness, death), immunocompromised patients (lungs, liver). Transmission-saliva, urogenital excretions, placenta, milk



http://pathmicro.med.sc.edu/virol/herpes.htm

- HHV-6 – children, fever and rash – *Exanthem subitum (roseola infantum)*, MS?, chronic fatigue? Transmission by saliva, contact, episome integrates, T-cells and?

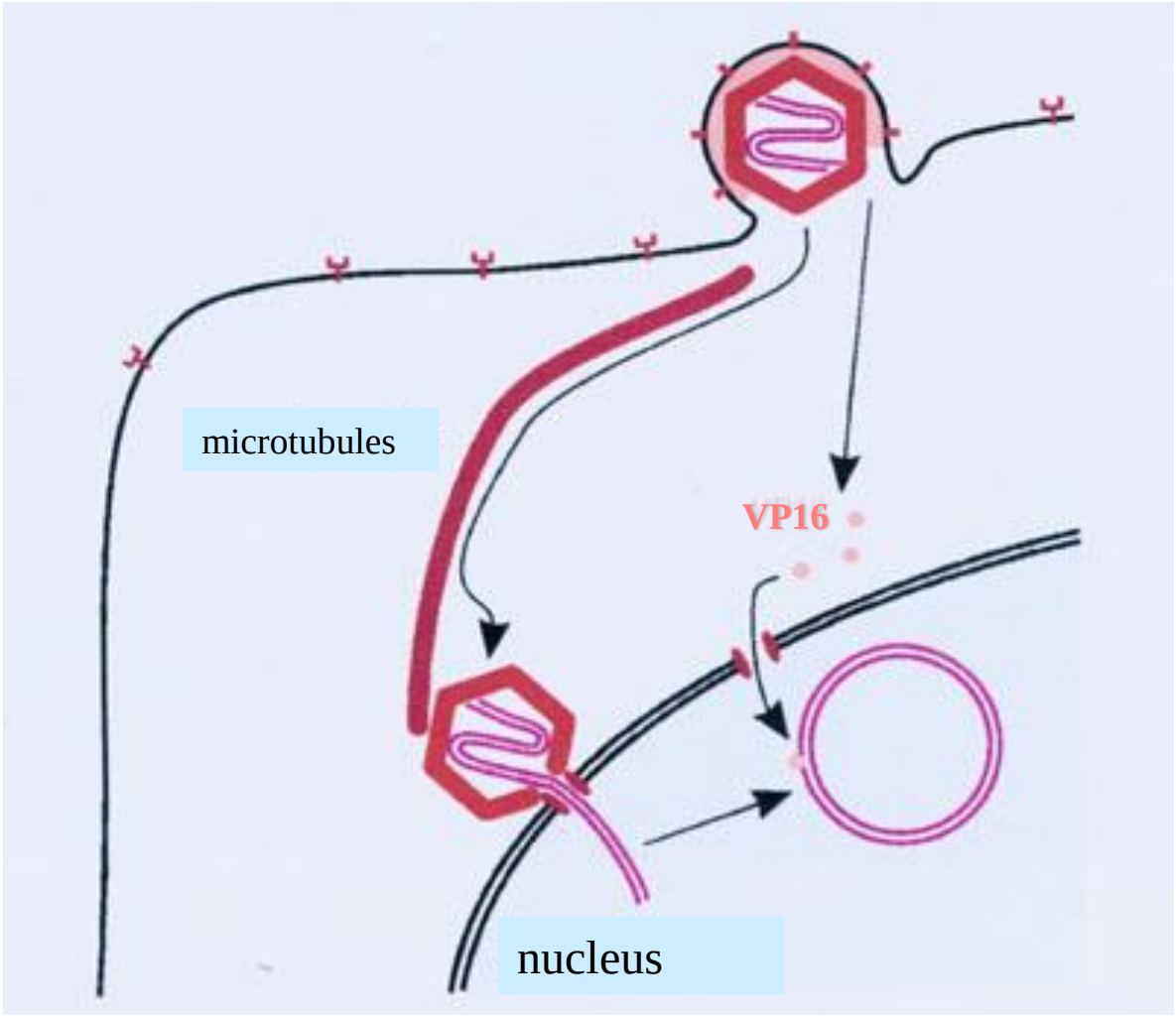
- HHV-7 - from CD4 T-cell culture of a healthy person, in saliva, urogenital excretions.

- HHV-8 - Kaposi's sarcoma, isolated in 1994 from tumor tissue, in lymphocytes and other cell types.

HHV-1

virion

genome



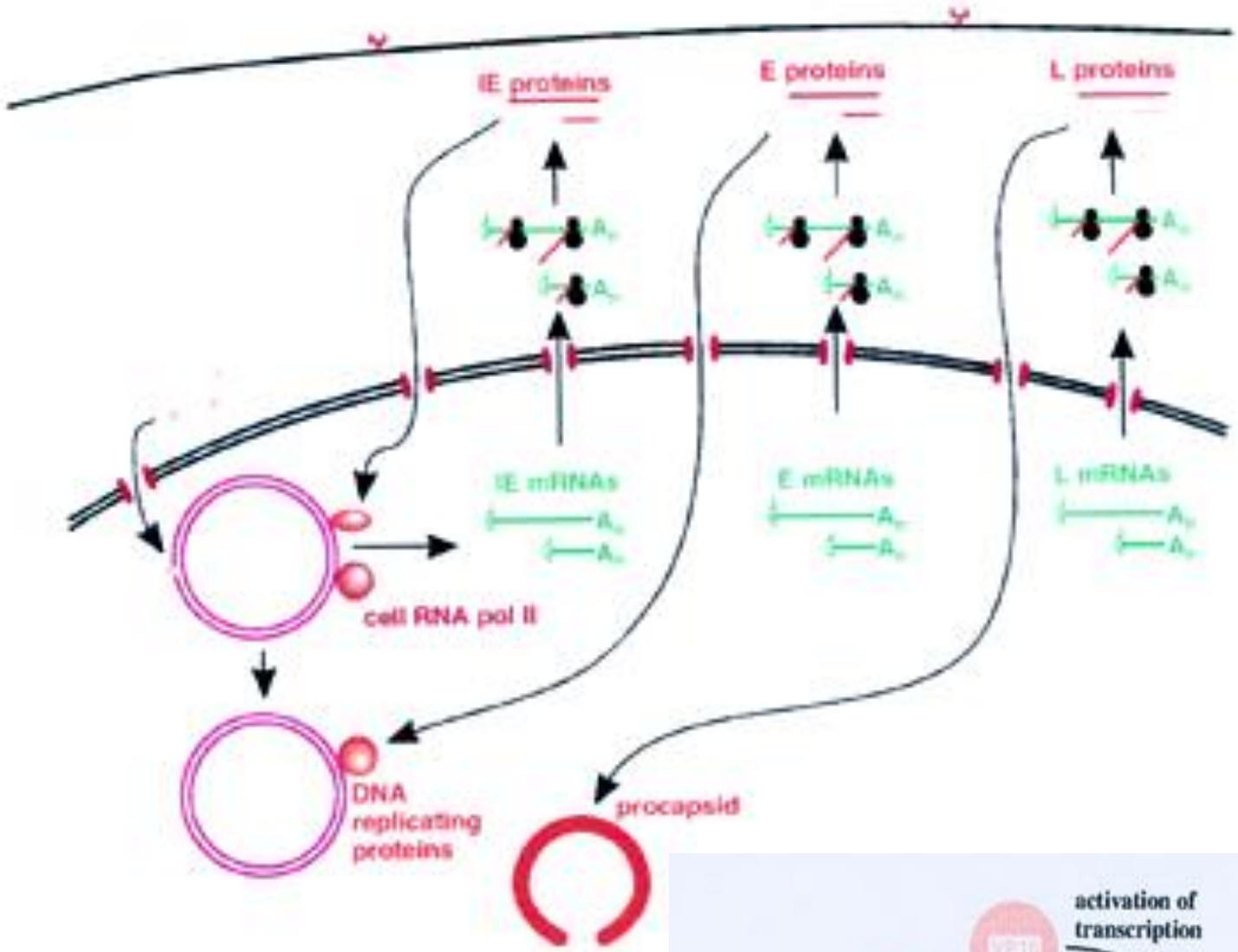
Adapted from Carter & Saunders, 2007.

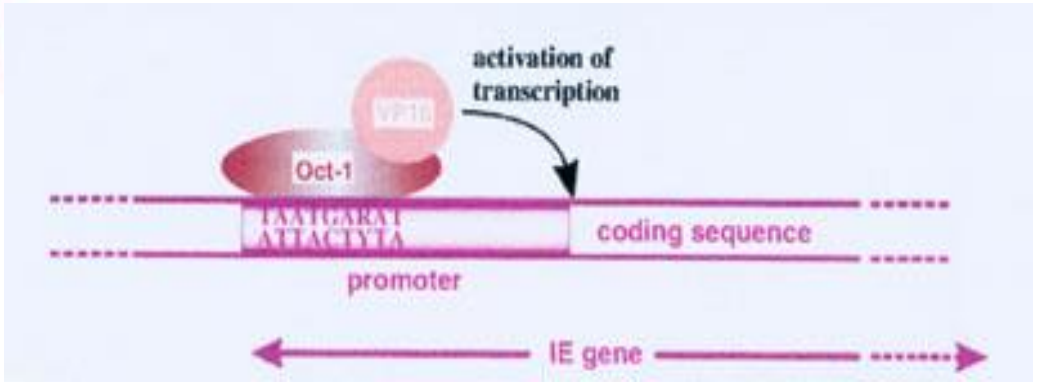
Linear genome circularizes!

Encodes about 70 proteins.

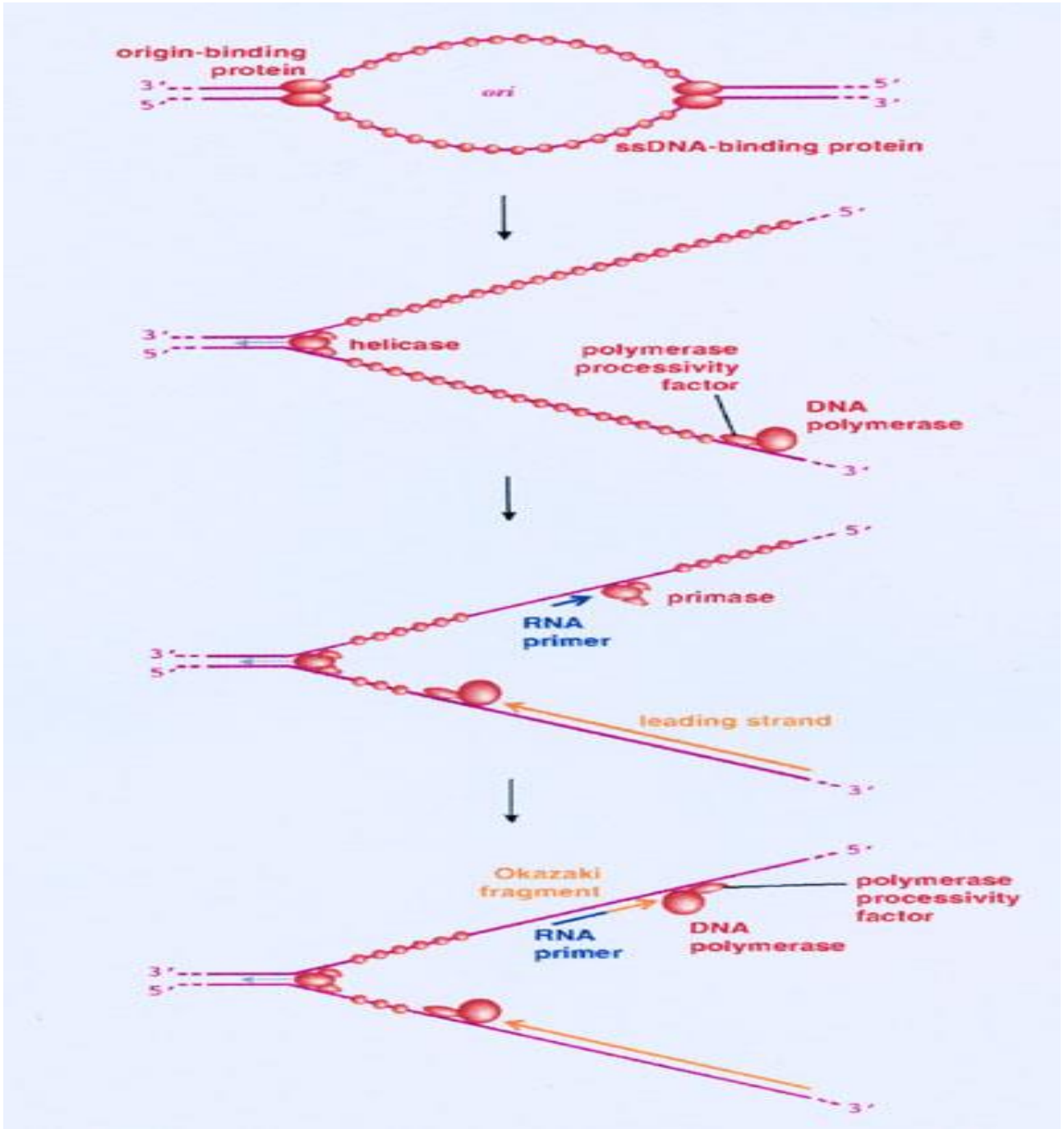
Virion proteins:

- tegument – min. 15 proteins (VP16) + viral mRNAs
- (nucleo)capsid - VP5
- envelope with at least 12 glycoproteins (gB, gC, gD)





Carter & Saunders, 2007.



θ – replication

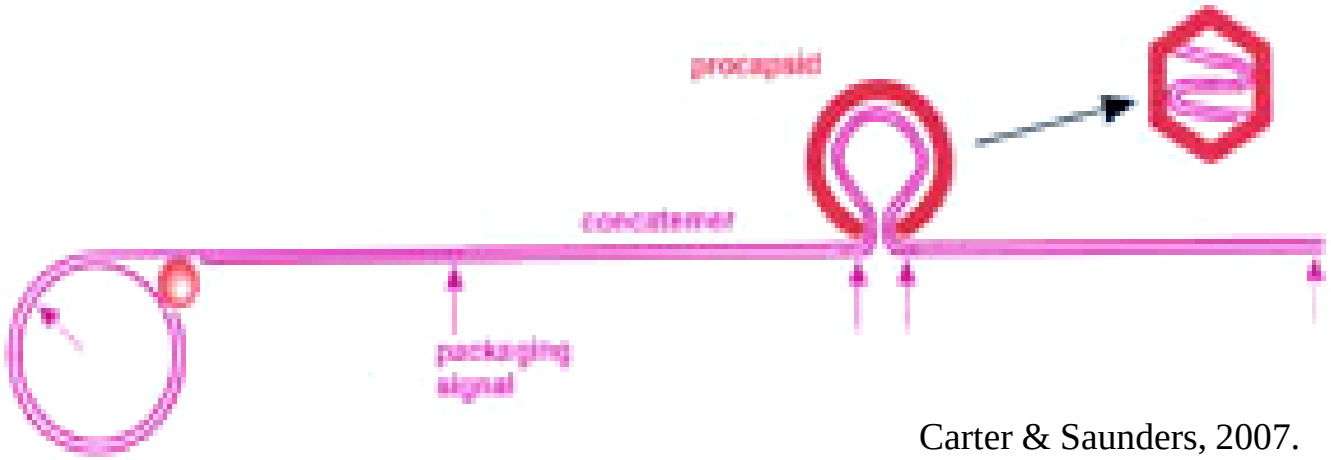
- proteins bind to 1/3 origins of replication.

-seven E proteins essential

Carter & Saunders, 2007.

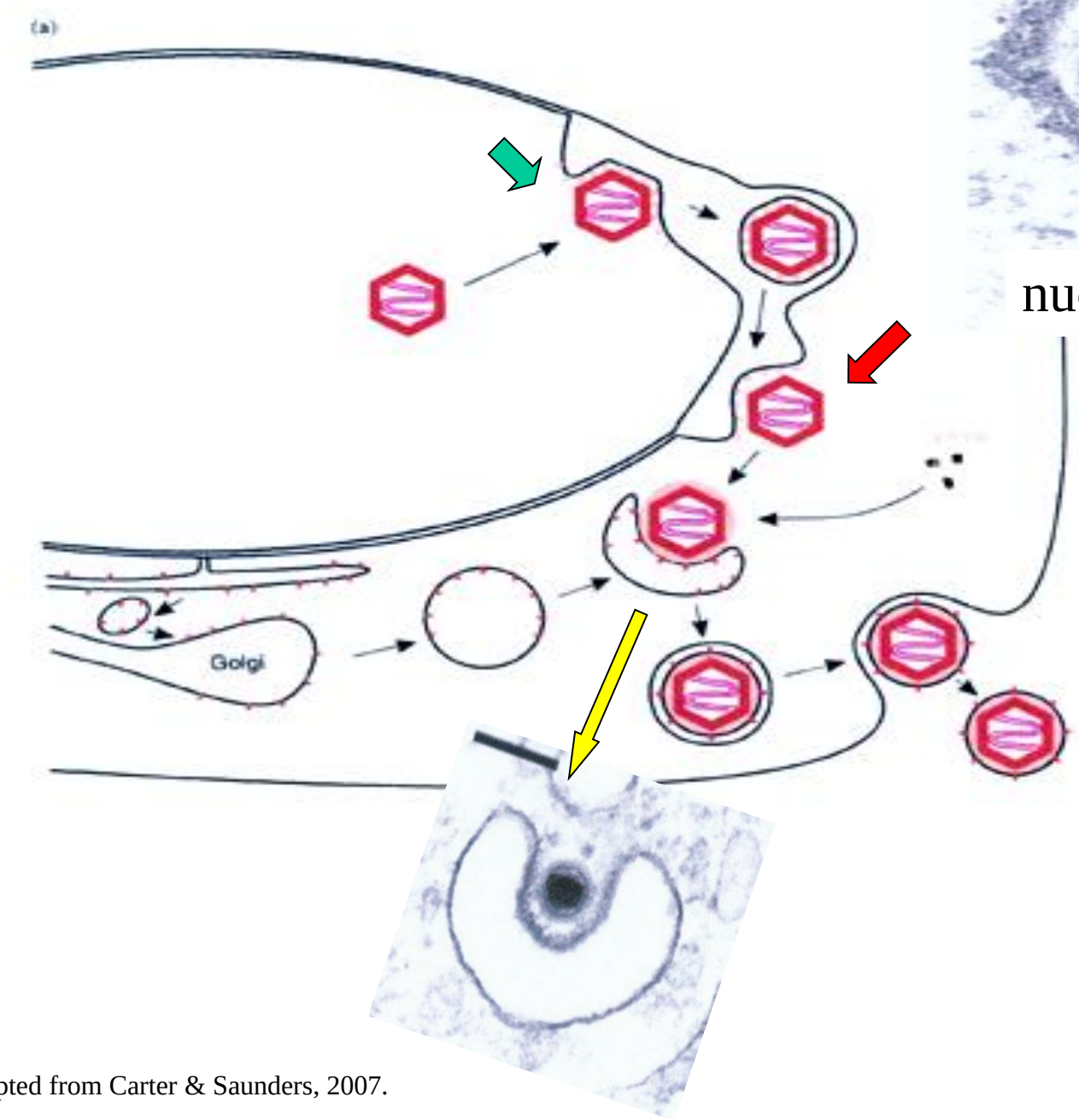
Strauss & Strauss, 2002.

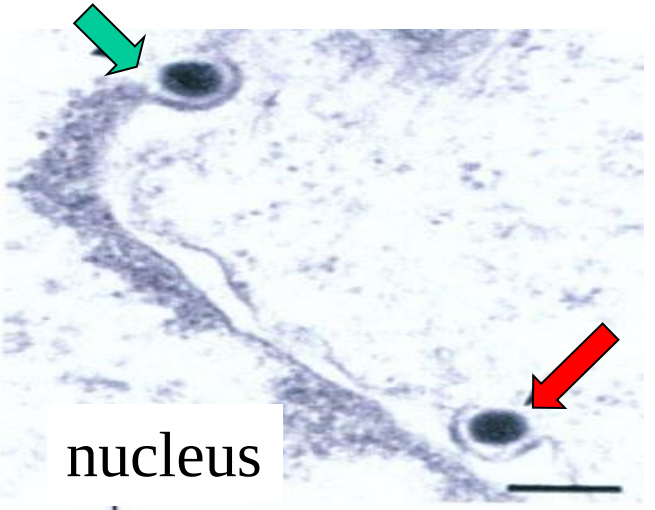
σ - replication



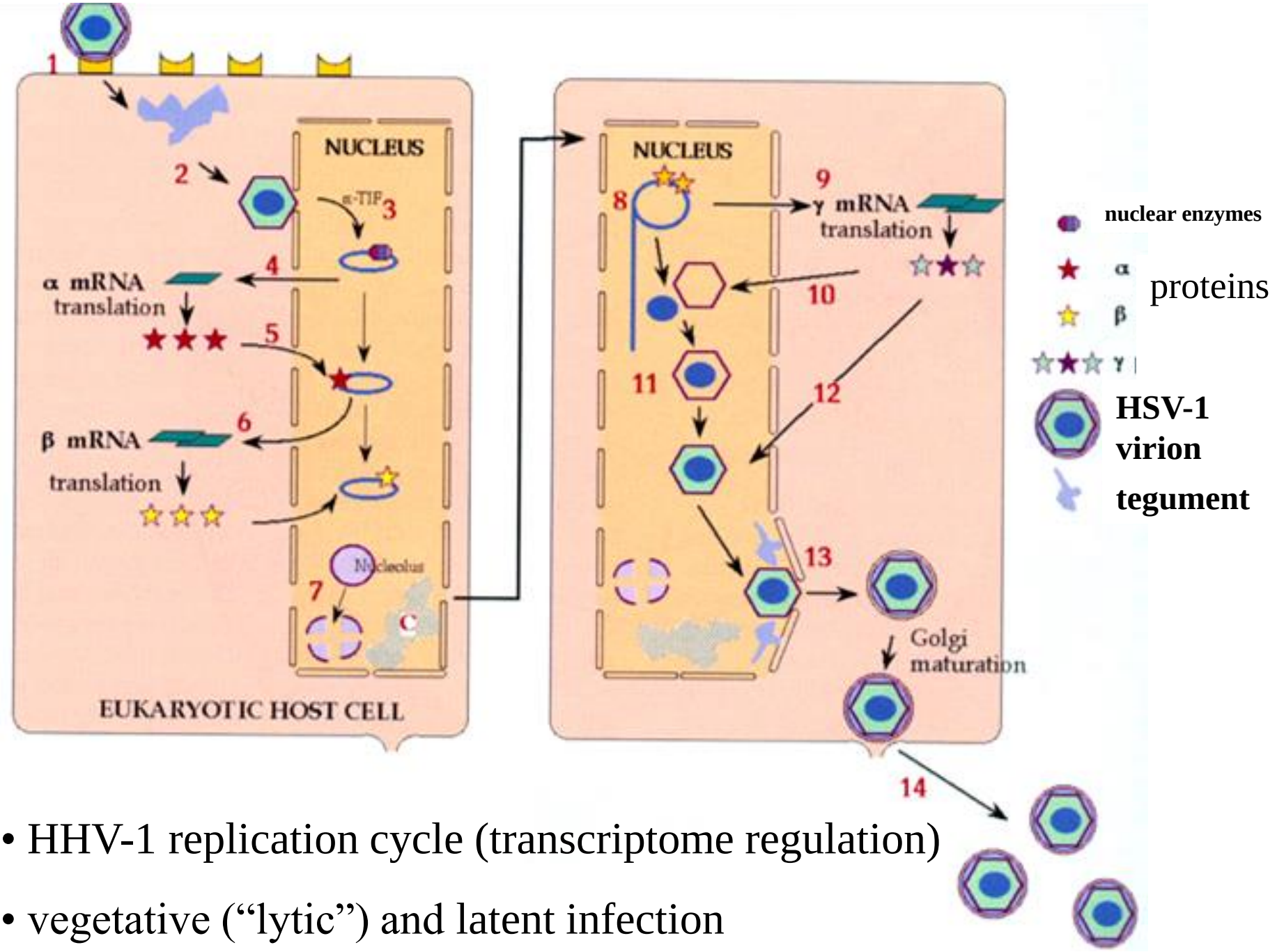
Carter & Saunders, 2007.

HHV-1 exit





Adapted from Carter & Saunders, 2007.



- HHV-1 replication cycle (transcriptome regulation)
- vegetative ("lytic") and latent infection

Strauss & Strauss, 2002.

How does a herpesvirus maintains latency?

HHV LATs – Latency Associated Transcripts

DNA HHV-1 genome region called Latency Associated Transcript Region is in the terminal repeats.

A set of micro RNAs (miRNAs) important for latency is also transcribed from the same locus.

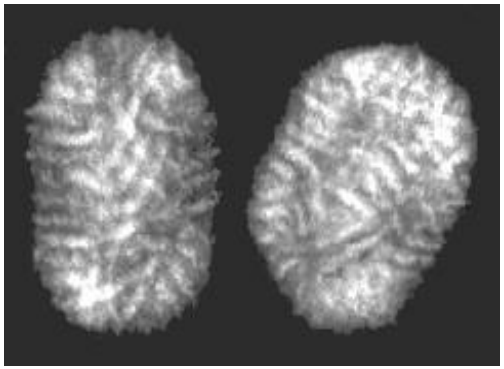
Farrell et al. 1991. Herpes simplex virus latency-associated transcript is a stable intron. Proceedings of the National Academy of Science (USA) 88: 790–794.

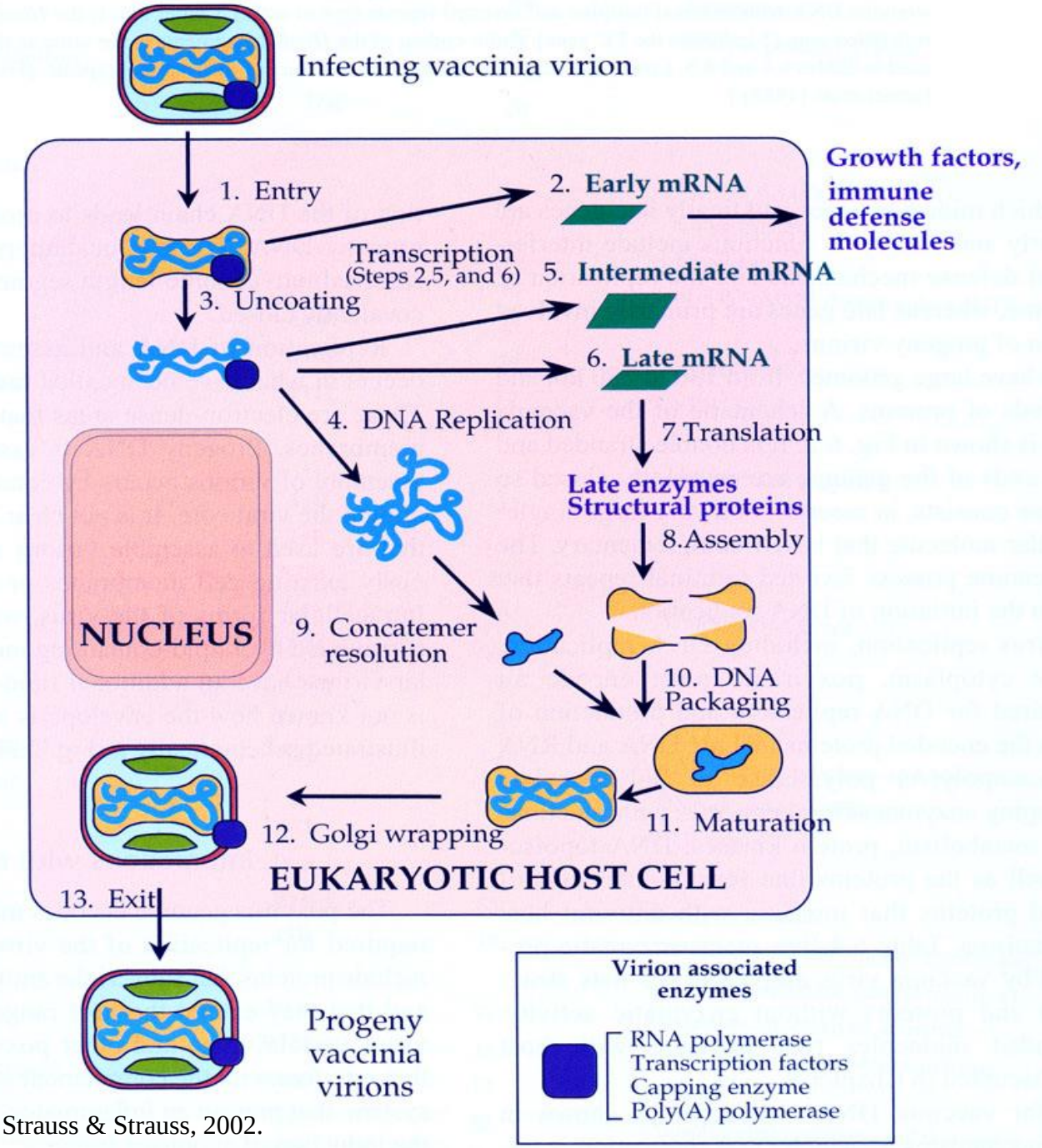
Phelan D, Barrozo ER, Bloom DC. 2017. HSV1 latent transcription and non-coding RNA: a critical retrospective. J Neuroimmunol 308:65–101. https://doi.org/10.1016/j.jneuroim.2017.03.002.

Singh N, Tscharke DC. 2020. Herpes simplex virus latency is noisier the closer we look. J Virol 94:e01701-19. https://doi.org/10.1128/JVI.01701-19.

Family	Subfamily	Genus	Species (virus)
Poxviridae			
	Chordopoxvirinae	*Avipoxvirus*	fowlpox
		Capripoxvirus	sheeppox
		Leporipoxvirus	myxoma
		Molluscipoxvirus	*Molluscum contagiosum*
		Orthopoxvirus	vaccinia
			variola (major, minor)
		Parapoxvirus	orf,
			pseudocowpox (pseudovaccinia)
		Suipoxvirus	swinepox
		Yatapoxvirus	Yaba monkey tumorvirus
			Tanapox monkey virus
	Entomopoxvirinae	*Entomopoxvirus A*	*Melolontha melolontha* entomopoxvirus
		Entomopoxvirus B	*Amsacta moorei* entomopoxvirus
		Entomopoxvirus C	*Chironomus luridus* entomopoxvirus

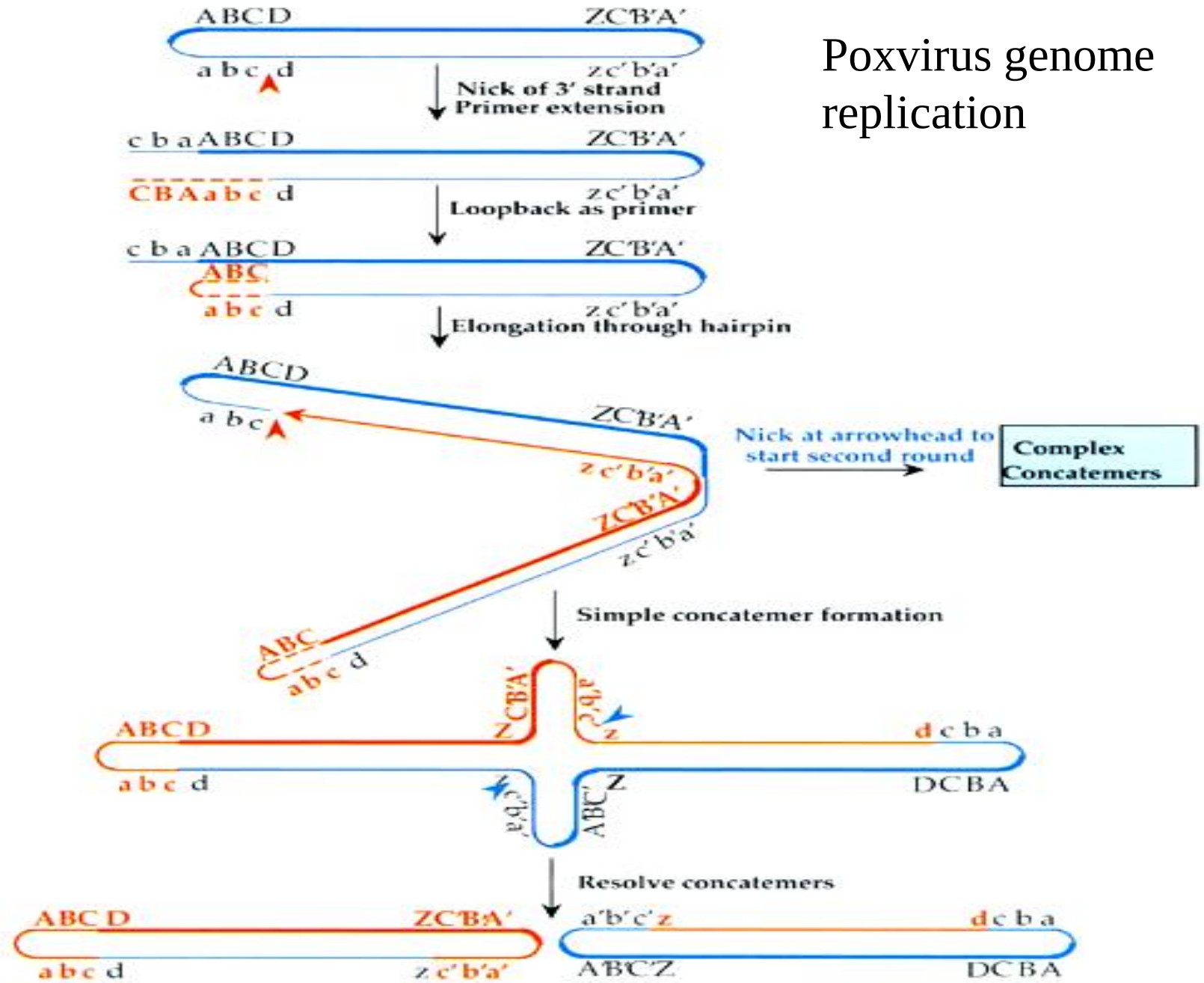
Linear dsDNA-genome with covalently closed ends , 130-300 kbp. More than 200 genes, about 100 proteins, complex strucutre, complete cycle in the **cytoplasm**.





Strauss & Strauss, 2002.

Poxvirus genome replication



Strauss & Strauss, 2002.

Baculoviridae – 90-160 kbp genome, big but not in the NCLDV group in literature, may be a seminar topic.

Main features for viruses with big dsDNA genomes :

•complex,

•genes in both DNA strands,

•linear genomes or linearn that can circularize (Herpes and Pox)

•not found in plant hosts,

•may cause tumors,

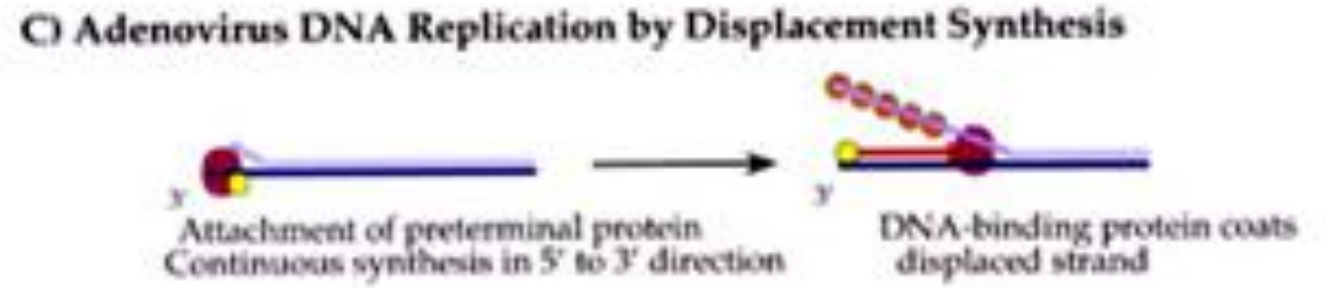
•important cloning vectors,

•important in gene therapy.

Adenoviridae

70-100 nm, preterminal protein - primer for DNA synthesis .

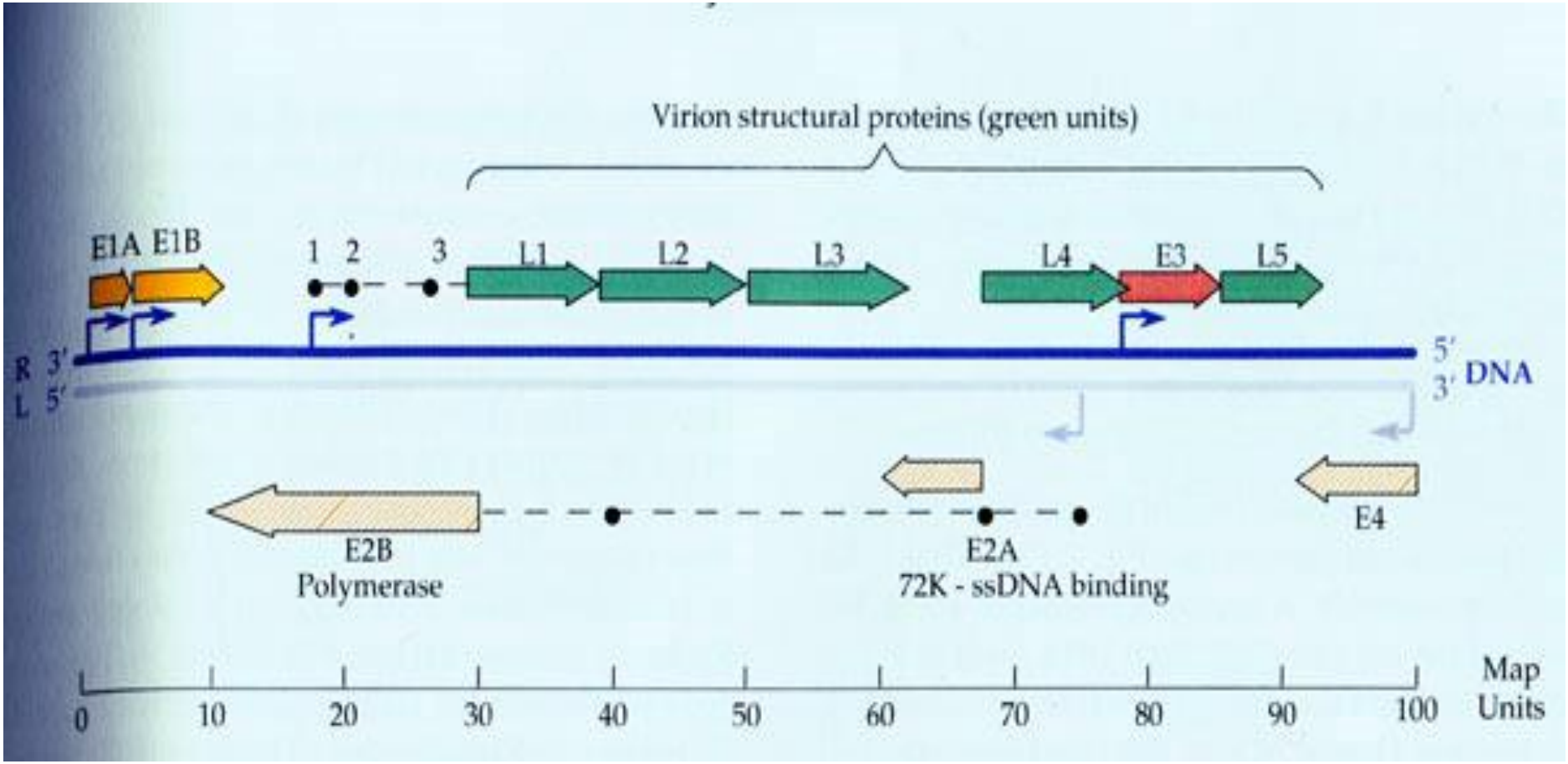
Genome – linear dsDNA, 24-45 kbp



Strauss & Strauss, 2002.

Human adenovirus type 2 – genome organization and transcription

(36 kbp)



Strauss & Strauss, 2008

Adenoviral oncogenic proteins (E1A, E1B) interact with cellular proteins