

VMC 321: Systematic Veterinary Virology

# *Retroviridae*

Dr Manoj Kumar

Assistant Professor

Department of Veterinary Microbiology

Bihar Veterinary College

Bihar Animal Sciences University



# RETROVIRIDAE

*Retro: from Latin retro, "backwards"*

- refers to the activity of reverse transcriptase and the transfer of genetic information from RNA to DNA.

# Retroviruses



Reverse (retro) transfer of genetic information

Usually, well adapted to their hosts

Endogenous retroviruses



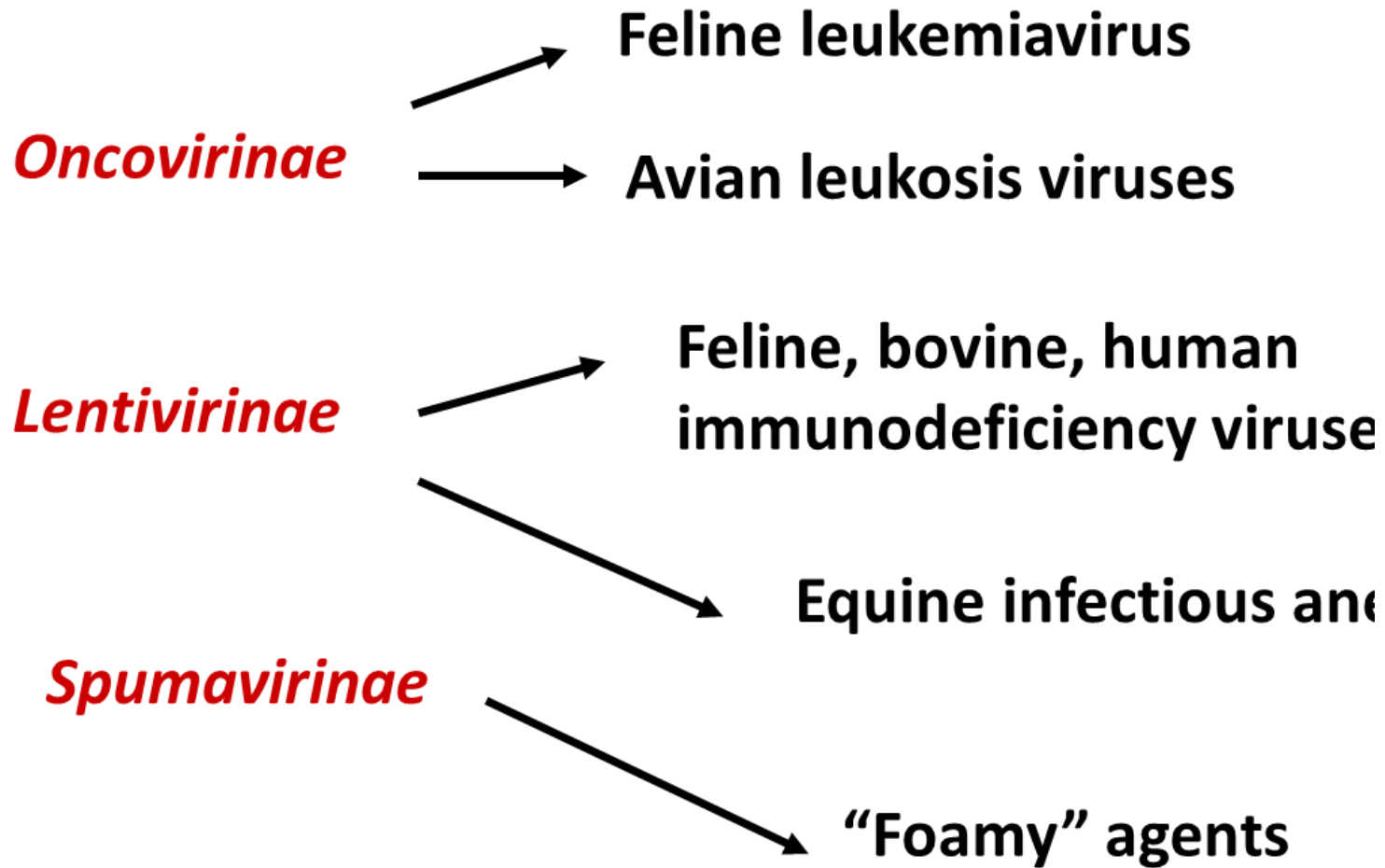
# Retroviruses

- RNA viruses
- single stranded, positive sense, enveloped, icosahedral.
- Distinguished from all other RNA viruses by presence of an unusual enzyme, reverse transcriptase.
- Retro = reversal
  - RNA is serving as a template for DNA synthesis.
- One genera of veterinary interest
- Alpharetrovirus
  -



# Family- *Retroviridae*

- Family - *Retroviridae*
- Subfamily - *Orthoretrovirinae* [*Ortho*: from Greek *orthos*"straight"]
- Genus -. *Alpharetrovirus*
- Genus - *Betaretrovirus*
- Genus - *Gammaretrovirus*
- Genus - *Deltaretrovirus*
- Genus - *Lentivirus* [ *Lenti*: from Latin *lentus*, "slow" ].
- Genus - *Epsilonretrovirus*
- Subfamily - *Spumaretrovirinae*
- Genus - *Spumavirus*



*Retroviridae*



# *Alpharetrovirus*

- **Subfamily**
  - *Orthoretrovirinae*
- **Genus**
  - *Alpharetrovirus*
- **Species**
  - *Avian leukosis virus (ALV)*
  - *Rous sarcoma virus (RSV)*
  - *Avian myeloblastosis virus (AMV)*
  - *Fujinami sarcoma virus (FuSV)*



# Avian leukosis- sarcoma virus (ALV)

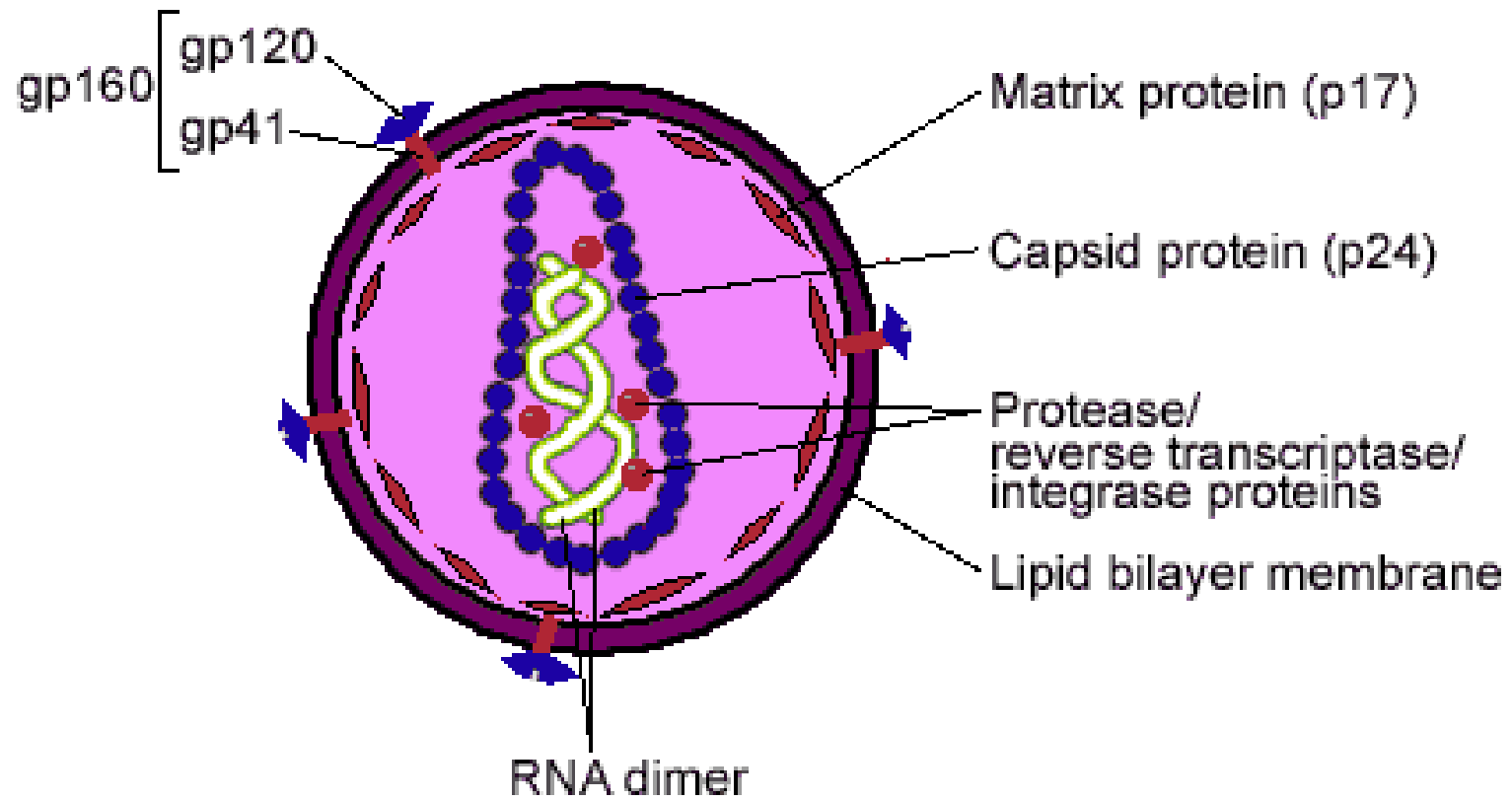
- ALVs have been divided into 10 envelope subgroups - A , B, C, D, E, F, G, H, I & J based on
  - host range
  - receptor interference patterns
  - neutralization by antibodies
- subgroup A to E viruses have been divided into two groups
  - Noncytopathic (A, C, and E)
  - Cytopathic (B and D)
- Cytopathic ALVs can cause a transient cytotoxicity in 30- 40% of the infected cells





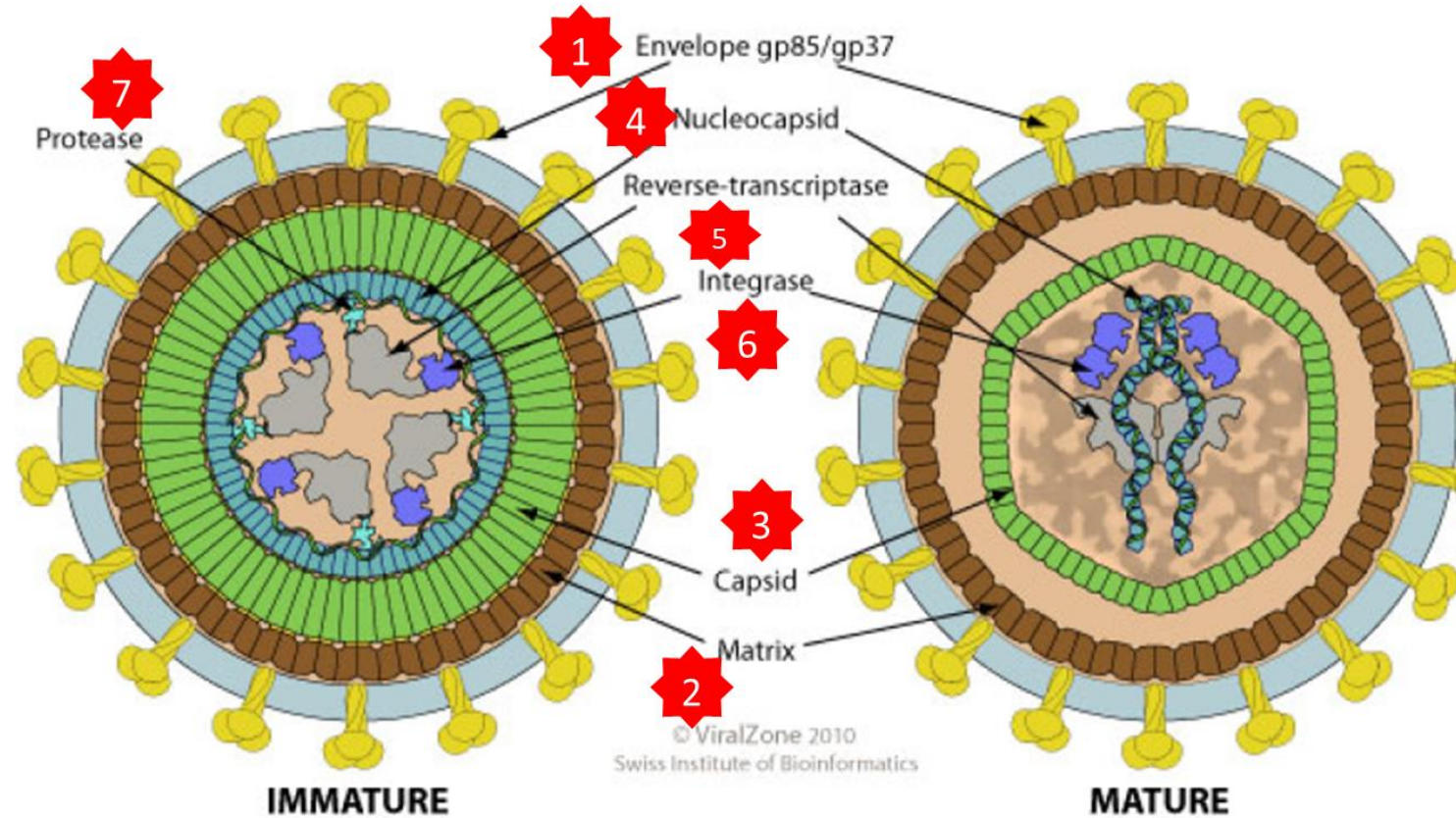
# Structure

1. The viral envelope formed from host cell membrane; contains 72 spiked knobs.
2. These consist of a transmembrane protein TM (gp 41), which is linked to surface protein SU (gp 120) that binds to a cell receptor during infection.
3. The virion has cone-shaped, icosahedral core, containing the major capsid protein
4. Between capsid and envelope is an outer matrix protein, MA
5. Two identical copies of positive sense ssRNA genome (retroviruses are diploid).
6. Enzymes: reverse transcriptase, integrase and protease.



## Structure - Retrovirus

VIRION

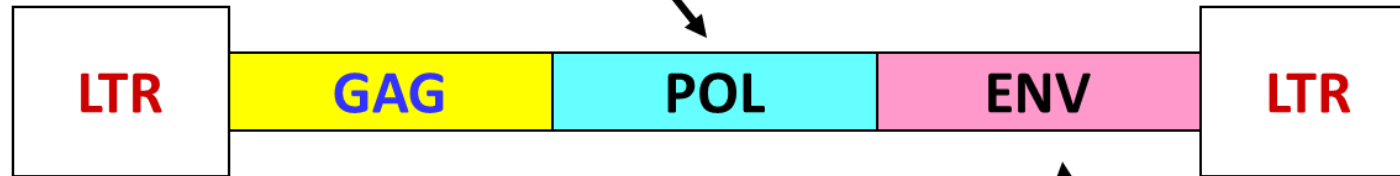


Structure -  
Alpharetrovirus

Enveloped, spherical to pleomorphic in shape, 80 - 100 nm in diameter.

Long terminal repeat

RNA dependant DNA polymerase



Group specific antigens  
(nucleocapsid)

Envelope proteins  
(type-specific antigen)

The viral genome  
(oncornaviruses)

All three genes - GAG, POL, ENV - required for replication



# REPLICATION - NUCLEAR

- Virus attaches to host receptors
- Fusion with cell membrane.
- Internalization and partial uncoating.
- ssRNA(+) genome is copied into a linear dsDNA molecule by RT



# Contd...

- Nuclear entry of the viral dsDNA at the nuclear membrane is disassembled at mitosis.
- Viral dsDNA is covalently and randomly integrated into the cell's genome by the viral integrase (=provirus).
- Transcription of provirus by Pol II



# Contd...

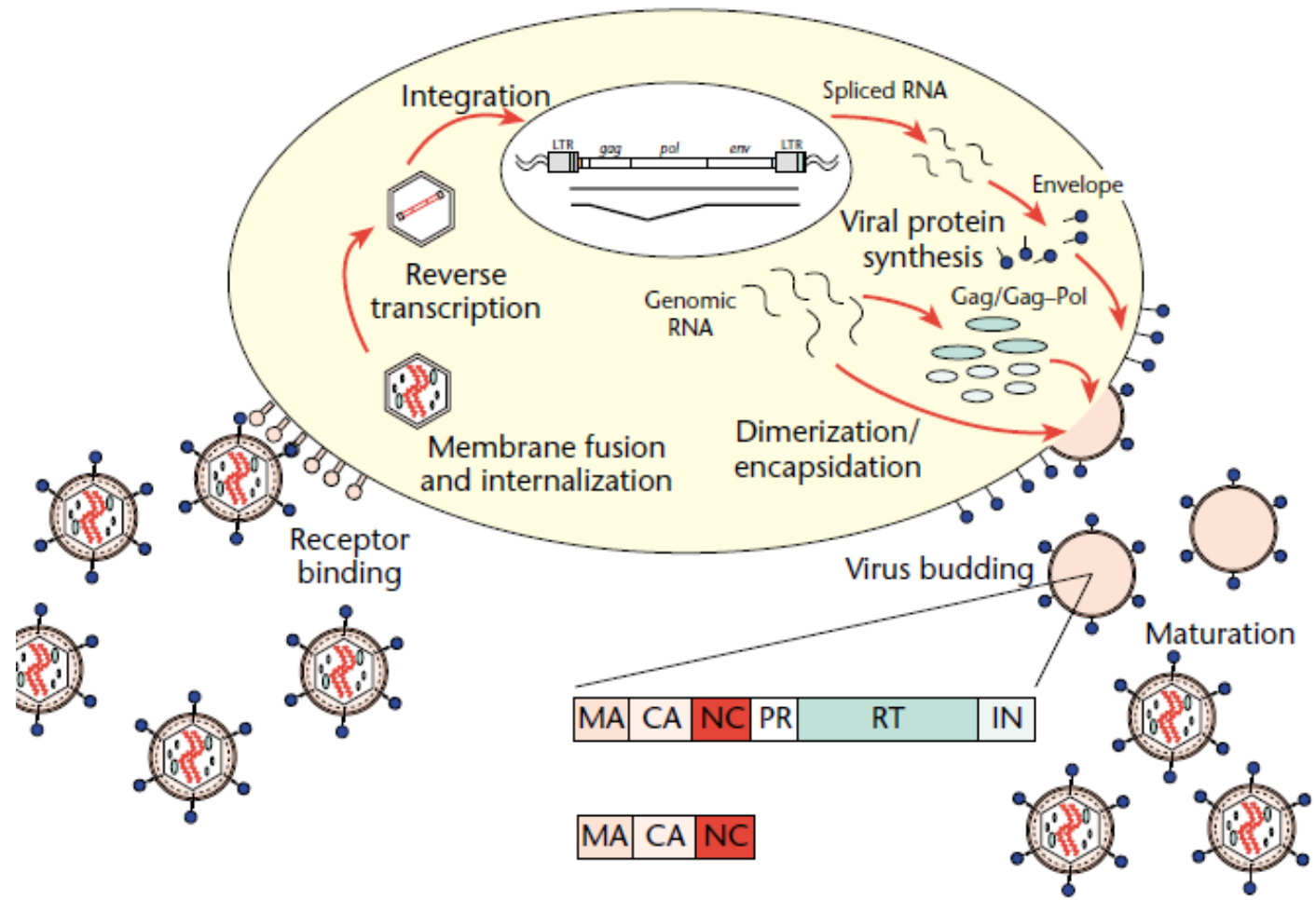
- Nuclear export of RNAs.
- Translation of viral RNAs >>> produces Env, Gag and GagPol polyproteins.
- Assembly of the virion at the host cellular membrane and packaging of the viral RNA genome.



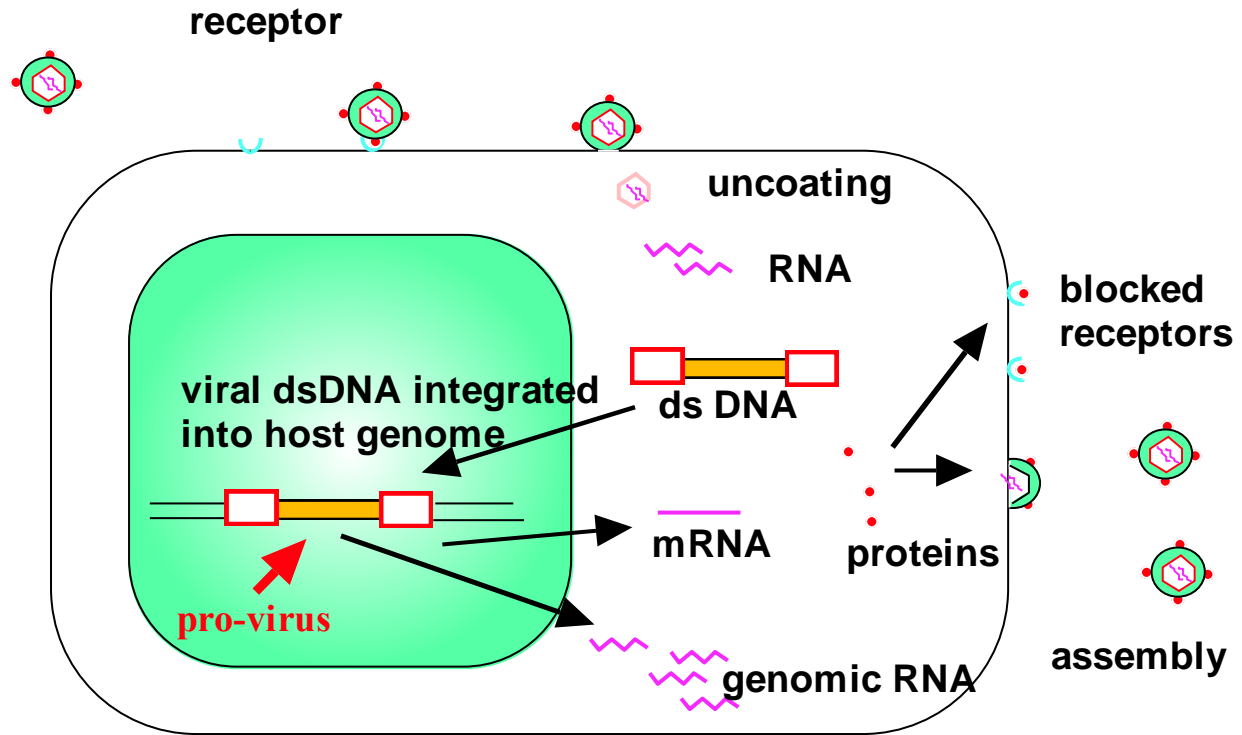
# Contd...

- Budding through the plasma membrane and release of the virions
- Proteolytic processing of the precursors polyproteins by viral protease and maturation of the virions.





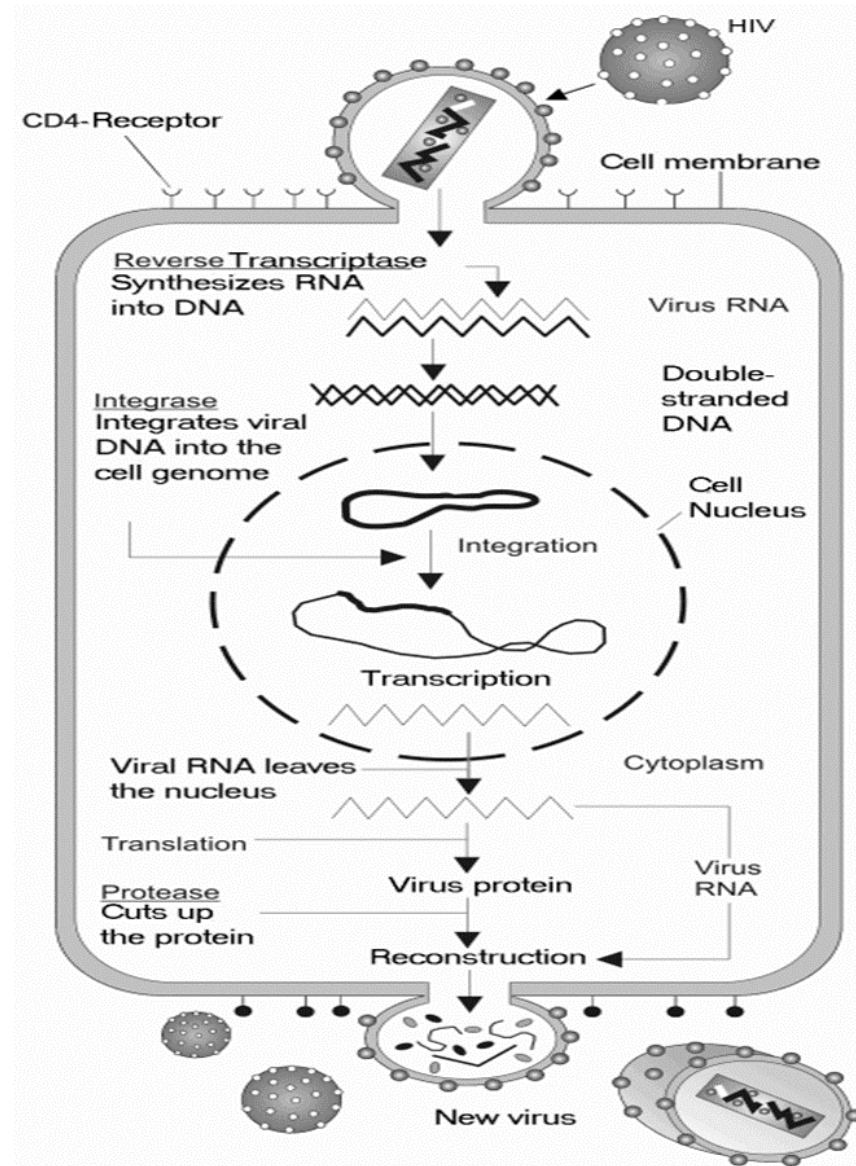
Replication cycle of Alpharetrovirus



# Replicative cycle

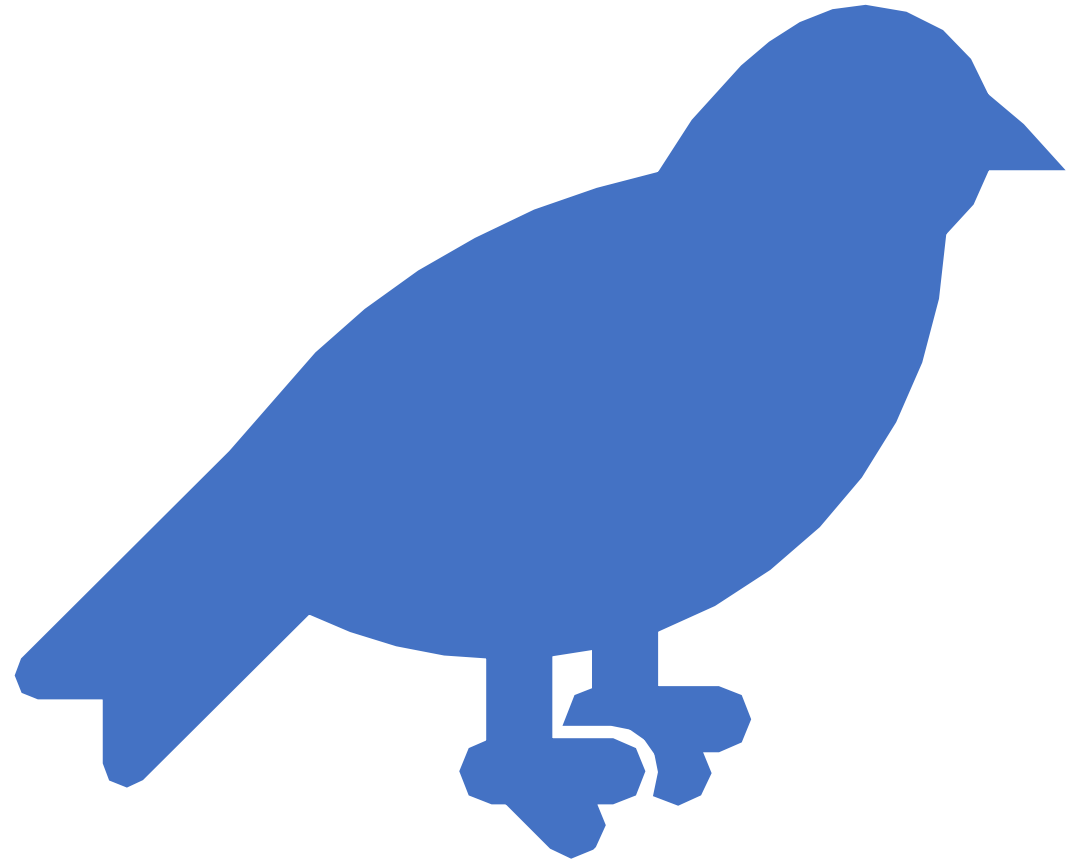
# Summary

Replication of retrovirus





# Avian leucosis





# General characteristics:

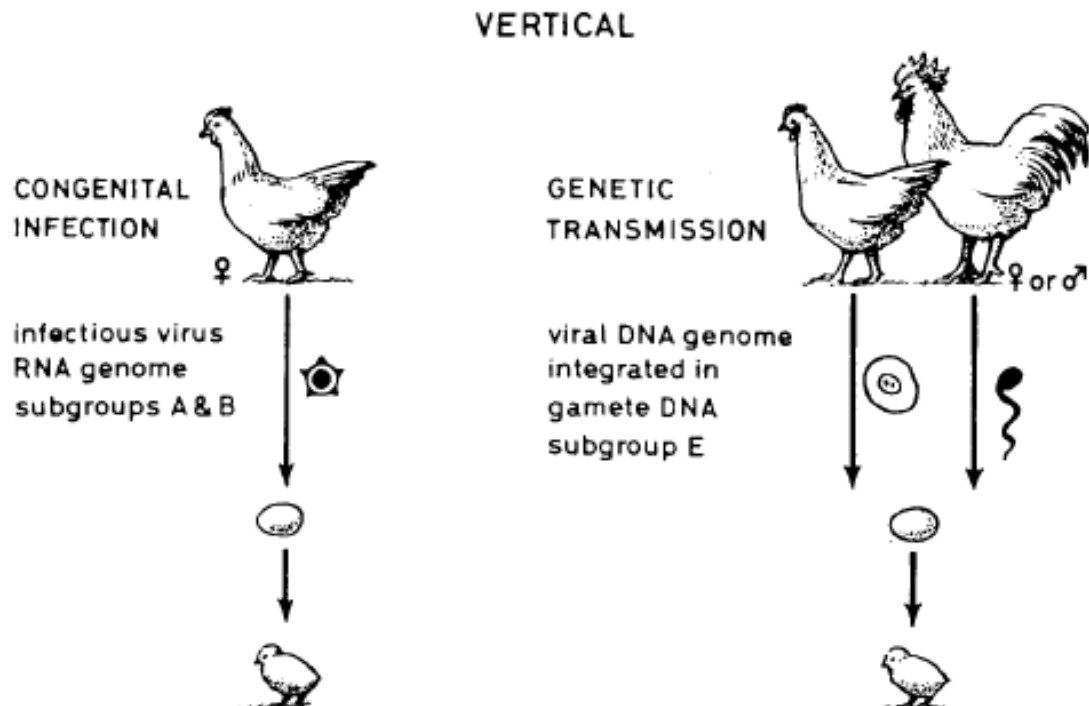
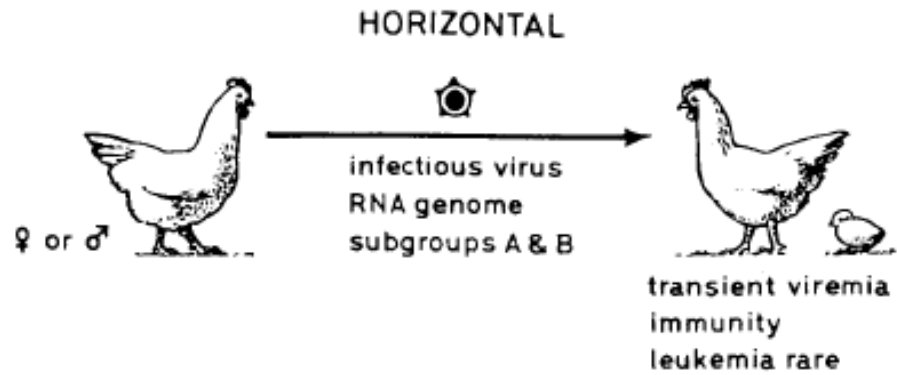
**The avian leucosis-sarcoma complex is**

- **caused by a closely related group of retroviruses**
- **appears in different forms of slowly developing proliferative diseases.**



# Aetiology

- ***Retroviridae, Alpharetrovirus. Avian leucosis, avian sarcoma, Rous sarcoma, avian myeloblastosis*** → most important is the avian leucosis-sarcoma: A-J serogroups.
- **Extremely sensitive virus: role of environment, fomites can be excluded.**



# Transmission

RNA viruses that replicate via a DNA proviral stage linearly present in the host genome, by virtue of the presence in the viral genome of a *pol* gene that encodes the enzyme reverse transcriptase necessary for the transcription of RNA to DNA



• LTR-gag-pol-env-LTR





# PATHOGENESIS OF ALSV-INDUCED DISEASES

- Avian leukosis/sarcoma viruses induce leukoses
- affecting the erythroid, lymphoid, and myeloid series of hematopoietic cells, solid tumors,
- solid tumors affecting cells of the mesenchyme, kidney, ovary, testis, liver, pancreas, & nervous system

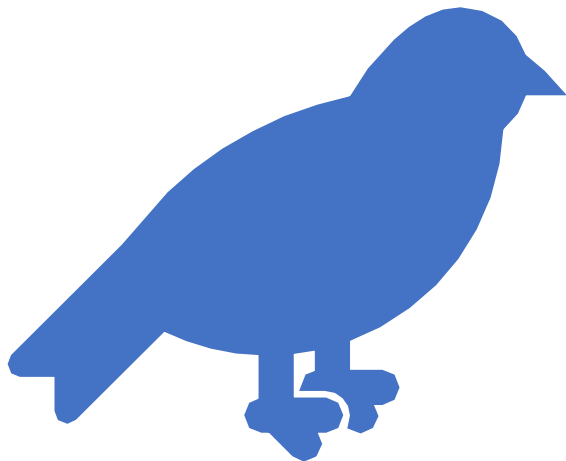


# Avian leukosis complex

- leukemia (leukosis) and sarcomas



# Retrovirus-Induced Disease in Poultry



- Three species of avian retrovirus cause disease in poultry:
- Avian leukosis/sarcoma virus (ALV)
- Reticuloendotheliosis virus (REV),
- Lymphoproliferative disease virus (LPDV) of turkeys.



- The incubation period for lymphoid leukemia is 4-6 months and as a consequence the disease is usually seen in broiler flocks.



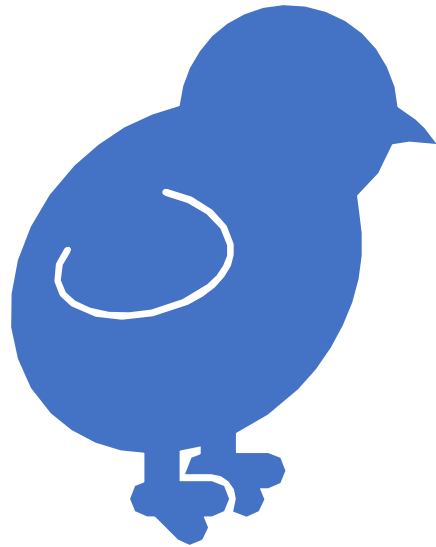
# Clinical signs:

- **Only in animals infected in embryonic life or in the first 2 month.**

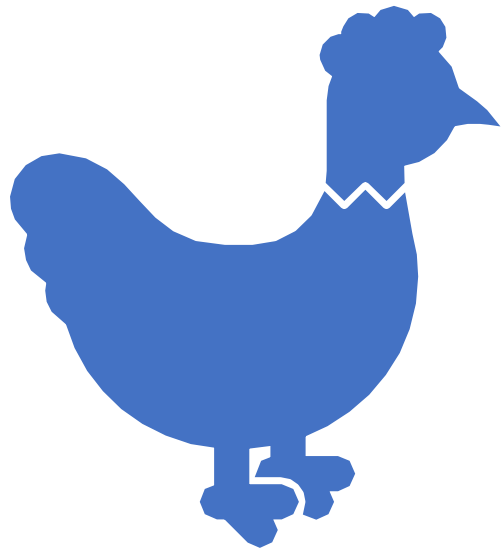
**Bursa → B cell lymphocytes → oncogenic transformation → metastases all over the body.**



# Clinical signs



- Chickens infected *in ovo* frequently
- Develop lymphoid leukemia (B-cell leukemia) arising from infected cells in the bursa of Fabricius.
- ALV replicates in chick embryo fibroblasts but does not transform them.
- Immunosuppression



- **Decreases in the immunologic function and productivity**
- **Chickens with a tolerant viremic infection are more likely to develop neoplasms because of more virus loads.**
- **Decreases in productivity performed as decline in weight gain, egg production, fertility, and hatchability**

- **Wasting disease and anemia**
- **Subgroup J ALV mainly attacks myeloid cells, causes a malignant growth**



Affected birds  
show non-  
specific clinical  
signs including:

- **Reduced feed intake**
- **Weakness**
- **Diarrhoea**
- **Dehydration**
- **Weight loss**
- **Depression**
- **Reduced egg production.**



*The internal organs  
of chicken affected by  
lymphoid leukosis*



- **Palpation often reveals an enlarged bursa of Fabricius**
- **Enlarged liver(hepatomagaly).**



# Epidemiology

- **Widespread**
- **Vertical:**
  - **Immunotolerance**
  - **Lifelong carrier animals**
  - **Germinative infection**
- **Horizontal infection (less important)**

# Laboratory Diagnosis

## Antigen / antibody detection

- ELISA
- Western Blotting
- COFAL test

## PCR

- Viral RNA or DNA provirus
- Blood or tissue specimens
- Quantitative PCR (viral load.



Any questions???





Thanks