



VIRUSES AND CANCER

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Medical Virology-Theory and MA 403

Summer Term

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Outline

- Overview of the cancer
- Viruses related to cancers

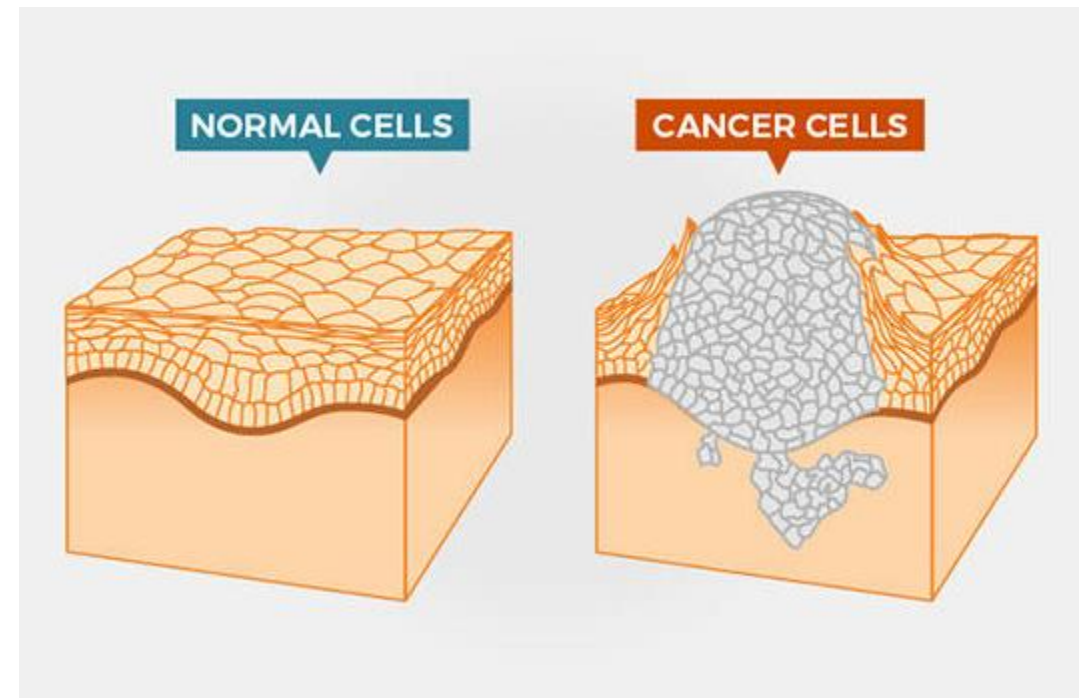
Objectives

- Get knowledge about the link between viruses and cancer
- Get information about viruses associated to cancers
- Teach students about mechanisms of viral carcinogenesis

Cancer

Cancer is a disease caused when cells divide uncontrollably anywhere in the body and spread into surrounding tissues.

- Normally cells grow and multiply in a controlled way, however, sometimes cells become abnormal and keep growing.
- Abnormal cells can form a mass called a **tumour**.
- Cancer is the term used to describe collections of these cells, growing and potentially spreading within the body.



The link between viruses and cancer



- **Carcinogen** is a substance, organism or agent, including viruses capable of causing cancer.
- The link between viruses and cancer is complex.
- Certain viruses have been identified as potential contributors to the development of cancer through various mechanisms.
- A virus must enter a living cell and take over the cell's machinery in order to reproduce and make more viruses.
- Viruses do this by inserting their own DNA (or RNA) into that of the host cell.
- Inside of the host cell, viral genetic material can push the cell toward becoming cancer

Virus-Associated Cancers

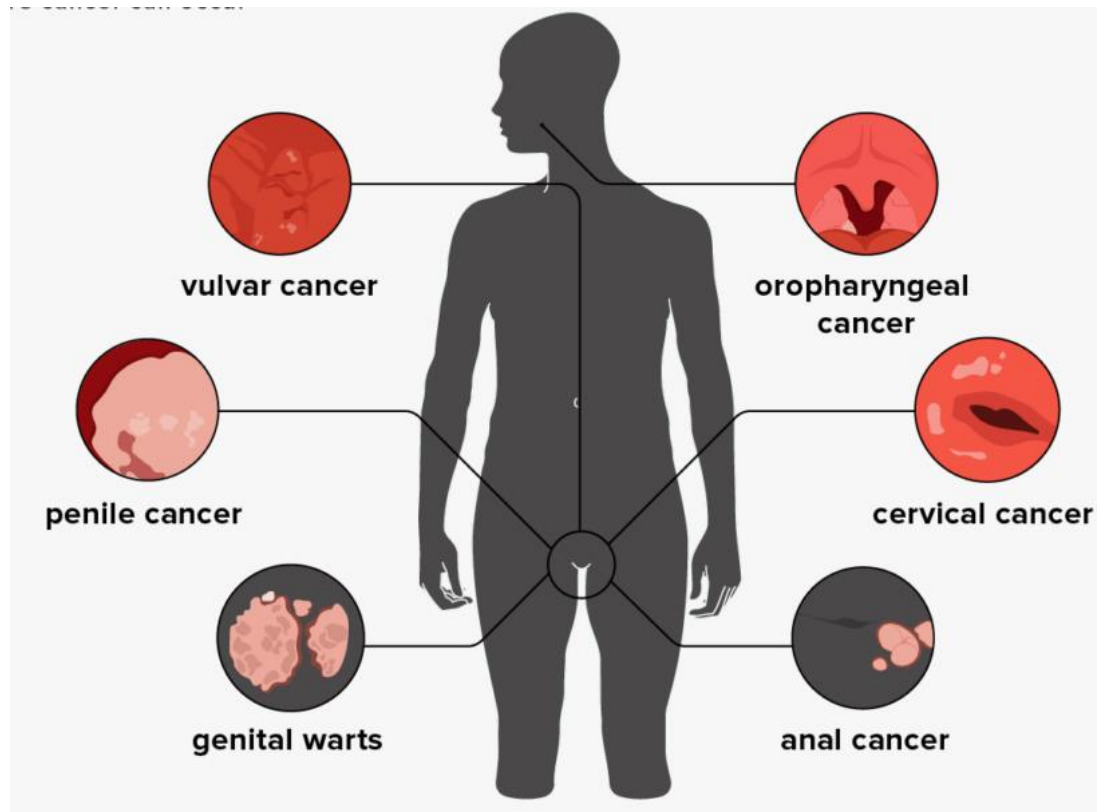


Examples of Viruses associated to cancers:

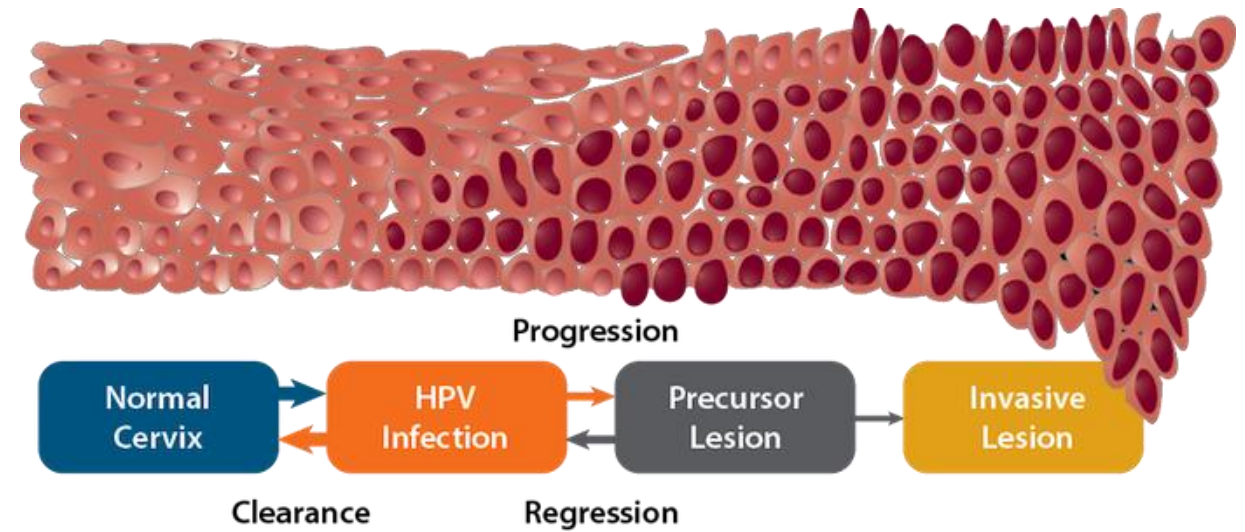
1. Human Papillomavirus (HPV)
2. Hepatitis B and C Viruses (HBV, HCV)
3. Epstein-Barr Virus (EBV)
4. Human T-Cell Lymphotropic Virus (HTLV-1)

Human Papillomavirus (HPV)

HPV can cause six types of cancer

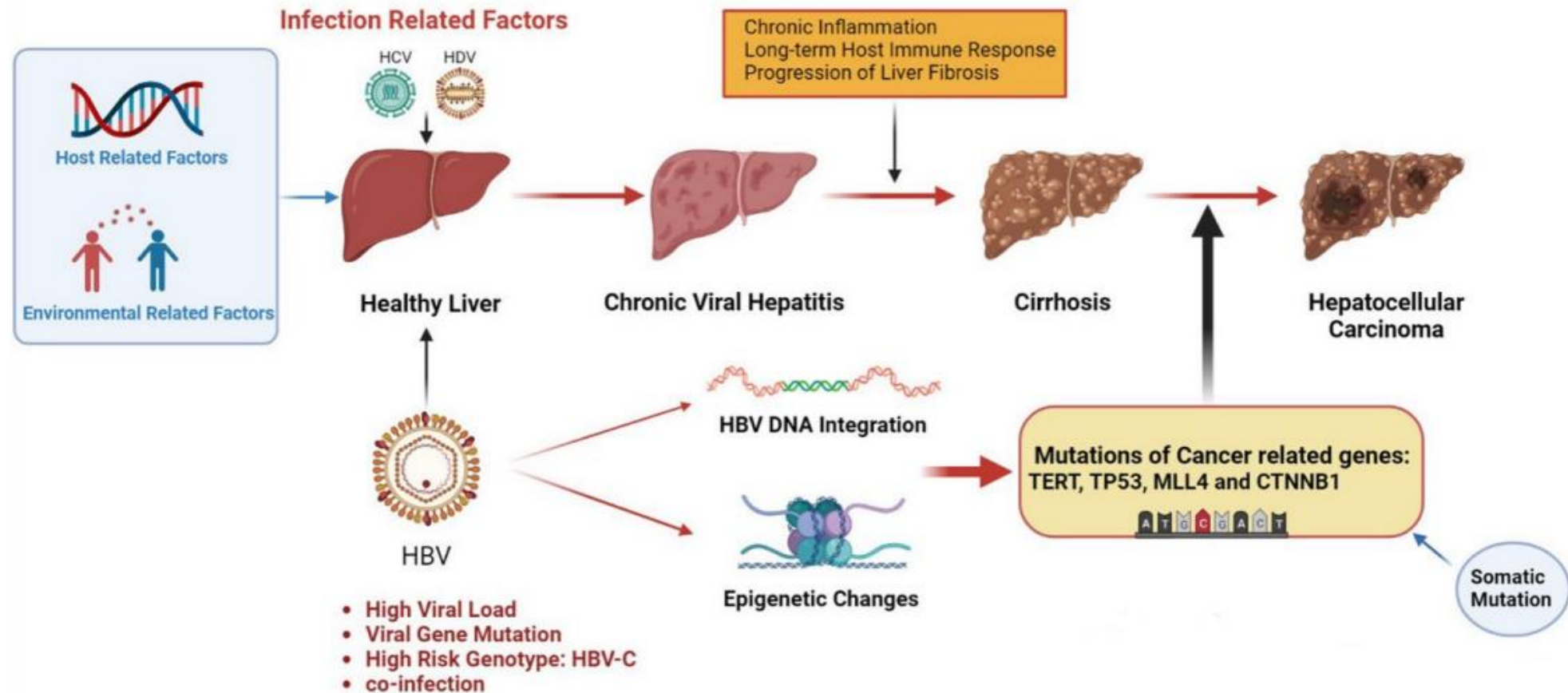


Cervical cancer development



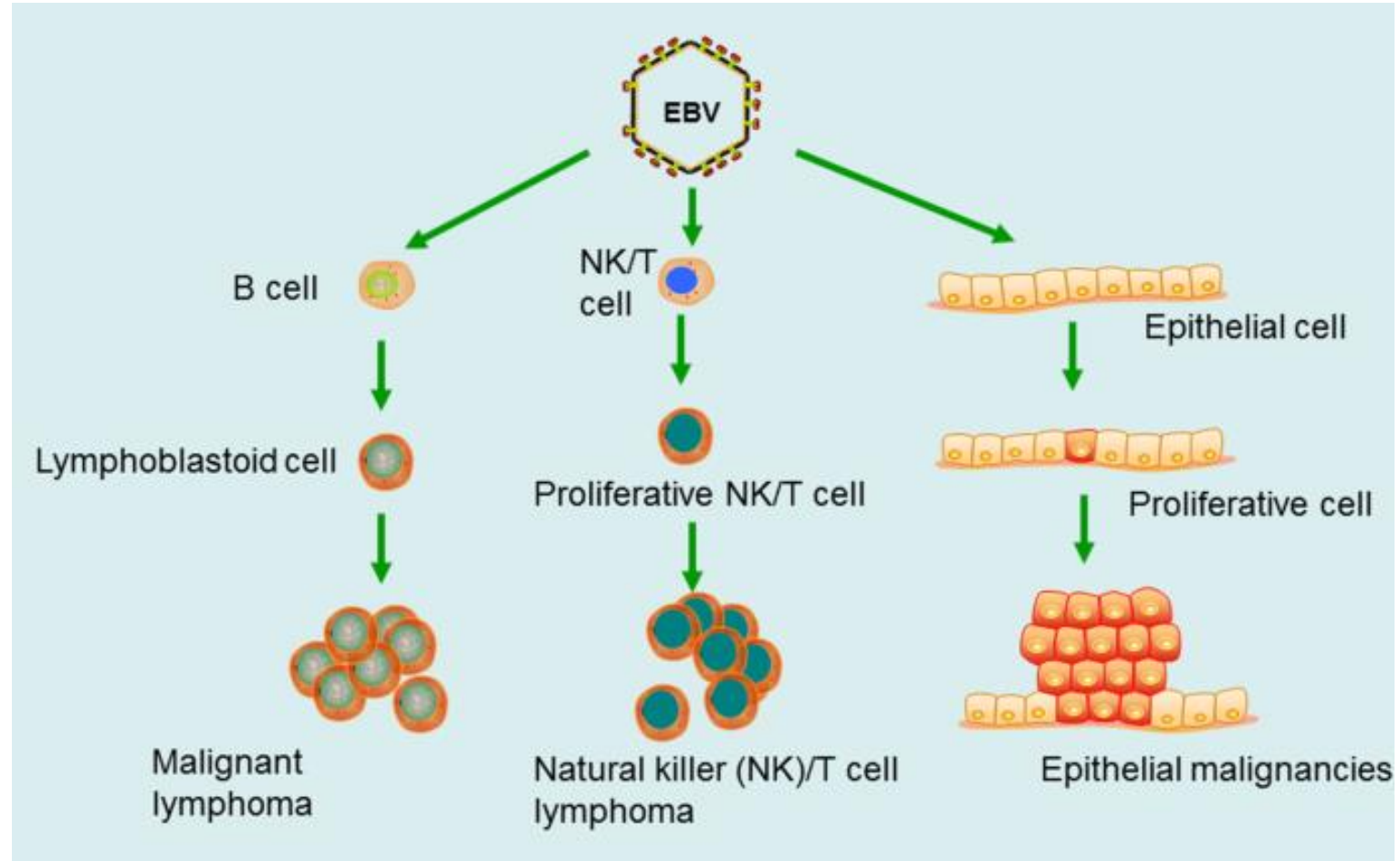
Hepatitis B and C Viruses (HBV, HCV)

Hepatitis B and C Viruses (HBV, HCV): Linked to liver cancer.



Epstein-Barr Virus (EBV)

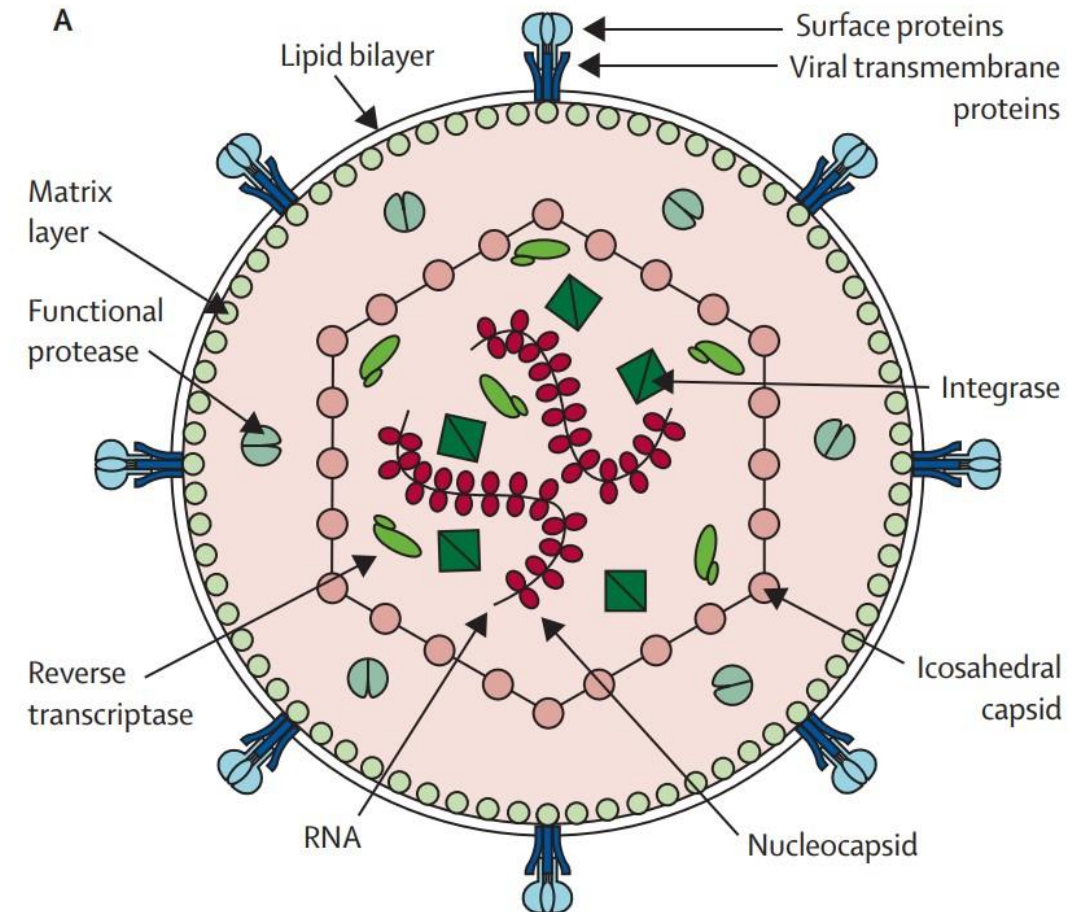
Epstein-Barr Virus (EBV): Associated with lymphomas and nasopharyngeal cancer.



Human T-Cell Lymphotropic Virus (HTLV-1)

Human T-Cell Lymphotropic Virus (HTLV-1): Linked to T-cell leukemia.

**What are enzymes of Human T-Cell
Lymphotropic Virus (HTLV-1)?**



Mechanisms of Viral Carcinogenesis



1. Viral Oncogenes:

- Some viruses carry genes known as **oncogenes** that can directly contribute to the transformation of normal cells into cancer cells.
- An **oncogene** is a mutated gene that has the potential to cause cancer. Before an oncogene becomes mutated, it is called a **proto-oncogene**, and it plays a role in regulating normal cell division.
- Viral oncogenes may
 1. **Stimulate cell growth**
 2. **Inhibit apoptosis (programmed cell death)**

Mechanisms of Viral Carcinogenesis



2. Integration of Viral DNA/RNA into Host Genome:

- Certain viruses, especially DNA viruses can integrate their genetic material into the DNA of the host cell.
- Integration may disrupt normal cellular functions, leading to the
 - 1. Activation of oncogenes**
 - 2. Inactivation of tumor suppressor genes.**

Mechanisms of Viral Carcinogenesis



3. Chronic Inflammation:

- Persistent viral infections can lead to chronic inflammation, creating a microenvironment that promotes the development of cancer.
- Inflammatory responses may cause
 1. **DNA damage**
 2. **Cell proliferation**
 3. **The release of growth factors that contribute to carcinogenesis.**

Mechanisms of Viral Carcinogenesis



4. Immunosuppression:

- Some viruses have the ability to suppress the host immune system, allowing infected cells to evade immune surveillance.
- A compromised immune system may fail to eliminate cells with genetic abnormalities, leading to the accumulation of cancerous cells.

Mechanisms of Viral Carcinogenesis



5. Viral Proteins and Cellular Transformation:

- Viruses often produce specific proteins that can interfere with normal cellular regulatory processes.
- These viral proteins may contribute to the development of cancer by
 1. **Disrupt the cell cycle**
 2. **Inhibit DNA repair mechanisms**
 3. **Interfere with apoptosis,**

Diagnostic and Therapeutic Approaches



A. Viral Detection and Screening

1. Molecular diagnostics
2. Serological testing

B. Cancer Treatment Strategies

- Vaccination against certain viruses, such as HPV and HBV, has proven effective in reducing the incidence of virus-associated cancers.
- Early detection and treatment of viral infections (Antiviral medications and Immunotherapies) may also help prevent the development of associated cancers

References (in APA style)

- Shen, C., et al. (2023). "Hepatitis Virus and Hepatocellular Carcinoma: Recent Advances." Cancers (Basel) **15**(2).
- Yin, H., et al. (2019). "Molecular mechanisms of EBV-driven cell cycle progression and oncogenesis." Med Microbiol Immunol **208**(5): 573-583.
- John Carter, Venetia Saunders - *Virology Principles and Applications*-Wiley (2007)