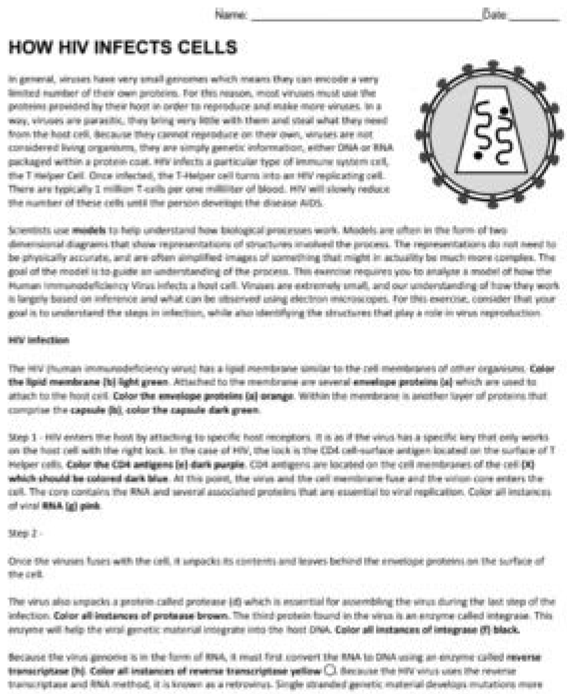
How Hiv Infects Cells Answer Key



Name: ______________________________ Date: ________

HOW HIV INFECTS CELLS

In general, viruses have very small genomes which means they can encode a very limited number of their own proteins. For this reason, most viruses must use the proteins provided by their host in order to reproduce and make more viruses. In a way, viruses are parasitic, they bring very little with them and steal what they need from the host cell. Because they cannot reproduce on their own, viruses are not considered living organisms, they are simply genetic information, either DNA or RNA packaged within a protein coat. HIV infects a particular type of immune system cell, the T Helper Cell. Once infected, the T-Helper cell turns into an HIV replicating cell. There are typically 1 million T-cells per one milliliter of blood. HIV will slowly reduce the number of these cells until the person develops the disease AIDS.

Scientists use **models** to help understand how biological processes work. Models are often in the form of two dimensional diagrams that show representations of structures involved the process. The representations do not need to be physically accurate, and are often simplified images of something that might in actuality be much more complex. The goal of the model is to guide an understanding of the process. This exercise requires you to analyze a model of how the Human Immunodeficiency Virus infects a host cell. Viruses are extremely small, and our understanding of how they work is largely based on inference and what can be observed using electron microscopes. For this exercise, consider that your goal is to understand the steps in infection, while also identifying the structures that play a role in virus reproduction.

HIV Infection

The HIV (human immunodeficiency virus) has a lipid membrane similar to the cell membranes of other organisms. **Color the lipid membrane (b) light green**. Attached to the membrane are several **envelope proteins (a)** which are used to attach to the host cell. **Color the envelope proteins (a) orange**. Within the membrane is another layer of proteins that comprise the **capsule (b), color the capsule dark green**.

Step 1 - HIV enters the host by attaching to specific host receptors. It is as if the virus has a specific key that only works on the host cell with the right lock. In the case of HIV, the lock is the CD4 cell-surface antigen located on the surface of T Helper cells. **Color the CD4 antigens (e) dark purple**. CD4 antigens are located on the cell membranes of the cell **(X) which should be colored dark blue**. At this point, the virus and the cell membrane fuse and the virion core enters the cell. The core contains the RNA and several associated proteins that are essential to viral replication. Color all instances of viral **RNA (g) pink**.

Step 2 -

Once the viruses fuses with the cell, it unpacks its contents and leaves behind the envelope proteins on the surface of the cell.

The virus also unpacks a protein called protease (d) which is essential for assembling the virus during the last step of the infection. **Color all instances of protease brown.** The third protein found in the virus is an enzyme called integrase. This enzyme will help the viral genetic material integrate into the host DNA. **Color all instances of integrase (f) black.**

Because the virus genome is in the form of RNA, it must first convert the RNA to DNA using an enzyme called **reverse transcriptase (h)**. **Color all instances of reverse transcriptase yellow** ◯. Because the HIV virus uses the reverse transcriptase and RNA method, it is known as a retrovirus. Single stranded genetic material develops mutations more

How HIV Infects Cells: Answer Key

HIV, or Human Immunodeficiency Virus, is a retrovirus that attacks the immune system, specifically targeting CD4+ T cells, which are crucial for the body's ability to fight infections. Understanding how HIV infects cells is vital for developing effective treatments and preventive measures. This article delves into the intricate process of HIV infection, exploring its mechanisms, stages, and implications for health.

Understanding HIV Structure

The first step in understanding how HIV infects cells is to examine its structure. HIV is comprised of several essential components:

- Envelope: The outer layer of the virus, made up of lipids derived from the host cell membrane. It contains viral proteins crucial for entry into host cells.
- Glycoproteins: The most notable are gp120 and gp41. Gp120 is responsible for binding to the CD4 receptor on host cells, while gp41 facilitates the fusion of the viral envelope with the host cell membrane.
- Capsid: A protein shell that encases the viral RNA and enzymes necessary for replication, such as reverse transcriptase.
- Viral RNA: The genetic material that is converted into DNA upon entering a host cell.

The Infection Process

The process of HIV infection can be broken down into several key stages:

1. Attachment

The infection begins when HIV comes into contact with a susceptible host cell. The virus uses its gp120 glycoprotein to bind to the CD4 receptor found on the surface of T cells. This specific interaction is crucial for the next steps in the infection process.

- Co-receptor Binding: After the initial attachment, the virus must also bind to a co-receptor, either CCR5 or CXCR4. This additional binding is essential for the virus to enter the cell.

2. Fusion

Once HIV binds to the CD4 receptor and the co-receptor, the viral envelope fuses with the host cell membrane, facilitated by the gp41 protein. This fusion process allows the viral contents to enter the host cell.

- Membrane Fusion Mechanism: The conformational changes in gp41 bring the viral and cellular membranes close together, allowing the viral RNA and proteins to be released into the cytoplasm of the host cell.

3. Reverse Transcription

Once inside the host cell, HIV's next step is to convert its RNA genome into DNA, a process carried out by the enzyme reverse transcriptase.

- Reverse Transcriptase Functions:
- It synthesizes a complementary DNA strand (cDNA) using the viral RNA as a template.
- It also degrades the RNA strand, allowing for the formation of double-stranded viral DNA.

4. Integration

The newly formed viral DNA is transported into the nucleus of the host cell, where it must integrate into the host's genomic DNA.

- Integration Mechanism: The viral enzyme integrase facilitates the insertion of the viral DNA into the host genome, creating a provirus. This step is critical, as it allows HIV to remain latent in the host cell and evade the immune response.

5. Replication

Once integrated, the proviral DNA can be transcribed into mRNA, which serves as a template for producing new viral proteins.

- Transcription and Translation:
- The host cell's machinery transcribes the viral DNA into RNA.
- This RNA is translated into viral proteins, which include structural proteins and enzymes necessary for new virions.

6. Assembly and Budding

After replication and translation, new viral components are assembled at the host cell's membrane.

- Virion Assembly: The structural proteins and RNA genomes gather at the cell membrane, forming new virions.
- Budding Process: Newly formed virions bud off from the host cell, acquiring a portion of the cell membrane, which becomes their envelope. This step allows the virus to exit and infect other cells.

Cellular Impact of HIV Infection

The infection of CD4+ T cells by HIV leads to significant consequences for the immune system.

1. Immune System Depletion

As HIV replicates, it leads to the gradual depletion of CD4+ T cells, which are essential for orchestrating an effective immune response.

- CD4+ T Cell Count: A decline in CD4+ T cells results in immunosuppression, making the individual more susceptible to opportunistic infections and certain cancers.

2. Chronic Inflammation

HIV infection may also lead to chronic inflammation, which can further damage the immune system and contribute to the development of comorbid conditions.

- Cytokine Release: Infected cells release pro-inflammatory cytokines, which can affect both infected and uninfected cells.

3. Latency and Reservoirs

HIV can establish latency in certain cell types, allowing it to persist in the body despite antiretroviral therapy.

- Latent Reservoirs: These reservoirs pose a significant challenge for eradication efforts, as the virus can reactivate and lead to renewed viral replication.

Prevention and Treatment Strategies

Understanding how HIV infects cells has led to various prevention and treatment strategies to combat the virus.

1. Antiretroviral Therapy (ART)

ART is the cornerstone of HIV treatment, involving a combination of medications that target different stages of the HIV life cycle.

- Types of Antiretroviral Drugs:
- NRTIs (Nucleoside Reverse Transcriptase Inhibitors): Block reverse transcriptase.
- NNRTIs (Non-Nucleoside Reverse Transcriptase Inhibitors): Bind to and inhibit reverse transcriptase.
- PIs (Protease Inhibitors): Inhibit the protease enzyme, preventing viral assembly.
- Integrase Inhibitors: Block the integrase enzyme, preventing viral DNA from integrating into the host genome.

2. Pre-exposure Prophylaxis (PrEP)

PrEP involves the use of antiretroviral medication by HIV-negative individuals at high risk of infection to prevent HIV acquisition.

- Effectiveness: When taken consistently, PrEP can reduce the risk of HIV infection by up to 99%.

3. Education and Awareness

Preventing HIV transmission also relies on education and awareness initiatives to inform individuals about the virus, modes of transmission, and safe practices.

- Safe Practices: Encouraging the use of condoms, regular testing, and reducing the number of sexual partners can significantly lower transmission risk.

Conclusion

Understanding how HIV infects cells is crucial for developing effective treatments and preventive measures. The complex interplay between the virus and the host immune system highlights the challenges in combating HIV. Continued research into the mechanisms of HIV infection and the development of innovative therapies is vital for improving the lives of those affected by this virus. Through education, awareness, and effective medical interventions, we can work towards reducing the impact of HIV on individuals and communities worldwide.

Frequently Asked Questions

How does HIV enter human cells?

HIV enters human cells primarily by binding to the CD4 receptor on T-helper cells, followed by the interaction with a co-receptor (CCR5 or CXCR4), which allows fusion of the viral envelope with the host cell membrane.

What role does the HIV envelope protein play in infection?

The HIV envelope protein, gp120, is crucial for the virus's ability to attach to and enter host cells. It facilitates the binding to CD4 and co-receptors, initiating the fusion process.

What happens to the HIV RNA once it enters a host cell?

Once inside the host cell, HIV RNA is reverse transcribed into DNA by the viral enzyme reverse transcriptase. This DNA is then integrated into the host cell's genome by the integrase enzyme.

What is the significance of reverse transcription in HIV infection?

Reverse transcription is significant because it converts viral RNA into DNA, allowing the virus to integrate into the host cell's DNA and replicate along with the host cell's genetic material.

How does HIV replicate within a host cell?

After integration, the viral DNA is transcribed into mRNA, which then translates into viral proteins. These proteins assemble with new viral RNA to form new HIV particles, which are released from the host cell to infect more cells.

What mechanisms do host cells use to combat HIV infection?

Host cells utilize various mechanisms, including the activation of immune responses, production of antiviral proteins, and apoptosis (programmed cell death) to eliminate infected cells and limit the spread of the virus.

Can HIV infect cells other than T-helper cells?

Yes, HIV can also infect other immune cells, such as macrophages and dendritic cells, as well as some neurons, which can contribute to the virus's persistence and the development of AIDS.

Find other PDF article:
https://soc.up.edu.ph/58-view/Book?trackid=ltd60-3326&title=the-art-of-logical-thinking.pdf

How Hiv Infects Cells Answer Key

□□□□□□□□□□□□□ - □□
□□□□□□□□□□□□□□□□□□□□□□□□□□□HIV □□□□□□□□□□□□□□□□□□□□□□□□HIV □□□□□□□□□□□□□□□□□□□□□□□□□ □□□□□HIV □□□□ …

□□□□ - □□
HIV□human immunodeficiency virus□□□acquired immunodeficiency syndrome□AIDS□□□□□□□□□□□ …

□□□□□□□□□□□HIV□□□□□□□□□□□□□□□□□□□□ …
□□□□□□□HIV□□□□□□□□□□□□□□□□□□□□□□□□□□□HIV□□□□□□□□ 2018□9□27□□HIV□□□□□□□□□□□□□□

Hiv□□□□? - □□
Jun 20, 2025 · HIV□□□□□□□□RNA□□□RNA□□□□□□□□□□RNA□□□□DNA□□□□□□□□□□□□□□□□HIV□□□□□□gp120□□□□□□□□□□□□□□□□□□□□□□ …

□□□□□□hiv□□□□□□□□□□□□□□□□□□□□□ - □□
□□HIV□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ □□ …

HIV□□□□□□□□□□□□□? - □□
Jan 5, 2025 · HIV □□ □1□□

HIV □ AIDS□□□□□□□□□□□□□□□□□□ - □□
Apr 7, 2023 · □□□□□□□□ HIV □□□□□□□□□□□□□□□□□□□ HIV□□□□□□□□□HIV□□□ …

□2025□□ HIV□□□□□□□? - □□
HIV□□□□□□□24□48□□□□□□□□□□□□5□10□□□□□□□□□□□□□□□□□□□□□ [1]□ □HIV□□□□□3□5□□□□□□□□□□□□□HIV RNA□□□□□□□□□□□□□□□□□□□□ …

hiv□□□□□□□? - □□
HIV□□□□□□□24□48□□□□□□□□□□□□5□10□□□□□□□□□□□□□□□□□□□□□ [1]□□HIV□□□□□3□5□□□□□□□□□□□□□HIV RNA□□□□□□□□□□□□□□□□□□□ …

□□□□□□HIV□□□□□□□□□□□□□□□□□□ - □□
□□HIV□□□□□□2-4□□□ …

□□□□□□□□□□□□ - □□
□□□□□□□□□□□□□□□□□□□□□□□□□HIV □□□□□□□□□□□□□□□□□□□□□□□□HIV □□□□□□□□□□□□□□□□□□□□□□□□□ □□□□□HIV □□□□□□□□□ …

□□□□ - □□
HIV□human immunodeficiency virus□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□acquired immunodeficiency syndrome□AIDS□□□ …

□□□□□□□□□HIV□□□□□□□□□□□□□□□□□□□□□□□□□□□ …
□□□□□□HIV□□□□□□□□□□□□□□□□□□□□□□□□HIV□□□□□□□□ 2018□9□27□□HIV□□□□□□□□□□□□□□

Hiv□□□□? - □□
Jun 20, 2025 · HIV□□□□□□□RNA□□□RNA□□□□□□□□□RNA□□□□DNA□□□□□□□□□□□□□□HIV□□□□□□gp120□□□ □□□□□□□□□□□□□□□□□□□□□□□ …

□□□□□*hiv*□□□□□□□□□□□□□□□□□□□□ - □□
□□HIV□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ □□ □HIV□□□□ …

Discover how HIV infects cells with our detailed answer key. Understand the mechanisms and implications of HIV infection. Learn more now!

[Back to Home]