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INSTITUTE FOR RESEARCH
OUTREACH EXPERIENCES

ANSWER KEY HIV WEBQUEST

Objective: The objective for this webquest is to learn about the human immunodeficiency virus (HIV) that causes AIDS. Use the provided website links to discover and learn more about how the virus infects the body's cells and replicates as well as the long term health effects due to HIV infection.

HIV Background: The Human Immunodeficiency Virus is a lot like other viruses, including those that cause the common cold or "flu". Usually the body's immune system has the ability to clear out those cold and flu viruses; however, this is not the case with HIV. Research has shown that HIV can remain hidden for long periods of time within the body and that HIV attacks the immune system cells known as T cells and CD4+ cells. These cells are needed by the immune system to fight infections, but HIV invades the cell to create more viruses and ultimately destroys the cells. Eventually, HIV destroys so many CD4+ cells that your body cannot defend against infections, resulting in Acquired Immunodeficiency Syndrome (AIDS).

Task: Use the following websites to learn more about the biology of HIV and the long term health effects due to HIV infection.

- National Institute of Allergy and Infectious Diseases: Biology of HIV: <http://www.niaid.nih.gov/topics/hivaids/understanding/biology/Pages/biology.aspx>
- Centers for Disease Control and Prevention: Basic Information about HIV and AIDS: <http://www.cdc.gov/hiv/topics/basic/>
- Avert: HIV Structure and Life Cycle: <http://www.avert.org/hiv-virus.htm>
- Avert Video: How HIV Affects the Body: <http://www.avert.org/media-gallery/video-76-how-aids-affects-the-body>

HIV Biology Questions:

1. HIV belongs to which class of viruses?
Answer: HIV belongs to a class of viruses known as retroviruses.
2. All known cells, use DNA to store their genetic material. Retroviruses are an exception because they store their genetic material in what form?
Answer: RNA (ribonucleic acid)
3. The outer most layer of HIV is composed of two layers of fatty molecules called lipids and is known as what?
Answer: viral envelope (membrane)



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4. What is contained within the viral core or capsid of HIV?

Answer: The capsid surrounds HIV's genetic material which is two single strands of HIV RNA. Inside the capsid are three enzymes required for HIV replication called reverse transcriptase, integrase and protease.

5. This enzyme found in HIV is responsible for creating DNA copies using viral RNA as a template and often makes random mistakes?

Answer: Reverse transcriptase

6. What type of immune cell does HIV most commonly target?

Answer: CD4+ T cell

7. While the use of antiviral drugs suppresses the amount of HIV in the body even to undetectable amounts, why is it that HIV cannot be completely cleared from the body?

Answer: The virus can hide within the cytoplasm or integrate into the cell's genetic material (chromosomes), where it is shielded from the immune system and can lie dormant for months to years. Current therapies cannot remove HIV's genetic material from these cells. Even if someone takes antiretroviral drugs for many years they will still have some HIV hiding in various parts of the body.

8. Describe what takes place within the body during the acute primary infection of the HIV.

Answer: The virus infects large amounts of CD4+T cells and replicates rapidly. The virus spreads throughout the body, including the thymus, spleen and lymph nodes. During this phase the virus may integrate and hide in the cell's genetic material, shielded from the immune system where it will lie dormant. Some people develop flu like symptoms during this phase of infection.

9. Describe what is taking place within the body when AIDS like symptoms occur.

Answer: When the HIV has reduced the number of CD4+T cells to dangerously low levels and the immune system is unable to fight off infections. Other opportunistic infections such as pneumonia or tuberculosis infect the body.

10. What is the definition of "viral load"?

Answer: The amount of the virus in a person's blood.

HIV Replication Cycle

Task: Use the following links to correctly order HIV replication cycle.

- NIAID: HIV Replication Cycle:
<http://www.niaid.nih.gov/topics/HIVAIDS/Understanding/Biology/Pages/hivReplicationCycle.aspx>
- Avert: HIV Structure and Life Cycle: <http://www.avert.org/hiv-virus.htm>
- Avert: Video explaining HIV Replication: <http://www.avert.org/media-gallery/video-89-hiv-life-cycle>

- 7 ____ The virus matures by protease releasing individual HIV proteins.
- 4 ____ Viral DNA is transported across the nucleus and integrates into the host DNA.
- 5 ____ New viral RNA is used as genomic RNA and for making viral proteins.
- 2 ____ HIV RNA, reverse transcriptase, integrase, and other viral proteins enter the host cell.
- 1 ____ Fusion of the HIV cell to the host cell surface.
- 3 ____ Viral DNA is formed by reverse transcription.
- 6 ____ New viral RNA and proteins move to cell surface and a new, immature, HIV virus forms.

Task: Use the HIV Replication Cycle webpage to match the glossary term to the correct definition.

NIAID HIV Replication Cycle:

<http://www.niaid.nih.gov/topics/HIVAIDS/Understanding/Biology/Pages/hivReplicationCycle.aspx>

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| a. CD4 | b. Co-receptor (CCR5 or CXCR4) | c. DNA (deoxyribonucleic acid) |
| d. Fusion of virus and cell membranes | e. gp120 | f. HIV (human immunodeficiency virus) |
| g. Integrase | h. Virion | i. RNA (ribonucleic acid) |
| j. Protease | k. Nucleus | l. Reverse transcriptase |



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h. Virion – a single and complete extracellular infective form of a virus that consists of an RNA or DNA core with a protein coat or "envelope".

f. HIV (human immunodeficiency virus) – is a lentivirus and a member of the retrovirus family. HIV infects and destroys helper T cells of the immune system causing a marked reduction in their numbers. Loss of CD4 cells leads to generalized failure of the immune system and susceptibility to life threatening opportunistic infections.

b. Co-receptor (CCR5 or CXCR4) – protein molecules on the surface of lymphocytes or monocytes that bind to the gp120 protein of HIV and facilitate, usually with CD4, entry of viral nucleic acid and proteins into the cell.

c. DNA (deoxyribonucleic acid) – A nucleic acid that contains the molecular basis of heredity for all known living organisms and some viruses and is found in the nuclei and mitochondria of eukaryotes. It consists of two polymer strands of units called nucleotides made up of one of four possible bases plus sugar and phosphate groups. The polymers are joined at the bases by hydrogen bonds to form a double helix structure.

k. Nucleus – An organelle of eukaryotes that functions to contain the genomic DNA and to regulate gene expression.

a. CD4 – A large glycoprotein that is found on the surface of helper T cells, regulatory T cells, monocytes, and dendritic cells. Its natural function is as a co-receptor that assists the T cell receptor (TCR) to activate its T cell following an interaction with an antigen presenting cell. This protein is a primary receptor used by HIV-1 to gain entry into host T cells.

i. RNA (ribonucleic acid) – a nucleic acid that differs from DNA in that it contains ribose and uracil as structural components.

j. Protease – an enzyme that hydrolyzes or cuts proteins and is important in the final steps of HIV maturation

d. Fusion of virus and cell membranes – a merging of cell and virus membranes that permits HIV proteins and nucleic acids to enter the host cell.

g. Integrase – An enzyme found in retroviruses, including HIV, that permits the viral DNA to be integrated into the DNA of the infected cell.

e. gp120 – an HIV glycoprotein having a molecular weight of 120 that protrudes from the outer surface of the virion. This glycoprotein binds to a CD4 receptor on a T cell to facilitate entry of viral nucleic acid and proteins into the cell.

l. Reverse transcriptase – an enzyme found in HIV that creates double stranded DNA using viral RNA as a template and host tRNA as primers.