Viruses, HIV and AIDS

AIDS (acquired immune deficiency syndrome) first appeared in the news in 1981 with cases being reported in L.A. By 1983, the pathogen causing the disease has been identified as HIV (human immunodeficiency virus).

HIV is a __________ that infects __________.

Retrovirus: enveloped RNA virus which translates into DNA once inside the host cell

Helper T cell: A type of WBC that helps stimulate the immune system reaction(s)

At this time there is no cure or vaccine and the disease has taken the form of a __________ (global epidemic) killing more than a million people each year. It has probably been __________ (already exists) in some African regions for decades.

Symptoms
The range of symptoms resulting from the HIV infection is huge and not directly the result of the virus. The symptoms arise from an onslaught of secondary infections that manage to take over the body due to the suppression of the immune system (lack of helper T cells). AIDS is actually only the end stage of an HIV infection. The three common stages of an HIV infection are listed below along with some common symptoms.

The Stages of an HIV Infection:

Some Symptoms:

- Fever, lymphoma, dementia
- Eye infections
- Skin infections
- Open sores + lesion in mouth
- Other infections including TB, pneumonia, etc
- Diarrhea
- Weight loss
- Kaposi’s sarcoma (skin tumors)
Transmission: HIV is transmitted in:
- unprotected sex
- needle sharing
- blood transfusion
- breast milk
- during child birth (blood)

In developed counties, infections via blood transfusions are rare as blood is now being tested for HIV antibodies.

HIV's ability to destroy, evade and hide inside cells of the human immune system makes it difficult to treat. Research is currently taking place into possible vaccinations and chemotherapy treatments. The first chemotherapy drug to show promise was AZT (inhibits reverse transcription). There are also protease inhibitor drugs (block the formation of the HIV protease enzyme) allowing HIV to make copies of itself that can’t effect other cells.

The Origin of HIV

There are two known strains of HIV. Researchers have confirmed that both of these originated from cross-species transmission from other primates. HIV-1 (responsible for the global pandemic) arose from simian immunodeficiency virus (SIV) in infected chimpanzees in west-central Africa. HIV-2 is less virulent than HOV-and, until recently, was restricted to West Africa. It originated from a strain of SIV found in sooty mangabey monkeys. The killing of primates for human consumption allowed the virus to transmit to human hunters when they handled infected carcasses with cuts or open wounds on their hands.

Social behaviours and risk factors
- Little or no condom use
- Large proportion of adults with multiple partners
- Large sexual networks (individuals who move back and forth between home and far off work places)
- Women’s economic dependence on marriage or prostitution robbing them of control over the circumstances or safety of sex.

Biological risk factors
- High rates of sexually transmitted infections
- High viral load (HIV levels in the blood are typically highest when an individual is first infected and then again in the later stages)
- Low rates of male circumcision (although poorly understood, circumcised males have a reduced risk of contracting HIV.)

![Diagram of HIV and CD4 cells]
HIV Infection

HIV infects a particular type of immune system cell, the CD4 + T Helper cell, or just plainly, the T Helper Cell. Once infect, 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.

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 (labeled q) dark green. CD4 antigens are located on the cell membranes of the cell (f) which should be colored black. At this point, the virus and the cell membrane fuse and the virion core enters the cell. The core contains the viral genes.

Step 2 - The viral RNA and core proteins are released into the cytoplasm where reverse transcriptase converts the viral RNA to DNA. The viral RNA is colored as above, and the viral DNA (h) should be colored red.

Step 3 - Viral DNA, now double stranded is transported into the nucleus (continue to color all instances of viral DNA red) and the nuclear membrane (n) grey. In the nucleus, an enzyme fuses it with the host cell's normal DNA. Viral DNA can persist within the cell's DNA for many years in a latent state, which further complicates efforts to treat or cure the disease. Lightly color the host cell DNA blue in all instances (labeled g). The viral DNA is transcribed into two splices of RNA, a shorter splice (j) and a longer splice (i) which are destined for two different things. Color the short splices yellow and the long splices orange in all instances.

Step 4 - The short spliced RNAs are transported to the cytoplasm and the golgi apparatus where their message is used to create viral proteins which will become part of the completed virus. Color the golgi apparatus (k) purple and the viral proteins as you did in the other instances (brown). The longer splices are the full length viral RNA and will become the core of new viruses. Another enzyme, called protease is needed to assemble the proteins into their final functional forms. Protease inhibitors are another drug used to combat AIDS.

Step 5 - Using the proteins assembled from the golgi apparatus and the completed viral RNA from the long strands, the mature virus buds off from its host cell. The process of budding destroys the host cell.
a) envelope proteins - brown
b) virus capsule - dark green
c) viral RNA - pink
d) lipid membrane - light green
e) reverse transcriptase - yellow
f) host cell membrane - black
g) host DNA - blue
h) viral DNA - red
i) long splice viral RNA - orange
j) short splice viral RNA - yellow
k) golgi apparatus - purple
m) viral proteins - brown
n) nuclear membrane - grey
q) e) CD4 antigens - dark green