5.3 TRANSCRIPTION

Case Study: Human Immunodeficiency Virus

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Understanding Concepts

1. No, HIV cannot attach itself to a muscle or a skin cell. HIV’s antigens are not complementary to the binding sites (receptors) of skin cells and muscle cells (Figure 6, p. 245 in the Student Text).
2. You cannot obtain AIDS through shaking hands, because for the AIDS virus to be transmitted, there must be contact between two individuals via body fluids. This type of contact includes sexual contact, blood transfusions, or from mother to child during pregnancy. There is no exchange of bodily fluids through shaking hands; hence, AIDS cannot be transmitted in this manner. The antigens on HIV are not complementary to the receptor sites on skin cells; therefore, HIV cannot bind to skin cells.
3. Reverse transcriptase uses RNA as a template and builds a complementary DNA strand, thereby transcribing RNA into DNA. Reverse transcriptase is an appropriate name for the enzyme, given that conventional transcription of genetic material is in the direction of DNA to RNA. In this case, RNA is transcribed into DNA, meriting it the label of reverse transcription.
4. If a helper T cell divides and viral DNA has been incorporated into the cell’s genome, it will also be replicated and be present in both of the daughter cells.
5. HIV can stay dormant for many years before symptoms are exhibited in its carrier, therefore, an individual can be infected with HIV but not necessarily show any symptoms.
6. People who are infected with HIV usually die of another infection because HIV attacks helper T cells, which are part of a human’s immune system. Helper T cells act as guards against invading pathogens. Since HIV destroys helper T cells, the body cannot launch an immune response to secondary infections such as pneumonia. Therefore, a person infected with HIV is susceptible to infection.
7. Severe combined immunodeficiency (SCID) is a genetic disease. SCID has three major causes: (1) the helper T cells are absent or functioning poorly, (2) the thymus gland is absent or functions poorly, or (3) the bone marrow stem cells from which the mature T cells develop are defective or absent. In the absence of T cells, the immune system cannot function normally. The thymus gland is the organ in which immature cells from the bone marrow mature and “learn” how to become helper T cells, suppressor T cells, or killer T cells. If the thymus is not working properly, no mature T cells are produced. In binary, the original source of the T cells may be defective. The mature T cells are derived from very immature cells of the bone marrow called stem cells. In some forms of SCID, bone marrow stem cells are missing. SCID differs from AIDS in that it is a genetic disease, whereas AIDS is viral based. SCID has numerous origins, whereas AIDS is solely caused by infection from HIV.
8. Antibiotics and other drugs are specifically designed to target a specific virus. The drugs must recognize the virus to be effective. Drugs recognize viruses by the protein particles that they carry on their outer membrane. If a virus mutates, it is possible that the protein found on its outer membrane will be affected and change shape. If protein conformation changes, the drug may no longer be able to recognize the virus and therefore will become ineffective.
9. Inquiring about a person’s travel before their blood is accepted at a blood bank is a preventative measure. In some parts of the world there, is a greater chance of becoming infected with a specific virus as compared with other parts of the world. Canadian Blood Services screens its donors, since people may be unaware that they are carriers of the virus.
10. HIV cannot be transmitted through food or beverages. Viruses need to infect a host cell to survive. When a virus gains entry to a host cell, it uses the cell’s biochemical machinery to propagate itself. A virus must come into contact with a bodily fluid to have access to human cells. Food and beverages prepared by an individual who is HIV positive are not vehicles of HIV transmission, given that food consists of dead cells and beverages are not cell based. Therefore, food and beverages cannot harbour the HIV virus.

Making Connections

11. Student answers will vary. Medical professionals wear gloves, facemasks, and other protective clothing to keep them from being infected with HIV and any other virus. Hospitals and other care facilities are careful about properly disposing all sharp instruments, such as needles and blades, as toxic waste. Instruments are autoclaved, sterilized using high-pressure steam, to kill any viruses.
12. Student answers will vary. Some possible ways that the spread of AIDS can be prevented is through education, the wearing of condoms during sexual intercourse, and needle exchange programs for drug users.