

Questions

- 1. Which of the following statements is (are) true?**
 - (a) Viruses can replicate outside of host cells.
 - (b) The common cold is a bacterial disease.
 - (c) Influenza A only infects humans.
 - (d) HIV evolved from SIV.
 - (e) It is possible to eradicate certain viruses through vaccination.
- 2. Viruses use the host cell's machinery to make copies of themselves. However, some human viruses need their RNA to be "transcribed" into DNA during their replication/life cycle, whereas human cells do not normally process heritable information in this direction (i.e. RNA to DNA). How could the virus replicate itself under these circumstances?**
 - (a) The virus causes mutations in the human DNA, resulting in the production of new enzymes, which are able to perform the required functions.
 - (b) The viral RNA codes for specialised enzymes—not found in uninfected cells—that are able to perform the required functions.
 - (c) Viruses stay in a dormant state within the host cell until the host cell evolves this ability.
 - (d) If the host cell cannot transcribe RNA into DNA, the virus switches to a different mode of replication.
 - (e) The virus infects only those cells that can perform all the roles necessary for replication.
- 3. In 2009, an H1N1 influenza A pandemic occurred, caused by a virus that was different from the seasonal human H1N1 viruses that had been circulating among people for years. The flu was named "swine flu", as it was thought that the virus was first transmitted from pig to human. Further examinations found various sequences from bird, pig, and human viruses within this newly identified virus. What is the most likely explanation for why this virus contained sequences from bird, pig, and human viruses?**
 - (a) The virus was descended from a common ancestor of bird, pig, and human flu viruses.
 - (b) The first infected human happened to be infected with all three virus types.
 - (c) Pigs became coinfecting by various influenza A strains of multiple origins, and reassortment of genome segments occurred during viral assembly.
 - (d) The human was likely infected with various bacterial strains that contained all three RNA viruses.
 - (e) As the virus travels from host to host, it takes useful parts of the host DNA with it.
- 4. Common cold is caused by many different viruses, mostly different kinds of rhinoviruses. Which of the following statements does this fact imply?**
 - (a) Cold-causing viruses evolve extremely quickly, even during the same infection within one host.
 - (b) We don't gain lifelong immunity after fighting a cold; we can get a cold over and over again.
 - (c) Our body cannot synthesise antibodies against cold-causing viruses.
 - (d) If our body cannot produce the right antibodies against the particular cold-causing virus, it is necessary to take antibiotics to fight the virus.

- (e) Handwashing is not an effective way to prevent the common cold from spreading.
5. **Picture the following scenario: A country introduces a rubella vaccination. Before this, no-one in the population had been vaccinated. From then on, 40% of all children receive a rubella vaccine at 15 months of age. Few people get vaccinated later in life. What are likely consequences?** (*Information: Infection with rubella confers life-long immunity.*)
- (a) Over the years, the average age at which unvaccinated people are infected increases.
 - (b) The virus spreads much more rapidly than before.
 - (c) Fewer children get the disease.
 - (d) If a rubella epidemic happens 25 years after introduction of the vaccine, a large number of children with birth defects due to the viral infection of the fetus will be born (“large” compared to a population without vaccination).
 - (e) The virus infects more infants (< 15 months) than before.
6. **Cowpox is an infectious viral disease. The virus mainly infects rodents but also other animals including cows (the reason for its name) and humans. In humans, it leads to a rather harmless disease that resembles a mild form of smallpox, which in turn is a severe human disease with high mortality. By the second half of the 18th century, it had been realised that people who had overcome cowpox (e.g. milkmaids who had contracted the disease from cows) would not fall ill of smallpox. How can this be explained?**
- (a) The cowpox virus occupies the same cells that the smallpox virus needs to infect to cause disease. Since they are already occupied by the cowpox virus, the smallpox virus cannot infect them anymore.
 - (b) Cowpox and smallpox have similar antigens, and antibodies developed against cowpox are also effective against smallpox. This is unusual.
 - (c) When the cowpox and the smallpox virus infect the same cell, their genomes recombine. The recombined virus is harmless. Since so many cells are coinfecting by both viruses, no pure harmful smallpox virions will be assembled.
 - (d) The cowpox virus stimulates certain bacteria on our skin to change their surface proteins. As a consequence, the smallpox virus is able to infect the bacterial cells and prefers those over the human cells.
 - (e) The cowpox virus kills the cells that the smallpox virus needs to infect to cause disease. These cells are only renewed very slowly, meaning that the smallpox lacks cells to infect for up to a year following a cowpox infection.

(The physician and scientist Edward Jenner (1749-1823) pursued this further – about a hundred years before viruses were even discovered. In 1796, he inoculated an 8-year-old boy with pus from the cowpox blisters of a milkmaid. Two months later, he inoculated him with the pus of smallpox blisters – the boy did not turn ill. Edward Jenner’s development of the very first vaccine was at the same time the first step on the way to the eradication of smallpox. – The word ‘vaccination’ is derived from the Latin word ‘vaccinus’, which means ‘coming from a cow’.)