Influenza and the Immune System

Name: __________________________

How your body fights influenza

Influenza is a respiratory illness caused by a virus that infects the cells lining the lungs, nose, and throat. To infect your cells, the virus has to enter them. To do that, the hemagglutinin protein on the virus binds to a receptor on the cell. The binding of the virus causes the cell to undergo endocytosis. Once inside, the virus starts making more viruses. Viruses use the “machinery” of the host cell to make new copies of their genetic material and to make proteins. These parts are assembled into a large number of new viruses.

One way your body fights influenza infections is by developing antibodies to the hemagglutinin on the virus. When antibodies attach to hemagglutinin, they keep the virus from attaching to healthy cells. This keeps the virus from infecting these cells.

**Figure 1. Schematic of antibodies binding to the surface of the influenza virus.**

*Source: National Institute of Allergy and Infectious Diseases.*

Influenza, the immune system, and natural selection

Scientists have explored changes in the hemagglutinin gene in many influenza viruses that circulated around the world. Some mutations resulted in changes in amino acids that make up hemagglutinin. These changes affected how the protein bound to cell receptors. Because these changes altered the phenotype, they affected a virus’s ability to infect a cell.

Other mutations in the hemagglutinin gene did not cause a change in any amino acids that make up hemagglutinin. These mutations did not affect a virus’s ability to infect cells. As a result, these mutations are mostly “invisible” to the process of natural selection.

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Scientists test for natural selection by comparing the number of mutations that caused amino acid replacements with the number that did not. For hemagglutinin in influenza viruses, scientists found that the number of mutations that cause amino acid replacements is higher than expected. This helped scientists conclude that the influenza virus seems to be evolving by natural selection by avoiding detection by the immune system. Natural selection is part of why influenza virus populations change over time.

**Questions**

1. Assume there is a change in the gene for hemagglutinin in the influenza virus. Describe how this change could alter the ability of an animal’s antibodies to bind to the virus.

2. Imagine an influenza virus that has a mutation that changes the shape of its hemagglutinin protein. Because of this change, antibodies no longer bind to the virus. A second virus does not have the mutation, and antibodies can bind to its hemagglutinin protein. Which virus would leave more descendants? Describe why you answered as you did.

3. How does learning about the immune system help explain the rapid rate of change in the hemagglutinin sequences you observed?

4. When you get an influenza vaccine, you develop antibodies to the hemagglutinin protein for the strains of virus included in the vaccine. Use what you learned in this portion of the activity to revise and improve the answer you gave to Question 5 on the *Notes about Influenza and Evolution* (Master 4.2) handout.