Bio 067, Fall 2003: Practice questions example answers

2. **Preventative measures** for a number of diseases include wearing **long pants** and **long-sleeved shirts** and using **bug repellent**. Name **four (4) diseases** for which these measures are recommended and **state why** these actions are a **good idea**.

Diseases: Dengue Fever, Lyme Disease, West Nile Fever, Malaria.

Since mosquitoes (Dengue, WNF, malaria) or ticks (Lyme) carry the microbes that cause these (vector-borne) diseases, covering one's body minimizes the ability of the vector to bite and transfer the microbe. In addition, using repellent helps keep the vectors at a distance to avoid transmission.

4. We tend to think of **bacteria** as ne'er-do-well, **havoc-wreaking**, worthless creatures, yet advertisers make a strong pitch for yogurt with **live *Acidophilus*** cultures.
Why can it be to **our advantage** to eat yogurt **containing** this **bacterium**?

Although *Acidophilus* bacteria can grow and multiply in our bodies, they do not cause any damage to their host (i.e. no disease). However, there are numerous other bacteria (as well as micro-organisms like fungi) that can cause damage to the human body. If *Acidophilus* is present in a host at the same time as harmful micro-organisms, it will compete with these harmful microbes for nutrients, limiting their growth and therefore minimizing the damage they do to the body.

5. One reason we have heard **against vaccination** for a disease (e.g. Lyme disease).is that **prior vaccination** can make it **difficult to detect subsequent infections** by a microbe, if the vaccine is not 100% effective.

A. **What type** of **diagnostic technique** for infection would be **obscured by vaccination** and **why**?

Any diagnostic technique that looks in a host for the presence of antibodies that recognize a certain infectious agent will be obscured by vaccination. One such technique is a fluorescence microscopy test in which cells infected with the agent to be tested are mixed with serum from a patient, all antibodies from the serum that have not bound to the infected cells are washed away and then bound (agent-specific) antibodies are detect with a second antibody that is fluorescent (glowing under the microscope=presence of antibodies for the specific agent). If a person has been vaccinated, they should have antibodies that are specific for the agent, whether or not they have been infected. So if their test comes up positive, it could be that they had been exposed to the agent or that their vaccination worked to cause them to make specific antibodies.

B. Is there **another technique** that might be useful to **distinguish** people/animals with **active microbial infections** from those who were **vaccinated**?

The use of the polymerase chain reaction (PCR) allows one to make multiple copies of genes from a specific agent you are testing for (used in SARS outbreak). Even if a "live" vaccine was used for vaccination, the body gets rid of the agent long before its immune response dwindles. One will only be able to detect the agent's genes (DNA or RNA) if the agent itself is there, whereas antibodies that recognize the agent can be present after the agent is cleared.

6. Give **three (3)** examples of how a **microbe** can **evade** the host's **immune system**. For each, describe the **evasion strategy** and a **microbe** that makes use of that strategy.

1. A microbe can mutate its genes such that the proteins that are normally recognized by the immune system no longer have the same amino acid sequence. Then B-cells (antibodies) and T-cells that bound to certain protein sequences will no longer recognize the microbe's protein and lead to the death of the microbe (or the cell it is infecting). Influenza virus (and many other microbes) uses this strategy.

2. A virus that integrates its DNA into the host DNA and does not express proteins can hide from the immune system (which specializes in recognizing foreign proteins). Human immunodeficiency virus reverse transcribes its RNA into DNA and then uses this strategy to hide for a longer period of time.

3. A microbe that causes a quick infection, entering, multiplying in, and leaving a host within a few days can escape the adaptive immune system, which takes two weeks to become fully active. Cold viruses and influenza virus use this strategy.

Other examples?

7. Why are blood banks worried about **mad cow disease**? **Explain** the **nature** of the **etiological agent**, **how** it **differs** from **other infectious agents** we have studied, and **why** it might be **difficult to detect** once it enters the blood supply.

Mad cow disease is caused by a prion, an altered, disease-causing form (structure) of a normal mammalian protein. This form of the protein can force normal forms of the protein to adopt the altered structure and therefore increase the amount of disease-causing form present in the body. Unlike other infectious agents, this agent does not have its own genes (RNA or DNA), "convincing" normal protein to become like itself rather than making more copies of itself from scratch. Since the altered form still has the same amino acid sequence as the normal form, once it enters the blood supply it would be difficult to distinguish it from the normal form, which would also be present.

8. What are the **advantages** and **disadvantages** of **smallpox** as a **biological weapon**? Give at least **two (2)** advantages and **two (2)** disadvantages.

Advantages

1. Smallpox is very contagious and is spread easily from person to person (respiratory).
2. Although there is an effective vaccine, it is not currently widely used and therefore many people are susceptible.
3. The short incubation time for smallpox allows it to do more harm quickly and to instill panic in the public
4. The initial flu-like symptoms of smallpox make it hard to diagnose early.

Disadvantages

1. Smallpox cannot survive for long outside the host.
2. Smallpox stocks are few in number and difficult to access.