Unit 4: Homeostasis Part 2 – Immune & Essential Skills

4-1. Explain the differences between a bacteria and a virus in terms of how they reproduce, their structure and effect treatments. (CSS: 1c, 10c-d)

4-2. Explain the differences between the body's specific & non-specific defenses. Give 3 examples of each type of defense. (CSS: 10a, 10f)

4-3. Explain how the Circulatory System and Respiratory System complement each other in providing cells with nutrients and removing toxic waste products. (CSS: 9a)

Vocabulary – see website

Study Guide

1. Explain the difference between a pathogen, parasite and an antigen. A pathogen is any biological agent that causes damage to cells & causes disease. A parasite is an organism that lives in or on a host and feeds on its host. An antigen is a marker protein on the cell membrane.

2. a) Give an example of a pathogen from each kingdom of life. Explain how they are transmitted and how to treat or prevent an infection of each pathogen.

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Example</th>
<th>Transmission</th>
<th>Treatment/Prevention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacteria</td>
<td>E. coli, salmonella</td>
<td>Direct contact (usually contaminated food)</td>
<td>Wash food before preparing, rest, antibiotics</td>
</tr>
<tr>
<td>Protozoa</td>
<td>giardia</td>
<td>Contact with contaminated water</td>
<td></td>
</tr>
<tr>
<td>Fungi</td>
<td>ringworm, athletes’ foot</td>
<td>Direct contact with fungus</td>
<td>Antifungal creams or oral medication</td>
</tr>
<tr>
<td>Plant</td>
<td>generally causes allergic reactions</td>
<td>Often airborne</td>
<td>Antihistamines</td>
</tr>
<tr>
<td>Animal</td>
<td>tape worm, roundworm</td>
<td>Eating contaminated food</td>
<td></td>
</tr>
</tbody>
</table>

b) What are Prions and Viruses? Why are they not classified in a Kingdom? Give examples of pathogens in each of the categories.

Prions – proteins that cause damage to cells, ex: Mad Cow Disease (no treatment known)
Viruses – DNA molecules surrounded by a protein coat, ex: influenza (prevented by vaccines)
Neither prions nor viruses are able to reproduce, maintain homeostasis, or metabolize, so they are not considered to be living things

3. a) What is the difference between nonspecific and specific immune defenses? Give 3 examples of each. Nonspecific immune defenses will protect the body from any pathogen. Examples of nonspecific immune defenses are skin, mucus membranes, mucus, anti-microbial proteins, nose hair, stomach acid and macrophages. Specific immune defenses will fight a specific pathogen. Examples of specific immune defenses are helper T cells, cytotoxic (killer) T cells, B cells and antibodies.

b) Why is a macrophage part of your specific and non-specific defenses?

Macrophages are part of both the nonspecific and specific immune defenses because they will destroy cells that are infected with any type of pathogen, but they activate helper T cells and start the specific immune response.
4. Fill in the chart below and explain what is occurring at each step.

5. a) How are Helper T-cells different from Cytotoxic (killer) T-cells in the way they defend your body? Helper T cells activate the killer T cells & B cells, but they do not directly fight off pathogens. Killer T cells destroy cells that have been infected by specific pathogens.

   b) How are B-cells involved in your specific defense? B cells produce antibodies that are specific to each pathogen.

6. a) What are antibodies?
   Antibodies that bind to the antigen on a pathogen, preventing the pathogen from entering body cells.

   b) How does your body develop immunity to a specific pathogen?
   After an infection, some killer T cells and B cells remain as memory cells that will fight off a pathogen if it appears again.

   c) How does a vaccine work?
   A vaccine contains antigens from a pathogen that cause the immune system to produce killer T cells & B cells

7. Explain the difference between immunodeficiency and autoimmunity? Give examples of each of these disorders.
   Immunodeficiency results in a weakened immune system that cannot respond well to pathogens. Autoimmunity occurs when the immune system attacks the body’s own cells.
8. Label the structures on the heart below. Explain the function of each structure.

9. a) What is the difference between an **Artery**, **Vein** and **Capillary**?
   - **Artery** – carries blood away from the heart
   - **Vein** – carries blood in to the heart
   - **Capillary** – tiny blood vessels that surround the body’s cells and the alveoli; diffusion of gases occurs across the capillaries in or out of the blood

   b) What are the **Aorta** and the **Vena Cava**?
   - **Aorta** – see #8
   - **Vena Cava** – see #8

10. Describe the route that blood takes through the **pulmonary circuit** and the **systemic circuit**?
    - **Pulmonary circuit** – the circulatory circuit between the heart and the lungs
    - **Systemic circuit** – the circulatory circuit between the heart and the rest of the body

11. Explain the difference between **Diastolic** and **Systolic blood pressure**. What is a normal blood pressure? What are 3 factors that may increase a person’s blood pressure?
    - **Diastolic pressure** is the pressure of the blood against the artery walls while the heart is relaxed. **Systolic pressure** is the pressure of the blood against the artery walls when the heart contracts. Normal blood pressure is approximately 120/80 mmHg (systolic/diastolic).
    - Some factors that may increase blood pressure are high cholesterol, obesity, unhealthy diet, lack of exercise, stress, and smoking.

    - **RBCs** (45%) – transport oxygen molecules
    - **WBCs** (<1%) – fight off pathogens
    - **Platelets** (<1%) – clot the blood
    - **Plasma** (55%) – carries nutrients, water, proteins and hormones

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13. Imagine that you are a cardiac surgeon and you have a patient needing a heart transplant. Your patient's blood type is B-negative. There is a heart available on the transplant list from an individual whose blood type was O-positive. Is this heart a good match to your patient? Why do you need to be concerned about blood types when transplanting organs or blood? Explain how the patient’s body might respond if you performed the transplant. The heart from an O-positive donor would not be a good match for a B-negative recipient because the recipient’s blood contains antibodies for the Rh factor that would be found in the donor’s blood. The recipient’s immune system would respond to the heart as though it were a pathogen and would destroy the cells of the heart.

14. Why do your cells need oxygen? Explain how oxygen is acquired from the atmosphere and transported to each of your cells. Include the terms external & internal respiration, diffusion and hemoglobin in your explanation.

Your cells need oxygen to carry out the reactions of cellular respiration, which provide energy for your cells. Oxygen is acquired from the atmosphere during external respiration, when air enters the lungs filling up the alveoli and diffuses across the capillaries into the blood (atmosphere → blood). Oxygen is transported throughout the body bound to the hemoglobin molecules inside of red blood cells. The blood reached the body’s cells through capillaries, where the oxygen diffuses out the RBCs, through the capillary wall and into the body cells in a process called internal respiration (blood → body cells).

15. Explain the role of the immune system, lymphatic system, circulatory system and respiratory system in maintaining homeostasis in the human body.

The immune system acts to protect tissues from damage so they may continue to function properly. The lymphatic system removes excess fluids and waste from tissues so they may continue to function properly. It is also involved in the production of mature WBCs. The circulatory system transports blood (nutrients, water, oxygen & waste) throughout the body, helping to maintain healthy levels of O₂, CO₂, water, etc. The respiratory system exchanges gases with the atmosphere, maintaining healthy levels of oxygen & carbon dioxide in the body.