# Focused Learning Lesson
# Science
# Grades 9-12
# LS-H-G3

**Overview:**
This lesson can be used to review the concepts of immunity and the body's way of defending against invading organisms. This lesson uses terminology and visual card sorts to assist the review process.

**Approximate Duration:** One 45-minute class period

**Benchmark:**
**LS-H-G3** explaining the role of the human immune system in fighting disease.
**Biology GLEs:**
39. Compare the functions of the basic components of the human immune system.
40. Determine the relationship between vaccination and immunity.

**Benchmark:**
**SI-H-A3** using technology and mathematics to improve investigations and communications
**SI GLE:** 5. Utilize mathematics, organizational tools, and graphing skills to solve problems.

**Objectives**:
1. The learner will identify the body's nonspecific and specific defenses against invading pathogens.
2. The learner will describe immunity and the cells involved in immunity.
3. The learner will explain the differences between active and passive immunity.

**Teacher Preparation:**
- Photocopy and cut out enough sets of cards for groups of two to three students.
- Mix each set of cards and place the set in an envelope.
- Assign students to groups of two or three prior to the beginning of the lesson.
- See Attachment 1 for teacher background information.
- See Attachment 2 for card sort for students.
- See Attachment 3 for correct key of card sort words and pictures.
- Make a transparency of Attachment 4 for review of material.
- See Attachment 5 for correct answers to Attachment 4.
- Make a transparency of Attachment 6 for complete assessment of student learning of the immune system and organisms that cause disease/infection.
- See Attachment 7 for answers to complete assessment of student learning of the immune system and organisms that cause disease/infection.

**Materials/Equipment/Resources:**
- Card sorts
- Transparencies
- Overhead projector

**Lesson Procedures:**

*Opener:*

Start the discussion by asking students to explain the organization of a castle' defenses. Hopefully, they will say a large brick/stone building with a wall around it to protect it. It has a moat that protects the castle too. There are guards in the castle for protection in case intruders get past the wall. Explain to the students that the body's immune system is like a castle with a fortress and guards. There is a primary system for warding off invaders. If invaders get past the primary system, there are guards (cells) to fight invaders inside the castle.

*Body of the Lesson:*

1. Explain that the immune system is the body's primary defense against pathogens. It consists of nonspecific and specific defenses against infection. Nonspecific defenses are the fortress walls of the system. They keep everything out and guard against all infections. Specific defenses work like security guards. They track down harmful pathogens that have managed to break through the body's nonspecific defenses.
2. Review with students the nonspecific defenses (first and second lines of defense).
3. Review with students the specific defenses: humoral (antibody) immunity, cell mediated (macrophages) immunity, and acquired immunity.
4. Pass out the card sorts. Instruct students to match a picture with the word and definition of the word.
   - Walk around to the room to check for understanding and probe for questions.
   - Allow 7-10 minutes for activity.
   - Once the students have completed the task, review the card sort with the students.
5. Review with students the difference between active and passive immunity and vaccination.
6. Use assessment items to ensure that students understand concepts.

*Closure:*

1. Review all concepts to ensure student understanding. Use Attachment 4 for review of material. Have students fill in the blank boxes and discuss correct responses. Attachment 5 contains the teacher's key.
2. As an overall assessment, use Attachment 6 for complete assessment of student comprehension of the immune system and pathogenic organisms. Attachment 7 has the teacher key.

**Attachments:**

Attachment 1: Teacher Background
Attachment 2: Student Card Sort
Attachment 3: Key for card sort
Attachment 4: Review of Material
Attachment 5: Key for Review of Material
Attachment 6: Complete Assessment
Attachment 7: Key for Complete Assessment

**Sample Assessment Items:**

1. The most important nonspecific defense against pathogens is your
    a. Tears
    b. Mucus
    c. Saliva
    d. Skin

2. The swelling and pain associated with an inflammatory response are caused by
    a. Secretion of antibodies
    b. Expansion of local blood vessels
    c. Secretion of antigens
    d. White blood cells destroying bacteria

3. A protein that helps other cells resist viral infection is
    a. Interferon
    b. Penicillin
    c. Predispose
    d. Histamine

4. A substance that triggers the specific defenses of the immune system is a (n)
    a. Antibody
    b. Antigen
    c. B cell
    d. Pathogen

*Key: 1. – d., 2. – a., 3. - a., 4. – b.*

**References:**

Miller, K. (2002). *Biology* (pp. 1034-1040). Upper Saddle River, NJ: Prentice Hall.

Raven, P., Johnson, G. (1992) *Biology* (pp. 1088-1102). St. Louis, MS: Mosby-Year Book, Inc.

*Pictures:*
Miller, K. (2002). *Biology* (Presentation Pro – CD-Rom). Upper Saddle River, NJ: Prentice Hall.

# Attachment 1
# Teacher Background

**Nonspecific defenses**

1. First line of defense
   - Skin, mucus, sweat, and tears block entry of pathogens.
     - Oil and sweat glands produce an acid environment to kill bacteria.
     - Pathogens will enter broken skin.
   - Pathogens can also enter through your mouth and nose.
     - Mucus in your nose and throat traps pathogens and allow cilia to push them away from your lungs.
     - Stomach acid and digestive enzymes destroy many pathogens that make their way in to your stomach.
   - Many secretions, including mucus, saliva, sweat, and tears, contain lysozyme, an enzyme that breaks down the cell walls of many bacteria.

2. Second line of defense
   - If pathogens do manage to enter your body, they may multiply quickly, releasing toxins into your tissues. When this happens, the inflammatory response is activated.
     - The inflammatory response is a nonspecific defense reaction to tissue damage caused by injury or infection.
     - Blood vessels near the wound expand, and white blood cells leak from the vessels to enter the infected tissues.
     - The infected tissue may become swollen and painful.
   - When pathogens are detected, the immune system produces millions of white blood cells (leukocytes), which fight the infection. Phagocytes engulf bacteria.
   - In addition, the immune system releases chemicals that increase the core body temperature. You may have experienced this elevated body temperature, called a fever.
     - Many pathogens can only survive within a narrow temperature range. An elevated temperature slows down or stops the growth of such pathogens.
     - The higher temperature increases heart rate so that the white blood cells get to the sites of infection faster.
     - An increased temperature also speeds the activities of the white blood cells and the rate of the chemical reactions that help repair damaged tissues.

3. Interferon production
   - Interferon refers to a group of proteins that help other cells resist viral infection.
   - Interferon inhibits the synthesis of viral proteins in infected cells and helps block viral replication.
   - This slows down the progress of a viral infection and often gives the specific defenses of the immune system time to respond.

**Specific Defenses**

1. Humoral immunity
   - *Humoral* means immunity against pathogens in the body fluids (blood and lymph).
     - This immune response is produced by the action of B-lymphocytes, a type of white blood cell. B-lymphocytes are responsible for producing antibodies.
   - An *antibody* is the basic functional unit of the humoral immune response.
     - An antibody is a protein that helps destroy pathogens. It is shaped like the letter Y and has two identical antigen-binding sites. These sites allow each antibody to bind to two antigens.
     - *Antigens* are proteins are found on the surface of pathogens or cells.
   - A group of antibodies can act on antigens to link pathogens or cells together in a large mass. The clump attracts phagocytic white blood cells, which engulf and destroy the mass.

2. Cell-Mediated Immunity
   - Lymphocytes called helper T cells regulate the production of antibodies by B cells.
   - Other T cells can attack antigen-bearing cells directly. These are called killer T cells.
     - These killer cells transfer proteins into the cell membrane of a pathogen, causing fluid from inside the cell to leak out of the membrane. The rapid loss of material causes the cell to rupture and die.
     - This immune response, called *cell mediated immunity*, is particularly important in the case of pathogenic diseases.

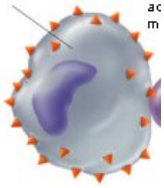
**Active immunity**

- A vaccine is the injection of a weakened, dead, or mild form of a pathogen to produce immunity.
- It is called active immunity because the body of the recipient has mounted an immediate active immune response against the pathogen.

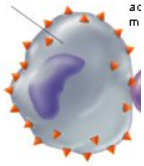
**Passive immunity**

- Antibodies produced by other animals for a pathogen are injected into the bloodstream; the antibodies produce a passive immunity against the pathogen as long as they remain in circulation, usually for several weeks.
- This form of immunity lasts only for a short time because the body destroys borrowed antibodies.
- Maternal immunity occurs when antibodies are passed from the mother to the fetus through the placenta or to the infant in mother's milk.
- Maternal immunity protects a child against most infectious diseases for the first few months of life, or longer if the child is breast-fed.

**Attachment 2**
**Card Sort**

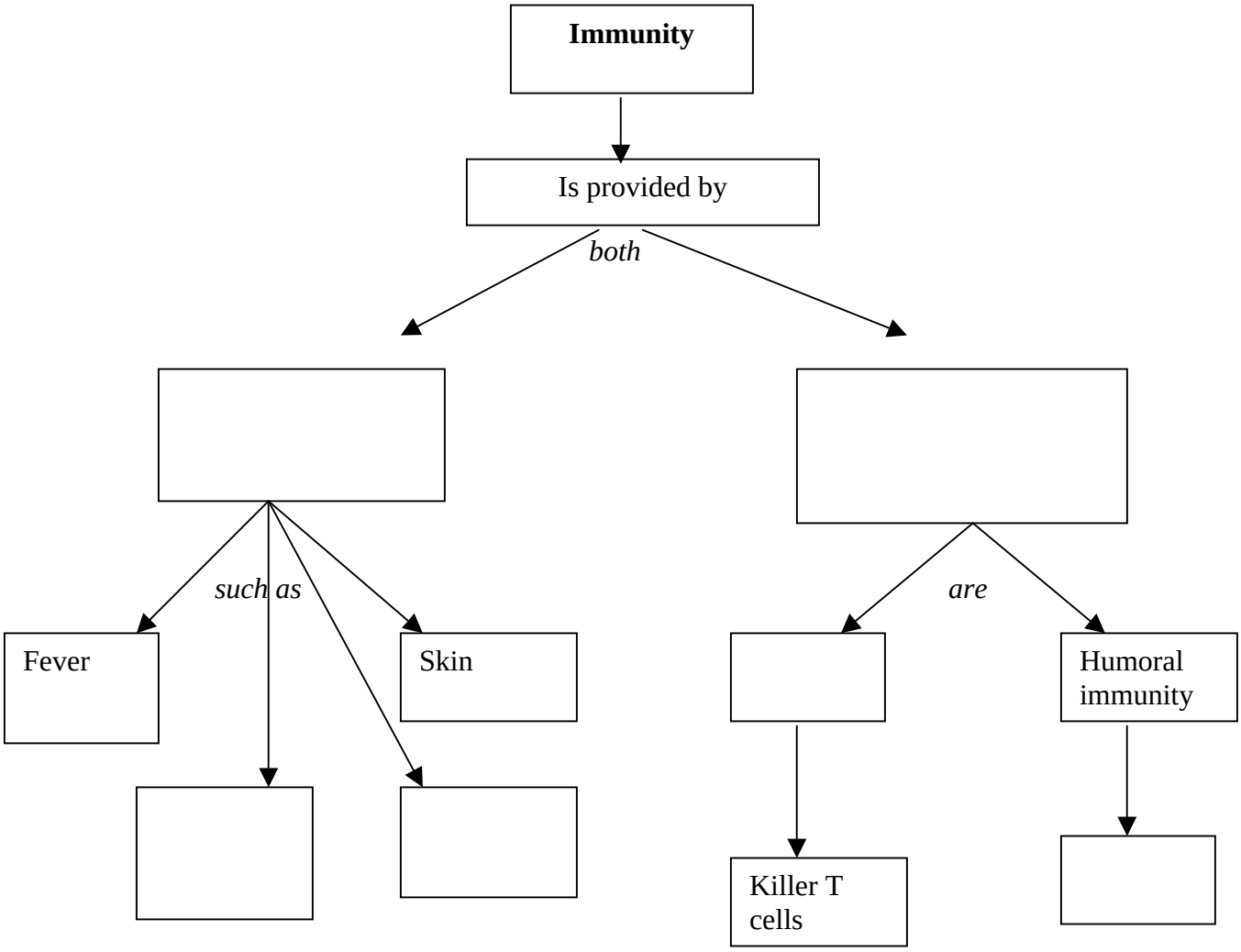
| | | |
|---|---|---|
|  | **Antibody** | White blood cells that produce antibodies |
|  | **Antigen** | Attacks antigen bearing cells |
|  | **B cell** | Proteins that bind to surface antigens |
|  | **T Cell** | White blood cells that can engulf pathogens |
|  | **Macrophage** | Substance that triggers an immune response |

## Attachment 3
## Key for Card Sort

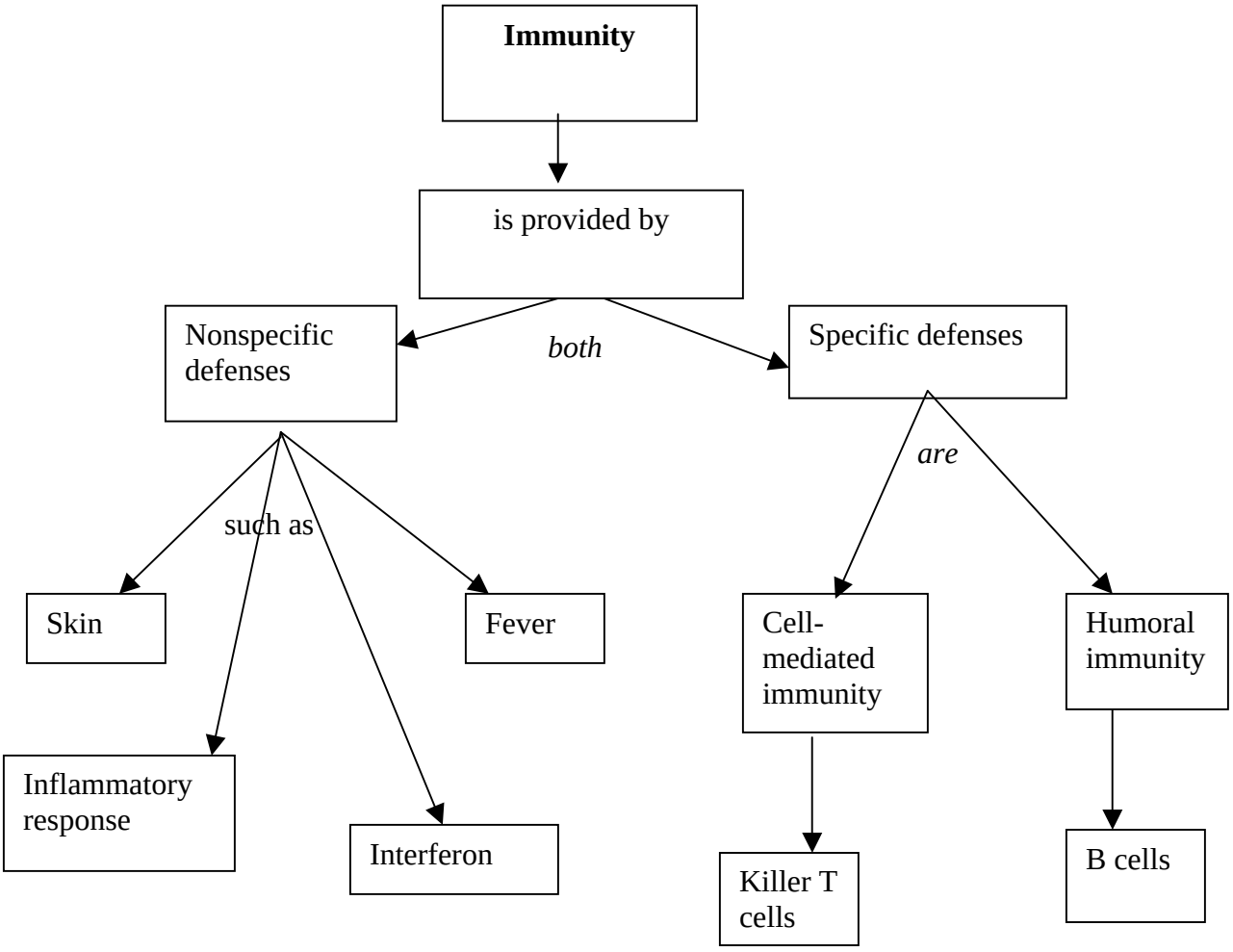
| | | |
|---|---|---|
|  | **Antigen** | Substance that triggers an immune response |
|  | **Antibody** | Proteins that bind to surface antigens |
|  | **B cell** | White blood cells that produce antibodies |
|  | **Macrophage** | White blood cells that can engulf pathogens |
|  | **T Cell** | Attacks antigen bearing cells |

## Attachment 4
## Review of Material

*Complete the concept map below.*



**Attachment 5**
**Key for Review of Material**



**Attachment 6**
**Complete Assessment**

1. List the four types of pathogens that are responsible for the spread of infectious disease. Give an example of a disease that each specific pathogen may cause.

2. Describe how antibiotics work.

3. What is the function of a fever?

4. Distinguish between humoral immunity and cell-mediated immunity.

## Attachment 7
## Key for the Complete Assessment

1. List the four types of pathogens that are responsible for the spread of infectious disease. Give an example of a disease that each specific pathogen may cause.
   *Viruses – common cold, flu, chicken pox, measles*
   *Bacteria – tuberculosis, meningitis, cholera, tetanus*
   *Protists – African sleeping sickness, malaria*
   *Fungi- Athlete's foot, ringworm*
   *Students will list one example.

2. Describe how antibiotics work.
   *Antibiotics kill bacteria by interfering with the synthesis of cell walls in fast-growing bacteria or by blocking the synthesis of proteins in bacterial ribosomes.*

3. What is the function of a fever?
   *A fever slows down or stops the growth of many pathogens; increases heart rate so that white blood cells get to the site of an infection faster; and speeds up the activity of white blood cells and the reactions that help repair damaged tissue.*

4. Distinguish between humoral immunity and cell-mediated immunity.
   *In humoral immunity, B cells secrete antibodies that bind to antigens.*
   *In cell-mediated immunity, killer T cells rupture infected cells.*