

# Immunology Primer

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## **Description:**

The Immune System Primer offers students a self-directed study of the Human Immune System. It is designed to give general biology students basic knowledge of the various mechanisms the body employs to defend itself against foreign invaders. It contains links to a number of on-line animations and reference materials.

Lesson #1: Invitation to Learn

Lesson #2: Non-Specific Immunity (Physical Barriers and Innate Immunity)

Lesson #3: Specific Immunity (Adaptive Immunity)

## **Standards Addressed:**

### **Massachusetts Curriculum Frameworks**

#### 2. Structure and Function of Cells

- 2.1 Relate cell parts/organelles to their function
- 2.5 Explain the role of cell membrane as a highly effective barrier

#### 4. Human Anatomy and Physiology

- 4.1 Explain how major organ systems in humans have functional units with specific anatomy that perform the function of that organ system

### **National Standards, Level IV Grade: 9-12**

#### **Standard 5**

#### **Understands the structure and function of cells and organisms**

#### **Level IV Grade : 9-12**

1. Knows the structures of different types of cell parts (e.g., cell wall; cell membrane; cytoplasm; cell organelles such as the nucleus, chloroplast, mitochondrion, Golgi apparatus, vacuole) and the functions they perform (e.g., transport of materials, storage of genetic information, photosynthesis and respiration, synthesis of new molecules, waste disposal)
2. Understands the chemical reactions involved in cell functions (e.g., food molecules taken into cells are broken down to provide the chemical constituents needed to synthesize other molecules; enzymes facilitate the breakdown and synthesis of molecules)
4. Knows how cell functions are regulated through changes in the activity of the functions performed by proteins and through the selective expression of individual genes, and how this regulation allows cells to respond to their environment and to control and coordinate cell growth and division

6. Understands the processes of cell division and differentiation (e.g., meiosis, mitosis, embryo formation, cellular replication and differentiation into the many specialized cells, tissues, and organs that comprise the final organism; each cell retains the basic information needed to reproduce itself.

# Immune System Primer

## *Lesson#1: Invitation to Learn*

### **A. Current Events**

1. What virus made headlines in Boston this summer when workers at five area restaurants tested positive for the virus?
  - a. SARS
  - b. HIV
  - c. Hepatitis A
  - d. Tuberculosis

Use the [Fact Sheet](#) to check your answer. The information from the fact sheet can be used to answer the questions below.

2. How might restaurant workers transmit the virus to customers?
3. Symptoms?
4. Why does hepatitis A often go undetected in day care centers?
5. What steps can you take to prevent infection?

### **B. Fighting Infections**

6. Viruses are one type of foreign invader that can infect a human. Disease causing organisms are called pathogens. Click here to find other examples of [pathogens](#) and list them below.
  1. Viruses
  - 2.
  - 3.
  - 4.
7. What organ system defends your body against pathogens?

# Immune System Primer

## *Lesson #2: Non-Specific Immunity*

### **C. First Line of Defense: Physical Barriers**

Skin is one of your body's best defenses against foreign invaders. It acts as a physical barrier that blocks foreign substances from entering the body. Wash your hands!

8. What factor(s) might prevent the skin from keeping pathogens out of your body?
9. How might a pathogen enter your body without having to pass through your skin? (Hint: Think of organ systems that are most commonly infected.)

Skin works with many other substances to block the entry of pathogens. Explain the role of the following substances in preventing infection.

10. [Sweat](#)
11. [Mucus \(a.k.a. Snot!\)](#)
12. [Saliva](#)

### **D. Second Line of Defense: Innate Immunity**

13. Some pathogens are clever enough to get past your body's first line of defense. Two of the cells sent to the site of infection to destroy foreign invaders are phagocytes and natural killer cells.

1. Click on each cell type to watch a movie that demonstrates how each cell type works. One movie focuses on cytolytic T cells that work the same way as Natural Killer cells.
2. Briefly describe how each cell works in the space provided.

[Phagocyte](#) (Macrophages)  
big cell = macrophage  
small = pathogen

[Natural Killer Cell](#)  
big cell = pathogen  
small cell = natural killer

[Inflammatory Response](#) shows how a body would react to a stab wound. To view the movie of the inflammatory response you must choose **Inflammation Movie** from the top of the list.

14. What enters the body with a knife to generate an inflammatory response?
  
15. What chemical is released from damaged cells?
  
16. Blood cells diffuse into capillaries and cause the blood vessels to dilate. What does dilate mean?
  
17. The four (4) symptoms of inflammation are:
  - 1.
  - 2.
  - 3.
  - 4.
  
18. How might an increase in body temperature assist in fighting off infection?

# Immune System Primer

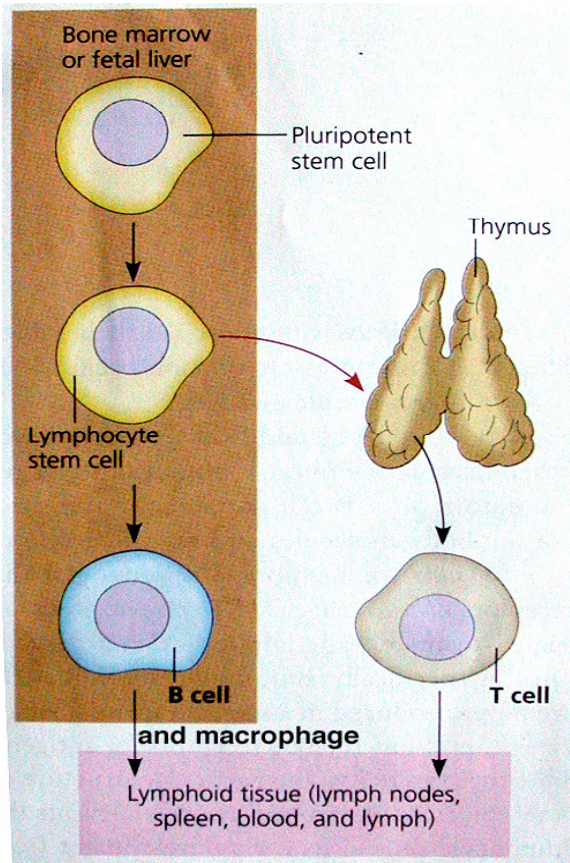
## Lesson #3: Specific Immunity

### E. Third Line of Defense: Adaptive Immunity

Your body wages a war against pathogens that get past the first two lines of defense. It calls in its highly specialized warriors, the lymphocytes.

#### Lymphocyte Development.

Use the diagram to answer the following questions.



19. All lymphocytes arise from stem cells in bone marrow or \_\_\_\_\_.

20. Lymphocyte stem cells that travel and develop in the \_\_\_\_\_ become "T" cells.

21. Lymphocyte stem cells that remain in bone marrow develop into \_\_\_\_\_ cells.

Making Connections to prior knowledge:

22. What process allows pluripotent stem cells to develop into different types of leucocytes?

### Organs of the Immune System.

Mature lymphocytes move to other lymphoid tissue.

23. Identify three (3) areas of the body where lymph nodes are found.

a.

b.

c.

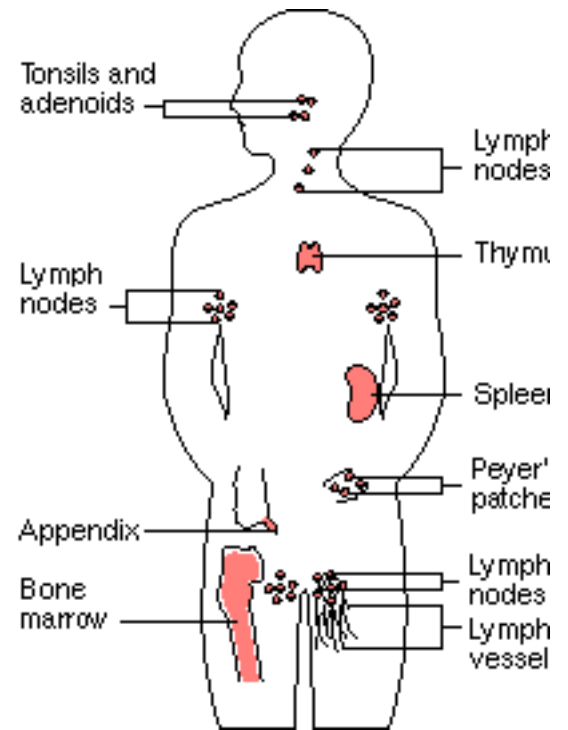


Diagram: <http://www.niaid.nih.gov/final/immun/immun.htm>

### Immune response.

24. What is an [antigen](#)?

To see how the human body elicits an [Immune Response](#), click on the “Animation” file. Use the animation to answer the following questions.

25. Briefly describe antigen processing.

26. What types (2) of cells present antigen on their cell membranes?

27. What type of cell is activated by antigen presentation?

28. Compare and contrast *Plasma* and *Memory* cells. Be sure to state how they are similar and how they are different.

29. What is the function of antibodies? How is their structure related to their function?

Making connections to previous knowledge.

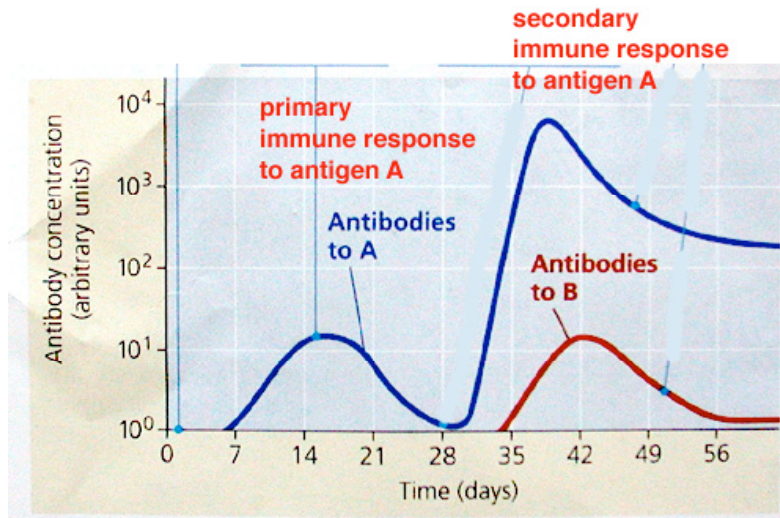
30. Why is important for B cells to contain numerous ribosomes? How is their structure related to their function?

31. What chemicals enable lysosomes to breakdown the antigen?

# Immune System Primer

## *Lesson #4: Primary and Secondary Immune Response.*

### Primary And Secondary Immune Response



<http://academic.brooklyn.cuny.edu/biology/bio4fv/page/aviruses/helperTcells.html>

### Interpreting the Graph:

B cells are activated to release antibodies when cells of the body are infected with a pathogen. Use the graph and information below to answer the following questions. Focus on [blue](#) line.

Primary immune response: body's first exposure to an antigen.

Secondary immune response: same pathogen is reintroduced to your body

Independent variable (x axis): the length of time the body has been exposed to the antigen

Dependent variable (y axis): concentration of antibodies in blood

31. How many days does it take for B cells to start producing antibodies against antigen A during a primary immune response?
32. On what day does antibody production peak during the primary immune response against antigen A?
33. Compare antibody concentrations for antigen A during a primary and secondary immune response.

View [Fighting Back](#). It summarizes the Innate and Adaptive responses to pathogens.

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