

Name: _____

Period: _____ Date: _____

Module 27: Immune System, Student Learning Guide

Instructions:

1. Work in pairs (share a computer).
2. Make sure that you log in for the first quiz so that you get credit.
3. Go to www.sciencemusicvideos.com. Select the AP Biology Menu. Then select "Module 27: The Immune System"

Tutorial 1: Non-Specific (Innate) Immunity

Introduction. Read "It's a Dangerous World."

Summarize: What's a pathogen?

What are some of the threats that multicellular organisms (like you and me) face?

1. Read "A Layered Defense System," and complete the interactive diagram.

Briefly describe the three lines of defense:

-
-
-

2. Read about "Defense Layer 1: The Outer Barriers" As you do, describe or define the following:

Term	Definition or description
Epidermis	
Resident flora	
mucous membranes	
lysozyme	

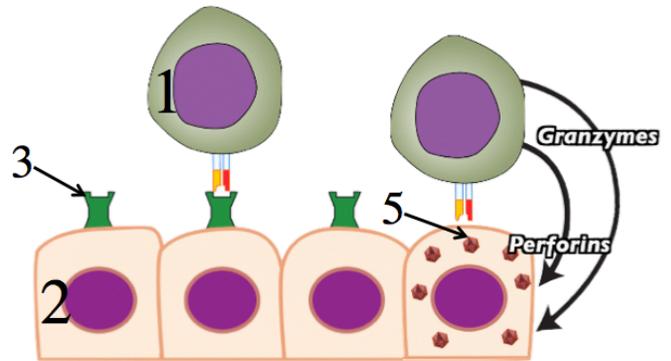
3. Read about "Defense Layer 2: Non-Specific (Innate) Immunity." As you do, answer the questions below.
Overview. Why is defense layer 2 *non-specific* and *innate*?

3a.1. What do phagocytes do?

3a.2. What does *sentinel* mean?

3a.3. What's a *leukocyte*?

3b.1. Create a key to the diagram below:

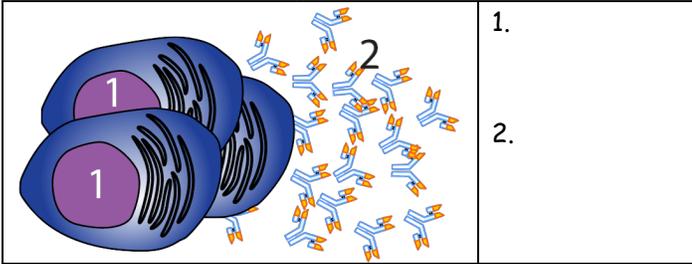


1	
2	
3	
4	
5	

3b.2. Explain how natural killer cells use the MHC protein system to know which cells to attack.

3b.3. Explain how natural killer cells destroy their targets.

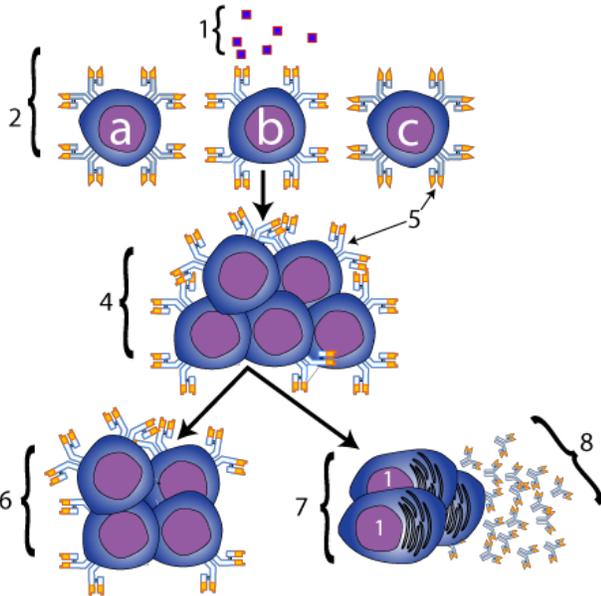
Make a key for this diagram:



- 1.
- 2.

SUMMARIZE: What is *specific* about the specific immune response? Why is the "custom tailoring" analogy for this specificity incorrect?

Now make a key for this diagram, and, in the space below the key, write an explanation of "clonal selection."

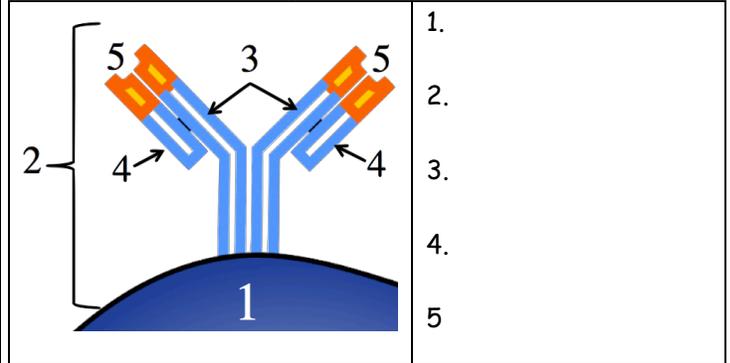


1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	

Clonal selection is

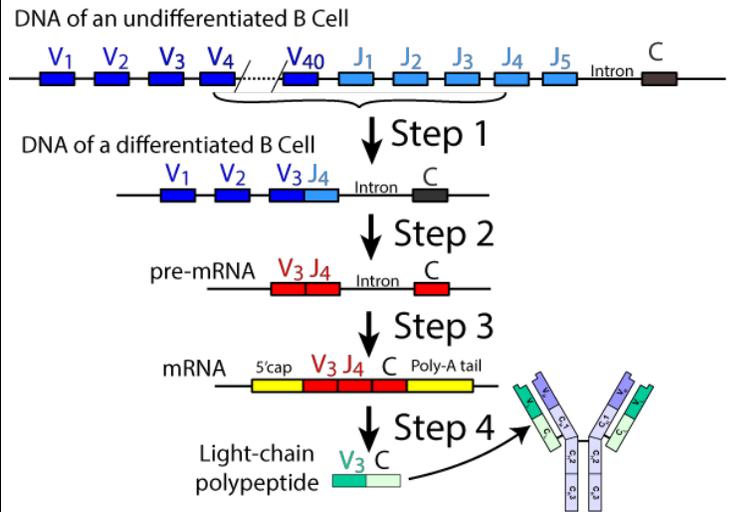
4. Read "Antibody Structure and Generating Antibody Diversity."
5. Take the Quiz "Antibody Structure and Antibody Diversity."

Make a key for this diagram:



- 1.
- 2.
- 3.
- 4.
- 5.

Using the diagram below, describe the steps involved in generating antibody diversity



1.	
2.	
3.	
4.	

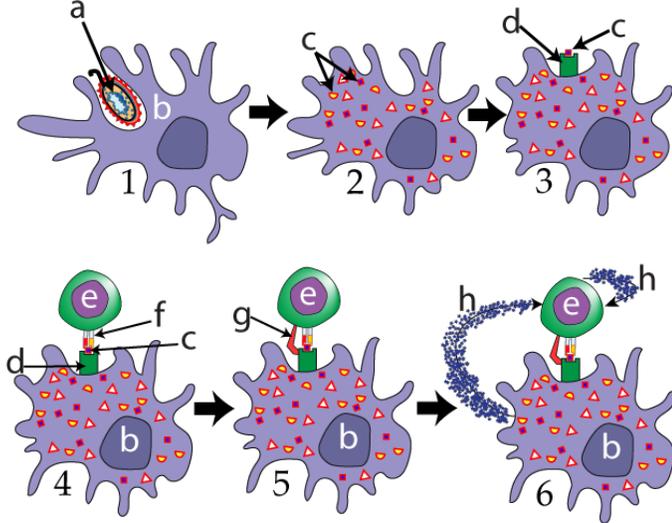
In the space below, write (from memory) a brief summary of how antibody diversity is generated. Write small.

Follow the link to the next tutorial, "The Humoral Response."

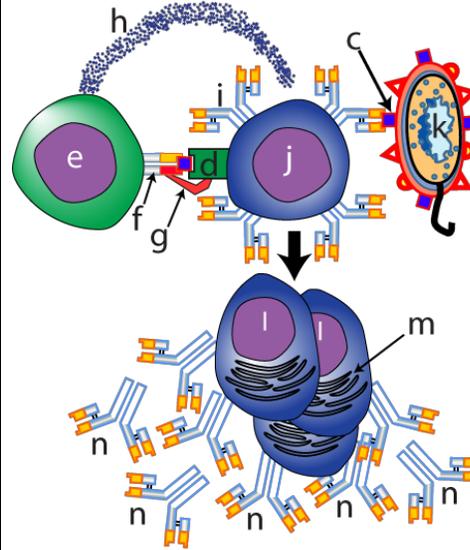
III. Immune System 3: The Humoral Response."

1. Read the Introduction.
2. Read "The humoral response begins with..."
3. Read "Phagocytes present antigen to helper..."

Summarize what you've read by creating a key to the diagrams below.



Checking understanding: Explain what's happening in the diagram below. Lay out your explanation as a sequence of events: *First...Second...Next...etc.* Write small.



a.	
b.	
c.	
d.	
e.	
f.	
g.	
h.	
1.	
2.	
3.	
4.	
5.	
6.	

4. Read "Helper T Cells activate B cells, which become..."
5. Complete the interactive table, "The Humoral Response."

6. Read "Antibodies help neutralize pathogens..."
7. Complete the quiz, "The Humoral Response: Checking Understanding."

More Checking Understanding: Describe the three ways that antibodies can neutralize pathogens.

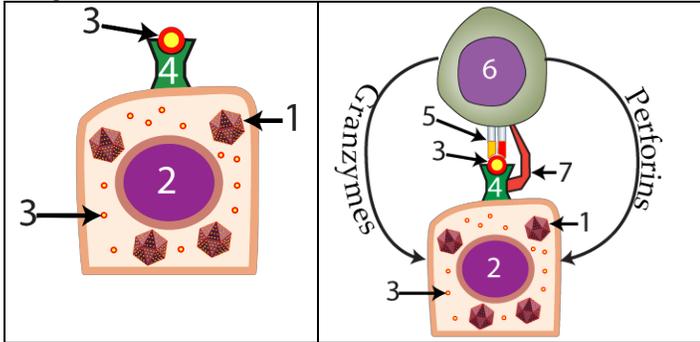
Follow the link to "Cell Mediated Immunity and Immunological Memory" (Immune System 4).

IV. Immune System 4: The Cell Mediated Response..”

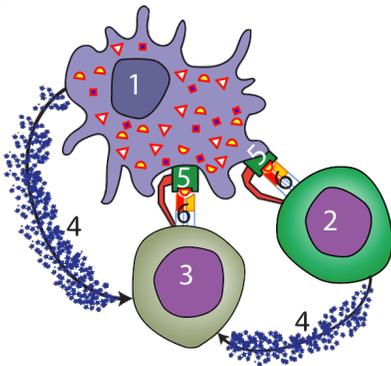
1. Read the introduction.
2. Read "Killer T Cells (AKA Cytotoxic T cells) use ..."
3. Read "Mobilizing Killer Ts"
4. Take the "The Cell Mediated Response" quiz.

Checking Understanding

In the space below, explain what's happening in these diagrams.



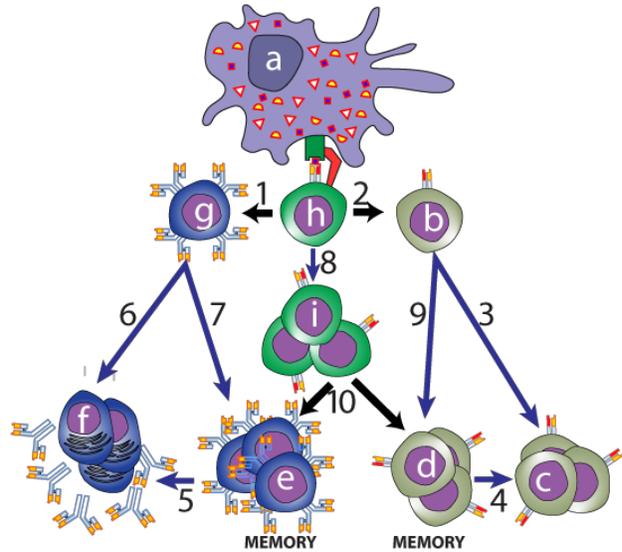
Now, using the diagram below, explain how cytotoxic T cells get activated.



5. Read "Immunological Memory."
6. Read "Primary and Secondary Immunity."
7. Read "Vaccinations and Passive Immunity."
8. Take the "Specific Immunity (the Whole Shebang)" quiz.

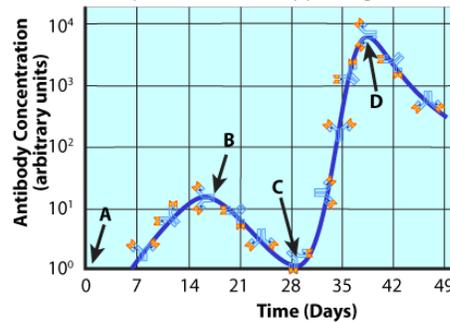
Checking Understanding:

Make a key to the diagram below.



a.	2.
b.	3.
c.	4.
d.	5.
e.	6.
f.	7.
g.	8.
h.	9.
1.	10.

And now explain what's happening in this graph.



Complete this sentence: Passive immunity is different from active immunity because...

9. Complete "Immune System Part 2: Interactive Lyrics"

Mariah's Immune System Adventure

Instructions: Read each of the passages below. Fill in the blanks with the choices below, which can be used once or more than once. Write your answers on the right side so that you can continue to use this as a study sheet.

Part 1: The Three Lines of Defense

When Mariah woke up, she knew she was in for trouble. Her throat hurt, and she felt feverish. Her swollen throat was an example of 1 , part of the body's 2 line of defense. Obviously, some kind of disease causing 3 had made it past the 4 , line of defense: the skin and 5 .

Mariah told her father, Reggie, about how she was feeling. Reggie took her temperature; the thermometer read 38.5 C. 6 is also part of the 7 immune response. Reggie asked Mariah if her glands were swollen. Mariah nodded yes, but also corrected her father: "Those swellings aren't glands, Dad. We learned in biology that those are actually 8 ."

Fearing strep throat, Reggie drove Mariah over to the local clinic to see what was causing Mariah's symptoms. The nurse gave Mariah a strep test: the result was negative. "It looks like it's a viral infection" said the nurse. "That means that I can't prescribe any 9 : they're only effective against 10 . All you can do is head home and try to get some rest.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

- | | | | |
|---|---|--|---|
| <ol style="list-style-type: none"> 1. antibiotics 2. bacteria 3. fever | <ol style="list-style-type: none"> 4. first 5. inflammation 6. lymph nodes | <ol style="list-style-type: none"> 7. mucus membranes 8. non-specific 9. pathogen | <ol style="list-style-type: none"> 10. secondary |
|---|---|--|---|

Part 2: The Battle, part 1

Mariah went home and got into bed. Within her body, a battle was occurring.

At the site of the infection, large white blood cells called 1 had swallowed the virus. After digesting it, they displayed pieces of it on their 2 . Those pieces of the pathogen, which will soon elicit an immune response, are called 3 .

Some of these macrophages died at the site of the infection, resulting in 4 . But other macrophages wandered back to 5 nodes, where they presented the antigen to the generals of the immune system army, the 6 cell. The Helper T cell now activates a cell that will produce antibodies, also known as a 7 . The B-cell that gets activated has a special attribute: it has a membrane 8 that is 9 in shape to the antigen.

Once the B-cell is activated, it 10 many copies of itself. Some of these clones become 11 cells, which release antibodies into the bloodstream. These antibodies will bind with 12 on the invading virus, making it impossible for the virus to 13 other cells. Attachment of antibodies also makes it easier for 14 white blood cells to swallow up the virus.

Other B cells will stay in Mariah's lymph nodes for the rest of her life. These are 15 B cells, and they are the basis for 16 .

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____
16. _____

- | | | | |
|--|---|--|---|
| <ol style="list-style-type: none"> 1. antigen 2. antigen 3. B-cell 4. clones | <ol style="list-style-type: none"> 5. complementary 6. Helper-T 7. immunity 8. invade | <ol style="list-style-type: none"> 9. lymph 10. macrophages 11. membranes 12. Memory | <ol style="list-style-type: none"> 13. phagocytic 14. plasma 15. pus 16. receptor |
|--|---|--|---|

Part 3: The Battle, Part 2

The battle is not quite over. From her studies of biology, Mariah knew that viruses are not independent 1. A virus, in fact, is little more than 2 surrounded by a protein 3. Viruses lack a membrane and 4. They're really like 5 that take over cells. For Mariah, that meant that any infected cells would be churning out new 6: they'd have to be stopped.

The creation of antibodies in the 7 response was not enough to meet this threat. Rather, what's needed is the 8 response. In this response, helper T-cells activate 9, which have 10 that match with the pathogen's 11. These Killer-T cells will move through the blood and tissues. When they meet body cells displaying the 12 antigen, they'll kill the 13 cells.

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____
- 6. _____
- 7. _____
- 8. _____
- 9. _____
- 10. _____
- 11. _____
- 12. _____
- 13. _____

- | | | | |
|------------------|--------------|-------------------|-------------|
| 1. antigen. | 5. cytoplasm | 9. Killer-T cells | 13. viruses |
| 2. cell-mediated | 6. Genes | 10. pirates | |
| 3. cells | 7. humoral | 11. receptors | |
| 4. coat | 8. infected | 12. viral | |

Part 4: After the Battle

Three months later, Mariah went to a party. Her classmate, Isabel, coughed while telling a story. Isabel was in the early stages of the same infection that Mariah had suffered. Tiny droplets of virus-containing fluid were forced into the air, some of which went into Mariah's nose. While most of these viruses were trapped in the 1 lining Mariah's nasal passages and destroyed by 2, some virus managed to drip back to the site of the previous infection.

This time, the story unfolded quite differently. Because of her previous infection, Mariah possessed a large clone of 3 cells. After a macrophage captures some of the invader, it quickly finds these memory cells. The 4 quickly start producing antibodies, which immediately 5 the virus. The Killer T cells sweep into action, destroying the few 6 cells, preventing them from producing more 7. Before Mariah feels any symptoms, this 8 has been defeated.

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____
- 6. _____
- 7. _____
- 8. _____

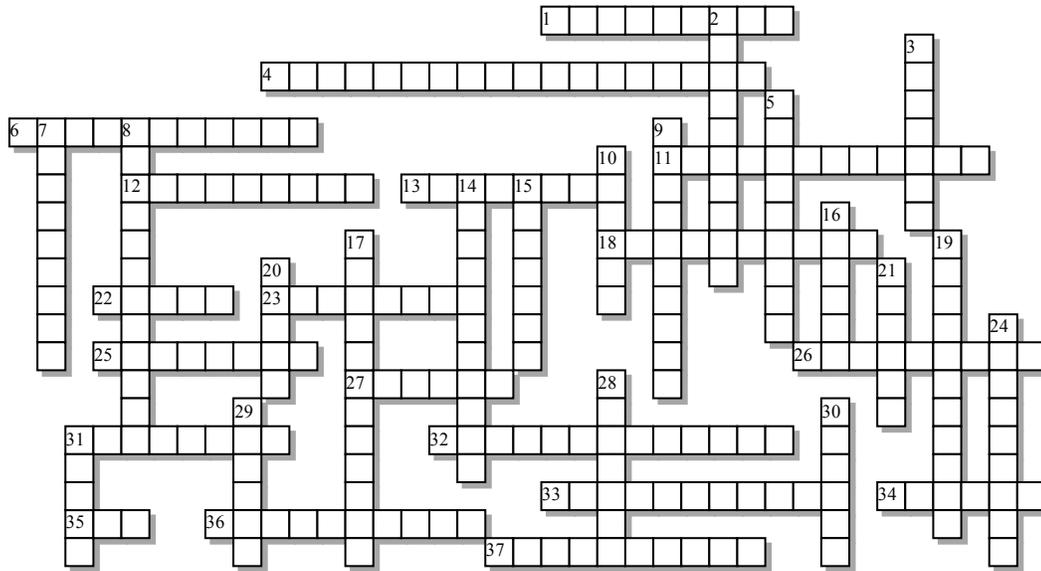
- | | | | |
|------------|-------------------|---------------|-------------|
| 1. B cells | 3. infected | 5. mucus | 7. pathogen |
| 2. enzymes | 4. memory B and T | 6. neutralize | 8. viruses |

Part 5: Earlier in life

The events above are very similar to what happened -in an artificial way—when Mariah had a series of injections or 1. These injections involved weakened forms of the 2, or even just a bit of 3. Without causing any significant symptoms, these antigens stimulated the formation of clones of 4. And with these cells present in 5 nodes around Mariah's body, she now has 6 to several common diseases.

- 1. _____
- 2. _____
- 3. _____
- 4. _____
- 5. _____
- 6. _____

- | | | |
|-------------|-----------------|----------------|
| 1. antigen | 3. lymph | 5. pathogen |
| 2. immunity | 4. memory cells | 6. vaccination |



Across:

- 1 - T cell secretions that blow holes in target cell membranes
- 4 - These proteins are used to display antigen.
- 6 - Viruses that can't bind with their targets because they're covered with antibodies have been
- 11 - The redness and swelling that are part of the non-specific responses.
- 12 - These T cells are specific assassins that attack virus-infected and pre-cancerous cells.
- 13 - Antibodies have constant and _____ regions
- 18 - General name for sentinel cells that find and engulf pathogens
- 22 - The kind of pathogen that requires the cell-mediated response
- 23 - We don't tailor-make antibodies; their diverse shapes are pre-_____
- 25 - A disease-causing agent
- 26 - These molecules act as messages that induce immune cells to clone themselves.
- 27 - Immune responses that we're born with
- 31 - An anti-microbial enzyme in tears and saliva
- 32 - Antibodies (and T cell receptors) work because their binding sites are _____ to an antigen.
- 33 - This is the clade that evolved the specific immune response
- 34 - The type of selection that's key to the specific immune response.
- 35 - Results from the accumulation of dead white blood cells.
- 36 - Proteins that bind with and neutralize pathogens
- 37 - A team of proteins that can attack bacterial cell membranes

Down:

- 2 - A substance secreted by virus-infected cells that tells their neighbors to resist infection
- 3 - The type of immunity that results when you receive antibodies from an outside source.
- 5 - T cell secretions that induce apoptosis in infected cells.
- 7 - The outermost layer of our body's outermost barrier.
- 8 - Enzymes that recombine DNA segments in a way that amplifies antibody diversity
- 9 - Molecules released by mast cells that promote swelling and allow phagocytes to reach an infected area.
- 10 - This T cell is the general of the immune system army.
- 14 - The first step of the specific immune response involves _____ of a pathogen.
- 15 - A molecular part of a pathogen that elicits an immune response.
- 16 - These B and T cells result from previous infections, and help to quickly fight off new infections
- 17 - Marking a pathogen for phagocytosis
- 19 - Medical induction of immunological memory
- 20 - A heat-related sign that our bodies are fighting an infection.
- 21 - These membranes line our orifices
- 24 - You develop this type of immunity by immunologically remembering previous infections.
- 28 - This part of the specific response involves B cells that secrete antibodies.
- 29 - The system that fights off pathogens
- 30 - A B cell that matures becomes an antibody-secreting _____ cell.
- 31 - These nodes are the immune system's command centers.

Possible Answers: Plasma, antibodies, antigen, clonal, complement, complementary, cytokines, cytotoxic, epidermis, existing, fever, granzymes, helper, histamines, histocompatibility, humoral, immune, inflammation, innate, interferon, lymph, lysozyme, memory, mucous, neutralized, opsonization, passive, pathogen, perforins, phagocytes, pus, recognition, recombinases, secondary, vaccination, variable, vertebrates, virus