



National Teacher Training Institute



Lesson Plan

Antigens versus Antibodies

"KO'd in Round Three"

The Third Line of Defense of the Human Immune System

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Grade Level: 7

Time Allotment: Three 45 minute periods.

Overview:

The human immune system is the body's **specific line of defense** against invading organisms. The unbroken skin, mucous membranes, and cilia stand as the first line of defense against attacking organisms. But if the first line of defense is broken, and disease-causing microbes enter the body, two more lines of defense are called into action. The second lines of defense are inflammation, the body's method of providing more white blood cells, and interferon. If the **second lines of defense** succumb to the heavy toxin attacks, the **third line of defense**, antibodies, will enter. Antibodies are proteins that are produced by certain kinds of white blood cells in a response to an invasion by a specific organism, called an antigen. Antibodies are produced by the immune system to fight, and hopefully destroy, specific antigens. When an antigen invades the body, specific white blood cells called T-cells and B-cells are immediately put into action. T-cells alert B-cells to produce antibodies. Antibodies then repel and destroy the enemy, antigens, by joining together like puzzle pieces. Yet, there is an exception to the antigen/antibody puzzle connection. For when an HIV virus invades the body and riddles past the first two lines of immune defense the immune system begins to break down. The virus viciously attacks the T-cells with its hereditary material, reproduces within and then destroys the cell before it can send a message of

alert to the B-cells to make antibodies. The patient becomes ill and susceptible to many illnesses and the patient dies.

Through the activities presented in this lesson, students will become familiar with the human immune system's third line defense and how it can specifically destroy antigens by creating antibodies, but fail with the AIDS virus, HIV.

After examining Web sites and video clips, students will participate in hands-on activities which will further familiarize them with the activities of the human immune system, and the relationship of antibodies, antigens and HIV.

These lessons will be used as a progressive lesson in the study of the human body's lines of defense.

Vocabulary: AIDS, Antibody, Antigen, B-Cell, HIV, Immune System, Pathogen, T-Cell

Subject Matter: Biology, Immunology, Virology

Learning Objectives:

Students will be able to:

- Identify the importance of the third line of defense in the human immune system.
- Describe the process of the antibodies adjoining specific antigens and then repelling those pathogens and destroying them.
- Differentiate between the interaction of a nonvirus with a T-cell and a virus with a T-cell.
- Explain why, when invaded by a virus, a T-cell cannot send antigen warnings to a B-cell to make antibodies.
- Articulate why antibodies fail to defend the human immune system against such deadly invaders such as HIV.
- Create (for assessment) a dramatization of the antibody/antigen/HIV relationship within the human immune system.

Standards:

Content Standard 1: Students design, conduct, evaluate and communicate scientific investigations.

Content Standard 2: Students demonstrate knowledge of properties, forms, changes and interactions of physical and chemical systems.

Content Standard 3: Students demonstrate knowledge of characteristics, structures, and functions of living things, the process and diversity of life, and how living organisms interact with each other and their environment.

Content Standard 5: Students understand how scientific knowledge and technological developments impact society.

Content Standard 6: Students understand historical developments in science and technology.

Media Components:

Video:

"Surviving AIDS" NOVA, PBS

This video describes a new kind of experiment in which doctors are trying to determine if the body's natural defense mechanism, the immune system, can keep the virus under control after drug therapy is stopped.

Web Sites:

www.pbs.org/wqbh/nova/aids/action.html

This website demonstrates the interaction between an antibody and an antigen.

www.pbs.org/wqbh/nova/aids/fighters.html

This website demonstrates a cell being attacked by a HIV agent.

Materials

For each student:

- Antigen/Antibodies Worksheet
[Microsoft Word version of worksheet](#)
[Adobe Acrobat version of worksheet](#)
- Dear Sue/Sam letter
[Microsoft Word version of letter](#)
[Adobe Acrobat version of letter](#)
- 2 pieces of colored construction paper (each a different color)
- Scissors
- Glue
- Pencil
- Poster board

AIDS-What You Should Know Diagram

For each group of 4 students:

- HIV/Antibodies/Antigen Character Cards (*to be available soon*)

- Paper
- Markers
- Scissors
- Masking Tape

Prep for Teachers:

Prior to teaching this lesson, bookmark the websites used in the lesson on each computer in your classroom. Load the Shock-wave plug-in (available free at www.macromedia.com) onto each computer as well.

Prepare the hands-on element of the lesson by:

1. Copying the antigen/antibodies worksheet.
2. Copying the AIDS-What You Should Know diagram.
3. Making character cards for each student in each group to individually pull out of a box. There will be 4 cards per group. Each card will have a specific character: virus, T-cell, B-cell, nonviral antigen.

When using media, provide students with a FOCUS FOR MEDIA INTERACTION, a specific task to complete and/or information to identify during or after viewing of video segments, Web sites, or other multimedia elements.

Introductory Activity:

Step 1. Distribute the activity worksheet "Antigens (Nonviral) and Antibodies" to your students.

Step 2. Have each student cut out the figures on the worksheet. Trace each antigen shape onto one color of construction paper and then trace each antibody onto the other sheet of construction paper.

Step 3. Have each student label each shape, antibody or antigen, according to the label from the traced shape.

Step 4. Have each student cut out the shapes from the construction paper.

Step 5. Have each student find two shapes that fit together like pieces of a jigsaw puzzle.

Step 6. Have students glue the shapes in place on one piece of poster board. It does not matter where the shapes are placed on the poster board as long as they are placed together. Do keep in mind to indicate to the students that all pieces will have to fit on the poster board.

Step 7. Have students repeat step 6 until they have matched up all the shapes

and have glued them onto the poster board.

Step 8. Lead a class discussion with critical thinking questions:

- Ask your students how the pieces of the puzzle are like antibodies and antigens. (*Specific antibodies only fit with their specific antigen.*)
- Ask your students what relationship seems to exist between antigens and antibodies. (*One-on-one*)
- Ask your students (according to the models that they have constructed), what seems to happen when an antibody comes in contact with an antigen. (*They lock together making the antigen ineffective.*)
- Ask your students why they think the action of an antibody is helpful in preventing disease or infection. (*Antibody action prevents the antigen from attacking.*)
- Inform your students that sometimes it takes time for T-cells to signal B-cells to produce antibodies needed to attack an antigen. If this were the case in their bodies, what would they experience while waiting for the antibodies to be produced? (*Symptoms!*)
- Inform your students that there are specific types of pathogens called viruses that invade the T-cell, stop the communication from the T-cell to the B cell to make antibodies, and then destroy the white blood cell. How do they think that this invasion and death of the cell occurs? (*Accept all answers.*)

Learning Activity:

Step 1. Ask your students what they think of when they hear the word, "AIDS" What images come to mind? (*Accept all answers.*)

Step 2. Explain to your students that AIDS, acquired immune deficiency syndrome, is a disease caused by the virus, HIV. HIV is a microscopic antigen that can only reproduce itself by entering human cells and using the cells to make the building blocks for new viruses. It does this by attacking the T-cells before they get a chance to signal killer T-and B-cells that would ordinarily destroy the virus. In fact, HIV can be present in the human cell for many years before symptoms emerge. The virus becomes AIDS when there is a drop in helper cells and the human contracts an AIDS-defining illness. Hand each student the worksheet, "AIDS-What You Should Know," diagramming HIV going through the T-cell entry cycle.

Step 3. Explain to your students that at this time there is no antibody that can connect with and repel the devious HIV. Refer to the nonviral antigen/antibody activity.

Step 4. Ask your students to log on to <http://www.pbs.org/wgbh/nova/aids/action.html>. Provide your students with a FOCUS FOR MEDIA INTERACTION, asking them to go the the shockwave demonstration on Viral Entry. Have them note how the virus enters its hereditary material into the the cell.

Step 5. Inform your students that, at the point of viral entry into the T-cell, the ability for the T-cell to signal the helper T-cell, B-cell, has now been destroyed. The T-cell is now taken over by the virus and the virus is in total control of the cell's activities.

Step 6. Ask your students to predict what they think will happen to the T-cell next. *(Students may write their predictions or share them orally with the class.)*

Step 7. After some prognostication on the cell's condition, inform your students that the virus begins to replicate itself in the cell and does so until the cell bursts and dies. Ask your students to log on to <http://www.pbs.org/wgbh/nova/aids/action.html>. Provide your students with a FOCUS FOR MEDIA INTERACTION, asking them to go the the shockwave demonstration on Viral Gene Transfer. Have them note how the virus transfers its hereditary material throughout the the cell. Then have the students click on Viral Exit. Provide your students with a FOCUS FOR MEDIA INTERACTION, asking them what happens in the final stage of viral action.

Step 8. Insert the NOVA program "Surviving AIDS," into your VCR. Provide your students with a FOCUS FOR MEDIA INTERACTION, asking them to identify reasons why, when stopping drug therapy for AIDS, the body's natural defense mechanism, the immune system, may fail. Students should record 5 facts relate to the program.

Step 9. Ask your students, based on their knowledge of the relationship between the virus and the T-cells, if they feel that the immune system, specifically the T-cells, would be strong enough to send messages to the helper cells for antibodies if an AIDS patient decided to stop antiviral therapy. *(Probably not!)*

Step 10. Ask your students to predict what the effects of stopping the antiviral therapy would be on the AIDS patient. *(The patient will become sicker and sicker.)*

Culminating Activity:

Step 1. Divide the class into 4 groups.

Step 2. Tell the students that they are going to perform dramatic pantomime

scenes depicting the varied occurrences when a specific antigen begins to attack the immune system's third line of defense.

Step 3. Indicate what the scenes will depict: Student group 1 & 2- a nonviral antigen attacking the T-cells. Student groups 3 & 4- an AIDS virus attacking a T-cell and destroying the cell.

Step 4. Indicate to the students that each student must have an active part in the play. Inform students that each part must be identified to the audience by writing their part on a piece of paper with a marker and attaching the paper with masking tape to the actor's back.

Step 5. Explain to the students that they will have 10 minutes to create a pantomime and then perform their play for the class.

Step 7. Inform the students that they will present their productions in the order that one representative (from each group) pulls a slip of paper, 1-2-3-4, from a container.

Step 8. Indicate to the students that they are to form their groups, they are to send two representatives from each group to pull out their assignment and to pull out their presentation position. Indicate to them that they have 10 minutes to create a visual representation through drama.

Step 9. At the end of the 10 minutes, have each group pantomime their factual creation. This will constitute a visual assessment.

Step 10. Ask the students how they reinforced their kinesthetic and visual intelligence by using drama to assess their knowledge of the subject matter.

Step 11. Inform the students that they are to return to their personal sites for a written assessment.

Step 12. Indicate to the students that their assessment for the lesson comes in a letter form from a "fan" who enjoyed their pantomime presentation, but is still a little confused.

It will read:

Dear Sue/Sam:

I so enjoyed your presentation. I absolutely love pantomime and hope to become a mime myself some day. But I am still muddled over the lesson you were trying to convey.

Could you please tell me what antibodies and antigens are and how they relate

to each other? And, why does HIV seem to consistently win the battle against the human immune system? Isn't there something we can do about building up those T-cells? Please be very specific in your written answer because I am really still confused. Oh yes, I am a visual learner so I really like diagrams.

Signed,
Bill/Betty Precept

Step 13. Hand out the letter "Dear Sue/Sam," and give the students 20 minutes to reply.

Cross-Curricular Extensions:

LANGUAGE ARTS:

Have the students write a journal entry from the point of view of the virus. How does the virus feel entering into the human immune system's T-cells? How does it feel inserting its hereditary material into the T-cell? How does it feel dominating the T-cells functions and then destroying the T-cell? How does it feel to be the "arch enemy" of the human immune system's playground? How does it feel about a possible "superman" antiviral vaccine?

MATHEMATICS:

For an mathematical analogy, give each student a penny. Indicate that a virus can multiply within the body to a comparable building height of 17 stories within seconds. Lay your penny on the classroom floor and then have each student put their penny on top of another until each student has put their penny on the stack. Then have each student estimate how many pennies it would take to make a stack 17 stories tall.

TECHNOLOGICAL STUDIES:

Have students do media research on the HIV virus and its impact on the biochemistry of the human body.

HEALTH ENHANCEMENT:

Have students research the latest methods of treating HIV and AIDS including attacking the virus itself by logging on to:

www.niaid.nih.gov/daids/vaccine/

This site includes news, general information, science, resources, and a bulletin board offering the latest information on efforts to find an AIDS vaccine.

VISUAL ART: Create a three-dimensional model of the structure of a healthy T-cell and a structure of a T-cell invaded by HIV.

Have students construct a poster with the column headings:
First line of defense, second

line of defense, third line of defense, viral attack. Have students provide a definition and examples of each type of defense or lack.

Have students design and make quilt squares for a classroom HIV quilt, having each square tell the progressive story of the virus's interactions in the human immune system.

Log on to The Names Project Foundation AIDS Memorial Quilt at:

www.aidsquilt.org

This site features the quilt display schedule and a searchable image database of over 78,000 names and over 41,000 viewable images of panels in the AIDS Memorial Quilt.

Community Connections:

- You will want to make sure that your school district has adopted an appropriate policy for dealing with students and staff infected with HIV. It is important to have such a policy in place before a situation arises in your school.
- Parents play an important part in the success of any program that relates to the study of the AIDS virus, HIV. Inform your parents that you are studying the human immune system and specific antigens, and the study relates to the biological functions of the human body.
- On the art days that you are making quilt squares invite members of the community into your classroom to aid the students with their projects.

Student Materials include:

Antigen/Antibodies Worksheet
AIDS-What You Should Know diagram
Pantomime Character Parts
Dear Sue/Sam letter