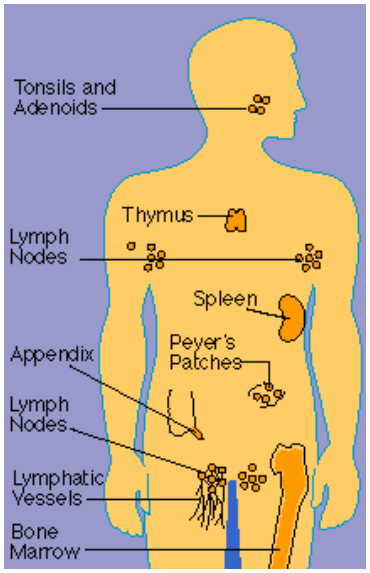
WHO COMPROMISED MY IMMUNE SYSTEM?



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Who Compromised my Immune System?

I. Introduction

The primary goal of this unit is to engage students in investigative activities which will extend and refine their knowledge and understanding of anatomy and physiology of immune system, immune response, waterborne diseases including *Vibrio vulnificus*, compromised immune response due to chronic alcohol abuse and genetic factors, and laboratory assays to quantify immune response. Students will investigate disease transmission and symptoms specifically of *Vibrio vulnificus*, develop ways to communicate findings to a large audience, use the internet as a tool for research and investigation, perform specific laboratory protocols associated with an immune response (ELISA) and simulations demonstrating how compromised immune systems react to various environmental and genetic stimuli. *Vibrio vulnificus* was chosen because it is the leading cause of fatalities from ingesting raw seafood found in warm estuarine waters, such as the Chesapeake Bay. The lessons students will complete include: 1) an Immune System WebQuest which will enable them to understand how the body defends itself against invading microorganisms; 2) an investigation of the symptoms of several waterborne diseases; 3) an internet scavenger hunt to research information specific to *Vibrio vulnificus*; 4) simulate the various conditions of *V. vulnificus* infections in humans that provides real-life

scenarios and 5) complete an ELISA (Enzyme Linked Immunosorbent Assay) simulation and demonstration of an Immune System response.

The ultimate goal of this unit is to provide students with skills and strategies to understand the intricate mechanisms of the human immune system and the practices, behaviors and acquired conditions that may influence the functioning of this system. They will in turn become more competent in the skills used by scientists, specifically immunologists to solve problems in the real world.

II. Overview

(Source: Maryland State Department of Education-Science Content Standards)

Science Concepts**:** The student will demonstrate ways of thinking and acting inherent in the practice of science. The student will use the language and instruments of science to collect, organize, interpret, calculate, and communicate information.

1. **The student will pose scientific questions and suggest investigative approaches to provide answers to questions.**

    - The student will identify meaningful, answerable scientific questions.
    - The student will pose meaningful, answerable scientific questions.(NTB)
    - The student will formulate a working hypothesis.
    - The student will test a working hypothesis.(NTB)
    - The student will select appropriate instruments and materials to conduct an investigation.
    - The student will identify appropriate methods for conducting an investigation (independent and dependent variables, proper controls, repeat trials, appropriate sample size, etc.).
    - The student will use relationships discovered in the lab to explain phenomena observed outside the laboratory.

2. **The student will carry out scientific investigations effectively and employ the instruments, systems of measurement, and materials of science appropriately.**

    - The student will develop and demonstrate skills in using lab and field equipment to perform investigative techniques.(NTB)
    - The student will demonstrate safe handling of the chemicals and materials of science.(NTB)
    - The student will learn the use of new instruments and equipment by following instructions in a manual or from oral direction.(NTB)

3. **The student will demonstrate that data analysis is a vital aspect of the process of scientific inquiry and communication.**

- The student will organize data appropriately using techniques such as tables, graphs, and webs (for graphs: axes labeled with appropriate quantities, appropriate units on axes, axes labeled with appropriate intervals, independent and dependent variables on correct axes, appropriate title).
- The student will analyze data to make predictions, decisions, or draw conclusions.
- The student will determine the relationships between quantities and develop the mathematical model that describes these relationships.
- The student will describe trends revealed by data.
- The student will use models and computer simulations to extend his/her understanding of scientific concepts.(NTB)
- The student will use analyzed data to confirm, modify, or reject a hypothesis.

4. **The student will use appropriate methods for communicating in writing and orally the processes and results of scientific investigation.**

- The student will demonstrate the ability to summarize data.
- The student will explain scientific concepts and processes through drawing, writing, and/or oral communication.
- The student will use computers and/or graphing calculators to produce the visual materials (tables, graphs, and spreadsheets) that will be used for communicating results.(NTB)
- The student will use tables, graphs, and displays to support arguments and claims in both written and oral communication.
- The student will create and/or interpret graphics. (scale drawings, photographs, digital images, field of view, etc.)
- The student will read a technical selection and interpret it appropriately.
- The student will describe similarities and differences when explaining concepts and/or principles.
- The student will communicate conclusions derived through a synthesis of ideas.

5. **The student will show that connections exist both within the various fields of science and among science and other disciplines including mathematics, social studies, language arts, fine arts, and technology.**

- ## General Goals of the Laboratory Exercises

1. Students use the processes of science and scientists when they perform laboratory activities as stated previously.
2. Students will develop skills and techniques used by immunologist to test for the presence of antibodies. (ELISA)
3. Students will simulate skills and techniques used by immunologists in laboratory settings.

- ## Recommended Placement for Materials within a Biology and other courses

(Placement of this module is school or district dependent. The advanced concepts make it suitable for placement late in Biology courses)

1. Cell Biology, Cell Physiology- responses of cells to changes the environment
2. Microbiology/Biotechnology- Immune System and Response
3. Environment Science- Estuarine Studies
4. Science ,Technology and Society-Waterborne Diseases
5. Health and Wellness- Immune System and Response

- ## What students will do and technical skills they will learn

1. Students will research topics directly related to immunology. (immune system, immune response, ELISA , compromised immune response)
2. Students will utilize the Internet for research and to perform simulations and experiments dealing with immunology located at specific sites.
3. Students will investigate the human immune system and immune response.
4. Students will relate how various conditions alter the immune response (i.e. chronic alcohol abuse, liver disease, HIV/AIDS, diabetes, hemochromatosis).
5. Students will perform an ELISA, which simulates the conditions and responses of cells, which have been cultured in conditions, which may alter their immune (cytokine) response.
6. Students will use word processing software to compose reports, essays and formal letters.
7. Students will enter data and graph using spreadsheets.

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8. Students will construct PowerPoint presentations.
9. Students will investigate water borne pathogens.
10. Students will compare and contrast symptoms and other characteristics of individuals who develop infections from waterborne pathogens.
11. Students will investigate the bacterium *Vibrio vulnificus* using several Internet sites.

- **Relevance to other science concepts and students' lives**

1. The information, concepts and technical skills acquired by students may be relevant in the study of molecular biology, genetics, cell structure, public health and Wellness and Ecology.
2. Students will be able to identify behaviors, genetic factors and other risk factors, which contribute to compromised immune responses, which in turn may cause immediate and long term health risks and death.
3. Students will relate what they have learned about *Vibrio vulnificus* and estuarine environments to their own situation as part of the population living in the Chesapeake Bay watershed or as consumers of organisms which comes from, estuarine waters.

I. Science Background

1. Explanation of content that may be unfamiliar to teachers.
   - **Information and background on *Vibrio vulnificus***-read
     Inflammatory Cytokine Response to *Vibrio vulnificus* Elicited by Peripheral Blood Mononuclear Cells from Chronic Alcohol Users is Associated with Biomakers of Cellular Oxidative Stress
     Jan L. Powell, Kathy A. Strauss, Cynthia Wiley, Min Zhan, and Glenn Morris, Jr., Department of Epidemiology and Preventive Medicine, University of Maryland School of Medicine and Veterans Affairs Medical Center, Baltimore, Maryland, Infection and Immunity, July 2003
     http://iai.asm.org/cgi/content/full/71/7/4212?view=long&pmid=12819121

     http://www.cdc.gov/ncidod/dbmd/diseaseinfo/vibriovulnificus_g.htm
     http://vm.cfsan.fda.gov/~mow/chap10.html
     http://vm.cfsan.fda.gov/~ear/FLVIBV.html
     http://hgic.clemson.edu/factsheets/HGIC3663.htm
     http://www.diseasesdatabase.com/ddb31476.htm
     http://www.vibrio.com/VibrioFacts.htm
     http://www.issc.org/edu/pamplets/risk_eating_raw_oysters_clams.html
     http://www.emedicine.com/derm/topic847.htm
     http://www.vibrio.com/
     http://www.edcp.org/factsheets/vibrio.html
     http://www.thedoctorsdoctor.com/diseases/vibrio%20vulnificus.htm

   - **Information on the Immune System and Immune Response**
     http://www.howstuffworks.com/immune-system.htm
     http://www.niaid.nih.gov/final/immun/immun.htm
     http://www.cancerresearch.org/immresp.html
     http://www.albany.net/~tjc/immune-system.html
     http://rex.nci.nih.gov/behindthenews/uis/uisframe.htm
     http://uhavax.hartford.edu/BUGL/immune.htm

   - **Information on the relationship of chronic alcohol abuse, liver disease, hemochromatosis, HIV/AIDS, diabetes and other conditions lead to a compromised immune system response**.

1. Alcohol, host defense and society
Steve Nelson and Jay K. Kolls
Nature Reviews/Immunology Volume 2/ March 2002
2. Ethanol and Cytokine Secretion
Frncisca Martinez, Edward R. Abril, David L. Earnest and Ronald R. Watson- Department of Family and Community Medicine and Internal Medicine, Arizona Health Science Center, University of Arizona, Tucson, AZ 85724

- **Descriptions of laboratory procedures and apparatus which may be unfamiliar to teachers.**

- ELISA http://www.edvotek.com/269.html
http://www.hhmi.org/biointeractive/vlabs/

II. Student Outcomes

1. General Description of content material

- Water borne pathogens- descriptions of disease symptoms and methods of transmission.
- *Vibrio vulnificus*- morphology, susceptibility, habitat, disease transmission, symptoms of infection, treatment
- Human Immune System – structure and function, reaction to foreign bodies such as pathogens, allergens, and auto immune response
- ELISA- how to perform and read outcomes, understanding of the methodology and antigen-antibody complex.

2. What will students learn from the curriculum

- Students will investigate and learn the names, symptoms and methods of transmission several common water borne pathogens.
- Students will investigate and learn about *Vibrio vulnificus*, a bacterium that is indigenous to estuarine waters worldwide and is the leading cause of death from ingestion of raw seafood. Individuals with compromised immune responses due to chronic alcohol abuse and subsequent liver disorders, hemochromatosis, diabetes, and HIV/AIDS are more likely to be infected with *V. vulnificus* after eating raw seafood. These individuals have defects in cellular and humoral immunity.

- Students will investigate the anatomy and physiology of the human immune system and be able to explain how the immune system functions when invaded by pathogens. This understanding is needed to be able to understand how the ELISA will function to show the presence a specific antibody.
- Students will investigate how a compromised immune response affects an individual and which part(s) of the immune response are not functioning correctly.

3. Relationship between technical procedure(s) and science concepts.

- Students will gain experience is using the Internet as a research tool to locate information on *Vibrio vulnificus*, the human immune system and the ELISA.
- Student will use equipment and materials found in a modern laboratory to perform an important assay (ELISA) which is routinely use by scientists to test for protein production in cells.

III. Learning Objectives

1. Students will investigate the human immune system and immune response, including immune system defects by completing a WebQuest on this system and producing a PowerPoint presentation.
2. Students will simulate an ELISA that produces the conditions of individuals with compromised immune responses due to various acquired or genetic factors.
3. Students will perform an ELISA according to the recommended protocol. Students will record their findings, data analysis and conclusions in a laboratory report.
4. Students will learn the names, symptoms, method of transmission of several waterborne diseases by completing the activities in the Project WET (Water Education for Teachers) Activity, "Super Sleuths".
5. Students will compose a letter to the Center for Disease Control requesting specific information on a disease which has symptoms that do not fit with any of the names and descriptions in the previous activity. Students will write letters in response to a writing prompt.
6. Students will use the Internet and specific recommended sites to identify and record information on *Vibrio vulnificus*. (Scavenger hunt)
7. Students will compose a well-written report of their findings on *Vibrio vulnificus*.
8. Students will complete an activity demonstrating how various acquired or genetic factors or conditions may alter the immune response and how this relates to fighting infection, particularly *Vibrio vulnificus*.

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9. Students will demonstrate that they know specific information about the concepts, topics and skills in the curriculum through discussion, reports, and written assessments.

IV. Time Requirements

Activity	Single Period	Double Period
1. Immune System WebQuest	4	2
2. Water Borne Disease	2	1
3. *Vibrio vulnificus* Scavenger Hunt	2	1
4. *Vibrio vulnificus* Survivor; Who gets the Immunity Card	2	1
5. ELISA Demonstration of Immune System Response to *Vibrio vulnificus*- http://www.hhmi.org/biointeractive/vlabs/	2	1
TOTAL	**12**	**6**

V. Advance Preparation

1. Purchase from Edvotek-EDVO-Kit #269: Introduction to ELISA Reactions. Materials will be shipped at ambient temperature and will need to be refrigerated upon arrival.
   - Each kit contains materials for 10 groups of students. To perform the experiment they following will also be needed
     - Distilled or deionized water
     - Beakers
     - 3 7 °C Incubation oven
     - Disposable lab gloves
     - Safety goggles
     - Automatic micropipets (0 - 50 µl) and tips recommended

VI. Materials and Equipment

1. Materials can be purchased in kit form from Edvotek. Each kit contains materials for 10 groups of students and the cost is $95.00.

2. Other materials such as beakers, distilled water, disposable lab gloves and safety goggles are usually found or stocked by high school science departments.
3. If the school teaches microbiology a 3 7 °C incubation oven may be available for use or the procedure may work at room temperature.
4. Micropipets may be purchased from Edvotek or borrowed from a local community or four-year colleges.
5. Complete directions for the protocol can be obtained from Edvotek and are included with the purchase of the kit.
6. Access to the Internet.

VII. Student Prior Knowledge and Skills

1. Expected content knowledge

- The student will be able to explain the correlation between the structure and function of biologically important molecules and their relationship to cell processes.
- The student will demonstrate an understanding that all organisms are composed of cells, which can function independently or as part of multicellular organisms.
- The student will conclude that cells exist within a narrow range of environmental conditions and changes to that environment, either naturally occurring or induced, may cause changes in the metabolic activity of the cell or organism.
- The student will investigate how natural and man-made changes in environmental conditions will affect individual organisms and the dynamics of populations.
- The student will investigate a biological issue and develop an action plan.

2. Expected Technical Skills

- Students should be able to demonstrate a working knowledge of how to use the Internet as a research and reference tool and how to judge if a site is a reliable source of information.
- Students should be familiar with the use and care of micropipets.
- Students should be familiar with metric system measurements, in particular those for volume. (Liter, milliliter, microliter).

3. **Possible preconceptions**
   - Incomplete knowledge of role of the immune system in fighting disease, allergies, and auto-immune disease.

VIII. What is Expected from Students

Students will be expected to produce several products from this curriculum that will include:

- A business letter
- Pamphlet on *Vibrio vulnificus* based upon specific criteria and researched on suggested Internet sites.
- Completion of WebQuest task on the Immune System (http://www.manteno.k12.il.us/webquest/high/Science/HumanImmuneSystem/webquest.htm)
- Lab report for the ELISA
- Lab report for the ELISA simulation of a compromised immune response.
- Webpage for the CDC, state government, or WHO concerning any condition, disease, or behavior which could compromise the immune response to Vibrio vulnificus.

IX. Anticipated Results

It is anticipated that students will be able to perform the ELISA according to the protocol and desired results should be obtained. Possible sources of error could occur if students are not familiar with measuring small quantities with micropipets, or they place samples in the wrong wells in the plates. Also the incubation time and temperature plays an important role in the results of the experiment**.**

X. Classroom Discussion

Lessons are developed to include all analysis and discussion questions. The unit is designed to spiral to build upon concepts and skills learned in previous lessons.

XI. Assessment

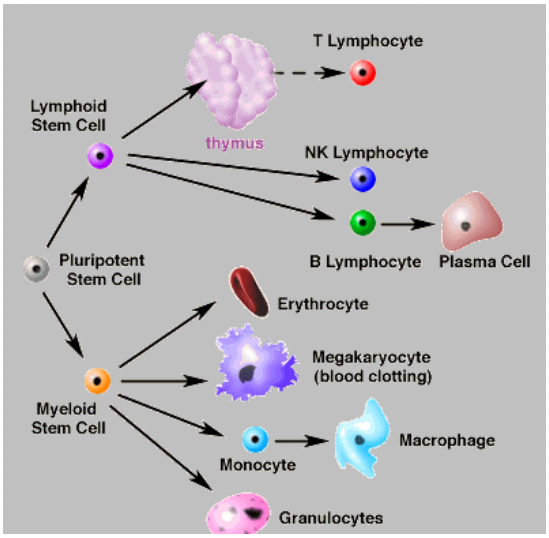
Rubrics are included with each lesson where applicable.

Science Background for Teachers

The Human Immune System

The human immune system is vital to the health and well-being of all people. It protects us from the millions of foreign invaders we get exposed to throughout our lives. The immune system also has a 'memory' so that when you see a foreign invader or agent for a second time you will respond more quickly and fight the disease more efficiently.

The immune system is made up of a series of organs, cells and molecules that work together to repair tissue, fight and destroy foreign invaders, and kill cancer cells. An important role is the ability of the immune system to distinguish between our own cells and tissues (self), and exposures to things that are foreign (non-self). The organs of the immune system fall into two broad categories: primary lymphoid tissue and secondary lymphoid tissue. Primary lymphoid tissue includes the bone marrow and the thymus. Different cells of the immune system are derived from stem cells in the bone marrow via a process called hematopoiesis. Once these cells are differentiated into their specific types, they move to other organs of the body. Mature B lymphocytes (the cells that make antibodies) remain in the bone marrow. The thymus contains a variety of immune cells including macrophages and lymphocytes and it is the organ where T lymphocytes mature.

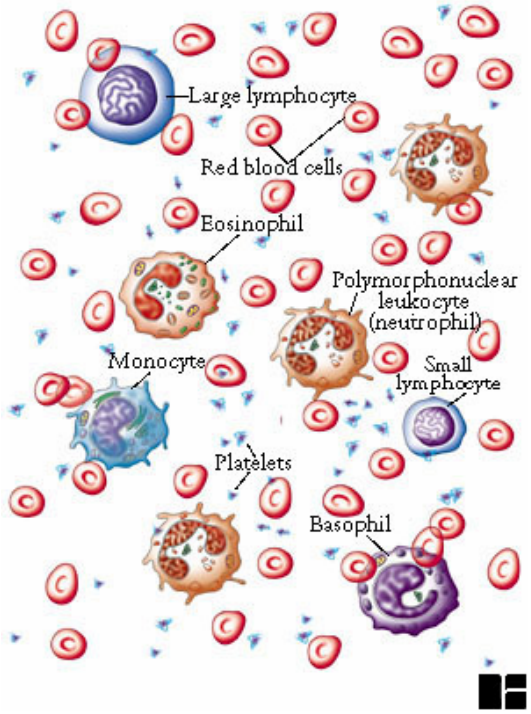


http://www.biology.arizona.edu/immunology/tutorials/immunology/graphics/cell.gif

Because foreign invaders come into the body through a variety of sources e.g. mouth, nose, skin, the role of the secondary lymphoid tissue is to capture the foreign invaders for recognition by the immune system. Secondary lymphoid tissue includes the spleen and lymph nodes and these

organs play an important role in filtering the blood and lymph respectively. Immune cells such as macrophages and lymphocytes continually circulate through these tissues so there is optimal opportunity for them to encounter, and respond to, a variety of foreign invaders. We also have specialized secondary lymphoid tissue lining the surfaces of our gut, nose, and bronchus that are designed to respond to foreign agents we eat or breathe.

Cells of the immune system play an important role in acting as first responders to foreign invaders. The myeloid lineage gives rise to monocytes, neutrophils, eosinophils, basophils, mast cells, platelets and erythrocytes, while the lymphoid lineage gives rise to B and T lymphocytes. Monocytes/macrophages and neutrophils engulf foreign invaders, break them down and then display pieces of them on their cell surface for T lymphocytes to recognize and respond to. Once a specific T cell recognizes the foreign invader, it then produces signals called cytokines and chemokines, which call other immune cells into the site of invasion or infection. These signals can then tell B cells to differentiate and make antibodies, or direct other cells to kill infected or cancerous cells.



http://uhavax.hartford.edu/BUGL/immune.htm

When we get exposed to a foreign invader we have two parts of the immune system that can respond. The first is the innate (natural) immune response, which is a non-specific response. Innate immunity includes physical barriers such as the skin or epithelium, which blocks the ability of many agents to enter the body. Phagocytic cells such as monocytes, neutrophils and dendritic cells are part of the innate immune response because they are constantly sampling their

environment to detect things that are 'foreign'. We also have specific proteins called complement that can form a pore on the surface of a bacterium, punch a hole in the cells wall, thereby killing the bacterium.

The other part of the immune system is the specific (adaptive) immunity. This involves a specific recognition of the foreign invader/agent and a coordinated response by the cells of the immune system. As mentioned above T cells respond to foreign proteins displayed on the surface of the macrophage and this results in specific cytokine and chemokine signals being produced to call in the appropriate cells to deal with the foreign invader or agent. The key component of specific immunity is the development of memory T and B lymphocytes that can quickly respond to the same foreign invader should it be seen a second time. One of the goals of adaptive immunity is the development of specific antibodies that are effective on second exposure to the foreign invader. This is the principle behind the effectiveness of vaccination.

What is a compromised or weakened immune system?

Having a strong immune system is the best defense against infectious diseases, cancer and other foreign exposures. However there are a number of ways that your immune system can become weakened and therefore unable to fight off foreign invaders properly. People who have Acquired Immunodeficiency Syndrome (AIDS) as a result of infection with HIV will have a weakened immune system. In addition, people with chronic conditions such as diabetes, hemochromatosis (iron storage disease), people taking immunosuppressive agents following organ transplants, or people who have had chemotherapy or radiation therapy to treat cancer will also have weakened immune systems. Other things that can weaken the immune system include chronic heavy alcohol use and exposure to chemicals or metals like mercury. Finally, as we age our immune systems also become less strong which is why the elderly are more prone to infections than younger people.

When you have a compromised immune system it means that some part of the system is not as it would be in a normal healthy person. This may mean you do not have enough monocytes or neutrophils to scavenge invading foreign agents. There may not be enough T lymphocytes to provide the proper signals to other immune cells or enough B lymphocytes to make sufficient levels of antibodies. Physical barriers of the innate immune response may be weakened so they don't provide an adequate barrier against exposures. The end result is that a person with a compromised immune system will get more infections, and the infections have the potential to be more serious or life-threatening than in a healthy individual.

Vibrio vulnificus

Vibrio vulnificus is a disease causing organism that occurs naturally in coastal or estuarine waters. It is most commonly found in the Gulf of Mexico, but also throughout the world. It normally lives in warm seawater and is part of a group of vibrios that are called "halophilic" because they require salt . *Vibrio vulnificus* is a bacterium in the same family as those that cause cholera.

Vibrio vulnificus can cause disease in those who eat contaminated seafood or have an open wound that is exposed to seawater. Symptoms include vomiting, diarrhea, stomach pains,

severe weakness, skin rashes and blisters, shaking, chills and high fever. In immunocompromised persons, particularly those with chronic liver disease, *Vibrio vulnificus* can infect the blood stream, causing severe and life threatening illness characterized by fever, chills, decreased blood pressure (septic shock) and blistering skin lesions. *Vibrio vulnificus* bloodstream infections are fatal about 50% of the time.

Lesson 1
Title: Immunology WebQuest - Launching a Defense; Understanding the Human Immune System

(Time: 4, 45 minute classes or 2, 90 minute classes)

Amy Bertrand

http://www.mantano.k12.il.us/webquest/high/Science/HumanImmuneSystem/webquest.html
(If this site is not available, use the web questions and allow students to conduct a search of the following sites to help answer their questions.)
http://www.kidshealth.org/kid/closet/index.html
http://press2.nci.nih.gov/sciencebehind/immune/immune01.htm
http://www.factmonster.com/ipka/A0774536.html
http://encarta.msn.com/T_Cells.html
http://www.bestoftulsa.com/health/immunology.shtml

Summary: Students link to sites to answer questions about the immune system and make a final PowerPoint presentation. Rubrics are included on this site. Resource list included.

PreAssessment: Journal entry. Respond in writing to the following prompt:

- What do you already know about the immune system?
- What are some things you would like to find out about the immune system?

Objective: Students will learn about the immune system by answering questions and completing a WebQuest.

Materials:

- Internet access
- Printed copy of WebQuest questions

http://www.mantano.k12.il.us/webquest/high/Science/HumanImmuneSystem/webquest.htm

Activity:

1. Break students into groups of no more then 4.
2. There are 4 areas of questions:

    - **The Body's Initial Defense System Against Invading Microorganisms**
        1) **What is the first line of defense in protecting your body from an attack my a microorganism? How does your body defend itself when it is invaded by such an organism?**
        2) **What is any foreign substance that triggers an immune response in the human body known as?**
        3) **Identify the 8 organs of the immune system. What are they generally referred to as and why?**
        4) **What organ is responsible for producing the immune cells in your body? How are these cells carried throughout your body?**
        5) **What is the function of each organ in an immune response? Where is it located in your body? How are these organs connected?**

- **Cells of the Immune System**
  1) **What are the main immune cells in the body called and what are the two major types?**
  2) **What cells are responsible for producing antibodies? What role does an antibody play in an immune response? What system "cleans up" after the antibodies do their work?**
  3) **What are the two major contributions of the T cells to the immune defense? Explain why T cells are so important in an immune response.**
  4) **How are the two major types of immune cells able to recognize and fight off invading microorganisms?**
  5) **How do we gain immunity from future infections?**

- **Role of Antibiotics in Fighting Infection**
  1) **Why are antibiotics used and for what type of infections are they most effective in treating?**
  2) **In what two ways are antibiotics created? How do they destroy "foreign invaders" in our bodies?**
  3) **Why is it important to follow the instructions for taking a prescribed antibiotic very carefully? Except for in times of allergic reaction, why should you always finish a course of antibiotic once you have started it?**
  4) **What are some problems that arise when a bacteria becomes resistant to an antibiotic?**

- **Disorders of the Immune System**
  1) **How does each of the three disorders you have chosen affect the immune system? Where do they originate?**
  2) **What are some ways to treat these disorders? What are some diseases that may develop due to an immune system disorder?**
  3) **Describe in detail immunotherapy and some of the pros and cons in using this approach to combat immune disorders. Give your opinion on the concept of immunotherapy (is it good or bad)**

3. Each student is responsible for answering all group questions. The final product is a portion of a PowerPoint presentation on the Immune System.
4. Each group will send their PowerPoint to their teacher; the teacher will join them together to show to the class as whole. Class will take notes on each section.
5. Each group submits a written copy of what they have researched.

Use http://rubistar.4teachers.org/index.php to construct the rubric.

Lesson 2
Water Borne Diseases

Summary: In this lesson students will investigate diseases which are transmitted by water. They discover the symptoms of each disease and attempt to correlate symptoms with disease descriptions. They attempt to gather information on an unidentified disease and to use reliable sources to assist them in the identification of the mystery illness.

Time: two 45 minute classes and one 90 minute class

Objective: Students will

- Identify the role of water in transmitting diseases.
- Compare symptoms of several well-known waterborne diseases.
- Gather background information and data on symptoms of an unidentified disease.
- Begin writing a letter to the Center for Disease Control (CDC) for help identifying the "unknown" disease. (The completion of this letter will take place in the final lesson of the curriculum.)

Materials:

- Symptoms of diseases (make 1 copy of the symptom card pages for each group; laminate, cut and put them in an envelope)
- Copies of Disease descriptions (laminate)
- Unknown Disease Symptom Worksheet
- Transparency markers / colored pencils

Activity:

1. Read background information to students, or have them read as warm-up.
2. Tell students that they are going to compare symptoms and mode of transmission of diseases.
3. Hand out the symptom cards in 1 envelope per group of 4 students and Disease Descriptions.
4. Pass out the Disease Description cards (also laminated) Have students try to match up the "patients" with their disease. There should be one patient for each disease.
5. Direct the students to read each card from the envelope and circle or underline important details. Construct a chart to keep track of the comparisons and matches.
6. Compare each of the cards, looking for commonalities until they think they have them correctly matched. (If cards are laminated, students can write directly on cards and erase later.)
7. Check for correctness. Students will eventually find that there are 6 patients/victims that although they have common symptoms, there is no disease description that fits.
8. Hand out the Unknown Disease worksheet. Instruct students to compose a description that includes details from all 6 of the patients, dead or alive. This will be used in the next activity, writing a letter to the CDC.

Assessment: Completed Unknown Disease worksheet
Background: (student page)

Waterborne diseases are those acquired through the ingestion of contaminated water. About 80 percent of all diseases are water-related. In many of theses illnesses, water infiltrated with sewage spreads the disease. An infected person or animal may pass pathogenic bacteria, viruses, or protozoa through waste into the water supply. Some bacteria, however, are indigenous to water environments, and are naturally occurring in estuarine bodies of water.
The microorganisms that cause illness cannot be seen, smelled, or tasted; contaminated water often appears fresh and clear. This causes particular concern with municipal water supplies. Contamination may not be detected until a noticeable number of people have become ill. One specific bacterium has been isolated from water, sediment, plankton and shellfish (oysters, clams and crabs) located in the Gulf of Mexico, the Atlantic Coast as far north as Cape Cod and the entire West Coast. Cases of illness have also been associated with brackish lakes in New Mexico and Oklahoma.

Most ailments caused by ingestion of water infiltrated with sewage are intestinal, causing gas, cramping and diarrhea. Some pathogens (harmful microorganisms) attach to intestinal linings and produce toxic materials which the body then tries to purge. Others invade intestinal epithelial cells and cause inflammation but do not produce toxins. Still another bacterium occurs naturally and is not caused by pollution. It does not affect sealift, but in people, can cause wound infections, gastroenteritis, (diarrhea and other stomach and intestinal symptoms), septicemia (blood poisoning) and even death. Fluids containing disease-fighting white blood cells are secreted into the intestine to id in attacking or flushing the harmful organisms from the body. Unfortunately, this loss of fluids also causes dehydration, the major concern in patients with these types of diseases. Another concern is to individuals who have a compromised immune system. In those people, the bacteria can infect the bloodstream, causing severe life-threatening illness that can induce fever and chills, decreased blood pressure and skin sores. When this bacterium causes a bloodstream infection, it is fatal about 50 percent of the time. [CDC *(Vibrio vulnificus)*]

If a patient is very young, elderly, or malnourished, dehydration can be life-threatening. Children with diarrhea must be closely monitored. They have not yet developed the immunities of adults, and their systems can be quickly overwhelmed by the shear number of pathogens. As many as one-third of pediatric deaths in developing countries are attributed to diarrhea and the resulting dehydration. Africa, Asia, and Latin America experience estimated 3-5 billion cases of diarrhea, with 5-10 million deaths, each year. *Vibrio cholerae*, *Salmonella* sp., and *Shigella* species of bacteria are among the leading causes of bacterial diarrhea. *Vibrio vulnificus* is a leading cause of reported deaths from food-borne illnesses in coastal states such as Florida. Bacteria are everywhere are everywhere including in our water. However, water supplies are monitored to prevent contamination by fecal pathogens in concentrations that will produce infections in humans. Water treatment facilities routinely test for these pathogens by checking levels of indicator bacteria, such as *Escherichia coli* (a common organism in our intestines). If these organisms rise above a set level, fecal contamination has occurred and more intensive water testing should begin. This does not mean pathogens are present, but serves as an "indicator" that they may be. It may be necessary to accelerate water treatment procedures. Also,

the source of contamination must be located and protective measures taken to avoid further contamination.

Until recently, Americans have regularly suffered through epidemics of waterborne illness such as cholera and typhoid fever. Improvements in wastewater disposal practices and the development, protection, and treatment of water supplies have significantly reduced the incidence of these diseases. The treatment and chlorinating of municipal water have made infection by microorganisms rare in developing countries; however, in many developing countries treatment of waste water is minimal or nonexistent. In some cases, sewage and other wastes are dumped directly into rivers that are used by people downstream for drinking and washing.

Epidemiologists study the incidence, transmission, distribution, and control of disease. When outbreaks of a particular disease occur, epidemiologists research symptoms, incidence, and distribution of cases; they try to determine the cause of the disease, its means of spreading, and possible methods for controlling or preventing the illness. With waterborne diseases, determining how the water supply was contaminated is critical to solving the problem. The case histories of affected patients and any associations among patients help epidemiologists solve the mysteries of disease.

Water-Bourne Identity Cards
(teacher page-to be copied for student use, see directions)

Case Background #1-
- Symptoms occurred ten days after attending a family camp
- Discovered that camp's sewage system was faulty and chlorinator was not functioning.
- Family reunion used same camp the previous week; two people attended who had recently recovered from typhoid fever.
- Began feeling lethargic with general aches and pains.
- Malaise- general weakness and discomfort, and anorexia- loss of appetite.
- Developed high fever, became delirious.
- Tender abdomen with rose-colored spots on skin.

Case Background #2-
- Chain smoker lived in a warm climate
- Lives in a home that is constantly air conditioned during the summer months
- Sudden onset of fever that progressed to a high fever with shaking chills
- Developed a cough and excessively rapid breathing
- Pain in chest; lungs have rattling sound when breathing
- General, diffuse muscular pain and tenderness
- Intense headache and mental confusion

Case Background #3-
- Recently returned from Bangladesh
- Symptoms occurred two days after eating fruit thoroughly washed at outdoor pump
- Family members have been coming down with these same symptoms
- Severe dehydration
- Painless diarrhea, vomiting
- Severe muscular cramps in arms, legs, hands and feet
- Eyes appear shrunken; hands have dishwashing appearance or prune like appearance

Case Background #4-
- Returned from Thailand two weeks ago
- Drank un-bottled water
- Feverish
- General abdominal discomfort and tenderness' especially on the lower right side
- Dysentery
- Tires easily, mental dullness
- Moderate weight loss

Case Background #5-
- Just returned from visiting friends in Mexico
- Symptoms began 12 hours after drinking several swallows of water from a bucket pulled from a well
- Experiencing dehydration caused by diarrhea
- General, diffuse muscular pain and tenderness
- Low-grade fever
- Nausea, vomiting
- Abdominal cramps

Case Background #6-
- Symptoms occurred two weeks after backpacking trip
- Filled water bottle with clear, fresh-tasting water from a stream below a beaver dam
- Abdominal cramps
- Intermittent dysentery (which is greasy and odorous)
- Excessive intestinal gas
- Malaise- general weakness and discomfort
- Weight loss

Case Background #7-
- Lives on a ranch that raises cattle and chickens
- Symptoms occurred 10 hours after drinking from pump outside of barn (ground water may have been contaminated by surface water in the pasture after heavy rain)
- Malaise- general weakness and discomfort
- Fever
- Dysentery
- Abdominal cramps
- Nausea and vomiting

Case Background #8-
- Four years old
- Symptoms began 15 hours after bobbing for apples in pre-school class
- Severe abdominal cramps
- Frequent, painful dysentery
- Blood and mucus in stool
- High fever, chills
- Dehydration

Case Background #9-
- Visited favorite beach and swam with friends
- Malaise-general weakness and discomfort
- Anorexia- loss of appetite
- Fever
- Nausea, mild diarrhea
- Jaundice- yellowing of the skin and whites of eyes
- Sick for a week

Case Background #10-
- Lives in an apartment in the city
- Chain smoker living in a warm climate
- Drinks tap water
- Pain in chest; lungs have rattling sound when breathing
- Visited favorite beach and swam with friends
- Recently visited an alligator farm
- Eats lots of fresh seafood

Case Background #11-
- Four years old
- Attends a daycare center five days a week
- Diarrhea
- Nausea and vomiting
- Fever
- Sucks thumb
- Recently swam in a local pond

Case Background #12-
- Lives on a ranch that raises cattle and chickens
- Just returned home from visiting friends in Mexico
- Lives in a home that is constantly air conditioned during the summer months
- Is tired in the late afternoon
- Often conducts pack trips in the mountains
- Works 14 hours a day, usually seven days a week
- Drinks eight glasses of water a day

Case Background #13-
- 46 year old man admitted to hospital
- eaten raw oysters purchased from a retail store
- fever, sweats and nausea
- history of alcohol use
- cirrhosis diagnosed prior to admittance to hospital
- died 2 days later

Case Background #14-
- 51 year old woman admitted to hospital
- fever, nausea, muscle aches
- cellulitis on legs- infection of the skin and underlying tissues.
- eaten raw oysters served at a party
- previously diagnosed with breast cancer and Hepatitis C.
- admitted to hospital, developed septic shock
- died 1 day later

Case Background #15-
- 75 year old man admitted to hospital
- fever, chills and nausea
- myalgia- muscle pain
- two circular lesions on the left leg
- reported history of regular beer consumption
- previously diagnosed with diabetes
- worked as a boat captain
- died 3 days later

Case Background #16-
- 19 year old woman admitted to hospital
- nearly drowned in a recent water skiing accident
- skin abrasions and superficial wounds on legs and arms
- gastroenteritis
- diarrhea, nausea, vomiting
- pneumonia
- treated with antibiotics
- wound treatment
- eventually released from the hospital

Case Background #17-
- 30 year old man
- works at a marina
- does not eat raw seafood
- has hereditary hemochromatosis- an iron metabolism disorder
- regularly performs boat maintenance such as scraping barnacles off of boats and cleaning the bilge
- wears protective gloves when working with tools to avoid cuts or scrapes
- uses topical antibacterial

Case Background #18-
- 38 year old man
- does not eat raw seafood
- recently underwent gastric surgery and has persistent low stomach acid
- Works in an oyster packing plant
- Routinely wears protective gloves when working with tools
- Washes hands frequently

Case Background 19-

- 55 year old man admitted to hospital
- seafood worker at a roadside seafood stand
- infected cut on foot, spread through leg, which doctors amputated
- records show he suffered from cirrhosis, hepatitis
- records show he had chronically weak health due to exposure to the chemical Agent Orange during the Vietnam War
- died 2 days later

Case Background 20-

- 32 year man admitted to hospital
- stuck in the finger fish hook during a recent Rock fishing trip in the Bay
- painful localized swelling of the ring finger
- wedding band needed to be cut off to relieve swelling
- infection then spread up the arm, was later amputated
- eventually recovered and was released from the hospital

Disease Descriptions
(teacher page- copy for student use, see directions)

Typhoid Fever, caused by *Salmonella typhi* bacterium Now uncommon in the United States, this is usually acquired during foreign travel. During the first half of this century it was the most commonly reported cause of waterborne disease in the U.S. It can be acquired by contact with contaminated water, swimming, etc. In 1907, Mary Mallon, nicknamed "Typhoid Mary", was identified as a carrier of the disease. She transmitted the disease while working as a cook in restaurants and private homes in New York City. She escaped authorities for eight years, but was finally apprehended in 1915. She infected some 50 people, wit three cases resulting in death. In 1973 a major outbreak of typhoid fever affected 225 people in a migrant labor camp in Dade County, Florida. The well that supplied water to the camp was contaminated by surface water.	**Cholera**, caused by *Vibrio cholerae* bacterium. This disease is extremely contagious; if untreated, dehydration can lead to death. Cholera originated in Europe and was spread to the United States by transatlantic liners through New Orleans. It reached California through the forty-niners in their quest for gold. Recent outbreaks of cholera have occurred throughout the United States. Along the Gulf Coast, water and seafood were identified as contributing to the outbreaks. In Louisiana, undercooked crab was the culprit, and in Texas in 1981, people were infected by eating cooked rice that had been washed with contaminated water.
Enterotoxigenic *E. coli* gastroenteritis caused by *E. coli* bacterium. Leading cause of infant morbidity worldwide. Visitors to Latin American countries who partake of the food and water occasionally come down with "traveler's diarrhea," also known as "turista" or "Montezuma's Revenge." A large outbreak of this disease occurred in 1975 in Crater Lake National Park and about 200 park employees became ill after consuming water that had been contaminated by sewage.	**Giardiasis**, caused by the *Giardia lamblia* protozoan Sickness results with only a low dose of the protozoan; it is the most commonly reported causative pathogen of waterborne outbreaks. The giardia protozoan is killed by boiling water for at least five minutes or is removed by passing water through a filter whose pore size is at least 0.2 microns.)

Salmonellosis, caused by species of *Salmonella* bacteria. This is carried by humans and many animals; wastes from both can transmit the organism to water and food. The largest waterborne salmonella outbreak reported in the United States was in Riverside, California, in 1965 and affected over 16,000 people.	**Shigella**, caused by species of *Shigella* bacteria. Most infection is seen in children 1-10 years old; a very low dose can cause illness. Waterborne transmission is responsible for a majority of the outbreaks.
Hepatitis A. caused by *Hepatitis A* virus Third most common cause of waterborne disease in U.S. The term hepatitis relates to inflammation of the liver.	**Cryptosporidiosis**, caused by *Cryptosporidium*. This was first identified as a cause of diarrhea in people in 1976. It can be transmitted through contact with animals, [particularly cattle and sheep], other humans [especially in daycare centers], and contaminated water supplies.
Complications caused by *Vibrio vulnificus* *Vibrio vulnificus* is a bacterium in the same family as those that cause cholera. It normally lives in warm seawater and is part of a group of vibrios that are called "halophilic" because they require salt. Vv can cause disease in those who eat contaminated seafood or have an open would that is exposed to seawater. In immunocompromised persons, particularly those with chronic liver disease, *V. vulnificus* can infect the blood	stream, causing severe and life threatening illness characterized by fever chills, decreased blood pressure (septic shock) and blistering skin lesions. *V. vulnificus* bloodstream infections are fatal about 50% of the time. is a disease causing organism that occurs naturally in coastal waters most commonly found in the Gulf of Mexico, but also throughout the world. Symptoms include vomiting, diarrhea, stomach pains, severe weakness, skin rashes and blisters, shaking, chills and high fever. (CDC

Waterborne Identity Cards KEY (teacher page)

Cases by number

1. Typhoid Fever Caused by *Salmonella typhi* bacteria
2. Legionnaire's disease caused by *Legionella pnuemophilia*
3. Cholera caused by *Vibrio cholerae* bacteria
4. Amebiasis caused by *Entamoeba histolytica*
5. Enterotoxigenic *E. coli* gastroenteritis caused by *E. coli* bacteria
6. Giardiasis, caused by*Giardia lambilia* protozoan
7. Salmonellosis, caused by species of *Salmonella* bacteria
8. Shilgella, caused by species of *Shigella* bacteria
9. Hepatitis A. caused by *Hepatitis* A virus.
10. Control card. (individual had no waterborne illness)
11. Cryptosporidiosis caused by *Cryptosporidium.*
12. Control card (individual had no waterborne illness)
13. Death by vibrio infection caused by the *Vibrio vulnificus* bacteria
14. Death by vibrio infection caused by the *Vibrio vulnificus* bacteria
15. Death by vibrio infection caused by the *Vibrio vulnificus* bacteria
16. Complications from vibrio infection caused by the *Vibrio vulnificus* bacteria
17. Complications from vibrio infection caused by the *Vibrio vulnificus* bacteria
18. Complications from vibrio infection caused by the *Vibrio vulnificus* bacteria
19. Death by vibrio infection caused by the *Vibrio vulnificus* bacteria
20. Complications from vibrio infection caused by the *Vibrio vulnificus* bacteria

Sample Unknown Disease Symptom Page (student page)

Name_____Class_____Date_____

Disease Name Unknown, caused by an unknown *Genus species* bacteria
Symptoms-

CDC PROMPT (student page)

Imagine that there is an outbreak of a disease in your community. Many of your neighbors, as well as yourself, are concerned about the cause of the disease, susceptibility and prevention. Write a three paragraph letter to the Centers for Disease Control (CDC) describing what you already know about the disease and asking for more information.

Before writing, think about all of the symptoms and possible adverse health outcomes of this mysterious disease. Next, based on your current level of knowledge on this outbreak, make some predictions about how you think people are exposed to this disease causing agent. Finally, think about what prevention strategies the community would need to know about in order prevent this disease from occurring in the population.

Now write a three paragraph letter to the CDC asking for more information about the disease, who is susceptible and its prevention. Use the graphic organizer to help organize your thoughts.

CDC Prompt Graphic Organizer (student page)

Introductory Paragraph: Tell them all of the things you are going to tell them.

Sentence #1_____.

Sentence #2 _____.

Sentence #3 _____.

Sentence #4_____ .

Body Paragraph 1 Topic

_____

Sentence #1_____.

Sentence #2 _____.

Sentence #3 _____.

Sentence #4_____.

Sentence #5 _____.

Sentence #6_____.

Body Paragraph 2 Topic

_____

Sentence #1_____.

Sentence #2 _____.

Sentence #3 _____.

Sentence #4_____.

Sentence #5 _____.

Sentence #6_____.

Closing Paragraph

Sentence #1_____.

Sentence #2 _____.

Sentence #3 _____.

Be sure to use the spell and grammar check on your laptop before you turn your work in.

Lesson 3
Title: *Vibrio vulnificus* Internet Scavenger Hunt

Summary: This is an Internet scavenger hunt on *Vibrio vulnificus*, a disease affecting persons with compromised immune systems. After their research on the Immune system, students will choose an illness that impacts the immune system. The final product will be an informational pamphlet to send to a national or local association for that disorder. Have students think about the answers to the USFDA questions below keeping in mind the 8 unidentified water borne illness cases from the previous activity. This should help to guide their *Vibrio* research.

Time: Time: two 45 minute classes and one 90 minute class

Pre-Assessment: The USFDA, in collaboration with the Centers for Disease Control and Prevention (CDC) and state health departments, have collected *Vibrio vulnificus* illnesses data since 1989. Among the most important questions were:

1) Where have most illnesses occurred?
2) Who has gotten sick? (age, race, gender)
3) Did these persons have any common pre-existing health conditions?
4) Where did they consume shellfish? (home, restaurant, bar)
5) What type of shellfish was eaten? (clams, oysters, fish)
6) What was the origin of the shellfish?

Objective: Students will

- Use the Internet and specific teacher recommended sites to identify and record information on *Vibrio vulnificus*.
- Identify More to be added here???
- Compose a well written pamphlet

Materials:

- *Vibrio* research worksheet
- Internet access and *Vibrio* website list
- Materials pre-ordered from ***http://www.issc.org/EDU/Brochures.PDF***

Activity: (Time: 60)

1. Students are assigned to work in groups of two.
2. Each student in the group is responsible for recording the information.
3. Pass out *Vibrio* graphic organizer
4. List on the board, or hand out a printed list of websites for *Vibrio* research.
5. Students should find information on and answers to the following:
    - **What is *Vibrio vulnificus*?**
    - **Who is at risk for becoming infected?**
    - **How can you become ill?**

- **What are the symptoms?**
- **How is *V. vulnificus* diagnosed and treated?**
- **Is *V. vulnificus* a serious problem?**
- **What can be done to prevent *V. vulnificus* infections?**
- **Are there any situations that put persons at a higher risk then the average consumer?**
- **What can be done to improve the safety of seafood?**

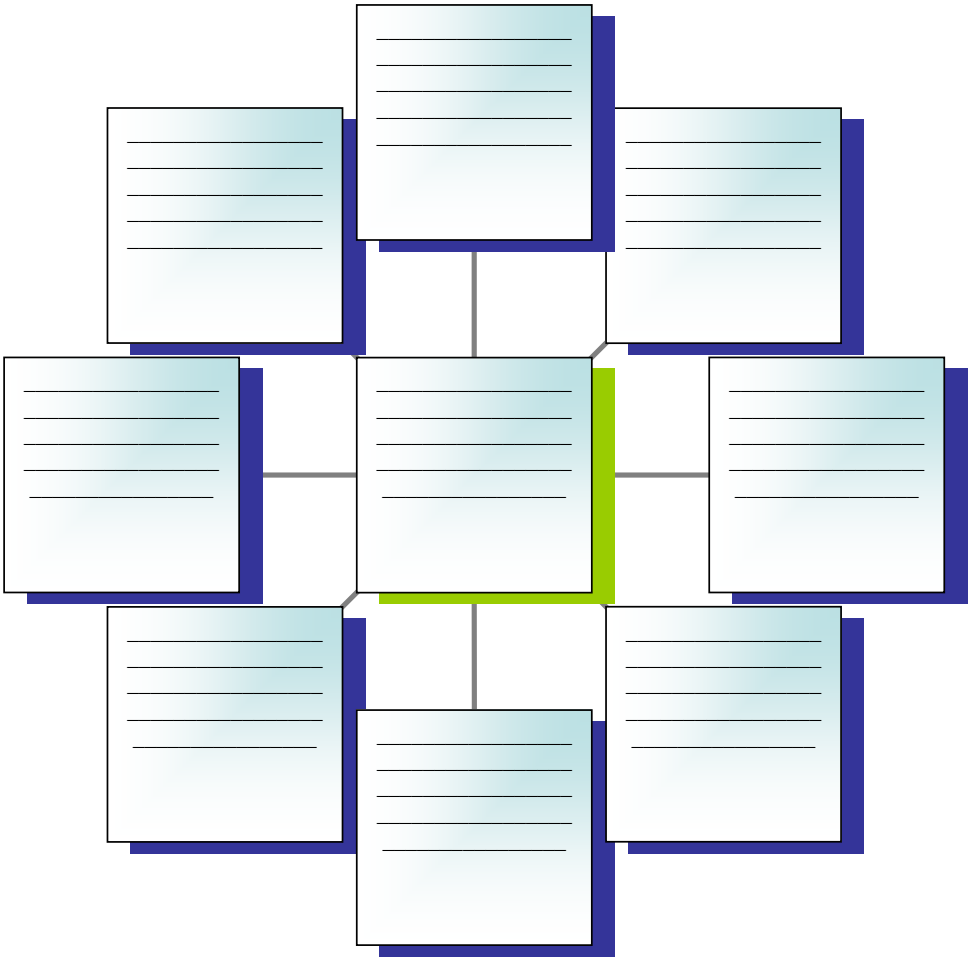
Some sites to consider using for research;

http://var.teletask.com/Links/vibrio_vulnificus.htm
http://hgic.clemson.edu/factsheets/HGIC3663.htm
http://vm.cfsan.fda.gov/~mow/chap10.html
http://www.edcp.org/factsheets/vibrio.html
http://www.cdc.gov/ncidod/dbmd/diseaseinfo/vibriovulnificusa_a.htm
http://www.medhelp.org/NIHlib/GF-661.html
http://www.issc.org/EDU/pamplets/Risk_Eating_Raw_Oysters_Clams.html
http://www.nzfsa.govt.nz/science-technology/data-sheets/vibrio-vulnificus.pdf
http://www.gulfoysters.org/gaocritical.cfm
http://www.liverfoundation.org/db/articles/1055
http://www.diabetesdigest.com/News16.htm
http://research.nwfsc.noaa.gov/research/divisions/reutd/fhm/vibrio.cfm
http://www.issc.org/Vibrio_vulnificus_Education/Vv-Edu.htm
http://www.kalanghorne.com/health/vibrio.asp
http://www.theglassceiling.com/supermoms2/su1_37.htm

Extension

Lose a Million Bacteria game
http://www.cfsan.fda.gov/~cjm/million.html

Vibrio vulnificus Graphic Organizer



Lesson 4
Title: *Vibrio vulnificus* Survivor; Who Gets the Immunity Card?

Summary: The purpose of this culminating activity is to bring together all the concepts included in this curriculum, by providing real-life scenarios. Students should be able to understand how the immune system functions and how immune system defects can lead to serious bacterial infections and complications from organisms such as *Vibrio vulnificus*.

In this activity, students review the 7 *V. vulnificus* case histories from a previous lesson to determine the commonalities in the cases. Using a chart provided to organize information about V. vulnificus cases in Lesson 3, students are given a bag of icons representing key components of each case history. The lesson is completed by students writing a letter to the CDC (Center for Disease Control) for more information about *Vibrio vulnificus* using evidence collected during this match up game.

Time: two 45 minute classes and one 90 minute class

Pre-Assessment:
Construct a written "case study" of your own for one of the diseases we learned about. Be prepared to share with the class and have them guess the water borne illness.

Objective: Students will gather information on an unknown disease by studying cases of patients involving this unknown disease (*Vibrio vulnificus)*

Materials:
Survivor ID Chart
Survivor symptom icons, copy 6 full sets for each group of students (I recommend laminating the chips to increase shelf life.)
Case histories of unknown disease from Water Bourne Disease Cards set. (I also recommend that these be laminated to ensure longevity)

Activity:
1. Hand out supplies of icons, case history cards and the Survivor ID Chart.
2. Students may work in groups of 4 working together to share the reading of the case histories.
3. As they read, they should underline the evidence that supports the mysterious illness. Each detail that is underlined should also be identified on the ID chart using the laminated symptom chips. At least one member of the group should be the recorder to record the information on a chart in pen or pencil in case they do not finish in one period.
4. Depending on the number of groups the class is divided in to, each group can be selected to share one case history and charted information with the class.
5. By looking at the completed charts students should be able to gather enough evidence to include in their letter to the CDC asking for more information on this mysterious illness, caused by the things they see on the chart.

Assessment:

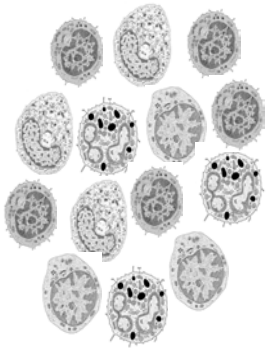
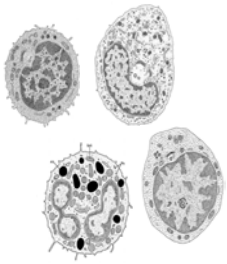
Use the key to check the answers of each group. The letters the students write to the CDC in the next part of this unit will also assess what they have learned about *Vibrio vulnificus*.

Contact Information:
(Centers for Disease Control and Prevention, 1600 Clifton Rd, Atlanta, GA 30333, U.S.A
Tel: (404) 639-3311 / Public Inquiries: (404) 639-3534 / (800) 311-3435)

Survivor Chart: Record information from each case history, represented by icons in this table before determining the prognosis for each case. Students use this information to complete writing their letters to CDC.

Vv Case #	Eats Raw Oysters	Alcohol	Immune System		Death	Sea Water Exposure	Diarrhea
			Compromised	Healthy			
13							
14							
15							
16							
17							
18							
19							
20							

Icons for student activity: Reproduce, laminate and cut into individual pieces before student use.

 http://www.bioeng.aucklan Normal immune system	Diarrhea 	Compromised immune system 	Exposure to sea water  http://www2.eng.cam.ac.uk/~dkk20/images/various/waves.
Consumed raw oysters  http://collections.ic.gc.ca/red_i	Death  http://www.anstonconsoc.org.uk/RIP%20tombstone.gif	Unknown factors ?	Alcohol consumption  http://www.goodfeeling.nl/

Survivor Key : Teacher use only

Vv Case	Eats Raw Oysters	Alcohol	Immune Status		Death	Sea water exposure	Diarrhea
			Compromised	Healthy			
13	+	+	+		+	-	-
14	+	-	+		+	-	-
15	-	+	+		+	+	-
16	-	-		+	-	+	+
17	-	-	+		-	+	-
18	-	-		+	-	+	-
19	?	?	+		+	+	-
20	-	?		+	-	+	-

Lesson 5
Title: ELISA Simulation and Demonstration of Immune System Response to *Vibrio vulnificus.*

Time: two 45 minute classes and one 90 minute class

Teacher Preparation:

Laboratory Safety:

- Perform the following activity under appropriate safety conditions
- Students should wear aprons/lab coats and safety goggle. (This is a simulation but in real life gloves would also be worn when handling infectious or other biological samples)
- Remind students of broad laboratory safety concerns associated with this activity such as:
    - Clothing, skin and eye protection
    - Handling and potential spread of biological samples
    - Chemical handling and hazards (Review Material Safety Data Sheet (MSDS))
    - Disposal of biological and chemical waste

Introduction:

The purpose of this lesson is to introduce students to performance of the Enzyme Linked Immunosorbent Assay (ELISA), an assay routinely performed in an immunology laboratory. These assays are based on the principle of antibody binding to specific antigens or pieces of infectious agents. When people are exposed to an infectious agent they make antibodies that can be detected in serum separated from a whole blood sample. If a person is immunocompromised they may have a decreased ability to make enough antibodies to protect them from infection. This activity will demonstrate how a person with a compromised immune system will not make antibody to bacterial pathogen *Vibrio vulnificus* compared to a person with a healthy immune system.

Scenario for Teacher to transition into this activity:

You have just learned that the uncle of one of your classmates has died suddenly from a serious bacterial infection. While you are sad for your classmate, you are also curious to learn more about what happen. You hear that the uncle had a compromised immune system and that might be why he died so quickly. From your WebQuest you have learned that the immune system is a complex system of cells and molecules that protects humans from infection. You wonder if the reason the uncle could not fight the infection was because he did not have enough antibodies to fight the disease. Your teacher provides some activities to investigate this problem.

Part 1: Simulation of Enzyme Linked Immunosorbent Assay (ELISA)
Procedure:

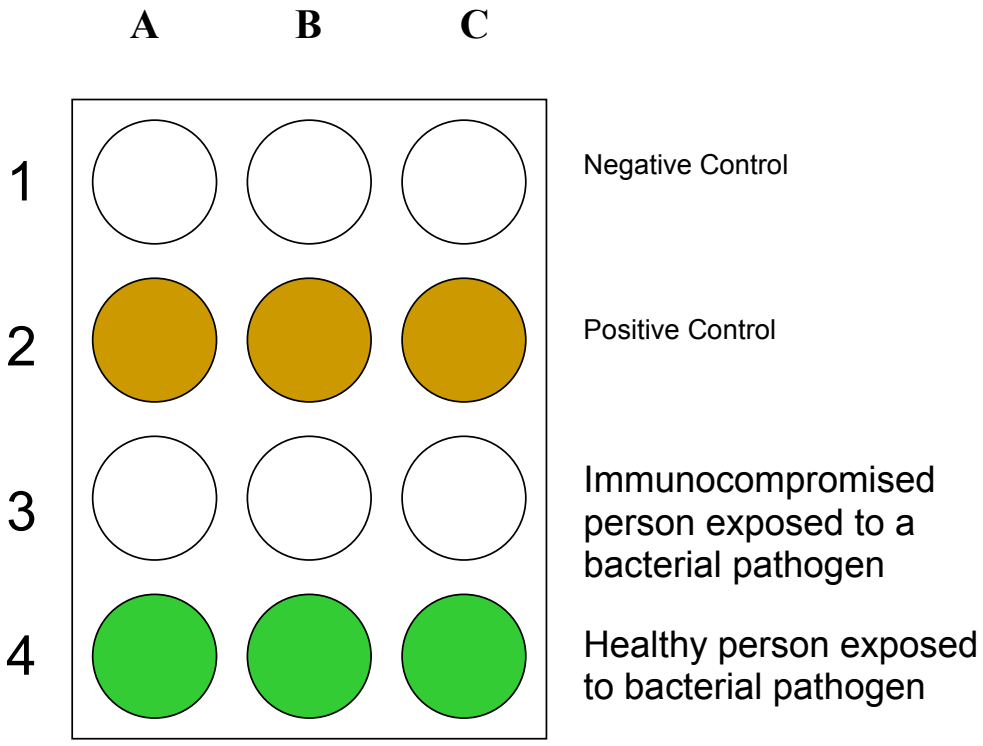
1. Have the students go through an ELISA simulation on the web. Initiate discussion regarding ELISA principles.
    a. www.bio-rad.com
    b. click on Life Science Information tab
    c. Catalog index on left, click on ELISA Immuno Explorer Kit
    d. Under picture click on link "See the Interactive ELISA Immuno Explorer Animation"
    e. Click on ELISA antibody test

Part 2: Perform EDVOTEK ELISA in class with students (www.edvotek.com)

EDVO-kit #269 Introduction to ELISA Reactions
Read instructions provided with the kit
Additional materials needed:

- Distilled water
- Beakers (make sure glassware is clean and dry with not soap residue)
- 37°C Incubator
- Disposable lab gloves
- Safety goggles
- Automatic micropipets (0-50 µl) and tips recommended

2. The ELISA will be completed per instructions provided by EDVOTEK. For interpretation of the results to simulate the difference in antibody response in healthy versus immunocompromised individuals to a bacterial pathogen have the students use the following template:



(student page)

Student Objectives:

1. Develop a hypothesis that includes an ELISA to determine what level of antibodies a person with a compromised immune system will make towards *V. vulnificus*
2. Record all experimental data in lab notebook, including methods, results and conclusion
3. Fill out ELISA plate template with results to provide a visual record.

Student Activity:
ELISA Results:
Use the following template to record the results from your ELISA. Paste into your lab notebook