

# Next on FOX® – When Germs Attack!

**Grade Level:** 6<sup>th</sup> Grade Science

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**Length of Unit:** Ten class periods of 45 minutes each

## I. ABSTRACT

Microbes surround us. Some are harmful; some are necessary. This two-week unit allows sixth graders to explore this hidden world and how our bodies spring into action in response to microbes. The culminating activity is a research project, in which students present information on one of several microbial diseases or a specific part of the immune system after conducting research from a variety of sources.

## II. OVERVIEW

### A. Concept Objectives

1. Students develop a basic understanding of concepts surrounding prevention and control of disease.
2. Students understand how the immune system functions within the body as a whole, as well as the factors that influence its structures and functions.
3. Students understand how to use information seeking strategies to access a variety of sources of information for a specific purpose.

### B. Content from the *Core Knowledge Sequence* (page 154)

1. The immune system fights infections from bacteria, viruses, fungi.
2. White cells, antibodies, antigens
3. Vaccines, communicable and non-communicable diseases, epidemics
4. Bacterial diseases: tetanus, typhoid, tuberculosis; antibiotics like penicillin, discovered by Alexander Fleming
5. Viral diseases: common cold, chicken pox, mononucleosis, rabies, polio, AIDS

### C. Skill Objectives

1. Students will frame questions to direct research.
2. Students will summarize and organize information gathered from multiple sources in different ways and will present that information orally and in writing.
3. Students will be able to articulate an understanding of how lifestyle, pathogens, family history and other risk factors may relate to cause or prevention of disease.
4. Students will describe the structures and functions of the immune system.

## III. BACKGROUND KNOWLEDGE

### A. For Teachers

1. *101 Questions About Your Immune System* by Faith Hickman Brynie.  
This book is the one great resource, in very readable terms, for this unit. If you can find it, BUY IT!
2. *The Immune System - Your Body's Disease-Fighting Army* by Mark Friedlander, Jr., and Terry M. Phillips, PhD, DSc
3. *Science Explorer: Human Biology and Health* by Prentice Hall textbooks

- B. For Students
1. Students should know that the immune system's purpose is to help our bodies fight attack from bacteria, fungi, viruses, and any other "invaders" that are foreign to our bodies. Students should know that the circulatory and lymphatic systems are key pieces to immunity from diseases and infections. Students can brainstorm various types of illnesses, diseases and infections and then can try categorizing them as bacterial or viral, OR teacher can provide small groups of students with lists of diseases and have students categorize them only. Following this activity, teacher can share the correct responses/categories with students and lead into a discussion recalling the differences between bacteria and viruses (see fifth grade science sequence).

#### IV. RESOURCES

- A. *The Unknown World*, NOVA Video, ISBN# 1-57807-030-9
- B. *101 Questions About Your Immune System* by Faith Hickman Brynie.
- C. *Invisible Enemies: Stories of Infectious Disease* by Jeanette Farrell
- D. *The Disease Book – A Kid's Guide* by Margaret O. Hyde and Elizabeth H. Forsyth, MD
- E. *The Immune System – Your Body's Disease-Fighting Army* by Mark Friedlander, Jr., and Terry M. Phillips, PhD, DSc
- F. *Concepts In Science, Curie Edition* by Paul F. Brandwein, et. al.
- G. *Modern Biology* by James H. Otto and Albert Towle

#### V. LESSONS

##### **Lesson One: Introduction to Microbes and the Immune System**

- A. *Daily Objectives*
  1. Concept Objective(s)
    - a. Students understand how the immune system functions within the body as a whole, as well as the factors that influence its structures and functions.
  2. Lesson Content
    - a. The immune system fights infections from bacteria, viruses, fungi.
    - b. White cells, antibodies, antigens
  3. Skill Objective(s)
    - a. Students will describe the structures and functions of the immune system.
- B. *Materials*
  1. Paper and pencils for each student
  2. Two Petri dishes for each group
  3. Eight squares of plastic wrap\*
  4. Eight rubber bands\*  
\*or Petri dish covers
  5. One package of plain gelatin for each group
  6.  $\frac{3}{4}$  cup of boiling water for each group
  7. Hot plate and pan for boiling water

8. ¼ cup cold water for each group
9. ½ tsp. Listerine, Betadyne or other antiseptic for each group
10. Scotch tape and pens for labeling dishes
11. Spoon or other stirring instrument that can be used in boiling water
12. Overhead projector, pens and transparencies

C. *Key Vocabulary*

1. Acquired immunity – immunity gained through life experiences such as receiving a vaccination or from actually having the illness
2. Active immunity – immunity gained from the work of the immune system; Memory cells make antibodies to protect from certain antigens
3. Antigen – anything that triggers a response from the immune system
4. Allergen – anything that produces an allergic response
5. Allergy – an overreaction of the immune system to an ordinarily harmless antigen
6. Antibodies – Y-shaped proteins that attack and destroy certain microbes that enter the body
7. Immunodeficiency – the loss of certain immune system functions and/or structures
8. Leukocytes – any white blood cells
9. Lymph – a clear fluid that washes all body cells and that carries immune cells
10. Lymph nodes – nodules that help develop and then store leukocytes and that act as a filter for ridding the lymphatic system of disease-causing organisms
11. Lymphocytes – leukocytes such as T cells or B cells that circulate in lymph
12. Memory cells – special cells that give our bodies immunity by “remembering” certain pieces of information required for producing antibodies against specific antigens
13. Microbe/microorganism – an organism too small to be seen without a microscope
14. Pathogen – any microbe that can cause disease
15. Vaccine – a man-made substance that stimulates antibody production in the body to produce immunity against a specific disease/illness
16. Virus – a particle of genetic material such as DNA or RNA that is surrounded by a protein coat
17. HIV/AIDS – HIV is the specific virus that causes the disease AIDS. It is called the Human Immunodeficiency Virus. AIDS, or Acquired Immune Deficiency Syndrome, is the disease resulting from HIV infection. Its effects include the general failure of the immune system, certain infections and types of cancer.
18. Phagocyte – any one of several white blood cells (leukocytes) that consume and digest invading pathogens

D. *Procedures/Activities*

1. In Lesson One, students should be given a general overview of the Immune System, its parts and their function(s). This can be done using

the information from the “Student Background” portion of this unit’s overview. Much user-friendly information can be taken from the resource books and materials listed, although this is by no means a comprehensive listing of available materials. The children’s librarian at my neighborhood library collected these particular resources for me. I highly recommend the use of the children’s librarian at your local library. The libraries are often able to set aside all their available materials on a particular subject, either for teachers to check out or for students to use in the library for research. All our local library requires is 10-14 days notice, so please utilize this valuable resource in your own community! Students should keep a vocabulary section in their science notebooks, or on lined paper in a folder for this unit. Review (from fifth grade) bacteria, fungi, and viruses and the characteristics and classification of each.

2. **EXPERIMENT ONE:** Ask each student to get a piece of paper and pencil. Have each student write his/her own name at the top of the page. Then, ask each student to shake hands with two other students, writing their names on the paper. Each of those two students, in turn, shakes hands with two other different people, and so on, until every member of the class has shaken hands with at least one person, writing that person’s name down each time. Ask students to assume that they are infected with a disease that is transmitted through handshaking. Have them calculate how many total students were infected, stemming from them, if each person they shook hands with also transmitted this “disease” to everyone with whom they shook hands. This illustrates the spread of an infectious disease. Show APPENDIX A: THE SPREAD OF THE CHOLERA on the overhead and ask students to make a prediction about the spread of the plague through the water supply based on this information. Next, ask them to think about this: two more deaths occur. Think about the questions that doctors would likely ask about those two deaths, based on the map.
3. **EXPERIMENT TWO: (APPENDIX B)** This is a weeklong experiment that should begin today. Divide students into four groups for this activity. Two cups of water should be boiled and then cooled. Have each group add one gelatin packet’s contents to  $\frac{1}{4}$  cup cold water (**not** the boiled water!). Stir this mixture until gelatin dissolves. Stir well. Pour some of the mixture into each of two Petri dishes, to a depth of about  $\frac{1}{2}$  cm, allowing it to cool completely. Allow the mixtures to sit uncovered in the air for several hours (3-4). Add  $\frac{1}{2}$  tsp. Antiseptic to one of the dishes, and boiled water to the other to a depth of about  $\frac{1}{2}$  the distance to the top of the dish. Label the dishes (Antiseptic/Non-Antiseptic), cover them [either with plastic wrap secured with a rubber band or with Petri dish covers], and place them in a warm, dark place in the room. They will be observed daily over the next several days. Students will note any changes in the solutions in their lab journals/science notebooks. (Note to teachers: this experiment should yield a very nice culture, one of which will be eradicated by the introduction of the antiseptic solution. Kids LOVE this,

because it looks, to use a quote from one of my own students, “kinda gross, but cool!”)

- E. *Assessment/Evaluation*
  - 1. Teacher observation of various groups to ensure procedures are followed correctly. Teacher observation of student lab/science notebooks to ensure that students completed the write-up of this experiment following directions from Appendix B.

## **Lesson Two: How the Immune System Works**

- A. *Daily Objectives*
  - 1. Concept Objective(s)
    - a. Students understand how the immune system functions within the body as whole, as well as the factors that influence its structures and functions.
  - 2. Lesson Content
    - a. The immune system fights infections from bacteria, viruses, fungi.
    - b. White cells, antibodies, antigens
  - 3. Skill Objective(s)
    - a. Students will describe the structures and functions of the immune system.
- B. *Materials*
  - 1. Transparency, APPENDIX C: B Cells Release Antibodies
  - 2. Transparency, APPENDIX D: Organs of the Immune System
  - 3. Transparency, APPENDIX E: Immune System Triggers a Fever
  - 4. Transparency, APPENDIX F: The Immune System in Action Flowchart
  - 5. Copy of APPENDIX G for teacher
  - 6. Video, *The Unknown World*
  - 7. Overhead projector and transparency pens
- C. *Key Vocabulary*

No new vocabulary
- D. *Procedures/Activities*
  - 1. Show the first half of the video, which will be about 30 minutes. (The entire video is about one hour in length.) Ask students to write a brief summary of what they saw as homework, after taking quick-notes during the video.
  - 2. Using the transparencies listed in the materials section, take students through a step-by-step process of how the immune system works. You may use examples from your own resources/texts, or utilize the information contained in APPENDIX G: TEACHER BACKGROUND INFORMATION. (NOTE: Do not introduce allergies/asthma at this point. That will be in Lesson Five.
- E. *Assessment/Evaluation*
  - 1. Teacher observation of student engagement during video and during direct instruction. Also, a homework grade may be taken for their part-one summary of the video, if desired.

### **Lesson Three: Grant Us Immunity**

#### **A. Daily Objectives**

1. Concept Objective(s)
  - a. Students develop a basic understanding of concepts surrounding prevention and control of disease.
  - b. Students understand how the immune system functions within the body as a whole, as well as the factors that influence its structures and functions.
  - c. Students understand how to use information seeking strategies to access a variety of sources of information for a specific purpose.
2. Lesson Content
  - a. The immune system fights infections from bacteria, viruses, fungi.
  - b. White cells, antibodies, antigens
  - c. Vaccines, communicable and non-communicable diseases, epidemics
  - d. Bacterial diseases: tetanus, typhoid, tuberculosis; antibiotics like penicillin, discovered by Alexander Fleming.
  - e. Viral diseases: common cold, chicken pox, mononucleosis, rabies, polio, AIDS
3. Skill Objective(s)
  - a. Students will be able to articulate an understanding of how lifestyle, pathogens, family history and other risk factors may relate to cause or prevention of disease.
  - b. Students will frame questions to direct research.
  - c. Students will summarize and organize information gathered from multiple sources in different ways and will present that information orally and in writing.

#### **B. Materials**

1. Pencils and science notebooks/folders for each student
2. Overhead projector and transparency pens

#### **C. Key Vocabulary**

No new vocabulary

#### **D. Procedures/Activities**

1. Using your preferred text or other resources, review fungi and bacteria from fifth grade *Core Knowledge Sequence*. Introduce Viruses and parasitic infestations. Particularly helpful items from this bibliography's resources include *101 Questions About Your Immune System* (Brynie), *The Disease Book* (Hyde and Forsyth), and the *Immune System: Your Body's Disease-Fighting Army* (Friedlander). However, again, I encourage the use of your local library for additional resources, particularly any in video format.
2. Explain to students that when people receive donated organs in a transplant, their body recognizes the new organ as being foreign. The organ recipient must take special medications for the rest of his/her life to try to keep his/her body's immune system from rejecting the new organ. If students (or others) know personally anyone who is an organ recipient,

- perhaps that person would be willing to speak with the class about the complicated process of matching, waiting, and then taking every precaution to ensure that the new organ is stabilized within their body.
3. During this class, devote the discussion to explanations and examples of diseases and/or illnesses caused by each of the four “body snatcher” antigens: viruses, bacteria, parasites and fungi. Some examples are listed below. Have students create some type of user-friendly chart to list these diseases/illnesses, one that they can add to as the unit and their research continues.
  4. PARASITIC ILLNESSES: Malaria, Sleeping sickness
  5. BACTERIAL ILLNESSES: Tetanus, Strep throat, Food poisoning, Flesh-eating bacteria
  6. VIRAL ILLNESSES: Chicken pox, Common cold, Measles, Ebola
  7. FUNGAL ILLNESSES: Athlete’s foot, Ringworm\* (\*Explain that ringworm is not actually a “worm” at all.)
  8. Introduce the PROJECT today. Tell students that they are to select one of the illnesses/diseases listed in APPENDIX H on which to conduct some research. They are to find out how it is classified (i.e., bacterial, fungal, etc.), how it is contracted, its symptoms, any treatment and/or prevention information, whether it is age- or gender-specific, and whether it is common or rare, as well as any other interesting information about their chosen ailment. Students will contact the Centers for Disease Control (in writing or on-line at <http://www.cdcnac.org>) for additional information. They may also choose to contact one of the more specific organizations listed in APPENDIX I, as well. Students will prepare a display with both original work and the information gathered from CDC (or other sources). Each source is to be properly cited in an attached bibliography. Students are to be prepared to discuss their project orally, making sure it clearly answers, at a minimum, the questions posed above. Other possible resources include medical schools, personal interviews with physicians/toxicologists/bacteriologists, Internet sites, encyclopedias, medical journals, encyclopedias or books, magazine or newspaper articles, etc. Set a due date, either just prior to or just after the final test on this unit (APPENDIX J). You may or may not choose to give students some class time during which to do research or write.

E. *Assessment/Evaluation*

1. Teacher ensures understanding of project requirements and due date by all students.

**Lesson Four: I Get By With A Little Help From My Friends...Like Edward Jenner!**

A. *Daily Objectives*

1. Concept Objective(s)
  - a. Students develop a basic understanding of concepts surrounding prevention and control of disease.

- b. Students understand how the immune system functions within the body as a whole, as well as the factors that influence its structures and functions.
  - 2. Lesson Content
    - a. The immune system fights infections from bacteria, viruses, fungi.
    - b. White cells, antibodies, antigens
    - c. Vaccines, communicable and non-communicable diseases, epidemics.
    - d. Bacterial diseases: tetanus, typhoid, tuberculosis; antibiotics like penicillin, discovered by Alexander Fleming.
    - e. Viral diseases: common cold, chicken pox, mononucleosis, rabies, polio, AIDS
  - 3. Skill Objective(s)
    - a. Students will be able to articulate an understanding of how lifestyle, pathogens, family history and other risk factors may relate to cause or prevention of disease.
    - b. Students will describe the structures and functions of the immune system.
- B. *Materials*
  - 1. Pencils and paper for each student
  - 2. Overhead projector and transparency pens
  - 3. Transparency of APPENDIX A
- C. *Key Vocabulary*  
No new vocabulary
- D. *Procedures/Activities*
  - 1. NOTE TO TEACHERS: Before beginning this lesson, you might wish to review (and even learn some new things, perhaps) a great tutorial website about the immune system maintained by the National Institutes for Health. You can access this tutorial at this URL: [http://rex.nci.nih.gov/PATIENTS/INFO\)TEACHER/immune\\_sys/Title.html](http://rex.nci.nih.gov/PATIENTS/INFO)TEACHER/immune_sys/Title.html). In this lesson, using the transparency of the Spread of Cholera (APPENDIX A), explain how Dr. Edward Jenner experimented with a cowpox/smallpox vaccine in 1796. Show transparency (APPENDIX K) of smallpox infested child. Explain how smallpox was eradicated, but ask students to check the arms of their parents/grandparents for smallpox vaccine scar. Perhaps you (the teacher) have one you could show.
  - 2. In the 1860s, Dr. Joseph Lister (for whom LISTERINE is named), a surgeon, began cleansing surgical wounds, instruments and his own hands in carbolic acid, as well as dressing surgical wounds with cloth soaked in the acid because he knew the acid killed many of the germs that caused deadly infections. For statistics' sake, almost half of surgical patients died from infections following surgeries during this time. After Lister's discovery, that number decreased to roughly 15%, still high by today's standards, but a tremendous breakthrough during the nineteenth century!
  - 3. Discuss Louis Pasteur's vaccines from the 1880s. Pasteur worked to weaken microorganisms to use in vaccines for cholera in chickens, anthrax

in sheep and later, for humans who had been bitten by rabies-infected animals.

4. Discuss Robert Koch's 1882 hypothesis that each kind of infection is caused by a specific type of pathogen.
5. Discuss Dr. Jonas Salk's polio vaccine from 1954, which used a dead poliovirus. In 1961, however, Dr. Albert Sabin developed a virus using a weakened live virus that was able to produce lifelong immunity to polio.
6. Ask students to have their parents look up their own immunization records. Have them find out when (if?) they were vaccinated against measles, mumps, rubella, polio, etc. Ask students why they think schools require proof of these immunizations for admission.
7. Discuss active immunity and passive (or acquired) immunity, explaining that active immunity is when a person's immune system "automatically" produces the antibodies to fight a specific pathogen, while passive (or acquired) immunity comes when the antibodies needed to fight a particular pathogen come from outside the person's body. For example, acquired immunity can come from vaccinations against particular pathogens, or from having the disease. In *most* cases, once people have had chicken pox, they don't get it again.

E. *Assessment/Evaluation*

1. N/A, ongoing observation/discussion

**Lesson Five: The System Runs Amok: Allergies**

A. *Daily Objectives*

1. Concept Objective(s)
  - a. Students understand how the immune system functions in the body as a whole, as well as the factors that influence its structures and functions.
2. Lesson Content
  - a. The immune system fights infections from bacteria, viruses, fungi.
3. Skill Objective(s)
  - a. Students will describe the structures and functions of the immune system.
  - b. Students will be able to articulate an understanding of how lifestyle, pathogens, family history and other risk factors may relate to cause or prevention of disease.

B. *Materials*

1. Pencils and paper or science notebooks for each student.
2. Overhead projector and transparency pens
3. One copy of APPENDIX L: Lesson 5 Homework Problem

C. *Key Vocabulary*

No new vocabulary

D. *Procedures/Activities*

1. In this lesson, students will learn that allergic reactions are simply hypersensitive reactions by the immune system to ordinary microbes. Ask how many students have identified allergies. Ask how they were

identified, and at what age. Ask how many students take regular allergy shots or take prescription medications at certain times for allergies (e.g., medications for hay fever, etc.). Ask students who have allergies if their parents or siblings also have the same allergies. If so, ask what conclusions might be hypothesized from that information. (*Some allergies may be genetic.*)

2. Ask students to brainstorm in groups of 4-5 students some common things that people are allergic to (animal dander, cats, dust, grass, foods, pollen, milk, etc.) Compile a master list on the board or overhead projector. Ask students who said they have identified allergies to raise their hand as you read each item if it is an identified allergen to them. Keep a running tally using tally marks.
3. When the entire list has been read, ask students to work individually or in pairs (your preference based on needs and class length) to create some sort of graph to show the allergens in order of prevalence of occurrence.
4. If possible, this is a good time to show the remainder of the video, *The Unknown World*, as it shows several microbes that are often allergens. Additionally, if an allergist is able to give a brief presentation during today's class, that would be helpful to students, as they would be able to ask questions and better understand their own, or their family members', allergies.
5. Finally, ask students how many have ever "teared up" when peeling a really strong onion. Explain that the tears are what are called a histimic reaction, and that it is the immune system's response to a very strong invader, the fumes from the common onion. Perhaps you might even like to peel an onion, or have a student volunteer do it, in the classroom, after having made certain that no one is actually allergic to onions and that no serious histimic reaction is a risk.
6. Discuss people who are allergic to bee stings. An ordinary honeybee's sting, for most of us, is just a painful episode. But for some people, that small dose of poison is enough to cause a serious reaction, or even death. Ask how many students may be allergic to bee stings and have to keep an "epi pin" (or epinephrine injection) handy in case of a sting. If you have a school nurse, s/he could be a great resource for information about this.
7. Explain homework problem (Appendix L). Students are to read the scenario and formulate a hypothesis regarding the immune system's response to the food. They will write up the hypothesis including facts and information they have gained through this unit so far.

E. *Assessment/Evaluation*

1. Student graphs of allergen occurrences could be graded. Today would also be a good day for a pop quiz on the material so far. ☺ (I usually give only five questions, worth about five points each. Examples for this might include questions such as "Explain briefly the difference between a bacteria and a virus;" "For the next three questions, classify the disease or illness as bacterial or viral: cholera, influenza, pneumonia (a trick

question, since in can be either! ☺)” “Explain briefly how the smallpox vaccine was developed (or tell by whom...)”.

**Lesson Six: Houston, We’ve Got a Problem! When The Immune System Breaks Down**

A. *Daily Objectives*

1. Concept Objective(s)
  - a. Students develop a basic understanding of concepts surrounding prevention and control of disease.
  - b. Students understand how the immune system functions within the body as a whole, as well as the factors that influence its structures and functions.
2. Lesson Content
  - a. The immune system fights infections from bacteria, viruses, fungi.
3. Skill Objective(s)
  - a. Students will understand the structures and functions of the immune system.

B. *Materials*

1. For teacher: Prior to this lesson, be absolutely certain what your school and/or district allows/desires as far as HIV/AIDS education. This is a “hot” issue in most districts, and while vital information, the amount of information given and its delivery are often strictly regulated. Your district or your school should have a printed policy regarding this issue, but if not, a trip to the administrative office is encouraged.
2. Students: Pencils and science notebooks

C. *Key Vocabulary*

No new vocabulary

D. *Procedures/Activities*

1. In this lesson, begin by recalling the information given previously about organ transplant recipients, and how the body’s immune system often engages and rejects an organ.
2. Give the example of David, the “Bubble Boy” who was born in 1971 in Texas with a very rare immunodeficiency. NASA engineers created his bubble suit for him so that he could function outside a sterile room’s environment. (See *101 Questions About Your Immune System* and/or *The Immune System: Your Body’s Disease-Fighting Army* both for photographs of David and information.)
3. Explain the difference and the correlation between HIV and AIDS. Explain that HIV is not a virus that is airborne or contracted from casual contact, so far as current research shows. Explain the reasons why it is so difficult for scientists to create a vaccine for HIV (there are over 700 variations of the HIV virus so far; the virus changes its own proteins very quickly, helping it to become resistant to drugs quickly; the virus can cloak itself in other organs of the body, making it difficult to locate for antibodies/vaccines; when the immune system engages to fight other infections, HIV seems to reproduce itself more quickly).

4. Explain that HIV is contracted through contact with an infected person's bodily fluids (urine, etc.). This is usually through sexual contact, shared needles by drug addicted persons, or through blood transfusions, although the third method of transmittal is becoming increasingly less common as blood donors are more thoroughly screened. While most people develop AIDS after infection with HIV, there are a very few who have contracted HIV and then lived for many years without developing any symptoms of AIDS. Additionally, in 1994, one man, Steve Crohn, was found to be genetically resistant to the HIV virus.
  5. Explain the meaning of AIDS: **ACQUIRED** – the result of a contracted virus, **IMMUNE DEFICIENCY** – the inability of the immune system to fight off disease, **SYNDROME** – a specific group of symptoms occurring together.
  6. Explain to students that viruses must have a “host” cell in which to reproduce; they cannot reproduce themselves unassisted. In the case of AIDS, the virus invades the T Cells, eventually destroying them or crippling them so that no signals are sent to the B Cells to manufacture antibodies to prevent the spread of the virus. When no antibodies are produced and no T cells do their killing work, no immune system work is accomplished at all. While bone marrow transplants or other treatments may be effective for other viral infections, these tactics are ineffective with AIDS, because the virus simply invades and destroys any new T Cells that come along. Additionally, HIV can mutate itself, that is, change itself, adapting to changes in its environment. It is a “smart” virus.
  7. In addition to HIV/AIDS, the body can turn against itself when infected with other diseases, such as rheumatoid arthritis, lupus, and multiple sclerosis. Most of these kinds of diseases are not “caught”; they are present at birth, the result of some genetic problem(s).
- E. *Assessment/Evaluation*
1. No formal assessment, but make sure that students are at work on their research project. Do they need additional resource materials? Have they received materials from the CDC or other specialized organization/foundation for the disease they chose? If not, what is their plan? Where else might they find information in print that could be used on their display? (*In the worst-case scenario, students could perhaps obtain information from their family physicians or could copy materials from reference resources, although they must be mindful of copyright laws.*)

## **VI. CULMINATING ACTIVITIES**

- A. The Presentations Day: The presentations of the student research projects on their selected diseases. (This activity will likely take at least two class days, depending on the scope of the students' work.)
- B. Written test (APPENDIX J)

## VII. HANDOUTS/WORKSHEETS

- A. Appendix A: The Spread of the Plague
- B. Appendix B: Experiment 2 – Student Directions
- C. Appendix C: B Cells Release Antibodies
- D. Appendix D: Organs of the Immune System
- E. Appendix E: The Immune System Triggers a Fever
- F. Appendix F: The Immune System in Action
- G. Appendix G: Teacher Background Information
- H. Appendix H: Selections for Project
- I. Appendix I: Health Organizations as Resources
- J. Appendix J: Final Test
- K. Appendix K: A Child with Smallpox
- L. Appendix L: Student Homework Problem for Lesson Five

## VIII. BIBLIOGRAPHY

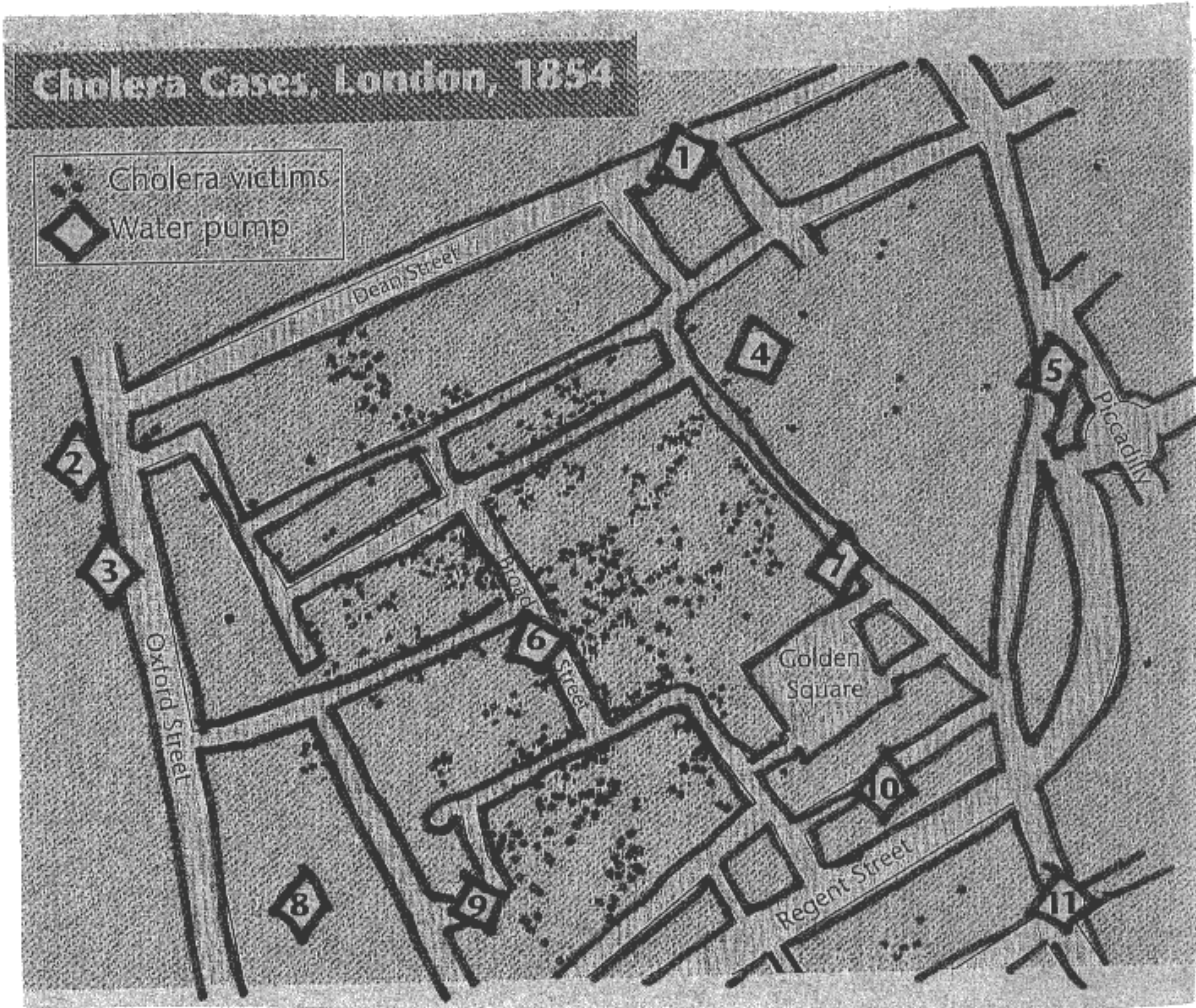
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**APPENDIX A-Next on FOX, When Germs Attack**

The Spread of Cholera in London

(adapted from *Science Explorers: Human Biology and Health*, Prentice Hall, 2000)

**Cholera Spreads Through London, 1854**



**Appendix B-Next on FOX, When Germs Attack  
Experiment Directions for Lesson One**

NAME \_\_\_\_\_ DATE \_\_\_\_\_  
GROUP MEMBERS: \_\_\_\_\_  
\_\_\_\_\_

**This will be a weeklong experiment, and it will require attention and journaling each day you are in class.**

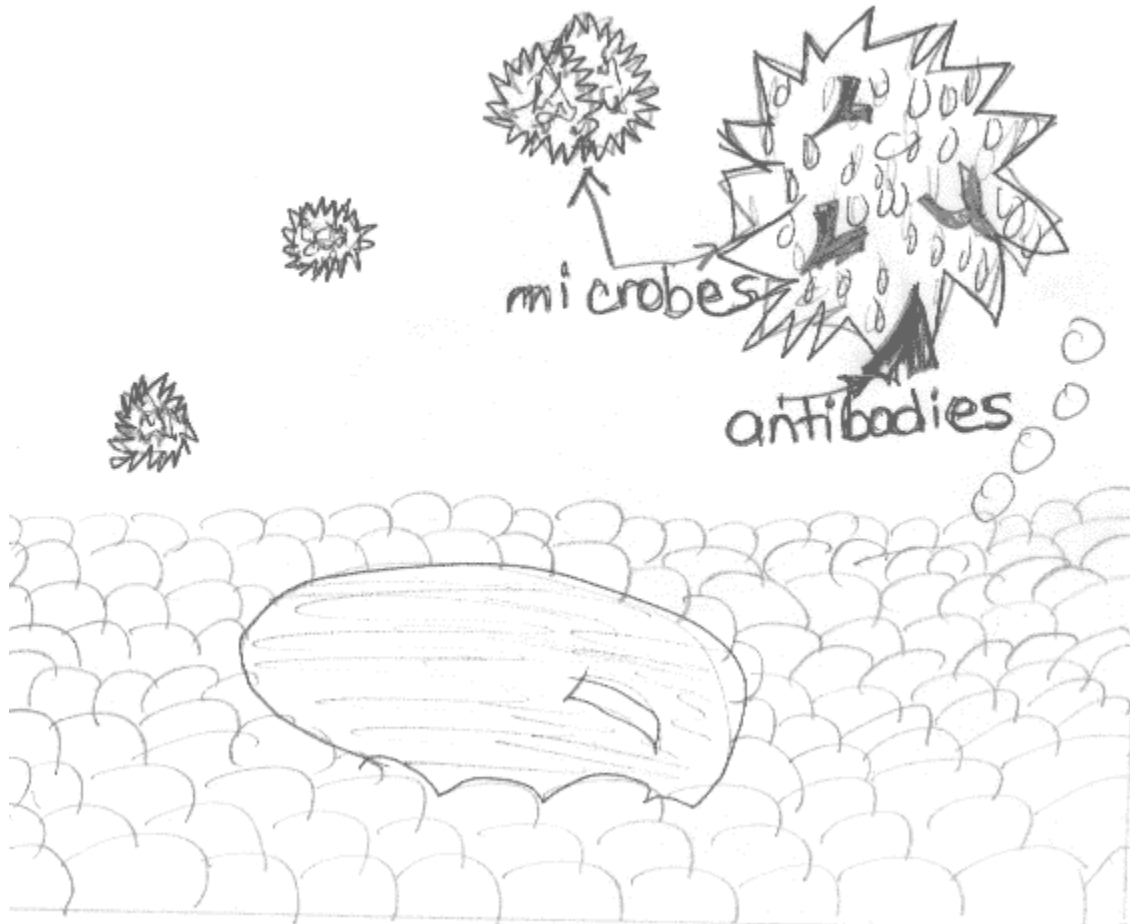
**EACH GROUP WILL NEED: ¼ cup cool water, ¾ cup boiling water, 2 Petri dishes with covers (or with a square of plastic wrap and a rubber band), a spoon or other stirring instrument that can be placed into boiling water, ½ tsp antiseptic, 1 packet of plain gelatin granules, tape and pens for labeling dishes.**

**YOU MUST WRITE UP THE ENTIRE PROCEDURE IN YOUR LAB JOURNALS, following the scientific method. This is to be done individually, even though you are doing the lab as a group.**

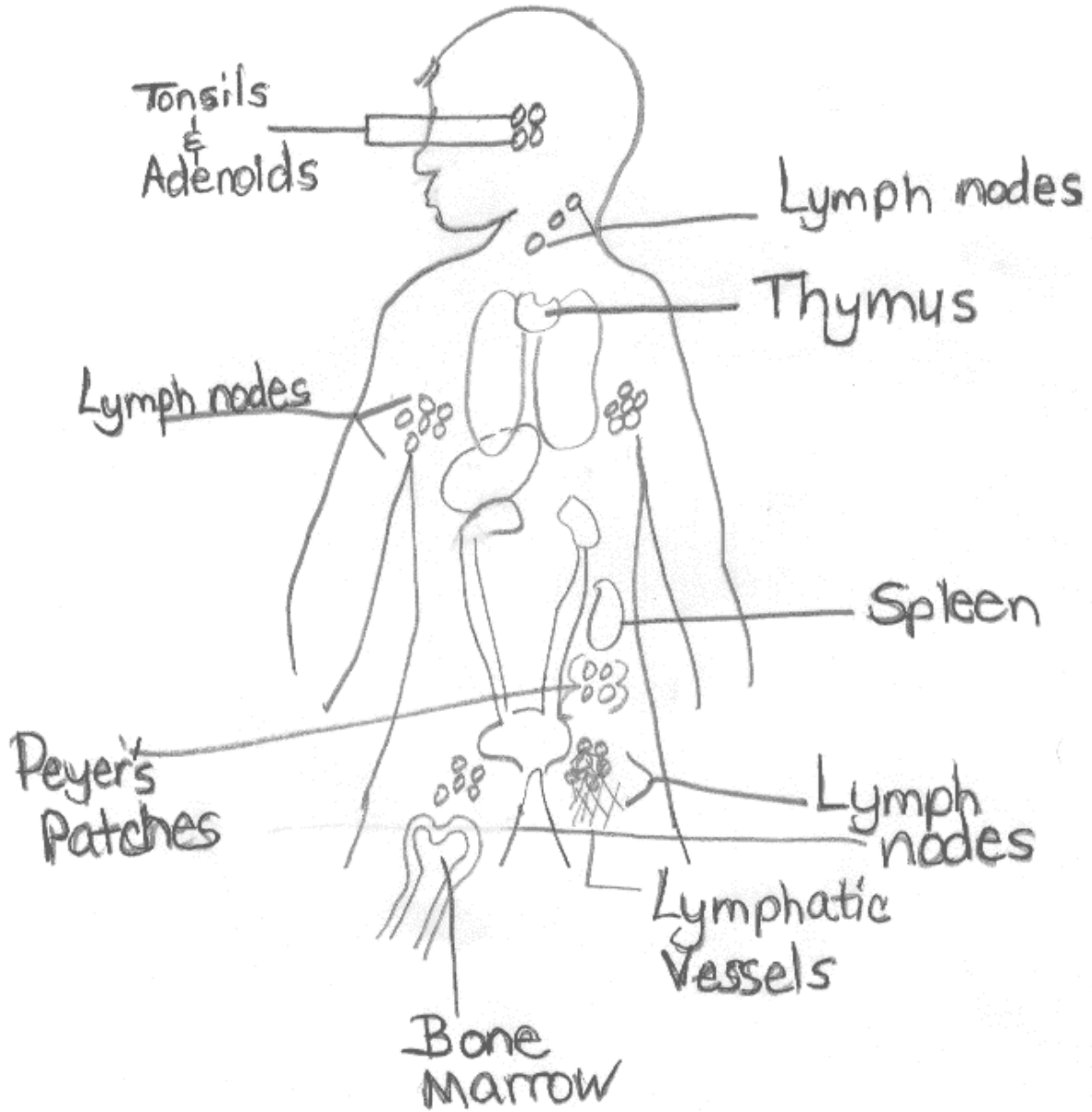
**First, pour the contents of the gelatin packet into the ¼ cup cool water. Stir it until the gelatin dissolves. Add the bouillon cube to the boiling water. Stir this until the bouillon dissolves. Next, pour the gelatin mixture into the bouillon mixture and stir well. Place a bit of this new mixture into each of two Petri dishes, to a depth of about ½ cm. Allow both dishes to sit, undisturbed and uncovered for several hours. Then, add the ½ tsp antiseptic to one of the dishes, marking both dishes carefully: ANTISEPTIC, NON-ANTISEPTIC. Now, cover both dishes and move them to a warm, dark place in the room. You will observe both dishes over the course of the next week and note any and all changes in your journal.**

**For today, you should create a hypothesis as to what you think might happen.**

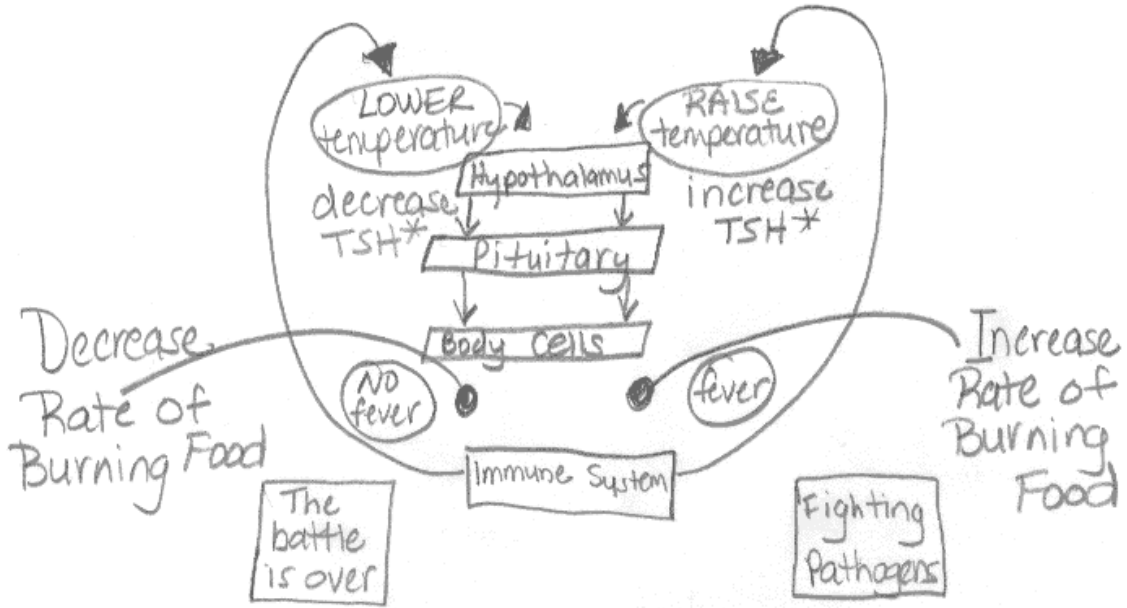
**Appendix C-Next on FOX, When Germs Attack  
B Cells Release Antibodies**



Appendix D-Next on FOX, When Germs Attack  
Organs of the Immune System

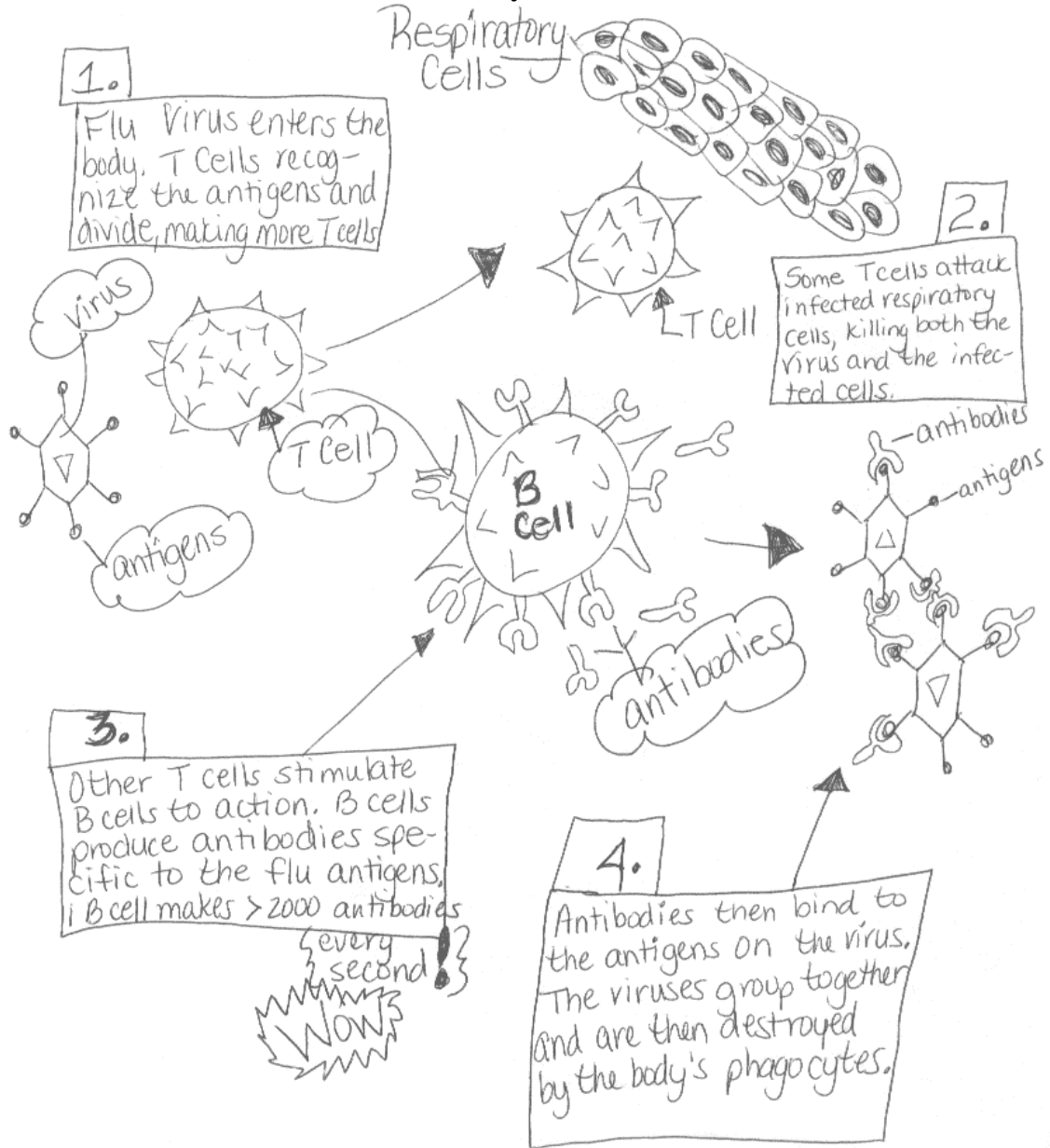


**Appendix E-Next on FOX, When Germs Attack  
The Immune System Triggers a Fever**



\* TSH = Thyroid stimulating hormone

**Appendix F-Next on FOX, When Germs Attack  
The Immune System in Action**



## **Teacher Background Information: Just the MAJOR Facts, Ma'am!**

In addition to the vocabulary given in lesson One, these are the major points that need to be taught for this unit:

1. The four major groups of pathogens for humans are: bacteria, fungi, viruses, and protists (parasites).
2. Some bacteria attack the body's cells directly, but others produce toxins that attack the cells. An example of the latter would be tetanus. The toxin causes damage to the nervous system.
3. Viruses cannot reproduce without a host cell. Many can mutate, or change, into forms that are drug- and antibody-resistant.
4. Fungi infections would include such common things as athlete's foot.
5. Parasitic infections include malaria, in which the parasite is carried by the tsetse fly in hot tropical areas.
6. Pathogens can come from a variety of places, including other people, foods or things that have been contaminated with the pathogen, environmental sources, and animal bites.
7. In the 1854 London Cholera Epidemic, Dr. John Snow used a map similar to the one used in Lessons One and Four to study the spread of the disease through London's water supply. He plotted the various water pump locations throughout the city and noted the deaths in and around those areas, hypothesizing that the contaminate was initially localized in one pump (number 6 on the map students have).
8. Our bodies have many defense systems against germs/pathogens. The first line of defense is our skin. Also, the cilia in our respiratory system help to act as another barrier. Our saliva contains certain chemicals that help break down pathogenic organisms, as does the acid produced in our stomachs.
9. The INFLAMMATORY RESPONSE is when fluid and leukocytes leak into tissues containing pathogens. Then the leukocytes spring into action. This INFLAMMATORY RESPONSE happens in the same way, regardless of the kind of pathogen, so sometimes it is called the General Defense. Sometimes, the body will run a fever during an inflammatory response, because many pathogens cannot live and reproduce at elevated body temperatures.
10. Phagocytes are leukocytes that engulf, digest and destroy pathogens. The cells of the immune system are able to recognize differences in pathogens and to "attack" accordingly.

11. T Cells' major function is to make those pathogenic identifications and then to signal the B Cells. The T Cells recognize a specific part of the pathogen. It is

Appendix G, page 2-Next on FOX, When Germs Attack

called an ANTIGEN. Antigens are specialized molecules that allow your immune system to tell whether a cell is a friendly cell from inside your body or is an "outsider" cell that is potential trouble.

12. B Cells are alerted by the T Cells, and their job is to make the antibodies for specific antigens. The antibodies bond with their "matching" antigen forcing the antigens into binding with another antigen and producing large "chains" or clusters of "germs" in our bodies. Then, once these clusters are formed, phagocytes can swoop in and devour them.

13. Timeline of information about discoveries and advancement in immunology:

In 1796, Dr. Edward Jenner of England, created and administered the first successful vaccination for smallpox. He used cowpox material because it is similar to smallpox in structure. Even though his vaccine worked on the child he gave it to, Jenner didn't know enough to understand why.

In 1854, British nurse Florence Nightingale demanded cleanliness in her hospital areas. By doing this, she created an antiseptic environment for her soldier patients, saving many of their lives.

In the 1860s, Dr. Joseph Lister, another Brit, sterilized his hands and all his surgical instruments in carbolic acid prior to an operation. He knew that the acid killed germs. After the surgeries, he also dressed the surgical wound in cloths that had been soaked with carbolic acid. The death rate from infection dropped dramatically.

In 1868, Frenchman Louis Pasteur proposed that microorganisms caused infectious disease in humans.

In 1882, Dr. Robert Koch of Germany made the assumption that each kind of illness/infection was caused by a specific kind of microorganism, not just by some generally infectious pathogen.

In 1928, Alexander Fleming observed that some fungi growing in the same place killed some bacteria he had growing in his lab. His discovery led to his identification of penicillin, the first antibiotic, grown by the fungus.

**Appendix H-Next on FOX, When Germs Attack  
Selections for Research Project**

**Please choose one of the following topics for your research. If you absolutely, positively cannot find ANYTHING on this list to suit your fancy, please see your teacher BEFORE beginning your research to have your outside topic approved. Thank you. ☺**

**TETANUS**

**TYPHOID**

**MEASLES**

**MUMPS**

**RHEUMATOID ARTHRITIS**

**ATHLETE'S FOOT**

**MONONUCLEOSIS**

**CHICKEN POX**

**TUBERCULOSIS**

**RABIES**

**POLIO**

**SMALLPOX**

**INFLUENZA**

**ASTHMA**

**ALLERGIES (You might wish to focus on a specific type of allergy!)**

**DIPHTHERIA**

**STREP THROAT**

**STAPH INFECTION**

**CHOLERA**

**MALARIA**

**AIDS\*      \*MUST HAVE PARENTAL PERMISSION IN WRITING!**

**LYME DISEASE**

**TRICHONOSIS**

**EBOLA VIRUS**

**FLESH-EATING BACTERIA**

**GRAVES' DISEASE**

**LUPUS**

**SCLERODERMA**

**Appendix I-Next on FOX, When Germs Attack  
Health Organizations as Resources**

**The American Academy of Allergy, Asthma and Immunology**  
611 E. Wells Street  
Milwaukee WI 53202  
<http://www.aaaai.org/>

**American Association of Immunologists**  
9650 Rockville Pike  
Bethesda, MD 20814-3994  
<http://www.scienceexchange.com/aai/>

**Arthritis Foundation, Inc.**  
1330 W. Peachtree Street  
Atlanta, GA 30309  
<http://www.athritis.org>

**CDC National Prevention Information Network**  
P. O. Box 6003  
Rockville, MD 20849-6003  
<http://www.cdcnac.org>

**Immune Deficiency Foundation**  
25 W. Chesapeake Ave., Suite 206  
Towson MD 21204  
<http://www.primaryimmune.org/>

**Lupus Foundation of America**  
1300 Piccard Drive, Ste. 200  
Rockville MD 20850-4303  
<http://www.internet-plaza.net/lupus/info/about/indec/html>

**National Foundation for Infectious Disease**  
4733 Bethesda Ave., Suite 750  
Bethesda MD 20814  
<http://www.nfid.org>

**Appendix J, page 1-Next on FOX, When Germs Attack  
Final Test**

Name \_\_\_\_\_ Date \_\_\_\_\_

**Explain the function of lymph fluid.**

**List the four major types of bodily invaders, or pathogens, and briefly give an explanation of each.**

**Match the disease to its source, using B = BACTERIA, F = FUNGI, V = VIRUS, and P = PARASITE/PROTIST**

___ Athlete's foot	___ Chicken pox	___ Malaria
___ The common cold	___ Tetanus	___ Food poisoning
___ Strep throat	___ Ringworm	___ Measles
___ Sleeping sickness		

**How did Dr. Edward Jenner discover the smallpox vaccine?**

**Give a general explanation as to how a vaccine works.**

**Why are food allergies often difficult to identify?**

**Explain the difference between an immunodeficiency, such as AIDS, and autoimmunity, such as rheumatoid arthritis.**

**Appendix J, page 2-Next on FOX, When Germs Attack**

**The generic name for all white blood cells is \_\_\_\_\_.**

**What is the function of T Cells?**

**What is the function of B Cells?**

**What is the difference between antibodies and antigens?**

**What is the INFLAMMATORY RESPONSE, and why is it important?**

**Why is the fever sometimes produced during an inflammatory response often another helpful aid to the immune system?**

**Appendix K-Next on FOX, When Germs Attack**

**A child with Smallpox**

**(The picture is taken from the book, *The Immune System-Your Body's Disease-Fighting Army*, page 43, you can show students the picture from the book)**

**TO BE A HANDOUT WHEN PRESENTED, or OMIT IF YOU FEEL THIS IS TOO GRAPHIC FOR YOUR STUDENTS**

**Appendix L-Next on FOX, When Germs Attack**  
**Student Homework for Lesson Five**

Read the following scenario and develop a hypothesis as to why the rash occurred. Defend your answer with facts.

Approximately 10 days ago, you ate a huge bowl of strawberry shortcake with whipped cream on top. Then, you developed a rash that itched terribly! Other than the obvious strawberries, the other ingredients in this dessert included sugar, flour, butter, eggs, baking powder, vanilla, salt, and of course, cream.

Last night for dessert, you ate a piece of your grandma's famous strawberry custard tart, and you got the same rash! The tart ingredients, other than the strawberries, were sugar, cornstarch, eggs, milk, flour, vegetable shortening, vanilla and salt.

Do you think the allergic reaction was to strawberries? What else could it have been? Explain your reasons for your answer. Use your "clues" carefully!