

**HOW DO IMMUNOLOGISTS
STUDY DISEASE?
And
The Immune Response to Friend Virus Disease**

**Focus Question:
WHY ARE SOME MICE RESISTANT TO FRIEND VIRUS
DISEASE?**

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How Do Immunologists Study Disease?

Focus: Identification of the Rfv3 Gene and Determination of its Mechanism of Resistance to Retroviral Disease

I. OVERVIEW

Following is a lesson designed to assist teachers and high school students in understanding how Immunologists study disease. This lesson focuses on a mouse, retrovirus called Friend Virus (FV) which causes a fatal erythroleukemia (red blood cell cancer) in some strains of mice

Five activities are included for teachers to use over the course of three or four class periods, depending on period length. The first three activities introduce students to important immunological information and prepares them to engage in activity four. Activity five is a post unit assessment. A summary of the activities follows:

ACTIVITES	SUMMARY
<i>Activity One</i> Pre-assessment of student knowledge of immunology.	Students construct a pre-unit concept map as a primer, and pre-assessment of knowledge.
<i>Activity Two</i> Understanding Retroviral Disease, History of Friend Virus	Students will engage in reading about retroviruses, (Friend Virus) and answer questions. One of the resources is located on an National Institute of Health Website.
<i>Activity Three</i> What are the cells of the Immune System?	Students will collaborate with classmate to use focus questions to investigate cell of the immune system. Students will present information to classmates.
<i>Activity Four</i> Investigation of a Genetic Resistance to Friend Virus	Student engage in an interactive PowerPoint presentation
<i>Activity Five</i> Post Assessment of student understanding of immunology.	Students construct a post-unit concept map of key immunology concepts.

II. **TARGET AUDIENCE:** High school Biology students in either AP Biology or Biology. These activities can be used as part of an immunology unit or an addition to a microbiology unit.

III. **OBJECTIVES/OUTCOMES:** Objectives are included with each activity.

Activity One: Pre-assessment of student knowledge of immunology?

OVERVIEW: Students will prepare a concept map using key immunology terms. The map will serve as a primer and pre-assessment of student immunology understanding.

OBJECTIVES: *Before doing this activity students should understand:*

- how to make a concept map.

After doing this activity students should understand

- more about their level of understanding of immunology.

INTRODUCTION: In order to orient students to the upcoming activities have students prepare a concept map following the instructions below. Instruct students that the concept map will not be graded on its content, only on its completion. Students should complete the exercise using only their prior knowledge and no other resources. After completion of the map the teacher should collect the maps and summarize misconceptions and areas of weakness. Students should be informed that they will be asked to make a concept map using the same terms at the end of the unit. An example map is included as a reference of one possible correct way to organize the terms. It should be noted that there are many correct ways to organize these terms on a concept map. The teacher should engage students in a short discussion after the act of mapping and help students to understand some of the correct relationships between the terms and to help them realize that the rest of the unit will be helping them learn these concepts.

TIME REQUIREMENTS: 15-25 minutes

EXERCISE:

Construct a concept map using the following terms:

Immunologist

Immunology

Immune system

Pathogen

Virus

Bacteria

Innate Immunity

Adaptive Immunity

Skin

Macrophages

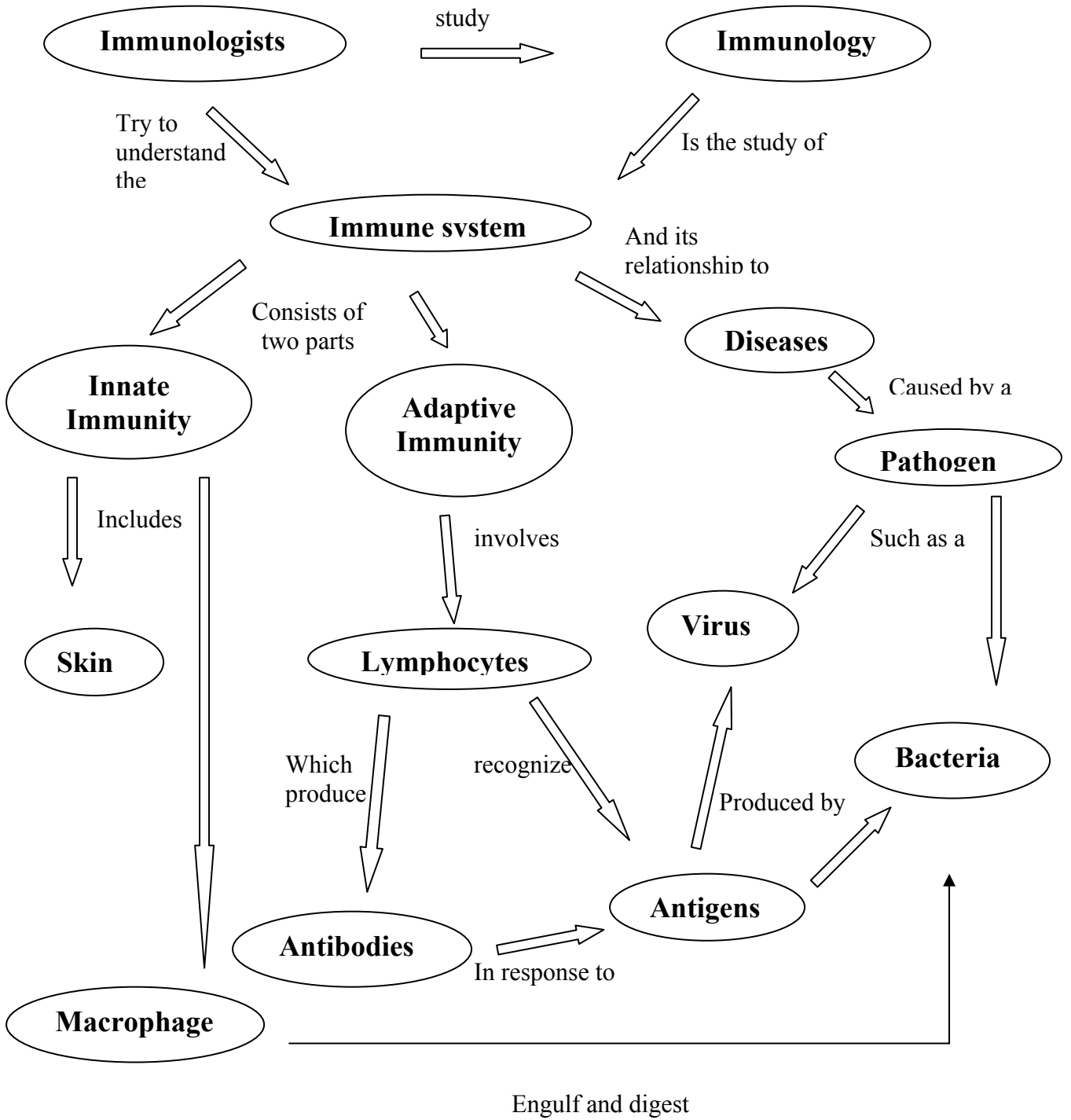
Lymphocytes

Antigens

Antibodies

Disease

EXAMPLE CONCEPT MAP



Activity Two: Understanding Retroviral Disease? HIV and Friend Virus Disease

OVERVIEW: In this activity students will learn about retroviruses like HIV and Friend Virus and how they cause disease. Students will use a National Institute of Health website (<http://www.niaid.nih.gov/factsheets/howhiv.htm>) as a resource and use a short reading included in this document to learn about Friend Virus. It is possible to print and copy the information from the NIH website so that computers are not necessary for this activity. Students will read the information and answer questions.

OBJECTIVES: *Before doing this activity students should understand:*

- what a virus is and how it replicates (lytic and lysogenic cycles)
- basic knowledge of cells

After doing this activity students should be able to:

- explain how retroviruses replicate and are different from other viruses
- understand HIV and its method of causing disease
- understand Friend Virus and how it affects mice

TIME REQUIREMENTS: 30-40 minutes, can be given as homework. Teacher may need to print out copies of information prior to class time or reserve computer lab.

INTRODUCTION: Retroviruses are RNA viruses that are unique in their method of replication. HIV and Friend Virus are two retroviruses that cause disease. HIV causes the disease AIDS in humans and Friend Virus causes an Erythroleukemia in mice.

EXERCISE:

1. Students are given a copy of or use of a computer to read information on HIV/AIDS at <http://www.niaid.nih.gov/factsheets/howhiv.htm>.
2. Students read information on Friend Virus included in this packet.
3. Students prepare a "Retrovirus Notecard" of important information about each retroviral disease as shown below and each student answers the reflection questions provided in this packet.
4. Teacher engages students in discussion of answers to the questions.

Retrovirus Notecard

Have students determine the information below about each retrovirus and have them write it on a notecard or in their notes.

- Name of infectious agent
- Cell type infected by agent
- Disease caused
- Symptoms of disease
- Treatment
- Interesting Facts (three)

Reflection Questions

1. Explain how Friend Virus and HIV are alike? Different?
2. How does a retrovirus replicate itself, explain in detail.
3. What is a CD4+ lymphocyte what is its role in the immune system?
4. What does the Rfv3 gene allow some mice to do?
5. What is erythroleukemia?



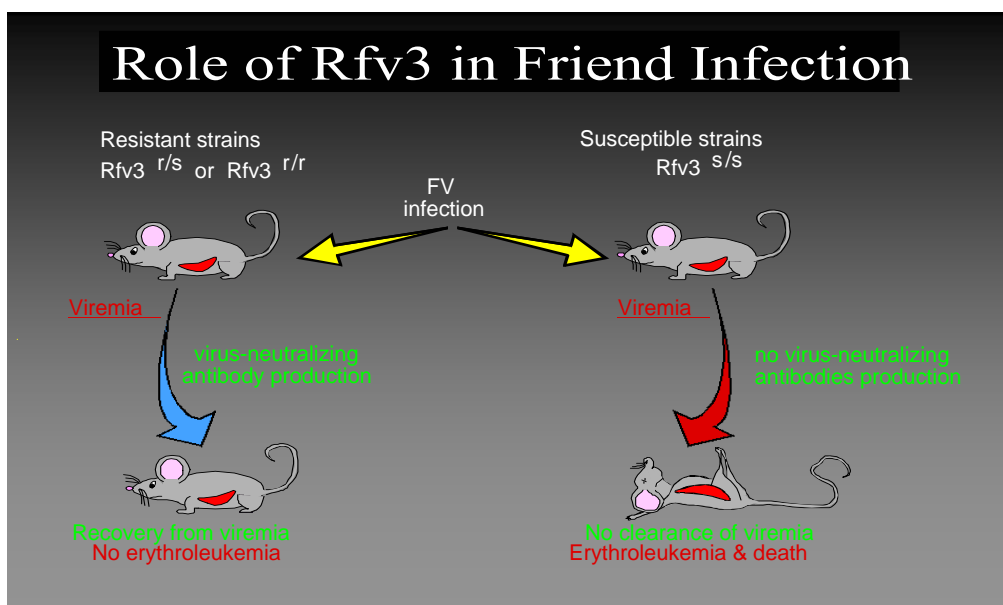
Charlotte Friend
Photo courtesy of
The New York
Academy of
Sciences Archives

ACTIVITY TWO:STUDENT HANDOUT FRIEND VIRUS

In 1956 a woman name Charlotte Friend discovered the first direct link between a virus and cancer. Although she did not discover the identity of the actual virus she did discover that some unknown particle was causing a deadly erythro leukemia (red blood cell cancer) in mice.

Years later that “particle” was determined to be a retrovirus and was named in her honor – *Friend Virus*. The virus was not named for its qualities as was HIV, Human Immunodeficiency Virus, the cause of AIDS. Friend virus causes disease much the way its close relative HIV does only FV has a different victim. HIV seeks out CD4+ T-lymphocytes. Friend virus is also very specific and seeks out only the cells in the spleen, liver and bone marrow that give rise to erythrocytes (red blood cells). Once inside these cells the virus takes over the cellular machinery and forces these cells to overproduce immature erythrocytes. The result is an overabundance of immature red blood cells and eventually death. The immature blood cells are unable to carry perform their normal functions.

Immunologists have discovered that there are some mice that can resist the infection of Friend virus, while they may get sick, in the long run they can recover from FV infection and live a normal mouse life (*See figure below*). In fact, it has been determined that some mice have a gene called Rfv3 that allows them to produce antibodies against Friend virus. If a mouse has the genotype Rfv3 r/r or r/s they survive Friend virus infection. If they have the s/s genotype they do not survive. Insight into the ability of some mice to resist a retroviral infection could lead to a better understanding of how to fight HIV infection and assist humans in surviving AIDS. Immunologists are now studying how some mice recover from FV infection.



Some mice are able to resist Friend Virus Infection (FV) due to a gene called Rfv3 which helps mount a neutralizing antibody response.

Activity Three: What are the cells of the immune system?

OVERVIEW : This is as collaborative activity in which students gather information about cells of the immune system and present that information to each other. Initially, the teacher will present information on hematopoiesis (production of blood cells) and students will be given a copy of the included diagram called “HEMATOPOIESIS AND LINEAGE OF THE CELLS OF THE IMMUNE RESPONSE”.

OBJECTIVES: *Before doing this activity students should understand:*

- The concept of cell differentiation.
- Basic cell biology.
- Basic understanding of the components of the immune system.

After doing this activity students should understand

- The roles of the different cells in the immune response.

TIME REQUIREMENTS: One fifty minute period and/or assignment could be given for homework.

INTRODUCTION:

The teacher should discuss the main components of the immune system as an intro to this assignment. The discussion/lecture should help students to set up a framework for the upcoming assignment and other sections of this curriculum. An outline of main concepts follows:

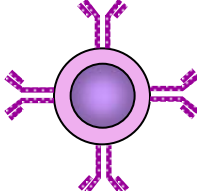
- I. Nonspecific Defenses : Innate Immunity
 - A. Skin and Mucous Membranes
 - B. Inflammatory Response
 - C. Fever and Interferon
- II. Specific Defenses: Adaptive Immunity
 - A. Pathogen recognition
 - B. Immune Response
 1. Hematopoiesis
 2. Cell-Mediated Immune Response
 3. Humoral Immune Response

After the discussion/lecture students will be making notecards (as described below) of each of the cells of the immune response. Notecards serve as discrete manageable ways to learn and organize information.

EXERCISE:

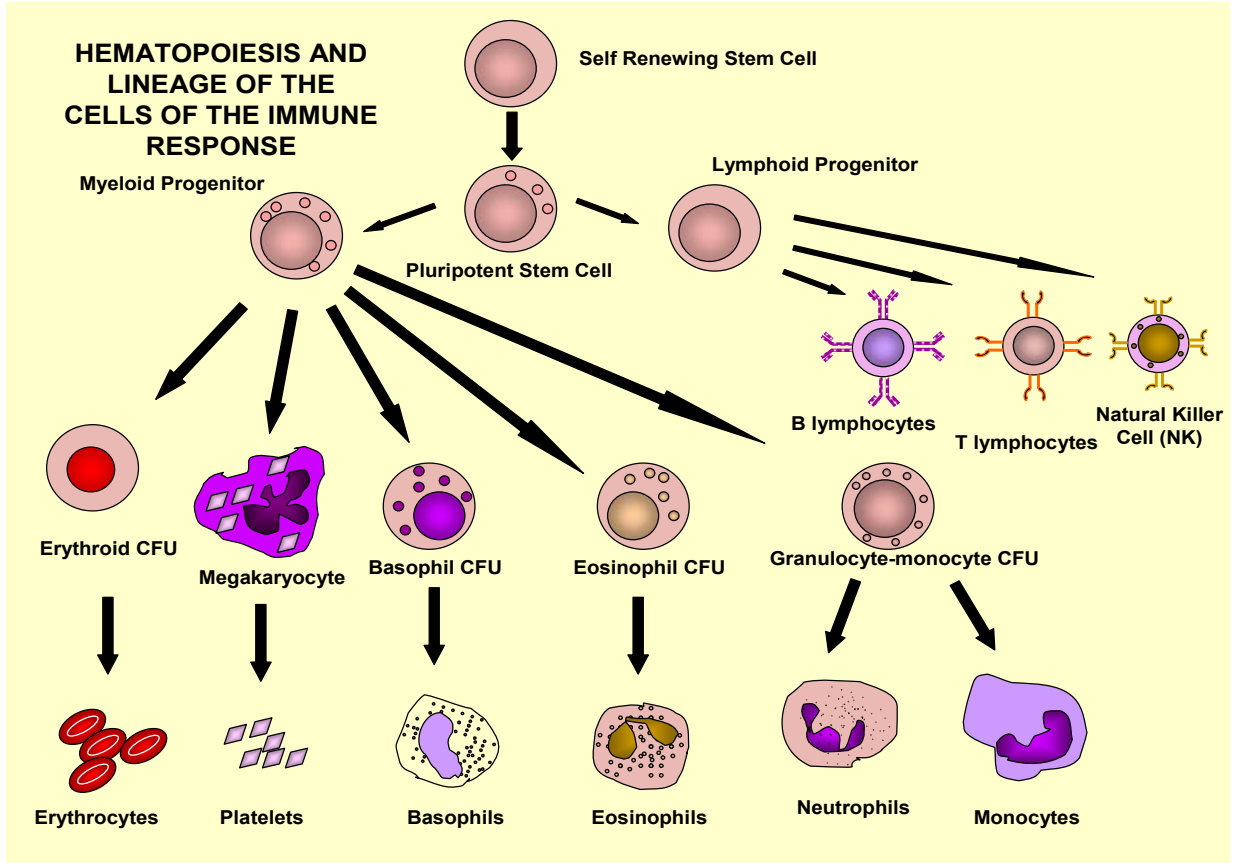
1. After short discussion on the diagram: “HEMATOPOIESIS AND LINEAGE OF THE CELLS OF THE IMMUNE RESPONSE”. Students are put into groups by teacher. (3-6 students can be in a group)

2. Each student in the group chooses one or two of the cells of the immune response to research. The cell types are: basophils, eosinophils, neutrophils, monocytes, T-lymphocytes, B-lymphocytes and NK cells.
3. Using resources in the classroom, library and/or internet, give students time (30 minutes or more) to research his/her cell/cells and create a notecard which follows this example:

<ul style="list-style-type: none">• Name and picture of cell:• Where does it mature in the body:• Role in the Immune Response : <i>Have students write one paragraph of main points</i>	
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4. Once students have prepared their notecard/s they return to their small groups. Within each group, each student presents information on their cell/s. While one student presents, others make a notecard of that new cell. Upon completion of the task, each student will have a notecard for each of the cells.

STUDENT HANDOUT



NOTES:

Activity Four : How do Immunologists Study Disease? Determining the role of the Rfv3 Gene in Resistance to Friend Virus

OVERVIEW: This activity consists of an interactive powerpoint presentation that helps students understand how an immunologist might study a disease.

OBJECTIVES: *Before doing this activity students should understand:*

- Basic immunology
- How to use the scientific method

After doing this activity students should understand

- How an immunologist sets up experiments
- How scientists use the scientific method
- The retroviral disease caused by Friend Virus.
- The role of the Rfv3 gene in providing immunity to Friend Virus Disease..

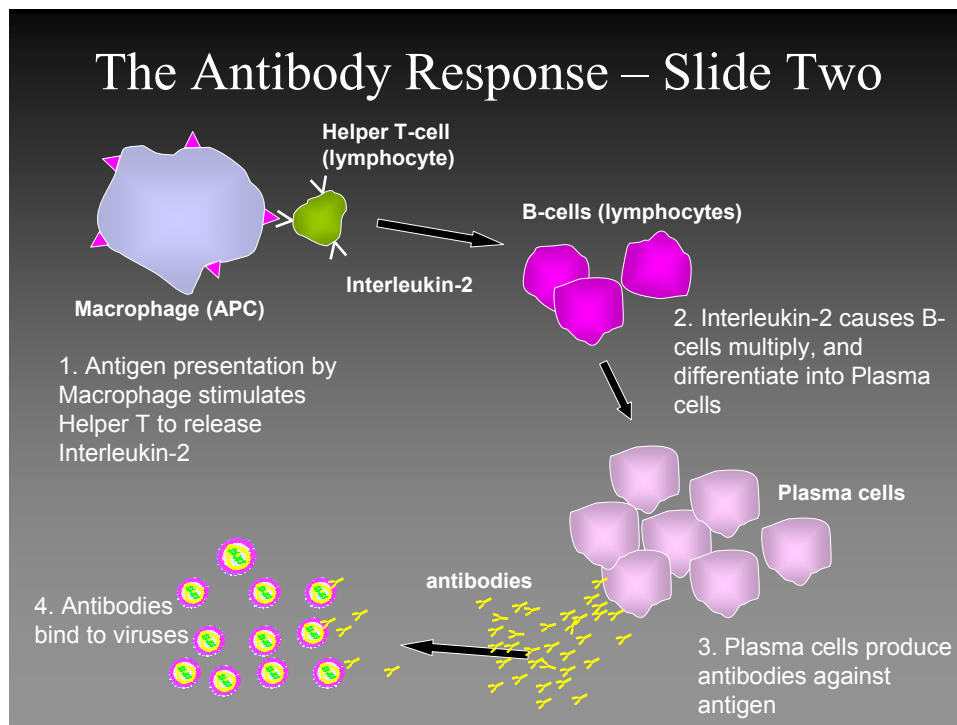
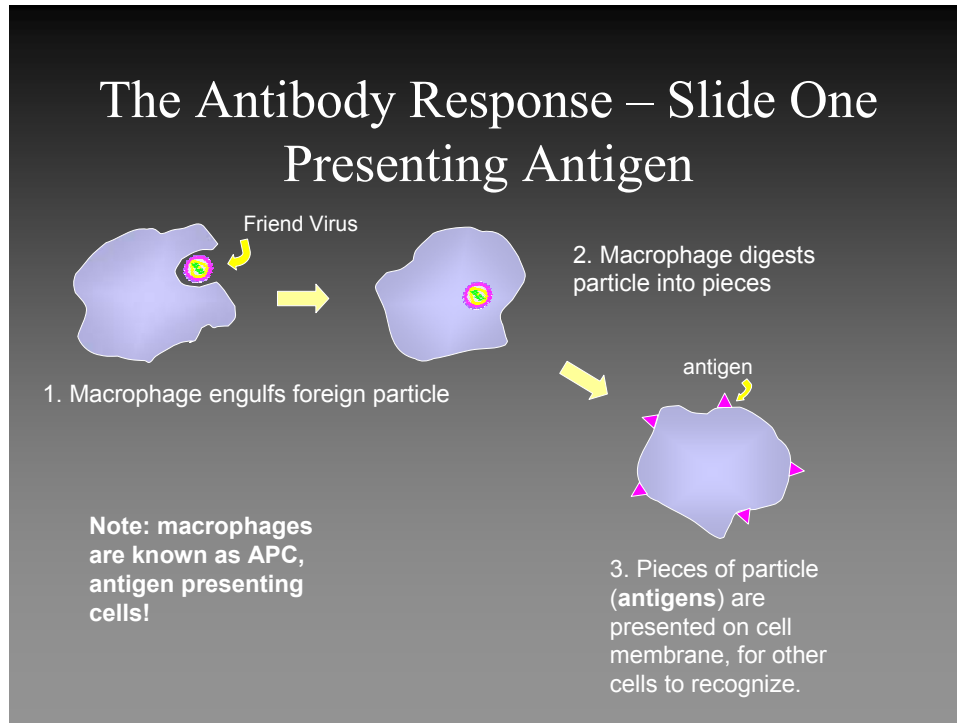
TIME REQUIREMENTS: **Two forty five minute class periods, or one block. .**

INTRODUCTION: This activity uses a powerpoint presentation that is designed to be shown to an audience. It could be used by individual students on a personal computer. There are included student and teacher materials. An outline with speaker notes is included for the teacher. The student materials include: two handouts and a question/answer sheet. The teacher is encouraged to make the powerpoint as interactive as possible. Inquiry type questioning can be used throughout to engage the students. It is recommended that the teacher review the powerpoint before presenting.

EXERCISE:

1. Handout the two diagrams and one question/answer sheet to students.
2. Begin powerpoint.
3. Allow students opportunities to ask questions and answer questions on their worksheet.
4. After the presentation discuss the experiment with students.

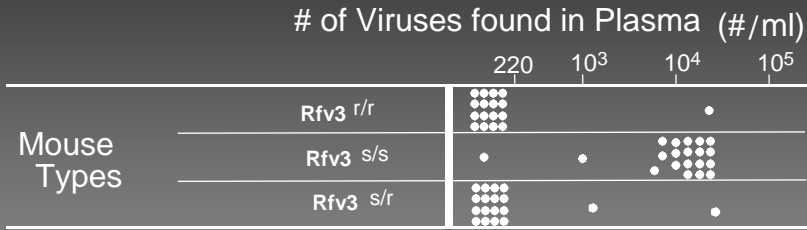
Activity Four
Student Handout #2



Activity Four
Student Handout #1

DATA: FIRST DISCOVERY

Viremia in Mouse Blood



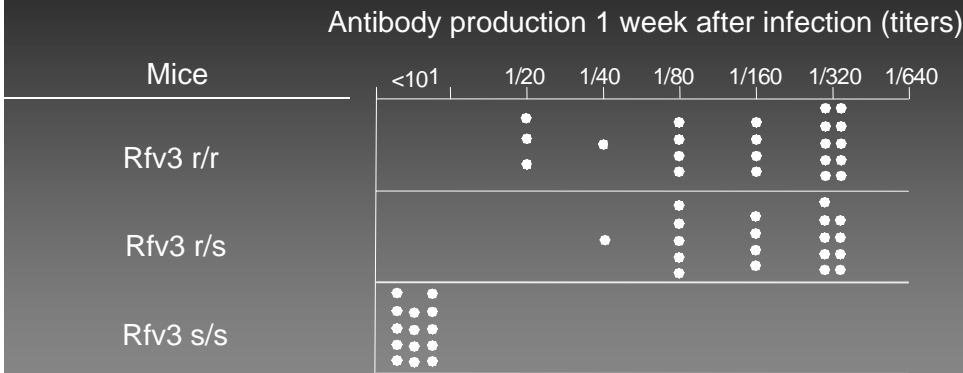
One dot = one mouse

EIGHT DAYS AFTER INFECTION



What can you conclude from this data??

Antibody Production against Friend Virus



One dot = one mouse



What can you conclude from this data?

Activity Four
Student Question and Answer Sheet

How Do Immunologists Study Disease? –
Why are some mice resistant to Friend Virus Disease?

1. What is Viremia?
2. What is Erythroleukemia?
3. What is a retrovirus?
4. Why would an immunologist study a mouse disease (Friend Virus) in order to find a cure for AIDS?
5. Why do you think some mice recover from Friend Virus Infection?
HYPOTHESIS:
6. What would an immunologist do next? What question might he/she ask?

7. With your teacher design an experiment to answer this question. How could you find out what Rfv3 does???

8. Viremia Data: What can you conclude from this data?

9. Antibody Production Data: What can you conclude from this data?

10. What do we do next? What is the next important question to ask?

11. How does the Rfv3 gene participate in the antibody response? Can you make a Hypothesis to answer the question above??

12. What cells participate in the antibody response?

13. Write a short summary about how the immune system responds to a virus.

14. Why is it so difficult to answer the question: *What role does Rfv3 play in the antibody response?*

Activity Five Post Unit Concept Map?

OVERVIEW: Students will prepare a concept map using key immunology terms. The map will serve as a post assessment of key ideas learned during the unit..

OBJECTIVES: *Before doing this activity students should understand:*

- How to make a concept map.
- Information on basic concepts of immunology

After doing this activity students should understand

- more about their level of understanding of immunology.

INTRODUCTION: In order for students to be cognizant of their own learning it is important for them to see a change in their learning. A test over the information learned in this unit can provide this information. However having students make a both a pre unit and post unit concept map and having them compare these maps side by side will provide a clear picture of their own learning. Have students complete the map assignment below and upon completion return their pre unit map and have them complete the questions below. An example map is included as a reference of one possible correct way to organize the terms. It should be noted that there are many correct ways to organize these terms on a concept map.

TIME REQUIREMENTS:25 minutes.

EXERCISE:

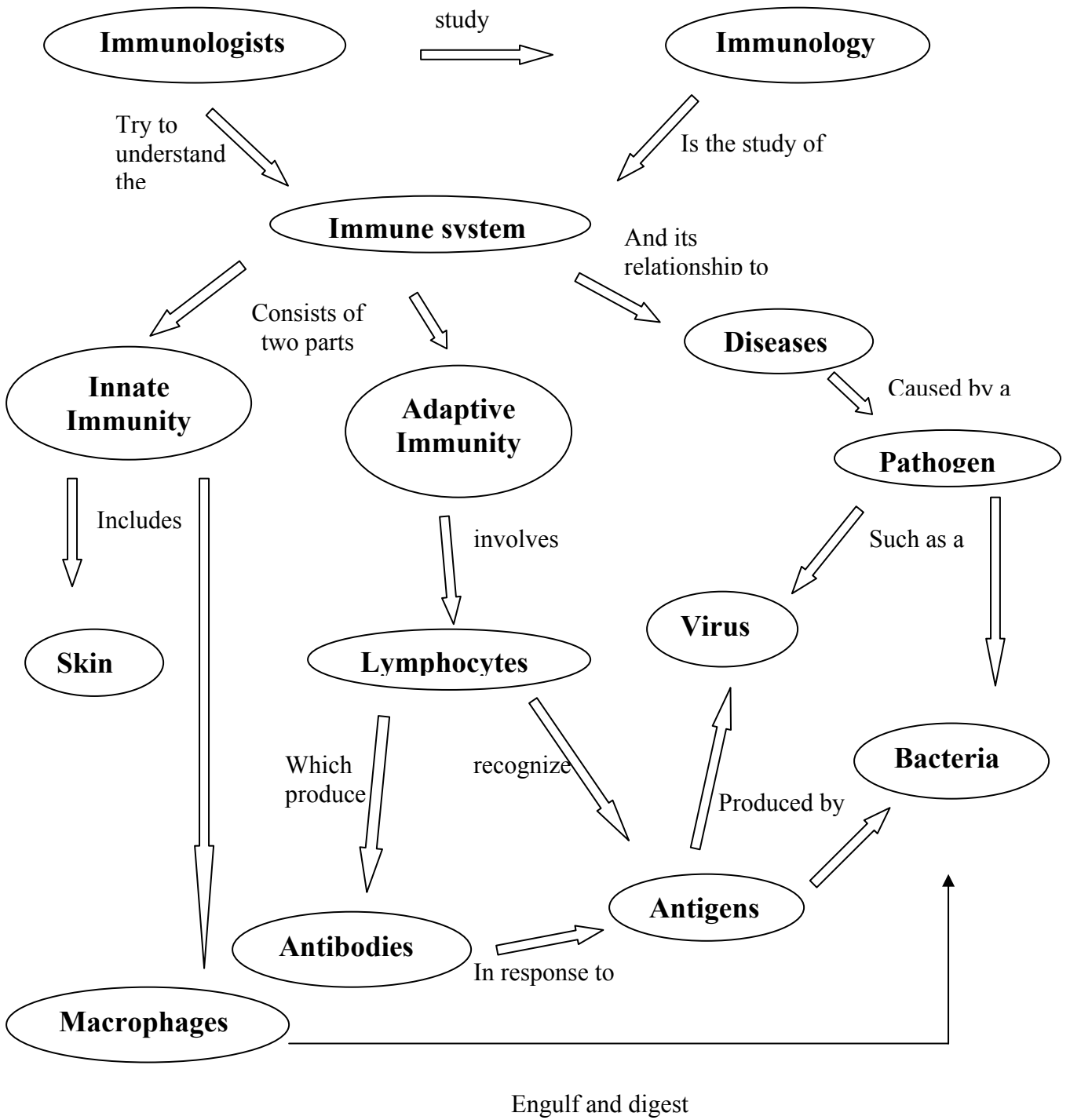
I. Construct a concept map using the following terms **and include as many new terms from the lessons on your map as possible. After you have completed your map, obtain the map you made at the beginning of the unit. Compare your maps side by side and answer the questions below. :**

Immunologist	Adaptive Immunity
Immunology	Skin
Immune system	Macrophages
Pathogen	Lymphocytes
Virus	Antigens
Bacteria	Antibodies
Innate Immunity	Disease

II. Questions (rank yourself, 1 is very weak, 5 is very strong)

- a. My new map is accurate. 1 2 3 4 5
- b. My 2 maps are different 1 2 3 4 5
- c. My 2nd map shows me that I learned new information during this unit.
1 2 3 4 5
- d. What changed on your map? Be specific
- e. Can you identify any misconceptions about immunology on your first map?
- f. What concepts are still fuzzy about immunology?

EXAMPLE CONCEPT MAP



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