

# The Vaccine Makers Project

## Teacher's Introduction

UNIT 2: Disease and Vaccination

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## **INTRODUCTION**

The Vaccine Maker's Project is a Medical History Pictures, Inc. initiative with the sponsoring partnership of the Vaccine Education Center at The Children's Hospital of Philadelphia. The goal of the project is to provide accurate, up-to-date science-based information and educational tools about the immune system and vaccines.

These lesson plans provide resources and tools for educators to present students with engaging material for learning about vaccines and the immune system.

Each lesson plan includes standards alignment to Pennsylvania Standards, Next Generation Science Standards and Common Core State Standards. Each lesson follows the 5Es pedagogic model and includes a glossary, lesson objectives and key questions.

## UNIT DESCRIPTION

**Overview:** This unit is comprised of four lessons and a summary activity. The lessons focus on how diseases affect the immune system and on the connection between the immune system and vaccines. Students also investigate scientific innovation and human interest stories related to the development of vaccines. Animations from *The Vaccine Makers Project* support the key concepts.

**Why Study This Unit:** Diseases afflict everyone at some time in their lives. Students can lead healthier lives by learning why the immune system fails to protect us from disease and how vaccination can protect people from disease. The science of disease and vaccines provides insight into medical and scientific innovation and why we now live longer, healthier lives than at any time in history. Students also learn how societal and ethical influences can affect the perception of complex scientific information.

**Learning Objectives:** Students analyze the causes of disease in terms of the pathogen's interaction with the immune system. Students describe some pathogens evolve ways to counteract the immune system. Students summarize how vaccines work and the methods used to make them. Students examine the importance of herd immunity and the development of widely used vaccines.

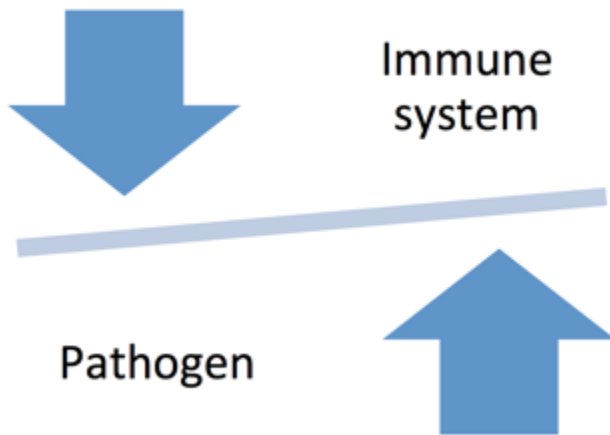
**Success Criteria:** Students identify the causes of disease, describe the function and manufacture of vaccines, and describe how vaccination contributes to the health of the community.

## CONTENT OUTLINE

### Lesson 1 – The Development of Disease

**Description:** In this lesson, students explore the origins of diseases, and particularly the pathogens that cause disease. Students explore glossary terms and read a passage about the causes and development of infection and disease. In a hands-on activity, students simulate an attack by pathogens on the immune system. Students analyze models of the immune system and the infection process.

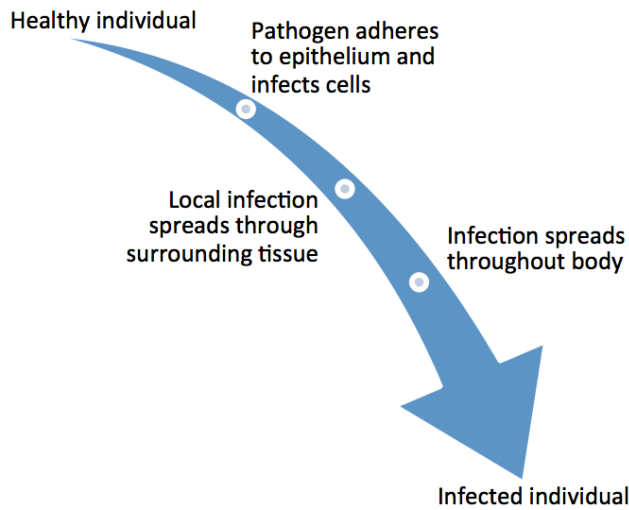
#### Models of disease in this lesson:



*Figure 1. Pathogens and the immune system. Pathogens and the immune system are in a constant tug-of-war. A reservoir of susceptible hosts allows the pathogen to persist. The immune system is always trying to elude pathogens.*



*Figure 2. Persistence. For a pathogen to persist, it must continually infect new hosts. If there are no susceptible hosts, the pathogen cannot survive. Varied habitats (the reservoir) of susceptible hosts allow pathogens to persist.*

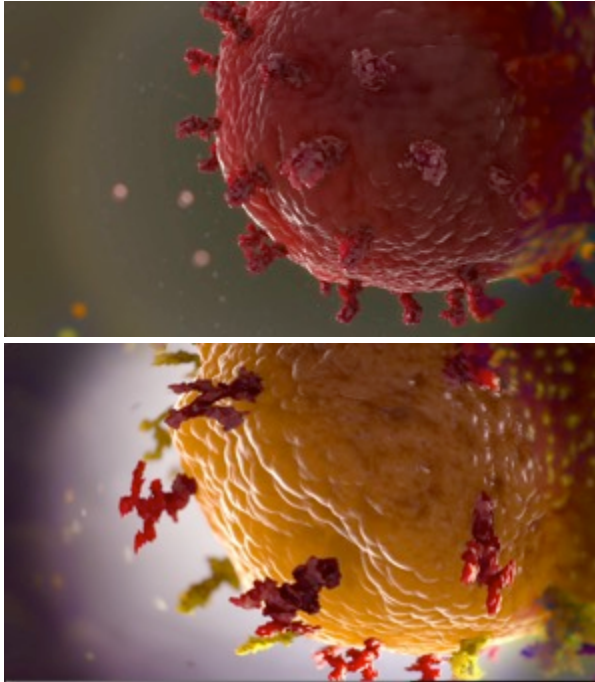


*Figure 3. Steps of the infection process. The infection process begins with a healthy individual and ends with an infected individual.*

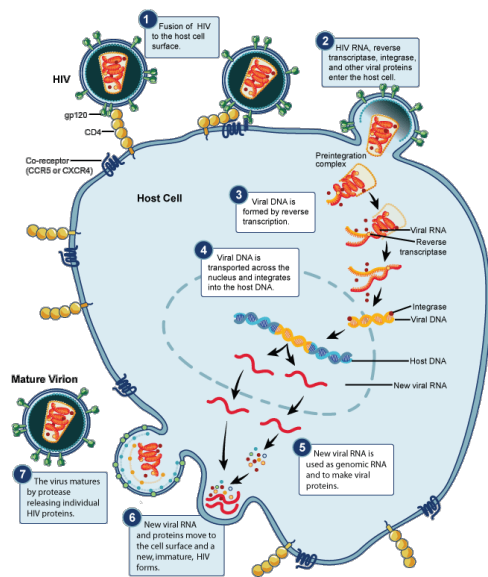
## **Lesson 2 – Development of Disease Case Studies - Influenza and HIV**

**Description:** In this lesson, students examine the concepts of antigenic variation and resistance in more detail using influenza and HIV as models. Students conduct an activity to model antigenic shift and drift. They research the influenza pandemic of 1918 to investigate how influenza uses antigenic variation to overcome the immune system. Students also investigate the mode of HIV infection, exploring a model of the structure and function of HIV, and the process of HIV infection. Students apply their knowledge of the HIV infection mechanism to analyze why HIV degrades the human immune system.

**Disease and infection concepts in this lesson:**



Antigenic drift versus antigenic shift in influenza viruses.



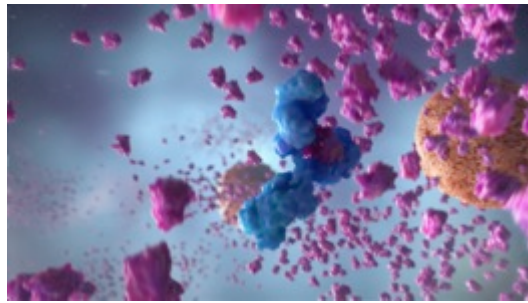
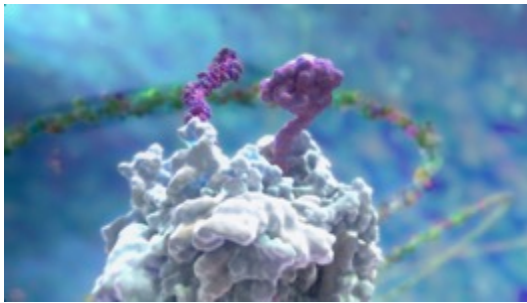
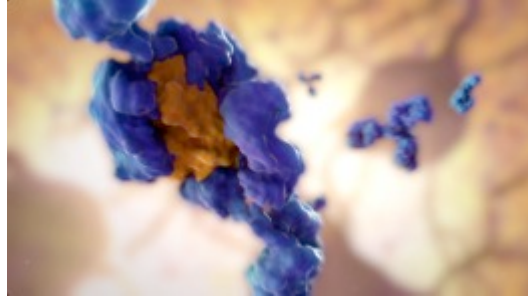
HIV replication process. *Source – NIAID*

### Lesson 3 – Development of Vaccines

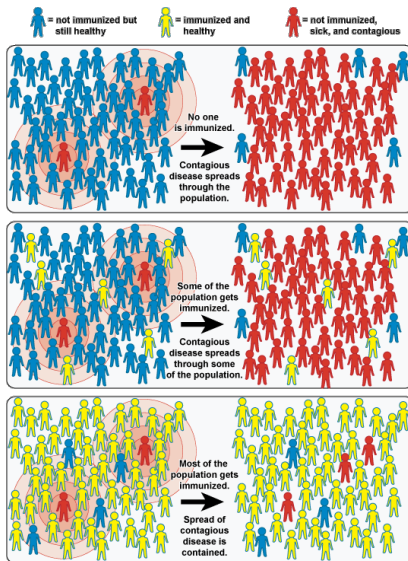
**Description:** In this lesson, students explore the function and manufacture of vaccines. Students evaluate the advantages and disadvantages of the various approaches to

making vaccines. Students analyze and graph data from a computer simulation of herd immunity and describe the concept of herd immunity.

**Vaccine development concepts in this lesson:**



Molecular views of technologies used in making vaccines



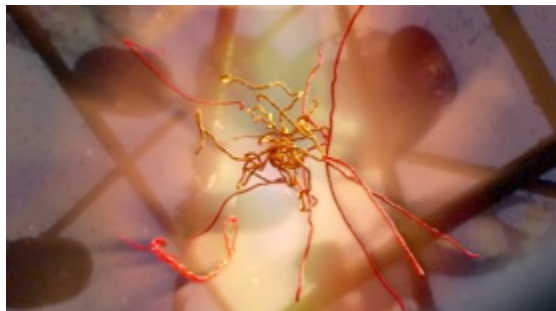
Herd Immunity. Source: NIAID



#### Lesson 4: History of Vaccine Research

**Description:** In this lesson, students will explore the process by which Dr. Maurice Hilleman developed the vaccines for mumps and hepatitis B. Students consider the development of these vaccines as examples of the role of serendipity in the scientific process. They also analyze how societal pressure against blood-derived hepatitis B vaccine led Dr. Hilleman to create the first vaccine using recombinant technology.

#### Vaccine technology concepts in this lesson:



Viral attenuation



Recombinant technology

#### Lesson 5: Understanding Vaccine Safety

In this lesson, students synthesize their understanding of disease and the immune system to address concerns about vaccine safety. Students work in groups to research a selected vaccine safety concern. The groups evaluate the veracity and credibility of related resources and review the scientific conclusions related to their chosen concern. Groups then complete a project to educate others about the concern, comparing scientific evidence with unsupported claims.