

## Who's Got The Flu?

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 Subject: Life Science  
 Level: 8 - 12  
 Standards: CCSS: Reading Standards for Literacy in Science 3, 6-9  
 Schedule: Two 50 minute periods

### Objectives:

- The human body uses active immunity to defend against infectious diseases as a second-line of defense mechanism.
- Enzyme-linked immunoabsorbant assay (ELISA) may be used as a diagnostic tool to identify Infectious diseases. .

### Students will:

- Understand how the human body defends against infectious diseases.
- Understand how ELISA is used a diagnostic tool to diagnose infectious diseases.
- Use an ELISA simulation kit to diagnose the Avian Flu Virus in hypothetical patients.
- Understand how infectious diseases are transmitted.

### Vocabulary:

ELISA	Passive Immunity
Antibody	Enzyme
Antigen	Substrate
Immunity	
Active Immunity	

### Materials:

#### For Each Group:

- ELISA Simulation Kit from Carolina Biological:
  - One microtiter plate
  - Eleven disposable pipettes
  - One copy of patient profiles of each disease being tested
  - Student Guide worksheet for each student
  - 300 uL diluted solutions of positive and negative controls
  - 1500 uL diluted solutions of patient samples A-F
  - Diluted solutions of antigen, secondary antibody, and chromogen (ALL are simulated samples)
  - Internet access

### Safety:

- All solutions used in this activity are simulated, thus there is no risk of infection of any disease.
- Do not ingest any of the solutions used during this activity.
- Actively supervise students throughout the entire laboratory investigation.

## **Science Content for the Teacher:**

The human body uses two methods to defend against infectious diseases. Our skin serves as our first line of defense. It serves as a barrier between the internal and external environments. Cilia present in our respiratory tract also prevent pathogens from invading our body. Coughing and sneezing are ways our bodies respond to foreign particles that might have entered our bodies. However, when bacteria or viruses invade our bodies, the second line of defense is stimulated to help us fight off these, possibly, deadly pathogens.

Our second line of defense, also called active immunity, is a process in which our body produces antibodies that identify a certain pathogen. Once identified, a cascade of reactions occurs to stimulate the production of white blood cells to fight off and destroy the foreign pathogen.

Viruses and bacteria are coated with specific proteins that only certain antibodies can recognize. The enzyme-linked immunoabsorbant assay (ELISA) is a diagnostic tool to detect the specific proteins that may be present in patient blood samples. Antigen proteins are first placed in the wells of a microtiter plate. Patient samples with antibodies are added. The antibody will contain sites that are specific to the antigen proteins and will adhere to each other and form a complex. A secondary antibody (anti-antibody) is added. A special enzyme is attached to this secondary antibody. This antibody will attach to the patient sample. In the final step, a substrate is added to attach to the enzyme to produce a color change in the sample to indicate a presence of the virus or bacteria in the sample.

## **Preparation:**

- Dilute original patient samples and antibody solutions to allow enough samples for each group.
- Provide students with basic background in how active immunity occurs in the body.
- Equip each group with necessary copies of Student Guides, Patient Profiles, and Periodicals.
- Ensure each group has one microtiter plate and enough pipettes.
- Review Lab Safety Rules with students



## **Classroom Procedure:**

### ***Engage (Time: 40 min)***

Engage students with primary sources from the World Health Organization. Since the outbreak of the avian influenza virus in 1997, the WHO has been tracking the occurrence of each case around the world.

[http://gamapserver.who.int/mapLibrary/Files/Maps/Global\\_H5N1inHumanCUMULATIVE\\_FIMS\\_20100831.png](http://gamapserver.who.int/mapLibrary/Files/Maps/Global_H5N1inHumanCUMULATIVE_FIMS_20100831.png)

Provide students with periodical from the New York Times related to the concerns of the Avian Flu Virus,

[http://www.nytimes.com/2004/11/30/international/asia/30flu.html?\\_r=1](http://www.nytimes.com/2004/11/30/international/asia/30flu.html?_r=1)

Allow students to imagine that they are immunologists who just received patient samples from a local hospital. Doctors suspect these patients are infected with the Avian Flu Virus. Students must use the ELISA test determine which patients are infected with the virus.

Model the procedure to perform the ELISA test. Be sure to remind students to change pipettes every time samples are transferred to avoid contamination.

### ***Explore (Time: 40 min)***

Following the directions presented in the Student Guide, perform ELISA tests on patient A through F.

Draw a diagram of the microtiter plate before placing solutions in each well. Have students plan which solutions should be added in each well of the plate to avoid confusion.

Have students practice using the pipettes with plain water first. Perform positive and negative control tests.

Perform tests on samples A through F with three trials for each sample. Record observations on Student Guide. A purple color change indicates a positive test and a light green color change indicates a negative test for the virus.

### ***Explain (Time: 30 min)***

Compare the results of each group. Ask students which patients are infected with the Avian Flu Virus. Explain to students the function of each solution added to each well during the ELISA test. Link the antibody-antigen complex to the enzyme-substrate complex. The final step is used as an indicator of the presence of the virus. Show students the following animation to differentiate learning:

<http://www.sumanasinc.com/webcontent/animations/content/ELISA.html>



**Expand (Time: 10 min)**

During this activity, students performed an ELISA test to identify the Avian Flu Virus. Ask students conduct research to answer the following questions:

- What other diseases can ELISA detect?
- Can ELISA detect non-communicable diseases, such as diabetes or cancer?

**Assessment:**

The following rubric can be used to assess students during each part of the activity. The term “expectations” here refers to the content, process and attitudinal goals for this activity. Evidence for understanding may be in the form of oral as well as written communication, both with the teacher as well as observed communication with other students. Specifics are listed in the table below.

1= exceeds expectations

2= meets expectations consistently

3= meets expectations occasionally

4= not meeting expectations

	Engage	Explore	Explain	Expand/Synthesis
1	Shows leadership in the discussion and link real-world data to current events relating to the avian flu virus	Completes work accurately while providing an explanation for what is observed. Works very well with group.	Provides an in-depth explanation of findings, making good use of vocabulary terms. Writes a detailed description in science journal.	Shows understanding of how ELISA test can be used to detect various diseases. Writes detailed description of the process in science journal.
2	Participates in the discussion and shows an understanding of real-world examples of infectious diseases transmission.	Completes work accurately and works cooperatively with group.	Provides clear explanation of findings. Writes a good description of observations and procedure.	Shows understanding and can express a good description of the process of performing an ELISA test.
3	Contributes to the brainstorm, but shows little understanding of real-world data linked to infectious diseases transmission.	Works cooperatively with group, but makes some mistakes with the procedure.	Provides a limited explanation of findings in science journal.	Shows some understanding of the process of an ELISA test. Records the process in science journal.
4	Does not participate in brainstorm. Shows no understanding of how real data linked to infectious diseases transmission	Has trouble working with group. Does little to complete the procedure.	Is not clear in explanation of findings. Incomplete explanation in science journal.	Does not understand how ELISA tests are performed. Incomplete description of the process.



### **Extension Activities:**

- In this activity, students used an “indirect ELISA test” to detect an infectious disease. How is a “direct ELISA test” different? Have students research the difference between a direct and indirect ELISA test.
- Create a flip-book showing a positive or negative ELISA test.

### **Supplemental Information:**

- More information on the Avian Flu Virus at [www.who.int](http://www.who.int)
- Periodicals on the Avian Flu Virus available at [www.nytimes.com](http://www.nytimes.com)
- Animations on ELISA available at <http://www.sumanasinc.com/webcontent/animations/content/ELISA.html> and <http://www.biology.arizona.edu/IMMUNOLOGY/activities/elisa/technique.html>

### **Safety:**

- All solutions used in this activity are simulated, thus there is no risk of infection of any disease.
- Review lab safety rules before this laboratory investigation.
- Do not ingest any of the solutions used during this activity.
- Actively supervise students throughout the entire laboratory investigation.

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