

Shoreline Biotech Experience: Influenza Outbreak Investigation Kit

Synopsis

The kit scenario is an outbreak of influenza amongst a group of people who had all been on the same airline flight. The kit includes 32 Patient Cards that contain information regarding: age, date of last influenza vaccine, height, weight, blood pressure, symptoms, etc. These cards have a numbered patient ID on them to protect the privacy of each individual.

The kit is designed for students to work in 8 groups of 4, with each group conducting tests and analysis (ELISA, PCR, etc) on 4 patients.

Background information is provided regarding: the immune system, influenza vaccine formulations, the ELISA test, ELISA test applications, the pros and cons of the ELISA test vs the PCR test, other viruses that cause flu-like symptoms (so teachers can use this kit to look at outbreaks of other viruses), and epidemiological statistics (sensitivity, specificity, positive predictive values and negative predictive values of molecular diagnostic tests).

A summary of labs and other activities, as well as the suggested number of class days dedicated to each activity, is as follows:

Activity	Number of Class Periods	Notes & Comments
<u>Micropipetting Practice Lab 1:</u> Students practice micropipetting small volumes (20 uL and smaller) <i>See also: Micropipetting videos at: URL</i>	0.5-1	Not necessary if students have already learned how to use micropipettes
<u>Micropipetting Practice Lab 2:</u> Students practice micropipetting larger volumes and gaining familiarity working with 96-well plates (75-15 uL, "Suncatchers"). Also included here is an activity using the Suncatchers the students make to calculate their pipetting accuracy. <i>See also: Micropipetting videos at: URL</i>	0.5-1	Not necessary if students have already learned how to use micropipettes
<u>Serial Dilution Practice Lab 3:</u> Students practice making serial dilutions using colored water.	0.5-1	
<u>Introduction to the Immune System:</u> A PowerPoint presentation that	0.5-1	Links to documents and videos giving further explanation of: the immune response and antibody

introduces students to the basics of the immune system		gene rearrangement are available in the DropBox folder.
<u>Antibody Model Activity:</u> Students create a 3 dimensional model of an antibody protein using chenille stems and Perler beads	0.5-1	This activity was developed by Science Education Partnership. This activity works well in concert with the 'Intro to the Immune System' ppt
<u>Overview of the Influenza Virus:</u> A PowerPoint presentation that introduces students to the biology of the Influenza virus	0.5-1	
<u>Overview of the ELISA Test and ELISA Model Activity:</u> The PowerPoint presentation introduces students to the ELISA test. Students use models to construct what is happening in and ELISA well (both positive and negative controls).	1-1.5	
<u>ELISA Lab:</u> Students conduct an ELISA assay to detect the presence of anti-Influenza antibodies in 'patient' samples.	1-2	This activity can be done either as: -A positive/negative assay, where students only determine if antibody is present or not -A trinary assay, where positive results may be high antibody positive or low antibody positive Stop reaction can be included in the kit if teachers wish to bring plates back to SCC to generate numerical values on our plate reader (for graphing activities).
<u>Excel Graphing Activity:</u> Students use Excel to graph the values of their standard curve and generate the equation of a line. The equation of the line is then used to calculate the concentration of anti-influenza antibody in the 'patient' samples.	1-2	Not necessary if teachers choose to do a positive/negative assay.
<u>Introduction to Polymerase Chain Reaction (PCR):</u> A PowerPoint presentation that introduces students to polymerase chain reaction	0.5-1	This lecture works well in concert with the paperclip pcr modeling activity.

<u>Paperclip PCR Model Activity:</u> Students carry out virtual pcr reactions using colored paperclips	0.5-1	
<u>PCR Lab:</u> Students carry out PCR reactions on 'patient' DNA samples to detect the presence of Influenza Neuramidase protein gene.	1-1.5	
<u>Agarose Gel Electrophoresis Lab:</u> Students run their PCR reactions on agarose gels to determine the presence or absence of the Neuramidase protein gene.	1-2	
<u>Introduction to the Basic Local Alignment Search Tool (BLAST):</u> A PowerPoint presentation introducing students to BLAST	0.5-1	
<u>BLAST Lab:</u> Students use BLAST to compare 'patient' neuraminidase protein sequences with the protein sequences of the neuraminidase proteins used in the most recent vaccine	1-1.5	
<u>Introduction to Epidemiology:</u> A PowerPoint presentation introducing students to the basic concepts of Epidemiology and some of the statistical tests used in that field	0.5-1	
<u>Epidemiology Statistics Worksheet:</u> Students work through a number of calculations to determine the sensitivity and specificity and ELISA, using the PCR assay as 'gold standard, and an optional extension to predict the positive predictive values and negative predictive values. of ELISA given different influenza prevalence values.	1-2	This activity is optional.

1. Micropipetting Practice Lab – practice micropipetting small volumes (20 uL and smaller)

2. Micropipetting Practice Lab – practice micropipetting larger volumes and gaining familiarity working with 96-well plates (75-15 uL, “Suncatchers”). Also included here is an activity using the Suncatchers the students make to calculate their pipetting accuracy.
3. Serial Dilution Practice Lab – serial dilutions are a common technique in immunological assays, especially those performed with 96-well plates
4. Overview of the Immune System – PowerPoint
5. Antibody model activity – using chenille stems and beads to understand the shape and diversity of antibodies
6. Overview of the Influenza Virus – PowerPoint
7. Overview of the ELISA test – PowerPoint and ELISA model activity
8. ELISA Lab – detection of anti-influenza Abs in ‘patient samples’
9. Excel Graphing activity – computer lab to determine the concentration of anti-influenza Abs in the patient samples (optional extension)
10. Overview of Polymerase Chain Reaction (PCR) – PowerPoint
11. Paperclip PCR model activity
12. PCR Lab - detection of influenza genome (neuraminidase gene) in ‘patient samples’
13. Agarose gel electrophoresis Lab – to determine the results of the PCR lab
14. Introduction to the Basic Local Alignment Search Tool (BLAST) – PowerPoint
15. BLAST Lab – computer (bioinformatics) lab - comparison of ‘patient’ neuraminidase protein sequences with the protein sequences of the neuraminidase proteins used in the most recent vaccine
16. Introduction to Epidemiology and Epidemiology Statistics – PowerPoint
17. Epidemiology Statistics worksheet – calculating the sensitivity and specificity and ELISA, using the PCR assay as ‘gold standard, and an optional extension to predict the positive predictive values and negative predictive values of ELISA given different influenza prevalence values.

Teacher preparations worksheets are included. Teachers can tailor the kit to the level of their students. There are some sections that can be removed or simplified. There are multiple ‘build out’ activities for teachers who wish to teach an area more in-depth to advanced students.