Capturing the H1N1 Virus & SP IRIS Refining

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Introduction:

There is an increased need for an instrument that is capable of quickly identifying viruses in infected persons. The current methods of viral detection require lengthy multiple steps and the results are not quickly available. The NSF AIR SP IRIS is a virus detection instrument that illuminates a virus particle on the surface of a substrate and measures the interference of scattered light from the particle in relationship to the reflected light from the known surface. It allows us to see what was basically invisible. The goal: perfect this machine and allow for viral identification in two to five minutes.

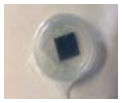
The Processes:

A.

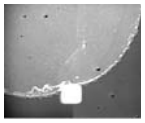
1. Purchase the antibody

2. Spot Antibody

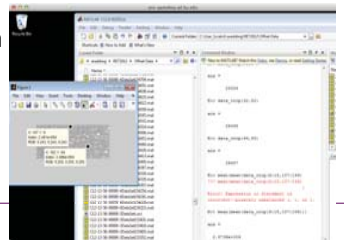
3. Incubate with Virus



4. Take IRIS Images

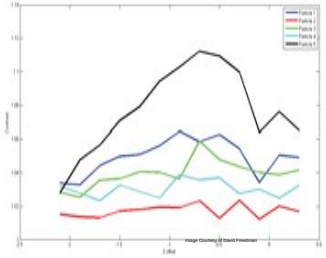


5. Analyze Data

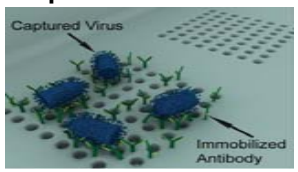


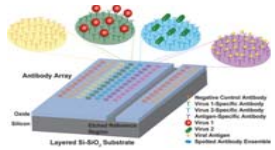
B. NSF AIR SP IRIS

Gather Data → Anlayze Data

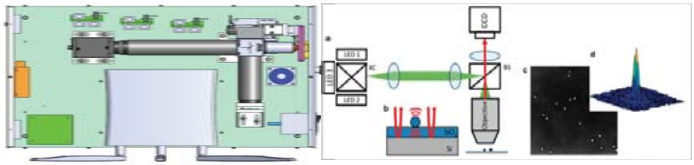


The Experiment:





1.Via the internet, hours were spent researching both nationally and internationally which commercially available antibodies would be likely to catch the H1N1 Virus. The criteria included that the antibody be polyclonal, able attach to a number of different epitopes on the virus contained in the neruaminidase and hemagglutinin proteins on the viral coat. It also needed to be compatible with the ELISA procedure. Once purchased, the antibodies had to be attached to a microchip, incubated with the H1N1 virus, washed, imaged, and then the images had to be analyzed.



2. Continue refining the NSF AIR SP IRIS by imaging incubated spots on a microchip, taking hundreds of images at varying focal heights on the optical axis and then analyzing the data to determine a set reference point with which the focusing ability of the NSF AIR SP IRIS can be calibrated.

Conclusions:

PROJECT 1 - Two antibodies were used to test the capture of the H1N1 virus, USBio. 78B and USBio. 05E. The results for both were inconclusive. There was better success with the USBio 78B but the binding behaviors of the particles detected were not uniform across the entire spot which led us to believe that there was unrelated binding, perhaps of other proteins. The experiments would need to be repeated with different antibodies and the method of purifying the samples will need to be reviewed.

PROJECT 2 - The conclusion for the NSF AIR SP IRIS indicated that the instrument had an issue with the stage moving nanometers every time it refocused on a new image. This was easily corrected by modifying the stage structure. Collected data also documented that the ideal focal calibration was narrowed down to be between -1 and -.5 on the optical axis. In order for the NSF AIR SPI to be placed in the field, it is important that its use be simple and quick. The focus command needs to be automatic and our data helped determine the ideal optical calibration level.

Application in the Classroom:

Grades: 7-8

Duration: 3- 4 50 minute Class Periods

Overview: The goal of this lesson is to introduce students to the structure and multiplication of a virus and the uses of light to measure & detect nano-sized particles.

Essential Questions:

1. What is a virus and how do viruses affect organisms?
2. How is light an appropriate tool to detect viral particles?

Massachusetts Science & Technology Curriculum Frameworks:

***Life Science (Biology)**

2. Recognize that all living things are composed of cells and that many organisms are single-celled (unicellular) e.g. bacteria, yeast.
7. Recognize that every organism requires a set of instructions that specifies its traits. These instructions are stored in the organism's chromosomes. Heredity is the passage of these instructions from one generation to another.
8. Recognize that heredity information is contained in genes located in the chromosomes of each cell.

***Physical Sciences (Chemistry and Physics)**

3. Recognize that the measurement of volume and mass requires understanding of sensitivity of measurement tools and knowledge and appropriate use of significant digits.

Lesson Objectives: Students will be able to:

1. Diagram and label the parts of a virus.
2. Explain the viral multiplication cycle.
3. Compare and contrast the lytic and lysogenic cycles.
4. Using a spectrophotometer, measure the amount of light in a specific nano-range being transmitted from varying plant samples.

Assessment Procedures:

1. Students will complete answers to questions from information packet.
2. Students will write a multiparagraph essay comparing and contrasting the lytic and lysogenic cycles.
3. Students will complete the graphing of data collected from using the spectrophotometer to measure the amounts of light transmitted from varying samples of liquids.

Boston University Biophotonics Research Experiences for Teachers
Mike Ruane, Cynthia Brossman, and Helen Fawcett: Program Directors

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