

## **Food for thought: How Pathogens lead to Genetically Modified Crops**

Ailyn Barrios  
Palm Beach Central High School  
Wellington,FL

### **Abstract:**

This action plan is designed to expose 10<sup>th</sup> grade students in a curriculum unit that focuses on emerging pathogens and biotechnology in the real world. This is designed to be a unit that encompasses prior knowledge and newly acquired information to discover the problematic issue of pathogens in agriculture. The action plan will take place in six 50 minute classes, where differentiated instruction will be used to motivate all learners. They will also participate in various labs identifying microbes. At the conclusion of this unit, students will create a brochure or video to present to the local farmers market informing the public on pathogens that require the use of genetically modified foods. Without genetically modified agriculture, expenses on insecticides and pesticides would be on the rise for most crops. Many fields would not be salvageable once the insect has invaded the field. Finding a gene in these plants that can deter the pathogen from invading, would be most cost efficient and beneficial in saving that plant.

### **Rationale:**

This unit will be carried out by 10<sup>th</sup> Grade "Regular" Biology students. Typically, these are the low level readers who are taking this course for their graduation requirement. Incorporating pathogens into the agriculture unit will hopefully spark their interest in the science field while educating them on pathogenic bacteria and viruses.

This unit will primarily focus on the influence of Tomato Spotted Wilt Virus and agriculture which have been affected by this pathogen. Students will perform Immunostrip Assay tests to identify the presence of the virus on peanut plants. A simulated gel electrophoresis will also be conducted to further investigate the presence of the virus in another area of the farm that has now infected another plant; tomatoes.

This in-depth research on the effects of this pathogen will conclude in a public health brochure that will allow the students to share their research to the public. By allowing the students to participate in the various labs identifying the pathogen, they will have a better understanding on the need for genetically modified plants to withstand these pathogens without the use of harmful herbicides and pesticides.

### **Description of teaching unit of module(s), including expected outcomes:**

This teaching unit will span approximately six instructional days and will focus on the following learning objectives and outcomes:

- SC. 912.L.14.6- Explain significance of pathogenic agents to health from perspective of individuals and public health.
- SC.912.L.16.10- Evaluate impact of biotechnology on individual, society, and environment including medical and ethical issues.
- SC. 912.L.17.6- Compare and contrast the relationships among organisms, including predation, parasitism, competition, commensalism, and mutualism.
- SC.912. L. 15.6- Discuss distinguishing characteristics of the Domains and Kingdoms of living organisms. -Viruses and Bacteria

### **The above learning outcomes will be achieved through the completion of the following activities**

- Lessons (2): Pathogens

- “Menacing Microbes” Activity
- Assign pathogen project
- TSWV Jig saw Activity
- Lessons (2): Biotechnology:
  - ImmunoStrip Assay Tests
  - Micropipetting and Designer Plates
  - Gel electrophoresis
- Lessons(1): How Pathogens lead to GMO’s
  - Discussion on Pro’s and Con’s to Genetically Modified Organisms

**Data Collection techniques and/or student assessments:**

- Unit Pre and Post Test
- Lab reports: ImmunoStrip Assay Test and gel electrophoresis
- Class Presentation on assigned pathogen.
- Brochure: How Pathogens lead to Genetically Engineered Food.

**Use of equipment Lockers and/or UF visit**

- Menacing Microbes with Questions and Answers
- Pipetting Station Locker
- Gel Electrophoresis and PCR

**ICORE summer institute elements specifically included (UF connections)**

- Topics from: Dr. Morris- *Emerging Pathogens and Pandemics*; Dr. Rowland- *Tomato Spotted Wilt Virus and Transgenic Plants*; Dr. Gabriel- *Transgenic Citrus with Immunity to Citrus Greening Disease*; Dr. Green- *ELISA techniques*
- Activities/ Labs: Detecting TSWV using ImmunoStrip Assay, Designer Plate, Menacing Microbes

**Budget and Budget Justification**

Item	Vendor/Source	Cost	Supplies needed for..
ImmunoStrip Assay --Qt. 25 X 2= 50 (ImmunoStrip® ISK 39300/0025)	Agdia	(\$105 X 2=) \$210.00	ImmunoStrip Assay Lab
PCR samples ( 211210 E2 Bulk evidence 2 for PCR Forensics Simulation Kit, per mL) and (211210SX1 Bulk Suspect X1 for PCR Forensics Simulation Kit, per mL)	Carolina	(\$ 52.95 X 2=) \$104.90	Gel Electrophoresis
E-Gel Power source	UF provides	FREE	Gel electrophoresis
Gel E-Gel® 1.2% with SYBR Safe™, Invitrogen, , G5218-01, Qt- 18 gels	Invitrogen.com	\$183.92	Gel Electrophoresis
<b>TOTAL COST</b>		<b>\$ 498.82</b>	

## Lesson Plan

**Title:** Food for thought: How Pathogens lead to Genetically Modified Crops

**Key Questions:** Why are genetically modified foods essential?

What is a pathogen?

How does biotechnology relate to GMO's?

**Science Subject:** Biology

**Grade and Ability level:** Regular 10<sup>th</sup> grade students

**Science Concepts:** Bacteria, Viruses, agriculture, biotechnology

**Overall Time Estimate:** Six 50 minute class periods.

**Learning styles:** Visual, auditory, and kinesthetic

**Lesson summary:** This lesson will cover pathogens and their importance to agriculture and the foods we consume. We will see the reasoning behind genetically modified foods which are a result of invasive pathogens by doing simulation labs, activities, discussions and demonstrations.

### **Student Learning Objective with standards:**

1. SC. 912.L.14.6- Explain significance of pathogenic agents to health from perspective of individuals and public health.
2. SC.912.L.16.10- Evaluate impact of biotechnology on individual, society, and environment including medical and ethical issues.
3. SC. 912.L.17.6- Compare and contrast the relationships among organisms, including predation, parasitism, competition, commensalism, and mutualism.
4. SC.912. L. 15.6- Discuss distinguishing characteristics of the Domains and Kingdoms of living organisms. -Viruses and Bacteria

**Materials:** Pretest, Powerpoint on pathogens, Jig Saw Activity Materials (see Attached), ImmunoStrip Assay, peanut plants, test strips, Micropipettes, 96 well plates, colored water, Menacing Microbe animals, Gel electrophoresis lab supplies (See attached).

### **Background information:**

Pathogens are defined as a biological agent that causes diseases or illness to its host. Tomato spotted wilt virus (TSWV) infects over 80 plant families. This virus is an RNA virus that is vectored by thrips. TSWV in peanut plants display a variety of symptoms. Some include minor spots on leaves, while more drastic symptoms cause death to the plant.

Using a variety of different testing techniques, scientist can detect the presence of this pathogens in peanut plants even though there are no symptoms. They have to obtain samples of the plants tissues from the root and leaves. An ImmunoStrip assay test can be conducted using these tissue samples and an indicator strip.

We can also run a gel electrophoresis to further conclude the presence of this pathogen in a plant. Once thousands of copies of the target DNA have been produced, a process called gel electrophoresis is used to separate the DNA fragments. Since all DNA is negatively charged, when we place the fragments in an

electrical field, the smaller pieces will be able to travel farther. Moving through the agarose gel, DNA fragments will form bands that are visualized by staining the DNA. Comparing our 3 samples to a positive control, allows us to determine which plant had the presences of the virus.

We will be performing both labs to determine if all of Ms. Barrios' peanut plants are infected with the virus.

### **Advance preparation:**

- Powerpoint on Pathogens
- Select Pathogens for students to research
- Copies and stations for Jig Saw activity
- Obtain peanut plants that are positively and negatively infected for the ImmunoStrip assay test
- Obtain test strips, and sample extract bags from agdia.
- Fill beakers with two different colors of water for designer pipette plates.
- For Each group of 4 (Gel electrophoresis)
  - One vial of "Water" (100 microliters)
  - One vial "positive control" (8 microliters) (E2)
  - One Vial of "Area #1 sample" (8 microliters) (E2)
  - One Vial of "Area #2 sample" (8 microliters) (SX1)
  - One Vial of "Area #3 sample" (8 microliters) (E2)

### **Procedures with time estimates:**

Day One: Pretest on Pathogens (15 minutes), Short lecture on Pathogens (15 minutes), Students will pick a pathogen to investigate and write a report, tape an informative video, or create a brochure with information on that pathogen and its importance to humans (20 minutes)

Day two: Tomato Spotted Wilt Virus Careers Jig Saw Activity. (50 minutes)

Day three: ImmunoStrip Assay test- groups of 4 (20 minutes) and Micropipetting designer plates- groups of 2 (30 minutes)

Day four: Menacing Microbe Activity (20 minutes), Teacher Demo on Gel electrophoresis lab for next day (30 minutes)

Day five: Gel electrophoresis- groups of 4 (50 minutes)

Day six: Posttest and student pathogen investigation presentations. (50 minutes)

### **Assessment suggestions:**

**For objective 1:** Students will write a report, make a video, or create a brochure on assigned pathogen. Students will also perform immunoStrip assay lab and questions to determine if the entire field is infected, or only specific areas.

**For objective 2:** Students will participate in gel electrophoresis lab that uses biotechnology to identify the presence of the pathogen in the plant. Students will be asked how this technology is important to humans (DNA matching on crime scenes).

**For objective 3:** Students will answer the following questions on the pre and posttest- “How has identifying a pathogen on a plants been beneficial for farmers? If scientist find a gene that can deter pathogens from invading, how could this be useful in the agriculture field? Compare the relationship of thrips and TSWV to another pathogen and host.”

**For objective 4:** Students will take notes on bacteria and viruses from teacher prepared PowerPoint.

**Resources / References:**

<http://biotechintheclassroom.webs.com>

Bokor, Julie, “Getting Jiggy with it”. University of Florida.