LESSON 2 – Why Genetically Modify?

Timeframe:

One or two 50-minute class periods

- one period could be used to review information and fill out the worksheet
- another period to develop and present information to the class about their GM application

Target Audience:

Any Middle School (6-8) or High School (9-12) class

Materials:

- Why Genetically Modify? Worksheet
- Student Presentation Rubric
- GMO Product Flashcards
    - Flavr Savr Tomato
    - AquAdvantage Salmon
    - Rainbow Papaya

Description:

Students learn about 3 different types of genetically modified products to understand that each GMO is different from others – they all have specific goals and reasons for their existence. In break out groups, students will learn about the Flavr Savr Tomato, AquAdvantage Salmon, or the Rainbow Papaya. Students will use a variety of provided sources (videos, articles) to answer questions about these applications. As a group, students will present information about these applications to the class to help the class understand the differences between these products.

Objectives:

- Students will understand:
    - Each GMO is developed for a unique reason with specific goals
- Students will be able to:
    - Use a variety of sources to find information and answer questions
    - Work in groups to present information about what they've learned
    - Use a rubric to develop a group presentation

Guiding Question:

- What types of benefits could genetic modification provide food producers and consumers?

Teacher Background:

Genetic modification includes a wide variety of biotechnologies that can be used to improve plants in numerous diverse ways. This activity is meant to introduce students to this concept through 3 individual products: Flavr Savr Tomato, Rainbow Papaya, and AquAdvantage Salmon – all of which have vastly different goals.

The **Flavr Savr Tomato** was the first genetically modified plant commercially available to consumers in 1994. It was genetically modified to remain ripe longer without getting soft. Thus, this product had a longer shelf life than conventional tomatoes, making it easier to ship and store. Additionally, this modification allowed the tomatoes to ripen on the vine before being picked, as opposed to being picked green and being artificially ripened using spray chemicals. Subsequently, the modification benefitted both tomato consumers and producers. These GMO tomatoes were clearly labeled on the shelves. However, they were not commercially viable – they were twice as expensive as conventional tomatoes and did not retain the tomato flavor consumers wanted. Additionally, Calgene, the company that produced them, had very high production costs and inexperience growing tomatoes at an industrial scale, reducing the general profitability of this product. They were removed from the market in 1997, only three years after their introduction.

The **Rainbow Papaya** is a genetically modified version of papaya that is resistant to the Ringspot Virus, which was decimating papaya trees throughout Hawaii. This genetic modification saved the Hawaiian papaya from extinction and protected an important farming industry. It was modified to insert a resistance gene so this variety of papaya would be resistant to the Ringspot Virus. The modification primarily benefitted papaya growers who were at risk of losing their industry as the Ringspot Virus infected large percentages of papaya trees on the Big Island. Consumers benefited in that the Hawaiian papaya remained available in the grocery store, which might not have happened if the species wasn't modified. The product has been successful and is currently available on the U.S. market. This was an early genetically modified product and thus there were significant concerns about the human and environmental health and safety of the product – many of which have been scientifically disproven.

The **AquAdvantage Salmon** is a genetically modified version of salmon that has a growth gene that is continuously expressed, allowing it to grow to adult salmon size in half the time as traditional wild salmon. This reduces pressure on native salmon fisheries by ensuring a supply of adult-sized salmon, which is an increasingly popular food product given its significant health benefits. Therefore, the modification is primarily focused on the production side. Environmentalists have expressed a number of concerns about this product, including fear of its escape and the subsequent genetic contamination of wild populations and fear of the potential for negative human health impacts. Despite over 20 years of testing and review, this product has not been approved for commercial markets in the U.S., although it is available for sale in Canada.

Activity Introduction:

- Refer to last week and briefly review genetic modification with students
- We will be learning about three different types of genetically modified products to learn about how this technology can be used to improve our food supply, consumer needs, and environmental issues

Activity Procedure

- Handout worksheet to students
- Divide students into 3 groups: one group for each of the different GMO products (Flavr Savr Tomato, Rainbow Papaya, AquAdvantage Salmon).
- Each group uses the following sources to find information to answer the questions on the worksheet:
- **FS Tomato Group**
    - **Radio Broadcast:** BBC, The 'Flavr Savr' Tomato – The World's First Genetically Engineered food: https://www.bbc.co.uk/sounds/play/p04xj4d1

    - **Video:** New York Times, You Call That a Tomato? https://www.nytimes.com/2013/06/24/booming/you-call-that-a-tomato.html
    - **Articles:** Whatever Happened to the Flavr Savr genetically Engineered Tomato? http://www.tomatocasual.com/2008/02/28/what-ever-happened-to-the-flavr-savr-genetically-engineered-tomato/ ; Flavr Savr Tomato https://biotechnologysociety.wordpress.com/2015/02/16/flavr-savr-tomato/
    - **Rainbow Papaya Group**
        - **YouTube Video:** GMO Answers, How are GMOs Created? The Hawaiian Rainbow Papaya Story: https://www.youtube.com/watch?v=2G-yUuiqIZ0
        - **Business Insider:** This Cornell scientist saved an $11-million industry — and ignited the GMO wars: https://www.businessinsider.com/gmo-controversy-beginning-fruit-2017-6?jwsource=cl
    - **AquAdvantage Salmon Group**
        - **Youtube Video**: CBC News, Genetically-modified Salmon Approved by FDA: https://www.youtube.com/watch?v=PQSArjT8j9o
        - **Articles:** Food Safety fact Sheet: Genetically Engineered Fish: https://www.centerforfoodsafety.org/files/ge-salmon-fact-sheet_56203.pdf ; Nine Things You Need to Know About GMO Salmon: https://gmoanswers.com/nine-9-things-you-need-know-about-gmo-salmon
- While watching the videos, students work with their groups to fill out the worksheets and answer questions about the product.
- Pass out presentation rubric to each group.
- Students develop a group presentation to share what they've learned back to the club, using the worksheet to guide what information they include and rubric to understand presentation expectations. NOTE: this doesn't have to be a traditional powerpoint presentation – students can use a variety of visual aids to make this engaging for the class (e.g. make a video, poster board, transform the information into a story, etc.)

Discuss:

- As a class, discuss any similarities/differences that exist among these products. How do/don't they relate to one another?

Extension:

- To build digital literacy skills, students have to find 1-2 additional sources to corroborate what they learned during the video. Students should use the CRAAP test to ensure these sources are credible.
- This activity can be scaffolded multiple ways to help students
    - You can demonstrate how to use the sources to find information by doing one of the products as a class.
    - You can focus on one product for a class period and divide the class into supporting and opposing groups and have them review the sources for their specific product through that lens. If you only choose one of these products, the AquAdvantage salmon sources help prepare the students for the "Investigating the GMO Controversy" lesson in this unit.

Resources:

- See links above in the Activity Procedure for more information about these three genetically modified products.