To GMO or not to GMO? That is the Question!

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Abstract: This action research proposal is designed to utilize biotechnological laboratory skills along with deductive reasoning to come to a decision to personal real-life problems pertaining to their school, their community an ultimately their world. This project will be the GMO unit for my Agricultural Biotechnology class. Portions of this proposal will be adapted for my AP Environmental Science class, Agriscience class and Environmental Resource Management class. This project will take place over 8 classes over a two and a half week period combining traditional teaching methodologies with E-gel Electrophoresis, and enzyme-linked immunosorbant assay (ELISA), a biotech case study and GMO webquest creating a lesson that will utilize all teaching styles.

Rationale: Students in Island Coast High School's Academy of Natural Resources are taught sustainability through aquaculture, aquaponics, alternative energies and environmental stewardship. In this 3 year academy students run a modified commercial aquaponics and hydroponic farm to offset the cost of running the program as well as giving back to the community in the form of food donations to food banks and hydro/aquaponics farming outreach. The students take great pride in the tilapia and fresh vegetables that they grow. They students traditionally associate the growing of their crops as organic but at the same time have a negative opinion of GMOs . What they are having a hard time coming to accept is the "reality is that "Organic food is, by definition, supposed to be free of genetically modified material, and organic crops are required to be isolated from other crops" (Thottam, 2007).

The Academy of Natural Resources this coming year will be producing the vegetables for the school cafeteria. The students are excited by this project and are looking forward to this challenge of producing at this scale. Certain realities are soon going to become evident such as the realities of producing in hot sub-tropical environment and pest management issues. To produce at the quantity and quality they desire will force them to take a close look at their perceptions of GMO's and ultimately the choice of using them.

As science teachers we are always being told that in order to really get students into science we need to make science relevant to them and give them lessons in which we are incorporating "real world" science connections. So what are "Real World Connections"? "Real-world connections are learning opportunities that present science content and processes in a way that is relevant to the students"(Shiverdecker, 2013).

The goal of "To GMO or not to GMO" is to give my students that real-world connection and excite my students about science from Agricultural Biotechnology to Zoology, increase academic scores and hopefully produce a few future scientist in the process.

Standards of Unit & Outcomes:

SC.912.L.16.3: Describe the basic process of DNA replication and how it relates to the transmission and conservation of the genetic information.

SC.912.L.16.4: Explain how mutations in the DNA sequence may or may not result in phenotypic change. Explain how mutations in gametes may result in phenotypic changes in offspring.

SC.912.L.16.5: Explain the basic processes of transcription and translation, and how they result in the expression of genes.

SC.912.L.16.6: Discuss the mechanisms for regulation of gene expression in prokaryotes and eukaryotes at transcription and translation level.

SC.912.L.16.7: Describe how viruses and bacteria transfer genetic material between cells and the role of this process in biotechnology.

These objectives will be accomplished through the completion of the following timeline:

Day 1: Plant Virus detection through Immunostrip Assay Lab using plants that students have grown hydroponically or through aquaponics combined with reading and outlining text for homework (HW). GMO pretest.

Day 2: Traditional lecture on HW and lab work, combined with outlining HW

Day 3: GMO Webquest: http://www.zunal.com/teacherspage.php?w=76810 , combined with outlining HW

Day 4: GMO Investigator lab (UF campus visit?), combined with outlining HW.

Day 5: Traditional lecture on HW and lab work, combined with outlining HW

Day 6: Case Study: "Frankenfoods: The Debate over Genetically Modified Crops", combined with outlining HW.

Day 7: Finish lecture, review for test

Day 8: Timed test (post-test), informational brochure.

These objectives will be assessed by:

- Lab/activity assessments
- Outline
- HW
- Pretest
- Unit test (posttest)
- Brochure

ICORE/Bench Connections"

- Plant Virus Detection Through Immunostrip Assay Lab
- GMO Investigator EISA (UF campus visit)
- Case Study: "Frankenfoods: The Debate over Genetically Modified Crops"

Literature Cited:

Shiverdecker, Terry. *Incorporating Real-World Connections into Science Instruction* May 18, 2013. http://www.ohiorc.org/for/science/ogt/article.aspx?articleId=65

Thottam, Jyoti. *When Organic Isn't Really Organic* March. 14, 2007. Time Health & Beauty http://www.time.com/time/health/article/0,8599,1599110,00.html

Budget: $547.75

Any overages will be taken out of internal funds

Item	Vendor/Source	Cost
TSWV immunostrip	**Agdia.com**	**$0.00…begging**
E-gel 1.2%	**Invitrogen**	**$196.00**
GMO investigator refill kits	**Biorad**	**2 x 151.25 = $300.50**
Instagene matrix	**Biorad**	**$51.00**