

Inoculating Middle School Students with Biotechnology

Principle Instructor:
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Abstract:

Biotechnology and emerging pathogens are a concern in today's world. We need to be able to give our students the opportunities to learn about these concerns and new ideas that are happening in the world of science through the study of biotechnology and emerging pathogens. This proposal shows a way of introducing our middle grade students to the types of labs that they will be experiencing when they move up to the High School level science classes. The students will learn the techniques of DNA extraction, the use of microarrays in a simulation, and PCR and gel electrophoresis in a simulated setting. Students will also use microarrays to show how various virus and diseases can be spread. While completing these techniques the students will be learning the basic information about genetics, environmental issues, and viruses that can infect different types of organisms.

Mission Statement:

The purpose of using the different techniques in biotechnology with Middle school students is to allow them to recognize and explore the impact of biotechnology on individuals, society, and the environment by using hands on activities. After mastering the modules with my students I will use my knowledge to show other teachers the techniques and encourage them to experience ICORE.

Description of the Teaching Unit:

At the conclusion of this unit:

1. Students will be able to explain DNA and what it is in regards to genetics
2. Students will be able to explain the process of DNA extraction and why scientists use DNA extraction
3. Students will understand how different diseases can be transmitted both genetically and through DNA by a vector.
4. After I have mastered the techniques that I will be using with my students I will help other teachers learn the different techniques.

This module will be taught in conjunction with our units on Heredity/reproduction/Punnett Squares, Evolution, and Scientific Processes throughout the first 9 weeks of school. In Heredity the students will be able to identify traits, differences between genotype and phenotype, uses of a Punnett Square, meiosis, basic structures of DNA and how it is copied, and the uses and different types of biotechnology.

While moving through the curriculum, labs will be incorporated to help the students understand how scientists use biotechnology and different hands-on activities to make sure students are grasping the concepts being taught. Some of the different activities will include drawing and even making a 3D model of a cell, using activities involving cartoon characters to learn the key

concepts in heredity, DNA model making and DNA extraction from strawberries or several fruits, PCR simulations, and the use of microarrays to show viruses are transmitted.

The Unit:

1. Overview of a cell and its organelles. Students will create a 3D model of a cell to show their understanding of a cell and the organelles.
2. Process of cell mitosis and different cell processes.
3. Heredity
 - a. Genotypes and phenotypes- Genetic Aliens and Sponge Bob activities
 - b. Punnett Squares and Probability
 - c. Meiosis -
 - d. DNA structure and How DNA is copied. DNA extraction and PCR simulations will be incorporated.
 - e. Biotechnology and how it is used in DNA extraction to help find viruses or diseases.

Expertise of Principal Instructor:

B.A. Biology and Environmental Science from Davis & Elkins College , Elkins, WV
7 years of teaching Integrated and Life Sciences in St. Lucie County Schools
2009 ICORE (Interdisciplinary Center for the Ongoing Research Education) 2 week summer institute on Biotechnology and emerging pathogens.
FAST (Florida Association of Science Teachers) presenter and participant for several years
Florida Teaching Certificate: Biology 6-12

Literature Cited:

"Strawberry DNA Extraction Lesson." [The Science Behind our Food](http://apps.caes.uga.edu/sbof/main/LessonPlan/strawberryDNAExtra.pdf). 24 June 2009
<apps.caes.uga.edu/sbof/main/LessonPlan/strawberryDNAExtra.pdf>.

Drs. Mavis and Robert McKenna. Presentation: How do Viruses Change Their Coats to Fit A New Host? ICORE 16 June 2009

Holt Science and Technology: Life Science. Austin: Holt Rinehart & Winston, 2005.

Chuck Lawrence . Presentation: Simulations in Biotechnology 18 June 2009

Budget and Budget justification:

Portable UV Light UV-635	6 * 10.95	65.70
Conical Bottom Centrifuge Tubes 50ml	pkg of 25	9.95
Prepared Agarose Gel .8 200ml	3* 10.50	31.50
Glass Stirring Rods	pkg of 12	5.95
Ethanol 500ml bottle	1	9.00
Copy Paper	2 reams	10.00
DNA Extraction Lab	2 * 40.00	80.00
DNA Extraction Lab Demo	1 * 18.00	18.00
	TOTAL	230.10

Theme: Emerging Pathogens

Lesson Title	DNA extraction on the way to Learning about Emerging Pathogens
Grade Span	Middle School Grade 7
Content Emphasis (Mathematics or Science)	Science- Genetics and DNA, Emerging pathogens through vectors
Targeted Benchmark(s)	
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-Lesson Preparation	
<p><u>Learning goals:</u> What will students be able to do as the result of this lesson? The students will be able to explain what a DNA structure looks like and be able to explain how DNA plays a role in heredity. Students will be able to explain the process of DNA extraction and Why scientists use DNA extraction to help them in their research. Students will understand how different diseases can be transmitted both genetically and through the DNA by a vector and be able to use equipment that they normally wouldn't be able to use.</p>	

Estimated time: Please indicate whether this is a stand-alone lesson or a series of lessons.

This lesson will continue throughout the school year. As we move into different areas of science we will look at different areas of biotechnology and emerging pathogens from insects to viruses that affect plants and their growth. We will begin with heredity, DNA, and then we will continue through how emerging pathogens affect the environment and different plant life. I am hoping that we will be able to use a number of the different techniques learned at ICORE throughout the whole school year.

In the spring I am hoping to use DNA extraction again through the PCR process of testing for the tomato spotted wilt virus in plants by having the equipment locker come. This will give the students a chance to use some of the technology that they would normally not be able to use in a middle school setting.

Materials/Resources: Please list any materials or resources related to this lesson.

Portable UV Light UV-635
Conical Bottom Centrifuge Tubes 50ml
Prepared Agarose Gel .8 200ml
Glass Stirring Rods
Ethanol 500ml bottle
Copy Paper
DNA Extraction Lab
DNA Extraction Lab Demo
Micro Arrays

I will be using information from Dr. Charles Lawrence

Teacher Preparation: What do you need to do to prepare for this lesson?

I need to give the students background information on heredity and DNA. Teach the students where DNA is found in a cell. Vocabulary on the unit.

Prepare for the lab. Make an extraction solution.

Prepare microscopes and have slides for looking at the DNA the students have extracted.

Prepare solutions for using the micro arrays to show how different germs can be located in many different places.

Make a lab sheet to go with what the students are learning.

Continue to show the students how biotechnology will help us to learn more about DNA and emerging pathogens.

Lesson Procedure and Evaluation
<p><u>Introduction:</u> Describe how you will make connections to prior knowledge and experiences and how you will uncover misconceptions.</p> <p>I am going to introduce the students to heredity and DNA first by understanding what a cell is and then by discussing that you look the way you do because of their parents and the DNA that they share with their parents. I will discuss what heredity is and how there are many factors that can contribute to the way that you look and the genetics that you carry. I will also be teaching the students about the advances in biotechnology and how with this technology we are learning more and more about emerging pathogens and diseases.</p>
<p><u>Exploration:</u> Describe in detail the activity or investigation the students will be engaged in and how you will facilitate the inquiry process to lead to student-developed conclusions.</p> <p>The students will be learning about heredity and DNA through class work and lab experiences. The students will be learning about heredity and genetics through the use of cartoon characters and making a paper genetic creature by learning the differences between phenotypes and genotypes. Then they will move into learning what the structure of DNA is and who discovered the shape and was able to develop it. The students will then have a lab activity where they get to extract DNA from different types of fruit and learn what DNA looks like through a microscope. I will facilitate the inquiry process by getting the students to discuss what they think DNA is going to look like when it is extracted and by having them to complete the lab by following directions so that if they miss a step they can determine what caused their lab not to work correctly. Hopefully we will have enough time to allow the students to extract DNA from several fruits.</p>
<p><u>Application:</u> Describe how students will be able to apply what they have learned to other situations.</p> <p>The students will be able to apply what they have learned because it will show them why they look or the qualities they have compared to their parents or ancestors. Also they will be able to understand how different diseases can not only affect them but also affect other organisms (such as plants, insects, etc.) It will give them an understanding of how to use certain equipment that they may get to use in high school as they move up through the different sciences.</p>
<p><u>Assessment:</u> Describe how student knowledge is being assessed at the appropriate cognitive level for the targeted benchmarks.</p> <p>The students' knowledge will be tested through in class quizzes and discussion. They will also be assessed through the ability to follow directions and get a product from the lab work. Also through the ability to create a genetic creature. Also by being able to answer questions that are inquiry based to help them us higher thinking questions to determine what the outcome should be.</p>

Teacher Self-Reflection: Record your thoughts on the lesson and describe any modifications you would recommend based on the outcomes.
This will have to wait until I am able to complete the lab with the students.