

Title: CSI - Fleming Island High School – DNA Investigative Laboratory Techniques and Mission Biotech Gaming

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Abstract:

Students have seen many television shows where biotechnology and the knowledge of DNA and emerging pathogens are used to solve crimes. These techniques must be understood, however, most lessons on this topic tend to be somewhat boring. In this proposal students will be exposed to Mission Biotech a computerized gaming program where students will learn and use various biotechnologies before actually doing real labs. This proposal shows a way of introducing students to the techniques of DNA extraction, PCR, and gel electrophoresis in a simulated setting. While completing the Mission Biotech game, students will be learning the basic information about laboratory procedures, application, and analysis of DNA and DNA fingerprinting used to solve many real world problems such as those portrayed on television shows like CSI. Upon completion of lessons and Mission Biotech gaming, the students will actually perform the techniques in a laboratory setting.

Rationale:

This module will be inserted into my curriculum after we have studied cell structure, organic molecules, and DNA molecular structure. The students will not have completed the isolation of DNA, been exposed to PCR, or have performed DNA gel electrophoresis. These lab activities will be the culmination of this unit following and lessons and the Mission Biotech gaming. Previously, upon completion of these labs, students rarely understand the how's and why's of the steps used in the analysis. My goal is for Mission Biotech to provide the students with this information, but more importantly, codify it through the use of Mission Biotech Science Content Quizzes and Tests.

Description of Teaching Unit:

NEW GENERATION FLORIDA STATE SCIENCE STANDARDS

- 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.16.9: Explain how and why the genetic code is universal and is common to almost all organisms.

- SC.912.L.16.12: Describe the basic DNA technology (restriction digestion, gel electrophoresis, polymerase chain reaction, ligation, and transformation) is used to construct recombinant DNA molecules.
- SC.912.L.18.1: Describe the basic molecular structures and primary functions of the four major categories of biological macromolecules.

Day 1 – Friday, 14 January 2011

Lesson – Classroom - Unit Pre-test & Introduction to equipment to be used with DNA extraction, PCR, and DNA Gel electrophoresis.

- LAB activity using micropipettes

Day 2 – Tuesday, 18 January 2011

Lesson – Computer Lab - Mission Biotech – Game Introduction/Game Play

Day 3 – Wednesday, 19 January 2011

Lesson – Classroom - DNA Extraction – LAB – **BioRad** Genes in a Bottle – DNA Extraction

The cell must be lysed (broken open) to release the nucleus. The nucleus (if present) must also be opened to release the DNA. At this point the DNA must be protected from enzymes that will degrade it, causing shearing. Once the DNA is released, it must then be precipitated in alcohol.

Day 4 – Thursday, 20 January 2011

Lesson – Computer Lab - Mission Biotech Game Play (complete Level 1, DNA Extraction)

Day 5 – Friday, 21 January 2011

Lesson – Computer Lab - QUIZ – Level 1

- Game Play (Level 2, PCR Techniques)

Day 6 – Monday, 24 January 2011

Lesson- Classroom – **BioRad** Crime Scene Investigator PCR Basics – Denature, Anneal, Elongate

- Crime scenes often contain very tiny biological specimens (such as blood, semen, hair, and saliva) from which a small amount of DNA can be extracted. DNA profiling cannot be done on these tiny samples until DNA replication and amplification via PCR is performed.
- BioRad PCR song (video)

Day 7 – Tuesday, 25 January 2011

Lesson - Computer Lab - Mission Biotech Game Play (complete Level 2 – PCR Analysis)

Day 8 – Wednesday, 26 January 2011

Lesson – Classroom **BioRad** CSI PCR Basics – continued,

- Gel Electrophoresis techniques

Restriction enzymes are essential tools for molecular cloning and the mapping of genes and genomes. Restriction enzymes recognize specific double-stranded DNA sequences and cut by making two incisions, one through each of the phosphate backbones of the double helix. Electrophoresis techniques that distinguish DNA fragments by size are essential in forensics and in the mapping of restriction sites within genes.

Day 9 – Thursday, 27 January 2011

Lesson – Computer Lab - QUIZ – Level 2

- Mission Biotech Game Play (begin and/or complete Level 3)

Day 10 – Friday, 28 January 2011

Classroom - Mission Biotech Post-test

- **BioRad** CSI PCR Basics – continued - Analysis

Student Assessments

Pre-test

Completion of Student Checklists, Virtual Lab Notebooks, and Embedded questions

Mission Biotech Level 1 & 2 Quizzes

Post-test

ICORE Summer Institute Elements

Dr. Sadler's Mission Biotech

Literature Cited:

1. Klosterman, M, and Sadler, T, Mission Biotech Teacher Guide, University of Florida, 2010.
2. Kawamoto, Kevin, "Healthy Learning Can Be Fun: Digital media and Health Education"
<http://bcis.pacificu.edu/journal/2003/07/kawamoto.php#.04>, accessed July 22, 2010.
3. Biotechnology Explorer BioRad - Science Education Pamphlet

Budget

Total \$909.00 –

- **BioRad** Crime Scene Investigator PCR Basics Kit – EDU Price - \$ 160.00 for 32 students, require 2 kits - \$320.00
- 20-200 ul adjustable micropipet - \$148.00 - Qty 2 - \$296.00
- 2-20 ul pipet tips, aerosol barrier - \$152.00

- 20-200 ul pipet tips, aerosol barrier - \$141.00

BioRad DNA Extraction and Gel Electrophoresis Kits, Minicentrifuges, and Thermocycler were previously purchased.

Week of: 10 January 2011

Monday	Tuesday	Wednesday	Thursday	Friday
<p><u>SSSS:</u></p> <p>SC.G.1.4.1, SC.G.1.4.2, SC.G.2.4.5</p> <p>SC.G.2.4.6</p>	<p><u>SSSS:</u></p> <p>SC.G.1.4.1, SC.G.1.4.2, SC.G.2.4.5</p> <p>SC.G.2.4.6</p>	<p><u>SSSS:</u></p> <p>SC.G.1.4.1, SC.G.1.4.2, SC.G.2.4.5</p> <p>SC.G.2.4.6</p>	<p><u>SSSS:</u></p> <p>SC.G.1.4.1, SC.G.1.4.2, SC.G.2.4.5</p> <p>SC.G.2.4.6</p>	<p><u>SSSS:</u></p> <p>SC.912.L.16.3, SC.912.L.16.9, SC.912.L.16.12, SC.912.L.18.1</p>
<p><u>Essential Question:</u></p>	<p><u>Essential Question:</u></p>	<p><u>Essential Question:</u></p>	<p><u>Essential Question:</u></p>	<p><u>Essential Question:</u></p> <p>What kind of evidence at a crime scene might contain DNA?</p>
<p>Vocab</p>	<p>Vocab:</p>	<p>Vocab:</p>	<p>Vocab:</p>	<p>Vocab: DNA fingerprint</p>
<p><u>Bell ringer -</u></p>	<p><u>Bell ringer -</u></p>	<p><u>Bell ringer -</u></p>	<p><u>Bell ringer :</u></p>	<p><u>Bell ringer :</u> List the type of evidence at a crime scene that might contain DNA.</p>
<p><u>Agenda:</u></p> <p>1. Bell ringer – TBD</p>	<p><u>Agenda:</u></p> <p>1. Bell ringer – TBD</p>	<p><u>Agenda:</u></p> <p>1. Bell ringer – TBD</p>	<p><u>Agenda:</u> CAMBRIDGE DAY</p> <p>1. Bell ringer – TBD</p>	<p><u>Agenda:</u></p> <p>1. Bell ringer – CSI DNA evidence</p> <p>2. Assessment – Unit Pre-test</p> <p>3. Presentation - Introduction to equipment to be used with DNA extraction, PCR, and DNA Gel electrophoresis</p> <p>4. LAB – Using micropipettes</p>
<p><u>HW/Reading Assignments</u></p>	<p><u>HW/Reading Assignments</u></p>	<p><u>HW/Reading Assignments</u></p>	<p><u>HW/Reading Assignments</u></p>	<p><u>HW/Reading Assignments</u></p> <p>Textbook – Read pages 305-306 – Gel Electrophoresis</p>

Week of: 17 January 2011

Monday	Tuesday	Wednesday	Thursday	Friday
<u>SSSS:</u>	<u>SSSS:</u> SC.912.L.16.3, SC.912.L.16.9, SC.912.L.16.12, SC.912.L.18.1	<u>SSSS:</u> SC.912.L.16.3, SC.912.L.16.9, SC.912.L.16.12, SC.912.L.18.1	<u>SSSS:</u> SC.912.L.16.3, SC.912.L.16.9, SC.912.L.16.12, SC.912.L.18.1	<u>SSSS:</u> SC.912.L.16.3, SC.912.L.16.9, SC.912.L.16.12, SC.912.L.18.1
<u>Essential Question:</u>	<u>Essential Question:</u> What is a genotype?	<u>Essential Question:</u> How can DNA be extracted from cells?	<u>Essential Question:</u> Why does PCR need to be performed on DNA obtained at a crime scene?	<u>Essential Question:</u> What is an allele?
Vocab	Vocab: genotype	Vocab: DNA extraction	Vocab: PCR	Vocab: allele
<u>Bell ringer -</u>	<u>Bell ringer -</u> None	<u>Bell ringer -</u> None	<u>Bell ringer :</u> None	<u>Bell ringer :</u> None
<u>Agenda:</u> 1. HOLIDAY Martin Luther King Remembrance	<u>Agenda:</u> 1. Bell ringer – None 2. Computer Lab – Day 1 - Mission Biotech – Game Introduction/Game Play	<u>Agenda:</u> 1. Bell ringer – None 2. LAB – DNA Extraction – Genes in a Bottle	<u>Agenda:</u> CAMBRIDGE DAY 1. Bell ringer – None 2. Computer Lab – Day 2 - Mission Biotech – Game Play (complete Level 1, DNA Extraction)	<u>Agenda:</u> 1. Bell ringer – Any questions? 2. Computer Lab – Day 3 - QUIZ – Level 1 - Game Play (Level 2, PCR Techniques)

<u>HW/Reading Assignments</u>	<u>HW/Reading Assignments</u> BioZone - Workbook - DNA extraction	<u>HW/Reading Assignments</u> None	<u>HW/Reading Assignments</u> Review for QUIZ	<u>HW/Reading Assignments</u> None
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Week of: 24 January 2011

Monday	Tuesday	Wednesday	Thursday	Friday
<u>SSSS:</u> SC.912.L.16.3, SC.912.L.16.9, SC.912.L.16.12, SC.912.L.18.1	<u>SSSS:</u> SC.912.L.16.3, SC.912.L.16.9, SC.912.L.16.12, SC.912.L.18.1	<u>SSSS:</u> SC.912.L.16.3, SC.912.L.16.9, SC.912.L.16.12, SC.912.L.18.1	<u>SSSS:</u> SC.912.L.16.3, SC.912.L.16.9, SC.912.L.16.12, SC.912.L.18.1	<u>SSSS:</u> SC.912.L.16.3, SC.912.L.16.9, SC.912.L.16.12, SC.912.L.18.1
<u>Essential Question:</u> Why do forensic labs analyze non-coding DNA and not genes?	<u>Essential Question:</u> What does PCR allow you to do with DNA?	<u>Essential Question:</u> How can DNA be visualized?	<u>Essential Question:</u> What is an allele ladder?	<u>Essential Question:</u> What is a loci?
Vocab: non-coding DNA	Vocab: DNA polymerase	Vocab: staining	Vocab: allele ladder	Vocab: loci
<u>Bell ringer</u> - BioRad PCR Song	<u>Bell ringer</u> - None	<u>Bell ringer</u> - None	<u>Bell ringer</u> : None	<u>Bell ringer</u> : None

<p>Agenda:</p> <p>1. Bell ringer - BioRad PCR Song</p> <p>2. LAB – Day 1 –</p> <p>- Review Safety Items</p> <p>- BioRad Crime Scene Investigator PCR Basics – Denature, Anneal, Elongate</p>	<p>Agenda:</p> <p>1. Bell ringer – None</p> <p>2. Computer Lab – Day 4</p> <p>- Mission Biotech – Game Play</p> <p>- complete Level 2 – PCR Analysis</p>	<p>Agenda:</p> <p>1. Bell ringer – None</p> <p>2. LAB – Day 2 –</p> <p>BioRad Crime Scene Investigator PCR Basics – Gel electrophoresis</p>	<p>Agenda: CAMBRIDGE DAY</p> <p>1. Bell ringer – Any questions?</p> <p>2. Computer Lab – Day 5</p> <p>- QUIZ – Level 2</p> <p>- Game Play (Begin and/or complete Level 3)</p> <p>- Complete LAB Checklists & Virtual Lab Notebooks</p>	<p>Agenda:</p> <p>1. Bell ringer - None</p> <p>2. Assessment – Mission BioTech – Post-test</p> <p>3. LAB – Day 3 –</p> <p>- Gel electrophoresis analysis</p>
<p>HW/Reading Assignments</p> <p>Student Questions: Lesson 1 BioRad PCR Basics</p>	<p>HW/Reading Assignments</p> <p>None</p>	<p>HW/Reading Assignments</p> <p>Student Questions: Lesson 2 BioRad PCR Basics</p> <p>Review for Quiz</p>	<p>HW/Reading Assignments</p> <p>None</p>	<p>HW/Reading Assignments</p> <p>None</p>