

**Action Proposal: Title: Biotechnology Careers “ Unveiled”**

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**Abstract:**

At the beginning of each school year, I poll my 150 plus 8<sup>th</sup> grade middle school students with the following question: If you wanted to pursue a career in science, what are your options? Each year, I get the same limited responses: Doctor, Scientist, or Teacher. From there, it becomes my mission to expose them to as many of the various career options that I can fit into our year together. Biotechnology is a rapidly growing field, with great impact on our healthcare system, agriculture and environment. There are a variety of career opportunities available to a range of students, from the Associate Degree seeking student and upwards. Through this project, I will expose my students to a variety of Biotechnology careers, by experiencing techniques utilized by professionals in the field via CPET simulations, and virtual exploration using the Mission Biotech virtual gaming system.

**Rationale:**

By the time many students leave middle school, they have already decided against pursuing a career in science. ( Based upon Jones classroom surveys 2004- 2010). One reason for this is the lack of information they have regarding the variety of opportunities that are available. In addition, many believe that a career in science equates to many, many years of school, (either medical school or graduate and post graduate school). While this is the case for a portion of science careers, it is not true for all. I believe that if more students are exposed to the full spectrum of the science field, e.g. Biotechnology Careers, then we will see the interest and participation rise dramatically. This interest has to be ignited during the middle school years, so that it will follow them through high school. Then, when they are given the choice to pursue the advanced sciences or stop at the mandatory requirements, they will be equipped to make a more informed decision.

**Description of Teaching Module:**

This project will combine two components from the ICORE 2010 Institute: Mission Biotech Virtual Gaming & CPET Biotechnology Simulation Kits.

**Module One: Building Background Knowledge**

My students will have some basic understanding of general cell anatomy, DNA/RNA Structure/ and common laboratory safety and equipment. However, since Biotechnology is not a part of our middle school curriculum, I will need to spend some time initially familiarizing them with the specifics relative to this field. To facilitate this task, we will utilize some of the support lessons and activities included in the Mission Biotech Teacher Manual. We will cover common biotechnology lab equipment and techniques.

**Module Two: Common Biotechnology Techniques (Simulations)**

Once the students have become familiar with Biotechnology lab equipment and techniques, we will practice these skills using simulation protocols supplied by CPET Equipment Locker.

First, we will do the “Practice Pipetting Station”. For all of my students, this will be their first encounter with the pipet.

Then, we will proceed with two of the simulations: The High Rise Killer: DNA Fingerprinting and a Microarray.

**Module Three: Virtual Gaming & Career Exploration**

After the students have gained adequate background knowledge and hands-on experience with the skills, they will have the opportunity to use this experience in an engaging format: gaming.

Mission Biotech will facilitate the reinforcement of the Biotechnology concepts while introducing the variety of Career Options in this growing field.

I plan to incorporate the “Level 3 Collaboration “ model into this project. This entails a well-outlined 2 week implementation schedule which includes pre and post assessments, equipment lesson, Game play, performance of virtual Biotechnology techniques, and of course Career Exploration.

**Data Collection techniques/Student Assessments**

First, I will administer a pre-assessment to determine student’s current knowledge on Science Career Options and more specifically on Biotechnology career options. I post assessment will be administered at the end of the project.

**Module Assessments:**

**Module One:** The above mentioned Pre-assessment will be given

**Module Two:** The CPET simulations will fall into the category of Performance Assessments. Basically, the students will be graded on successful participation in and completion of the assays. I will also use the Microarray Data Sheets as documentation of completion.

**Module Three:** Mission Biotech comes equipped with a variety of lesson plans and assessments which I will select and use accordingly.

**ICORE Summer Institute/UF Connections:**

This project incorporates two components of the ICORE Summer Institute: CPET Simulation Kits and Mission Biotech. Additionally, I will consult the CPET website for other resources, including the Sifters Guide and Excursions in Science.

**Literature Cited:**

Mission Biotech Game & Teacher Manual: University of Florida. College of Education. Dr. Troy Sadler. July, 2010

CPET. Biotechnology Simulation Kits. University of Florida. Dr. Charles Lawrence. July, 2010

CPET website: <http://www.cpet.ufl.edu/default.html>

**Budget & Budget Justification**

Item	Cost	Justification
Practice pipetting stations (96-	\$0 ( Equipment Locker )	Hands-on Skill intro and practice

well plates to make designs)		
Microcentrifuge tube holders	\$0 (Equipment Locker)	Hands-on Protocol practice
CPET Biotechnology Simulations	\$0 ( Equipment locker)	Hands-on Protocol practice
Mission Biotech Computer Lab	\$0 ( Check-out)	Virtual gaming & career exploration
50 ml centrifuge tubes	\$150	Extra supplies for simulations
15ml centrifuge tubes	\$150	Extra supplies for simulations
Food color & yogurt	\$30	Extra supplies for simulations
<b>Total</b>	<b>\$330.00</b>	

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Jones Action Proposal **Lesson Plan:** Biotechnology Careers “Unveiled”  
 Module 1: Building Background Knowledge  
 Lesson taken from “Mission Biotech” Teacher Manual, University of Florida

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# BIOTECHNOLOGY LAB EQUIPMENT

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## LESSON SUMMARY

This lesson is designed to introduce students to the specialized equipment and supplies that they will be using in the gaming environment, and to instruct them on how to work with hazardous materials and within other safety constraints in a laboratory setting.

## GUIDING QUESTIONS

- What instrumentation is used in a biotechnology laboratory?
- What are some of the specialized supplies used in a laboratory?
- Is the waste generated in laboratories hazardous?
- How important is it to dispose of laboratory waste properly?
- What are the common safety rules and procedures in a biotechnology laboratory?

## RELATED GAME CONCEPTS

- Equipment: micro-pipettor and tips, water bath, centrifuge, microcentrifuge (microfuge) tube, tube rack, spin column, real-time PCR machine, vortex mixer, refrigerator and freezer, glassware, conical tube.
- Safety: Working with hazardous waste, laboratory safety including Personal Protective Equipment and work habits, Eye wash and Safety showers.

## NEW GENERATION FLORIDA STATE SCIENCE STANDARDS

- SC.912.L.17.14 Assess the need for adequate waste management strategies

## TIME ESTIMATE

Approximately 50 minutes

## STUDENT LEARNING OBJECTIVES

- The student will be able to determine the appropriate equipment for a given task
- The student will discuss appropriate safety procedures and guidelines
- The student will demonstrate knowledge of handling and disposing of laboratory hazards

## BACKGROUND INFORMATION

Just about every career has a unique set of tools, techniques, and vocabulary that goes along with it. Oftentimes, it can feel like you are learning a whole new language! Biotechnology is no different, with processes and equipment that have unique terms. It is important to know

what these are, so that the correct piece of equipment is used for the right application. Biotechnology labs also have specific rules for making certain that people who work in the laboratory are safe, so that products or samples being made/tested in the lab are not contaminated, and so that everyone outside the lab (the general public too!) are not negatively affected by reagents, chemicals, and microorganisms that might be used in this environment.

### **MATERIALS**

- Laminated photos of equipment used in game (and in PowerPoint)\*
- Equipment and Safety PowerPoint
- Computer with internet access and projector (see suggested websites below under Teacher Resources)

### **ADVANCED PREPARATION**

Review the in-game documents in the teacher's manual and select, copy, and laminate images of biotechnology equipment students will encounter in the game. If possible, collect the real objects for the students to examine during class. If you have access to enough supplies, consider creating a small bag or box or supplies for small groups of students.

### **PROCEDURE**

1. Have students divide a piece of paper into four columns labeling each column as follows: Illustration, Name, Purpose, Care
2. Show students pictures (or real examples) of common biotechnology equipment. On a piece of paper, have students sketch each item, predict its name, and predict its purpose. (Similar to *This Old House's* "What's that?")
3. Discuss student predictions as a class.
4. Show PowerPoint presentation. The PPT provides the name of each object, descriptions of their purpose and how they work.
5. Have students check their prediction sheets and make corrections to the name and purpose in the first two columns. Tell students to add new information about use and maintenance in the fourth column (Care).

\*If possible, collect and pass around the real objects for the students to examine during class

### **DISCUSSION QUESTIONS**

- Why are there so many different tools for measuring volume? (Different tools measure different quantities of volume, from very small volumes of liquids measured in  $\mu\text{L}$  to larger quantities measured in Liters.)
- Can you think of way to improvise if we did not have access to a specialized piece of equipment, such as a centrifuge or PCR machine? (Answers will vary.)
- Why is it important for a technician to not be hungry, thirsty, or need to use the restroom immediately before starting an experiment? (Because it is a safety hazard to have food or

drink in the laboratory and using the restroom may reduce the amount of time you have to complete an investigation or may result in contamination of your samples. )

- Regarding trash, wouldn't it be easier to throw all of our trash into one container rather than separating it? Why shouldn't we place regular trash into the biohazardous waste containers? If the gloves we were wearing did not become contaminated, why do we still need to dispose of them in biohazardous waste? (While it might be easier to do this, some materials are hazardous to the environment and people if disposed of with "regular" trash. Contaminated gloves may have biohazardous waste on them and therefore need to be disposed of properly.)

### ASSESSMENT

- Consider administering the quiz located in this teacher's guide on safety symbols and equipment encountered in the game.

### EXTENSIONS

- Show and discuss safety Song video: <http://www.the-scientist.com/blog/display/56138/>. Consider having students create a safety song or video of their own.
- Show video of how to work in a lab handling pathogenic agents: <http://research.uthscsa.edu/safety/secure/index.html>
- Discuss hazardous waste and how it is disposed of.
  - How is it handled differently than regular waste?
  - How do you know if it is hazardous?
  - Is it ok to throw regular trash into a hazardous waste container?
- Discuss procedures for waste removal in your own classroom and how that compares or contrasts to that in the game.
- Have students describe how working in a laboratory is different from working in another type of work environment (office, store, etc...)

### TEACHER RESOURCES

- Sounds of Science Lab Safety Song <http://www.the-scientist.com/blog/display/56138/> (Cute, engaging)
- BEST\*\*\*\* <http://research.uthscsa.edu/safety/secure/index.html> Under "Biological" "Controlling Your Risks: HIV in the Research Laboratory" Howard Hughes Medical Institute.

## Safety and Instrument Mini-Quiz

Write the letter in the blank space preceding the described hazard warning corresponding to the symbol of that hazard.

\_\_\_ Radiation Hazard

\_\_\_ Biohazard

\_\_\_ Flammable Material

\_\_\_ Harmful or Irritant

\_\_\_ Electrical/High Voltage

\_\_\_ Eye Wash Station

\_\_\_ No Eating/Drinking



A



B



C



D



E



F



G

**Match the tool with its Function/Use:**

**Function/Use**

**Tool**

\_\_\_ 1. Measures volumes (above 1mL)

A. Graduated cylinder

\_\_\_ 2. Used to identify cells

B. microscope

\_\_\_ 3. Measures mass

C. pH meter or litmus paper

\_\_\_ 4. Used to dispense microliter volumes of liquid

D. Lab coat

\_\_\_ 5. Used for holding, not measuring, liquids

E. Beaker

\_\_\_ 6. Worn to protect your body and arms

F. Meter stick or ruler

\_\_\_ 7. Used to maintain records of experiments

G. Balance

\_\_\_ 8. Used to measure length

H. Vortex mixer

\_\_\_ 9. Used to see if a liquid is acidic or a basic

I. Autoclave

\_\_\_ 10. Used to sterilize solutions, trash, supplies

J. Test tube rack

\_\_\_ 11. Used to hold two or more test tubes

K. Goggles

\_\_\_ 12. Used to mix small volume solutions

L. Thermometer

\_\_\_ 13. Worn to protect your eyes

M. Centrifuge

\_\_\_ 14. Measures temperature

N. Micropipette

\_\_\_ 15. Separates substances based on density

O. PCR machine

\_\_\_ 16. Has information on safe use of a chemical

P. Lab notebook

\_\_\_ 17. Amplifies DNA by heating and cooling

Q. Material Safety Data Sheet (MSDS)













