BIOTECHNOLOGY CAREERS

Title: Develop a title page with your name, position, correspondence information, and descriptive title of your Action Research project; use it as a cover sheet for your proposal.

Biotechnology Careers

Preparing High School Students

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Abstract: The abstract should summarize your action research purpose and methods. It should have a 150 word limit.

Abstract

As careers in biotechnology rise, qualified individuals are needed to fill those positions. Because many of these careers are new, many Americans are not aware of the opportunities they provide to young people as they begin to decide what they want be when they grow up. This project was designed to increase high school student's exposure to the growing field of biotechnology. Students were given the opportunity to learn some of the skills used in biotechnology by performing electrophoresis, transformation, protein crystallization and simulated biotechnology laboratory exercises as they learn the content related to these practices. In addition, students will be exposed to real time research and the scientists and technicians doing that research throughout the course. Students will also progress through the video game Mission Biotech exploring careers in biotechnology. As a result students will be able to identify and hopefully begin to pursue paths that will lead them to careers in molecular biology, medicine and biotechnology. In the process they will gain technical skills used in those same careers.

Rationale: This section should describe your "story", i.e., your particular area of action research emphasis and your reasons for choosing it. These reasons should be based on your own experience, the learning needs of your students, and your review of pertinent literature related to biotechnology (biomedical and/or bioscience) teaching and learning. You need to include at least *three* references; you may use articles, books, relevant websites, etc. Library databases and Google Scholar are good starting points. This section should end with your research "area of focus" statement, which includes an intervention and its impacts on students (You will collect data to determine these impacts on student achievement, interests, attitudes, etc.) *See p. 60 in Mills text for "area of focus"statement format.*

Rationale

"People with Pompe disease cannot produce the enzyme acid alpha-glucosidase, or GAA. Without the enzyme, sugars and starches that are stored in the body as glycogen accumulate and destroy muscle cells, particularly those of the heart and respiratory muscles. Many patients need ventilators to breathe." (Pastor, 2010)

This statement may not seem significant on its own, of course unless you or a loved one suffers for the disease. However, this disease recently entered the public forum by way of the movie *Extraordinary Measures*. The film opened in January 2010 highlighting the disease and the work

of scientists, like Dr. Byrnes of the University of Florida, as they try to find answers to the multitude of diseases that can afflict any human being at any given point in time. (Dooley, 2010) Scientists, like Dr. Byrnes, are created in science classrooms across the United States. The teachers in our science classrooms provide the spark and support that lead people like Dr. Byrnes down a path that leads to the discovery of new treatments to diseases to help improve the quality of life for all humans. (Byrnes, 2010)

Unfortunately, we do not find ourselves currently in a position to fill industry's continuing and increasing need for scientists (and doctors) like Dr. Byrnes. We are unable to keep up with the industry demand for bright and talented individuals with math and science backgrounds. (Payne, 2004)

"Those planning to pursue science and engineering careers will need higher levels of science literacy than most, but perhaps not so obvious is the fact that even nonscientists will need a baseline level of science understanding if they are to become responsible citizens, capable of functioning fully in a technology-driven age." (Payne, 2004) Science literacy does not come from simply cruising the internet or clicking an ap. As with literacy in all academic disciplines, classroom teachers find themselves in drivers seat. If teachers are expected to provide students with adequate education in science and technology they also need to be educated as science and technology have grown exponentially in the past few decades. The Centerr for Precollegiate Education and Training (CPET) at the University of Florida has been actively engaged in providing such education/training for teachers for the past 15 years. (Bokor, 2010) CPETs Bench to Bedside (B2B) program was designed to educate teachers in all aspects of translational research. During a two week period, teachers were immersed in translational research content ranging from bench level pipetting (as scientific skills needed in the discovery phase) through to

market production of those same scientific discoveries. The intent of this program is to empower teachers with the skills, knowledge and possible applications needed to bring this information into the classroom. In doing so, students may be stimulated to pursue avenues in biotechnology (whether as a craft or as research scientists and MDs) or, at the very least, become more scientifically literate. With either outcome, CPET participants in B2B are able to begin addressing some of the concerns regarding industry needs in emerging careers in science and biotechnology as well as scientific literacy in the population in general.

Action research intervention:

See attached

Describe the intervention or innovation that you are implementing and the biotechnology content and skills that it encompasses. Also, provide background on your teaching context (Who are you studying and when?). You may develop a unit, module, or other creative approach to implementation. *Your required lesson plan (according to the template provided or a template of your choosing) will be an expanded segment of this section and should be attached to the proposal.*

The target group for this project is a class of AP biology students. The majority of the students are in their sophomore year in high school (age 15+/-). While the AP Biology curriculum runs wide and deep, there is a need for these students to engage in aspects of biotechnology as both trends and skills in the biological sciences are increasingly requiring students be competent in the concepts and techniques commonly used in current (and future) scientific research. All of the content and techniques learned during the B2B program speak directly to this component of the AP Biology curriculum. At the beginning of the course, students will be surveyed regarding any previous knowledge of career options an AP biology course might open doors to. As the course progresses, relevant names and places of real scientists doing real work will be used to provide content relevance to real life application. For example, as the course moves through simple

chemistry to the properties of water and into macromolecules, the process of protein crystallization can be referenced to demonstrate application of all of that content knowledge. The result of crystallization and protein structure reinforces all concepts related to protein function. Because protein function is related to metabolism control, genetic and evolutionary concepts are previewed to be reinforced later as that content is discussed. Discussion of genetic disorders currently being researched regarding carbohydrate metabolism make understanding the role of those macromolecules relevant (both type I diabetes as well as GSD). ***As a point of interest, one student in this class does have Type I diabetes***

Students will be required to research and report on two scientists and their body of work. One scientist must be dead and the other must be alive and currently actively working in their field. In both cases, students will have to focus on the work of the scientist and its impact on humanity. Students will engage in DNA extraction, chromatography (plant pigment for chromatography concepts), electrophoresis, and transformation laboratory exercises. If time permits, students will perform simulated microarray testing. After the AP biology exam, students will participate in the Mission Biotech program exploring biotech careers as the play a computer game simulating the application of biotechnology knowledge and skills..

Connections to Bench to Bedside summer institute: Describe the specific UF institute connections.

The CPET B2B has opened the door for these students to access real time science in action. As a participant, I was made aware of a multitude of research opportunities available to students. In addition to research opportunities, skill related careers were also highlighted during the course of the program. Besides awareness, the B2B program has given me access to some biotech equipment/materials that my student would not otherwise have the opportunity to be exposed to. Students would not be exposed to e-gel and microarray simulation beyond the textbook and

online simulations without access to these materials via B2B. In addition, course/student information will be shared with Dr. Troy Sadler for his Mission Biotech project.

NOTE: PENDING-----Spring Genetics class and their participation in these labs as well

Data collection and analysis: Develop and describe a data collection plan that links to your research purpose. Describe data analysis and interpretation plans. *See Mills Chapters 4, 6, and appendices for ideas.*

The initial biotechnology careers survey will be used pre and post course to determine if student awareness of biotech careers changes as a result of information from B2B inserted into the curriculum. Pre and post testing during the DNA technology section of the course will be used to determine if student gains are made.

Students will watch Extraordinary Measures and identify when/where content knowledge and biotech careers were applied in the movie.

PENDING SPRING SCHEDULING

NOTE : If this is used with a genetics class, the required data analysis documents will be used for data collection and analysis.

Literature cited: Include a reference list of all pertinent print or digital resources that you used in your rationale or will use in your implementation of your action research project.

Works Cited

Byrnes, D. B. (2010, June 258). Bench to Bedside Presentation Transitional Research Clinical Trials. *CPET Bench to Bedside Program* . Gainesville, FL, USA: University of FLorida, NIH.

Dooley, K. (2010, January 21). *Byrne is noSstrange rto "Extraordinary Measures) when it comes to Pompe Disease.* Retrieved June 26, 2010, from College of Medicine Insider: http://news.medinfo.ufl.edu/articles/top-stories/byrne-is-no-stranger-to-extraordinary-measures-when-it-comes-to-pompe-disease/

John Payne. (2004, October 9). *Issues in Science and Technology: Precollege Science Teachers need Better Training.* Retrieved june 28, 2010, from Issues in Science and Technology: http://www.issues.org/21.1/p_payne.html#

Pastor, J. (2010, June 22). *UF Doctors among First to Administer Therapy for Rare Disease.* Retrieved June 26, 2010, from UF College of Medicine: http://news.medinfo.ufl.edu/articles/top-stories/uf-doctors-among-first-to-administer-therapy-for-rare-disease/

Teitelbaum, M. (2006, October 9). *Issues in Science and Technology, Fall 2006, Perspectives: A new Science Degree to meet Industry Needs.* Retrieved June 28, 2010, from Issues in Science and Technology : http://www.issues.org/index.html

Budget and budget justification: List and describe necessary resources and costs.

Class set of micropipette practice activity (protocol, pipettes, elisa trays)

Class (~24 student/ max 3 per group = total 8 stations) set of e-gel electrophoresis materials. (AP lab 6)

Class set of simulated microarray assay.

Scheduled Mission Biotech May/June 2011

Permissions: Describe any permissions that you need to implement your action research project (principal, parents, etc.)

Check county policy for required permissions for sharing student data/pictures/work

Reflection

To follow

Lesson Plan Template Sample

Theme: Biotechnology

Lesson Title	**Biotech careers and skills**
Grade Span	**9-12**
Content Emphasis (Mathematics or Science)	**Science, biotechnology**
Targeted Benchmark(s)	HE.912.C.1.4, LA.910.2.2.3, LA.910.4.2.2, MA.912.S.1.2, MA.912.S.3.2, SC.912.L.16.10, SC.912.L.16.11, SC.912.L.16.12, SC.912.N.3.1
Author(s)	**Laura Bushwitz**
School	**East Ridge High School**
District	**Lake**

Lesson Preparation

Learning goals: What will students be able to do as the result of this lesson?

Students will be able to identify the presence/absence of specific genes, identify DNA fingerprint patterns and calculate DNA segment size. Students will be able to accurately measure specimens and reagents utilized in test methods yielding laboratory results that will allow them to make the preceding identifications and calculations. Students will be able to identify scientists and careers that these skills are utilized in or originated from.

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

This is a series of lessons that will begin with the study of DNA and the evolution of our knowledge of DNA. Scientists and their past and current contributions to that body of knowledge will be researched and reported. Electrophoresis testing will be performed. Students will also engage in playing Mission Biotech as they practice simulated diagnostic testing for microarray, DNA extraction, etc.

This project will also evolve into a student generated extracurricular Science National Honor Society chapter at our school.

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

Micropipettes, tips, color solutions and elisa trays for pipetting practice.

e-gels and current generator for electrophoresis.

DNA specimens for testing

MBt laptops

Microarray simulation testing kits

Reagents, lysozyme and testing trays for protein crystallization.

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

I will need to prepare/order any reagents/specimens that will be utilized by students (color solutions, DNA specimens, DNA extraction reagents, simulation specimens).

I will need to have performed each of the labs/activities students will be engaging in.

I will need to insure appropriate permissions are given for the use of any student outcomes in my Action Research Project.

I will need to investigate and complete required paperwork necessary for a student driven chapter of Science National Honor Society on my campus.

I will need to contact Dr. McKenna's lab to arrange use of protein crystallization reagents/materials/protocol.

I will need to schedule use of all materials/equipment through the Bench to Bedside program directors.

Lesson Procedure and Evaluation

Introduction: Describe how you will make connections to prior knowledge and experiences and how you will uncover misconceptions.

Prior to implementing the activities in this lesson plan, students will learn basic molecular biology and develop basic laboratory skills (ie gross pipetting, laboratory design, conduct experiments, data analysis). Prior lab experience will include pigment chromatography. Specimens used for electrophoresis will include simulated genes for cancer, paternity testing and crime scene investigation. Movement of DNA through an electrophoresis gel is based on concepts similar to those used in pigment chromatography. Chosen DNA specimens make testing relevant to real life occupations and trends in genetic testing in modern medicine. Development of laboratory skills helps students recognize they are able to perform skills/experiments and analyze data just as is done in modern biotech careers.

Researching living scientists as well as dead scientists emphasizes the impact new scientific knowledge has on a continuous basis. Students will also be able to recognize scientific research is ongoing and that they can develop the skills needed to be a participant in scientific discovery.

Exploration: 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.

Laboratory skills will begin with simple laboratory activities that engage students in inquiry and the Scientific Process with The Penny Lab. Students divide into groups and are told to determine how many drops of water fit on a penny. Materials available are pipettes of varying sizes and pennys. Students runs three trails and record data. The diversity on class data, group data are discussed together in detail with students lead (teacher directed, Socratic method) to discover the appropriate steps in the Scientific Method, experimental design and laboratory technique.

Evolution in laboratory skills will continue with laboratory exercises that engage students with use of laboratory equipment (pH lab, macromolecule labs, enzyme labs, cell division labs, cell membrane labs, photosynthesis labs, respiration labs).

Students will eventually engage in DNA technology labs which require use of micropipettes, electrophoresis gels. Prior to engaging in these DNA technology labs, students will practice micropipetting skills using protocol and materials from UF Bench to Bedside program. Students will then perform DNA testing utilizing e-gels provided via UF Bench to Bedside program. Students will perform to DNA testing to identify specific genes (cancer genes or mad cow disease genes), paternity testing via DNA fingerprints and crime scene investigation via DNA fingerprints. Students will also interpret these results (applied DNA technology). Students will also perform simulated microarray testing to further develop laboratory skills and application of DNA technology.

Finally, students will participate in Mission Biotech. Students will engage on a three week project utilizing laptops and the video game Mission Biotech with associated lab activities.

Students will also generate research reports on scientists. Students will be required to report on scientists that are both dead and alive. Reports will be shared with classmates in oral presentations.

Application: Describe how students will be able to apply what they have learned to other situations.

As a result of these activities, students will be able to identify careers in biotechnology. They will have developed skills that will give them confidence to pursue these careers at every level. They will have confidence in their ability to engage themselves I undergraduate research opportunities as they work towards degrees that will make these careers possible.

Assessment: Describe how student knowledge is being assessed at the appropriate cognitive level for the targeted benchmarks.

Students will initially be asked to identify their knowledge of scientists and contributions made by those scientists. As students progress through laboratory exercises, they will be expected to improve laboratory skills and eventually be able to design and carry out appropriate laboratory

investigations. The extended extracurricular Science national Honor Society chapter will support student participation in the Junior Science, Engineering and Humanities Symposium in February 2011.

Teacher Self-Reflection: **Record your thoughts on the lesson and describe any modifications you would recommend based on the outcomes.**

To follow