Will the inclusion of material from Bench to Bedside affect my students understanding of biotech?

An action research project emphasizing curriculum development, student learning modalities and differentiated instruction of lessons.

(I will more than likely study a small group of black, male students who are also categorized as Free and Reduced as this group of students tend to score lower in FCAT reading. A great caveat if I do study this group is the potential opportunity to attend Symposium)

Nancy Browne
Bay District Schools
Purpose? Student/Teacher
Why do we come to school?

- L Lesson
- E Essential Question
- A Assessment
- R Rubric and Reflect
- N Next Step
Student Learning & Instruction

- **Purpose**
  - Develop student skills and understanding

- **Delivery**

- **Modalities**
  - Kinesthetic
  - Auditory
  - Interpersonal
  - Intrapersonal
  - Musical
  - Visual
  - Logical/Mathematical
A Change in Teaching Practices

• How?
  ◦ Differentiated Instruction
  ◦ Activity threads
    • Engage in multiple activities over many weeks that cycle over and over and revisit prior labs/activities so as to build a larger themes and ultimately a continuity in the curriculum.
    • Inclusion of information will lend to higher levels of inquiry.
    • Student directed inquiry has higher value than teacher directed lessons

• Why?
  • Perplexity
  • Model testing
  • Synthesis
Curriculum Inclusions (but not inclusive)

Mission Biotech Video Game
  lab protocol, skills and techniques
Role Model: Sara Josephine Baker
  illustrate bacteria and viruses transmission p. 81
Role Model: Gerty Cori
  Diagnosing and monitoring diabetes p. 296
Power Point Presentation: Dr. Michael Haller
Role Model: Linda Laubenstein
  A disease transmission simulation p. 107
Antibody Microarray
  qualitative/quantitative measurements (Dr. C. Lawrence)
Role Model: Alice Huang
  Substitution, addition and deletion mutations in DNA p. 231
YouTube Videos: GCTA, etc.
Role Model: Barbara McClintock
  Transposon p. 309
Role Model: Lambratu Rahman
  DNA Fingerprinting p. 271
Assessment Possibilities

- **SURVEY/QUESTIONNAIRE**
  - A. Yes/No/Short Answer Items
  - B. Open-ended Questions
  - C. Statement Completions
  - D. Agree/Disagree Items
  - E. Rating Items
  - F. Listing Questions
  - G. Situation Resolution
  - H. Reflection Questions

- **INTERVIEWS**
  - A. Guidelines
  - B. Interview Structure
  - C. Interview Formats

- **CATEGORIZATION**
  - A. Card Sorts
  - B. Picture Arrangement
  - C. Product Evaluation/Comparison

- **DOCUMENTATION**
  - A. Journals
  - B. Logs
  - C. Anecdotal Records
  - D. Suggestion Box
  - E. Letters

- **TESTS OF RIGOR**
  - A. Post-Test
  - B. Wet Labs
# Vigor and Rigor Analysis

## Item Data Recording Sheet
for Analysis of Classroom Tests

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What do I hope to find out?

- I hope to find with the inclusion of labs, activities and resource materials from Bench to Bedside will not only enhance the curriculum presentation. Rather, I hope it will stimulate students to engaged in, experiment as, and ultimately explore careers in the biotech field.
Expertise/Materials from CPET

- Mission Biotech Video Game CD
- Antibody Microarray materials
- Protocols (experimental design process, Center of Excellence, Mediopoly)
- Resources to bring real-world careers and skills into my classroom to empower students (lessons/video interviews)
- Network of the Professionals
- Knowledge of B2B Philosophy
- Study group attendance at Symposium
Literature

- Garrison, C., & Ehringhaus, M., Formative and Summative Assessments in the Classroom
- PBL Model and concept mapping. [Http://www.cotf.edu/ete/pbl.html](http://www.cotf.edu/ete/pbl.html)
Science and Technology in the Middle School Science Classroom

Science in Personal and Social Perspective

Life Science

Biotechnology
ABSTRACT: The National Science Education Standards Criteria for Content Standards used to guide curriculum development do not specifically list content standards for biotechnology in the middle school. This, however, does not mean that biotechnology education cannot be presented to the middle schooler. It is appropriate as a means to strengthen the middle school course with the inclusion of biotechnology education. The addition of content provides depth and detail in the form of enrichment for the middle school student - something the gifted or advanced middle school student thirsts for.

At the beginning of the school year 2010-2011, our school's science department created a pacing guide for life science in middle school. This meant a rigid framework for working through the required standards as outlined by the FLDOE. Biotechnology then, had to be presented in the course through enrichment activities tangentially connected to the Big Ideas. Depth and detail would be added to lessons and activities for rigor of instructional. Middle school students’ conceptual understanding of biotechnology would be heeded through an inquiry activity for students to investigate spreading of disease, practical application of techniques necessary in the biotechnology lab such as pipetting, and through reporting on famous scientists.

Students will have a greater understanding of the biotechnology field. By introducing this field of study I am exposing students beyond minimal cellular understanding, to enhancing their introduction to cells and microorganisms, and establishing a foundation for developing understanding of molecular biology at the high school level.
RATIONALE: I teach middle school advanced science in a Title I school. Our student population has typically been underachievers. Past years testing data hovers at about 30 percent of the students being proficient in science. This number is comparable to the math and reading scores, until last year. Our math scores did improve significantly and our reading scores also showed gains. Unfortunately, the science scores did not show any substantial improvement. Obviously the same old thing was not working and change was needed in order for improvement of students proficient in science.

According to the National Science Education Standards Criteria for Content Standards, science material that is suitable for the developmental and learning abilities of the students and presented with enough breadth and depth of content is appropriate for the middle school student. With an appropriate curriculum and adequate instruction, students can develop the skills and the understanding of science disciplines through the context of inquiry. The scientific inquiry involves students seeking more information – digging deeper to understand the why. Biotechnology offers investigative study for the most curious student intent on probing deeper for understanding within the life science class.

I have found it necessary to investigation student understanding using techniques and/or materials suggested by Paige Keeley. Developing questions and presenting material for students to think and respond to allows me to determine if students have knowledge in a particular subject. I am also able to determine misconceptions students may have in a topic. I find student understanding of genetics
based on observable traits. I also find motivated students questioning deeper into “the obvious answers” as something they want to explore. Inquiry opportunity is a must.

Our Reading Leadership Team (RLT) began researching and studying characteristics of 90/90/90 school. The RLT determined improvement was necessary in defining choice in curriculum and created a pacing guide to ensure all teachers covered all standards and benchmarks per the subscribed course pacing guide. For me, this was destructive to an inquiry science classroom as we were told to be only 3 days off the guide – hard to add in rigorous instruction. With the RLT’s additional study of Marzano’s Dimension of Thinking, the science department determined a book study would be valued. The book should provide a way to observe student metacognition of scientific information. We chose to implement Klentschy's Using Science Notebooks in Middle School in hopes to enhance student-learning process.

My focus is to study the effects of including biotechnology education on student development of science understanding, utilizing the science notebook as way to evaluate student cognitive development.

ACTION RESEARCH INTERVENTION: My plan was to do a complete unit on biotechnology, but with the requirement to follow a pacing guide, the inclusion seemed impossible. I had hoped to install the software for a virtual biotechnology lab experience. This had the appearance of a great beginning step to introduce the biotechnology field and career for my students. Unfortunately the process to have software
approved and installed or allowed to be used on the school computers is not terribly efficient, and Mission Biotech has not been utilized by my students.

Finding ways to include biotechnology surprisingly was easily connected in my physical science class during the unit of chemistry in the form of skill techniques necessary in this career field.

With many middle school students holding misconceptions that plants and animals are the only living things and humans are not animals, the path to divulging viruses and diseases having an invasive and perhaps a destructive presence in cells required many “aha!” moments for my 11-13 year olds. Extraction of DNA from their cheek provided personal involvement in understanding cells and now genetic material. At this point, I included use of activities and web links pertaining to viruses and diseases. I asked students to list and research specific diseases and viruses.

Students did have access to research the genetic codes and characteristics of viruses under the broad heading of diversity of living things. The exposure of finding websites with incredible information at times have students realizing they can use the powerful tool. The students think more as scientists, rather than students in a middle school class when equipped with tools and knowledge in how to utilize the information.

Integrating scientists accomplishments or their biographies in the course also has been important for students realize the people behind the science and to allow the students to dream of professions and careers. With a large minority population, a high poverty level as well as low proficiency of student achievement, expo-
Sure for my students is key to breaking the cycle and trends. The addition of lessons from Women in Science has been excellent as a motivation for students to inspire performance and strive to break the cycle of low achievement.

DATA COLLECTION AND ANALYSIS: Much data was formative in nature and noted through journal response, or similar techniques to ask students to place their thoughts onto paper. Student reflection throughout lesson units is valuable as offered in exit cards or student flyers to advertise what upcoming students might learn.

Pipetting and using the well plates is considered skill enhancement and therefore students were not “tested” on their abilities. This activity was the next step after studying surface tension of water in “Give Mr. Lincoln a Bath”. Although the connection of surface tension is not obviously connected to a biotech lab, it is relevant to fine motor skills development of middle school students. Bringing out the well plates and having students count drops made them feel as scientists. By using colored waters for students to pipette into well plates, the effect was another “aha!” moment to the students as they could now replicate techniques in lab jobs and the skill of pipetting.

The inclusion of studying female scientists was motivation for a particular 7th grade student of mine when it came to science fair last August. By following the lead of many successful scientists, she also decided to study something that intrigued her. She investigated ladybugs with dedication and developed a fine project determining the habits of ladybugs in an environment of aphids and tomato plants.
Her perspective has earned her rewards at the state science fair by placing 5th in her division. The point being, through study of several important female scientists she found role models in recognizing passion plays an important role in studying or investigating. Honestly, this is probably the most important success in my school year - recognizing the how’s, what’s and why’s to becoming a lifelong learner. Passion.

Having students perform DNA extraction in the middle school was another “aha” moment. Prior to doing the extraction, students only had abstract understanding of a cell nucleus. Students now held material from the nucleus of cells.

BUDGET AND BUDGET JUSTIFICATION:

*Well plates, pipettes, 14.5 cm petri dishes,
*ScienceKits pH kits
*Alcohol to perform DNA extraction of strawberries and of cheek cells
*GLOWGerm

LEARNINGS FROM THE ACTION RESEARCH:

I had hoped to create a unit of study that would give students the opportunity to play Mission BioTech as well as to specifically dedicate an ample amount of time to delve into biotechnology in relation to life science. Unfortunately, a window of three weeks was not sufficient for the software to be loaded on computers. Also, had the IT department instructed me it would take that long, I could have requested.
During the activities involving lab techniques, I found students were very engaged and appreciated relevance in the lesson. I am become more confident in micro and bio, and I will be able to include more details through higher order thinking questions that might intrigue student learning.

Presenting lab activities and experiments based on famous female scientists, was a great inclusion and extension of study. For the students of a school with high poverty and low achievement, it is exciting to see success of minorities in science.

I would like to add that I never thought DNA extraction was appropriate in the middle school classroom. I honestly can say that my students truly learned more than I expected. Their ability to see the DNA floating in the alcohol matured them from being middle school students to now understanding “this is like what happens in a lab”, or “wow, there really is stuff in the nucleus”, to “what else could we get the DNA of?” Studying meiosis now was more than Punnett square tools. The stuff that make me, me, has all kinds of information in it. Simply put –realizing cells, nucleus, DNA,…..life. My students took me through a path with relevance.

Our district has selected a new path of study in middle school science – from subject specific courses of Earth/space, Life and Physical science courses, to a three-year course. Middle school science teachers from the district will be meeting to develop a pacing guide for teachers to cover all standards and benchmarks. At this meeting, I will have the occasion to advocate inclusion of biotechnology in the middle school curriculum through career opportunities, techniques necessary to work
in a biotechnology lab and possibilities of what biotechnology can do for society. It is my goal to be successful in this quest.

I have found this year to be a challenge to create windows of opportunity to incorporate biotechnology education. But, I have strived to include the subject vigorously. With so much conversation to specifically generate STEM activities, the life science course lends easier to inclusion of biotechnology. With our district now switching gears and transitioning to a three year course of science study in the middle school, I think there should be more exposure to biotechnology as in each of the years, students will have some of each of the 3 major sciences allowing prospect to a broader curriculum with inclusion of rigorous instruction. My impetus is to design a thorough framework.