Bench to Bedside Institute 2011,
CPET, University of Florida, Gainesville, Florida

Action research evaluating the effectiveness of enriching high school biology lessons with biotechnology skills/careers and biomedical case studies in order to improve at-risk student attitudes about science and performance on standard course assessments

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KEYWORDS: Enrichment, at-risk students, dropout prevention, Response to Intervention (RtI), high school biology, biotechnology, career, biomedical, case studies, high stakes testing, standards driven, National Research Council (NRC).
Title: Action research evaluating the effectiveness of enriching high school biology lessons with biotechnology skills/careers and biomedical case studies in order to improve at-risk student attitudes about science and performance on standard course assessments.

Abstract: At-risk students often feel marginalized in academic settings and seldom experience enrichment in their learning environment. If NRC draft guidelines for secondary school are effective, then targeting the struggling and at risk student population in a high school biology classroom with a career-oriented, high interest enrichment curriculum, in this case biotechnology and biomedicine, should have positive outcomes. Enrichment including high interest activities and career options should specifically result in better attendance; fewer discipline episodes, a better sense of personal satisfaction with academic work and improved performance on assessments. This action research study relies heavily on student electronic and paper journaling, attendance and intervention event tracking, periodic Likert and written response surveys, and frequent, proscribed content tests. This qualitative and quantitative data will be used to track and trend self-reflection and academic performance in Biology over the course of the year.

Rationale:
There is a shift in approach to pedagogy away from transmitting content knowledge alone (teacher-centered approach) and toward determining how well that content knowledge can be applied by the learner (learner-centered approach). The National Resource Council (NRC) has suggested targeting student motivation through reference to real world application, authentic/inquiry-learning settings, the use of 21st century learning strategies and tie-ins to potential career paths. (NRC-CCF, 2011) Response to Intervention (RtI) is a strategic approach designed to identify students who are struggling academically and provide academic or behavioral interventions with the intent to de-escalate inappropriate classroom conduct and improve academic performance. RtI proscribes frequent testing and timely intervention. (FLDOE-RtI, 2011) End of Course Exams (EOC) are replacing an all-inclusive Science Florida Comprehensive Achievement Test (Science FCAT) taken in the Junior Year. (FLDOE-EOC, 2011)
At a time when high stakes tests and academic performance are being emphasized, at-risk students are even more likely to feel marginalized if poor academic performance really drives their desire to “act out” in school, skip school or drop out of school entirely. Socio-economic, medical issues, dysfunctional friends or family problems may interfere with a students’ focus in the classroom as well. (Hammond, Smink & Drew, 2007) However, in my experience working with at-risk students, I have also noted that if a student is able to establish an identity that separates him or herself from anxiety and self-doubt as well as the “problems beyond school,” to the point that they are able to feel that they can overcome circumstance, and even succeed in spite of it, they actually can improve their academic performance and their conduct.

At-risk students are different from ordinary students in their approach to new information, learning and participation. Enrichment may provide the deep, pragmatic approach that may appeal to at-risk students. Please find attached my NRC driven curriculum approach diagram and my Observation to Teaching Strategy Questions regarding at-risk students that I will use to drive my Action Research Questions (ARQs) listed in the Data and Analysis Section. (Mills, 2011) I have also attached the benchmarks groupings I will embed biotechnology and cases within as they are organized by the FLDOE for the Biology End of Course Exam. (FLDOE-EOC 2011)

Please note that my at-risk students are embedded within two facilitated biology classes and not segregated. In these classes, I need to differentiate learning in a student-centered manner. I have found my students to tend to be Kinesthetic Visual or Visual Kinesthetic learners. I also subscribe to Vygotsky’s Zone of Proximal Development, believing that regardless of age, grade level or scores, each student comes to me where he or she actually is including attitudes, misconceptions and learning styles. Using constructivism and collaborative learning, we move as a class to stretch our individual Zones in order to deal with things at the very edge of our ability. We expand our Zones as we learn. We demonstrate learning by doing or explaining. We bring gifts and shortcomings to the team and we try to make sure everyone eventually meets the standard as we move on. (Harland, 2003)
This decidedly student-centered perspective and the opportunity to participate in the 2011 Bench to Bedside Summer Institute at University of Florida, has provided me with the training, methods and resources to explore using an enrichment curriculum to give my at-risk students an extraordinary opportunity to experience a different kind of “school.” Historically at-risk students are subjected to remedial, essential, test driven approaches in the face of mandated assessments, while successful test-takers are given the time and resources of enrichment almost as a reward. It seems that the NRC wants to redirect educational leaders toward a connection with post-secondary careers or college and enhance technical skills, but making it happen without resources and in the face of testing anxiety would be difficult even under the best of circumstances. Without the support of this program, I am not sure I would be able to carry out this kind of action research plan because it turns the classical approach to at-risk students on its head. At least I feel prepared to start to take on the problem.

Ultimately, biotechnology will be a burgeoning manufacturing and service field that has already embraced trainable high school graduates as well as displaced machinists, administrative assistants, technical writers, and industrial robotics programmers. (GU-CEW, 2011) 21st Century learners can expect to be taking on jobs that have not even been invented yet. (Fisch, 2009) This action research plan allows students to connect to the real world in terms of biological careers with all of its potential and problems. It may help them learn adult learning skills as they explore, reflect on and take responsibility for their own learning experience in a supportive setting. (Taylor, 2008) It may or may not help them to handle the pain that may be pushing them into an at-risk status, but it should clearly make the case for enrichment or not.

**FOCUS STATEMENT:** Can at-risk students benefit from a biology curriculum enriched with biotechnology methods/careers and biomedical case studies, as demonstrated by test scores and changes in attitude toward learning science?
**Action research intervention:**

In 2011, I will need to adapt my Biology lesson planning to meet a coordinated curriculum aligned with the EOC groupings, the common testing schedule for Biology at JWMHS and incorporating the enrichment curriculum I would like to study as an intervention. I may have certain time restraints that come up making enrichment interventions less likely in certain units.

The Immune System EOC Grouping is my most desired intervention unit, but it is also the largest. I would like to use the following to demonstrate the grouped benchmarks:

- The principles of ELISA testing and ELISA technology with cases
- Bacterial transformation/plasmid exchange and transfection technology with cases
- Viral Lifecycles and viruses as tools especially (transfection)
- How vaccines work – Developing a Cancer Vaccine
- Rejection, Transplants and engineered tissues from IPCs

I may or may not be able to accomplish a Classroom Visit on a Wednesday that allows the support I need to help my students through a real lab investigation. I would like to have them trace a real mutation rather than simulated. I would like to do a real hair follicle ALU genotype or other traceable mutation. The goal is to go through an entire investigative cycle from a real sample to a clear determination using real techniques and equipment. If I am not able to do the classroom visit day, I will step them through each step with simulated labs as I can fit the steps in the curriculum. I may offer an after school clinic setting for interested students to carry out the real lab if I cannot accomplish the lab day.

Regardless of the time or availability of biotechnology skills equipment, I will provide simulations and case studies or articles as enrichment so that I can carry out the study. I would need additional support from Dr. Lawrence on how to organize the outcome slides for a class of 30.
Connections to Bench to Bedside 2011 Summer Institute:

While I have developed instructional material in the past, I had no idea what Action Research entailed, no idea how to communicate the material I have developed to others and no skills or knowledge about biotechnology or translational research. Because I work with students who are not regularly engaged in active learning or equipment-based labs, I had to be secure in my knowledge of what I could or could not attempt with my students. I now have that knowledge and confidence entirely due to this Summer Institute. The Action Research Project will help me to learn how to communicate my practice to others and I am grateful for the continuing attention and support that CPET provides during the school year.

How to Do Action Research

- UF-CPET - Drs. Barnes: Developing an Action Research Study
- UF-CPET - Drs. Barnes: Using Likert Scales to Track and Trend Attitude Adjustments
- UF-CPET - Drs. Barnes: Planning How to Handle Qualitative Responses Effectively

Simulations and Technology Aides

- UF-CPET - Dr. Lawrence: Careers in Biotechnology Video CDs
- UF – CPET - Dr. Lawrence: Lab Simulations – Adding Kinesthetic Action to Case Studies to provide complex biotech lab results without student frustration and expense.

Biotechnology Literacy for Lesson Development including Career

- Incubator Visit: Biotechnology Career Database
- Incubator Visit: How a Biotechnology Cluster Works
- Incubator Visit – RTI Tour: A model company to discuss biomedical manufacturing
- Incubator Visit – Dr. Mandel: cGMP – How working in biotechnology works
- Shands Hospital Visit – Dr. ?: Medical Occupations without Direct Patient Contact: CLIA Clinical Laboratories

Storytelling to Enhance Science Literacy
• HHMI Christmas Lectures 2003 DVD – Learning From The Patient – Dr. Huda Zoghbi –
   How Patient History and Genetics can be translated into research and clinical care
• UF-CPET – Dr. Darwiche: Creative Storyline Technique – Authentic Application
• Movie Night: Both sides of orphan drug research

My Literacy on Current Research/Issues Enhanced for High Interest Authentic Lesson Building

• B2B Lecturers - Dr. Weinstein: “Bed to Bench side:” Refining a Diagnosis using
  biotechnology and Responsible use of animal models to protect patients
• B2B Lecturers - Dr. Shultz: Understanding the problem of biofilms and bringing a
  solution product to market
• B2B Lecturers – Drs. McKenna: How protein crystallization works
• B2B Lab Tour – Drs. McKenna: 3D Imaging, Graphics and Robotics in protein research
• Several Lecturers: How Cells Form Tissues in vivo and in vitro
• Several Lecturers: Problems in Tissue Engineering using stem cells
• TED Talk: Regeneration
• Stetson Tour: Human Robot Simulation Technology Labs
• [Dr in charge of UF medical school reform]: How Medical School and Medicine is
  changing in the 21st Century

The Immunology Unit Enhancement (A specific Unit that I need to work on)

• Incubator Visit - Dr. Mandel: How ELISA works using antigen-antibody specificity
• Lecturers: Building ELISA

Data collection and analysis:

Action Research Questions (ARQs) will drive each Data Set and Analysis within a theme. Data
and Analysis has been segmented into themes regarding changes in at-risk student conduct
specifically, student perspective in terms of likes/dislikes, perceived readiness and ability to
reflect on making connections (like planning, work and results, or how this affects me now or in
my future.)
Theme 1: Measuring Changes in At-Risk Student Conduct

Attendance: eSembler Attendance Program Data

ARQ: Will at-risk students respond to the enriched segments by improving attendance and subsequent performance on tests?

Student attendance is a direct measure of avoidance for at-risk students that signals an expected drop in performance.

- **Attendance Days in Unit Vs. Content Area Standard Assessment Scores - Scatter Plot w/Line**
- **Attendance (with Enriched Days Highlighted) vs. Student – Empty-Filled Block per day**

Engagement: Direct Behavior Rating (DRB) Form: 3 Standard Behaviors

ARQ: Will at-risk students respond to the enriched segments by increased active engagement, increased respectfulness and decreased disruption?

Classroom conduct including active engagement, respectfulness to teacher and class and disruptive actions is an important measure in the at-risk student classroom. This will be administered as a daily slip for students to self assess their own behaviors and on the back of their forms, they will be able to comment on one other student’s behavior that they noticed that day. I will keep a simplified scale for each student in each domain noting the exceptionally SMILEY FACE and SAD FACE along with a comment on my own modified class form.

- **Student Conduct Self Assessment vs. Days (Enriched Days highlighted) Scatter Plot w/Line** (3 views: Whole Class, At-risk students only, Ordinary students only)
- **Teacher Assessment of Student Conduct vs. Days (enriched days highlighted) Scatter w/Line** (3 views: Whole Class, At-risk students only, Ordinary students only)

Theme 2: At-risk student described motivational measures

ARQ: Will at-risk students respond differently to their perceptions regarding learning when some units contain enrichment and others do not? Will at-risk students perceive all units as better because some units have enrichment?
[DRAFT NOTE: All testing instruments will be provided in the final report] Some surveys will be provided in teacher’s Moodle site or SurveyMonkey.com with iPod Touch class set to gather data rapidly and qualitative text effectively.

**Pre & Post Likert Surveys Coupled to Qualitative Written Response Questions or Surveys***

1. Interest in School, Science, Biology
2. Case Study Interest
3. Perceived Difficulty of Carrying Out Skills Labs
4. Usefulness of Case Studies to My Life Now and In the Future
5. Usefulness of Skills Labs to My Life Now and in the future
6. Career Tie-ins Interest
7. *How does knowing about these career options affect my current career plans?*
8. How hard is this unit going to be? / How hard will the test be? (After unit plan intro)
9. How hard was this unit now that we have finished / How hard will the test be?

**Theme 3: At-risk students Reflecting and Connecting**

**ARQ:** Does enrichment influence an at-risk student’s realization of a connection between Unit Work, Personal Preparation and Test Scores?

This will be a writing exercise carried out on Moodle or via upload of Word Documents to Moodle Site. It may be necessary to provide students access to computer lab or to scan some written documents.

**Unit Reflection Survey:**

- How well did the unit plan, the unit work and the unit test align?
- How well did the unit work and personal preparation work help with your test scores?
- How can the Unit Work be improved?
- How can your Personal Preparation Work be improved?
Literature cited:


**Budget and budget justification:**

DRAFT NOTE: I will need to document each lab to check out or purchase.

**Option 1 - UF Classroom Visit – Wednesday from 10AM – 3PM Lab time with 8:30 -10AM available for setup.**

- BioRad or Carolina Kit Refill For ALU mutation 2 Bio classes up to 50 persons

**Option 2 – Local Labs and simulations**

- Diabetes lab
- Simulation Labs per Lesson Plans
- Allele Detecting Lab
- Pipettes
• Gel Electrophoresis

Permissions:

Option 1 - UF Classroom Visit
• Videotape and SRA permissions from Parents due prior to UF visit.
• Arrange for a videotape person or persons from UF or from Mitchell/District.
• Reserve Room 528 for entire day on a Wednesday and arrange for fewer laptops
• School Related Activity – (SRA) for 3rd and 6th Period to attend lab during 3, 5, 6 on a Wednesday in Room 528
• Substitute Teacher for 2nd Period Chemistry on that Wednesday

Option 2 – Restricted Labs and Simulations
No special permissions required
APPENDIX

Driving Classroom Research from Policy Compliance and Standards

[DRAFT Note: I will have a pretty version of something like this if it needs to be there.]
## OBSERVATION → QUESTION DEVELOPMENT EXERCISE

<table>
<thead>
<tr>
<th>Observation</th>
<th>Teaching Strategy Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>At-risk students seem to be marginalized in terms of the richness of their learning experiences. They are not allowed to move beyond the remedial or trusted with the use of expensive materials or equipment.</td>
<td>How can I enrich the curriculum of at-risk students and still assure that they are safe and skilled at handling equipment and are not missing concepts required by the standard curriculum?</td>
</tr>
<tr>
<td>At-risk students have attendance problems. They are always trying to catch up rather than to be able to manage their time. Absence, Avoidance or Distractions cause the work to build up to an overwhelming point, justifying continued failure.</td>
<td>How can I instill a sense of personal ownership of the learning process in my students, which allows them to break the AAD cycle and succeed?</td>
</tr>
<tr>
<td>At-risk students tend to be kinesthetic, pragmatic and holistic, while ordinary students tend to be auditory/visual, compliant and sequential. At-risk students need to have busy hands and interaction. At-risk students need to know that what they are doing has a real world, lasting purpose that makes it worth doing. Grades and graduation are not something that at-risk students consider sole motivators. They are not compliant and sequential in their motivation or visualization of life. They are critically pragmatic of anything they undertake and they see the world as a splash, a landscape and rather directionless with many possible places to explore or none. They do not trust the pathways to goals set by others, perhaps because adults have disappointed them in the past. They tend not to Ordinary students can see and are willing to follow pathways to a goal that are constructed by others. Ordinary students</td>
<td>How can I enrich the curriculum toward authentic, practical knowledge applicable to the real world to appeal to the pragmatic perspective? How can I apply teaching strategies that emphasize interaction (integration with the class), validation (success without a test) and authentic work (pragmatism)? How can I communicate that I believe in them because I see their potential and not their circumstance and that they really can escape circumstance by seeking out their potential? How can I communicate goals and encourage pathways through pragmatism rather than proscription?</td>
</tr>
<tr>
<td>At-risk students have a sense that because they cannot perform academically, they cannot perform within any established conventional parameters. As outsiders, they develop an anarchistic attitude that if they cannot learn, nobody should. They also develop a worldview that, as outsiders, they should not aspire to take a pathway to any conventional road to success or bad things will happen.</td>
<td>How can I break the cycle of academic failure and introduce these students to academic success and real world possibilities?</td>
</tr>
<tr>
<td>At-risk students want to be successful in life but feel tortured in high school because they cannot make a connection between high school and the real world. Sometimes it also means that education is a goal important to parents that they are rebelling against.</td>
<td>How can I motivate a student to ignore their home circumstances and accomplish things in my class that will benefit their need to become an independent person and form their own pathways to success?</td>
</tr>
<tr>
<td>Policy in education is shifting toward performance rather than completion.</td>
<td>How can I leverage the shift in policy to use pragmatism, performance, authenticity and independence to redirect at-risk students?</td>
</tr>
</tbody>
</table>
APPLYING THE CRITERIA TO MY PROPOSED FOCUS

→ Must include B2B Biomedicine/Biotechnology

<table>
<thead>
<tr>
<th>Criteria As Questions</th>
<th>My Justifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>What have I noticed that needs changing?</td>
<td>At-risk students need real world goals, practical problems to learn how to think through and performance-based grades.</td>
</tr>
<tr>
<td>Why does it need changing?</td>
<td>At-risk students are capable of success in the real world but are frustrated in academia because their learning styles and motivations do not align with the ordinary student. Unfortunately, a high school diploma has become a minimal measure of real world success.</td>
</tr>
<tr>
<td>How is this about teaching and learning?</td>
<td>These students require a different teaching approach that can alienate ordinary students if they are not given adequate support. It is difficult to handle both types in the same class.</td>
</tr>
<tr>
<td>How is this about improving my professional teaching practice?</td>
<td>I came to teaching from the real world specifically to reach this population, who I see as differently-abled and in great need of a life-line to help them make it through to the real world more successfully (with a diploma)</td>
</tr>
<tr>
<td>Do I have the authority to make these kinds of changes?</td>
<td>I have some freedom in my strategies; however, I must show academic growth within an RtI framework and compliance with 10th grade guidelines.</td>
</tr>
<tr>
<td>How can I control the change?</td>
<td>Our district is emphasizing formative assessment strategies. Any biotechnology/biomedicine enrichment will need to be shelf ready with assessments for other teachers to emulate. I need to assure success rather than frustration and in the face of frustration, be able to model and encourage resilience.</td>
</tr>
<tr>
<td>How will I know that the change shows improvement?</td>
<td>I will provide written evidence to supplement Multiple Choice Tests. Since part of the change is motivational, I will use frequent Likert tests and student journaling</td>
</tr>
<tr>
<td>Is this something really worth the effort on my part?</td>
<td>Absolutely. Very few teachers can adapt the curriculum to shift to real world adult style training techniques that is what these students might find in a technical school.</td>
</tr>
<tr>
<td>Potential EOC Benchmark Groupings to Target with Biotechnology/Case Enrichment</td>
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<td>-----------------------------------------------------------</td>
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</table>
| **Inheritance** | L.16.1 with L.16.2 | Use modified Darwiche simulation up to allele determination with pedigree map  
Designer Babies Video |
Clarify vocabulary of L.16.8 using readings in biomedicine regarding switches and controls including IPS and Teratomas, Regeneration and HOX/Homeobox, Cell Death and Turnover. |
| **Theory, Law & Pseudoscience** | N.2.1 with N.3.1, N.3.4 | Theories change readings including PKU from B2B, Wilsons & Willi-Prader, Not So Identical Twins, and Prion Diseases. |
| **Molecular Genetics** | L.16.3 with L.16.4, L.16.5, L.16.9 | 16.4 – Genetic Engineering is not Inheritable in eukaryotes but can be in prokaryotes – The Story of Insulin  
16.5 – How PCR works  
L16.9 – BLAST Diabetes!  
Insulin across species and manufacturers  
Diabetes Genes |
| **Immune Response** | L.14.52 with L.14.6, L.16.10  
WITH NONSCIENCE | L.16.10 IS THE BIOTECHNOLOGY BENCHMARK  
How can we know if it is a genetic, pathogenic or environmental problem?  
ELISA testing, Genetic Identification of pathogens  
Relate to my standard reading article on Mercury Man as a starting point.  
Toxic Baby Bottle BPA  
GATTACA  
OSMOSIS JONES |
| **Scientific Investigation** | N.1.1 , WITH NONSCIENCE | HHMI DVD, Learning from patients Huda Zoghbi as a research model.  
Steps to Product Cycle  
GATTACA |
AT RISK STUDENTS: BUILDING BRIDGES TO A BETTER WORLD WITH BIOTECHNOLOGY ENRICHMENT

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Bench to Bedside Institute 2011, UF
FOCUS STATEMENT

- General theory and policy trends indicate that authentic learning opportunities will help at-risk students as well as high school students in general.
I work with at risk students that my literature search indicates may benefit from career and authentic lab experiences

- 40-50% of my classes are Free/Reduced Lunch
- 30 to 70% of my students may be Reading Challenged in any given class.
- Less than 10% of my students have parents who follow up when there are problems.
- 25 - 40% of my students are in Drop Out Prevention or on the waiting list.
- 10 - 15% are repeat discipline offenders or on Behavior, Attendance or Anger Management Groups.
- Up to 5% are suspended or pending expulsion
Planned Lessons that align **Case Readings & Biotechnology Lab Experiences** with

- NRC Framework Draft
- NGSSS Testable Items Groupings for Biology EOC Exam
- Marzano’s Model (Adopted by FLDOE)
- 10th Grade Academy Guidelines
- Authentic and Problem Based Learning
- Constructivist, Collaborative Learning
- Differentiated Instruction/ Learning Styles
- Drop Out Prevention/ RtI / IDEA
EOC NGSSS groupings will define instructional units for data analysis. APPENDIX B: SCIENCE CONTENT ASSESSED BY BIOLOGY 1 END-OF-COURSE ASSESSMENT

10th Grade Academy Weekly Content Testing will provide content knowledge trending.

RESULTS SO FAR: On each test my students have generally doubled their scores, however, many are still not at a level where they can pass.
Data Collection & Analysis Plans

- Moodle Online Site for
  - gathering student qualitative statements regarding preconceived ideas and how they change with standard lessons and with biotechnology lessons and
  - Likert Attitude Surveys regarding school, science and the lessons.

- RESULTS SO FAR: This was not effective because too many of my students do not have access to internet to accomplish these tasks. Our computer labs are nearly entirely booked for testing. Paper will be more effective. I will need to prepare for the hand correlations.
Game Cell Quest (Supported By Carolina)
- Present and work with cell parts for students who have low reading skills, poor attention, poor study skills.
- Incentivize with extra credit.

RESULTS SO FAR: It allowed students who had some access to internet to download or to play online. We spent two class periods with one or two class heroes to see how far they could get.

Finally engaged the sports kids from my 6th period class, who thought that science was too hard for them. Now they get Endoplasmic Reticulum...
PREPARING FOR THE EXPERIENCE

- Moving beyond the Experiential World to the Molecular World.
  - We started the year looking at how Linneaus categorized what he could see. We created keys and algorithms.
  - We moved on to learn about how the microscope changed the world from an engaging video “What the Stuarts Knew” which reinforced Linneus and introduced microscopes.
  - Another video brought us to genomics in classification.
  - Bonnie Bassler on Nova ScienceNow “The Bacteria Whisperer “ 9 minute sequence introduced how science works and that it is not boring, even in the Lab.

Who did Nt “Th D Chil” ith D
From Cell Craft, Dr. Bassler and looking at Pond water under the microscope - Things to Come.

- I reminded them how the world changed for people when microscopes revealed a whole new realm.
- I then introduced the world of walking molecules and what the molecular biology world looks like to me.
- I explained that this is where they needed to get to in order to be up to date in the 21st century for jobs that will come and research that needs to be done.
- I used clips from DNALC - http://www.dnalc.org/resources/3d/index.html
- I also used TED talks and other sources for students to be able to see molecular biology in motion.

RESULTS SO FAR: They were amazed and they really wanted to know more and how it
Preview is Done …
Starting this week Biotech Happens

- We will complete our work on Bag Babies which introduce and carry out all the essential information of Mendelian Genetics that we are required to cover first.
- We will reproduce this week as we learn about DNA structure, DNA Replication and then Meiosis.
- We will tie meiosis to Mendel’s Laws.
- We will then have time to work on some biotechnology labs and genetics research over the next month.
I tied in Chemistry concepts to biological molecules to start the year including a DNA probe lab using paper simulations, building amino acids and their mirror images, naming organics and functional groups.

This also previewed how well my 10th graders will handle this information. I can now adjust my approach so they should be able to handle the biotechnology materials I hope to try.
The Plan

- We will use some paper Likert Scales so I can pace and scaffold for these students.
- We will match the idea of genotype to quantifying genetic materials.
- We will expand the pedigree to link it with gene discovery and genetic testing.
- We are watching Designer Babies regarding modern technologies used in fertility clinics.
- We will watch Gattaca a science fiction movie of the first generation that has to face the implications of genetic engineering.
- Researching Synthetic Biology and Biotechnology work and careers.