A Study Investigating the Effect of Incorporating Real-World Case Studies, Hands-On Biotechnology Activities, Web-Based Assignments and Scientific Research, Based on Cancer on Student Mastery of NGSS, CCSS and STEM Practices In a Regular Level Biology Course

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Abstract:

This action research will investigate the effect of incorporating real-world case studies, hands-on biotechnology activities, web-based assignments and scientific research based on cancer on student mastery of state standards in a regular level biology course. Students are required to pass an end of course (EOC) biology exam. Since the scope and sequence of the course is district mandated this unit plan will continue throughout the academic year beginning on day 4 of the 2015-2016 schedule with a cancer survey and web activity and culminating in a cancer case-study research project and presentation during the final weeks of class.

Rationale:

Cancer has affected all of us. In 2001, my husband died at the age of 37 of stage four colon cancer. The companies that are fighting hard to understand this disease and create effective medicines and treatments are known as biotechnology or biopharmaceutical companies. In connecting cancer and biotechnology through "The War of the 21st century: The Cell Cycle, Cancer and Clinical Trials", a curriculum designed by Jennifer Broo and Jessica Mahoney I will present real-world case studies, hands-on biotechnology activities and labs, web-based assignments and scientific research into clinical trials to teach students about the cell cycle and how mutations can lead to cancer. (Modification to the unit plan has been made to accommodate both time and biology course level).

A survey of the following statistical information convinced me to introduce cancer and biotechnology into my curriculum as a means to deliver biology content with a real-world, emotional edge that will make covering the standards interesting and meaningful. (NGSSS, CCSS & STEM Practices listed in my unit plan).

The National Cancer institute estimates that there will be 1,658,370 new cases of cancer in 2015 and an estimated death rate of 589,430 in the United States. The Florida Cancer Data System (FCDS) reports that in 2012 there were 5,011 new cases of cancer in Orange County alone and 106,166 cases in the state of Florida.

According to The UF Sid Martin Florida Biodatabase State of the Industry report (Fall 2014), Florida's biotechnology industry has increased by more than 75% in six years (2006-2012) and has grown by 10% (2013). Currently more than 10% of the nation's biotechnology companies are located in Florida. The Pharmaceutical Research and Manufacturers of America (PhRMA) representing the country's leading biopharmaceutical research and biotechnology companies reports that the biopharmaceutical industry is responsible for creating a total of 83,916 jobs in Florida in 2011 (22,438 direct jobs and 61,478 indirect jobs).

PhRMA's "In your backyard" publication, (Florida, 2013) reports that biopharmaceutical research companies (from 1999 to 2013) conducted more than 7,800 clinical trials of new medicines in collaboration with the state's university medical schools, clinical

research centers, and hospitals. Of those trials, 3,840 targeted the nation's six most debilitating chronic diseases —asthma, cancer, diabetes, heart disease, mental illnesses and stroke.

Literature Review:

The US Bureau of Labor Statistics predict that there will be nearly three million (3,000,000) STEM jobs by 2020. However, with only about 16% of US students (mostly men) earning a STEM related degree out of 1.6 million bachelor's degrees leaders are concerned about the limited labor pool. President Obama in his "Educate to Innovate Campaign" speech on 11/23/09 said that, "American 15-year-olds now rank 21st in science and 25th in math when compared to their peers around the world." He discussed his plan to improve education in math and science to produce engineers, researchers, scientists and "innovators who are going to help transform our economy and our loves for the better."

An ancillary benefit of my cancer & biotech curriculum will be to inform students of STEM careers and develop interest in taking upper level science courses (like AP Biology) which would prepare them for STEM majors in college. I plan to use the STEM-CIS survey (modified) (Kier, et al., 2014) at the beginning and end of the school year to determine if, as a result of my curriculum students are more interested in STEM fields.

Several studies have been conducted on the benefits of incorporating hand-on biotechnology activities and labs in the classroom to stimulate active learning, using authentic tasks, to stimulate reflection, interest in STEM careers and ultimately create a more science literate society. I have used the following four publications to develop both my lesson plan, and unit plan and additional web-based animations and activities, case studies and relevant classroom lab activities.

1. Broo, Jennifer & Mahoney, Jessica. "The War of the 21st Century: The Cell Cycle, Cancer and Clinical Trials". A Biomedical Curriculum Series. UF Center for Precollegiate Education & Training, July 2013.

2. *BioCONECT (Biology of Cancer, Online Education Connecting Teens)*. Rutgers, The State University of New Jersey. Center for School and Community-Based Research and Education (CSCBRE) 2nd edition, 2014.

3. Klop, T. et al. "Research Report: Effects of a Science Education Module on Attitudes towards Modern Biotechnology of Secondary School Students." *International Journal of Science Education. Vol. 32, No. 9, 1 June 2010, pp. 1127–1150*. (Module on Cancer and Modern Biotechnology).

4. *Cell Biology and Cancer*. Curriculum Supplements created by NIH, NCI, BSCS and Videodiscovery, Inc., 2003. Available in print or on line: http://science.education.nih.gov/supplements/nih1/Cancer/default.html

Action Research Intervention:

Over all, my goal is to use the topic of cancer together with case studies, biotech labs and activities, cellular animations, student presentations and student reflections to teach required standards (Unit Plan) so that my students will earn passing grades on the Biology EOC (End of course exam), learn about cellular biology, the importance of biotechnology in the fight against cancer and STEM careers.

I will be working with my regular biology students at West Orange High School. Most of the students will be in 10th grade. However, it is possible that I will have some upper level 9th grade students.

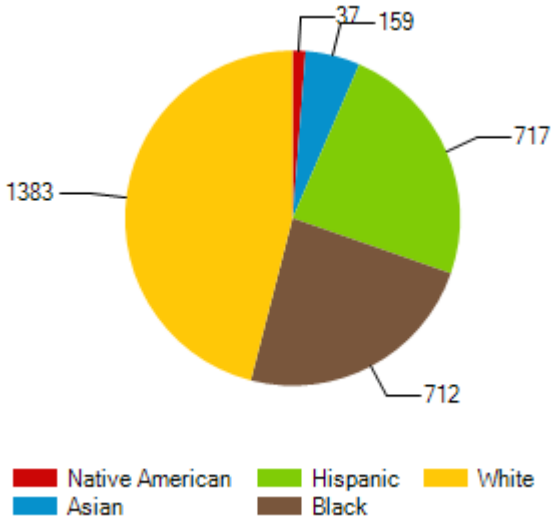
Using cancer as an example of a science problem to be solved, I will incorporate information on this topic in nearly every unit in the biology course. Because the students will each have Lenovo Think Pads and internet access I can bring the "bench" to the classroom with web-based biotech animations, virtual labs and activities.

CPET's generous offer of supply lockers will allow students the opportunity to develop biotechnology skills such as pipetting, microscopic studies, creating cell culture assays and serial dilutions. These activities will give students the opportunity to follow protocols, gain an understanding of the scientific process, determine how clinical trials are conducted and investigate the bioethical considerations of research. Another benefit to the students will be the opportunity to learn to problem-solve and work collaboratively to gain and present new information, complete meaningful labs and reflect on their learning.

I plan to develop relationships with several different Central Florida Biotechnology companies and if financially feasible and administratively approved will schedule a field trip to stimulate further student interest in this field and encourage a speaker to visit my biology classes.

I am using my regular level biology classes to gather data rather than my honor classes because I want to determine if these planned interventions will stimulate learning and successful scores on the EOC in a population that may not have an initial strong interest in biological sciences. My control group will be students from another regular biology course at West Orange High School with similar academic levels that will not receive the biotech curriculum I will be providing my students

Student Demographics for West Orange High School



Asian	159 (5%)
Black	712 (23.15%)
Hispanic	717 (23.32%)
Native American	37 (1.20%)
White	1383 (44.98%)

Approximately **37%** percent of WOHS students are considered economically disadvantaged as determined by their participation in the Free/Reduced Lunch Program.

Connection to Bench to Bedside Summer Institute 2015:

There are four significant connections to B2B 2015 that encouraged the development of this action plan. First, the tours of the biotechnology companies stimulated a strong personal interest in learning more about this field, its careers and educational pathways and biotech projects occurring in Central Florida.

Secondly, the lectures presented during B2B were outstanding. I learned about stem cell research, translational research, bioengineering, Glycogen Storage Disease, pharmacogenomics and innovative cancer treatments that I want to share with my students.

The labs and other hands-on activities that we participated in during the B2B experience allowed me to improve my biotech lab skills and see how easily they could be incorporated into and enhance my biology curriculum. Access to biotech equipment has

always been a problem. But, having the opportunity to borrow the CPET lockers I am able to offer my students the same lab experiences I had this summer.

Finally, having access to the extensive UF library system allowed me to indulge my passion for research and generated many new learning strategies and ideas of ways to incorporate biotechnology into my biology curriculum.

Data Connection and Analysis:

- At the beginning of each school year I conduct a ***student learning styles assessment***. This allows me to select and adapt learning activities that compliment learning style. It also helps the student understand how they learn most efficiently.
- The first week of school before the students know me I will have each student complete a modified version of the ***STEM-CIS*** survey created by (Kier, et al., 2014). This will also be given to the control class as well. It will determine individual interest in science, technology and math as topics of study and as career fields. This assessment will also be repeated at the end of the year.
- The second assessment is by based on student understanding of cancer, ***Cancer Truth or Myth Survey Data*** created by Broo and Mahoney, 2013. This will be given to both the test group and control group before instruction on the topic has begun. This assessment will also be repeated at the end of the year.
- Students will begin journaling in their e-notebooks the second week of school. This activity is part of their course portfolio. Their reflections will give qualitative information regarding their learning.
- Standards-based assessments will be given throughout the year by the entire biology PLC. Specific item analysis will be conducted on each. I will incorporate pre and post standards-based Likert-styled surveys throughout the year.
- Each biology student will participate in two benchmark assessments prior to the EOC.
- Student learning will be evaluated using Marzano-type rubric/scales for each standard and/or unit learning goals.
- I used this assessment tool to measure student/group performances as well.
- The End-of-Course Exam (EOC) will ultimately determine how effective my teaching strategy was on student mastery of the NGSS, Health standards, Engineering practices and CCSS.

Budget and Budget Justifications:

- ***Explore genetic testing for PKU*** (STO-132): Science Take Out. 10 kits plus 1 refill pk.: $207.00
- ***Which animals should be used to test a new drug?*** (STO-129): Science Take Out. 10 kits plus 1 refill pk.: $173.00
- ***Bus for field trip*** to tour biotech companies: $700-$1,000.
- ***Pipetting by design***: CPET Locker: No cost
- ***IC $_{50}$ cell culture assay***: CPET Locker: No cost
- ***Gel-Electrophoreses lab***: on line at Biointeractive: http://www.hhmi.org/biointeractive/bacterial-identification-virtual-lab or http://cinjweb.umdnj.edu/site/theboldinitiative/forum/ or CPET Locker: No Cost
- ***BioCONECT, Cell Biology and Cancer, The War of the 21st Century*** paper-based (or internet-based) activities: Minimal cost for colored paper. No cost for copies.

Permissions:

School, District and parental consent/approval will be needed for field trip. Principal gave tentative support for field trip to biotech company (6/26/15).

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SINGLE LESSON PLAN		
Teacher: Carlene Rogers	**Content Area/Grade:** Bio/10-11th	**Date:** 6/24/15
Unit Name:	THE BIOLOGY OF CANCER. Lesson 1: Cassandra's Story	

Unit Goal What unit goal does this daily lesson address?	**Standard(s)/Benchmark(s)** What standard(s)/benchmark(s) does this daily lesson address?
The goal of lesson one is to hook student interest in cancer biology.	• SC.912.N.1.1 • SC.912.N.4.1 & 4.2 • HS-LS3-3 • CCSS.ELA-Literacy.WHST.9-10.1 & 10.9
Students will understand that… What should the students understand by the end of today's lesson?	**Essential Questions** What essential question(s) does this lesson address?
By the end of lesson 1 students will: • Have evaluated their understanding and personal experiences with cancer • Cited textual evidence to support their opinions • Used various sources to create a personal position regarding the case of Cassandra C.	(OVERVIEW) What is cancer? Who gets cancer? How is it treated?
Connecting Concepts How will you review yesterday's content and connect today's lesson to it?	**Organizing Students for Learning** How will students be organized for the lessons activities?
This lesson will be the first of an ongoing unit on the Biology of Cancer and is scheduled to be conducted on the 4th and 5th day of the 2015-2016 school year.	Each student will have their own internet device and will have time to individually read & view the videos, group sharing time and classroom wide discussion, so will be arranged in a group of 4 with 2 students per science table.

LEARNING EXPERIENCES, INSTRUCTION AND RESOURCES

What activities or experiences (from your Unit Plan) will students engage in today?

Lesson Sequence		
Activating Prior Knowledge	• 15 Question Cancer Truths or Myth Survey (Modified from War of the 21st Century by Broo & Mahoney). Students answer survey via polleverywhere	☒ Survey ☒ Anticipation Guide ☒ Motivational Hook ☒ Class discussion
Explicit Instruction (cites listed below)	• Scan article 1 and watch short video – discuss (TPS) • Scan article 2 and watch short video – discuss (TPS) • Class poll (Likert Scale) on Cassandra case (White Boards)	☒ ***Read***-Think-Pair-Share ☒ Class debate ☒ Reflection ☒ Note-taking Guide

Lesson Sequence				Resources and Materials
Group Processing of New Information	• **Students will evaluate medical, social, ethical and legal aspects of Cassandra's case within their groups and create a graphic organizer of the essential points.**	☒ Pro/Con Debate ☒ Refine position ☒ Concept Attainment ☒ Graphic Organizers	☐ Lab/Inquiry Activity	☒ Computer ☒ LCD Projector ☒ Paper ☒ Pencils ☒ Whiteboards ☒ Markers ☒ Moodle Doc with links to all materials ☒ Name tags for role play ☒ Guided notes ☒ Video Clip(s) ☒ Rubric/Scale ☒ Website(s): **(See Below)**
Elaborative Questioning	• **After reading article 3 & reviewing video students may want to revisit opinions on the case.** • **Students will be asked to view controversy from 4 points of view: Cassandra's, Her Mom's, the Court's and from and a bioethical standpoint.**	☒ Socratic Questioning ☒ Role playing		
Demonstrating Understanding	• **Student volunteers will create a skit to demonstrate the opposing points of view. (Cassandra, Mom, Doctor, Cassandra's lawyer, Judge, Oncology Nurse & Cassandra's friend)**	☒ Revise Concept Maps ☒ Role Playing		
Reflection	• **Students will reflect on and write their impressions of the case, the role playing and what they would do if they found themselves in Cassandra's position.**	☒ Reflective writing & graffiti		
Daily Progress Monitoring Assessment	• **Students will write a case summary including pertinent facts (using their graphic organizer as a guide). This will be evaluated using a rubric (Peer review & teacher assessment)**	☒ On Line Notebook Case summary ☒ Exit Ticket (Post to Forum) ☒ Rubric/Scale		

Based on the results from your Daily Progress Monitoring Assessment, what concepts need to be revisited in the next lesson?

- We will revisit cancer several times during the year in the following units: Cells, Mitosis & Meiosis, DNA replication and Protein Synthesis, Cell Cycle & Cancer, Biotechnology and Human Systems.
- Several other bioethical lessons are planned.
- Four labs relating to cancer will reinforce student learning of the biology of cancer and biotechnology programs, majors and employment opportunities.

Web-based resources for this lesson

http://www.npr.org/sections/health-shots/2015/01/08/375659085/can-connecticut-force-a-teenage-girl-to-undergo-chemotherapy
NPR article & video: "Can CT Force a Teenage Girls to Undergo Chemotherapy?" (#1)

http://www.courant.com/opinion/op-ed/hc-op-cassandra-my-body-my-life-0109-20150108-story.html
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http://foxct.com/2015/04/27/cassandra-c-to-be-released-from-the-hospital/
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http://www.lymphoma.org/atf/cf/%7Baaf3b4e5-2c43-404c-afe5-fd903c87b254%7D/LRF_FACTSHEET_HODGKIN_LYMPHOMA.PDF
Hodgkin Lymphoma FACT SHEET

UNIT PLAN

Unit Title: **The Biology of Cancer**	Content Area/Grade: **Biology/10th-11th**
Teacher: **Carlene Rogers**	Implementation Time Frame: **Throughout 4 quarters**

STAGE 1: THE DESIRED RESULTS
What are my learning goals?

Unit Goals
Students will …

1. Understand that cancer is a genetic disease that effects all ages, races and ethnicities
2. Describe the basic process of DNA replication, transcription & translation
3. Explain how mutations in DNA may/may not result in phenotypic changes
4. Explain how mutations in gametes may result in phenotypic changes
5. Explain relationship between mutation, cell cycle & potential for cancer
6. Describe stages and activities in the cell cycle
7. Prove through experimentation that enzymes are catalyst that lower the activation energy of biochemical reactions and are affected by factors such as pH and temperature
8. Explain how DNA structure determines shape of proteins & their functions
9. Explain how homeostasis requires the interaction of body systems
10. Solve scientific problems
11. Evaluate the impact of biotechnology, medical & ethical issues on the individual, society & environment
12. Explore use of animals for medical testing.
13. Research the field of biotechnology in Central Florida
14. Learn useful biotechnology lab skills (pipetting, arrays, PCR)
15. investigate careers, majors and programs in biotech
16. Investigate local clinical trials *
17. Research path of new drug from Bench-to-Bed. *
18. Research a cancer case study and create presentation to share with class*

Standard(s)/Benchmark(s)
What standard(s)/benchmark(s) does this UNIT PLAN address?

- SC.912.N.1.1
- SC.912.L.16.8
- SC.912.L.14.1
- SC.912.L.14.2
- SC.912.L.14.4
- SC.912.L.14.6
- SC.912.L.14.26
- SC.912.L.14.36
- SC.912.L.15.2
- SC.912.L.15.3
- SC.912.L.16.3
- SC.912.L.16.4
- SC.912.L.16.8
- SC.912.L.16.13
- SC.912.L.16.10
- SC.912.L.16.14
- SC.912.L.16.16
- SC.912.L.16.17
- SC.912.L.18.11

Standards are arranged numerically rather than by lesson sequence.

- HE.912.C.1.3
- HE.912.C.1.5
- HE.912.C.1.7
- HE.912.C.1.8
- HE.912.L.14.52
- HE.912.L.14.6
- Science & Engineering Practices
- CCSS-Reading Standards for Literacy in Science & Technical Subjects
- CCSS-Writing Standards for Literacy in Science & Technical subjects
- CCMP-Common Core Math Practices
- (*) STEM project at end of year
  - ☑ SC.912.N.1.2
  - ☑ SC.912.N.1.3
  - ☑ SC.912.N.1.4
  - ☑ SC.912.N.1.5
  - ☑ SC.912.N.1.6

Students will know…
Vocabulary, terminology, definitions

Cancer	**Meiosis**	**Synthesis phase (S- phase)**	**Protocol**
Hodgkin lymphoma	**Interphase**	**Spindle assembly**	**Informed Consent**
Other types of cancer	**Prophase**	**Apoptosis**	**Placebo**
Chemotherapy	**Metaphase**	**Oncogenes**	**In vitro**
radiation	**Anaphase**	**Tumor Suppressor Gene**	**Serial dilution**
Cytoxicity	**Telophase**	**Proto-oncogenes**	**Cell culture Assay**
Angiogenesis	**Cytokinesis**	**Mutation**	**Pipetting**
Cell Cycle Mitosis	**Checkpoint Gap G_0**	**Clinical trials**	**Specific Chemo drugs ***
	Gap 1	**Control**	
	Gap 2		

Related Misconceptions
What misconceptions are predictable?

- Students have difficulty visualizing biological molecules in 3D and understanding that these molecules interact.
- Students rarely see the connection between what they are learning in class and everyday biological processes like diseases or eating.
- Students do not understand how a genetic change can result in a phenotypic change at the protein level.
- Students rarely understand the importance and prevalence of proteins in cells
- Students are unable to see the important concept(s) in historical experiments.
- What are genes, alleles, chromosomes, DNA, and nucleic acids and how are they related?
- How can a change in a gene cause a change in a protein?
- How are the genetic changes related to the phenotypic changes?

Essential Questions
What questions will foster inquiry, understanding and transfer of learning?

1. What is cancer? Who does it affect? Can it be cured?
2. What do biotech companies do? What is translational medicine?
3. What types of biotech jobs are available in Orlando?
4. What is scientific research? What's a clinical trial?
5. How does the structure of the parts of the cell affect its functions?
6. How does the cell cycle and mitosis result I growth and development of an organism?
7. What is the difference between mitosis and meiosis?
8. What is "Central Dogma"?
9. What are mutations and do they always change phenotype or cause disease?
10. How does our immune system work to maintain health in the human body?
11. How is the cardiovascular system involved in cancer development?
12. How is cancer inherited?

Other Essential Knowledge
Students will know…Key facts, formulas, critical details, important events, important people, timelines

This year I will be teaching a combination of regular and honors biology. Generally my students will be in 10^{th} and 11^{th} grade, but I will have some higher level 9^{th} graders. Since this will be their first high school biological science I do not expect they will know much about the topics I will teach.

Our school will be giving each student a Lenovo Think Pad which will allow me to flip the classroom and build scaffolding lessons as needed.

Students will be able to…
Specific skills students will acquire as a result of this unit

- Using a model, students will be able to describe in depth the cell cycle, check points and problems that may result in uncontrolled cell growth.
- Students will explain how translational medicine leads to the creation of novel treatments for cancer and other diseases.
- Students will understand how cancer grows and spreads and describe how new biomedical interventions interfere with this process. They will also know cancer risk factors.

- Students will be able to identify the process of how a new drug goes from bench to bed and describe current regional trials.
- Students will know what area biomedical companies do, the many different possible biotech careers and paths of further study to achieve a career in this emerging field.
- Students will gain general lab tech skills such as pipetting, creating assays, dilutions, effective microscope skills, literature research, and effective lab procedures and documentation.

STAGE 2: ASSESSMENT EVIDENCE
What evidence will show that my students have achieved the learning goals?

Performance task***: Through what specific "real-world" performance task(s) will students demonstrate their understanding of the learning goals?***

1. Students will demonstrate correct lab skills and techniques during lab practicals.
2. Students will achieve higher post test scores as compared with the control group.
3. Students will demonstrate mastery of the NGSSS, Health standards, Science and engineering practices and CCSS on district and national exams.
4. Students will transition from teacher directed lab activities to student inquiry-based labs as evidenced by their data analysis and evaluations of lab work.

Rubric
By what criteria will "performance of understanding" be judged?

1. Pre and post unit assessments.
2. Performance rubrics
3. Unit Scales that score mastery of unit learning goals
4. Surveys
5. Exit slips
6. Reflective writing
7. Creation and use of models – Rubric graded
8. PLC created exams
9. District & State exams
10. Willingness to take upper level science (AP Biology)

Other Evidence: ***What other evidence needs to be collected in order to monitor student progress on these concepts and skills along the way?***	**Self-Assessment/Reflection** ***How will students reflect and self-assess their learning?***
1. I will enlist the cooperation of another Reg. Bio teacher to administer the same pre/post exam (control group). 2. Data analysis will be done at the school and district level comparing student mastery of individual learning goals across teachers, classes and schools using benchmark testing.	Reflection is an important part of evaluating learning. Reflective writing is incorporated into each unit. Students will maintain their reflections in an online biology notebook that will be graded quarterly and become part of their biology e-portfolio.

STAGE 3: LEARNING EXPERIENCES, INSTRUCTION, AND RESOURCES ***What activities will help my students achieve the learning goals?***	
What **H**ere	**What** is expected? How will you ensure that students are aware of the learning goals? **Where** are your students? How will you establish your students' prior knowledge?
	At all OCPS schools teachers are required to maintain a common white board that includes, essential question, Target learning goal, daily activities, assessment of learning goal and homework as well as upcoming activities. I prefer surveys to assess prior knowledge or pretests, but occasionally use KWLs or concept mapping activities.
Hook **H**old	How will you **hook** students at the beginning of the unit? How will you **hold** their attention throughout the units?
	The **HOOK** is my favorite part of each unit plan. I create a fun, sometimes controversial or emotionally charged, current example or activity related to the topic.
Experience **E**xplore **E**quip	What critical input **experience** will help students **explore** the key ideas and essential questions? How will you **equip** your students with needed skills and knowledge?
	Since I will have regular biology students I'm planning on using some type of initial survey so I can scaffold appropriately. Students will have access to technology (They all will have think pads) so we will always have GOOGLE. I also create resources and enrichment activities for my students on Moodle.
Reflect **R**ethink **R**ehearsing **R**evising **R**efining	How will you encourage students to **reflect** and **rethink**? How will you guide students in the process of **rehearsing**, **revising**, and **refining** their work?
	Reflection is an integral part of each activity, lab and overall unit requirement. Student will maintain on line journals which are evaluated and become part of their final biology portfolio.
Exhibit **E**valuate	How will you help students to **exhibit** and **self-evaluate** their developing skills, knowledge and understanding throughout the unit?
	Performance (skits, role-play, human models & presentations) are great strategies to get students out of their seats and to identify level of learning. It allows students to coach each other, review peer performance and self-evaluate their own knowledge.
Tailor	How will you **tailor** your instruction to meet the different needs, interests and abilities of all learners in your classroom?
	I routinely offer any accommodation or modification I can dream up to ensure adequate student learning. The list ranges from extra time on assignments to special tutoring sessions.
Organize	How will you **organize** and sequence the learning activities to maximize the engagement and achievement of all students?
	Unfortunately, the scope and sequence for biology for all OCPS teachers has been mandated by the district. I keep a lively pace, enthusiasm for the topic and create kinesthetic activities for each unit.

Marzano-style Scales/Rubrics scoring from 0 to 4.0 are created for each standard assessed/activity/unit and must be given to students and posted in the classroom to use as a tool for monitoring student learning.

Big Idea:		**Standard(s)/Benchmark(s):**
Unit:		**Sample Activities**
Grade:		
Score 4.0	**In addition to Score 3.0, in-depth inferences and applications that go beyond what was taught.**	
Score 3.0	**The student:** **The student exhibits no major errors or omissions**	
Score 2.0	**There are no major errors or omissions regarding the simpler details and processes as the student:** • Recognizes or recalls specific terminology • Performs basic processes, such as: **However, the student exhibits major errors or omissions regarding the more complex ideas and processes**	
Score 1.0	**With help, a partial understanding of some of the simpler details and processes and some of the more complex ideas and processes.**	
Score 0.0	**Even with help, no understanding or skills demonstrated.**	