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| **First Name** | **Last Name** | **School** | **District** | **Implementation Plan** | **Mid-Year Evaluation** | **Reflection** |
| **Kristina** | **Buenafe** | **Josiah Quincy Upper School** | **Boston** | **X** | **X** | **X** |
| **William** | **Chan** | **Josiah Quincy Upper School** | **Boston** | **X** | **X** |  |
| **Michael** | **Clark** | **The Engineering School** | **Boston** | **X** | **X** |  |
| **Chris** | **Connors** | **Duxbury High School** | **Duxbury** |  | **X** | **X** |
| **Kenneth** | **Cray** | **Greater Egleston High School** | **Boston** | **X** | **X** | **X** |
| **Viviana** | **De Mello** | **Jeremiah Burke High School** | **Boston** | **X** | **X** | **X** |
| **Michael** | **Dudley** | **North Central Charter Essential School** |  | **X** | **X** | **X** |
| **Ramiro** | **Gonzalez** | **Boston Arts Academy** | **Boston** | **X** | **X** | **X** |
| **Michael** | **Graeber** | **Hopkinton High School** | **Hopkington** | **X** | **X** | **X** |
| **Lisa** | **Henderson** | **TechBoston Academy** | **Boston** | **X** |  | **X** |
| **Anthony** | **Iarrapino** | **Lowell High School** | **Lowell** | **X** | **X** | **X** |
| **Mark** | **Kobel** | **Gardner High School** | **Gardner** | **X** | **X** |  |
| **Ann** | **Latino** | **The Learning Center for the Deaf** |  | **X** | **X** | **X** |

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| **First Name** | **Last Name** | **School** | **District** | **Implementation Plan** | **Mid-Year Evaluation** | **Reflection** |
| **Brian** | **Lenda** | **Southeast Alternative School** |  | **X** | **X** |  |
| **Raphael** | **Matty** | **Newburyport High School** | **Newpurbyport** | **X** | **X** | **X** |
| **Joshua** | **Miranda** | **Revere High School** | **Revere** | **X** | **X** | **X** |
| **Kristin** | **Newton** | **Cambridge Rindge and Latin School** | **Cambridge** | **X** | **X** |  |
| **Patrick** | **Nsumei** | **East Boston High School** | **Boston** | **X** |  | **X** |
| **Fred** | **Pontillas** | **O'Bryant** | **Boston** | **X** | **X** |  |
| **Stacy-Michelle** | **Reid** | **East Boston High School** | **Boston** | **X** | **X** |  |
| **Susan** | **Sanford** | **Doherty High School** | **Worcester** | **X** | **X** |  |
| **Tri** | **Tran** | **Jeremiah E. Burke High** | **Boston** | **X** | **X** | **X** |
| **Rosalie** | **Williams** | **Cambridge Rindge and Latin** | **Cambridge** | **X** | **X** |  |

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**Prepared By:**

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## Kristina Buenafe

### Implementation Plan

*Target Actions*

Through effective capstone experiences, students build their understanding of STEM concepts by applying these concepts in solving open-ended, real-life problems. I have collaborated with other Geometry teachers to develop capstone project ideas and will implement a variety of these projects in my 10th grade Geometry class. Two of the projects are described in this implementation action plan.

*Context*

I teach 10th-12th grade math at the Josiah Quincy Upper School (JQUS). JQUS is a Boston Public Schools (BPS) pilot school that serves approximately 500 students. Students are mostly African-American, Asian-American, or Latino. Many are English Language Learners. Most receive free or reduced lunch.

The mission of JQUS is to develop students to be knowledgeable, productive members of society through an education that promotes cultural awareness, skillful use of information, personal renewal, and both individual and community path-finding for the 21st century. JQUS was recently authorized to be an International Baccalaureate (IB) school and will be adjusting curriculum accordingly. Math classes are offered through Precalculus. A variety of technology classes as well as after-school robotics and programming are also available to students.

*Purpose*

Currently, project-based learning varies widely in JQUS math classes. As JQUS begins its first year as an IB school this fall, teachers will need to incorporate projects that emphasize critical thinking and international-mindedness in keeping with the IB learner profile. Additionally, teachers will need to align curriculum with Massachusetts state standards and prepare students for the MCAS. Adjusting to a new curriculum while meeting district and state requirements poses considerable challenges to JQUS.

*Action Plan #1: Three Legged Chair Project*

Students will work in groups to design and build three-legged chairs from recycled materials. During the first day of the project, students will come into the classroom to find that all the chairs have been removed and that they must act as engineers to create new, three-legged chairs. Students will work through the engineering design process as they ask about constraints, imagine designs, plan, create, and improve their chairs. The groups will compete to see whose chairs can hold the most weight, then redesign their chairs to see who can achieve the greatest percent change in weight held.

This project will start in the beginning of the year, after class rules and expectations have been established. Students will continue the project to gain experience with the engineering design process and apply concepts that they learn within the first two units (e.g., planes, perimeter, distance, angles, and slopes of lines). For example, they could create scale drawings of their chairs that identify angle measurements and dimensions. They could also make subsequent redesigns based on geometric properties and ergonomic principles.

Standards Addressed:

* 10.G. 2 Draw congruent and similar figures using a compass, straightedge, protractor, or computer software. Make conjectures about methods of construction. Justify the conjectures by logical arguments.
* 10.P. 2 Demonstrate an understanding of the relationship between various representations of a line. Determine a line's slope and x- and y-intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line, e.g., by using the "point-slope" or "slope y-intercept" formulas. Explain the significance of a positive, negative, zero, or undefined slope.
* 10.G.7 Using rectangular coordinates, calculate midpoints of segments, slopes of lines and segments, and distances between two points, and apply the results to the solutions of problems.
* 10.G.10 Demonstrate the ability to visualize solid objects and recognize their projections and cross sections.

We anticipate that this project will introduce students to the engineering design process, engage them in problem solving, and give them ownership of their own learning. I hope that chair design will provide a meaningful context for the building blocks of geometry and help students see that math is not just an isolated set of rules to apply to homework problems. Assessments for this project will include a reflection essay on student experience with the engineering design process, the physical protoype of the chair, scale drawings of the chair, and a Google SketchUp model of the chair.

*Action Plan #2: Habitat for Geometry Project*

In keeping with the IB learner profile and service learning focus, I extended the group’s original idea for house design to include service learning and the Boston community. Through volunteer work and donations, Habitat for Humanity Greater Boston builds and rehabilitates simple, decent houses for low-income families. Students will help Habitat for Humanity Greater Boston design a house for a lot in Roxbury. They will consider maximizing the size of the house itself, making the best use of space inside the house, and estimating costs.

This project will be implemented after the MCAS in late May 2011 as a way to pull together student learning for a culminating project. Students will work in groups over a period of four weeks to complete the project. They will take different leadership roles over the course of the project. The project will include:

1. Designing the footprint of the house to fit on a given lot while meeting City of Boston zoning restrictions.
2. Designing the floor plan of the house to fit inside the footprint while meeting Habitat for Humanity restrictions.
3. Answering real-life “builder” problems.
4. Building a 3D model of the house in Google Sketchup.

Standards Addressed:

* 10.G.10 Demonstrate the ability to visualize solid objects and recognize their projections and cross sections.   
  10.M.2 Given the formula, find the lateral area, surface area, and volume of prisms, pyramids, spheres, cylinders, and cones, e.g., find the volume of a sphere with a specified surface area.
* 10.M.3 Relate changes in the measurement of one attribute of an object to changes in other attributes, e.g., how changing the radius or height of a cylinder affects its surface area or volume.
* 12.M.2 Use dimensional analysis for unit conversion and to confirm that expressions and equations make sense.

*Connections*

My two actions fit into a larger plan of incorporating capstone experiences into Geometry curriculum. My group of Geometry teachers analyzed the current state of our schools and brainstormed possible ways to integrate capstone experiences that meet Massachusetts state standards and include the concepts addressed by the BPS pacing guide. We agreed that introducing capstone gradually through bigger and bigger projects would provide the best learning experience for our students and ourselves. As I develop my curriculum, I will post it online on my CAPSULE Google Site or on <http://www.betterlesson.org> and solicit feedback from other teachers to improve it.

*Beyond your Zone of Influence*

Several factors may impede my progress with Geometry capstone implementation. First, the best-laid plans often go awry in the reality of urban public schools. Many teachers left my school at the end of the past year, so I anticipate that there will be some cultural changes in addition to those related to IB implementation. Additionally, my own growth as an educator will influence the capstone implementation. This will be my first year teaching Geometry, so I anticipate that I will have some “growing pains” as I teach it, particularly with re-familiarizing myself with the curriculum and learning to anticipate where students will have difficulty. I have also been told to spend a few weeks on MCAS prep, so I hope that I will be able to balance the project time with that test prep time. I also hope that I will be able to introduce Google Sketchup to most efficiently get the students to learn the appropriate skills for creating models of their houses.

*People, Organizations and Things*

I feel extremely fortunate to have gotten to know so many technology/engineering-minded teachers through the CAPSULE program. I look forward to continuing to learn from each other as we move forward with our implementations. I also anticipate leveraging the following resources throughout implementation: Tufts Center for Engineering Education and Outreach (CEEO), Museum of Science Educator Resource Center and ETF web site, Northeastern University Center for Stem Education, BPS OIIT, and the EXCL Recycle Center.

### Mid-Year Evaluation

**Start Date:** 11/02/2010

**End Date:** 11/02/2010

**Email Address:** Kristina.buenafe.jqus@gmail.com

**School:** Josiah Quincy Upper School

**Have you already started your capstone project work with students?** No

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

I am revising my capstone action plan because of an unexpected schedule change (i.e., the Geometry class I had planned to teach was taken out of my schedule). I will start in mid-November 2010 and end in June 2011.

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

See above--I am revising.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

The unexpected schedule change has made things go badly with respect to CAPSULE. I have to stay consistent with the other 11th grade math teacher and would like to get her on board with any projects that I do. Additionally, there is another CAPSULE teacher at my school and he has already done the three-legged chair with my math students in his tech class, so I removed that from my action plan. I will start coordinating with him to incorporate ETF curriculum as capstone work in my senior math classes.

### Reflection

**Class Size**

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**Course Name**

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**Highlights of your Action Plan**

I have started a "design your own house" project (but had to move it to next term), completed some house design activities, and used stop-animation videos for a project.

**Implementation of your Action Plan?**

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**In Class Activities Created as a Result of CAPSULE**

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**Sample Student Work?**

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**Have your students reaped the benefits of more CAPSTONE based learning?**

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**What have you changed about your style of teaching as a result of participation in CAPSTONE?**

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**And please add ANYTHING else you would like to these questions…!!**

I will be concentrating on implementing more during the upcoming two terms. I have not requested SolidWorks so I do not need it.

## William Chan

### Implementation Plan

This Capstone experience is designed for Josiah Quincy Upper School (JQUS) students enrolled in Technology Literacy I & II classes that meet the Massachusetts Curriculum Frameworks Standards. The students will build and test a prototype of backup power source for an electronic device such as an iPod in the event that its battery becomes fully discharged. The prototype will be assembled and tested as the students study electrical systems. Later, when studying manufacturing technologies, the students will use the Engineering Design Process (EDP) to redesign the prototype with the goal of optimizing for a mass production system. The students will document their experience by creating a poster and a PowerPoint presentation.

This Capstone experience has been developed in order to give the students hands on real-life experiences to reinforce the concepts they are studying. Building and testing the circuit will reinforce the electrical systems skills and concepts. Using the Engineering Design Process (EDP) to redesign the original circuit for mass production will reinforce the concepts in the manufacturing and any related EDP topic areas.

Josiah Quincy Upper School (JQUS) is a plot school within the Boston Public School district located between the communities of Chinatown, Bay View and South End of Boston. JQUS houses grades 6 – 12 among three campuses: 152 Arlington Street, 900 Washington Street, and 20 Church Street. All or most of our students arrived at JQUS from Josiah Quincy Elementary School located at 885 Washington Street. JQUS is a middle and high school.

It was the vision of the parents from the Josiah Quincy Elementary School eleven years ago and the current headmaster, Dr Bak Fun Wong at Quincy Upper School to have a school that will house students from Kindergarten to grade 12 and possible to grade 16. In fact we have two students who have stay together from kindergarten to completion of their college education (K to 16). The enrollment at JQUS is approximate 600 students with 85% of the students’ population is on free lunch waivers and reduced lunches.

I have several roles and responsibilities at JQUS. First, I teach two technology literacy courses at the high school and an entrepreneurship course based on the Network Foundation for Teaching Entrepreneurship (NFTE) curriculum. Second, I am in charge of the school’s network infrastructure, faculty and staff’s laptops and information technology (IT). Finally, I was a FIRST[[1]](#footnote-1) FRC[[2]](#footnote-2) mentor for 3 years and currently a mentor for FTC[[3]](#footnote-3).

I have chosen these actions hoping to encourage more students to pursue the field of engineering studies or at the least having the students changed their attitude towards STEM education. Mostly, I want my students to have positive experiences with their STEM courses during high school.

**Action Plan #1 Duration about 2 weeks**

1. Present an example of a simple circuit and Ohms Law.
2. Conduct a wire stripping and soldering lab activity.
3. Conduct a circuit building and testing lab activity.
4. Introduce the USB Power Source project.
5. Complete building the USB Power Source project.

**Content and skills to be learned**

The following lesson addresses the learning standard found in the Massachusetts Curriculum Frameworks for Science and Technology/Engineering, May 2006.

**5. Energy and Power Technologies—Electrical Systems**

5.1 Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit. Identify the instruments used to measure voltage, current, power consumption, and resistance.

* 1. Identify and explain the components of a circuit, including sources, conductors, circuit breakers, fuses, controllers, and loads. Examples of some controllers are switches, relays, diodes, and variable resistors.
  2. Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm’s law

**Action Plan #2 Duration about 3 weeks**

Week 1:Using the Universal Systems Model (previously studied) the students will apply it to the USB Power Source project they built in the electrical systems activity.

Each student will create a PowerPoint presentation illustrating the steps of the fabrication process they experienced building the USB Power Source prototype.

Week 2: Using the Engineering Design Process, the students will redesign the USB Power Source container for mass production.

The students will produce orthographic and isometric sketches of possible redesign solutions

The students will model their best solution using 3D Computer Aided Design software.

Week 3: Students will develop a PowerPoint presentation and poster describing their Engineering Design Process experiences with the USB Power Source product.

**Content and skills to be learned**

The following lesson addresses the learning standard found in the Massachusetts Curriculum Frameworks for Science and Technology/Engineering, May 2006.

1. Engineering Design

1.1 Identify and explain the steps of the engineering design process: identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct prototypes and/or models, test and evaluate, communicate the solutions, and redesign.

1.3 Produce and analyze multi-view drawings (orthographic projections) and pictorial drawings (isometric, oblique, perspective), using various techniques.

1.4 Interpret and apply scale and proportion to orthographic projections and pictorial drawings (e.g., ¼" = 1'0", 1 cm = 1 m).

1.5 Interpret plans, diagrams, and working drawings in the construction of prototypes or models.

7. Manufacturing Technologies

7.1 Describe the manufacturing processes of casting and molding, forming, separating, conditioning, assembling, and finishing.

7.2 Identify the criteria necessary to select safe tools and procedures for a manufacturing process (e.g., properties of materials, required tolerances, end-uses).

7.3 Describe the advantages of using robotics in the automation of manufacturing processes (e.g., increased production, improved quality, safety).

**Beyond Implementation**

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| |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | **Build of Materials (BOM)** |  | Vendor | Part # | Alternate Vendor | Part # | | 9V Battery | 0.69 | RadioShack | 23-875 |  |  | | 9V Battery Snap Connectors | 0.50 | RadioShack | 270-325 |  |  | | 5V Voltage Regulator (7805) @ 1A | 1.59 | RadioShack | 276-1770 |  |  | | Female USB Connector | 2.22 | Microcenter | 243717 | [www.xionusa.com](http://www.xionusa.com/) | XON-USBFFH | | Container to hold 9 V battery, clip, and regulator |  |  |  |  |  | | Solid Copper Wire |  |  |  |  |  | | Solder |  |  |  |  |  | | Heat Shrink Tubing |  |  |  |  |  | | SuperGlue or epoxy |  |  |  |  |  | |  | $5.00 |  |  |  |  | |  |  |  |  |  |  | | **Start-up Materials** |  |  |  |  |  | | Safety Glasses & Plastic Gloves |  |  |  |  |  | | Dremel Tool & cutting bits |  |  |  |  |  | | Mini square file |  |  |  |  |  | | Cutters & wire stripper |  |  |  |  |  | | Soldering Iron |  |  |  |  |  | |

**Implementation Impact**

Schedule: This plan is for a class scheduled to meet 5 times per week for four 50 minute periods and one 72 minute period.

Lab Considerations: Computers with 3D CAD software are required.

Tools required include soldering irons, wire cutters/strippers, safety glasses, digital volt meters, mini files, and a dremel moto-tool & cutting bits.

Lab Availability: Shared labs need to be reserved in advance.

**Performance Monitoring**

The deliverables are worksheets, the prototype, the poster, and the PowerPoint presentation.

**Appendix A: References**

[www.maximumpc.com](http://www.maximumpc.com)

Engineering the Future: *Science, Technology, and the Design Process*

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Key Curriculum Press Publisher

### Mid-Year Evaluation

**Start Date:** 10/28/2010

**End Date:** 10/28/2010

**Email Address:** wchan3@boston.k12.ma.us

**School:** Josiah Quincy Upper School

**Have you already started your capstone project work with students? No**

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2:

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

Dec 1 - Jan 15

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

Possibly an USB power source. 16 students. Student will research, prototype, and manufacture an USB power source. The other possible project would be to research, design, and build a device that would be able to move water from point A to Point B in a developing country using only the country's resource.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

We get $500.00 funding for the CAPSULE project.

### Reflection

## Michael Clark

### Implementation Plan

1. Describe the current status of engineering education at your school.

Currently at The Engineering School @ Hyde Park we have implemented a 9th grade Principles of Engineering course. The course brings together science, technolgy, engineering, math, and humanities (english and history). I use the PLTW (POE), Museum of Science (Engineering the Future), and Autodesk 2010 curriculums. I also use online resources from other engineering fields. All student must have a flash drive as this device becomes their text book. The POE curriculum is place on their flash drive and a hard copy is placed into their three inch engineering binder/journal. Draft copies of Engineering the Future textbooks are available in the class room as well as one set of Autodesk 2010 tutorial textbook.

I belong to the 9th grade team. As a team, we work well together. We support each other. We have community meetings with our students. We reinforce the science, technology, engineering and math connections with each others subject area. We help each other with their

My classroom will hold up to 25 students. Room 051 has 25 computer work areas as well as hands on work space. Each computer is loaded with Autodesk 2010. I have an In Focus machine and two moveable tool carts. I have table version drill press, band saw, electric mitre saw and grinder. All this equipment is bolted to the moveable carts. Down below the carts are equiped with hand tool, such as hammer, screw driver, epoxy, clamps, hand saws, string, rubber bands, glue, hails, screw, sandpaper, skill saw, hand drill, palm sanders, etc., etc., etc. TES is also equiped with a computer lab for the othe subject areas. The two cart are moveable so that the sience, math and humanity taechers can use them in the classroom as the year move on.

The only other engineering course offered is a capatone type program at the 12th grade level. I do not know anything about the program, except that a lot of 12th grade students will come to me or assistance. I do not know of any type of previoys experience that in coming 9th grade students need to have to enter TES.

1. Provide your assessment of your district’s view on graduation requirements related to STEM.

I do not know what the graduation requirements are related to STEM. I do know that beside the general requiremennts for graduation that each school have their own requirements approved by the city.

I believe that STEM education is very important for the education of our students and for what the future will hold for them in the job market, the economy and the world theatre.

**Action Plans**

1. What types of actions will you take?

My first action plan will be to build support in my school TES to add a second CAD program Solidworks to the computers in room 051. In the first week of school I will see if the towers have enough room to download a second CAD program. If it can, I’m all set and I can go onto my fourth action plan. If not I will need to go to action plan two.

My second action plan I will need to go to the administration an make a request that the ram is increased on each computer in room 051. If my request is approved, I’m all set and I can go onto my fourth action plan.

My third action plan I will need to go to the administration and request two computers that have enough ram to hold the Solidworks software. On this plan I will use the Solidworks software as an incentive for students to go further into engineering during the class or as an after school program or club. If my request is approved I’ll move onto my fourth action plan.

My fourth action plan will be to improve my current course POE by adding a second CAD system to the curriculum. This software will be Soildworks. Engineering is a vast area. Different areas use different types of CAD programs. I will be using this program with capstone like projects, reverse engineering, mouse trap vehicle, putt-putt boat, SMET device, Rube Goldberg device, and the marble sorter. I will introduce Solidworks by implementing the 5 tutorials that are being developed by Abe Zeid, Professor of Mechanical and Industrial Engineering at Northeastern University, College of Engineering.

### Mid- Year Evaluation

**Start Date:** 10/28/2010

**End Date:** 10/28/2010

**Email Address**: mclark2@boston.k12.ma.us

**School:** The Engineering School

**Have you already started your capstone project work with students**? No

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other: As soon as we receive the SolidWorks 2010 software and it is loaded on each cpu

**What are the approximate planned start and end date(s) of your capstone project work with students?**

See answer to #3

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

Course is the Principles of Engineering with 45 students. I will be working with Abe and Jess at NEU. They will be creating the orientation to SolidWorks for my students.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

Have not heard from whoever will be helping with the software. I emailed Jess our contact person. Still have not received the large posters on The EDP.

### Reflection

## Chris Connors

### Implementation Plan

### Mid-Year Evaluation

**Start Date:** 11/10/2010

**End Date:** 11/10/2010

**Email Address:** connors934@gmail.com

**School:**

**Have you already started your capstone project work with students?** Yes

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

second half of term two

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

In each of my three courses, I plan on having students do a capstone project where they take on a challenge, develop a solution and present their findings. I plan on having their findings presentation occur after school hours at the school similar to a band concert in importance. There are approximately 75 students in the program at this time. Courses include: Engineering the Future, Junior Senior STEM and Fashioning Technology. Projects will include some combination of computer designed objects fabricated with 3D printer, lasercutter and vinyl cutter.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

This year, I am developing a new program in Technology and Engineering. One of the challenges that I am having is converting one off hacker style projects into classroom lessons with repeatable results across the population of students.

### Reflection

**Class Size:**

Range of 3 to 18

**Course Name:**

Engineering the Future, Fashioning Technology and Junior/Senior STEM

**Highlights of your Action Plan:**

None.

**Implementation of your Action Plan?**

I have had students in each of the classes do capstone like projects, but none that formally meet what I see as the total criteria.

**In Class Activities Created as a Result of CAPSULE:**

In several classes, I have had students make posters explaining their projects. I did several group projects, and several individual projects. In some of the group situations, students in some groups took advantage of individual accountability loopholes in the grading. In other cases, students did very excellent work that they may not have had they been working solo.

**Sample Student Work?**

**http://www.flickr.com/photos/connors934/sets/72157625338318641/**

**Have your students reaped the benefits of more CAPSTONE based learning?**

Yes

**What have you changed about your style of teaching as a result of participation in CAPSTONE?**

I have been organizing the projects with larger goals that are more challenging.

**And please add ANYTHING else you would like to these questions…!!**

New website created this year = http://pemtech.pbworks.com/

My classes have a pretty wide range of abilities. There is also a very wide range of motivations. Many students are really only motivated by grades. Some of them don't care anything other than whether they are passing. Others just want an easy class. Others will work with great personal dedication regardless of their grades. It is much easier to categorize the lower performing students than the higher performing ones. I can give a dozen or so name to students who don't work/learn well in class. The ones who do work/learn well in class are just good kids who are great to be around and work with. They are positively motivated and well adjusted. However, you don't get a whole lot of recognition and awards for getting results from the good students. If you can convert the lower performing students to higher performers, then you can be a hero.

## Kenneth Cray: (Team)

### Implementation Plan

Current status of engineering education at my school:

K: Being a pilot school we have a small student body and very limited resources. I teach the sole engineering class using a modified ETF curriculum. Limited resources means I typically provide whatever consumables and supplementary resources (equipment, tools, videos, and additional print) materials that are used in the class. There are no fabrication tools or facilities as my classroom is not a standard laboratory or shop room. It’s just a typical classroom that you would find on the second floor of any YMCA building, although it does have water (I’m thinking Putt, Putt boat here). If all of the enrolled students attended class every day there would be between 15-18 students, and the room has very little space available for storing project work. We have access to ten laptops which the students share in producing engineering and/or portfolio related assignments at the end of each trimester.

A: The Learning Center for the Deaf’s technology education consists of me. My high school has approximately 50 students so there is need of only one teacher. Technology is not taught as a separate class until the high school level. It is not integrated in any of the subject matter. In the fall I will have a larger classroom so that the students have more space to create but there is little storage space. We do have access to Mac laptops, a woodworking classroom, and some equipment the school’s maintenance department.

B: I am the only science teacher at the Southeast Alternative School. However, I collaborate extensively with the math and Language teachers in order to integrate cross curricular projects which can provide assessable student work.

My assessment of STEM graduation requirements at my school.

K: My school is a grade 10 thru 12 alternative education facility which requires nine credits, or the equivalent of three full-year classes, in both math and science for graduation. The engineering class is one of four science classes that students may pass to meet the graduation requirement. Not all students will take the engineering class. During the past five years the school has emphasized literacy, language and math skills.

A: The Learning Center for the Deaf (TLC) requires 4 years of science and math. A two-day per week technology /engineering course for one year is also required. STEM classes are valued; however, ELA is the priority.

B:

Other details that impact teaching and learning at my school. We consider these the “constraints” that impact teaching and learning.

K: My students typically range in age from 17 to 21 years old, have a wide range of math and communication skills, and have arrived in my classroom after having voluntarily or involuntarily, left one or more of their previous schools. It’s not uncommon for my students to have been out of school for one or more years, to be involved with the legal system, or to be a parent. Sometimes they arrive in our school because of safety issues in their previous school. Beyond these life situations, or perhaps because of them, our biggest constraint to their success is poor attendance.

A: The students who I teach range in age from 14-22 years. Their abilities range from college bound students to students working on basic life skills. Many have multiple physical, cognitive, and social issues in addition to deafness. All classes are taught in ASL, spoken English is taught as a separate class. TLC has a bilingual education philosophy where ASL is used to teach English as a second language. All my students are considered underserved.

B:

Action Plans

We are planning to create and/or improve on our technology course to meet the unique needs of our students.

Much of our planning time is spent on modifying existing curriculum or searching for appropriate curriculum to meet the needs of our students.

Our focus is to develop a capstone-like project that is geared to maintain high motivation, contains a variety of hands-on activities, provides opportunity for a wide range of skills and abilities, and has a balance between student creativity with support constructs to guide their learning. The timeline for the project is defined only by the individual tasks involved instead of amount of class time so that the unique constraints of our populations are served.

Our goal is for the students to use project based learning to gain an understanding of the engineering process.

Action Plan #1

Solar Cooker

Using the engineering design process, the students will build a solar cooker that will either cook a hotdog until it splits (Kayem franks WITH skin) or to melt chocolate and a marshmallow to make a delicious s’more. Materials to build the cooker include cardboard boxes, shiny silver laminate from Flexcon (or aluminum foil), tape, and clear contact paper. This project must be done in early fall or late spring to maximize the strength of the sun (sun angle).

Students will:

* Document each step of the project by taking pictures and/or videotaping.
* Organize the visual media into a poster, bulletin board, and/or PowerPoint AS they are moving through the process.

Steps:

* Identify the problem(s) in their own way.
* Research types of solar cookers that exist. Determine how they work. Discuss conduction, convection, radiation, and solar angle as it relates to the solar cooker.
* Determine the minimum temperature needed to cook the item.
* Create a list of the materials needed and what materials are available.
* Determine other constraints that may impact the construction.
* Either as a whole group, small group, or individual, sketch possible designs using orthographic and isometric drawings if appropriate.
* Discuss each design to share ideas.
* Determine the best possible design based on the ideas generated.
* Either as a whole group, small group, or individual, constructs the solar cooker.
* Test (record time vs. temperature data), compare, and evaluate their cookers. List ways to make changes.
* Redesign and retest.
* Communicate their results.

ACTION PLAN #2

STRAW TOWER

Using the engineering design process, students will design and build a free-standing tower that will support a minimum weight of 1 lb for a minimum of ten seconds. It is suggested that this activity be presented after the solar cooker since there are more constraints in this project.

Constraints

* Students are given 40 straws & 50 small paper clips to construct the structure.
* Students are allowed to use tools like a drawing compass, a pair of scissors, and a ruler but they cannot be part of the tower.
* The tower must be self-supporting and free standing.
* The minimum height is 30 cm.

Students will:

* Document each step of the project by taking pictures and/or videotaping.
* Organize the visual media into a poster, bulletin board, and/or PowerPoint AS they are moving through the process.

Steps:

* Identify the problem(s) in their own way.
* Determine and represent the height of 30cm.
* Research types of towers to determine common characteristics. Introduce and discuss the physics involved including the forces of compression, tension, live/dead weight, points of strength and weakness, etc.)
* Experiment with the material to determine the best way to connect them.
* Either as a whole group, small group, or individual, sketch possible designs using orthographic and isometric drawings if appropriate.
* Choose the best idea.
* Create the structure.
* Test it to see if it meets the constraints.
* Rebuild or improve if necessary.
* Communicate their results.

Outcomes for both Action Plans:

Formative assessments: a rubric and the visual media generated for each step or group of steps.

Summative assessment: Using the visual media of this process, students are videotaped explaining the process. This is put on a CD and shared with parents, teachers, other staff, or each other. Models will be placed on display.

Describe how success will look.

K: To me a successful team will have created a final product, while having exhibited an ability to work cooperatively. They will also have demonstrated a working knowledge of the engineering design process by explaining the process and presenting their design(s) to their peers, or others, through a PowerPoint presentation, followed by a question and answer session.

A: I will consider this activity successful if the students are engaged, if they are able to work in a group or team, if there is a low level of frustration and maintain a challenge, and if they can communicate at least one concept that they have learned.

### Mid-Year Evaluation

**Start Date:** 10/29/2010

**End Date:** 10/29/2010

**Email Address:** kencray@verizon.net

**School:** Greater Egleston High School

**Have you already started your capstone project work with students?** No

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1:

Semester 2:

Trimester 1:

Trimester 2: x

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

Start first week in January and hopefully finish by the first week in February

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

The engineering class has 13 students at present and uses the MOS ETF curriculum as the basis of the class, but is modified as needed. We are currently learning about the engineering design process and applying it to the creation of an improved cell phone holder. The capstone project will consist of the students using the EDP to design and build solar cookers which could be used in third world countries. The students will document their work by taking photos during the EDP stages and the photos will be used to create a PowerPoint presentation as part of the Communication step of the EDP.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

None.

### Reflection

**Class Size:**

12

**Course Name:**

Science & Engineering

**Highlights of your Action Plan:**

We are just about ready to begin the first part of the plan which will be to use the EDP in designing and building a solar cooker. The second part of my plan has changed in that the topic, originally to be tower related, will be to introduce the students to electricity and communication systems via the MOS electronic kits…something we’ve never been able to do before due to a lack of equipment. CAPSULE’s equipment stipend has made this possible.

**Implementation of your Action Plan?**

The first part of the plan is about to begin. The students will review the Chapter 2 reading in the Engineering the Future text and brainstorm some other possible solutions to Shawn Frayne’s dilemma about finding suitable environmentally friendly cooking fuels for use in Haiti. Hopefully, someone in the class will suggest using the sun to cook, and if not, I will suggest it. Then we’ll define the problem, and begin the research.

**In Class Activities Created as a Result of CAPSULE:**

We have done a couple of bridge-building projects instead of the tower project originally planned, but after the solar cooker project is completed, Project 4.0 in the Engineering the Future curriculum will be done and, again, this is only possible as a result of CAPSULE funding which allowed the purchase of the necessary equipment.

**Sample Student Work?**

There are no samples as of yet. Hopefully, there will be some solar cooker research results to share by the end of the month.

**Have your students reaped the benefits of more CAPSTONE based learning?**

My class has always been project based so in that regard, there has been little change other than the type of projects we’ll undertake will change.

**What have you changed about your style of teaching as a result of participation in CAPSTONE?**

My teaching has always been a more hands-on, team-based activities approach, and that really hasn’t changed. What will change is the activities in which the students will participate.

**And please add ANYTHING else you would like to these questions…!!**

The teaching schedule at my school, an alternative pilot school, is frequently interrupted for a variety of life-based learning opportunities for our students. This does take a bit of a toll on regular classroom time and activities. Another factor that impacts the progress we are able to make in class is the students’ attendance rates. High absenteeism, due to a variety of factors, tends to slow down forward progress. However, I’m hoping the new projects we’ll be undertaking as a result of the CAPSULE program will make the students want to attend class on a more regular basis in order to be able to participate in these projects which, hopefully, they’ll find both fun and educational.

## Viviana De Mello

### Implementation Plan: Team (See Kristina Buenafe)

### Mid-Year Evaluation

**Start Date:** 11/19/2010

**End Date:** 11/19/2010

**Email Address:** vivianademello@gmail.com

**School:** Jeremiah E. Burke High School

**Have you already started your capstone project work with students?** Yes

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1:

Semester 2:

Trimester 1: x

Trimester 2: x

Trimester 3: x

Other: To be more accurate we will work during Terms 1, 2, 3 & 4.

**What are the approximate planned start and end date(s) of your capstone project work with students?**

We will be working all school year around until the end of the school year. We already started. However, we work in the project in the After school program.

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

We are doing the 3 legged chair project, for three Geometry classes. I have a total of approximately 45 students. They work in groups to develop the project in the after school. After the building of the chair students will have to write a report where they will have to use some of the Geometry concepts that they learned in the course.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

None.

### Reflection

**Class Size:**

Approximately 15 English Language Learners for each class where the projects were implemented

**Course Name:**

Sheltered English Instruction Geometry (for English Language Learners)

**Highlights of your Action Plan:**

Students will complete "hands on", capstone projects that require the use of the Geometry concepts learned in class.

**Implementation of your Action Plan?**

I implemented the first project in the After school program, for my 3 Geometry classes

**In Class Activities Created as a Result of CAPSULE :**

Students completed the " 3 legs chair project" in the after school, not in class, so that the project would not interfere with the Geometry pacing guide

**Sample Student Work?**

None, since we only did the hands on projects in the After school

**Have your students reaped the benefits of more CAPSTONE based learning?**

Not yet, because the projects were developed in the After School, and I feel the need to develop a rubric for some type of Capstone project report. In this report students would connect the hands on activities of the projects with the abstract concepts learned in class.

**What have you changed about your style of teaching as a result of participation in CAPSTONE?**

My teaching style is starting to change as we are going to start working on the reports for the first project, connecting the "hands on" projects to the abstract concepts learned in class. So, hopefully my students will realize that the project best solutions (in real life) had specific Geometric characteristics. For example: for the maximum stability and loading capacity of the 3 legs chair, the legs had to touch the ground as the 3 vertices of an equilateral triangle.

## Michael Dudley

### Implementation Plan

Project Description:

This project is a culmination of your physics learning experience. Students are

expected to apply physics principles acquired throughout the year to the design of a

system, component, or process. Each project includes the development and use of

design methodology, formulation of design problem statements and specifications,

consideration of alternative solutions, feasibility considerations and detailed system

descriptions. Projects include realistic constraints, such as economic factors, safety,

reliability, maintenance, aesthetics, and social impact. Students are expected to present

orally their results in a series of design reviews and students document their solutions in

a written report. A working prototype or detailed design, as appropriate, of their solution

is required to complete the project.

Project Objectives:

The students are expected to learn and demonstrate the following abilities:

1. To solve open-ended problems,

2. To learn and effectively utilize the engineering design process to solve a real-world

problem

3. Apply physics concepts and other science and math skills to implement a solution

4. To effectively communicate ideas in a written and oral format,

5. To effectively engage in scientific, peer-reviewed discourse around the

presentation of their ideas;

6. To effectively work in a team,

7. Develop critical self-evaluation and risk evaluation techniques.

Project Topic:

Each student group is responsible for choosing their own topic and having the topic

approved. The topic choice is entirely up to the group, with the following guidelines/

restrictions:

1. Projects should be a solution to a non-trivial problem that improves people’s everyday

lives or impacts the community. Project work should be proven non-trivial through an

analysis of its impact on others or on the environment.

2. Projects must be broad enough in scope (difficult enough) to warrant a half or full year

of work.

3. If there is already an available solution to the problem, the project should provide a

significant and needed improvement to the current solution.

Deliverables:

Each group is responsible for turning in pieces of work that serve as a documentation

of their capstone. These deliverables should culminate in a portfolio that students can

present in addition to their final solution.

1. A statement of the problem or need that the group wishes to resolve;

2. A research log that contains a breakdown of the following:

○ Full theoretical explanations of the physics principles that the group will need

to study or use in order to understand how to solve the problem or improve a

previous solution to a problem;

○ Research about how others may have gone about solving the problem;

○ A full bibliography (APS format or other) that accurately cites the sources used.

3. A log of the possible solutions that have been developed by the group to solve the

problem (with drawings or diagrams), and a documented determination of which solution

the group wishes to pursue or build;

4. A full breakdown of the testing and evaluation of the prototype or solution, including

numerical data and failure analysis if necessary;

5. Next steps that your group would take for a redesign.

6. Three design reviews (presentations) spaced throughout the project: Initial research

and problem statement, possible solutions and prototyping, final design presentation

7. Final poster detailing research, prototypes, designs, and final solution

These deliverables can be turned in as a binder, a group notebook, or some other

format.

Assessment:

Because this capstone project is a learning experience, it will not be assessed in a

formal way. Instead, the aim of the project will be to complete the capstone and engage

in formal discourse around each group’s work, as scientists and engineers would. This

project will be given an (Exemplary) (A) grade upon its full completion.

Timeline:

This capstone project will be completed over the course of the Spring Semester. There

will be three milestone presentations that will be given by each group at different points

throughout the semester. This will allow each group to account for their work and keep

up with its completion. Each group will present to the class and to the instructor:

1. The problem that they to solve and the initial research about the problem,

Including a bibliography of sources that they found in their research (week 4);

2. The possible solutions that they have brainstormed and the solution that they

chose to implement, including the method that they used to determine which

solution to implement (week 10);

3. A final evaluation of the prototype, the results of any testing done with that

prototype, and any proposed next steps or redesign work (week 16).

### Mid-Year Evaluation

**Start Date:** 11/09/2010

**End Date:** 11/09/2010

**Email Address:** dudleym@ncces.org

**School:** North Central Charter Essential School

**Have you already started your capstone project work with students?** No

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

Planned start date: January 2011 Planned end date: May 2011

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

I plan on a mini-capstone to close Semester One that focuses on the mouse trap car, and asks students to make improvements to that system with their knowledge of mechanics in my Physics class. I will also be using a final capstone project involving engineering projects that touch all aspects of my physics course (mechanics, E & M, optics, and sound) at the end of the second semester.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

I haven't received the surveys that I needed to give to my students. Is this a problem?

### Reflection

**Class size:**

` 7

**Course Size:**

**Physics**

**Highlights of action plan:**

Complete a mini-capstone on mousetrap cars in conjunction with our unit on Momentum and Energy; end Physics with a general engineering capstone asking students to apply their physics knowledge to an engineering context.

**Implementation:**

Pending beginning of Momentum and Energy; this unit is running a little late.

**Created activities:**

The Mouse Trap Capstone is completed and waiting for implementation. No sample student work or reportable results as of yet.

## Frankin Garcia-Mansilla

### Implementation Plan

### Mid-Year Evaluation

### Reflection

## Ramiro Gonzalez

### Implementation Plan

What I propose to do at BAA next year is to ramp-up my current lessons that will scaffold to a Capstone Experience. In addition to developing a capstone-like end of term experience, I also want to ramp-up the ETF projects by adding a 3-D modeling component, using ***Sketch-Up*.** With the honor’s students in both Chemistry and Engineering and Technology, I will launch the Science as Exhibition a different type of capstone experience.

**Context:**

Boston Arts Academy is a BPS Pilot School whose mission is to be Boston’s premier Visual and Performing Arts High School. Students are admitted by audition. We offer five majors, they are: Visual Arts, Vocal Music, Instrumental Music and Dance. As you might guess from this information, the student body self-identifies as artists and hence science and other disciplines are generally seen as academic hurdles they must persevere. They often come to us with a history of failure in the hard sciences and as a result come to class with some amount of avoidance behavior. This avoidance behavior presents itself in a variety of ways such as passive aggressive behavior, failure to engage, or plain fear of failure. As a result of this emotional response, new or different pedagogical methodologies should be encouraged.

With this being said, I am interesting in changing the dynamic relationship between teacher and student. Project based education poses a unique experience for young learners, especially in classrooms with heterogeneous populations. Projects often provide multiple entry points for learners. Well-designed projects can provide for a complex set of learning experiences. It also changes the relationship dynamic; it moves the teacher from evaluator to coach or resource. This shift in dynamic may encourage reluctant leaners to go from avoidance behavior to approaching behavior.

I see the capstone as being a win-win dynamic between the student, the community and the school. Too often schools get bad press about low student performance, poor teaching, excessive drop-outs, and schools that fail to meet student’s and parental expectations. This is often due to the fact that schools lack transparency about the work they are doing. Schools often fail to realize that in order to be successful they be must responsive to the many stake-holders. Students also need reasons to ramp-up their game; public exhibitions have a very profound and powerful way of motivating students to engage the curriculum. Capstones experiences when done well motivate students to engage the curriculum in a different and profound way. It is also taps into system of behaviors that are often unreachable by standard paper and pencil assessment methodologies. I am referencing creativity and synthesis (Blooms Taxonomy) the ability to use knowledge in a novel way to solve problems. Inviting the community to witness a capstone is very impressive and makes people feel that schools are in fact doing good jobs and students feel that they are really developing meaningful knowledge and skills.

**Action Plan**

**I have three actions steps related to this experience.**

**Action plan #1**

Though we teach drawing (orthographic and isometric), there is a lack of commitment form me on demanding substantial drawings in the projects submitted by the students. The CAD experience made me realize that 3-D modeling needs to be a substantial part of my expectations. I do not feel competent enough to insist on CAD as the 3-D modeling instrument, nor do I feel that for 9th grade students, such a powerful tool is appropriate. Instead I will explore and become competent in Sketch-Up a free and easily understood 3-D modeling instrument. It is about scaffolding and I believe that Sketch-Up is a good program to scaffold to CAD.

**Action Step #2**

For a variety or reasons Boston Arts Academy does not participate in the science fair sponsored by the district. As an Arts school we mount many performances and exhibition; as a result our students generally feel comfortable presenting and performing. Freshmen do not as a whole have a great deal of experience with exhibitions and performances but they witness the other students perform, for this reason they have expectations on performance. For every unit we cover in ETF we have one or more project that students work in groups to present. What I want to implement is capstone experience that forces the student to use two or more systems learned previously to solve a problem. I want to develop several problems that groups may choose to solve. I want the problem to produce a product that students will defend to an external audience. I want to use this Capstone to assess their understanding of the Engineering Design Process and at least two different scientific domains (electricity, thermal, energy, materials, etc.)

**Action step #3**

The last action step is associated with the work I am doing at the Museum of Science. I am very interested in Science as Exhibition. I am also interested in exploring the intersect between science and art. I think of works like those of Rube Goldburg, some instillations that use physics or chemical principles or even dances that either have a physics theme or use physics to produce the movement. I am thinking initially of using the honor’s students to mount elaborate engineering exhibitions, exhibitions that are interactive with the audience and somehow meld both arts and science. I am thinking that the groups will brainstorm ideas and then work throughout the semester to mount the exhibitions. I want the exhibitions to be mentored by arts staff so that both arts and science are on equal footing and neither is done n the service of the other. I see actions 2 and 3 being end of semester assessment.

**Connections:**

The two Capstones (Actions 2 and 3) clearly have authentic assessment as a common principle. As stated earlier, there are many ways of assessing students but the Capstone experience taps into certain student skills and knowledge that cannot be assessed by paper and pencil exams. The first action step adds another dimension (excuse the pun) to the work being done by the students. All three actions help make the work being done by the students more transparent to the community and the support system of the school and district.

**Beyond your Zone of Influence**

As Jonathan mentioned earlier, change is difficult for schools and institutions. Fortunately I work in a school that is willing to try new and novel things. My first barrier is to move my department to accept the three action steps. Of the three action steps the first action step is the most difficult to implement. Due to the fact that teachers in my department will not be willing to insist on something they do not understand or feel proficient. This requires that we learn it together so that no one feels left out and that our mutual struggle will help us be more supportive of each other and supportive of our students.

I feel that I have administrative support for the action steps 2 and 3, as I have already spoken to my administration about these at the end of the school year. There is both time and funding issues that need to be addressed and solved before we can begin. I need to make several timelines and benchmarks that will help me mark progress. I also need to develop a series of documents that will scaffold the students towards their capstone experience. These include a checklist, schedule and presentation rubric.

**People, Organizations and Things**

This summer has been a great experience both in terms of the work done, but most importantly the people in the group that I feel will be invaluable resources, and I hope that I can be a resource for others. I am also fortunate that as an institution, BAA has many partners that can be taped for support. We also have a culture of exhibition and performance so it will be fairly easy to get others to buy-in. I am expecting to sue the MOS and NU specifically with my action steps. I also want to make sure that the BPS is also meaningfully involved in our implementations. Additionally we have the Qatar Foundation as one of the resources that will be very involved in the action implementation.

### Mid-Year Evaluation

**Start Date:** 11/01/2010

**End Date:** 11/02/2010

**Email Address:** rgonzalez@bostonartsacademy.org

**School:** Boston Arts Academy

**Have you already started your capstone project work with students?** No

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1:

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

begin Sept finsh june

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

Chemistry honors student, about 25 students. Using the engineering process design a solution to a chemcial problem that uses Arts as an element. Engneering students will have a similar project but to so developed.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

I may need support to make some of these projects a reality.

### 

### Reflection

**Class Size**

20-25

**Course Name**

Chemistry/ Engineering

**Highlights of your Action Plan**

This a pilot project for the first year. Honor Students are asked to develop an engineering project that has a chemistry focus that follows the Engineering design Process.

**Implementation of your Action Plan?**

Students will meet on Tues. to work on their project. The deadline for the prototype is Jan. 24. Students will present a working model to an external audience on Jan. 24.

**In Class Activities Created as a Result of CAPSULE**

The whole design of the student experience was the result of the Capsule Program.

**Sample Student Work?**

A group of students is developing a solar-energy water filtrating community fountain.

Another group is developing color-changing make-up

Another group is designing a “decorative wall ornament that uses some of the elements of the “lava lamp.”

**Have your students reaped the benefits of more CAPSTONE based learning?**

Yes, they have learned to ask for help, and at the same time to be more self-reliant. It helps them to realize the complexity of systems and the great amount it takes to develop something.

**What have you changed about your style of teaching?**

I need so do more scaffolding so that students feel more empowered to that this type of challenge. It is hard for students who are usually directed by the curriculum and teachers, to suddenly be expected to solve problems independently.

## Michael Graeber

### Implementation Plan

* **Purpose:**
* The purpose of the Capsule course was to provide us with a variety of information regarding on how we can bring a Capstone like project into our classroom. This will allow students the opportunity to be introduced to the Engineering Design Process. Students can then use the knowledge gained in a Physics course and apply it to their projects.
* **Target Actions:**
  + - * I would like to: Integrate several small “capstone like” projects into my Senior Physics Classes throughout the school year.
      * Also Assist/ Mentor students with their Science Fair or Engineering Projects. Explain how they can use the Engineering design process to design their experiment or project and what other engineering tools like *solid works* can be used in the process.

* **About me and my courses taught:**
  + - * I am a Physics Teacher:
        + I have been teaching Physical Science and Physics courses for just over 10 years now, including other subjects.
      * At Hopkinton HS in Hopkinton, MA:
        + **Hopkinton** is a town just over 30 miles west of Boston. It is best known as the starting point of the Boston Marathon. Population is ~14,000. ~4,500 households w/ a medium income of $90,000 per household and $103,000 for family. ~50% of households have children under age 17.
        + **Education:** At Hopkinton HS there are ~1000 students (~250 in each grade)
      * Currently I teach:
        + Intro to Physics (9th grade, half year), Conceptual Physics (11th and 12th grade) and Honors Physics (11th and 12th grade)
        + The physics in the 9th grade course and Senior Conceptual Course is treated more conceptually, then mathematically. Although, The basic formulas are still utilized as a guide to thinking and solving introductory problems.(math skills are needed) Much greater depth and the level of difficulty mathematically will increase in the Senior Honors Physics course. All levels will cover the same topics.
      * Also I Mentor students with their Science Fair or Engineering Projects.

**Action Plan:**

* Action Plan #1:

During the school year I have a planned curriculum of topics that I should cover by the end of the year. These constraints make it difficult to integrate a large full year capstone project into my class. What I would like to do this year is to utilize the topics and content I cover and add unit based or mini capstone like projects into the curriculum. These projects will be designed and used a way to enhance the current topic covered. For example a mousetrap car designed to use the potential energy stored in the mousetrap to propel a car a certain distance or an egg drop activity into my impulse-momentum unit. These projects will easily fit into the curriculum with out hindering the time needed to cover all the topics throughout the year.

* + ***Unit-based projects*:** Students will be introduced to a new unit using a quick design challenge such as building bridges for a forces unit. The students will come into class the first day of the unit with no previous knowledge of the design challenge and spend approximately half the period completing the challenge and competing with the rest of the class. This design challenge will be referred to throughout the unit (wherever appropriate) to reinforce the concepts covered. Additionally, students will be given a unit project following the design challenge. This project will be similar to the design challenge, but with more constraints and detailed goals. Each of these projects will also include a specific focus component from the engineering design process. The idea will be to teach EDP without having to add another unit to the curriculum. (1-2 weeks)
  + ***Mini-Capstone Project***: This project will be placed at the end of the first semester, halfway through the year. Students will be expected to use all components of EDP, but will not necessarily go into deep detail with any specific step. Similar to the design challenges and unit projects, the mini-design project will also be developed as a competition with no set solution and multiple goals to achieve. Students will also present their final solution to the class and develop a report or portfolio to document their work. (2 weeks or more with deliverables due halfway)
* Timeline: First year introduce a few unit-based projects, see how they progress and depending on success I can add/modify for the years to come.
* Action Plan #2:

During the school year I also Assist/ Mentor students with their Science Fair or

Engineering Projects. This will be an easier way to integrate a capstone project into our school. I will definitely be able to provide the students that choose to do an engineering project with the engineering design process and the tools needed to complete this type of project.

* Timeline: We already have a timeline in place for when certain parts of the project are due.

**Attached (The Following Pages to keep in one document):**

* Table and Outline of unit-based projects.

**UNIT PROJECT IDEAS:**

* **Unit/Topic                           Project**

|  |  |
| --- | --- |
| Intro | Towers, penny boats |
| Forces | Bridges |
| Kinematics | Catapult |
| Momentum | Egg drop |
| Energy | Rube Goldberg – chain reaction |
| Circular motion | Mousetrap car (mini capstone) |
| Waves/light/sound | Instrument design |
| Optics | Mirror maze |
| E&M | Electric motor |
| Thermo/thermal | Putt-putt boat |

### Mid-Year Evaluation

**Start Date:** 10/28/2010

**End Date**: 10/28/2010

**Email Address:** mgraeber@hopkinton.k12.ma.us

**School:** Hopkinton High School

**Have you already started your capstone project work with students?** No

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

~Jan 3 - 31, ~Apr 1 - 29 and All year

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

Conceptual Physics Class; 12th Grade; 20 students Plan to do: Mouse Trap Car Design; Egg drop Design Science Fair / Engineering Projects; several students; all year, guide them through the process; Their own projects

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

At this time I don't have anything to share. Sorry.

### Reflection

**Class Size:**

~21

**Course Name:**

Conceptual Physics (12th grade)

\*Also mentoring a few students with Science Fair Projects.

**Highlights of your Action Plan:**

Wanted to add/continue to do small activities in class. Then have students do a couple of small Capsule like projects/activities; "Egg Drop Lab" and/or "Mouse Trap Car"

**Implementation of your Action Plan?:**

I've continued to do the same type of activities I've always done, but I'm getting ready to have my students do a 2 part egg drop lab in the next week and a half. I'm also "planning" on doing a mouse trap car at the end of the school year.

**In Class Activities Created as a Result of CAPSULE:**

An extended "Egg Drop Lab"

**Sample Student Work?:**

Hopefully I will have student work/ photos in a few weeks.

## Lisa Henderson

### Implementation Plan

**Introduction:**

The goal of this action plan is to redesign common inquiry-based chemistry experiments so they allow students to engage in the Engineering Design Process (EDP). Two filtration labs (The Separation of a Heterogenous Mixture, Cleaning Your Water) will be reworked so that they are contextualized, problem-driven and include the development of an actual product. The redesign of the labs will require student teams to collectively keep a log, develop an action plan based on research, create 2-D and 3-D models, refine their plan, build a mockup and a prototypes, present their findings and submit a final report.

**Context:**

TechBoston Academy is a small pilot school with 755 students in grades 6-12 that offers a traditional college preparatory curriculum that is infused with interdisciplinary and project-based learning. The school requires four yearss of English, Math and Science. The school is housed on the basement and first floor of the Dorchester Education Complex, located in Dorchester, MA. The school is sixty-five percent male and thirty-five percent female. Sixty percent of the student-body lives with-in a three-mile walk zone and the other forty-percent represents the other twenty Boston neighborhoods. The school is culturally rich with students representing the Caribbean, South/Central America, Africa, Southeast Asia, and USA. Statistically, TechBoston’s student body is fifty percent Black, thirty percent Latino, eight percent White and seven percent Asian.

The redesign of the chemistry lab will be piloted in my environmental chemistry class, which consists of students in grades 10 – 12, at least two to three English Language Learners and three to five special education students. The class size ranges between fifteen and twenty-four and most of the students enrolled have taken physics and/or biology. For the past five years males have dominated the class, representing between eighty and eighty-five percent of the population. The majority of the students enrolled in the class are in it because it fits their schedule or they assume that it is not as demanding as traditional chemistry.

**Purpose:**

My overall action plan is to redesign my environmental chemistry curriculum over the next three years so enables students to use the engineering design process and chemistry concepts to so solve environmental problems that are contextually relevant. It is my hope that the redesign will make chemistry more interesting to students by showing them that it is part of their real world; engage students in EDP; develop students conceptual, critical and creative-thinking process; develop student academic social skills; increase students understanding of contemporary environmental problems and gain an appreciation of the use of science and technology to solve them.

I chose to begin my redesign journey with the filtration labs because only small changes need to be made in order to integrate the EDP. Students will be introduced to EDP and the filtration process in the fall and will be challenged to develop a method of filtering sand, salt, iron, and seeds. Teams consisting of two to three students will be responsible for developing and documenting their plan by keeping a written journal, creating final report that describes their methodology and creating 2-D drawings of their solution to the problem. In the spring students will be reintroduced to the concept of water filtration and will be challenged to design a low-cost water purification device to be used by rural people in an assigned country (Ethiopia, Rwanda, Haiti, Afghanistan, Laos).

**Action Plan #1: Design of a Simple Filter**

*MA Technology and Engineering Frameworks Addressed:* *1.1, 2.1, 2.2*

*Chemistry Frameworks Addressed:* *1.1 1.2*

Students will develop a method to filter sand, salt, iron, and seeds using a set of predetermined materials. This exercise is used to introduce the engineering design process, technical drawing in context and assess students’ understanding of physical and chemical properties. Students will be responsible for:

* Creating a report that describes their methodology
* Following their plan
* Analyzing the effectiveness of the plan
* Revising the plan, if necessary.
* Creating an isometric drawing of their final setup

Student success will be determined by measuring the mass of each separated substance and comparing it to class averages. The quality of the final report and drawing will also be assessed via the use of a holistic rubric.

*Implementation Timeline*

|  |  |  |
| --- | --- | --- |
| Time (Days) | Task | Outcome |
| 1 | Invent a holder for six cans that's animal-safe, sturdy, convenient, and easy to carry. | Understand the Relationship between the Engineering Design Process (EDP) and Scientific Method (SM) |
| 3 | Round Robin - Properties of Matter Exploration | Describe properties of matter, explain the difference between a chemical and physical change |
| 3 | Introduction to Engineering Drawing | Learn how to create engineering drawings; understand why engineering drawings are important. |
| 2 | Filter Challenge   * Define criteria and constraints * Brainstorm method * Test method * Revise method if necessary * Communicate findings using power point and a written report | See above |

**Action Plan #2: Design of a Water Purification System**

*MA Technology and Engineering Frameworks Addressed: 1.1, 2.1, 2.2*

*Chemistry Frameworks Addressed:* *1.1 1.2*

Student teams will be challenged to develop a low-cost water filtration system that can be used by rural people around the world. Students will be responsible for the following.

* The completion of a set of activities that will give students background knowledge about concentration units, toxicity, risk, and various types of water quality tests.
* Pre and post testing of various samples of drinking water.
* Analysis of water data
* Analysis of data from commercially tested drinking water
* A list of water toxin removal methods based on research.
* Creation of a 2-D and 3-D drawing of their water purification system that reduces the identified contaminants by at least 75 percent
* Analysis of commercial filters
* Creation of a mock up and prototype
* Analysis of benefits and drawbacks of design
* Presentation of results via PowerPoint
* A 3-D redesign drawing after hearing from other teams (optional)

Student success will be determined by the effectiveness of the filter to remove the contaminant(s) as well as the quality of the final report and presentation.

*Implementation Timeline*

|  |  |
| --- | --- |
| Time (Days) | Task |
| 0.5 | Define the problem including criteria and constraints. Form a team. |
| 1 | Water quality test |
| 0.5 | * Communicate and discuss results * Analyze professional water analysis data |
| 1 | Research possible solutions – use the internet and books to determine possible substrates to be used to cleanup the water toxins. |
| 3 | Engineering drawing – learn how to make engineering drawings in solid works |
| 1.5 | Analysis of commercial filters  Brainstorm, create filter mock-up and evaluate mockup |
| 1.5 | Design prototype |
| 0.5 | Analysis of pros and cons of design |
| 1 | Presentation and critique of other groups designs |
| 1 | Redesign (completed outside of class) – base on performance and other designs, propose redesign that builds on the strengths of your previous design and corrects some of its weaknesses. |

**Connections**

The actions build upon one another. The first action will be used to introduce students to EDP and properties of matter. The second action enables students to build on the knowledge they gained from the first action and apply that knowledge to a current issue. Students will the engineering design process to solve the same type of problem but the issue.

**Beyond your Zone of Influence**

I do not forsee any unusual barriers that might impede my pro(1 - 2 paragraph)

* + - * What barriers might impede your progress?
* People, Organizations and Things (1 - 2 paragraph)
  + - * Who or what might provide you some supports needed to be successful?

### Mid-Year Evaluation

### Reflection

**Class Size:**

24

**Course Name:**

Environmental Chemistry

**Highlights of your Action Plan:**

Completed phase 1 of the action plan. Thinking about phase two, will I able to do it as written or will i have to change it.

**Implementation of your Action Plan?**

I will start part two of the action plan in march

**In Class Activities Created as a Result of CAPSULE:**

Tried a material science project, called biodegradable materials, however, it did not work out that well.

**Have your students reaped the benefits of more CAPSTONE based learning?**

Not yet

## Anthony Iarrapino

### Implementation Plan

The district has a published STEM pathway and is supportive of STEM activities and courses. We currently have excellent supportive relations with U Mass Lowell and Middlesex CC. Lowell High school has an Engineering Academy under the Math Department and the robotics course is offered within the Academy. There is adequate latitude to revise the course as I am the only teacher in the academy and for the robotics course.

Course enrollment is anticipated to be between 20 – 25 honors/college weight students in grades 10-12 who will meet daily for a 45 minute period. The course is based on the VEX robotics curriculum [appendix A] and Autodesk Inventor 3D software. As each unit is executed, additional knowledge about the VEX robotic platform is gained, underlying physical principles are introduced and skill using the Inventor application is improved.

The capstone project becomes the assessment of the skills and knowledge gained during the course and fits with the thrust at LHS to use alternatives to written tests. It will provide students the opportunity to experience an extended project with finite date deliverables in a concentrated team environment. The object is to provide a good opportunity to succeed while giving them realistic learning experiences.

Graduation requirements to gain Engineering Academy status annotated on a student official transcript are successful completion of the courses of CAD and Engineering or Advanced Architecture or Robotics.

I chose robotics because the course content is STEM-related, the engineering design process is inherent in the units, and the VEX platform and curriculum provides for design, integration of hardware and software, teamwork, hands-on and testing requirements and specific problems that can be set for autonomous robotic accomplishment.

**PROJECT COMPONENTS**

The project will be introduced during the month of October and culminate in January in lieu of a written question and answer type assessment. The project implementation will consist of the following major components

**Project Definition**

The project definition will contain;

* Clear statement and definition of project goal
* Explanation of learning objectives
* The project calendar with team/individual benchmarks/deliverables with completion dates
* Assessment techniques and related rubrics to be employed

**Team Membership**

During the introduction of the project, time will be dedicated to:

* Explaining the various roles that may be inherent in any project i.e. analyst, logistician, record keeper, researcher, designer, problem solver, time manager, etc.
* Emphasizing working styles and how that affects work completion
* Team make-up [anticipated to be between 2-3 members] will be based on gender and observed class behavior to try to balance team membership capability

**Project Sponsor**

To lend an air of reality to the project a representative from U Mass Lowell Robotics Department will be invited to introduce the project. This person, along with possibly other outside industry reps will also be the final judge of the project outcomes.

**Student Deliverables**

* Project notebook with notes, sketches, etc
* Project timeline
* Assembly drawings and Bill of Materials
* Reflective log
* Reflective summary paper
* PowerPoint benchmark presentations
* Operating robot

**Teacher Deliverables**

* The learning goals for the project
* Project definition
* Project supplies
* Project coaching
* Overall capstone project management logistics
* Training for
  + The Engineering Design Process
  + Inventor Software
  + Vex Robotics
  + Teamwork
  + Presentation Skills
  + Time Management

**Overall Project Implementation Schedule**

* Project initiated in October
* Benchmark reviews conducted every 2 weeks
* Final demonstration and presentation January [2 weeks prior to end of term]

**PROJECT IMPLEMENTATION ACTIONS PLANNED**

|  |  |  |
| --- | --- | --- |
| TASK | COMPLETION DATE | COMMENTS |
| Develop project definition | Mid September |  |
| Identify learning outcomes | Mid September | Will be used for assessment rubrics |
| Develop key rubrics for project assessment points | End of September | Benchmark reviews, notebooks, robot operations,  Reflection notes and paper, teamwork |
| Work with English Dept for paper summary rubric | End of September |  |
|  |  |  |
| Develop team membership matrix | End of September | Based on gender and individual capability |
| Identify project sponsors | Mid September | UML, MCC, Motorola, EMC, Abe, Jessica |
| Develop presentation material | End of September |  |
| Develop modules on team roles and dynamics, presentation skills, time management | Late Sept – Early October |  |
| Review with project sponsor | Mid to late September |  |
| Delivery of training modules | Mid to late October | team roles and dynamics, presentation skills, time management |

The constraints of the project may be the development of supportive material for the project. I plan on looking for already developed modules with supportive DVD’s. I will be working with my librarian for support.

Also the number of teams may be challenging to keep track of and provide adequate coaching. I might tap into supportive resources from Gear-up or U Mass Lowell Gk-12 fellows program.

**Student Outcomes**

Students will develop skills and knowledge of

* Teamwork
* Time management
* Written and verbal communication
* Application of STEM subjects to solve the project problem
* Robotics
* Physical principles of speed, torque, center of gravity, speed, and applied Newton’s Laws

**Appendix**

**A - Vex Cirriculum**

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Course Schedule continued

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APPENDIX A: REFERENCES

APPENDIX B: KEY TERMS

APPENDIX C: LESSONS & STUDENT HANDOUTS

APPENDIX D: ADDITIONAL DOCUMENTATION

### Mid-Year Evaluation

**Start Date:** 11/02/2010

**End Date:** 11/02/2010

**Email Address:** ajiarrapino@comcast.net

**School:** Lowell high School

**Have you already started your capstone project work with students?** Yes

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

Start Mid November End Mid January

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

Students will use the Engineering Design process to design a robot with the capability to successfully complete a specifies challenge given time and space constraints. Design will incorporate lessons learned about speed, torque, platform stability, operational mode [tank vrs arcade] gear ratios and friction traction considerations.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

Need to reinforce prior learnings with intro of each new lesson and always relate the engineering design process steps when applicable. Students need training in teamwork and project planning

### Reflection

**Class Size**

26

**Course Name**

Robotics I & II

**Highlights of your Action Plan**

Team Membership

Intro of team concept and setup of teams

Project Sponsor

Solicit participation of outside resource for project implementation

**Student Deliverables**

•Project notebook with notes, sketches, etc

•Project timeline

•Bill of Materials

•Reflective log

•Reflective summary paper

•PowerPoint benchmark presentations

•Operating robot

**Teacher Deliverables**

•The learning goals for the project

•Project definition

•Project supplies

•Project coaching

•Overall capstone project management logistics

•Training for

oThe Engineering Design Process

oInventor Software

oVex Robotics

oTeamwork

oPresentation Skills

oTime Management

**Implementation of your Action Plan?**

•Implemented teaming concept for unit activities changing team makeup to mix dynamics experience

•Established outside contact for external robotics resource

•Introduced Lab Report format to document unit test results and observations

•implemented 2 column notes to document research results

•training on VEX robotics ongoing - unit 6 gears, chains and sprockets

**In Class Activities Created as a Result of CAPSULE**

Teaming

Technical Lab Writing

Small Project testing

Limited Research and testing of concepts

**Have your students reaped the benefits of more CAPSTONE based learning?**

Seem to approach testing from a more technical perspective

Understanding dynamics of teamwork

**What have you changed about your style of teaching as a result of participation in CAPSTONE?**

Approach lessons from a more engineering design perspective with a better connectedness

## Mark Kobel

### Implementation Plan

This Capstone Experience is designed for 9-10 grade students enrolled in a Technology/Engineering class that meets the Massachusetts Curriculum Frameworks standards. The students will build and test a prototype of a device that will be used as an emergency/backup power source for an electronic device such as an iPod in the event that its battery becomes discharged. The prototype will be assembled and tested as the students study electrical systems. Later, when studying manufacturing technologies, the Engineering Design Process will be used to redesign the prototype with the goal of optimizing a mass production system. The students will create a PowerPoint presentation that documents their experiences.

This Capstone experience has been developed in order to give the students hands on experience to reinforce the concepts they are studying. Building and testing the circuit will reinforce the electrical systems skills and concepts. Using the Engineering Design Process to redesign the original circuit for mass production will reinforce the concepts in the manufacturing and EDP topic areas.

The students in the Gardner Public Schools come from varied backgrounds. Students come from intact families with parents in professional fields, parents in blue collar fields, and single parent households. There are neighborhoods with average home values over $250,000.00, neighborhoods of multifamily dwellings, neighborhoods of rental property, and a multi-building low-income apartment complex.

Gardner High School has a student population of approximately 900 students. The city of Gardner is known as the Chair City due to its former status as the furniture capital of the world. From 1805 until the 1970s, furniture factories in the city enjoyed a worldwide reputation for quality furniture. Since then, however, much of the furniture industry has left the city, resulting in high unemployment. The city is currently attempting to attract business and industry with a focus on accessibility along Route 2.

The community of Gardner has a median household income less than the state average, see table 1 below. The per pupil expenditure by the city of Gardner is also below the state average.

Estimated median household income in 2005: $43,300 (it was $37,334 in 2000)

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| Gardner | http://pics3.city-data.com/sg4.gif $43,300 |
| Massachusetts: | http://pics3.city-data.com/sg6.gif $57,184 |

Table 1

**Implementation in Action:**

**Action Plan #1**

Day 1-2: Present my previously developed Ohm’s Law lessons. (See attached worksheets)

Day 3: Conduct a wire stripping and soldering lab activity

Day 4: Conduct a circuit building and testing lab activity

Day 5: Introduce the USB Power Source project

Complete Ohm’s Law worksheets

Day 6 Review Ohm’s Law worksheets

Day 8-9: Complete building the USB Power Source project

**Content and skills to be learned**

The following learning standards, which are covered in this lesson, are from the Technology/Engineering Learning Standards for a Full First-Year Course in Grades 9 or 10 found in the Massachusetts Curriculum Frameworks for Science and Technology/Engineering, May 2006.

**5. Energy and Power Technologies—Electrical Systems**

5.1 Explain how to measure and calculate voltage, current, resistance, and power consumption in a series circuit and in a parallel circuit. Identify the instruments used to measure voltage, current, power consumption, and resistance.

5.2 Identify and explain the components of a circuit, including sources, conductors, circuit breakers, fuses, controllers, and loads. Examples of some controllers are switches, relays, diodes, and variable resistors.

5.3 Explain the relationships among voltage, current, and resistance in a simple circuit, using Ohm’s law

**Action Plan #2**

Week 1: Using the text, Technology: Engineering & Design by Brusic, Kutemeyer and Fales, and the text Technology by Wright, the students will read and complete manufacturing worksheets.

Using the Universal Systems Model (previously studied) the students will apply it to the USB Power Source project they built in the electrical systems activity.

Each student will create a PowerPoint presentation illustrating the steps of the fabrication process they experienced building the USB Power Source prototype.

Week 2: Using the Engineering Design Process, the students will redesign the USB Power Source container for mass production.

The students will produce orthographic and isometric sketches of possible redesign solutions

The students will model their best solution using 3D Computer Aided Design software.

Week 3: Students will develop a PowerPoint presentation and poster describing their Engineering Design Process experiences with the USB Power Source product.

**Content and skills to be learned**

The following learning standards, which are covered in this lesson, are from the Technology/Engineering Learning Standards for a Full First-Year Course in Grades 9 or 10 found in the Massachusetts Curriculum Frameworks for Science and Technology/Engineering, May 2006.

**1. Engineering Design**

1.1 Identify and explain the steps of the engineering design process: identify the problem, research the problem, develop possible solutions, select the best possible solution(s), construct prototypes and/or models, test and evaluate, communicate the solutions, and redesign.

1.3 Produce and analyze multi-view drawings (orthographic projections) and pictorial drawings (isometric, oblique, perspective), using various techniques.

1.4 Interpret and apply scale and proportion to orthographic projections and pictorial drawings (e.g., ¼" = 1'0", 1 cm = 1 m).

1.5 Interpret plans, diagrams, and working drawings in the construction of prototypes or models.

**7. Manufacturing Technologies**

7.1 Describe the manufacturing processes of casting and molding, forming, separating, conditioning, assembling, and finishing.

7.2 Identify the criteria necessary to select safe tools and procedures for a manufacturing process (e.g., properties of materials, required tolerances, end-uses).

7.3 Describe the advantages of using robotics in the automation of manufacturing processes (e.g., increased production, improved quality, safety).

**Beyond Implementation**

The cost per student is $5.00

Budget items:

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| |  |  |  |  |  | | --- | --- | --- | --- | --- | | 9V Battery | 0.69 | RadioShack | 23-875 |  | | 9V Battery Snap Connectors | 0.5 | RadioShack | 270-325 |  | | 5V Voltage Regulator (7805) @ 1A | 1.59 | RadioShack | 276-1770 |  | | Female USB Connector | 2.22 | Microcenter | 243717 | [www.xionusa.com](http://www.xionusa.com/) | | Container to hold 9 V battery, clip, and regulator |  |  |  |  | | Solid Copper Wire |  |  |  |  | | Solder |  |  |  |  | | Heat Shrink Tubing |  |  |  |  | | SuperGlue or epoxy |  |  |  |  | | total cost | $5.00 |  |  |  | | **Non-Consumables** |  |  |  |  | | Safety Glasses & Plastic Gloves |  |  |  |  | | Dremel Tool & cutting bits |  |  |  |  | | Mini square file |  |  |  |  | | Cutters & wire stripper |  |  |  |  | | Soldering Iron |  |  |  |  | |  |  |  |  |  | |

Implementation Impact:

Schedule: This plan is for a class scheduled to meet 5 times per week for four 50 minute periods and one 72 minute period.

Lab Considerations:Computers with 3D CAD software are required.

Tools required include soldering irons, wire cutters/strippers, safety glasses, digital volt meters, mini files, and a dremel moto-tool & cutting bits.

Lab Availability: Shared labs need to be reserved in advance.

Performance Monitoring:

The deliverables are worksheets, the prototype, the poster, and the PowerPoint presentation.

**Appendix A: References**

Technology. R. Thomas Wright, Goodheart-Willcox Company, Tinley Park, IL, 2004.

Technology: Engineering & Design. Brusic, Fales and Kutemeyer, Glencoe, 2008.

[www.maximumpc.com](http://www.maximumpc.com)

**Appendix B: Student Handouts**

### Mid-Year Evaluation

**Start Date:** 10/27/2010

**End Date:** 10/27/2010

**Email Address:** kobelm@garnerk12.org

**School:** Gardner High School

**Have you already started your capstone project work with students?** Yes

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2:

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

October 18 through December 10

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

Course: Technology/Engineering Number of Students: 64 The project begins with studying Ohm's Law, proceed to series and parallel circuit analysis, the students will build an electric motor from a kit, and finally they will generate power by turning the motor into a generator. All activities will be documented in a PowerPoint presentation.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

I'm just beginning. Nothing to report so far.

### Reflection

## Ann Latino

### Implementation Plan: Team (See Ken Cray)

### Mid-Year Evaluation

**Start Date:** 10/28/2010

**End Date:** 10/28/2010

**Email Address:** ann\_latino@tlcdeaf.org

**School:** The Learning Center for the Dead

**Have you already started your capstone project work with students**? No

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1:

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other: 11 month school year, I am planning to do it in July 2011

**What are the approximate planned start and end date(s) of your capstone project work with students?**

07/05/2028

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

I have 3 sessions of a 2-day per week technology class. 2 of the groups are intensive needs students (groups of 4 and 6), the third is functioning at 5-8 grade level (5 students). We have spent the last 2 months exploring the engineering design process, defining technology and engineers, and competing a capstone on bridges. I built my lesson around the Engineering is Elementary curriculum, adapting concepts to fit the needs of my students.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

It was interesting to see that that the students preferred to not follow the EDP process, their one idea was perfect and does not need adapting at first. Also, though they were able to determine which bridge type was the strongest, they did not apply that information to their design. It is clear that they have very little experience building a strong working team that shares and decides plans together.

### Reflection

**Class Size**

3 SESSIONS, GROUP OF 6, 6, 4 2 days per week

**Course Name**

TECHNOLOGY

**Highlights of your Action Plan**

My action plan emphasizes adapting projects for students who are accessing the MA framework standards at varying points.

**Implementation of your Action Plan?**

•Modified EDP and other worksheets that are more visual and less dependent on written English.

•The use of video equipment so the students can explain the EDP process in their own language and at their own level of understanding.

•The use of age appropriate parts of the Engineering is Elementary curriculum.

•Use of internet sites, field trips, MOS resource library to supplement and support the EDP process.

**In Class Activities Created as a Result of CAPSULE**

•hands on activities that emphasize technology is anything that is made by people

•technology can be good & bad at the same time

•various bridge construction activities involving research online, watch simulations of bridge building

•building stone walls after walking around campus examining them

•linking the science of catapults to geometry and force as we build and test them

•linking current events to our projects-why are domes strong and why do we need them-what happens when too much snow collects on them, and then designing and testing their strength

**Sample Student Work?**

I will bring some movie clips to show you along with the handouts that I have adapted.

**Have your students reaped the benefits of more CAPSTONE based learning?**

Yes, very much. The most impressing thing I have noticed is the teamwork relationships that have developed,. Many of the students have poor social skills and tend to not work well with partners. Having them build projects has capitalized on their hands on abilities and allows an avenue for teamwork. It is amazing how the more able students interact with the less able. They are always respectful in their daily routine, but tend not to mix socially. It truly benefits all the students.

I also emphasize to the students that I "grade" based on participation, not product. This has forced the students that tend to step back to remain an equal team member.

Teaching project based curriculum levels the playing field. The more "typical" students have by far been less successful than the intensive needs students. I am very intrigued with this observation.

**What have you changed about your style of teaching as a result of participation in CAPSTONE?**

• I spend much more time on the EDP process before, during, and after the projects. The students tend to want to DO but not to reflect or plan.

• I have included so much more background information on the concepts that the project will involve.

• I have enriched the lessons with resources on the internet, capitalizing on youtube, PBS Design Squad, and other websites.

• My comfort level teaching technology has increased as a result of the CAPSTONE project, resulting in more confidence & flexibility in my instruction.

• I am reminded every day that MY way is not the ONLY way. Allowing the kids to think on their own without my input has always been a challenge. Finding ways to inform the students without giving them my ideas for changing their plans is a major difference in my teaching.

## Brian Lenda

### Implementation Plan: Team (See Ken Cray)

### Mid-Year Evaluation

**Start Date:** 11/08/2010

**End Date:** 11/08/2010

**Email Address**: blenda@communitycareservices.org

**School:** Southeast Alternative

**Have you already started your capstone project work with students?** Yes

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2:

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

August 17-September 17

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

Solar cookers with special needs students. General Science. Build solar cooker Present Engineering Design Process in a PowerPoint, paper, poster, or movie

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

Building went okay. Most did not reach the required 165 F Most presentations were not of high quality as students did not see the value of presenting about failed experiments.

**Reflection**

## Raphael Matty

### Implementation Plan

Action Plan: Chemistry based Capstone experience

Design a water filter that is appropriate for a specific location that removes undesirable material because it is harmful or creates unpleasant taste.

**Location** Newburyport High School

|  |
| --- |
| **Course** |
| Robotics |
| Advanced CAD - Pro/Engineer™ |
| CAD - Pro/Engineer™ |
| Introduction to Web Design |
| Intermediate Web Design |
| Advanced Web Design |
| Engineering the 21st Century |
| Industrial Design |
| Introduction to Video Production |
| Intermediate Video Production |
| Advanced Video Production |
| Broadcast Journalism |
| Theater Set Construction |

**Context**: Newburyport High School is a traditional high school that plans to prepare students for college whether they want to go or not. The school requires students to take core classes in English, math, science, and social studies. Only two years of science are required, although many electives are offered, and they are very popular; most students take science all four years. Outside of the science department there is a technology department that offers the classes seen here on the left, none are required.

These classes stand alone and so I don’t know that they accomplish the task of exposing students to STEM careers because only students that are interested sign up for it.

My district currently only requires two years of science, and three years of math. English and social studies both have four year commitments. In addition, band is a club, although many other art classes are offered, sports are pay to play. Science has pushed to create a three year requirement, current freshman will have to meet that requirement.

Newburyport offers many electives and contains a majority of highly motivated students. This means that they score well on the MCAS and have a high percent of students graduate and go on to college

**Action plan**:

These two actions will be an attempt to integrate a capstone experience into a high school chemistry class. The actions were chosen because they fit well into laboratory activities that already exist in a chemistry curriculum. The challenges of an engineering experience in a chemistry atmosphere are lack of understanding in chemical concepts and safety. Students can’t be set free with materials in a chemistry wet lab environment.

**Action 1** – Early fall (September or October) 2 to 3 days

Filtration – Students will develop a method of filtering sand, salt, iron, and seeds. The goal is to create a plan that describes the process completely, have the students follow the plan, and then analyze how effective it was. They can then redesign the filtration method and try again. Success is determined by the complete separation of each component which will be analyzed by measuring the mass of each substance and comparing it to class averages.

Formative assessment:

* filtration plan written
* observation of filtration method (do the students follow their plan)
* redesign of filtration method
* verbal analysis of what happened

Summative assessment

* data showing mass of each substance
* 3D sketch of filtering system

**Action 2** – Spring (March or April) 2 to 3 weeks

Filtration – Students will develop a method for filtering drinking water in order to remove contaminants that are harmful to human health, or cause unpleasant taste. This action will be much more involved, requiring research and the creation of a prototype.

Many students at Newburyport High School believe the drinking water to be contaminated and have a bad taste. This belief is unsupported by evidence, although taste is subjective. Students will begin by reading articles about areas with poor water quality, and studying drinking water to gain a foundation in the area. They will test the water at school using a water testing kit. The water will also be tested commercially by a local water testing lab to give a more detailed report and a comparison of the results. Students will analyze the results and then research possible solutions. Materials will be given to the students that coincide with the researched methods and students will create a mock water filter. The water will be tested after filtration and the filter will be redesigned until significant improvement is measured. Students will report back to the class on their success and failure and then work to design a prototype that could be turned into a commercial product. Possible factors to consider at this point are

Portable vs. stationary

User (personal, family, school, town?)

Budget, materials, and environmental impact

Students will be given a budget but are allowed to go over budget if they find outside financing. (I will provide certain materials, if they want other materials they will have to provide them at their cost)

The prototype will be created in a 3D drawing program like solidworks, but after they have amassed all the materials.

Formative assessment:

* 2 Group presentations during the process
* Data analysis
* Mock up and redesign
* Pencil drawings of designs

Summative assessment:

* Final group PowerPoint
* Data from water filter
* 3D model
* Cost analysis and environmental impact summary
* A working prototype

These actions will be carried out with 10th graders in a “principles of chemistry” class. Students are under achieving due to lack of motivation or possible learning disabilities. The class will most likely be team taught which means that myself and a special education teacher will be present in the room each day. The main chemistry concepts for both actions are chemical and physical properties of matter. Other topics that will be important are solubility, properties of ions, concentration, mixtures, and polarity.

The school consists of 98 percent Caucasian students from middle to upper middle class income. The students in this class have been placed here because they were the lowest achieving of their peers. The goal is to use the EDP to create interest and motivation for the topic. Small groups, use of technology, and assessments that allow visual, verbal, written, and physical products are used to maximize different learning styles.

I think the project will be successful if I can have all students participate in at least 2 of the major activities, (testing water, research solutions, design a filter, build a filter, 3D model in Cad, present information) and if they can create water filters that meet the goal of reducing contaminants. I am also hoping to emphasize the need for engineers and people who are conscious of the environment in order for us to continue living the life we have become accustom to.

Massachusetts Standards - Properties of Matter

*Central Concept*: Physical and chemical properties reflect the nature of the interactions between molecules or atoms, and can be used to classify and describe matter.

1.1 Identify and explain physical properties (e.g., density, melting point, boiling point, conductivity, malleability) and chemical properties (e.g., the ability to form new substances). Distinguish between chemical and physical changes.

1.2 Explain the difference between pure substances (elements and compounds) and mixtures. Differentiate between heterogeneous and homogeneous mixtures.

1.3 Describe the three normal states of matter (solid, liquid, gas) in terms of energy, particle motion, and phase transitions.

### Mid-Year Evaluation

**Start Date:** 11/10/2010

**End Date:** 11/12/2010

**Email Address**: rmatty@yahou.com

**School:** Newburyport High School

**Have you already started your capstone project work with students**? No

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1:

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

Start middle of march. End at the end of the month.

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

17 low achieving 10, 11, and 12th graders in a team taught college prep chemistry class. I hope to teach them about water and chemical testing and then test the drinking water at school for minerals and impurities.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

We are still working on getting solidworks. That would be a problem if I wanted to be done by now. Was there a final say on if there was a deadline for getting our money. Do we turn in receipts to get the money?

### Reflection

**Class Size:**

Varies from 11 to 27

**Course Name:**

Chemistry

**Highlights of your Action Plan:**

We hope to make the school water more attractive to drink so that less bottled water is purchased.

**Implementation of your Action Plan?:**

Have not, still gathering data. Hope to start after February.

**In Class Activities Created as a Result of CAPSULE**:

There is a week long lesson, a presentation on water quality, basic environmental awareness throughout the year.

**Sample Student Work?**

Not yet

**Have your students reaped the benefits of more CAPSTONE based learning?:**

Not yet

**What have you changed about your style of teaching as a result of participation in CAPSTONE?:**

I don't have many projects that extend out of the classroom, so that will be a change.

## Joshua Miranda

### Implementation Plan

My goal when first applying for the CAPSULE program was to integrate a full capstone project into my AP Physics class. I noticed students had no problem learning and using equations and concepts to solve even the most difficult problems on unit tests, but would stumble when given a comprehensive test. I believe introducing a significant open-ended problem such as a capstone project will lead them to change their thought process and give them the ability to identify and clearly define a problem. Nearing completion of the program, I have expanded my goals to bring more EDP based projects and capstone-like experiences to all levels I teach in addition to my original goal at the AP level.

Context: The classes I teach include two levels of 11th grade physics (class sizes from 21 to 29 students) and one AP Physics C: Mechanics class (10 students). Because physics is a required class for all 11th grade students, my students have a wide range of capabilities and previous knowledge they have obtained from other classes. My college preparatory classes consist students who are average, borderline honors, bright but never pushed to work to their potential, and even a few with special needs. My honors classes are more homogeneous with the range consisting of students who may only be borderline honors students to those who could have probably jumped straight to the AP level if that option was offered. This will be the second year that we have taught a comprehensive physics course to junior students after switching from a conceptual physics course for freshmen. As such, we have only planned out a rough curriculum and this year will be a trial run of sorts for that curriculum. This will also be the first year that the AP level students will have had a comprehensive algebra/trigonometry based physics course the year prior to taking the AP course. Besides the make-up of my classes, the biggest barrier I have to deal with is the curriculum in place. While new curriculum does give me an opportunity to insert additional projects or units not currently in the place, I do still have to attempt to cover a set number of topics by the end of the year. In AP physics, the curriculum is set by the exam and I cannot skip any material and replace it with a project or additional units. Because I am only teaching the mechanics portion of the course and my students took physics last year, I should have time to work in the extra projects, but I have no way of accurately predicting the amount of time the class will have at this time. Action Plans

My action plans will utilize three different project categories:

1) Unit-based Projects: Projects where students will be introduced to a new unit using a quick design challenge such as building a device to catch a raw egg from a predetermined height and protect the egg from any damage. The students will come into class the first day of the unit with no previous knowledge of the design challenge and spend approximately half the period completing the challenge (see egg drop design challenge attached). Each of these beginning of unit challenges will be designed as a competition with clear goals. This design challenge will be referred to throughout the unit (wherever appropriate) to reinforce the concepts covered. Additionally, students will be given a unit project following the design challenge. In the case of the unit on momentum, students will then complete the egg drop project described in the documents attached. This project will be similar to the design challenge, but with more constraints and detailed goals. Each of these projects will also include a specific focus component from the engineering design process. The idea will be to teach EDP without having to add another unit to the curriculum. These projects will be short term, consisting of only a week or two of work done mostly outside the classroom.

2) Mini-Capstone Project: The second project category is the mini-design project or capstone-like experience. This project will be placed at the end of the first semester, halfway through the year. Students will be expected to use all components of EDP, but will not necessarily go into deep detail with any specific step. Similar to the design challenges and unit projects, the mini-design project will also be developed as a competition with no set solution and multiple goals to achieve. Students will also present their final solution to the class and develop a report or portfolio to document their work. The timeline for this project is approximately two weeks, with some deliverables due after the first week and a presentation and competition at the end of the second week.

3) Capstone Project: This project is a culmination of the physics learning experience. Students are expected to apply physics principles acquired throughout the year to the design of a system, component, or process. Each project includes the development and use of design methodology, formulation of design problem statements and specifications, consideration of alternative solutions, feasibility considerations and detailed system descriptions. Projects include realistic constraints, such as economic factors, safety, reliability, maintenance, aesthetics, and social impact. Students are expected to present orally their results in a series of design reviews and students document their solutions in a written report or project notebook. A working prototype or detailed design, as appropriate, of the solution is required to complete the project. The timeline for the capstone project is approximately one full semester (second half of the year) with deliverables due every three or four weeks.

Timeline:

I plan to use the three project categories differently at each level. For the college preparatory classes, I will integrate the unit projects the first year in addition to a simplified version of the mini-capstone project. At the honors level, I will implement the unit projects, the mini-capstone project, and a simplified version of the capstone project this year. All three project categories will be implemented at the AP level. Because these students are more independent and motivated, the class will provide a good test of the full EDP project progression that I would like to eventually implement at all levels that I teach. Any problems that I experience with the AP level would likely be magnified at the lower levels and indicate a need for a change.

After the first year at all levels, I hope to have determined what additional lessons and supporting materials I need to provide to my students for them to be able to successfully complete the projects and utilize the engineering design process to complete a full capstone experience. It is my new goal to bring the full capstone experience to all levels of classes I teach, first through the use of the unit projects to introduce the EDP steps, then using the mini-capstone utilize the full engineering design process in one directed project and finally through a full capstone project.

### Mid-Year Evaluation

**Start Date:** 11/01/2010

**End Date:** 11/02/2010

**Email Address:** josh.a.miranda@gmail.com

**School:** Revere High School

**Have you already started your capstone project work with students?** Yes

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

Small projects have already started, full capstone projects will be started at the beginning of 2nd semester (end of January).

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

mall projects have already started, full capstone projects will be started at the beginning of 2nd semester (end of January).

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

None.

### Reflection

**Class Size:**

one class of 7, three of approximately 25 and one class of 30

**Course Name:**

AP physics, physics, honors physics

**Highlights of your Action Plan:**

The plan was to introduce the engineering design process through multiple in class activities and unit projects. For the AP and honors classes, this would culminate in a very open ended final semester long capstone project. For the college preop classes, the activities culminate in a directed mini-capstone project.

**Implementation of your Action Plan?**

Activities and unit projects have been done at every level. Honors students have started work on their capstone project in order to incorporate parts into the science fair requirement. AP students have started

thinking about topics for their capstone projects and will be beginning work next week. College prep students have no yet begun their mini-capstone, but should in the middle of the next unit.

**In Class Activities Created as a Result of CAPSULE:**

Students have done the following design challenges in class: paper towers, balloon rockets, straw bridges, catapults, and egg drop.

**Sample Student Work?**

I still have samples of the best bridges built and many catapults that were turned in this past week.

**Have your students reaped the benefits of more CAPSTONE based learning?**

I have seen students benefit from doing engineering based activities in class. Many students are more excited about physics when they think of it from a design/challenge/competition point of view. Many of my students have gotten very into the engineering unit projects as well and say they look forward to having to do the projects. Some of the honors students really understand the idea of bringing different concepts together to solve a real problem and are excited about their capstone projects (others, of course, aren't quite as excited due to the amount of work required to complete the project).

**What have you changed about your style of teaching as a result of participation in CAPSTONE?**

I've started approaching physics as more of a project-based course. It's been difficult due to curriculum requirements and trying to figure out exactly how every topic can fit into a project. It's something I would like to work on more and try to bring to my department so it is a common way of teaching the material.

## Paul Mozynski

### Implementation Plan

### Mid-Year Evaluation

### Reflection

## Kristin Newton

### Implementation Plan

Target Actions:

The goals of this implementation plan are to introduce the Engineering Design Process to freshman physics students, practice EDP throughout the year and give them a hands on experience of a science fair project that is very similar (if not identical) to a Capstone Project. To accomplish this goal, students will be introduced to EDP early in the school year with a fun, hands on quick tower building exercises that requires discussion, building, testing, and redesign - with reading, discussion, and notes on EDP. Students then use EDP throughout the year with chapter projects - where teachers pay special attention to connecting each day of work to the EDP. Finally, students will create an Engineering science fair project, utilizing the EDP in a Capstone like atmosphere.

Context:

Stacy-Michelle Reid teaches Introductory Physics to freshmen at East Boston High School (EBHS). EBHS is a typical urban traditional high school, with 100% free and reduced lunch students, approximately a 55% graduation rate, and about 60% English language learners (ELL), or former limited English proficiency (FLEP). The students are required to pass 3 math courses, 3 science courses (freshman physics, biology, chemistry, and an MCAS refresher Biology 2 course), and have AP Bio, AP Chem, and AP Environmental Science available to them. EBHS currently does not have any engineering type courses. The curriculum for the 9th grade physics is Active Physics by Arthur Eisenkraft, a very hands-on curriculum that, when properly implemented, is fun and educational. Parts of the engineering design process are in the current physics curriculum - with each chapter working towards a culminating project that addresses a design need.

Kris Newton teaches at Cambridge Rindge and Latin School (CRLS), which is the public high school in Cambridge. CRLS is an urban school with a widely diverse school population, which is 46% low-income students, 64% minority students, and 33% of students for whom English is not their first language. CRLS has a three-year science requirement and all students at CRLS are required to take a three-course science sequence: physics in ninth grade, followed by chemistry and then biology. The ninth grade course is heterogeneously grouped with an embedded honors option. In addition to required science courses, there are electives and AP courses for juniors and seniors. There are no required engineering courses, but there is an elective course called Applied Physics in which students complete a variety of engineering design projects. In addition, there is an engineering program in the Rindge School of Technical Arts (RSTA), which also offers an elective course for those not participating in the vocational program. Science classes can use one of the four school computer labs. The RSTA engineering lab has its own computer lab and CAD/CAM software and equipment, but there is not currently much collaboration between the science department and RSTA.

Purpose:

This introduction to the Engineering Design Process will give students a base to use for their future studies in college and beyond. Since the students have no background in engineering, this will give them an introduction to what engineering is in a fun and friendly way - at a time that they are starting to think of what they will do with their life beyond the basic fireman or ballerina. This introduction also comes at a time in their high school career where the students are doing the most hands-on concrete real-world experiments - where the building process can easily be integrated, rather than trying to fit it into a curriculum such as chemistry or biology.

Goal:

Integrate capstone-like engineering experiences into an existing science or math course.

Action Plan Part #1:

The start of this project is a one day introduction to the Engineering Design Process that will be placed near the beginning of the year shortly after the student prepare their interactive notebook. This day includes a tower building exercise where students are put into groups and have to build the tallest freestanding tower out of the materials provided.

* + Identify/Research Problem - any type of “we need a tall tower” background story can be used to give the students a problem to solve.
  + Brainstorm Solutions - students are then given a short period of time to survey the materials given to them without touching them (30 paperclips, 30 straws, one large tin can, and a tray in which the tower must stand on) and discuss design ideas.
  + Decide on a Solution/Build a Prototype - in the last 30 seconds of this time, students should decide what they want to proceed with - and then will be given a few minutes to build (usually 3-5 minutes).
  + Test/Evaluate - at the end of the time the products will be measured and tested with a small fan to see if they topple.
  + Communicate - students will then share out the good/bad parts of their design.
  + Redesign - lastly, students will go through the process again - with the winner being the team that has the highest percentage of growth compared to their first try at the tower.

As a formative assessment, students will be given a “Do Now” of reading on the Engineering Design Process, where they will have to dissect certain parts of the process explained in the article to show their understanding in the interactive notebook. A summative assessment will come in the form of a worksheet that outlines the steps of the Engineering Design Process and requires them to explain what they did in this project for each step.

Because both schools have the AVID program, there is also a focus on WICR (Writing, Inquiry, Collaboration, Reading) in the day’s plan:

* 1. Writing - the worksheet, and the exit ticket of imagining what kind of materials we could use in the classroom to create a better tower
  2. Inquiry - the design and planning process
  3. Collaboration - the design and planning process, as well as the team building project
  4. Reading - the “Do Now” includes reading and comprehension question to start off the day

As an extension and reinforcement to this lesson, day two can include an activity where there are materials available to build a sturdier project that students must “buy” with a limited amount of money. Students will need to redesign their tower, submit a material request list, put together the kit, and then rebuild the towers. Redoing this process a day later reinforces the concepts taught. A copy of the lesson plan for the day and worksheet are included in the Appendices.

Action Plan Part #2:

Both Stacy-Michelle and Kris teach physics courses modeled after the Active Physics curriculum, in which students complete activities which build toward a culminating project. The projects don’t all fit the model of Engineering Design Process, but some of them match some of the steps of the process. Our goal with respect to our projects is to be more explicit about matching our unit projects with the steps of the Engineering Design Process and in having students complete the steps of the project throughout the unit.

One project in which we will explicitly include the Engineering Design Process is the Electricity “Living Unit” Project. In this project, students design and build an electrical model of any kind of living unit of their choice, from a single room to a stadium. Students are required to use both series and parallel circuits, as well as switches. They need to document their work with a written description and schematic diagram. A description and rubric of the project are included in the Appendices.

The following is an approximate timeline for implementation of the Living Unit Project:

Day 1 (Identify Need or Problem) - Introduce culminating project, including design problem, materials and constraints. Give students some time to brainstorm ideas as a large group and individually.

Days 2 to 4 (Research Need or Problem) - Students do open-ended circuit lab, investigating series and parallel circuits, learn circuit terminology, and develop analogies for circuits. Relate information to project so that students recognize the need for the content and give students time to reflect on how their ideas have changed or develop new ideas. (Develop Possible Solutions)

Days 5 to 7 (Research Need or Problem) - Students develop an experiment to test a hypothesis about current and relate their conclusion to Ohm’s Law.

Day 8 (Develop Possible Solutions and Select Best Solution) - Students use what they have learned about series and parallel circuits to develop a specific plan and draw a sketch of their model.

Day 9 (Research Need or Problem) - Students learn about household circuits, fuses and circuit breakers. (One of the honors requirements for the project is to include a fuse in the wiring).

Days 10 to 11 (Construct a Prototype) - Students build their living unit model. Students must have a plan drawn before they can begin building and must have complete working circuits before they can decorate their project.

Day 12 (Test and Evaluate Solutions) - Students do final testing of their project and work on a written report of their design.

Day 13 (Communication) - Students present their projects to the class and reflect on their work. In their reports, students make recommendations about any changes they would make to their design (Redesign).

The Living Unit project is differentiated to allow all students to access the content. The basic requirements of the project are do-able for students just beginning to understand series and parallel circuits, but the creation of the product motivates capable students to extend their learning with more complex circuits. Honors students are able to choose from a variety of extensions that allow them to demonstrate their understanding of the honors learning goals. Students are provided with an optional graphic organizer for their written report. The rubric for the final submission of the project is included in the Appendices and formative assessments include initial proposals and sketches of projects as well as a demonstration of working circuits before students may begin decorating. Materials are inexpensive and/or available at the EXCL recycling center and include holiday lights, wire, write strippers/clippers, paperclips, posterboard, cardboard boxes, fabric and carpet samples and other miscellaneous items for decorating.

Connections:

The specific actions detailed above provide the background necessary for students to apply the Engineering Design Process in an independent science fair project, which will serve as a Capstone-like project for the physics course. In developing their engineering projects, students will be encouraged not simply to consider what they will build or design, but to also be very clear about the engineering problem their design addresses. Students will be introduced to the science fair project soon after the Tower Building mini-engineering activity so that they can begin to generate ideas and conduct research. Students will be given opportunities to consult with the teacher and with each other about their ideas and within a month or two will submit a formal proposal including their engineering problem, background research, and materials needed. The next deadline will be a report of the final design chosen and progress toward building prototype. A few weeks before the final report/poster are due, students will be expected to show results of testing and redesign and provided with graphic organizers for their final report.

People, Organizations and Influence:

At CRLS, there is a shared physics curriculum and a cohesive working group of teachers. This is an incredible resource for thinking through ideas before and after implementation. Because the curriculum is common, however, teachers are expected to complete specific labs and projects. Therefore, large-scale curriculum changes are not feasible, but it is possible to adjust day-to-day lessons to incorporate the Engineering Design Process. As the physics group meets regularly, there are also ample opportunities to share engineering materials and resources with colleagues so that the Engineering Design Process can be extended into more of the ninth grade physics classes. One remaining question is how incorporating the engineering design process into the physics class will affect the work that we already do with the scientific method. This is a major focus of our course and students are expected to write several lab reports throughout the course. While there are many parallels between the scientific method and the engineering design process, it remains to be seen if students can develop a solid understanding of both of them in one course.

At EBHS, there is also a shared curriculum with most of Boston Public Schools that limit a large scale curriculum change. The ideas that we came up with for implementing the Engineering Design Process and the Capstone Project are specific items that are fully attainable and that we are realistically able to complete in a timely manner throughout the year. These goals include measurable milestones on a daily basis and throughout the year. The only issue that I forsee in the coming year could be that of including engineering projects in the school science fair. Our physics science fair consists mostly of physics projects using the scientific method. I see a need to expand the idea of the science fair projects, but we will (at the bare minimum) have to redesign the science fair rubric that we have used in the past. Beyond that small hiccup, we created an implementation plan that is more than just fluff written to appease the course instructors - but something that we can, and are excited to, use in our classroom.

### Mid-Year Evaluation

**Start Date:** 11/03/2010

**End Date:** 11/03/2010

**Email Address:** knewton@cpsd.us

**School:** Cambridge Rindge and Latin School

**Have you already started your capstone project work with students?** Yes

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

We began on the first day of class - 9/7/10. Our student exhibition is not yet scheduled, but their projects are due 1/12/11.

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

I have 35 students in two sections of ninth grade physics. I have begun introducing the engineering design process through a one day design activity on the first day of class. We will have two more slightly longer in-class projects that will incorporate the EDP. Some of the students who are doing the embedded honors option will be doing engineering design projects for their independent projects. Those will begin in the next week or two and wrap up in January. Then the cycle will repeat for second semester.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

I don't have anything else to add at this point.

### Reflection

## Alexander Njoku

### Implementation Plan

### Mid-Year Evaluation

### Reflection

## Patrick Nsumei

### Implementation Plan

**INTRODUCTION**

I teach freshmen Physics class at East Boston High school (EBHS). EBHS has no technology/engineering course. Students take science courses at the night grade level (Physics), tenth/eleventh grade (Biology and Chemistry). We have AP biology and Chemistry courses but no AP Physics at the moment. We have been considering AP Physics class and hopefully that will happen soon.

One way to have students engage in engineering/technology in classroom is to integrate it into an existing science course (e.g. Physics). Some of the ninth grade physics syllabus and classroom instructions style will need to be modified to incorporate engineering/technology components with the intent for capstone-like projects (or mini projects).

Secondly, we can build support and advocate for technology/engineering course at EBHS. *Building Support* may be a longer term goal for my school and may be the next step following success with the integration plan.

**TARGET ACTION**:

* Modify physics syllabus to integrate unit projects (capstone-like) with emphasis on engineering design process in addition to physics.
* Integrate mini capstone-like projects into freshmen physics class.

**IMPLEMENTATION**

**1. DEVELOP AND IMPLEMENT A UNIT DESIGN CAPSTONE-LIKE PROJECT**

I plan to introduce engineering design process at the beginning of the physics class, and then move on to develop and integrate unit and mini capstone-like projects in my physics class.

One example of unit projects that I plan to do with my students integrating EDP is outline below:

**PROJECT OVERVIEW**

In Active Physics we have a unit and project assignment on designing a universal dwelling. I plan to implement the engineering design process to make it a “capstone-like” project. Students will be placed in teams of 2 or 3.

**STATEMENT OF THE PROBLEM**

Every human needs a dwelling. Design and build a simple and affordable dwelling (home) that meets any chosen geographic climate. Students are to apply their knowledge of engineering design process in this project. The students need to research homes around the world and see different features of these homes. The shape, materials used in the construction of the home, the cost of these materials, energy requirements, etc.

**FIELD TRIP – MUSEUM OF SCIENCE, CONSTRUCTION COMPANY AND BUILDING STORE (E.G. HOME DEPOT)**:

A lot of our students do not know what scientists/engineers do. They also do not know why they should do math and science. So a field trip to a Construction Company will be scheduled.

* This will expose students to what scientists and engineers do and how science and engineering help improve the lives of people.
* This also will help them understand why they do math, science and engineering. Architectural designs (blueprints) and choice of building materials based on thermal properties of different materials and energy sources will be covered during the field trips.
* Students will visit building store (to see the building materials, cost of building materials)

**2. DEVELOP AND IMPLEMENT A MINI DESIGN CAPSTONE-LIKE PROJECT**

My students are introduced to kinematics, during the first semester. Detailed discussions on kinematics and energy transformations are done in the second semester. I plan at the beginning of the second semester, to review the EDP and give a 3-4 weeks mini capstone-like project.

**STATEMENT OF THE PROBLEM**

Build a unique car that best utilizes the potential energy stored in the spring of a mousetrap. Students are to apply their knowledge of physics concepts (Forces and Motion, Energy Transformation) and engineering design process in this project.

**FIELD TRIP TO MUSEUM OF SCIENCE, AUTOMOTIVE COMPANY/WINDMILL/VIDEO**

* Expose students to the design and manufacturing processes involved in building cars.
* Expose students to different energy sources to power a car; gasoline (combustion engine), electrical cars (battery), solar powered cars.
* Students will be exposed also to **energy transformations** involved in the motion of cars.

**CRITERIA FOR SUCCESSFUL “CAPSTONE-LIKE” ACTIVITY**:

* Variety of Designs (prototypes),
* Comprehensive log notes detailing the different steps of the engineering design process:
* Prototype showing understanding of math (geometry), physics (energy and heat transfer)
* Noticeable Improvement between initial and final design, and
* Power-point presentation

**TIMELINE**

* + Project 1 (unit-capstone-like) : 2 – 3 weeks (September – October, 2010)
  + Project 2 (mini- capstone): 3 – 4 weeks. (Second semester, Januray – March, 2011)

**DETAILED DESCRIPTION**

**1. UNIT PROJECT**

**DESIGNING AN AFFORDABLE HOME FOR SPECIFIC CLIMATIC CONDITION**

**PROJECT OVERVIEW**

This project will be used to introduce students to the EDP. In addition, students are to apply knowledge of science (physics) in making a number of decisions critical in their design.  

**PROJECT OBJECTIVE**

1. Students Will Be Able To (SWBAT) apply the knowledge of science (physics) and EDP to design and build a simple and affordable home giving certain specifications/constraints.
2. SWBAT master the engineering design process (EDP):

* The Problem/Need (students will need to state in their own words what they think of the problem)
* Research the Problem (use the library/internet resources)
* Develop Possible Solutions
* Chose the best Solution (state the why they chose the solution) using some criteria
  + Cost, Climatic/Environment Constraints, Culture, etc)
* Build a Prototype (Sample Home)
* Test and Evaluate
* Communicate Solution (Power-point presentation)
* Re-design (if necessary)

**CRITERIA/CONSTRAINTS**

Examples:

* Area of home in square feet
* Height of home
* Prevailing climatic condition (seasons/temperatures)

**DELIVERABLES**

* A floor plan and a complete home (prototype)
* Comprehensive log notes detailing the different steps of the engineering design process,
* Power-point presentation

**2. MINI CAPSTONE-LIKE PROJECT**

**MOUSETRAP CAR MINI CAPSTONE PROJECT**

**PROJECT OVERVIEW**  
This project is an introduction to the full implementation of the engineering design process and the physics concepts discussed in class so far.  Students are expected to apply physics principles to the design of a system. Each project includes the development and use of design methodology, formulation of design problem statements and specifications, consideration of alternative solutions, feasibility considerations and detailed system descriptions.    
  
**PROJECT OBJECTIVES**  
In this project, students will use the engineering design process to design and build a mousetrap car that will move a certain required distance. As part of their research, students will use their physics knowledge up to this point to inform their proposed improvements.  
  
**PROJECT TOPIC**  
*Problem Statement:* Build a unique car that best utilizes the potential energy stored in the spring of a mousetrap.  Each team will be provided one identical mousetrap to use in their design.  Teams cannot alter the mousetrap in anyway (the original tripping mechanism must be used to start the motion) and must supply their own materials for the construction of the car.  If you have trouble finding materials, see me for ideas.  A competition will be held to determine the car the travels the greatest distance and the car that has the greatest average velocity.  
  
**DELIVERABLES**  
To represent successful completion of this project, students will turn in the following:

* A complete Mousetrap Car prototype (obviously).
* A group notebook outlining the completion of the design through the Engineering Design Process. This notebook should include sketches of designs, calculations, data, and group thinking about how the design work has proceeded. Your instructor may require that you answer certain questions or include certain information in each step of the EDP; this information must be included in your notebook.
* Participation in a competition at the end of the project that pits each car in the class against one another. Cars MUST be able to travel a distance of 1.21 m (4 feet).
* A “check-in” paper briefly describing the research completed, your specific goals (velocity and distance) and a sketch of you design solution and any alternative solutions considered.  This paper should be one page with sketches attached.
* A final powerpoint presentation detailing your research, goals, basic calculations, alternative solutions and final design.  This presentation should last approximately 10 minutes per group.

**ASSESSMENT**  
The mini project is a learning experience. It will not be assessed in a formal way. Instead, the aim of the project will be to complete the deliverables and engage in formal discourse around each group’s work, as scientists and engineers would. This project will be given an (Exemplary) (A) grade upon full completion of the deliverables above. Additionally, extra credit will be given to the project that goes the greatest distance and

***Acknowledgement***

Mike Graeber, Hopkinton High School, Hopkinton, MA  
Josh Miranda, Revere High School, Revere, MA  
Michael Dudley, North Central Charter Essential School, Fitchburg, MA

### Mid-Year Evaluation

### Reflection

**Class Size:**

25 \* 3 ~ 75 students

**Course Name:**

Introductory Physics

**Highlights of your Action Plan**:

Project-based learning

(1) Introduction of Engineering Design Process (EDP)in a Science (Physics) Class.

(2) CAPSTONE PROJECT

**Implementation of your Action Plan?**

(1) Students were introduced to EDP and

(2) CAPSTONE Project – students designed a universal dwelling and a mouse trap cars.

**In Class Activities Created as a Result of CAPSULE**

Mouse trap Car Design project – class activity/library

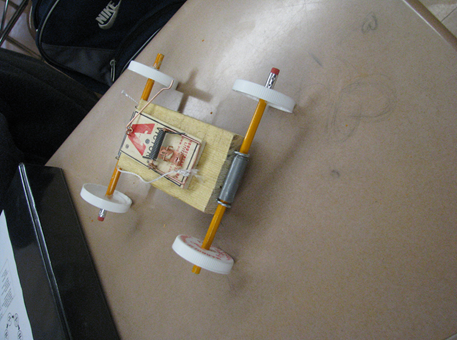
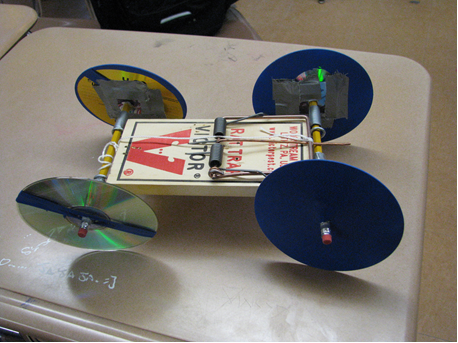
**Sample Student Work?**

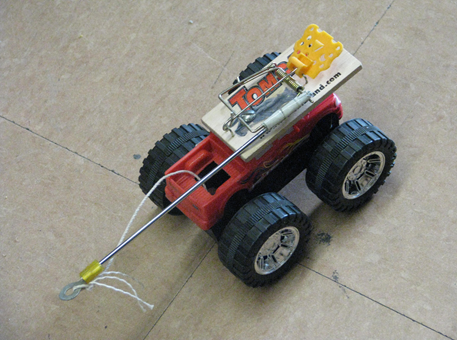
1. Students working on projects



1. Some Finished Projects



**Have your students reaped the benefits of more CAPSTONE based learning?**

Yes

**What have you changed about your style of teaching as a result of participation in CAPSTONE?**

More project-based learning.

## Fred Pontillas

### Implementation Plan

**Target Actions**

I would like to redesign and implement existing engineering projects and lessons into CAPSULE experiences. I aim to create a project implementation process that involves a more rigorous treatment of physics. Among other activities, students will be given the opportunity to make their work public by organizing class presentations and/or exhibitions that will be open to the whole school community and beyond.

**Context**

The John D. O'Bryant School of Mathematics and Science is a public exam school in the Boston Public Schools. We implement a rigorous and comprehensive Science, Technology, Engineering, and Mathematics program that is integrated with the Humanities. Our science department is dedicated to fostering intellectual curiosity; engaging students in inquiry-based investigations; developing creative and analytical problem-solvers; providing career exposure and "out-of-school time" learning opportunities; and developing partnerships that support student learning. I teach Principles of Engineering, a combined Engineering and Physics course. This full-year course is the first in a sequence of high-school, engineering coursesthat will prepare students for entry into a university/college engineering program. It is only open to students participating in the Engineering Pathway program.Potential students are recruited from the incoming 9th grade class. We require an application, a record of satisfactory academic achievement and good citizenship, and a recommendation from their 8th grade science teacher. This course engages students in a series of hands-on, project-based experiences and is coupled with Physics to form a double-period (110 minutes) class. Students learn Physicsconcepts and apply them to real-life, engineering projects. Emphasis is given to learning and practice of the Engineering Design Process. We use parts of the *Engineering the Future* curriculum, with the corresponding projects. Additional projects include: underwater submersibles,water bottle rockets, science exhibits/artwork, and several digital electronic devices. The class has access to a robotics and engineering laboratory and an auditorium for presentations. We have an informal partnership with MIT’s Edgerton Laboratory; a mechanical engineering instructor and undergraduate engineering students from MIT bring their expertise to our class. The Edgerton Laboratory is also open for students who are interested in doing original and/or extension projects on Saturdays.

**Purpose**

Last school year was the first time I taught the Principles of Engineering class. Through personal reflection, I came up with a list of things that I believe could be improved in my approach to the curriculum. I thought that these might help student access to the curriculum, improve rigor in their physics learning, and create a greater sense of ownership of their work. Presenting engineering projects as CAPSTONE experiences will address these concerns. Sharing student work to the public will create a whole different level of ownership and connection among the students. Too often, students are used to their teachers and their peers critiquing their work. I would like to move the products of their efforts beyond our classroom. Requiring my students to be more explicit in the physics behind their engineering solutions will hopefully lead to a more rigorous understanding of the science. After all, I have to make sure that in addition engineering my students have learn their required physics curriculum.

**Action Plan 1** Transforming Existing Class Projects into CAPSTONE Projects

I will not reinvent the wheel and try to come up with new engineering projects for my Principles of Engineering class. The following modifications/additions to the structure of the assignments will be done:

1. Present engineering problems in a real-life context.
2. Expand the audience for the public presentations.
3. Create exhibition-quality products.

**Action Plan 2** Improving Rigor in the Physics Content of Engineering Projects

The following modifications/additions to the structure of the assignments will be done:

1. Require students to use applicable physics concepts as part of their justification for their choice of the final solution for a particular project. The explanation must go beyond conceptual discussion.
2. Where applicable, prototype testing should involve an analysis of physics data.
3. If necessary, a redesign must include a corresponding analysis of the redesign’s effect on the related physics parameters.
4. Written reports and oral presentation (depending upon the audience) should include a thorough analysis of the physics behind the solution.

**Connections**

The two actions entail a ramping-up of student work and expectations. I like the idea of requiring students to use their problem-solving skills to find solutions to realistic problems, more so if the problem is something they can relate to. Requiring them to be explicit about the science, physics in particular, behind their solutions is an excellent way to integrate science and engineering. Taken together, the two actions I am proposing will show students that good engineering entails a solid understanding of the science behind proposed solutions. The plans elevate student work into something that is out of the ordinary, and gives them a chance to share beyond the classroom what they have accomplished.

**Beyond your Zone of Influence**

Budget and availability of materials may restrict the scope and size of the Capstone projects that the students can do. On the other hand, this issue may encourage students to engage in creative ways to raise funds and/or obtain materials for their projects, e.g. looking for sponsors, fund-raising.

Availability of space for gallery-type exhibitions may be limited. The planning and execution of such an event may also be a distraction to our class schedule. This will be the first time for me to organize this kind of event and I have no idea how much effort will go into it. Availability of audiences for the oral presentations may be restricted, so scheduling could be a problem.

**People, Organizations and Things**

I see Capstone projects as a possible requirement for all science classes in my school. In order for this to happen, every science teacher should be able to buy in to the idea. I really think that my department chair, and the school administration will be very amenable to this idea. Eventually, I would like to see the whole school community, including the parents, embracing this effort. Students might be able to gain outside sponsorships for their projects. Our partnerships with institutions of higher education in the area will hopefully enable students to use university facilities on their projects.

### Mid-Year Evaluation

**Start Date:** 11/17/2010

**End Date:** 11/17/2010

**Email Address:** upontil@gmail.com

**School:** John D. O’Bryant School of Mathematics and Science

**Have you already started your capstone project work with students?** No

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1:

Semester 2: 2

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

first week of May to third week of June

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

AP Environmental Science: 35 students; Working in groups of two or three, students will address a specific environmental problem related to the general area where they leave. One of the proposed solutions to the problem will require them to modify a device or a system involved in the environmental problem. AP Biology: 25 students; Working in groups of two or three, students will address a current issue in biology. Students will have to work on an experimental/investigative portion of the project on their own.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

None at this time.

### Reflection

## Stacy-Michelle Reid

### Implementation Plan: Team (See Kristen Newton)

### Mid-Year Evaluation

**Start Date:** 10/28/2010

**End Date:** 10/28/2010

**Email Address:** askmissreid@gmail.com

**School:** East Boston high School

**Have you already started your capstone project work with students**? Yes

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2:

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

09/01/2010

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

Introduction to the EDP using a tower building project. Students go through three rounds of redesign over two days.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

Went AWESOME. :)

### Reflection

## Susan Sanford

### Implementation Plan

**Implementation:**

To develop a section of the one- year technology/ engineering course to include Solidworks software.

**Course:**

Technology/Engineering course in Worcester Public Schools is a one-year course for Science credit for 9/10th grade students. These courses are taught by either a Technology Education teacher or a Science teacher whom is 20 percent out of discipline. The course meets the Massachusetts Science and Technology frameworks (Technology/Engineering) to prepare the students for the MCAS Science Technology Engineering test in the spring.

**Students and Mass STE frameworks**:

High school students are able to relate concepts and principles they have learned in science with knowledge gained in the study of technology/engineering. In a high school technology/engineering course, students pursue engineering questions and technological solutions that emphasize research and problem solving. They achieve a more advanced level of skill in the engineering design by learning how to conceptualize a problem, develop possible solutions, design and build prototypes or models, test the prototypes or models, and make modifications as necessary. Throughout the process of engineering design, high school students are able to work safely with hand and/or power tools, various materials and equipment, and other resources. The SolidWorks (CAD program) will help the students understand Learning Standard 1.3, 1.4 and 1.5. ( Mass STE 2006)

**Your assessment of your district’s view on graduation requirements related** STEM. Since this course meets the STE frameworks, it’s considered a tech/eng course for science credit. Presently, the board of Higher Education is not accepting these courses. But over this summer the DESE and the Higher education will be working together to find a solution to this problem.

**Students in the Tech/Eng Course:** The tech/eng students are in either the 9th

or 10th grades. These students are taking Biology or Biology II, along with the technology/ engineering course. At the end of the year, students will have to choose either to take the Biology or the Technology/Engineering MCAS science test.

**Course**: In the course, students will be required to produce several orthographic projections and pictorials drawings. The students will interpret their orthographic projections and isometric drawing to prototype (s) built in the manufacturing and construction labs, The SolidWorks program will develop/ enhance student’s computer and technical skills in technology/ engineering education.

**Action Plan: (Over-All)**

1. Improve an existing engineering- technology course with use of SolidWorks program
2. Deepen knowledge and skills with CAD in order to provide CAD based – learning for students.
3. To assist the student in designing their prototype to be built this year

**Describe at least two actions you plan to take: ( Specific)**

1. To teach students about basic drawing/sketching in regards to multi-view drawings

(orthographic projections, pictorial drawings, isometric, oblique, perspectives ).

2. Teach the basic concepts of SolidWorks in regards to mechanical drafting.

3. To teach the students how to interpret drawing and in order to build or design prototypes.

**Background of the students in Technology/ Engineering Courses**: (Level/ Learning style)

Students in these classes are visual/ hands-on learners. These students are in the lower percentile of their class. Usually, they have previously failed at least one of their STEM’s course(s).

**Action Plan 1:** Students will learn how to interpret/ draw orthographic projection on graphic paper. Students will be provided with models, and required to reproduce them on Graph paper. Also, several MCAS 9th/ 10th grade questions will be given to help the student see a correlation between technical drawing and MCAS Science questions.

**Action Plan 2**: Students will become proficient in basic technical/ mechanical drafting skills by using SolidWorks. The Teacher will provide lessons with simple Orthographic projections, Isometrics, Oblique, and Prospective drawings. (MCAS/STE Frameworks 2006). Students will be required to reproduce them these with accuracy scale in SolidWorks.

**Action Plan 3:** Students will use SolidWorks to design and develop models and prototypes that will be built throughout the year.

**Time Frame:**

**Action 1:** In the curriculum, provided by the teacher. The timeframe for the “Hand- drawing section will be 2- 3 weeks.

**Action 2:** In the curriculum, provided by the teacher. The timeframe for SolidWorks will be 2 to 3 weeks. (the one-year course for science credit, has only a small window to cover each of the Tech/Eng frameworks.)

**Action 3:** Will be used as a tool for designing prototypes in construction, manufacturing, and electrical areas.

**Material/ Time/ Classroom limitations:**

Materials for projects are always a “challenge” with these budget constraints. Since the teachers at our school share labs, sometimes problems do occur in regards to which teacher(s) will used the lab at a specific time. The one-year course, in technology/ engineering is difficult to teach because the entire TE frameworks have to be covered before June for the MCAS Science test. In order for teachers to prepare their students for the test, the subject matter must correlate exactly with the frameworks, which makes “time” a huge factor.

**Evaluation of work/Monitoring of student’s accomplishment of the material:**

Open-Ended questions from the MCAS Tech/Eng test from prior years.

Multiple choice questions from the MCAS Tech/Eng test from prior years.

Rubric on hand drawings

Rubric on SolidWorks designs

Project Rubric on projects used with SolidWorks

Written essays/ reports on technical information regarding SolidWorks

A student evaluation form (from the students) on how SolidWorks worked in designing their projects

**Implementation issues:**

Having enough copies of SolidWorks 2010 and SolidWorks books

Computers than can run SolidWorks “correctly”

Will there be enough time during the year to teach SolidWorks to the students in order for them to become proficient?

### Mid-Year Evaluation

**Start Date:** 11/02/2010

**End Date:** 11/02/2010

**Email Address:** sanfords@worc.k12.ma.us

**School:** Worcester

**Have you already started your capstone project work with students?** No

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1:

Semester 2: x

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

01/01/2010

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

Nightschool program -Students are from all districts, This year, because of the budget cuts. I'm in another school teaching technology.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

None.

### Reflection

## Tri Tran

### Implementation Plan: Team (See Kristina Buenafe)

### Mid-Year Evaluation

**Start Date:** 11/24/2010

**End Date:** 11/24/2010

**Email Address:**tmtran320@yahoo.com

**School:** Jeremiah E. Burke High School

**Have you already started your capstone project work with students?** Yes

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2:

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

Nov 1-Nov 5

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

Build three-legged chair 4 Geometry classes with total of 80 students. Each class will have about 6 3-students group. They have two days to build three-legged chair that is at least 6 inches high. The materials include: foam board, tape, ruler, 3 feet of small wood stick, dissecting knife, scissor, and a pipe cleaner.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

It is good to let students know what you use as the weight to test on the chair. Some students make surface of the chair too small to put on the weight. Also, set a time limit. I took picture while they were working and posted them around the room, students really like to see their picture in the classroom. I know other teacher did the same project, except she use drinking straw instead of stick and it work just fine. Be creative about the materials and just let students have fun with the project.

### Reflection

**Classrooom size:**

24 students per class

**Highlights of your Action Plan**

See students smile and engage in building the project.

**Implementation of your Action Plan?**

Implemented in 1st term and took about two days to complete.

**In Class Activities Created as a Result of CAPSULE**

Three legged chair competition

**Sample Student Work?**

Three-legged chair.

**Have your students reaped the benefits of more CAPSTONE based learning?**

Yes, I saw students, whom usually don't want to any work, are very engaged in the project and take leadership role in his/her small team.

**What have you changed about your style of teaching as a result of participation in CAPSTONE?**

More into exploration than lecturing style as the result of the program.

## Rosalie Williams

### Implementation Plan

***Context***

Cambridge Rindge and Latin School, CRLS, is a comprehensive high school divided into four Learning Communities. The school’s mission is to provide a quality education to every student through rigorous, comprehensive, and personalized teaching and learning. CRLS values academic excellence, creativity, diversity, perseverance, collaboration, and responsible decision-making. The school has a Block Schedule with four 84-minute periods each day and two 90-day semesters each year.

Cambridge Rindge and Latin offers an engineering program in Rindge School of Technical Arts Department, RSTA; it is Chapter 74 Engineering Technology. The Engineering program is a three-year course of studies that is based on the **Project Lead the Way** national curriculum for preparing high school students for a career in the field and is aligned with the Massachusetts Department of Education’s Career/ Vocational Technical Education, CVTE, Frameworks for Engineering Technology.

In Engineering, students apply mathematics and science knowledge and skills to the real world of problem-solving and decision-making. Students learn with hands-on activities to figure out “how things work.” Coursework includes exploring technology systems and engineering processes, concepts of robotics and automated manufacturing, 3-dimentional designs and model-making, architectural design and projects, and the exploration of civil and electronic engineering. The program has a state-of-the-arts lab; Students learn skills related to the use and programming of CNC equipment, Computer Assisted Manufacturing (CAM), robotics, and flexible manufacturing systems.

CRLS graduation requirements related to STEM are three years of math and science and two years of technology. In the Science department, the required courses are Physics, Chemistry, and Biology; elective courses offered are astronomy, ecology, epidemiology, genetics, physiology, marine biology, and environmental science. High School Math 1 and 2 and Algebra 2 are required courses in the Math department; electives are trigonometry, pre-calculus, advanced math topics, and calculus. Engineering Technology program required courses are Engineering 1, 2, and 3; the elective courses are Robotics/FIRST and Engineering Design/Computer Integrated Manufacturing.

STEM education is valued at the high school. This is evident in the courses offered and activities such as the Science Fair and Engineering students competing in Skills USA and a national FIRST robotics contest.

***Action Plans***

In my program, Computer Technology, all of my courses are project-based learning; all courses culminate with each student producing a project. Students are presented with a problem; they draw upon their knowledge and research to derive at a solution of the problem, create a workable solution, and present the workable solution by the use of description and demonstration.

The final project follows a similar path of a capstone; the oral and visual presentation of the process is missing. I want to expand the students’ learning experience by modifying the final project to a capstone-like experience. I will focus on my Game Development course.

I propose to enhance my Game Development curriculum by adding 3-D image creation to my Digital Image chapter and requiring students to include a PowerPoint to their final project presentation.

* In my Digital Image chapter, I introduce the students to 2-D images and Paint applications; an application that creates images and the other application edits images. I will use the SolidWorks application to introduce creating 3-D images; this will boost their knowledge about digital image development and add another tool and skill to their learning experience.
* The students’ final project is creating a game. Their presentation consists of describing and demonstrating the game. I want to change the presentation requirements to include the use of PowerPoint to summarize the project’s process. The use of PowerPoint will demonstrate their ability to apply key knowledge and skills by planning, completing and presenting their project as well as adding a visual dimension to the presentation.
* I plan to implement this lesson in the school year 2010-2011 during semester 1

**Action plan #1**

**Add 3-D imaging section to my Digital Image chapter**

* Create a section about 3-D images
* Create a tutorial introducing SolidWorks interface
* Develop tutorials to create and edit 3-D images using SolidWorks
* Add this section to my lesson outline and lesson plan
* Modify chapter rubrics

**The material I would need is the SolidWorks application**

**The barrier for this action is not having a copy of SolidWorks application for my class**

**Action plan #2**

**Modify specifications for final project presentation to include PowerPoint**

* Add instructions to use PowerPoint in their presentation
* Specify the content of the slides
* Presentation must begin with PowerPoint then the demonstration of their game
* Create a rubrics for the PowerPoint presentation

**The potential barrier would be students’ lack of experience creating a PowerPoint presentation**

***Action Plan Outcome***

**Students will understand the concept of 3-dimensional image and become competent in using the SolidWorks application. A description of assessment follows.**

I use informal and formal assessments for day to day learning. The informal formative assessment consists of observing performances and providing help when needed; passively observing discussions, making note of misconceptions, and addressing the misconceptions. The formal summative assessment consist of grading chapters’ written exercise, quizzes, tests, and chapters’ hands-on activity. I use a rubric for grading each chapter hands-on activity. The rubric categories are Specifications, Readability, Reusability, Documentation, Delivery, and Efficiency. The ratings are Exceptional, Acceptable, Amateur, and Unsatisfactory. The description of the ratings follows:

* **Exceptional (point 100)**

The code is extremely efficient without sacrificing readability and understanding.

* **Acceptable (point 80)**

The code is fairly efficient without sacrificing readability and understanding.

* **Amateur (point 70)**

The code is brute force and unnecessarily long.

* **Unsatisfactory (point 60)**

The code is huge and appears to be patched together.

There is place on the rubric for the teacher and student to place a grade. After completing the chapter hands-on activity, the student will write the grade she thinks she deserves; I will then grade the activity and explain my grade if the student's grade and my grade differ. **My grade** is the assignment grade.

**Students’ final project will include a PowerPoint presentation. A description of assessment follows.**

I use informal and formal assessments the final project. The informal formative assessment consists of observing project management and posting on the SmartBoard the project’s categories with the timeline and observing if they are on task, and providing help when needed. The formal summative assessment consists of using a rubric for grading the content of the project and a survey of the project by an audience.

**Success**

**Teacher’s success would be**

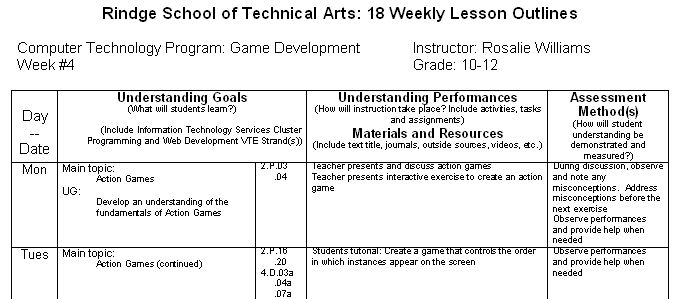
* creating easily understood tutorials for SolidWorks
* creating student-based lesson plans
* providing a clear project description

**Students’ success would be**

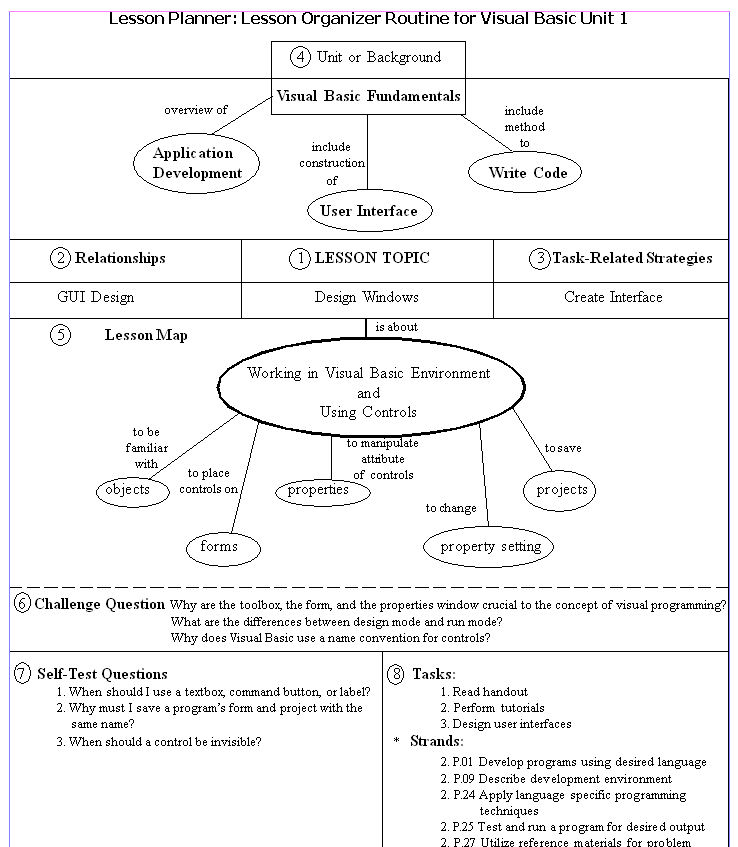
* creating professional-looking PowerPoint slides
* being proficient in SolidWorks
* creating a good game
* submitting their game to YOYO Games
* having confidence in their skills and abilities

**Additional Details**

* I will add to my Digital Image lesson outline the CVTE Frameworks competency for CAD and 3-dimensional imaging. A sample of my lesson outline is below.



* I plan to enhance my student-centered practice. I will change all of Game Development lesson plans from the linear planning model to the lesson organizer routine and share my lesson plans with students. The lesson organizer routine is used to organize content to help students understand it, connect prior knowledge to new knowledge, and engage students more actively in constructing knowledge for themselves. A sample of a lesson organizer routine used for my computer programming lesson follows.



### Mid-Year Evaluation

**Start Date:** 11/12/2010

**End Date:** 11/12/2010

**Email Address:** rwilliams@cpsd.us

**School:** Cambridge Rindge and Latin

**Have you already started your capstone project work with students? Yes**

**During which semester(s) or trimester(s) will you conduct your capstone projects with students? (CHECK ALL THAT APPLY):**

Semester 1: x

Semester 2:

Trimester 1:

Trimester 2:

Trimester 3:

Other:

**What are the approximate planned start and end date(s) of your capstone project work with students?**

I began the project September 7, 2010 and it will end January 5, 2011.

**Now that you are well into the school year, please describe briefly the capstone project work you are already doing or plan to do. For example, the course(s), number of students, general parameters of your capstone projects, and any other key information about your plans.**

I'm implementing the capstone in my Game Development class. The class has one student. The student will begin creating his capstone in December.

**If there is anything else you'd like to mention at this point, please do so here. (For example, what has gone well or badly, advice to share with other CAPSULE teachers, or anything else.)**

The student is competent; he created a game for the midterm. I'm currently expanding his game development understanding. I wanted to introduce the student to creating 3D images with SolidWorks, but I do not the program yet. I will be on medical leave before the end of the semester; I might be out for the entire second semester.

### Reflection

1. www.usfirst.org [↑](#footnote-ref-1)
2. FIRST Robotics Challenge [↑](#footnote-ref-2)
3. FIRST Technology Challenge [↑](#footnote-ref-3)