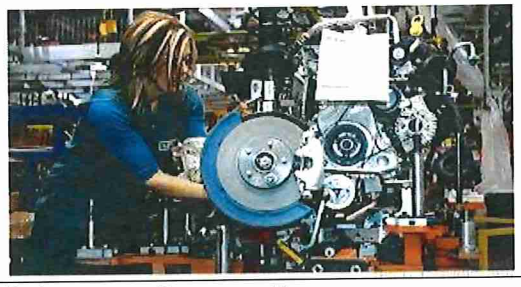
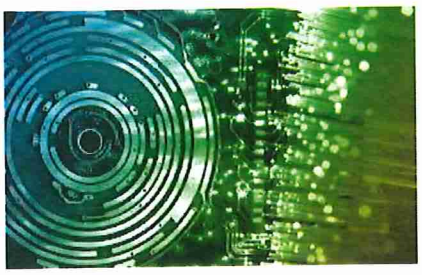
Amp It Up! Engineering/Technology and Industry Lesson Extension

Teacher Name(s):	**Nickerson Cammett**
School and District:	**Lynn English High School, Lynn**
Course:	**Chemistry**

Abstract: In 200 words or less, please provide a summary of the goal for the lesson extension and its relationship between industry and academic topic.

Medtronic is a global leader in production and sale of catheters for medical purposes. In the context of design and application, many considerations have to be made in relation to human anatomy and the materials necessary for application. The purpose of this extension lesson is to engage students in problem solving and incorporate concepts learned from their content classes of biology and chemistry. The classroom activity will be inquiry based, consisting of a design challenge for students to build a working model of a catheter to remove an item from a pvc model of an artery.

Engineering/Technology Link:

1. How did you *introduce* engineering/ technology concepts or the company/industry focus in your course? Check the appropriate box(es) or choose Other.

   ✓ Defined terms (science, engineering, technology)

   ☐ Described the engineering design process

   ✓ Engineering design challenge related to industry

   ✓ Overview of the company

   ☐ Challenge based on 'industry specific' area of focus (manufacturing process, quality control, measurement, development, teamwork etc.)

   ☐ Other: _____

Level of Inquiry: Which of the following best describes the level of inquiry (adapted from Bell 2005) you used for this lesson/unit? Check the appropriate level.

☐ *Structured inquiry*: Instructor provides question and procedure. Students determine the results based on given procedures.

☒ *Guided inquiry*: Instructor provides question. Students design procedure and determine the results.

☐ *Open inquiry:* Students investigate their own research question. Students design procedures and implement the procedure on their own.

Lesson Extension Plan:

Title/Topic: Catheter Design
Time (minutes): 1hr 30min (1 long block or 2 class periods of 45min)
Company Name and brief Description: Medtronic
Overview of the Lesson: Student driven inquiry activity in the creation of a working catheter model incorporating background chemistry concepts and critical thinking and reasoning skills (scientific method).
Standard(s)/Unit Goal(s) to be addressed in this lesson: HS-PS2-6 – Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
Essential Question(s) addressed in this lesson: What impact does molecular structure have to do with the strength or flexibility of a substance?
Objectives (academic and/or engineering/technology, career): Students will be modeling the design and production of a model as experienced by an engineer.
Link to Industry (how the lesson connects to the industry visited: Students will be designing and creating a model of a catheter.
What students should know and be able to do before starting this lesson: Basic types of bonding, basic concepts of polymer and organic chemistry.
Instructional Materials/Resources/Tools : Student handout provided by instructor, role cards (as needed), supplied materials to create catheter (i.e. straws of various diameter, string, fishing line, differing tapes, etc.), and pvc artery model.
Lesson Delivery
Lesson Opening: Present information regarding Medtronic. Review prior knowledge of structure and function of circulatory system. Review of lipids and arterial plaques. Introduce the design challenge.
During the Lesson (activities/labs/challenges): Catheter Design Challenge

Lesson Closing – Students present their findings and discuss challenges that they experienced within the context of the activity.
Assessment
Student Assessment: Student performance checklist for self-assessment.
Delivery Assessment: Self-assigned team roles during design challenge (in order to ensure full participation).

Additional resources and assessments: Attachments should include handouts, readings (with references), lab write-ups, rubrics, exams/quizzes, and/or other similar materials.

Name:_____Date:_____Group #:_____

Catheter Design Challenge

Background:

Design and create model of a catheter that will fit through a pvc modeled artery and be able to retrieve an object or place an object within it.

Problem:

Like real arteries, the pvc pipe model includes angled sections and differing diameters. The catheter has to be of adequate length, strength, and have the ability to remove or place an item.

Directions:

Within your groups choose your roles from those of:

Manager/facilitator:_____

Speaker/presenter:_____

Reflector/strategy analyst:_____

Recorder:_____

Draw a proposed model prior to construction:

Sometimes in the course of design and construction of a product, revisions are implemented in the creation of a model. In the creation of your team's model, were there some changes that needed to be made in order to accomplish the desired goal? If yes, briefly describe below:

_____

Name:_____ Date:_____ Group #:_____

_____

_____

_____

Draw revised model:

Questions:

What were some issues that were encountered by the team?

_____

_____

_____

What were some key characteristics of the chosen materials in this challenge?

_____

_____

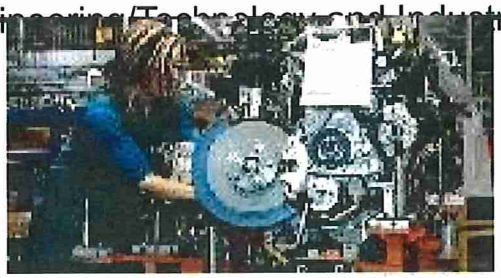
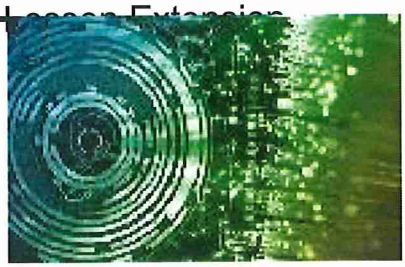
_____

Were some of the chosen materials more helpful or versatile in the activity than others? Why?

_____

_____

_____

Teacher Name(s):	**Lynn Petkewich**
School and District:	**Lynn Classical High School / Lynn Public Schools**
Course:	**Pre-Engineering Drawing**

Abstract: In 200 words or less, please provide a summary of the goal for the lesson extension and its relationship between industry and academic topic.

Engineering/Technology Link:

1. How did you *introduce* engineering/ technology concepts or the company/industry focus in your course? Check the appropriate box(es) or choose Other.

   - ☐ Defined terms (science, engineering, technology)
   - X Described the engineering design process
   - X Engineering design challenge related to industry
   - ☐ Overview of the company
   - ☐ Challenge based on 'industry specific' area of focus (manufacturing process, quality control, measurement, development, teamwork etc.)
   - ☐ Other: _____

Level of Inquiry: Which of the following best describes the level of inquiry (adapted from Bell 2005) you used for this lesson/unit? Check the appropriate level.

- ☐ *Structured inquiry*: Instructor provides question and procedure. Students determine the results based on given procedures.
- ☒ *Guided inquiry*: Instructor provides question. Students design procedure and determine the results.
- ☐ *Open inquiry*: Students investigate their own research question. Students design procedures and implement the procedure on their own.

Lesson Extension Plan:

Title/Topic: Float Boat/8 Steps Engineering Process
Time (minutes): Due to the nature of the project and the supplies, over the course of approximately 3 classes to complete the project.
Company Name and brief Description: GE Aviation is the world's leading producer of large and small jet engines for commercial and military aircraft, supplying aircraft-derived engines for marine applications and providing aviation services.
Overview of the Lesson: Using CAD software and the 8 Steps Engineering Design Process, design a prototype that stays afloat.
Standard(s)/Unit Goal(s) to be addressed in this lesson: Engineering Design Process
Essential Question(s) addressed in this lesson: **Did the prototype achieve its intended objection?** **Does the MS Word documentation reflect the steps accurately, the outcome, and any challenges?**
Objectives (academic and/or engineering/technology, career): To work through the 8 Steps of Engineering Design Process.
Link to Industry (how the lesson connects to the industry visited): GE uses CAD software and follows an engineering design process.
What students should know and be able to do before starting this lesson: Familiarity of the 8 Steps of the Engineering Design Process; essential vocabulary
Instructional Materials/Resources/Tools: Outline of the task, rubric, supplies, software
Lesson Delivery
Lesson Opening **Review assignment and rubric**
During the Lesson (activities/labs/challenges) **Circulate around the classroom to observe activity of the students.**
Lesson Closing **Review objective and any findings.**
Assessment

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Assessment

~~Student Assessment:~~ **Students thought the project was fun.**
Delivery Assessment: **The creativity of the students was amazing.**

Additional resources and assessments: Attachments should include handouts, readings (with references), lab write-ups, rubrics, exams/quizzes, and/or other similar materials.

Description:
This project in the Pre-Engineering & Drawing course relates to the GE Aviation industry in that the software the students use to draw their prototype and the process the students follow, are similar to the CAD software and the design process used at GE Aviation [Design, Manufacture, Assembly/Test, Flight Service Center, Program Management, Customer Support].

As with GE, engineering design involves practical problem solving, research, development, and invention/innovation. It requires designing, drawing, building, testing and redesigning. Students should demonstrate the ability to use the engineering design process to solve a problem or meet a challenge. Students are made aware that it is okay to fail in their design, in that, that's what the Engineering Design Process is about- they will learn from their mistakes, document, improve, test, redesign.

Learning Objective:
Student use the 8 Steps of Engineering Design Process to solve the problem [Float My Boat]:

1. Identify the Need or Problem
2. Research the Need or Problem
3. Develop Possible Solution(s)
4. Select the Best Possible Solution(s)
5. Construct a Prototype
6. Test and Evaluate the Solution(s)
7. Communicate the Solution(s)
8. Redesign

Essential Vocabulary:
Engineering Design Process, Prototype, Evaluate, Redesign

Materials Needed: Scissors, Tape, Stapler, Ruler, Paper, Straws, Drawing

Learning Experience(s):

- Your results should include amount of time, if at all, your boat floated (right side up) and how much weight it could hold and float (suggestions for objects for the boat weight are paper clips, erasers, coins, candy).
- Students will use a sink filled with water to test their designs.
- Possible solution will be presented. Prototype will be created, tested, evaluated and redesigned if necessary, according to the 8 Steps of Engineering Design Process.

Assessment:

- Students will create a prototype, test and report results. (Boat)

- Students will use MS Word to list and explain [2-3 sentences per step] the 8 steps of the engineering design process used to implement the prototype.

- Students will use TurboCAD software to design the prototype with measurements, geometric shapes, line widths, line formatting and color, and text labeling.

Pre Engineering **Student Name:**

Building A Structure: Float My Boat

CRITERIA	Effective Team Member	Self-directed	Attains Goals	Student Grade
Remarkable 4	**Always** Contributes as **productive and cooperative member** in the design, documenting and implementation of the prototype **to enhance the goal outcome.**	**Always** The boat prototype provides **clear evidence of troubleshooting, testing, and refinements based on data or scientific principles.**	**Always** The TurboCAD drawing is **neat** with clear measurements and labeling of **all** components.	
Acceptable 3	**Frequently** Contributes as **semi-productive and cooperative member** in the design, documenting and implementation of the prototype **to enhance the goal outcome.**	**Frequently** The boat prototype provides **clear evidence of troubleshooting, testing and refinements.**	**Frequently** The TurboCAD drawing is **neat** with clear measurements and labeling of **most** components.	
Making Progress 2	**Inconsistently** **Contributes toward the goal** outcome of designing, documenting and implementation of the prototype.	**Inconsistently** The boat prototype provides **some** evidence of troubleshooting, testing and refinements.	**Inconsistently** The TurboCAD drawing provides **clear** measurements and labeling of **most** components.	
Starting Out 1	**Rarely** **Contributes toward goal accomplishment** of designing, documenting and implementation of the prototype.	**Rarely** The boat prototype provides **little** evidence of troubleshooting, testing or refinement.	**Rarely** The TurboCAD drawing does **not** show measurements clearly or is otherwise **inadequately** labeled.	

Student's Reflective Assessment
Teacher Assessment