Amp It Up! Engineering/Technology and Industry Lesson Extension



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School and District:	Miles River Middle School & Hamilton Wenham School District
Course:	Grade 6 Science

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.

The objective of this lesson is for students to evaluate 3 different surgical instruments. After having discussed the features of a successful design, students will then use the Engineering Design Process to find a solution to a problem. Students must create a bandage for minor cuts and abrasions for a local medical device company. After finalizing their design, they will share it with classmates. Students will reflect on the strengths and weaknesses of not only their own design, but the design of other teams.

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: Bandage Solution
Time (minutes): 3 periods, each 50 minutes
Company Name and brief Description: Microline Surgical creates reposable instruments for laparoscopy. These tools are considered less invasive but also precise. Microline also developed Thermal Fusion technology that utilizes pressure and heat to move soft tissue. Microline is owned by HOYA Corporation in Tokyo, Japan.
Overview of the Lesson: Students will evaluate 3 surgical instruments, discussing both advantages and disadvantages of the design. Then students will collaborate as a team to create their own solution to a problem. The goal is to create a bandage for minor cuts and abrasions, using a product development procedure that is similar to that of Microline. Students will utilize the EDP to create their design.
Standard(s)/Unit Goal(s) to be addressed in this lesson: • 6.MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution. Include potential impacts on people and the natural environment that may limit possible solutions. • 6.MS-ETS1-6(MA). Communicate a design solution to an intended user, including design features and limitations of the solution. • 6.MS-LS1-3. Construct an argument supported by evidence that the body systems interact to carry out essential functions of life.
Essential Question(s) addressed in this lesson: What are the criteria and constraints of a successful solution?
Objectives (academic and/or engineering/technology, career): • Evaluate the use of 3 Microline tools • Use the Engineering Design Process to create a bandage for minor cuts and abrasions
Link to Industry (how the lesson connects to the industry visited): Representatives of Microline explained the use and development process of several reposable laparoscopic instruments. The lesson evaluates the use of 3 different tools created by Microline. During the visit an engineer described a product development cross functional flowchart, which is created at the beginning of every project. The flowchart included the goals of those working in marketing, research & development, operations, regulatory affairs, and quality control. The lesson requires students to collaborate as a team, with a

representative from each of those sectors. The visit also emphasized the importance of labels that follow regulations, which will be a requirement in the lesson's design challenge.

What students should know and be able to do before starting this lesson: In grade 6, students learn that subsystems make up multicellular organisms. Groups of cells work together to make tissues to perform a specific activity. Tissues make up organs, and organ systems include two or more organs working together to perform a specific activity.

Instructional Materials/Resources/Tools

- Warm Up handout
- Evaluation of surgical instruments handout
- Bandage Solution project handout (including rubric)
- Materials brought in by students may include (but is not limited to): cloth, adhesive, cotton, tape, eye droppers, ruler, paper, towels, cotton balls, gauze, saran wrap, etc.

Lesson Delivery

Lesson Opening: Students will be presented with a warm up that touches upon what they have learned in previous lessons about the interaction of systems in the body. The warm up asks students to list any instruments that they know of that have been used to strengthen our understanding of the human body. Students are also asked to describe one pro and one con for each listed tool. The second question on the warm up asks students to list and describe instruments that are used in the healthcare industry. The warm up is intended to access students' prior knowledge about tools that are used to aid in the treatment or academic exploration of the human body.

Next, students will be introduced to a manufacturing company that designs and produces surgical instruments (Microline). They will learn about 3 tools that have been developed at Microline, including Microline's ReNew handpiece and tip kit, a clip applier, as well as the MiFusion electrosurgical tool. Students will discuss the advantages/disadvantages of the design of each instrument.

During the Lesson (activities/labs/challenges): Students will use the Engineering Design Process to create a bandage for minor cuts and abrasions. Each group will consist of five students who will take on the following roles: marketing strategist, regulatory affairs specialist, biomedical engineer, research and development manager, and quality control specialist (the five components of a Microline project). After students have created and finalized their design, they will share it with their classmates.

Lesson Closing: Students will complete a reflection in which they describe the benefits and limitations of their design, as well as two other designs shared by classmates.

Assessment

Student Assessment:
Each group is graded using the attached checklist rubric.

Delivery Assessment: N/A

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

Name: _____ **Date:** _____

Bandage Solution

The Problem

A medical device company is working on designing a new and improved bandage for minor cuts and abrasions. They want to create a product that can be used to aid in the healing process of the wound. The company also wants the product to be cost effective in order to successfully sell it on the market. They have hired you and your team to help.

The Challenge

Use the Engineering Design Process to design and test a prototype of a bandage that can be used to protect a minor cut or abrasion. The bandage should protect the wound from dirt, bacteria, and friction. It must have a label. The bandage may or may not include an adhesive. You must modifications to your design to make improvements.

Suggested Materials

Cloth, adhesive, cotton, tape, eye droppers, ruler, paper, towels, cotton balls, gauze, saran wrap, etc. Note – you can bring in materials of your choice.

Roles

- *Marketing Strategist*: define the problem, determine the voice of the customer, decide on business plan
- *Regulatory Affairs Specialist*: research 2 laws that pertain to production of bandages
- *Research and Development Specialist*: research 2 bandage designs, compose materials list
- *Biomedical Engineer*: research materials, fixture development
- *Quality Control Specialist*: test the prototype, suggest modifications

Presentation

Present your final design to the class (use whiteboards). In your presentation, explain how you utilized EDP to create the final product. Discuss challenges and/or failures that helped to improve the design.

To be filled in by the team:

Problem: State the problem in your own words. Keep in mind the needs of the customer.

Research: List and describe 2 laws that pertain to the production of bandages.

Research: Describe 2 researched bandage designs.

Step 1: Brainstorm ideas. Sketch your prototype.

Ideas: List out materials you may want to use.

-	-
-	-
-	-
-	-
-	-

Sketch: Draw your bandage prototype here. Label the materials used. You must get your design approved by your teacher.

Teacher Initials: _____

Step 2: Build and Test Prototype
Build your design and test it. Does it meet all the criteria and constraints?

Summarize your results. What worked? What didn't work?

Step 3: Refine and Redesign
List modifications you will make to the design.

Use the space below to draw your new design. Label your drawing.

Step 4: Rebuild and Finalize
Build and test your final design. Present your final design to your class.
Note: If you have time, you may make more than one prototype.

***Describe your final product**:*

Reflection (to be completed individually):

1. What body system(s) does your bandage affect? Explain.

2. How did you utilize the Engineering Design Process to create your final product?

3. What were some benefits and limitations to other designs that were presented? Refer to at least 2 other designs.

Bandage Solution Rubric

Group Members:

Final Bandage Design (10 points)

__ Bandage successfully covers wound

__ Includes label

Presentation to Classroom Audience (10 points)

__ Discuss use of EDP

__ Discuss challenges and/or failures that were used to improve design

__ Describe features of final product

Team Approach (15 points)

__ Equal participation and communication of all group members

__ Team members support all roles as need arises

__ Materials are organized each day

Reflection Questions (10 points)

__ Completed questions/reflections

Total & Comments: