
Amp It Up! Engineering/Technology and Industry Lesson Extension

Teacher Name(s), Tiara Mason,

School and District: Peabody Veterans Memorial High School, Medtronic, Inc.

Course Name: Algebra 2

Lesson/Unit Name: Maximizing Volume; Manufacturing and Shipping

Science or Education Topic(s): Graphing Polynomials, Solving polynomials, maximizing volume, Manufacturing, Career and College Exploration

Engineering Technology Industry Related Field/Activity: Introduce students to Medtronic. Explain what Medtronic does in the medical field and all the subgroups that work together to create their product. Have students engineer a box used for shipping. The students will work in heterogeneous groups and use the A3 Problem Solving Template used by Medtronic engineers to manufacture a box made from cardboard.

When Taught: During Quarter 2 in Algebra 2 Courses (When discussing Polynomial Unit) (lesson created April 2016)

Abstract: The series of lessons is based on working in cooperative groups to design and manufacture a box used for shipping. The goal is for students to use the materials and maximize the volume of the two-dimensional piece of cardboard. The students will first do a scavenger hunt on the Medtronic website, and discover what the company does, job opportunities that are available, and what they do for the local community.

The second part of the lesson will be for the students to design and test strategies to maximize the volume of their piece of cardboard. Here they will use volume formulas, test different inputs and outputs and create a graph. The students will run final designs by the "Champion" and get their idea approved. Once approved, the students will create their box out of the given tools.

The last activity involves students reflecting on their experience. What did they learn about working in cooperative groups? How did each group member pull their weight? They should also reflect on what they learned about Medtronic and engineer career opportunities.

Amp It Up! Engineering/Technology and Industry Lesson Extension

Objectives and assessment: Using the table below, identify at least 3-5 learning objectives (content and/or pedagogical) and describe how each will be assessed.

Objectives <i>By the end of this lesson/unit, the students will be able to:</i>	Assessment <i>How was the objective assessed? List the example of formative or summative assessment.</i>
Students will be able to graph cubic functions	Using the Medtronic Problem Solving template, students will use input/output table to graph the function using $V=LWH$ and find the maximum value of the graph.
Students will be able to test input values to find best output for the given situation, using cubic functions	Using the Medtronic Problem Solving template, students will test different cut sizes of the box and create an input/output table.
Students will be able to create cubic equations based off of the graph and pattern in the table.	Using the Medtronic Problem Solving template, students will make a general volume equation using the dimensions of their cardboard box and their graph.
Students will be able to list different engineering careers, especially ones employed by Medtronic	Write a reflection on the activity, including what they learned about Medtronic and other engineering fields.

Engineering/Technology Link:

1. How did you *introduce* engineering/ technology concepts or the company/industry focus in your course?

- 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, development, teamwork, etc.)

Other:

2. After introducing the concepts, what did/will the students do to explore and apply the engineering/technology and industry specific concepts?

Amp It Up! Engineering/Technology and Industry Lesson Extension

Students will work in teams and use the Medtronic problem solving template to manufacture a box that could be used in shipping, which has maximum value. Each team will have a different size piece of cardboard, they will discuss and problem solve through the template to produce their best product for the company. I will then approve their design, acting as a “champion”, before they can construct their box. Students will also research engineering careers and what type of engineers Medtronic employs.

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.

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

Lesson Extension Plan:

Title/Topic: Maximizing Volume; Manufacturing and Shipping
Time (minutes): Multiple Classes, depending on how instruction goes and how long it takes for students to create an approved proposal. Approximately 100 minutes
Company Name and brief Description: Medtronic, Inc. is a biomedical engineering company that researches, designs, manufactures, and sells “instruments or appliances that alleviate pain, restore health, and extend life.” Medtronic employs 85,000+ employees, has 53,000+ patents, is located in 460+ locations around the world, serves patients in 155+ countries, and in 2015 donated 97.8 million dollars to charitable contributions. Medtronic has groups of employees that focus on cardiac vascular (46%), restorative therapies (33%), minimally invasive therapies (12%), and diabetes (9%). Medtronic is the leading medical company in the world for sales of catheters utilized in cardiac care.
Overview of the Lesson: The lesson involves students working as teams and following an engineering problem solving protocol to manufacture a box that has maximum volume for shipping. The students will also research engineering careers and what they do at Medtronic.
Standard(s)/Unit Goal(s) to be addressed in this lesson: (from the Common Core Algebra 2 standards) A-APR-1 Polynomial Operations F-IF-7c Graph polynomials from factorization F-IF.4 Interpret Key Features of Graphs F- IF. 7 Sketch functions by hand and technology

Amp It Up! Engineering/Technology and Industry Lesson Extension

A-CED-1 Create Equations to solve problems

Essential Question(s) addressed in this lesson: How can you optimize the volume of a box? How does the graph of the equation answer the maximum volume of the box? How can you create an equation based off of the change of length, width and height? How could this activity be relevant in the world of manufacturing and engineering?

Objectives: To work cooperatively in groups to problem solve and design a cardboard box that contains maximum volume given different dimensions.

Link to Industry: Medtronic is always trying to improve on their customer service methods. One of the important aspects of manufacturing is shipping and handling. Students creating a box with given supplies will show them the importance of optimizing supplies to save money. Medtronic also emphasized the importance of team work and solving problems cooperatively. Students will be problem solving together to create the best possible result.

What students should know and be able to do before starting this lesson: Students should know the volume of a rectangular prism. Students should also have a background of polynomial functions and their graphs.

Instructional Materials/Resources/Tools:

Chromebooks: For day one, researching Medtronic. This will also be used in the end to evaluate their group work

- Medtronic Problem Solving Template: One per group
- Scissors
- Different sized rectangular cardboard
- Student Handout
- Graph Paper
- Tape

Lesson Delivery

Lesson Opening: Introduce students to Medtronic by having them use the Chromebooks in class to complete a scavenger hunt. The students will answer the questions by looking at the Medtronic website. As a class we will share/discuss what the students learned about the company. This is where the students will be introduced to the Medtronic Problem Solving template and put into cooperative groups for the continuation of the project.

During the Lesson (activities/labs/challenges):

Groups will be given supplies and they will problem solve together to create a box that has a maximum volume for shipping and delivery. First they will recall the volume formula for a rectangular prism. Then they will test different input values for length, width and height to yield the largest output. They will then use these values to graph the function.

Amp It Up! Engineering/Technology and Industry Lesson Extension

The students will finally use the graph and table of values to find the maximum output. This is where they will create a design of the box to present to the “Champion” (The Teacher) and get their design approved.

Lastly, the students will create their box with the given tools.

Lesson Closing: At the conclusion of the activity students will individually write a reflection paper that must summarize their conclusions. The paper must also reflect on how students work together as a group. What were challenges and successes that the group encountered. Additionally, the students must also reflect on what they learned about Medtronic and STEM occupations.

Assessment

Student Assessment: Student assessments are based off of the answers to their scavenger hunt, their group output (box), and lastly their reflection paper.

Delivery Assessment: Daily feedback as teacher walks around to groups and observes the groups working collaboratively together. The students are also required to get their design approved by the teacher before creating their final project.

Additional resources and assessments: List the attachments here.

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

Attachment 1: Scavenger Hunt

Handout below will be given to each student so they can explore the Medtronic Website.

Attachment 2: Medtronic Problem Solving Template

Handout (this was given by Medtronic, will be photocopied for each group) and it discusses the process which Medtronic Engineers use to solve company problems.

Attachment 3: Reflection Paper Requirements

This will be given at the end of the project and will briefly described what is required in the reflection paper.

Amp It Up! Engineering/Technology and Industry Lesson Extension

Name: _____ Date: _____

Medtronic Scavenger Hunt

Go to www.medtronic.com and answer the following questions. Be prepared to discuss answers with the class.

1. What is Medtronic's Mission Statement?
2. What four medical subgroups does Medtronic supply equipment for?
3. How much money did Medtronic donate to charities?
4. How many employees do they have worldwide?
5. Find one engineering position open and state what qualifications are necessary for that job.
6. List 5 other job opportunities available in the company
7. State an example of each
 - One part of their hiring process:
 - One resume tip:
 - One interview tip:
8. Name the three "Student Opportunities" they are giving to college students.
9. What are 3 fun facts you learned browsing the site (cannot be things stated above)
10. What do you still want to know about Medtronic?

Medtronic Reflection Paper

Type a reflection paper about the activity. Please include the following items.

Typed, size 12 font, Times New Roman, Double Spaced

During this lesson what did you learn about Medtronic and the STEM field?

How did your group solve the problem? What was your final result?

What are challenges your group faced?

What were some successes your group had?

How did you like about problem solving/working with your group? What didn't you like?

How would you change this lesson in the future?