Amp It Up! Engineering/Technology and Industry Lesson Extension



Teacher Name(s):	**Mr. Joseph Maher**
School and District:	**HWRHS – Hamilton-Wenham**
Course:	**Algebra II**

Abstract:
The goal for this lesson will be for students to connect what they have learned about quadratic and polynomial functions (specifically their graphs) to heart catheters. One of the devices we saw modeled at Medtronics was the heart stint catheter. The lesson will focus around an activity where the students are developing a new catheter which can be mathematically programmed based on an individual's arteries and heart.

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

   X Engineering design challenge related to industry

   ☐ Overview of the company

   X 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: 2020 Catheter Design Plan
Time (minutes): 70 minutes
Company Name and brief Description: Medtronics – in the Danvers location we saw how Medtronics used catheters for many medical uses. The most intriguing use was using a catheter design to implement stints to blocked arteries for high risk patients. Overtime, Medtronics hopes that this procedure will be used to more patients so that people can avoid evasive surgery.
Overview of the Lesson Over the past two units, students have been studying the graphs of quadratic and polynomial functions. At the beginning of these units, students were presented with the dilemma of how to analyze a patients' arteries and heart and then mathematically construct a formula that will correctly model that path for the new Medtronics 2020 Catheter. Now that the students have the skills to successfully analyze and graph these functions, they are going to engage in an online activity that I have created through Desmos to successfully devise models of various patients.
Standard(s)/Unit Goal(s) to be addressed in this lesson: Analyzing a polynomial function Graphing a polynomials function Describing maximum and minimum values of a polynomial function Recognizing real zeros of polynomials functions
Essential Question(s) addressed in this lesson: How can polynomial functions model real-life?
Objectives (academic and/or engineering/technology, career): Students will be able to successfully model a polynomial function under specific parameters Students will recognize the real-life implications of polynomial models in engineering

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Link to Industry:

Students will make connections of their math knowledge to how a catheter needs to travel through the body to reach specific target areas. We will access the Medtronic website to explore what they are doing in the biomedical industry and how mathematics and engineering is needed for them to create new and innovative products.

What students should know and be able to do before starting this lesson

Students will know how to graph quadratic and polynomial functions

Students will understand how to factor polynomials and determine their roots

Students will know how repeated roots affect the graph of a polynomial function

Students will know how the degree of the polynomial relates to the number of turning points of a polynomial.

Instructional Materials/Resources/Tools

Students will need access to computers or iPads with Internet.
See attached links

Lesson Delivery

Lesson Opening

"At the beginning of the unit, we asked the question, 'How can we design mathematical models for catheters to travel to reach problem areas in a patients' heart'. Today, we are going to use our knowledge of polynomial models to design computer aided catheters that you will program to travel through a patients' arteries to alleviate medical issues."

During the Lesson

Students will be instructed to follow this link (it will be a class code when live) for instructions
Desmos Captivia 2020

Lesson Closing

Students will reflect on the following questions upon completing the assignment:

1. **How could scientists and engineers determine a patient's blueprint prior to the prodedure you are designing mathematically?**
2. **What are some benefits of having a catheter that had a pre-determined mathematical path?**
3. **What could be some risks in the product you designed?**
4. **Businesses often need to think of the cost of their product and whether or not the benefits of their new product are worth the price to their consumers. How would you gather information to determine if your product is marketable?**

Assessment

Student Assessment:

Students will be assessed on how successfully they are able to complete the slides in the Desmos activity. If slides are not "Successfully" completed, they should keep their unsuccessful models in the equation boxes and they will be assessed on how successfully the accomplished key points on the graphs (x-intercepts, turning points, etc)

Students will also be assessed on the thought they put into the reflection questions that will be posted on their Google Classroom portal. These reflection questions will begin a class discussion the following class.

Delivery Assessment:
I will reflect on the lesson after it is implemented. It will be important for students to recognize the connections between what they learned conceptually in math class and how they can apply their knowledge to a “real life” application.
I will be using the student reflections to help me guage the success and impactfulness of the lesson.

Additional resources and assessments:

Desmos Activity Link

See attached for other resources