**Teacher Name(s), School and District: Erik Hellmer, Lynn English High School, Lynn**

**Course Name: Biology 1**

**Lesson/Unit Name: The Right Tool for the Job**

**Science or Education Topic(s): Biology/Circulatory System**

**Engineering Technology Industry Related Field/Activity: Design a device that can cut tissue and also seal blood vessels**

**When Taught: 5/6/16**

**Abstract:** The objectives for this lesson were for the students to design a conceptual tool meeting outlined requirements to use during a hypothetical surgery. This lesson was implemented in the form of a case study/design challenge during a 90 minute class, and the students' results were shared during the following class period. Most groups were successful in meeting the requirements laid out for the design of their tool, and most, if not all, students were actively participating during the entire process.
**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**<br>*By the end of this lesson/unit, the students will be able to:* | **Assessment**<br>*How was the objective assessed? List the example of formative or summative assessment.* |
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| Design a conceptual tool meeting the outlined requirements for use during a hypothetical surgery. | A rubric was used to determine how well the students' design met the criteria given. |
| Describe the circulatory system as a closed system of vessels that transports gasses, nutrients, and waste to and from the cells of the body. | An oral quiz was given after the lesson. |
| Follow the steps of the engineering design process with precision and accuracy. | Students were observed and were required to keep a laboratory journal during the process. |
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**Engineering/Technology Link:** Please check the appropriate box(es) in question 1. And provide a brief answer to question 2.:

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: _____

2. After introducing the concepts, what did/will the students do to explore and apply the engineering/technology and industry specific concepts? (include information about the actual activity students did, discussions they had, or instructional strategies you used)

Students were asked to play the role of research and development engineers at a company which designs and manufactures surgical equipment. They were given the task of developing a conceptual device that would be able to cut a blood vessel or tissue and also seal the severed vessel(s).

**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:**

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| Title/Topic: The Right Tool for the Job |
| Time (minutes): 1 90 minute period for design, 1 50 minute period for presenting results. |
| Company Name and brief Description: Microline Surgical: Microline surgical is a manufacturing company that designs, produces, and distributes surgical equipment. |
| Overview of the Lesson<br>In this lesson students will use their knowledge of the circulatory system and tissues to design a tool that will be able to cut and seal a blood vessel, preventing bleeding. |
| Standard(s)/Unit Goal(s) to be addressed in this lesson:<br>MA Biology standard 4.2- Explain how the circulatory system (heart, arteries, veins, capillaries, red blood cells) transports nutrients and oxygen to cells and removes cell wastes.<br>MA Engineering standard 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. |
| Essential Question(s) addressed in this lesson:<br>What is the function of the circulatory system?<br>Why do ruptured blood vessels bleed?<br>What are the ways in which a blood vessel can be sealed? (stop bleeding) |
| Objectives<br>Students will be able to design a tool that will cut tissue and blood vessels, as well as seal the blood vessels to stop bleeding. |
| Link to Industry:<br>One of Microline Surgical's tools is able to use heat to sever tissue and seal blood vessels at the same time. It uses precise cauterizing technology, and has been very successful in the surgical field. |
| What students should know and be able to do before starting this lesson<br>Students should have an understanding of the circulatory system and tissues. They should also be familiar with the design process outlined by Engineering standard 1.1. |
| Instructional Materials/Resources/Tools<br>The materials needed were minimal. The students were given a handout explaining the objectives of the lesson and outlining the activity. A rubric was used to evaluate their design, and an oral quiz was given to test their knowledge of the circulatory system. |

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| Lesson Delivery |
| Lesson Opening<br>Students were presented with the hypothetical scenario via the student handout and oral instruction. The students were informed that they were being hired by a medical device company, and that they would be split into 4 person design teams. The teams were then presented with the challenge: Design a medical device that is able to cut tissue and or blood vessels and also seal the blood vessel(s) in order to prevent bleeding. The students were split into teams, and given the student handout. |
| During the Lesson (activities/labs/challenges)<br>The handout included a description of the engineering design process, a description of the task at hand, and an outline of what was expected from them.<br>During the first 90 minute block, student groups worked together to discuss the problem, research the problem using iPads with internet access, discuss possible ideas for a device, and then design the device. |
| Lesson Closing<br>During the second 50 minute period each group presented their device to the class, who critiqued each device using the rubric. The class shared ideas with each group, and offered suggestions for how they could improve their device. |
| Assessment |
| Student Assessment:<br>The group rubric grades were as follows:<br>G1=17 G2=18 G3=16 G4=19 G5=13 G6=15 G7=17<br>The oral quiz was used as formative assessment, and misconceptions were clarified as they came up. |
| Delivery Assessment:<br>The students enjoyed this activity, as it was a break from their typical biology class. This led to improved engagement. In the future I would give the students a bit more background information. The presentations were well received, and I was impressed with the amount of feedback the class gave to each group as they thought about each other's designs . |

**Additional resources and assessments:**
Student Handout/Rubric

# Extension: Designing A Surgical Device

***MA Biology standard 4.2-*** *Explain how the circulatory system (heart, arteries, veins, capillaries, red blood cells) transports nutrients and oxygen to cells and removes cell wastes.*
***MA Engineering standard 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.*

**Objectives:**

- You will be able to use the design process to design a tool that will cut tissue and blood vessels as well as seal blood vessels to stop bleeding.
- Describe the circulatory system as a closed system of vessels that transports gasses, nutrients, and waste to and from the cells of the body.

**Project Summary:**
You and your team mates have been hired by a medical device company to design a product that is in demand. You are to use the engineering design process to design a medical device that is able to cut blood vessels and or tissue, and also seal the blood vessels to stop bleeding. (Hint: Remember that blood vessels vary in size from extremely small capillaries to large arteries and veins.)

**Instructions:**
You will be split up into 4-5 person groups by the teacher. Once you have been placed into a group you may begin the design process, which is outlined below.

1. *Identify the problem*
2. *Research the problem (iPads are available in the cart)*
3. *Develop possible solutions*
4. *Select the best possible solution(s)*
5. *Construct prototypes and/or models (your group will make a sketch of your device)*
6. *Test and evaluate (you can skip this step)*
7. *Communicate the solutions (you will present your design next class)*
8. *Redesign*

**Assessment:**

You will take a quiz on the circulatory system and you will be scored on your design using the following rubric.

| | 5 | 4 | 3 | 2 | 1 | Score |
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| Design Process | All applicable steps of the design process were followed and documented | Most applicable steps of the design process were followed and documented | Most steps of the design process were followed and or were not documented. | Some steps of the design process were followed. The process was not documented. | The design process was not followed and nothing was documented | |
| Cutting Requirement | The device is able to cut tissue and or blood vessels. The concept could feasibly be constructed and used. | The device meets most of the cutting requirements, and could feasibly be constructed and used. | The device met most of the cutting requirements, but some aspect could not be feasibly constructed or used. | The device inadequately meets the requirements, but could not feasibly be used or constructed. | The device does not meet any of the requirements. | |
| Sealing Requirement | The device is able to seal a severed blood vessel after it has been cut. The device could feasibly be used to seal a blood vessel(s) | The device meets most of the sealing requirements and could feasibly be constructed and used. | The device met most of the sealing requirements, but some aspect could not be feasibly constructed or used. | The device inadequately meets the sealing requirements, or could not feasibly be used or contructed. | The device does not meet the vessel sealing requirement | |
| Presentation | The presentation was clear and accurate. The design and | The presentation was clear. The design process was included | The presentation was unclear or inaccurate. The process was | The presentation was unclear or majorly inaccurate. The process was not | The presentation did not convey the design or the process. | |

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| | process was shared adequately. All members contributed to the presentation. | but lacked clarity. Most members contributed to the presentation. | included, but was lacking. More than half of the group did not participate. | addressed adequately. Only one person presented. | One person/no one presented. | |
| | | | | | Total: | _____/20 Pts |