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| **Fellow Name:**  Alyssa George | **Contact Info:**  georgeag@mail.uc.edu | **Date:** 03/01/2016 |
| **Teacher Name:**  Amanda Sopko | **School Name:**  Indian Hill Middle School | **Grade and Class:** 6th grade STEM |

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| **Activity Title:** | Cost and Design Comparison Activity |
| **Estimated Activity Duration:** | 90 minutes |

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| **Setting:** | Classroom |

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| **Activity Objectives:** |

The student will be able to:

1. Compare the costs of alternate designs
2. Compare medical device design to the engineering design process
3. Compare the different effects of constraints on alternate designs
4. Apply the engineering design process to solve a design challenge
5. Build, test, and redesign a prototype that mimics the function of a laparoscopic closure device
6. Employ teamwork and communication to successfully solve the challenge

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| **Activity Guiding Questions:** |

1. What is the relation between cost and design?
2. What is the relation between constraints and design?
3. What is the engineering design process?

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| **Next Generation Science Standards (NGSS)** | |
| **Science and Engineering Practices (Check all that apply)** | **Crosscutting Concepts (Check all that apply)** |
| Check mark symbolAsking questions (for science) and defining problems (for engineering) | ☐ Patterns |
| ☐ Developing and using models | ☐ Cause and effect |
| ☐ Planning and carrying out investigations | ☐ Scale, proportion, and quantity |
| ☐ Analyzing and interpreting data | ☐ Systems and system models |
| ☐ Using mathematics and computational thinking | ☐ Energy and matter: Flows, cycles, and conservation |
| Check mark symbolConstructing explanations (for science) and designing solutions (for engineering) | ☐ Structure and function. |
| ☐ Engaging in argument from evidence | ☐ Stability and change. |
| ☐ Obtaining, evaluating, and communicating information |  |

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| **Ohio’s New Learning Standards for Science (ONLS)** |
| **Expectations for Learning - Cognitive Demands (Check all that apply)** |
| Check mark symbolDesigning Technological/Engineering Solutions Using Science concepts **(T)** |
| ☐ Demonstrating Science Knowledge **(D)** |
| ☐ Interpreting and Communicating Science Concepts **(C)** |
| ☐ Recalling Accurate Science **(R)** |

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| **Common Core State Standards -- Mathematics (CCSS)** | |
| **Standards for Mathematical Practice (Check all that apply)** | |
| ☐ Make sense of problems and persevere in solving them | ☐ Useappropriate tools strategically |
| ☐ Reason abstractly and quantitatively | ☐ Attendto precision |
| ☐ Construct viable arguments and critique the reasoning of others | ☐ Look for and make use of structure |
| ☐ Model with mathematics | ☐ Look for and express regularity in repeated reasoning |

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| **Unit Academic Standards (NGSS, ONLS and/or CCSS):** |

* Asking questions (for science) and defining problems (for engineering)
* Constructing explanations (for science) and designing solutions (for engineering)
* Designing Technological/Engineering Solutions using science concepts

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| **Materials**: (Link Handouts, Power Points, Resources, Websites, Supplies) |

* Marbles (1 for each team)
* Solo cup (1 for each team) marked on opposite sides
* Scotch tape
* Masking tape
* Linking blocks
* Cotton balls
* Paper
* Packing peanuts
* Small boxes/cardboard pieces
* Egg cartons
* Popsicle sticks
* Bags of air
* Toilet paper roll
* Pipe cleaners
* Straws
* Index cards
* Paper plates
* Rulers
* Purchase slip

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| **Teacher Advance Preparation:** |

* Solo cups will need to be marked at the farthest points
* Items need to be “priced” and collected in one area where they can be “purchased”

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| **Activity Procedures:** |

1. Students will be given pre-assessment
2. Presentation on laparoscopic surgery/capstone will be given
3. Students will be separated into different groups with 2-4 students in it
4. The groups are being tasked with creating a laparoscopic trocar port closure model by filling a hole to allow an object to move across the top, similar what would be expected in the body.
5. Each group will be given a marble, a solo cup, and a purchase slip to begin with
6. The following design requirements will be given to the students:
   1. The goal: Get the marble to roll across the top of the cup as cheaply as possible
   2. Design constraints:
      1. Design cannot go past 1 inch on either side of the cup
      2. Marble must roll without falling into or outside of cup
      3. Design must be as cheap as possible
7. Students will be given 20 minutes to come up with 3 different drawn out designs and three different product lists in order to build fixture, along with pros and cons
   1. Students will need a signature before they can move on into design
8. Students will build one design at a time in order to accomplish goal and requirements
9. Students will be verified by teacher in order to show that the design “passes” the roll
10. Once design has been checked off as passing, students will record their results, including the end cost of their design
11. Once one design is completed, students will go back to the design phase and try to make the design even more cheaply
12. At the end of the activity, students will discuss math/science in activity and what they would have changed

Formative Assessments:

The students will need to be checked off at two points for understanding during this assignment: once with their designs and once with the built prototype.



<http://goo.gl/forms/993XFdmOLo>

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| **Differentiation:** Describe how you modified parts of the Lesson to support the needs of different learners.Refer to Activity Template for details. |

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| **Reflection:** Reflect upon the successes and shortcomings of the Activity. This is done after the Activity is implemented. |