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| **Lesson Title :** Minimally Invasive Surgical Devices | **Unit #:**  **1** | **Lesson #:**  **2** | **Activity #:**  **2** |
| **Activity Title:** Real-World Surgical Devices |

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| **Estimated Lesson Duration:** | 13 days |
| **Estimated Activity Duration:** | 3 hours |

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| **Setting:** | Ethicon EndoSurgery |

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| **Activity Objectives:** |

* Students will discover how surgeons clamp and cut an organ
* Students will test devices used to clamp, cut and seal organs in human surgery
* Students will identify iterations involved in the design of a surgical device

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| **Activity Guiding Questions:** |

* How do surgeons clamp and cut an organ in real life?
* How are these newly cut organs sealed?
* What design flaws have led the engineers at Ethicon to redesign their devices?
* Why are there multiple devices designed to do the same task during surgery?

| **Next Generation Science Standards (NGSS)** | |
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| **Science and Engineering Practices (Check all that apply)** | **Crosscutting Concepts (Check all that apply)** |
| Asking 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 |
| Constructing explanations (for science) and designing solutions (for engineering) | Structure and function. |
| Engaging in argument from evidence | Stability and change. |
| Obtaining, evaluating, and communicating information |  |

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

| **Common Core State Standards -- Mathematics (CCSS)** | |
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| **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):** |

* Design, evaluate, and refine a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.
* Design criteria and constraints, which typically reflect the needs of the end-user of a technology or process, address such things as the product’s or system’s function (what job it will perform and how), its durability, and limits on its size and cost.

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| **Materials**: |

None (all provided by Ethicon Engineers)

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| **Teacher Advance Preparation:** |

Contact Ethicon EndoSurgery to set up field trip, using information below:

Ethicon EndoSurgery

4545 Creek Rd.

Blue Ash, OH 45242

(513) 337-7000

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| **Activity Procedures:** |

During this off-site field trip, students are introduced to real-life engineering. This field trip includes two parts: a tour of the facilities (including labs, work spaces, and operating rooms) at Ethicon EndoSurgery and a set of break-out sessions where students are able to learn about and use several of the devices created by Ethicon.

During both parts of this field trip the engineers will explain how the device was designed and what has led to several iterations of the same machine.

**Formative Assessments:**

Questions asked of students throughout field trip by Ethicon Engineers.

**Summative Assessments:**

None

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| **Differentiation:** |

No modification needed due to the small, homogeneous nature of the group of students (which includes no students with individualized education plans).

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| **Reflection:** |

This field trip is one I’ve been doing for several years, but with this unit I believe students learned a lot more from the field trip. I heard several students asking how the devices actually perform the task of clamping down on the organ. These questions resulted in a greater understand of how the devices are engineered. Students were fully engaged and understood much more of the reasons for many of the designs of the medical devices they were using. Students were also able to see many of the testing labs and I believe had a greater appreciation for the need for constant testing and redesigning during the development of a new device.