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| **Fellow Name: Jacob Knorr** | **Contact Info: 937-470-8075** | **Date: 12-13** |
| **Teacher Name: Samy Lafin** | **School Name: Scott High School** | **Grade and Class: 10th grade Biology** |

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| **Activity Title:** | **The Minimally Invasive Challenge** |
| **Estimated Activity Duration:** | **1-2 days** |

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| **Setting:** | **Classroom/Laboratory** |

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| **Activity Objectives:** |

The student will be able to:

1. Describe how cancer develops and affects body function.
2. Identify three types of cancer and risks for developing cancer
3. Describe the issues associated with treating a tumor surgically
4. Design a device to remove a tumor (jelly bean) from the body (Jell-O) with the least damage.
5. Predict how the device will work in the body.
6. Record quantitative observations on the performance of the device.
7. Critique other student devices and defend their own device.
8. Propose improvements to their device for improved function.

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| **Activity Guiding Questions:** |

1. Why does cancer form in the body and how does it affect normal function?
2. What features does the device need to remove the tumor effectively?
3. What are some issues with treating a tumor surgically?
4. How will the device affect the surrounding tissue in the body?
5. How did your device perform? How big was the incision that was left?
6. How did others’ devices compare to your own? What features did they have?
7. What improvements could device use? How would you make them?

| **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):** |

NGSS HS-LS1-4 --From Molecules to Organisms: Structures and Processes

* Use a model to illustrate the role of cellular division and differentiation in producing and maintaining complex organisms.

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

1. Small clear plastic cups
2. Red Jell-O
3. Jelly Beans
4. Paper Clips
5. Rubber Bands
6. Tape
7. Pipe cleaners
8. Toothpicks
9. String
10. Rulers

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| **Teacher Advance Preparation:** |

Creating Jell-O tumor models prior to class

Organizing and distributing appropriate device materials and handouts.

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| **Activity Procedures:** |

1. Watch presentation on cancer biology (10 minutes)

A fill-in-the-blank fact sheet will accompany this presentation

1. Introduction to activity: Problem, Goals, Materials, Design Process, Scoring (10 minutes)

Instructor will review activity with the class using a handout

1. Obtain materials (5 minutes)

Materials distributed to each group through “design kits” (small plastic boxes)

Grouping scheme will follow that already established for previous labs.

1. Individual Preliminary Design Sketch (5 minutes)
2. Group Critique and Brainstorming for Final Group Design(10 minutes)
3. Build device and Document Process (15 minutes)
4. Test Final Design (10 minutes)
5. Measure Effectiveness and Propose Improvements (10 minutes)

**Formative Assessments:** Link the items in the Activities that will be used as formative assessments.

1. Preliminary Individual Sketch
2. Group Design Process and Final Design
3. Final Device Build
4. Observations From Testing and Proposal for Improvements

**Summative Assessments:** Prepare a Pre-Test and Post-Test with the input of the RET Teacher. This should be a simple 10-12 question assessment tool. These questions will cover the content related to the Standards. The Pre and Post Test will be identical. There may be several summative assessments at the end of this Activity. Besides the Pre and Post Tests, the students might create a product for which this is a rubric developed. The rubric is also a summative assessment tool. Link the assessment tools.

1. What is cancer?
2. How is cancer related to mitosis?
3. How can cancer affect bodily function?
4. Name three types of cancer
5. What are some cancer risks?
6. In what ways is cancer treated?
7. How is cancer treated surgically?
8. What are some challenges to removing cancer surgically?
9. What structures must we be careful to avoid during surgical tumor removal?
10. How does the size of surgical incisions impact recovery?

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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. |

I found that, for the most part, students took initiative in this activity and did not have an issue with completing the design process and testing their device. For a few groups, however, they required a small degree of prodding here and there to come to design conclusions. I tried to take a bit more time during the activity with these groups to ask them questions that got them thinking about the pros and cons of their design vs. that of other group members. In a group that had not come to a design consensus, I asked them “What do you like about your design?” “What do you like about your team member’s design?” “Why do you like that particular feature?” What problems do you see with using the device in that way?”. These additional questions prompted a conversation within these groups that put them on the track to success.

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

As seen in the data above, the complete sample of tested students scored higher post-test averages than pre-test averages, improving from 79.1% to 84% after the activity. When breaking this data up into period-specific groups, we see that there is a disparity in the pre-test scores across all four groups, with period one performing significantly better than the other classes. However, when we examine the post-test scores, we see that period 2 exhibits a large improvement after the activity when compared to all other periods. I find this improvement in period 2 interesting as it is unexplained by observations in the classroom. Other than period 2, the other classes exhibit a modest improvement in test average.

Overall, I would conclude that this activity was very successful. I was able to cover some brief content in cancer biology while also implementing a major design activity, with every single group across four periods finishing in the allotted time. The task was simple enough to complete in one class period, but difficult enough to allow for a distribution of success by various groups. This activity got almost all students invested in the task at hand and challenged students to accomplish a task in new and creative ways. This activity was successful because it allowed all students, no matter their competency, to complete a task with varying success and be proud of what they have created. Furthermore, the jelly bean in Jell-O was realistic enough to intrigue the students that typically find biology to be boring. The task was made more realistic with “sterile” operating room drapes and a document camera serving as the “surgical monitor”.

Naturally, some groups took initiative with this activity, while other groups needed guided direction throughout the design process. The more tentative students often had acceptable design ideas, but did not have the initiative to present their ideas within in their group, or manage the groups conversation in the brainstorming stage. A shortcoming of this activity is not being able to control the group dynamics to create a successful learning environment for all students. If I was to have my own class and repeat this activity, I would put some thought into what group members would work best with one another for all groups participate in the meaningful discourse that can occur in the design process of this activity.