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Major Project Reflection
Summer 2020

Click **HERE** to view the design challenge presentation and student engineering design notebooks.	
Engineering Design Process Used	For this project, I used an engineering design process that was a blend of NASA Best, Engineer Girl, and EIE. The process we used is as follows: **ASK**: students identified the problem and stated it in their own words. **BRAINSTORM:** students completed this part of the design process in two phases. The first phase was independent and the second phase was with a partner. **DESIGN:**students decided on the plan from their brainstorming sessions they wanted to design and then created a plan for this in their notebooks. **BUILD:** during this part of the design process, students put their plans into action and built it using the materials available. **TEST AND EVALUATE:** students tested their design from a height of thirty nine inches. After all three groups tested, partners discussed the pros and cons of their design. **IMPROVE:** students used the test run to determine what needed to be improved and then made the improvements to their design. **RETEST:** after making modifications to their projects, students tested their improved designs. This time we increased the drop height by ten inches for successful landers until we reached a maximum drop height of eighty nine inches. **COMMUNICATE:** after completing the design challenge, students were given an independent questionnaire to reflect upon their experience. They also met to discuss things that went well and didn't go well with their project and created a short video to communicate their thoughts on the project.
What went well with the engineering design challenge?	The best part about this engineering design challenge was seeing the student who fought the most about having to do "school work during the summer" was the one who had the most fun and ended up having the most successful design. Another part of this design challenge was being able to test the successful lander fifty inches higher than the challenge called for.

What did not go well with the engineering design challenge?	During this engineering design challenge, I faced a few obstacles that I had to overcome. One of the biggest challenges I faced while implementing this engineering design challenge was structure due to not being in the classroom. Even though my family was more than willing to help me by participating in this, I wasn't able to actually hold class with a given amount of time and make sure that all concepts were covered. During the initial planning phase, I had thought that I would be able to cover mean, median, mode, and range with this design challenge. Due to limitations of time, and range of student ages, I thought it was in the best interest of the group I worked with to not utilize those math concepts. Another obstacle I faced was time. We had to wait until after dinner each evening to work on the challenge and for the most part, it didn't pose a problem. However, on the day we retested our designs, we ran into a space problem due to having to move indoors when the sun set. Once inside, the maximum testing height became eighty nine inches. Due to time constraints of having all participants together, we weren't able to push it back to the next day to see if the lander would be successful at heights greater than eighty nine inches.
What concepts were covered?	**<u>Virginia Science Standards of Learning</u>** 5.1 "The student will demonstrate an understanding of scientific and engineering practices by a)asking questions and defining problems; b)planning and carrying out investigations; c)interpreting, analyzing, and evaluating data; d)constructing and critiquing conclusions with explanations; e) developing and using models; f)obtaining, evaluating, and communicating information 5.3 "The student will investigate and understand that there is a relationship between force and energy of moving object. Key ideas include a)moving objects have kinetic energy; b)motion is described by an object's direction and speed; c) changes in motion are related to net force and mass; d)when objects collide, the contact forces transfer energy and can change object's motion; and e)friction is a force that opposes motion **<u>Virginia Math Standards of Learning</u>** 5.16 a "The student, given a practical problem, will represent data in line plots and stem-and-leaf plots." (We did not use stem-and-leaf for this lesson)
How did the engineering design	As the group of students I worked with moved through the engineering design process, they were able to understand how

process teach the science and mathematical concepts?	impact or collision causes energy to transfer. In the questionnaire I gave students, they were able to identify that dropping the lander from a greater height would cause speed to increase and would result in a greater impact. Using the engineering design process, students were able to discover and investigate these concepts instead of just reading about them. Due to the hands-on design process, students gained a deeper understanding of the science concepts we were working on as well as reviewing. In addition, the engineering design process allowed students a way to use math in an applicable manner that related to them. They weren't just graphing data related to an experiment but instead became increasingly anxious to determine how long it would take the egg to drop from each height and they enjoyed looking at the results.
Did I choose an appropriate engineering design process?	I believe that the engineering design process I chose was appropriate for the group of students I was working with. It allowed them to understand and engage with every aspect of the challenge. The process I used incorporated the best features of the three design processes I analyzed.
How can I improve this activity to use with future students?	After completing this design challenge, I have several ideas for improving the activity before using it with future students. The biggest change I would like to implement would be to have students use other materials, within reason, to create their landers. I would like to see how creative and successful students could be if they were able to utilize some of the materials they came up with for being good at absorbing shock. Another idea I had was to compare how weight affects impact by having students test their designs with one egg at first and then add a second egg at each tested drop height. In addition to comparing weights by adding eggs, I believe it would be beneficial to weigh each rover before beginning the trials.
What are my final thoughts	Throughout the design challenge, I learned a lot about how students perceive problem solving and the challenges that are brought to the table as they work through them. My biggest

	take away moment from this project came during the build phase. Mackenzie and Cameron were working on building their design and they quickly realized that they had not allotted enough room for an egg to be placed in the box they had designed. Their initial reaction was to go back to the design notebook and just come up with a complete, brand new design. They were getting increasingly frustrated seeing that the other two teams were either finished building or nearing completion of their build. I walked over right as they were going back to the drawing board and engaged in a conversation with them about what was going on. They voiced their frustration and through questioning, I quickly realized they didn't have a complete grasp on how materials could be handled. They wanted to recreate the box to hold their egg. I kept asking guiding questions about their design and they were able to determine that they didn't need to come up with a new plan, they just needed to look at the materials another way. In the videos of their testing, you can see that they ended up breaking the craft sticks in half in order to make their original design work. In this process, I learned that students are quick to give up and jump to what they think is the easiest solution. I learned that as an adult and teacher, I often take for granted their comfort with materials and forget that sometimes they don't see how materials can be manipulated in a variety of ways. Overall, as I watched my family work on this design challenge, my beliefs and convictions on using the engineering design challenge to teach math and science were confirmed even more. Four of five family members had never experienced an engineering design process before. In going over the student questionnaires and seeing how they were able to tell how speed, velocity, and gravity effect impact through the design challenge continues to prove that students gain a deeper, better understanding of concepts when engaged in hands on inquiry based activities. A colleague of mine once told me "Front loading vocabulary and concepts is like throwing out a fishing line with just the bobber and bait. When you reel it in,

	you aren't going to catch anything because there's nothing there for a fish to take hold off. When you front load with engaging engineering challenges and hands on learning, it is like throwing out a fishing line with a bobber, bait, and hook. When you reel this in, you are catching the biggest fish." In conclusion, engineering design challenges help you reel in the most learning outcomes. When you throw out the line of an engineering design challenge, vocabulary, content, and application are reeled in for every student, just as it was with this design challenge.