Engineering is Everywhere: Integrating Engineering in the Content Area Classroom

Professional Development Final Report

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NASA STEM Endeavor

SCED 545: STEM Leadership Seminar

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I. Title of Project

Engineering is Everywhere: Integrating Engineering in the Content Area Classroom

II. Curriculum Topics, School Name(s), Number of Educators, Grade Level(s)

Milton Middle School is located in a small, rural, and low-income school district in central Pennsylvania. According to the National Center for Education Statistics (2019), the school enrolls 501 students. There are 159 students, 170 students, and 172 students in sixth, seventh, and eighth grade, respectively. There are 227 females and 274 males enrolled in the school. The majority of the student population, 87%, is white, 7% are Hispanic, 2% are black, and 3% are two or more races. Over half of the student population, 54%, receives free or reduced-price lunches.

The vision of Milton Area School District is to innovatively leverage technology to extend and deepen student learning and foster the skills to compete globally. As a result, the teacher-developed curriculum for each subject incorporates multiple technology platforms. The English language arts and math departments use I-ready curriculum to differentiate and enhance their instruction. Like most middle schools, the curriculum does not include engineering, so traditional classrooms typically lack engineering design and do not prepare students to solve real-world problems. (Goktepe Yildiz & Ozdemir, 2018).

Engineering is one of the easiest ways to integrate more STEM into the classroom because it can involve science, technology, and mathematics all at once. The focus of the professional development (PD) was on integrating engineering in the content-area classroom. The PD was offered to the middle school math and science teachers of Milton Middle School. Ten teachers attended the PD: two sixth grade math teachers, two sixth grade science teachers, one seventh grade math teacher, two seventh grade science teachers, two eighth grade math teachers, and one eighth grade science teacher. See Appendix A for participant information, including contact details.

III. Standards Addressed

The professional development addressed the engineering integration portion of STEM education. Engineering aligns with several NGSS Engineering Design Standards, Pennsylvania Nature of Science Standards, and various Pennsylvania Math Standards that require real-world application. See Appendix B for a comprehensive list of the standards addressed.

IV. Summary of Project

I decided to emphasize engineering for the professional development session so my colleagues could learn about the ease and benefits of incorporating engineering into their classroom. I hope that this PD would eventually introduce more students to the engineering design way of thinking. During the PD, participants engaged in an engineering design challenge, learned about the engineering design process, and discussed the importance of incorporating engineering in content-area classes. I then showed each grade level cross-curricular engineering activities that they could integrate and resources where they could find more engineering materials. The goal of the PD was for the middle school math and science teachers to have a better understanding of the engineering design process, the benefits of using engineering in the classroom, and discover many resources, so they can integrate engineering to supplement their content curriculum.

V. Pre-survey Questions

Prior to the professional development, participants completed the Engineering is Everywhere: Pre-Survey on Google Forms to assess their current knowledge of the engineering design process and the

use of engineering in their classroom. The survey questions are listed below. Results from the pre-survey can be found in Appendix C.

1. Are you familiar with the Engineering Design Process?
    a. Yes
    b. No
    c. Unsure
2. How often do you incorporate engineering activities in your classroom?
    a. Never
    b. Occasionally
    c. Every Marking Period
    d. Every Chapter/Unit
    e. Other
3. Were the engineering activities you have implemented successful? (Open-ended)
4. What is your biggest challenge or limitation to incorporating engineering activities in your classroom? (Open-ended)
5. Are you familiar with any engineering resources to use in your classroom?
    a. Yes
    b. No
    c. Unsure
6. If yes, how often do you browse or use engineering resources?
    a. Never
    b. Rarely
    c. Sometimes
    d. Often
7. Any other initial thoughts or comments on engineering in the content area classroom? (Open-ended)

VI. Brief Description of Professional Development

Prior to the training, all of the middle school math and science teachers received an informational flyer about the Engineering is Everywhere professional development session, as well as an email to complete the pre-survey (Appendix D). The PD was offered three separate times throughout the day. Participants attended an eighty-minute long, in-person session with their grade level colleagues. I conducted the professional development in an inquiry-like manner in which participants engaged in an engineering design challenge and then we discussed the engineering design process and its importance. See Appendix E for the PD presentation.

To expose participants to engineering, they completed the PBS Design Squad Touchdown Challenge relating to the Mars Perseverance Rover, which launched a few weeks prior. Participants had to use the provided household materials to design and build a system that would protect two “astronauts” (marshmallows) when they landed on the surface of Mars. They had the opportunity to test and modify their design until they were successful. See Appendix F for photographs of the Touchdown Challenge.

After completing the engineering design challenge, we discussed how they solved the problem. Participants naturally went through the engineering design process as they completed the challenge. I then introduced them to the Engineering Design Process (EDP) as a model used to solve problems. I showed them three different versions of the EDP, and explained that teachers can use the EDP as a framework to help students who are still developing problem-solving skills.

We then discussed why educators should incorporate engineering into their classroom. According to the U.S.A. Department of Education (2010), STEM jobs, including engineering, are growing rapidly, yet many go unfilled because there are not enough qualified individuals in the workforce. Engineering is often excluded from the curriculum even though engineering activities promote teamwork, analytical thinking, improved math and science achievement, and provide a context for real-world connections to subject-specific content (Brown et al., 2011; National Research Council, 2009).

In order to address concerns expressed in the pre-survey about curriculum alignment and time to incorporate engineering, I provided each grade level with four engineering design activity examples that integrate both math and science topics. Although engineering design challenges do require more class time, teachers can achieve two goals at once if they collaborate to find resources that align to the math and science curriculum. I then showed participants several engineering resources. Participants had the remaining time of the PD to review the resources and collaborate with their colleagues to find an engineering design challenge that they could complete with their students.

To conclude the professional development, participants shared the engineering design challenge that they had found with the group. After completion of the training, participants completed the post-survey to reflect on their understanding of the engineering design process and the possibility of integrating engineering in their classroom.

VII. Outline of Activities

The following is a brief outline of the activities of the Engineering is Everywhere Professional Development:

Prior to PD: Engineering is Everywhere: Pre-Survey

PD Session:

1. Engineering Design Challenge: PBS Design Squad Touchdown Challenge
    - Challenge: Design and build a system that will protect two "astronauts" when they land on the surface of Mars.
2. Engineering Design Process: Problem-solving model/framework
    - NASA: Engineering Design Process
    - PBS Design Squad: The Design Process
    - TeachEngineering: Engineering Design Process
3. Importance and Benefits of Engineering
    - Increased need, but lack of skilled STEM workforce
    - Improved problem-solving skills and academic success
4. Possible Cross-Curricular Engineering Activities
    - 6th grade Math & Earth Science
        - Wind Power Station Design
        - Hurricane Resistant Structure
        - Down to the Core
        - On Target
    - 7th grade Math & Life Science
        - Biomimicry Shoe Design
        - Bird Beak Prosthetics
        - Cell or DNA Models
        - Engineering a Pandemic Response

- 8th grade Math & Physical Science
    - Roller Coaster Design
    - Solar Oven
    - Lunar Buggy
    - Catapults

5. Engineering Resource Review:
    - TeachEngineering
    - NASA BEST Activity Guides
    - PBS Design Squad Guides
    - Boston Museum of Science Engineering Everywhere Series
6. Engineering is Everywhere: Post-Survey

After PD: Department Meeting Check-ins

VIII. NASA or Endeavor Resources

The professional development incorporated NASA resources and resources from the "E" in STEM Endeavor course. These resources include: NASA BEST, PBS Design Squad, TeachEngineering, and the Boston Museum of Science Engineering is Everywhere series. I used these resources to introduce participants to various models of the Engineering Design Process. Participants also used these resources to located curriculum-aligning engineering design activities.

IX. Post-survey Questions & Follow-up Activities

At the conclusion of the professional development, participants completed the Engineering is Everywhere: Post-Survey on Google Forms to assess their knowledge of the engineering design process and the likelihood of incorporating engineering in their classroom after being exposed to various engineering resources. The survey questions are listed below. Results from the post-survey can be found in Appendix G.

1. After the training, are you familiar with the Engineering Design Process?
    a. Yes
    b. No
    c. Unsure
2. What would be beneficial about integrating engineering activities into your classroom? (Open-ended)
3. What would be your biggest challenge or limitation to incorporating engineering activities in your classroom? (Open-ended)
4. How often do you plan to incorporate engineering activities in your classroom (this year or in the future)?
    a. Never
    b. Occasionally
    c. Every Marking Period
    d. Every Chapter/Unit
    e. Other
5. After the training, are you familiar with engineering resources to use in your classroom?
    a. Yes
    b. No
    c. Unsure

6. What is one engineering activity that you could implement in your classroom that aligns with your curriculum? (Open-ended)
7. Which part of the PD (if any) was most beneficial for you? (Open-ended)
8. Any additional final thoughts or comments? (Open-ended)

Follow-up Activities:
I plan to follow up with the teachers who attended the PD at our department meetings. Typically, department meetings are held once a month, but due to the district's health and safety plan, they are only held once a marking period this year. The next round of department meetings will be held in May. During this meeting, I will ask if anyone has incorporated any engineering design challenges yet, or if they need assistance locating engineering resources that align with an upcoming topic in their curriculum. During the professional development, I made is very clear that I am available to help them in any way, so their students can experience the excitement and engagement of an engineering design activity. I also asked my administrator to consider having another PLC time dedicated to engineering design implementation next year, to allow more time for grade levels to collaborate and find resources that fit their content-area.

In addition, one of the goals for the middle school next school year is to begin looking at a curriculum to integrate more STEM in the science classroom specifically. As a result, we will have several STEM themed PLC's next year. The principal has already asked me to help lead the STEM initiative and act as a point person for my colleagues. I look forward to the opportunity to share more NASA and Endeavor resources with my peers in the future.

X. Outcomes: Data Analysis & Reflection
Content and Pedagogy Survey Results:
Pre-Survey Results – Appendix C
Prior to the professional development, only 25% of the teachers surveyed were familiar with the engineering design process. The remaining 75% were completely unfamiliar or unsure of the EDP. Likewise, only 25% of the teachers incorporated engineering activities in the classroom occasionally (1 – 2 times per school year). Seventy-five percent of the teachers never incorporated engineering activities. This may have been because 75% of the teachers were not familiar with engineering resources, or from a general lack of knowledge about engineering design activities. One teacher expressed that "I don't really know anything about it", while another declared he/she does "not [have] enough knowledge of the concept". Others conveyed time and tying engineering to their curriculum as challenges or limitation when incorporating engineering. Even though the teachers were not familiar with the engineering design process nor used engineering in their classroom, they were excited to learn how from the professional development. One participant acknowledged, "I would love to incorporate more hands-on activities that apply the mathematics I teach in the curriculum."

Post-Survey – Appendix G
Participants were very engaged in the professional development, asked many questions, and collaborated with each other to find engineering resources to integrate in their curriculum. After the professional development, 100% of the participants were familiar with the EDP. Participants also realized the benefits of incorporating engineering in the classroom such as, "increased engagement", "shows relevance of the content being taught", "real life problem solving skills", and "confidence building". Although the attendees still expressed concerns about time constraints, fewer expressed concerns about finding materials relating to their subject-area. This is most likely because I provided each grade level with four examples of engineering design activities that align to their curriculum, and

they had time to explore engineering resources. The concern about time also led me to ask my principal to arrange another PLC dedicated to engineering, so teachers have another opportunity to collaborate with their grade level teams. By the end of the PD, 100% of the attendees were familiar with engineering resources to use with their students. More importantly, all of the participants plan to incorporate engineering in their classroom in the future. Fifty-six percent of the participants plan to add engineering activities occasionally (1-2 times per school year), while the other 44% of participants hope to incorporate engineering every marking period.

Success of Professional Development:
The goals of the Engineering is Everywhere professional development were to engage teachers in an engineering design challenge, teach them about the engineering design process and the importance of incorporating engineering in the classroom, and provide them with engineering resources to find curriculum-aligning activities to use with their students. Based on these goals, the professional development was a great success.

All participants were able to engage in the Touchdown Challenge, and most of them were successful. Additionally, according to the post-survey results, all teachers reported understanding the EDP, could name an advantage of engineering in the classroom, were aware of engineering resources, and planned to integrate engineering activities at least occasionally in the future.

Above all, I think the professional development was successful because the attendees really enjoyed the PD and found the information to be helpful. They especially appreciated the time to collaborate and share ideas with their colleagues. One participant commended, ""Well done! Your PD was engaging and fun." While another attendee said, "Thank you for making PD enjoyable and insightful."

Relation to Class Readings:
The Engineering is Everywhere professional development relates to many of the professional development readings from the STEM Leadership Seminar. Jenkins and Yoshimura (2010), outlined a five-step guide to planning and implementing a professional development program. The process includes "1. Build readiness, 2. Conduct planning, 3. Implement training, 4. Allow for implementation, and 5. Maintenance (p. 37)." I paid close attention to the first two steps in this guide. Prior to the PD, I sent out a flyer to introduce the math and science teachers to the concept, asked for participants to take a pre-survey, spoke to administration about the district's goals in implementing STEM, and reached out to the high school STEM teacher to see how engineering was used in the STEM course. All of these steps were to prepare my participants and gain more information to share with them about the overall vision of STEM in the district. I then used the data from the pre-survey to conduct planning for the PD. Since many of the participants expressed concerns about time to implement engineering, I was sure to provide them with engineering design examples that would allow for cross-curricular connections.

I also used the seven characteristics of effective PD by Darling-Hammond et al. (2017) to guide my PD development. The seven characteristics of an effective PD are listed below:

1. Is content focused
2. Incorporates active learning utilizing adult learning theory
3. Supports collaboration, typically job-embedded contexts
4. Uses models and modeling of effective practice
5. Provides coaching and expert support
6. Offers opportunities for feedback and reflection
7. Is of sustained duration (Darling-Hammond et al., 2017, p. 4)

I feel that my PD contained six of these seven characteristics. The two characteristics that I explicitly wanted to include were active learning and collaboration. According to Darling-Hammond et al. (2017), professional development should "immerse the teachers in the types of learning activities and environments they would then create for their students" (p. 8). This is why I had teachers engage in an engineering design challenge at the start of the PD. Darling-Hammond et al. (2017) also states that "collective work in trusting environments provides a basis for inquiry and reflection into teachers' own practices, allowing teachers to take risks, solve problems, and attend to dilemmas in their practice" (p. 10). I made it a priority to provide teachers with time to collaborate with each other in order to find resources that would work for them, so they would feel comfortable and confident enough to try something new in order to improve student learning. The one characteristic that is missing from my PD was sustained duration. In the future, I would break my PD into multiple sessions to allow teachers more time to find and try engineering activities in their classroom, and then reflect on the process in later trainings.

Repetition of Professional Development:
Although I will not be conducting the Engineering is Everywhere professional development session again, I will continue to check in with the attendees about integrating engineering activities during department meetings. I also hope my principal plans for an engineering themed PLC to give teachers more time to collaborate, plan, and create engineering activities that align to their content-area with their grade level teammates. In addition, engineering will be discussed next year as the middle school plans to find a curriculum to increase STEM in the science classroom. Lastly, I plan to share all of my professional development materials with the science department lead at the elementary school, high school, and at my previous school district. The department leaders can then share the resources with their teachers, so more students can engage in the engineering design process.

Reflection:
Overall, the Engineering is Everywhere professional development was beneficial for all of those involved. The PD helped the teachers understand the engineering design process and the advantages of integrating engineering into the classroom. Even the teachers who already knew about the EDP walked away from the PD with new resources to explore to locate engineering activities. Currently I do not think there is much STEM happening in the math or science classes. When students reach my 8th grade physical science class, and we complete engineering design challenges, they remark that they have never completed similar activities before. I am optimistic that now that the math and science teachers have experienced an engineering design challenge and know where to find resources, they will begin to incorporate more STEM in their classrooms. Only time will tell if participants do integrate engineering, but I will continue to check in with my colleagues to offer support.

I really enjoyed planning and offering this professional development session to my peers. I feel that this was the only true professional learning community that we have had all year. Most of our PLC's cover mandated topics and teachers do not have much input. I appreciated the opportunity to share a new concept and resources with my colleagues that will improve student learning. After the PD, I requested that my principal schedules more free collaboration times for grade level teams in the future. Collaboration is the key to success in integrating STEM and improving academic achievement for our students.

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Appendix A

Participant Information

Participant's Name	Participant's Role	Participant's Email
Jessica Fuschetti*	6th Grade Math Teacher	jfuschetti@miltonsd.org
Duane Sweigard	6th Grade Math Teacher	dsweigard@mitlonsd.org
Desmond Shaffer	6th Grade Science Teacher	dshafer@miltonsd.org
Cathy Toland*	6th Grade Science Teacher	ctoland@miltonsd.org
Vanessa Yoder	7th Grade Math Teacher	vyoder@miltonsd.org
Jeffrey Bower	7th Grade Science Teacher	jbower@miltonsd.org
Walter Patynski	7th Grade Science Teacher	wpatynski@miltonsd.org
Eric Johnson	8th Grade Math Teacher	ejohnson@miltonsd.org
Jennifer McElwee	8th Grade Math Teacher	jmcelwee@miltonsd.org
Miranda Roush	8th Grade Science Teacher	mroush@miltonsd.org
Melissa Roberts (PD Facilitator)	8th Grade Science Teacher	mmroberts@miltonsd.org

*NOTE: These participants had to leave the PD about thirty minutes early due to an IEP meeting.

Appendix B

Standards Addressed

NGSS Engineering Design Standards:

- **MS-ETS1-1.** Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
- **MS-ETS1-2.** Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
- **MS-ETS1-3.** Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.
- **MS-ETS1-4**. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

PA State Standards – Science:

- **S8.A.1 1** Explain, interpret, and apply scientific, environmental, or technological knowledge presented in a variety of formats (e.g., visuals, scenarios, graphs).
- **S8.A.2.1** Apply knowledge of scientific investigation or technological design in different contexts to make inferences to solve problems.
- **S8.A.2.2** Apply appropriate instruments for a specific purpose and describe the information the instrument can provide.
- **S8.A.3.2** Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

PA State Standards – Mathematics:

- Varies by grade level but many standards assert that students must “solve real-world and mathematical problems”, which can be achieved through the engineering design process.

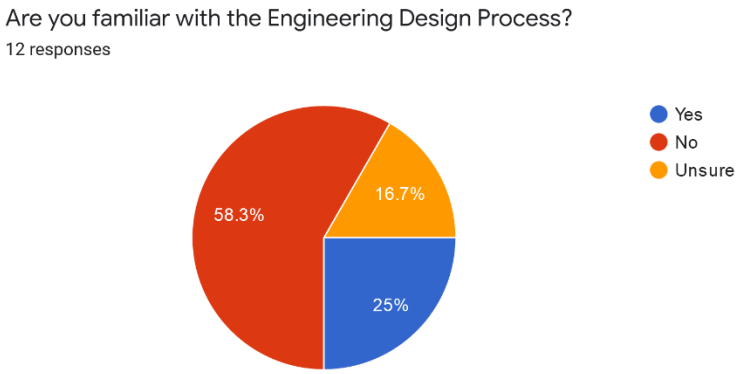
For example:

- **CC.2.2.6.B.2** Understand the process of solving a one-variable equation or inequality and apply to real-world and mathematical problems.
- **CC.2.1.7.D.1** Analyze proportional relationships and use them to model and solve real-world and mathematical problems.
- **CC.2.3.8.A.1** Apply the concepts of volume of cylinders, cones, and spheres to solve real-world and mathematical problems.

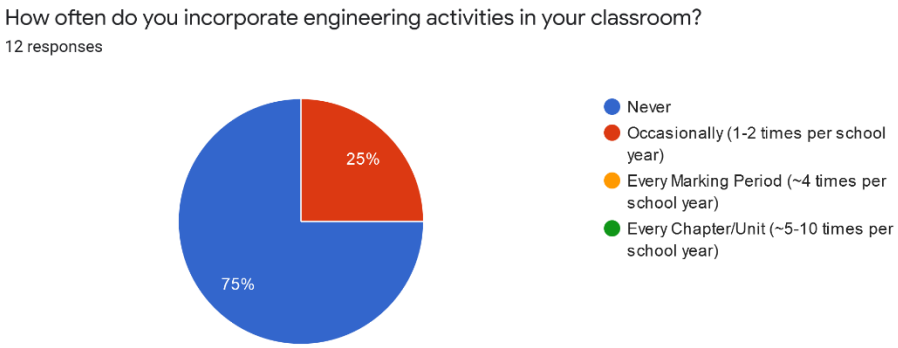
Appendix C
Pre-Survey Results

Engineering is Everywhere Pre-Survey Link: https://forms.gle/YKEibtDb7T9GmzmU7

Question 1:



Question 2:



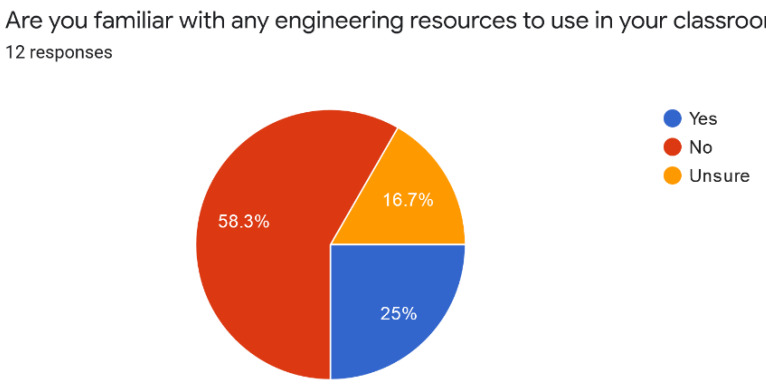
Question 3: Were the engineering activities you have implemented successful? (Open-ended)

- "Somewhat, but they could be better"
- "Successful in my eyes."
- "yes"

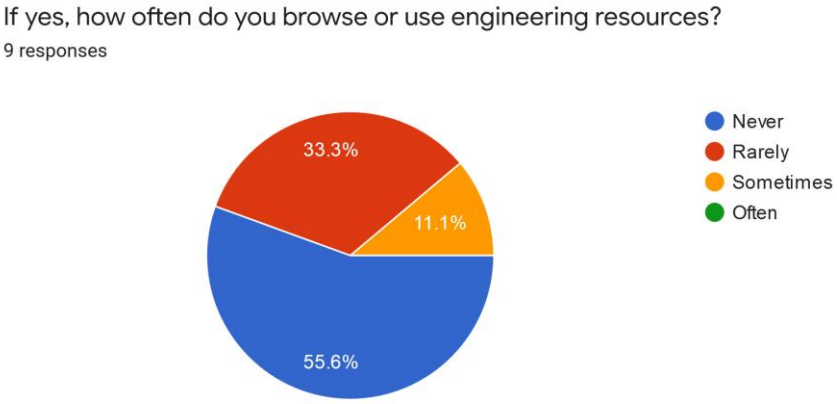
Question 4: What is your biggest challenge or limitation to incorporating engineering activities in your classroom? (Open-ended)

- "Content"
- "Difficult to tie to curriculum"
- "Not easily connected to life science curriculum"
- "Technology"
- "Time" (x2)
- "Time constraint"
- "Have never tried it"
- "I don't really know anything about it"
- "Not enough knowledge of the concept"
- "Don't know"

Question 5:



Question 6:

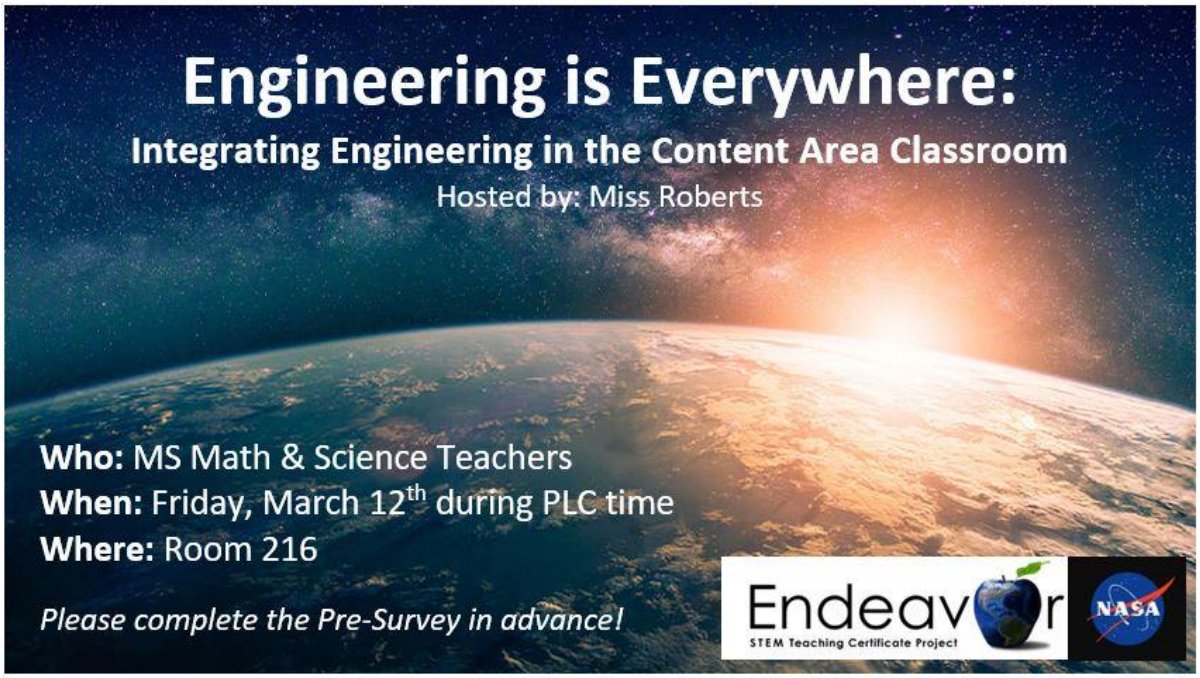


Question 7: Any other initial thoughts or comments on engineering in the content area classroom? (Open-ended)

- "I would love to discover more ways to incorporate this."
- "I would love to incorporate more hands-on activities that apply the mathematics I teach in the curriculum."

Appendix D
PD Communications

Professional Development Flyer:



Professional Development Reminder Email:

Sent: Thursday 3/11/2021 at 8:02 am

Good morning,

I look forward to sharing some STEM-related resources with you tomorrow during PLC that you can implement in your classroom (maybe not this year, but years to come). In the meantime, please complete this super short Pre-Survey if you have not done so already!

8th grade: 8:15
6th grade: 9:40
7th grade: 1:40

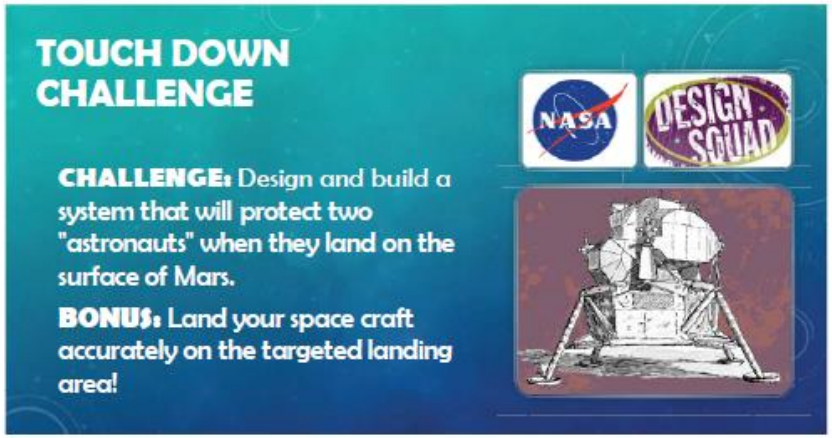
See you tomorrow!

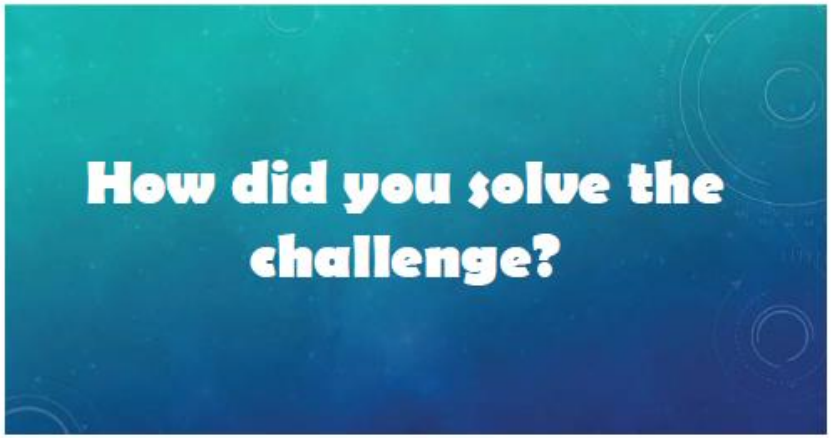
Melissa Roberts
8th Grade Science Teacher
Milton Middle School

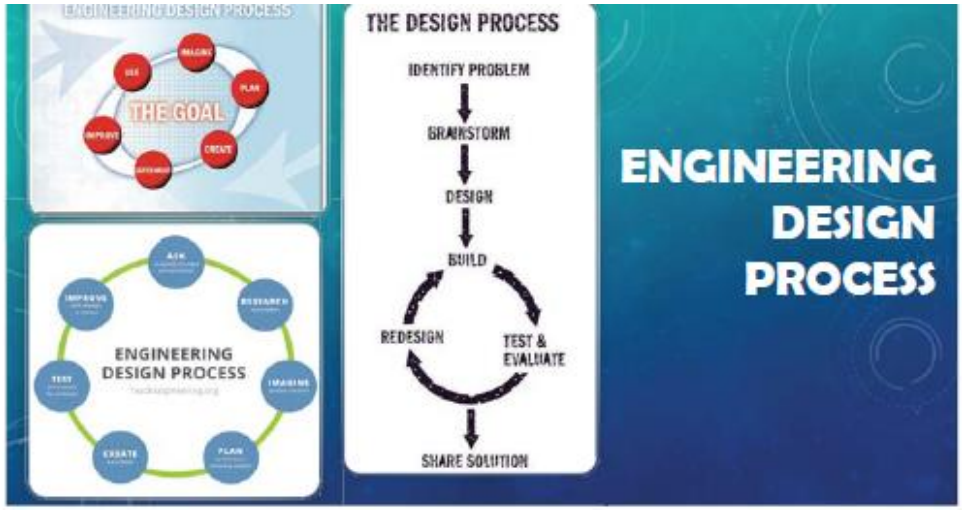
Appendix E
PD Presentation

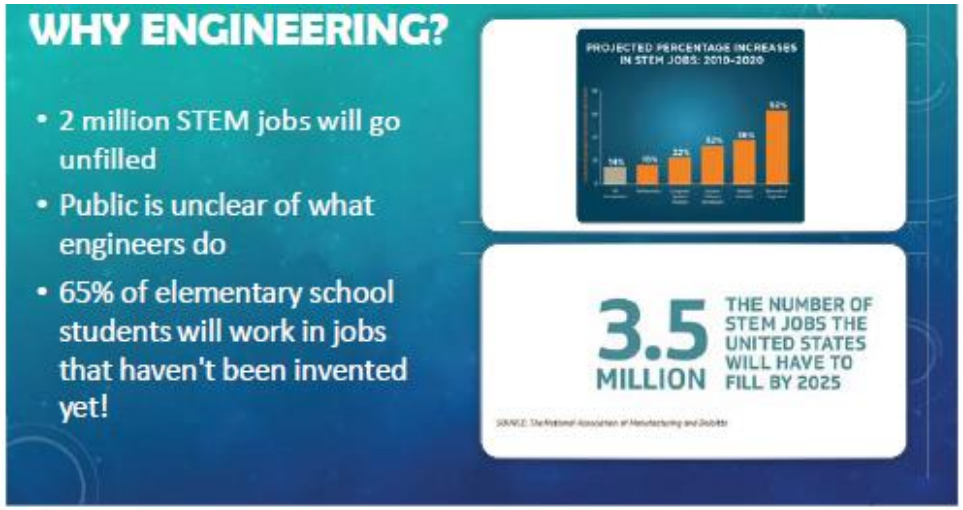
Presentation Link: https://miltonareaschooldistrict-my.sharepoint.com/:p:/g/personal/mmroberts_miltonsd_org/EXPErfSaPHZGh74sXSFzYukBmopod5jPFnrVRGKuOpPVSg?e=1btGmU

Links to PD Resources: https://wke.lt/w/s/vzrvOr






THE GOAL
ENGINEERING DESIGN PROCESS
THE DESIGN PROCESS
IDENTIFY PROBLEM
BRAINSTORM
DESIGN
BUILD
TEST & EVALUATE
REDESIGN
SHARE SOLUTION
ENGINEERING DESIGN PROCESS


WHY ENGINEERING?
• 2 million STEM jobs will go unfilled
• Public is unclear of what engineers do
• 65% of elementary school students will work in jobs that haven't been invented yet!
PROJECTED PERCENTAGE INCREASES IN STEM JOBS: 2010-2020
3.5 MILLION
THE NUMBER OF STEM JOBS THE UNITED STATES WILL HAVE TO FILL BY 2025


lifelong learner
teamwork
critical thinking
real-world connections
improves math and science
analytical thinking
better attendance
problem-solving
resilience
engagement
WHY ENGINEERING?


TYING ENGINEERING TO CURRICULUM: SCIENCE
NGSS Engineering Design Standards:
MS-ETS1-1. Define the criteria and constraints of a design problem.
MS-ETS1-2. Evaluate competing design solutions.
MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions.
MS-ETS1-4. Develop a model to generate data for iterative testing and modification.
PA State Standards – Science:
S8.A.1 1 Explain, interpret, and apply scientific, environmental, or technological knowledge presented in a variety of formats (e.g., visuals, scenarios, graphs).
S8.A.2.1 Apply knowledge of scientific investigation or technological design.
S8.A.2.2 Apply appropriate instruments for a specific purpose.
S8.A.3.2 Apply knowledge of models to make predictions, draw inferences, or explain technological concepts.

TYING ENGINEERING TO CURRICULUM: MATH

Common Core Standards for Mathematical Practice:

- **CCSS.Math.Practice.MP1: Make sense of problems and persevere in solving them.**
- **CCSS.Math.Practice.MP4: Model with mathematics.**
- **CCSS.Math.Practice.MP5: Use appropriate tools strategically.**
- **CCSS.Math.Practice.MP6: Attend to precision.**

PA State Standards – Math:

- **"Model and solve real-world and mathematical problems"**

8TH GRADE

Science

- Kinetic & Potential Energy
- Energy Transformations
- Convections, Conduction, Radiation
- Nonrenewable/Renewable Energy
- Forces
- Newton's Laws of Motion

Math

- Proportional Relationships
- Linear Equations
- Volume of Cylinders, Cones, Spheres
- Pythagorean Theorem
- Bivariate Data

8TH GRADE: PROJECT IDEAS

- **Roller Coaster Design:**
  - Kinetic & Potential Energy
  - Energy Transformations
  - Proportional Relationships
  - Linear Equations

- **Solar Ovens:**
  - Convection, Conduction, Radiation
  - Energy Transformations
  - Volume
  - Proportional Relationships
  - Bivariate Data

- **Lunar Buggy:**
  - Simple Machines
  - Forces
  - Linear Equations (slope)
  - Pythagorean Theorem
- **Catapults:**
  - Newton's Laws of Motion
  - Proportional Relationships
  - Linear Equations
  - Bivariate Data
  - Pythagorean Theorem

6TH GRADE

Science

- Environmental Science
- Human Impact
- Natural Disasters
- Ecology
- Space Science

Math

- Fraction Operations
- Multi-digit Operations
- Ratio Concepts
- Quantitative Relationship between Dependent and Independent Variables
- Area, Surface area, Volume
- Statistical Variability

6TH GRADE: PROJECT IDEAS

- **Wind Power Station Design:**
  - Environmental Science
  - Ratio Concepts
  - Independent/Dependent Variables

- **Hurricane Resistant Structure:**
  - Environmental Science
  - Human Impact
  - Natural Disasters
  - Ratio Concepts
  - Independent/Dependent Variables

- **Down to the Core:**
  - Space Science
  - Geology
  - Area/Volume
  - Statistical Variability

- **On Target**
  - Space Science
  - Natural Disasters
  - Statistical Variability

7TH GRADE

Science

- Structure of Living Things
- Adaptations
- Genetics
- Biotechnology
- Ecology

Math

- Fraction Operations
- Proportional Relationships
- Angle measure, Area, Surface area, Circumference, Volume
- Inferences about populations based on random sampling

7TH GRADE: PROJECT IDEAS

- **Biomimicry Shoe Design:**
  - Biomes
  - Adaptations
  - Fraction Operations
  - Area/Circumference

- **Cell or DNA Model:**
  - Structure & Function
  - Genetics
  - Proportional Relationships

- **Bird Beak Prosthetics:**
  - Structure & Function
  - Natural Selection & Evolution
  - Proportional Relationships
  - Volume

- **Engineering a Pandemic Response:**
  - Viruses
  - Proportional Relationships
  - Random Sampling

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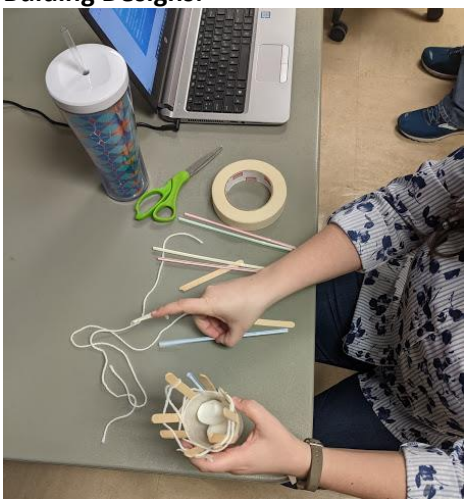
Appendix F

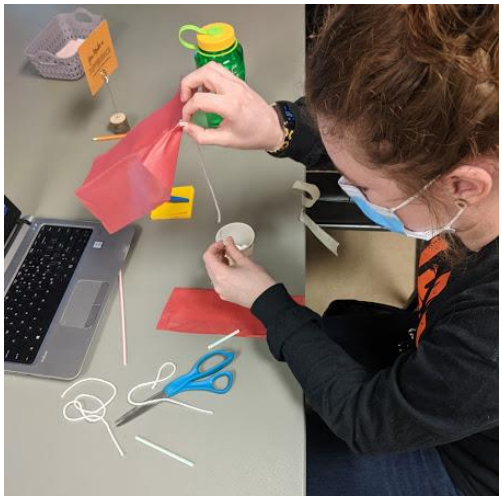
Photographs of Touchdown Challenge

Materials:

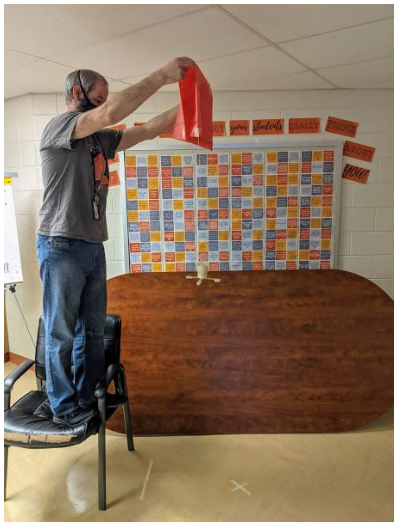
Final Products:

Buiding Designs:





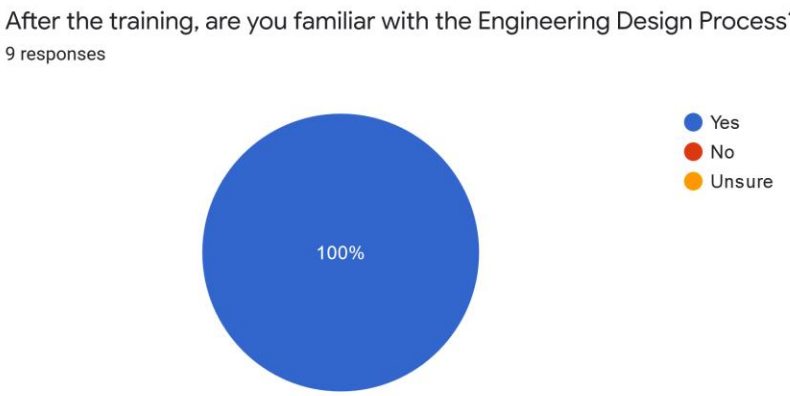
Testing Designs:



Appendix G
Post-Survey Results

Engineering is Everywhere Post-Survey Link: https://forms.gle/7YMa9bE9yQVfFUpJ7

Question 1:



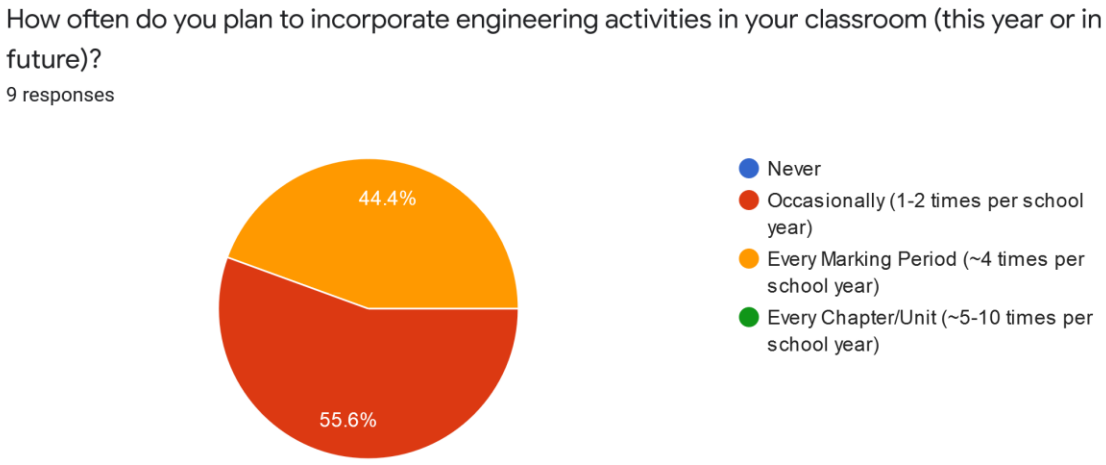
Question 2: What would be beneficial about integrating engineering activities into your classroom? (Open-ended)

- "Hands on activities, real world"
- "Increased engagement and actual learning"
- "It allows students to make connections to how mathematics is applied in "the real world"."
- "It shows the relevance of the content being taught. Helps them connect the taught content to the real-world."
- "High Engagement, Confidence Building, Problem Solving"
- "It would engage my students and show them ways that math is relevant in the real world"
- "great ideas to get kids interested and motivated"
- "incorporating more of the hands on, real life problem solving skills"
- "Make the connection of learning to real life situations"

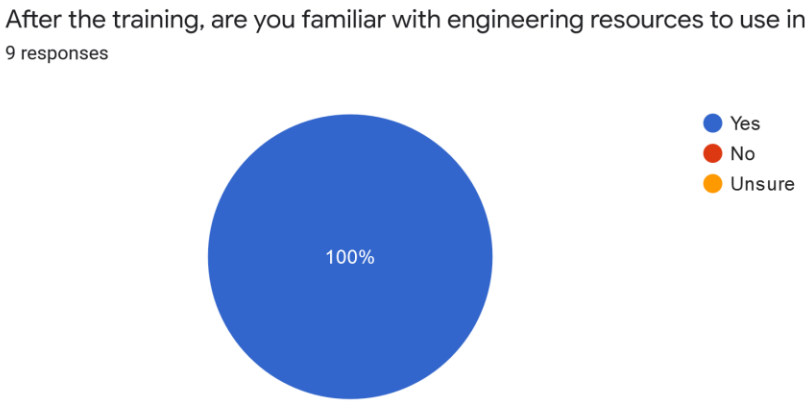
Question 3: What would be your biggest challenge or limitation to incorporating engineering activities in your classroom? (Open-ended)

- "Time" (x2)
- "Time constraints" (x2)
- "Time and applicable content"
- "Time to create/plan, curriculum timeline restriction, diagnostic testing often :-)"
- "Finding the supplies, like project materials. I have the mindset and knowledge, but limit sometimes from time and material access."
- "Curriculum and time"
- "Finding the appropriate activities to enhance the curriculum...today was a good starting point however."

Question 4:



Question 5:



Question 6: What is one engineering activity that you could implement in your classroom that aligns with your curriculum? (Open-ended)

- "Renewable Energy Living Lab: Power Your School"
- "Egg Bungee"
- "Barbie Bungee Jump (scatter plots, linear association, modeling)"
- "Maybe an activity that correlates to a Geometry concept."
- "Mars Rover - Space Science"
- "A design challenge where they have to take measurements and then find mean, median, mode, range"
- "rotting carrot activity"
- "Robot Wheels - dealing with circumference and circles"
- "Various genetic activities"

Question 7: Which part of the PD (if any) was most beneficial for you? (Open-ended)

- "The resources to use for engineering activities"
- "Web resources"
- "Resource-sharing "
- "Sharing of resources available to help include engineering activities in the classroom."
- "Reinforcing the Engineering Model. Loved it!"
- "The teach engineering website"

Question 8: Any additional final thoughts or comments? (Open-ended)

- "Go NASA!"
- "Well done! Your PD was engaging and fun."
- "None, thanks for sharing this concept."
- "Thank you for making PD enjoyable and insightful."
- "Thanks"
- "Thanks for sharing"