Theme

"Finish Strong!"

STEM Innovation Academy Unit 4

Subject: Engineering Design and Development Unit Title: Evaluation, Presentation and Reflection of the Design Process Grade: 12th	Teacher: Mrs. Allison Braizer-Martin Duration: 9 weeks; March - June

Summary of Unit

This unit puts the finishing touch on the Engineering Design Process. It is essential to seek and document feedback from all stakeholders, review the design process and present all content and findings. The teams will reflect on all design decisions and analyze the results that were generated from the testing process. Evaluation of the testing results will determine the effectiveness and functionality of their design. The teams will address if the synthesis of evaluations consistently address stakeholders specific questions, concerns, and opinions related to the design requirements. It will be determined if the team needs to jump back to a previous stage in the design process to make any adjustments and improvements. As the team works through the Critical Design Review, they will evaluate the entire design process, not just the testing results. The team will compile the work that has been performed throughout the course, reflect on the work, and make recommendations for the future regarding the project. In addition, each student will maintain their personal engineering notebook. Finally, each team will present their information in the form of a project portfolio as well as an oral presentation with visual aids.

Stage 1 – Desired Results

Standards/Outcomes:

New Jersey Student Learning Standards for Engineering Design

- HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.
- HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

New Jersey Student Learning Standards for English Language Arts

Progress Indicators for Reading Informational Text - Key Ideas and Details

- RI.11-12.1. Accurately cite strong and thorough textual evidence, (e.g., via discussion, written response, etc.), to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain. Research to Build and Present Knowledge

Anchor Standards for Writing - Research to Build and Present Knowledge

- NJSLSA.W7. Conduct short as well as more sustained research projects, utilizing an inquiry-based research process, based on focused questions, demonstrating understanding of the subject under investigation.

Progress Indicators for Writing

- W.11-12.7. Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

New Jersey Student Learning Standards for Mathematics

- N.Q.1 - Quantities Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
- N.Q.2 - Quantities Define appropriate quantities for the purpose of descriptive modeling.

2020 New Jersey Student Learning Standards – Career Readiness, Life Literacies, and Key Skills

- 9.2.12.CAP.2: Develop college and career readiness skills by participating in opportunities such as structured learning experiences, apprenticeships, and dual enrollment programs.
- 9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas.
- 9.4.12.CT.1: Identify problem-solving strategies used in the development of an innovative product or practice.
- 9.4.12.CT.2: Explain the potential benefits of collaborating to enhance critical thinking and problem solving.

2020 New Jersey Student Learning Standards – Computer Science and Design Thinking

Engineering Design

- 8.2.12.ED.1: Use research to design and create a product or system that addresses a problem and make modifications based on input from potential consumers.
- 8.2.12.ED.2: Create scaled engineering drawings for a new product or system and make modification to increase optimization based on feedback.

PLTW Science and Engineering Practices

- Design a test of a model to ascertain its reliability.
- Develop a complex model that allows for manipulation and testing of a proposed process or system.
- Developing and Using Models Develop and/or use a model (including mathematical and computational) to generate data to support explanations, predict phenomena, analyze systems, and/or solve problems.
- Planning and Carrying Out Investigations Plan an investigation or test a design individually and collaboratively to produce data to serve as the basis for evidence as part of building and revising models, supporting explanations for phenomena, or testing solutions to problems. Consider

possible confounding variables or effects and evaluate the investigation's design to ensure variables are controlled.

Essential Questions:

1. What do end users and experts directly related to this project and problem statement think of the testing results and my/our conclusions about the effectiveness of this idea?
2. Is the documentation of project evaluation by multiple, demonstrably qualified stakeholders and field experts presented and synthesized in a consistently specific, detailed, and thorough way?
3. Is the documentation sufficient in two or more categories to yield meaningful analysis of that evaluation data?
4. Does the synthesis of evaluations consistently address evaluators' specific questions, concerns, and opinions related to design requirements?
5. If I/we were going to do this project over, what should be done differently during the design process to improve the project?
6. How would those recommendations make the project better overall?
7. Did I/we document each step of the design process in this portfolio well enough that anyone else interested in the problem could pick up this work and replicate what I/we have done, as well as continue working from where I/we ended up?
8. How did I/we document each step of the design process in this portfolio so that anyone else interested in the problem could pick up this work and replicate what I/we have done as well as continue working from where I/we ended up?
9. Throughout the entire portfolio, why is it critical that the explanations, descriptions and information in each section be developed and presented with a wide variety of readers in mind?

Enduring Understandings: *Students will understand that…*

- In the design process, it is critical to seek and document feedback from all stakeholders.
- The designers should reflect on all design decisions and the analysis that was generated from the testing process.
- It is essential to evaluate the entire process (not just the testing conclusions).
- Technical writing is a type of expository writing that is used to convey information to a particular audience for a particular technical or business purpose.
- Capstone projects are to be presented in the form of a project portfolio as well as a detailed oral presentation with visual aids.

Stage 2 – Assessment Evidence

Unit Pre-Assessment:

- Element G, H, I

Formative, Summative and Authentic Assessments:

- Engineering Design Process
- Engineering Notebook Documentation
- 3D Model
- Prototype
- Portfolio
- Capstone Presentation

Presentation:

- Students will formally present their completed Capstone Project in front of a panel.

Summative Assessment:

- Quizzes and Tests: Multiple Choice, Fill-in-the-Blank, Short Answer
- Unit Test

Performance Task(s):

Component 4: Evaluation of Project and Process

Element J – Documentation of External Evaluation

Activity 1.0: Documentation of Project Evaluation: Each team will acquire documentation of project evaluation by multiple, demonstrably qualified stakeholders and field experts presented and synthesized in a consistently specific, detailed, and thorough way. Evaluations consistently address evaluators' specific questions, concerns, and opinions related to design requirements.

Element K – Reflection of the Design Project

Activity 1.0: Reflection of Design Project: Each team will provide a consistently clear, insightful, and comprehensive reflection on, and value judgment of, each major step in the project. The reflection will include a substantive summary of lessons learned that would be clearly useful to others who attempt the same or similar project.

Element L – Presentation of the Designer's Recommendations

Activity 1.0: Project Reflection: Students will reflect on the design process to answer the question: what would you, as a designer, change based on the testing, external evaluation, and internal reflection?

Component 5: Reflection and Presenting the Design Process

Element M - Presentation of Project and Project Portfolio

Activity 1.0: Capstone Presentation: Addresses the extent to which the students captured their work in both written form (portfolio or electronic portfolio) and in presentation format. It deals with the contents of the portfolio and the presentation. The presentation of the project should be clear, detailed, extensive, and professional.
Activity 1.1: Final Engineering Notebook Evaluation: Completed Engineering Notebook consisting of the entire capstone project engineering design process documentation.

Element N - Writing like an Engineer

Activity 1.2: Technical Writing Report: Addresses the extent to which the students followed standard conventions in writing like an engineer.

Women's History Month: March 1st - March 31st

1) Exhibitions and Collections

Students will access the Exhibitions and Collections of various influential women throughout history on the Women's History Month Website. Each student will choose one exhibition or collection to explore and write a summary describing the life, accomplishments and work of the person portrayed in the exhibition or collection of their choice.

2) Scavenger Hunt

Students will take part in a Women's History Month Scavenger Hunt. Students will be placed in groups. Each group will be provided with the Women's History Month Scavenger Hunt Worksheet. Each group will use their researching skills to figure out who each Scavenger Hunt description is describing. Points will be given for each correct answer. Points gained during activity will be used as extra credit.

3) Virtual Museum Tour

Students will take part in a virtual visit to the Smithsonian: Because of HER History to explore the ingenuity and accomplishments of Women in Science & Innovation. Students will choose one of seven Collection Objects to explore. Students will create a short video on Adobe spark to portray what was learned in the collection objects explored.

Juneteenth: June 19th

1) Juneteenth National Freedom Day Poster

Students will work in groups to create and present a poster that explains the history and importance of Juneteenth. Students will understand the significance of Juneteenth and explore present day celebrations and learn about the impact of African American leaders.

Extensions (Tier I):	Differentiation (Tier II):
● Mini Problem-Solving Challenges ● Research alternate materials ● Give opportunities for re-testing and data collection ● Office Hour Appointments	● Group work will allow high-tier students to support low-tier students in developing and testing prototype ● Provide aid in optimizing prototype and testing conditions ● Peer Tutoring ● One on one discussions ● Office Hour Appointments Tier (III): ● Options for expert aid in prototyping and testing ● Peer Tutoring ● One on one discussions ● Office Hour Appointments

Stage 3 – Learning Plan

Project Lead the Way (PLTW)

Engineering Design and Development Digital Textbook (password required): https://pltw.read.inkling.com/a/b/86a1841d86674ba5b7e3e00a55ccd89e/p/5cd7d7ae69aa45cb94c754e5cef6beca

The EDD Digital Textbook linked above includes informational text, videos procedures, project requirements, presentations, and technical drawings used in the design of the learning tasks described in the stage 2 section of this unit plan.

Vocabulary

Prototype / Model / Evaluation / Stakeholders / Analysis / Results / Design Reviews / Scope / Deliverables / Milestones

Expert/Field Experience(s)

- Potential Field Trips: PLTW Capstone Project Panel Presentation Fair
- Potential Guest Speakers: Past STEM Student, Engineer, Designer, 3D Printer Specialist, Mechanical Engineer

Literacy Connections/Research

- Students will incorporate research on prototyping, testing and data collection into their project.
- Students will research information about alternate materials and properties for their prototype.

Special Education/ 504:	English Language Learners:

-Adhere to all modifications and health concerns stated in each IEP. -Give students a MENU options, allowing students to pick assignments from different levels based on difficulty. -Accommodate Instructional Strategies: reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), handouts, definition list with visuals, extended time -Allow students to demonstrate understanding of a problem by drawing the picture of the answer and then explaining the reasoning orally and/or writing , such as Read-Draw-Write -Provide breaks between tasks, use positive reinforcement, use proximity -Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum by using manipulatives -Implement supports for students with disabilities (click here) - Make use of strategies imbedded within lessons -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 17-18)	- Use manipulatives to promote conceptual understanding and enhance vocabulary usage - Provide graphic representations, gestures, drawings, equations, realia, and pictures during all segments of instruction - During i-Ready lessons, click on "Español" to hear specific words in Spanish - Utilize graphic organizers which are concrete, pictorial ways of constructing knowledge and organizing information - Use sentence frames and questioning strategies so that students will explain their thinking/ process of how to solve word problems - Utilize program translations (if available) for L1/ L2 students - Reword questions in simpler language - Make use of the ELL Mathematical Language Routines (click here for additional information) -Scaffolding instruction for ELL Learners -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 16-17)
Gifted and Talented:	**Students at Risk for Failure:**
- Elevated contextual complexity - Inquiry based or open ended assignments and projects - More time to study concepts with greater depth - Promote the synthesis of concepts and making real world connections - Provide students with enrichment practice that are imbedded in the curriculum such as: ● Application / Conceptual Development ● Are you ready for more? - Provide opportunities for math competitions - Alternative instruction pathways available - Common Core Approach to Differentiate Instruction: Students with Disabilities (pg. 20)	- Assure students have experiences that are on the Concrete- Pictorial- Abstract spectrum - Modify Instructional Strategies, reading aloud text, graphic organizers, one-on-one instruction, class website (Google Classroom), inclusion of more visuals and manipulatives, Peer Support - Constant parental/ guardian contact - Provide academic contracts to students & guardians - Create an interactive notebook with samples, key vocabulary words, student goals/ objectives. - Plan to address students at risk in your learning tasks, instructions, and directions. Anticipate where the needs will be, then address them prior to lessons. -Common Core Approach to Differentiate Instruction: Students with Disabilities (pg 19)

21st Century Life and Career Skills:

Career Ready Practices describe the career-ready skills that all educators in all content areas should seek to develop in their students. They are practices that have been linked to increase college, career, and life success. Career Ready Practices should be taught and reinforced in all career exploration and preparation programs with increasingly higher levels of complexity and expectation as a student advances through a program of study.
https://www.state.nj.us/education/cccs/2014/career/9.pdf

- CRP1. Act as a responsible and contributing citizen and employee.
- CRP2. Apply appropriate academic and technical skills.
- CRP3. Attend to personal health and financial well-being.
- CRP4. Communicate clearly and effectively and with reason.
- CRP5. Consider the environmental, social and economic impacts of decisions.
- CRP6. Demonstrate creativity and innovation.
- CRP7. Employ valid and reliable research strategies.
- CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
- CRP9. Model integrity, ethical leadership and effective management.
- CRP10. Plan education and career paths aligned to personal goals.
- CRP11. Use technology to enhance productivity.
- CRP12. Work productively in teams while using cultural global competence.

Students are given an opportunity to communicate with peers effectively, clearly, and with the use of technical language. They are encouraged to reason through experiences that promote critical thinking and emphasize the importance of perseverance. Students are exposed to various mediums of technology, such as digital learning, calculators, and educational websites.

Technology Standards:
All students will be prepared to meet the challenge of a dynamic global society in which they participate, contribute, achieve, and flourish through universal access to people, information, and ideas.
https://www.state.nj.us/education/cccs/2014/tech/

8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge. A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations. B. Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using C. technology.Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others. D. Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior. E. Research and Information Fluency: Students apply digital tools to gather, evaluate, and use of information. F. Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.	Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment. A. The Nature of Technology: Creativity and Innovation- Technology systems impact every aspect of the world in which we live. B. Technology and Society: Knowledge and understanding of human, cultural, and societal values are fundamental when designing technological systems and products in the global society. C. Design: The design process is a systematic approach to solving problems. D. Abilities in a Technological World: The designed world in a product of a design process that provides the means to convert resources into products and systems. E. Computational Thinking: Programming- Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.