Component 3 Prototype and Test Lesson P G[redacted]re[redacted]re

Understandings

Students will understand that:

- Relevant principles and practices of Science, Technology, Engineering, and Mathematics (STEM) should be used to inform and justify design choices. They should be evident and well documented in an engineering design process.
- Project management is the discipline of planning, organizing, motivating, utilizing resources to achieve specific goals.
- During the construction of a prototype, safety in the workplace is a critical component. All safety guidelines and procedures should be followed.
- Material, tools, and equipment requirements are defined by creating a materials and cost analysis before the construction of a prototype.
- A prototyping provides the engineer with a scaled working model of the design solution that can be tested.
- Engineers write step-by-step instructions for the prototype assembly to guide the fabrication of the design solution.
- Designers must consider characteristics such as strength and weight of materials and fastening procedures to be sure that the final design meets design specifications.
- Testing is a critical component to any engineering design process. A plan and process for testing the proposed solution both qualitatively and quantitatively against design requirements should be created and carried out.
- Prototypes can generally be broken down into subsystems in order to isolate problems and conduct incremental testing.
- Prototype testing is a controlled procedure that is used to evaluate a specific aspect of a design solution.
- In order to gather useful data, specific criteria for success or failure of a test must be determined before testing begins.
- A detailed description of the testing procedure helps to ensure that the results of the design solution testing are valid.
- Data can be classified as either quantitative because it can be measured or qualitative because it describes a quality or categorization.
- The results of prototype testing are used to refine the design and to improve the design solution.
- A Critical Design Review are used to determine the quality and functionality of the final prototype.
- Designers should seek feedback from key stakeholders to determine if any modifications or improvements can be made before finalizing the testing process.

Knowledge and Skills

Knowledge: Students will:

- Know the principles and practices related to Science, Technology, Engineering, and Mathematics (STEM).
- Know the principles and practices related to working on a team and project management.
- Know safety procedures, policies, and practices associated with fabrication or prototyping in a small shop environment.
- Know the tools and materials available and how to see expert support in fabrication.
- Know purchasing procedures and practices outlined by the instructor.
- Know the principles and practices related to documenting an engineering project.
- Distinguish between a mock up and a prototype.
- Identify key stakeholders in a design process such as end user, investor, project manager, engineer, master craftsman or technician.
- Know the key component of a valid testing plan.
- Recognize qualitative tests and quantitative tests.
- Know the best practices for presenting testing results.

Skills: Students will:

Document project progress in an engineering notebook.
Create a step-by-step plan for building a prototype.
Devise a list of testing criteria that will be used to evaluate the prototype and determine the success or failure of the design solution.
Prepare a description of the testing method that will be used to validate and verify the design solution.
Construct a testable prototype.
Select and describe a valid testing method that will be used to accurately evaluate the effectiveness of their design solution in solving the problem.
Create a valid justification for the selected testing method.
Design and implement a prototype testing procedure and data collection plan.
Identify opportunities to incrementally test a prototype.
Conduct testing of their prototype.
Identify, define, and implement necessary modifications to testing methods based on expert feedback and ongoing research.
Design and participate in a critical design review to evaluate their prototype and determine how their project will proceed to identify, define, and implement necessary modifications to their design based upon their test results.

ESSENTIAL QUESTIONS:

Students will keep considering:

Why is it important to have clear, concise directions for the assembly of a product?
What steps can be taken to lower the cost of your prototype?

Pace the classroom instruction to clarify misunderstanding and provide opportunities for student feedback.
Introduce new content to be learned and how it connects to learning objectives and answers some (or all) of the essential questions.
Demonstrate skill practices students will gain from this lesson.
Demonstrate assignment(s) outcome expectations.
Review resources and equipment needed to problem-solve student assignments.
Share safety instructions to students. *Safety Instructions: Students should only utilize equipment they have been fully trained to use.*
Provide review material / resources for students to prepare for summative assessments.

Transition

☒ Classroom Expectations / Routines
☒ Review Questioning
☒ Stimulus or Signal (Example: "Pencil Drop", "Eyes on Me", etc.)
☒ Student Reflection
☒ Timer

Independent Practice (Varied Learning)

The students will:

Participate in teacher-led discussions / presentations.
Complete assigned assignment(s) in class.
Complete assigned homework assignment(s) outside of class.
Provide feedback by demonstrating skills.

Closure

The following techniques may be utilized:

The teacher will lead a classroom discussion to check for understanding and clarify misunderstandings.
The teacher may ask students to reflect on the outcomes from the lesson.
The teacher may ask students if they met and how they met the learning objectives for the lesson.
The teacher may ask students to demonstrate what was learned.
Teacher and students may play Kahoot! (or some other type of game) to check for mastery.
Student will share why the lesson is important via guided questions.
Student will complete some sort of exit ticket.

Assignments and Assessments

The students will:

Practice active listening skills while observing the teacher-led PowerPoint presentations.
Review the *Component 3 Prototype and Test* documents and PowerPoint presentations.
Complete *Component 3 Prototype and Test (Element G, H, and I).*
Create and continually add to and revise the *Technical Report*

Homework

The students will:

Complete assignments that were not completed in class.
Conduct research as needed for assignments.
Review the lesson/unit concepts, content, and skills as needed to prepare for lesson/unit assessments.

ASSESSMENTS:

Checks for Understanding (Formative and/or Summative):

- ☒ Bell Ringer(s)
- ☒ Check Class Assignment(s) / Homework
- ☒ Class Participation
- ☒ Group Activity
- ☒ Hands On / Lab Activity
- ☒ Independent Practice
- ☒ Oral Responses
- ☒ Peer Evaluation / Reflection
- ☒ Project / Presentation
- ☒ Student Reflection
- ☒ Teacher Observation
- ☒ Test / Quiz
- ☐ Other:

TEACHER REFLECTION / ADDITIONAL NOTES: