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McAllen High School/ McAllen ISD
Principles of Applied Engineering and Robotics
Grade 9-10
Days of Instruction: 30

This project will allow students to create a personalized keychain using the engineering design loop. Students will illustrate the keychain in both orthographic and isometric projection including calculated dimensions. Once the drawing are complete, the students will use Fusion 360 to design the keychain, 3D print the designs using ABS filament, and polish keychains using sandpaper and acetone for the post processing. As part of the quality control component, students will evaluate and test their products. Students will redesign as needed to complete the engineering design loop. Students will document the entire process in thier engineering notebook which will include any problems and solutions during the process. Keychains will be uploaded to Thingiverse.

Educational Standards
TEKS
130.402.c
1 (D) demonstrate time-management skills in prioritizing tasks, following schedules, and performing goal-relevant activities in a way that produces efficient results;
2 (F) conduct and present research on emerging and innovative technology;
2 (G) demonstrate proficiency of the engineering design process.
3 (A) use clear and concise written, verbal, and visual communication techniques;
3 (B) maintain a design and computation engineering notebook;
3 (C) use sketching and computer-aided drafting and design (CADD) to develop and present ideas;
3 (D) use industry standard visualization techniques and media; and
3 (E) use the engineering documentation process to maintain a paper or digital portfolio.
4 (A) master relevant safety tests;
4 (B) follow lab safety guidelines as prescribed by instructor in compliance with local, state, and federal regulations;
4 (C) recognize the classification of hazardous materials and wastes;
4 (D) dispose of hazardous materials and wastes appropriately;
4 (E) maintain, safely handle, and properly store laboratory equipment;
4 (F) describe the implications of negligent or improper maintenance; and
4 (G) demonstrate the use of precision measuring instruments.
6 (A) identify and describe the fundamental processes needed for a project, including the design process and prototype development and initiating, planning, executing, monitoring and controlling, and closing a project;
6 (B) identify the chemical, mechanical, and physical properties of engineering materials;
6 (C) use problem-solving techniques to develop technological solutions;

6 (D) use consistent units for all measurements and computations; and
6 (E) assess the risks and benefits of a design solution.
10 (A) set up, create, and modify drawings;
10 (B) store and retrieve geometry;
10 (C) demonstrate an understanding of the use of line-types in engineering drawings;
10 (D) draw 2-D single view objects;
10 (E) create multi-view working drawings using orthographic projection;
10 (F) dimension objects using current American National Standards Institute (ANSI) standards;
10 (G) draw single line 2-D pictorial representations;
10 (H) create working drawings that include section views; and
10 (I) demonstrate a knowledge of screw thread design per ANSI standards by drawing a hex head bolt with standard, square, and acme threads.

Objective
Students will follow the engineering design loop to design, create and test personalized keychains.

Activities

- Week 1 - Engineering Notebook, Drawings
    - Engineering Notebooks
    - Technical Drawings
- Week 2 - Measurement
    - Metrology
    - Technical drawings with measurement
- Week 3 - Design
    - Engineering Design Loop
    - Keychain Design Assignment
- Week 4 - Fusion 360/3D Printing
    - Additive Manufacturing
- Week 5 - Product Testing/Redesign/Quality
    - Stress, Crash, and Hardness Testing
    - Redesign
    - Surface Finishing
- Week 6 - Presentation
    - Present Projects

Engineering Notebooks and Drawings	Activity Teacher will introduce engineering notebooks, their origin and

	explain their importance in the engineering process. Students will be given an notebook to transform into their own engineering notebook. Materials needed Notebooks
Measurements	Activity Teacher will introduce the use of measuring tools such as calipers. Students will measure legos, document the measurements, and draw legos in both orthographic and isometric projections. Students will compare their tolerances between different legos. Materials needed: Calipers, Legos
Design	Activity Students will design personalized keychains. They will draw their design in their engineering notebook in both isometric and orthographic projection. Materials needed: Notebooks, Calipers
Fusion 360/3D Printing	Activity Teacher will introduce Fusion 360 and show students how to download and install on their personal computers. Students will design their keychains using Fusion. Materials needed: 3D printers, filament
Product Testing/Redesign/Quality	Activity: Teacher will demonstrate different ways to test products, including stress, crash, and hardness testing. Students will conduct tests on their first design and document the results. Students will redesign as needed and 3D print an updated version of their keychain. Students will then do any surface finishes to their keychains. Materials needed: Testing equipment, 3D filament, Fusion 360
Presentation	Activity Teacher will give examples of quality presentations. Students will

	prepare their presentations and present to the class. Materials needed: Poster, paper, projector, computer

Summary of Student Expected Outcomes

After the project has been completed, students will be able to understand the engineering design process; be able to demonstrate a knowledge of drafting by completing a series of drawings that can be published by various media; think critically and apply fundamental principles of system modeling and design to design projects; use appropriate tools and demonstrate safe work habits, present conclusions, research findings, and designs using a variety of media throughout the course; demonstrate professional standards/employability skills as required by business and industry.

Pre-Test and Post-Test/Ruberic

A pre-test and post-test will be given to the students using Google Forms. The link to the pre-test and post-test are shown below.

Pre-Test:
Post-Test:

Reflection Process

Students will create a presentation showing the learning process of their project. The presentation could be, but not limited to, a poster, a video, a slideshow, or a collage. It will show the entire process of the project including all failures and successes.

Closing Paragraph

This RET program was a great opportunity to build on the foundation of engineering education that I am accumulated over the course of two years. As a non-engineering major, this gave me experience in areas of engineering that I have not been exposed. The use of traditional machining was a notable experience and I will be be looking into adding that into my program in the future. The use of microscopes and SEM to examine roundness and/or surface quality was also captivating. 3D printing the drillbit to conduct testing and data analysis was fascinating and I will use some aspects of that lesson with my students. I will use what I have learned these past few weeks over the course of my teaching career. My lesson unit will be available on the

TeachEngineering website and I will be forwarding it to my colleagues at McAllen ISD who teach the same course. Other teachers, administrators and parents will be able to see the end result of this experience at the end of my unit as students will have a physical product and presentation to go with it.