# Unit 5: Vehicle Design

Content Area: **Applied Technology**
Course(s):
Time Period: **Marking Period 1**
Length: **10 days**
Status: **Published**

## Summary

In this unit students are provided with an overview of how technology and engineering are used to design wheeled vehicles, as well as how these vehicles are affected by mass, aerodynamics, and other forces. Students will be using the knowledge to design build, and test vehicles as they work through the Engineering Design Process.

Revision Date: July 2021

| | |
|---|---|
| CS.6-8.8.2.8.ED.1 | Evaluate the function, value, and aesthetics of a technological product or system, from the perspective of the user and the producer. |
| CS.6-8.8.2.8.ED.2 | Identify the steps in the design process that could be used to solve a problem. |
| CS.6-8.8.2.8.ED.3 | Develop a proposal for a solution to a real-world problem that includes a model (e.g., physical prototype, graphical/technical sketch). |
| CS.6-8.8.2.8.ED.5 | Explain the need for optimization in a design process. |
| CS.6-8.8.2.8.ED.6 | Analyze how trade-offs can impact the design of a product. |
| CS.6-8.8.2.8.ED.7 | Design a product to address a real-world problem and document the iterative design process, including decisions made as a result of specific constraints and trade-offs (e.g., annotated sketches). |
| WRK.9.2.8.CAP.1 | Identify offerings such as high school and county career and technical school courses, apprenticeships, military programs, and dual enrollment courses that support career or occupational areas of interest. |
| WRK.9.2.8.CAP.3 | Explain how career choices, educational choices, skills, economic conditions, and personal behavior affect income. |
| TECH.9.4.8.CI.4 | Explore the role of creativity and innovation in career pathways and industries. |
| TECH.9.4.8.CT.2 | Develop multiple solutions to a problem and evaluate short- and long-term effects to determine the most plausible option (e.g., MS-ETS1-4, 6.1.8.CivicsDP.1). |
| TECH.K-12.1.4.a | know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems. |
| TECH.K-12.1.4.b | select and use digital tools to plan and manage a design process that considers design constraints and calculated risks. |
| TECH.K-12.1.4.c | develop, test and refine prototypes as part of a cyclical design process. |
| TECH.K-12.1.4.d | exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems. |
| | Engineering design is a systematic, creative, and iterative process used to address local and global problems. The process includes generating ideas, choosing the best solution, and making, testing, and redesigning models or prototypes. |

## Essential Questions/Enduring Understandings

**Essential Questions:**

How does technology affect vehicle design?

What factors influence vehicle design?

How do aerodynamics influence a vehicle's speed?

How do vehicles affect the environment?

How can an object be modified to enhance its speed?

**Enduring Understandings:**

Technology is constantly changing to meet our wants and needs.

Technology has both positive and negative effects on our lives and planet.

Vehicle design continues to evolve as human wants and needs change.

## Objectives

Students will know that technology is defined as the human quest for solutions.

Students will know that aerodynamics are a key component of vehicle design.

Students will know that vehicles have changed since they were first invented.

Students will know that the weight of a vehicle will affect its speed.
Students will know that vehicle designs change based on human wants and needs as the effects on the environment and climate.

Students will be skilled at explaining how the aerodynamics of a vehicle will affect its speed.

Students will be skilled at demonstrating safe work habits when using tools, equipment, and technical processes.

Students will be skilled at explaining the role of trouble shooting, research and experimentation with regards to design.

Students will be skilled at explaining the reasoning behind their design.

Students will be skilled at identifying how this information is related to improving the efficiency and speed of

automobiles.

## Learning Plan

**Overview of Design Challenge**: Students will be provided with an overview of the unit's design challenge to establish understanding of the problem, its constraints, materials, and how the Engineering Design Process will be utilized. Students will be provided with a paper or online document where the steps taken to complete the process will be documented throughout the completion of the unit. Students will also explore how designed vehicles may impact the environment.

**History of Vehicle Design**: Teacher will provide students with information about the history of vehicle design and types of racing, including factors specific to drag racing and dragster design. Students should watch videos to enhance lesson content and will complete guided notes activities.

**Engineering and Aerodynamics in Vehicle Design:** Teacher will provide students with an overview of the forces of aerodynamics that will affect their space transportation system including drag, mass, and thrust.

**Vehicle Brainstorming**: Students will brainstorm ideas for potential vehicle designs with attention shown to streamlined designs and the impact of aerodynamics on speed. Teacher will provide examples of what is expected and will help students as they sketch and brainstorm ideas.

**Choosing a Solution and Selection Rejection**: Teacher will review key concepts of vehicle design and will guide students through the selection of choosing a solution from their sketched ideas. Students will be provided with questions that will be answered as they explain their choice and why that solution will best solve the problem. All questions will be answered as part of the documentation process. Teacher will guide students through the completion of an orthographic layout of their chosen solution as well as the production of patterns that will be used to transfer their outlines onto a blank.

**Finishing and Safety Practices**: Safety procedures including tool use, safety goggles, and best practices with finishing operations will be discussed and modeled. Teacher will explain finishing procedures including filing, sanding, and painting. Students will be provided with class time to sand, paint, and add detail to their designs while adhering to safety practices.

**Wind Tunnel Testing**: Students will be provided with a review of aerodynamics terms and will complete a

vocabulary assignment and wind tunnel testing of their individual vehicles using a Flo Visualization Wind Tunnel or similar virtual wind tunnel. The concepts of aerodynamics and their effects will be discussed.

**Race Preparation:** Teacher will review the impact of aerodynamics and mass on a vehicle's speed and will instruct students how to add finishing details to their vehicles such as wheels, eye hooks, roll tests, and the completion of checking their vehicles for race preparation requirements of minimum weight and length. The timing system and track length will be discussed, as well as race safety. Teacher will conduct time trials for each car, recording all data. Once races are complete, students will be provided with data for their individual vehicles so that they may calculate their vehicle's speed in feet per second and then miles per hour. This information will then be used as students self-evaluate their designs and explain how it could be modified to increase its speed.

**Evaluation and Redesign**: Following testing and racing of vehicles, teacher will guide students through the process of self-evaluation and a written redesign of their solution.

## Assessment

**Formative Assessments:**

Google Forms

Guided notes

Engineering Notebook

Brainstorming Sketches

Orthographic Layout

**Benchmark Assessments:**

Vehicle Design Challenge Documentation

Completed Vehicle Prototype

**Summative Assessment:**

Written self-evaluation and redesign

Unit Test

**Alternative Assessment:**

Checklist

Questioning

Discussion

## Materials

Guided note packets/Google Docs (teacher developed)

Technology (student & teacher laptops, SmartBoard, document camera)

Google Slides/PowerPoints

Worksheets/notes

YouTube links

Safety Equipment

Balsa Blanks

Steel Axles

Wheels

CO2 cartridges

Drill Press

Band Saw

Files

Sandpaper

Paint

Paintbrushes

Scale

Rulers

11” x 17” paper

Flo Visualization Wind Tunnel

Flo Visualization Fog

Masking tape

Tracing paper

Scissors

## Integrated Accommodation and Modifications

See attached document:

https://docs.google.com/spreadsheets/d/1bW0L5xhslCD9IsWWnzfbMJoRUI5vOFrgbQJ2saYTgLU/edit?usp=sharing