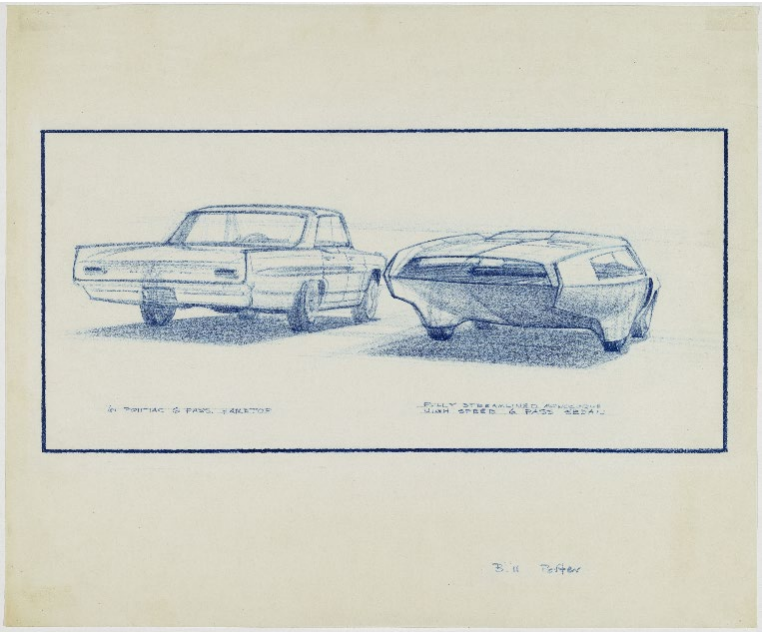
THINK LIKE AN ENGINEER | GRADES 6-8 TEACHER RESOURCE



William Porter (American, born 1931). '61 Pontiac Catalina vs. Aerodynamic Streamlined Sedan, 1959. Prismacolor on vellum; 14 × 16 15/16 in. (35.6 × 43 cm). Collection of Bill and Patsy Porter.

This lesson supports the special exhibition *Detroit Style: Car Design in the Motor City, 1950–2020*.

LEARNING TARGET

In this STEAM lesson, students are emersed into a world of Transportation Design as they use the Design Thinking Process to create their own vehicle prototype out of everyday materials. Students will plan, create, analyze data, and adapt their designs to produce a balance of form and function in their vehicle. Through trial and error, students will begin to understand how an Engineer thinks through problem-solving and reflection.

ESSENTIAL QUESTION

How does a creative idea become a reality?

STUDENT OUTCOMES | STUDENTS WILL

- create a functional vehicle.
- collaborate with a team to adapt an idea.
- analyze mathematical data to adapt design results.
- describe the evolution of Transportation Design through the decades 1950–2020.
- describe why form and function work together to create a more successful product.
- determine how line, shape, color, and texture affect the functionality and marketability of a vehicle.

MICHIGAN MERIT CURRICULUM VPAA STANDARDS

Perform

ART.VA.I.7.4 Employ reflective thinking skills by observing, analyzing, and critically evaluating works of art for the purpose of improving technical quality at an emerging level.

ART.VA.I.7.5 Produce and exhibit a final product that demonstrates quality craftsmanship and technique at an emerging level.

Create

ART.VA.II.7.1 Identify, design, and solve creative problems at an emerging level.

ART.VA.II.7.3 Collaborate, communicate, and work with others to create new ideas at an emerging level.

ART.VA.II.HS.7 Create preliminaries, possibilities, and drafts at an emerging level.

Analyze in Context

ART.VA.IV.7.2 Articulate an understanding of the historical, social, and cultural contexts of artwork with an emerging level of aesthetic sophistication.

Analyze and Make Connections

ART.VA.V.7.2 Recognize and describe the skills used in visual arts careers at an emerging level.

21ST CENTURY LEARNING SKILLS ALIGNMENT

Collaboration

Creativity

Critical Thinking

Flexibility

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PRE-VISIT ACTIVITIES

DAY 1

1. Introduce students to Career Pathways by showing them a short video about Industrial Designers by the U.S. Bureau of Labor Statistics.

2. Facilitate a discussion about career options with students by posing questions about engineering and creative occupations. Ask students to consider:

    - How might these two careers work together?
    - Do you think it takes both types of careers (and people) to create a successful design?

3. Explain to students that they are going to build a prototype of a car, similar to a Transportation Designer at a real car company. Before they begin, they should understand the idea of a prototype, also known as a base model, and that they will be building one that needs to be functional (it needs to propel forward because they will race them in a later step).

4. To deepen student's foundational understanding of car design and engineering concepts, encourage students to repeatedly use the lesson vocabulary (see "Think Like an Engineer – Student Packet") and refer to the videos located at the end of this document under Additional Teacher Resources.

DAY 2

1. Divide students into small groups to promote collaboration and give each design team "**Think Like an Engineer – Student Packet**." This handout will provide a step-by-step overview for the entire project.

2. Check that students understand the main components of the entire project, drawing their attention to the last section, **Step 9: Grading Rubric**. Remind teams to keep their end goal in mind throughout the various stages of the project, just like an Industrial Designer would.

3. As a team, they should complete **Steps 1 and 2** by reviewing the materials needed to create the *prototype* and then sketch their ideas of how to solve the "design problem."

4. Encourage collaboration and experimentation. It is important that students know that failing is okay and part of learning! Problem solving is a component of the engineering process, but if students truly struggle with the open-ended nature of problem solving, you may offer the **Building Videos for Balloon Powered Car** under **Additional Teacher Resources** on page 6.

5. After their team has reviewed the step-by-step overview of the project, they can begin **Step 3** and construct the base model. Notice that students are not given directions for the base model. This project is a problem that they must solve through experimentation! The question prompts will help students consider the results of their design decisions. Encourage them to plan ahead.
6. Explain to students that in **Step 4** they will use their prototype to race their car and record their time in their "**Think Like an Engineer – Student Packet."**

DAY 3

1. Refer to **Step 4: Calculating Speed and Recording Data.** Students will race their car and record their data in the chart provided in the handout. Direct students to compare their car's performance against the class average.
2. Encourage design teams to discuss the design process and what affected the performance of their functional prototype vehicle. Did it perform better on carpet or tile? Was it durable? If they were to change the surface texture, would it improve the performance?

VIRTUAL TIP

If you are facilitating this lesson virtually, ask students to gather the materials at home and each build their own *prototype*. Give design teams time to collaborate online to complete the steps of the "**Think Like an Engineer – Student Packet."**

DURING VISIT ACTIVITY

DAY 4 | *Detroit Style: Car Design in the Motor City, 1950-2020*

Instruct students to explore the "***Detroit Style* Presentation**" and at least one of the short videos produced for this exhibition, found at dia.org/detroitstyle. Students should choose one era of car design as a focus. This era will help influence changes to their *prototypes* in the next phase of this project. Have students complete **Step 5: See, Think, Wonder Self-Guided Experience** graphic organizer and provide ample time for students to make connections and discuss them with their design team.

POST-VISIT ACTIVITIES

DAY 5

Once student reach **Step 6**, they use their previous research from **Steps 3 and 4**, and their thinking during their exploration of the exhibition materials from **Step 5** to determine how they will change their vehicle to make it more functional AND more marketable. Will students choose a type of material for the surface of the car? Is it decorative and serve a practical purpose? Does the surface material slow the speed? Allow ample time for students to implement these changes before moving on to **Step 7**.

DAY 6

Students will put their remodeled prototype to the test by racing their car again, entering their new data in the **Step 7: Adaptable Data** handout, and comparing their results to the class average.

DAY 7

1. The **Reflection Page** in **Step 8** is meant to help students think about their own thinking (metacognition). This can be done in class or as a homework assignment.
2. To conclude this unit, assemble a team of teachers and school staff who will act as judges during the grading process. Since this is a STEAM project, consider your Construction Trades Teacher, CAD Teacher, or Automotive Repair Teacher to give a quality judgement from their level of expertise. Give each judge the **Step 9: Grading Rubric**. This is a great opportunity for cross-curriculum learning.

This educational resource was developed by graphic design teacher Noelle Scharer in collaboration with the Education Programs at the Detroit Institute of Arts.

ADDITIONAL TEACHER RESOURCES

Career Pathway Information

"Occupational Outlook Handbook, Industrial Designers." Bureau of Labor Statistics, U.S. Department of Labor. Last modified on September 1, 2020. https://www.bls.gov/ooh/arts-and-design/industrial-designers.htm.

"This is how Elon Musk hires..." The not so boring Man. April 21, 2019. Video, 2:30. https://www.youtube.com/watch?v=LLSb8phQ1t8.

The Design Process

"Designing a Car – from Sketch to Presentation." Form Trends. June 14, 2019. Video, 11:25. https://www.youtube.com/watch?v=ar31DrNV_pM.

Van den Acker, Laurens. "Automotive Design: The Life Cycle for Inspiration." TEDx Talks. January 18, 2018. Video, 17:26. https://www.youtube.com/watch?v=MgvledYpkO0.

FOR TEACHERS AND STUDENTS

Historical Background Knowledge

"Who built the first automobile?" History.com. July 29, 2019. Video, 3:35. https://www.history.com/news/who-built-the-first-automobile.

Building Videos for Balloon Powered Car

"Balloon Powered Car." Questacon. Accessed on October 20, 2020. Video, 3:39. https://www.youtube.com/watch?v=3Dw6N0Tn_sU&frags=pl%2Cwn.