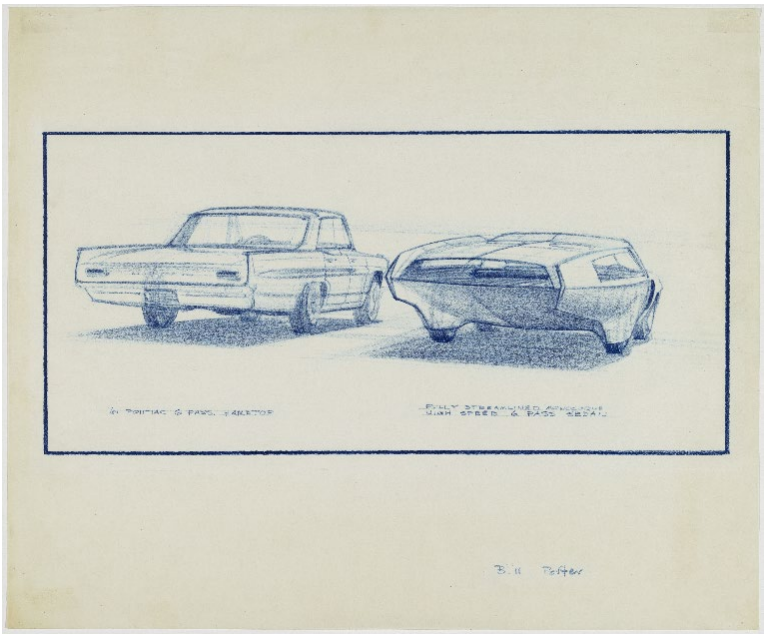
THINK LIKE AN ENGINEER | STUDENT PACKET GRADES 6-8



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*.

GLOSSARY

PROTOTYPE: a first, typical or preliminary model of something, especially a machine, from which other forms of art are developed or copied.

DESIGN THINKING: a non-linear, repetitive process that teams use to understand users, challenge assumptions, redefine problems and create innovative solutions to prototype and test. It involves five phases: Empathize, Define, Ideate, Prototype and Test-it is most useful to tackle problems that are ill-defined or unknown.

FORM: external appearance of a clearly defined area, as distinguished from color or material.

FUNCTION: the purpose for which something is designed or exists.

TEXTURE: the visual and especially tactile quality of a surface.

MATERIALS

Gather the following materials to create your base model car:

- 2 Regular Straws
- 1 Bendy Straw
- 1 Piece of cardboard 8.5" x 5.5."
- 4 Water bottle caps for wheels (make sure they are the same size)
- 2 Bamboo Skewers (use wire cutters to cut them)
- 1 Balloon
- 1 Small Rubber band

Scotch Tape

Scissors

Hammer and Nails *(to create holes in wheels)*

Students are encouraged to add materials for design/style purposes in the "Post Visit Activities"

STEP 1: CREATE A TEAM!

In a formal work setting, it is common to work in a team. Think about the strengths of your team members and assign work accordingly. This is a great way to bounce ideas off each other!

Team Member Names

1. _____
2. _____
3. _____
4. _____

STEP 2: IDENTIFY THE PROBLEM

Your job is to create a functional prototype car with a marketable design. Not only does the *prototype* have to work, but it also has to be beautiful! By experiencing the Engineering Design Process, you will consider many aspects of car design. Be prepared to use your Growth Mindset to adapt your design throughout the process to make it better.

STEP 3: PLAN AND BUILD YOUR PROTOTYPE

Considering your materials, sketch a design for your *prototype*. How can these materials work together to make a *functional* vehicle?

Questions to ponder first:

1. How do wheel axles work? Will your wheels spin correctly?

2. Does your vehicle need traction?

3. How will the performance change based on the material of the ground, such as tile or carpet?

4. What will happen if your vehicle is too light or too heavy?

5. How can you make your car go faster?

6. Will the vehicle travel in a straight line?

Sketch your ideas here:

Next, use your sketch as a guide to build your *prototype* vehicle.

STEP 4: CALCULATING SPEED AND RECORDING DATA

After you have made your car and you figure out how it can "go," each team will calculate the car's speed, distance and the class average. Use the worksheet and tables to record information.

First, your car will have three trial runs. To calculate speed, use the following equation:

$$\text{Speed} = \frac{\text{total distance (cm)}}{\text{total time (seconds)}}$$

To calculate the Average Speed, add the three final speed results together and then divide by 3. For the Class Average Speed, add the calculated speeds together and divide by the number of groups.

GROUP DATA TABLE

Trial	Distance (cm)	Time (Seconds)	Speed (cm/s)
Trial 1			
Trial 2			
Trial 3			
Average Speed			

CLASS DATA TABLE

Group	Speed (cm/speed)	Rank
Group 1		
Group 2		
Group 3		
Group 4		
Group 5		
Group 6		
Group 7		
Group 8		
Class Average Speed		

STEP 5: SEE, THINK, WONDER SELF-GUIDED EXPERIENCE

Using the **Detroit Style Presentation** and at least one exhibition video, explore *Detroit Style: Car Design in the Motor City, 1950–2020* before completing the **See, Think, Wonder** graphic organizer. If able, visit the exhibition in person!

Name_____

THINK LIKE AN ENGINEER | SEE, THINK, WONDER

SEE	THINK	WONDER
What do you *see*?	What do you *think* about that?	What does it make you *wonder*?

This thinking routine was developed as part of the Visible Thinking project at Project Zero, Harvard Graduate School of Education.

STEP 6: DEFINE THE NEW PROBLEM, IDEATE, AND ADAPT

It's time to gather your creative minds!
Collaborate with your group and discuss new design ideas inspired by your exploration of the ***Detroit Style*** **Presentation** and exhibition videos! Review each other's ideas and decide on which design will be the most successful. You will be racing them again and you will be judged by a team of experts!

1. How did Transportation Design change through the decades 1950–2020?

2. Choose a time period that inspires you. What decade is your favorite? How will you incorporate that into your design?

3. What will you add to your car to make it more beautiful? Consider color, texture, and shape.

Define the Problem to Solve:

4. Will the items that you add make the car go faster or slower? How will it impact the *function* of the vehicle?

5. Does the color and style you choose appeal to a marketable audience?

Sketch your final ideas here:

STEP 7: ADAPTABLE DATA

Now that you have designed a newer and more beautiful vehicle, let's see how it performs. We are going to re-evaluate our data and test our vehicles with their new changes.

GROUP DATA TABLE

Trial	Distance (cm)	Time (Seconds)	Speed (cm/s)
Trial 1			
Trial 2			
Trial 3			
Average Speed			

CLASS DATA TABLE

Group	Speed (cm/speed)	Rank
Group 1		
Group 2		
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Group 5		
Group 6		
Group 7		
Group 8		

1. Did the results come out as expected?

2. What could you have done differently?

3. How did your team personalities and dynamics contribute to the project? What was your role and contribution?

STEP 8: REFLECTION

1. How do you feel about your vehicle's overall performance?

2. If you could change your vehicle again, what would you change?

3. Identify two examples of decisions that were made during collaboration. Did your ideas improve due to the teamwork environment?

4. Identify the role *Design Thinking* played in the entire process.

5. Describe how your group used "brainstorming" to develop your idea.

6. Describe how your group used *Design Thinking* and editing to adapt your idea to improve the final concept.

7. Make connections. Describe two connections you made between this design process and something outside of this project. How does the information you learned connect to our world?

8. How does the information you learned connect to a career pathway?

Name_____

THINK LIKE AN ENGINEER | GRADING RUBRIC

1 = Strongly disagree 2 = Disagree 3 = Neutral 4 = Agree 5 = Strongly agree

Function
The vehicle's build is functional.

1	2	3	4	5

Performance
Review the data sheet. The team showed improvements in its performance and speed.

1	2	3	4	5

Design
The design is appealing and creative.

1	2	3	4	5

Craftmanship
The outer design reflects quality and durability.

1	2	3	4	5

Curb Appeal
The choice of color, design, and texture improve its appeal and marketability.

1	2	3	4	5

Style
The style reflects the trends and inspiration of a time period from the Detroit Style Presentation. Review the sketches for evidence.

1	2	3	4	5

Form and Function
The form and function of the vehicle are cohesive.

1	2	3	4	5

Teamwork and Collaboration
The team worked well together, combining ideas and listening to all team members.

1	2	3	4	5

Final Thoughts
The overall design shows an understanding of the phases of *Design Thinking*.

1	2	3	4	5

TOTAL SCORE = _____ / 45

Comments: