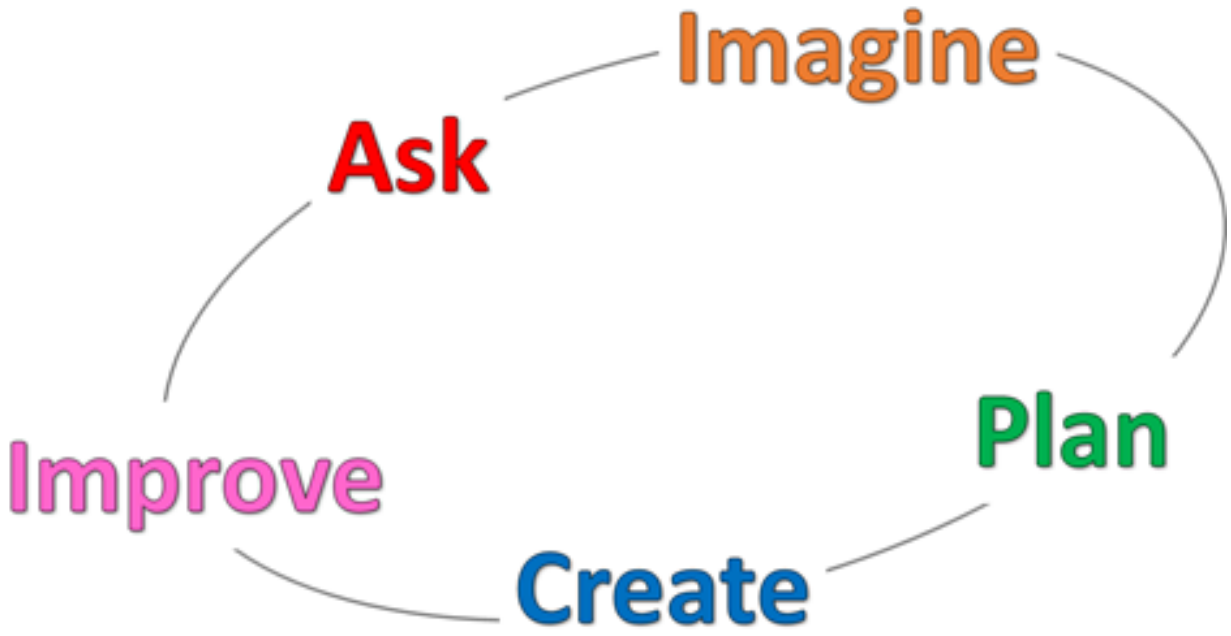
Gravity Racers Engineering Notebook



Problem:

Sadly, your parents have hit you with a shrinking ray, and you have shrunk down to the size of a mouse. Luckily, there is a gravity racer competition that you can now enter with the size that you are. Your racer needs to be able to travel down a 3 meter track using the force of gravity. The car should not be more than 8.5" long, 5.5" wide and 1½-2" high with at least 2 wheels and cannot be heavier than 10 ounces (oz).

What is your **goal** for this project? What are you building?

Engineering Notebook Instructions

Each step of the Engineering Design Process (EDP) will be documented to show important aspects including student reflections, data, illustrations, research, and instruments. A snapshot of each section maps the steps of the EDP.

***Guidelines* and G*uiding Questions* for your notebook:** *(Please write in the ʻŌlelo Hawaiʻi.)*

Nīnau *Hana* *Kuhi* *Holomua* *Kaha kiʻi* *Kamaʻilio*

1. **ASK: _____**
    a. **Define the *Problem Statement* –** Who has the problem? What is the problem? Why is it important?
    b. **Empathize –** Identify the customer's needs.
    c. **What are the constraints?**
    d. **Start background research.**
    e. **Define the requirements / specifications to meet the customer's needs or design challenge parameters.**

2. **IMAGINE: _____**
    a. **Background research –** What have others done?
    b. **Brainstorm and sketch design ideas –** All ideas are welcome!
    c. **Develop multiple concepts before evaluating them.**

3. **PLAN: _____**
    a. **Create a *Pugh Chart* (**a decision tool to evaluate all design concepts against your list of specifications / requirements) and choose the best idea or design.
        i. **Evaluate all of the design's strengths and weaknesses.**
        ii. **Does the design meet all the specifications / requirements?**
    b. **Draw a detailed sketch and label the important elements of your selected design (as required).**
    c. **Make a list of the materials required to build your selected design.**

4. **CREATE: _____**
    a. **Follow your plan and create a prototype.**
    b. **Test the prototype against your specifications / requirements.**
    c. **Fully document and evaluate the test results.**

5. **IMPROVE: _____**
    a. **What worked and what didn't work?**
    b. **What could work better?**
    c. **Improve your design based on your findings.**
    d. **Test your improved design against your specifications / requirements.**
    e. **Fully document and evaluate the test results.**

6. **COMMUNICATE: _____**
    a. **Share your solution or design with your peers.**
    b. **Justify your design choices using the data you collected.**
    c. **Provide EDP documentation.**

Research: _____ (ʻŌlelo Hawaiʻi)

EDP Research Sheet - Complete *Gravity Racer Research* assigned in Google Classroom, and press turn in.

Part 1

1. Read the articles.
2. Complete the table

Part 2

1. Talk with someone that is not a student to explain your project, your goal for building, and ask for tips on building your gravity racer. You can reach out to experts via social media or talk with someone in your house who is an adult or older sibling.
2. Answer the questions.

Group Share Out:

1. After completing your research, share with your assigned group what are some things you want to include in your design.
2. Write an example of ideas you liked from your partners' information.

	*Manaʻo (ideas, thoughts), ʻike (knowledge) of design ideas you **liked**: (Pono)*
Classmate 1 (write their name here)	*1.* *2.*
Classmate 2 (write their name here)	*1.* *2.*

Ask

Specification Sheet (Please complete the chart below.)

Specifications - The client's requirements for this stage of the project.

Weight of Importance - Please give a score for how important each specification is. *(on a scale of 1 to 5, with 5 being the most important)*

Justification - Please give a reason why the specification is important and weighted based on the client's needs.

#	Specification	Weight of Importance	Justification (Why?)
1	*The car must be no longer than 8.5" and wider than 5.5"*		
2	*Required components at the front of the car Must have a thickness of ½" and be between 1½" - 2" in height from the ground (to trigger the sensor.) The larger the component, the greater the chance of triggering the sensor. Fastest car to trigger the sensor wins.*		
3	*Must have at least 2 wheels.*		
4	*Must be able to travel 3 meters.*		
5	*Cars must use the wheels provided.*		
6	*Cars cannot be heavier than 10 ounces (oz)*		

Imagine

Please create TWO ideas (A & B) to solve the problem. Please make sure you label the parts and materials as well as include dimensions.

A

***Materials* (Ukana)**

Materials	*Quantity*	*Materials*	*Quantity*

Imagine

Please create TWO ideas (A & B) to solve the problem. Please make sure you label the parts and materials as well as include dimensions.

B

Materials **(Ukana)**

Materials	*Quantity*	*Materials*	*Quantity*

Plan

Problem Statement:

PUGH CHART *(decision matrix)*

Score is based on a scale of 1 to 5 with 5 being the design that best meets the specification.

Total = Weight x Score

Total Weighted Score = sum all of the numbers in the "Total" column. Do this separately for Design A and B

#	Specifications	Weight	Design A		Design B	
			Score	Total	Score	Total
1	*The car must be no longer than 8.5" and wider than 5.5"*					
2	*Required component at the front of the car Must have a thickness of ½" and be between 1½" - 2" in height from the ground (to trigger the sensor.) The larger the component, the greater the chance of triggering the sensor.*					
3	*Must have at least 2 wheels.*					
4	*Must be able to travel 3 meters.*					
5	*Car must use the wheels provided.*					
6	*Cars cannot be heavier than 10 ounces (oz)*					
	Total Weighted Score:					

Which Plan Did You Choose? *Circle the Design which has the higher Total Weighted Score*

A *or* ***B***

Justification: *(Why was the design better?)*

Improve

Write what are 2 things you think worked well about someone else's design and why (you should be writing more than how their device looked)?

1.
2.

Draw:
Please create a sketch that shows the improvements. Include labels and dimensions.

Test Data Inoa: _____

Initial weight: _____ grams

Weight	Trial 1	Trial 2	Trial 3	Average

Please find the average speed of your car: Rate = Distance x Time

Please find the acceleration of your car: Acceleration = $\frac{\text{Final Velocity - Initial Velocity}}{\text{Time}}$

Please find the force of your car at the finish line: Force = Mass x Acceleration

Improvement Data Inoa: _____

Initial mass of racer: _____ grams

Weight	Trial 1	Trial 2	Trial 3	Average

Please find the average speed of your car: Rate = Distance x Time

Please find the acceleration of your car: Acceleration = $\frac{\text{Final Velocity - Initial Velocity}}{\text{Time}}$

Please find the force of your car at the finish line: Force = Mass x Acceleration

Graph

Please make a graph showing the average time for your initial design and your improved design.