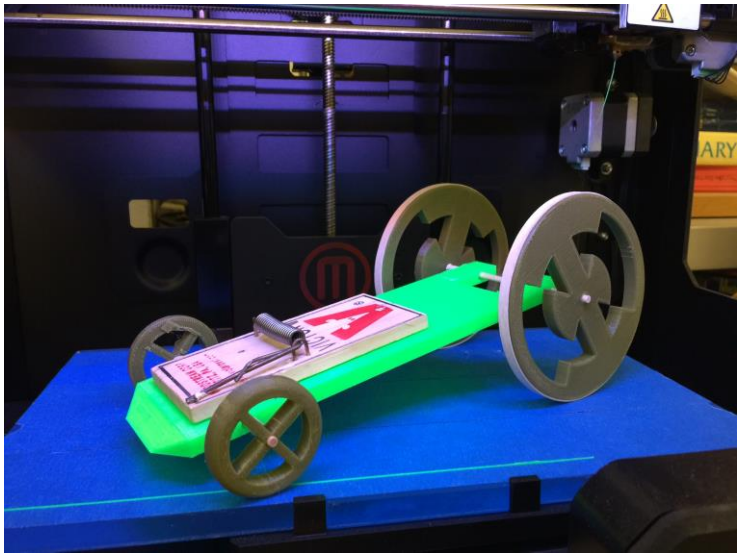
Name:_____

Date:_____

3D Printed Mousetrap Car Module



Team Members:

_____

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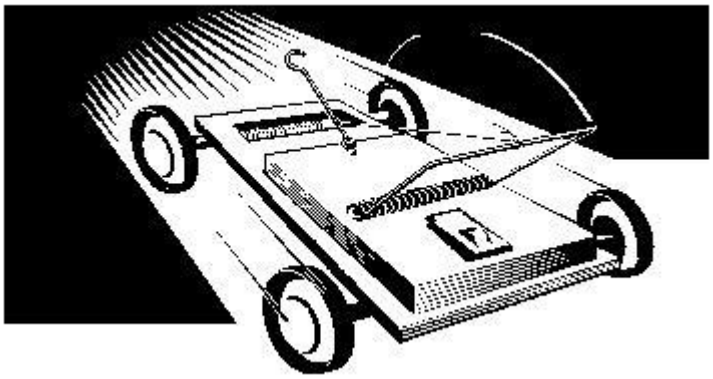
Mouse Trap Challenge

Specific Aims/ Problem Statement

Your classroom is sponsoring a competition for the fastest, farthest, and most unique vehicle ran by a simple mouse trap. They are even providing the mouse trap for you! Your mission is to figure out the best, most efficient way to design such a con**trap**tion. Only the mouse trap provided can be used to power your cars… and yes, using rubber bands is cheating! To use a mouse trap to power your vehicle, attach a string to the arm of the trap and wind the other end around the axel of your wheels. Experiment with size and length of all parts of your vehicle.



Competitions will be held ____(date)_____ . There will be two separate measured competitions, speed and distance. At the end of class your vehicle will be set on display for class to vote on the most unique. Note: your vehicle must function correctly to win the unique competition.

You will be required to keep track of everything you do in class. You can record this is your engineering journal. This is to prove that you did your own work. You will also be required to do a little bit of research about mouse trap cars.

After competitions calculations will be made for speed, acceleration, and distance. Good luck! Everything you need to know you can find in the scenario.

Scenario

This scenario is a guide to tell you everything you will need to know to do this project on mouse trap cars. You will be working within groups to accomplish this task, although every group member will receive an individual grade.

Engineering Journal

Your engineering journal should be a record of everything you do on the project. **Refer to your assessment paper to get a more visual list of the required components.** The very first page should be a table of contents. Everyday you are in class you should date and number the top of a blank page and include everything you do in it. This includes, but not limited to, your brainstorming, sketches, modifications, and records of trials and materials. At the end of the day you and your team should initial your entry indicating that everything is your own work and that it was done on that day. Before you start your project and your daily entries you will be required to do research on mouse trap cars. The research can be internet based and is put in place in order to get some good ideas on how to build your car. Cite at least three sources and include a summary of the key points. Once you have completed your car you will be required to write a conclusion section in your journal. The conclusion needs to include a list of materials, design changes, observations and conclusions, and a final sketch. Questions to address in your observations and conclusions include: What problems did your car experience? What can be done to improve your mousetrap car's performance? What problems did your car experience? What can be done to improve your mousetrap car's performance? Make sure to also include other important observations and conclusions you may come up with. The final sketch should be done using Autodesk.

Building the Car

The basic idea is to build a car that is propelled by attaching a string to a mouse trap and wrapping the other end around an axel so that when the mouse trap is triggered it will pull the string spinning the axel.

Your instructor will provide the following:

- Knife for cutting 3D plastic (extra)
- Mousetrap
- Access to 3D printer
- Rubber bands for wheels
- Dowel for mousetrap arm
- String
- safety glasses

A basic design for your car would be to drill holes into balsa wood slightly bigger than the size of your axel, and glue the mouse trap to the balsa wood. Attach string to the mouse trap lever arm and wrap the other end around one axel. Attach your wheels to the axels and voila you have a simple mouse trap car. Feel free to modify this design.

There are key ingredients to make the mouse traps the best. All good engineers solve their problems with the end in mind. In this situation the end of the experiment is the kind of race you want the car to excel in. There will be two measured competitions, one is a speed competition, and the other is a distance competition. Modifying the length of the lever arm on the mouse trap will greatly change the performance of the vehicle. If you want distance lengthen the lever arm, but if you want to win the speed race a short lever arm is the way to go. If you are modifying the lever arm to make it longer, keep in mind that it must stay rigid. If the arm bends while it is in action, then energy will be taken from your outcome. Also, wheel size will affect the race. The larger your wheels are, the more distance will be traveled, but at the cost of speed.

Getting the right string can be important. Fishing line works, but only for a couple of runs. Thread for sewing buttons onto coats is good. It is tough to break, and cheap to buy. Most likely whatever your instructor provides will be fine, but you may also provide your own.

Testing the car is extremely important; make sure the mousetrap is disarmed at all times until its ready to test. Testing can get a lot of the bugs out of a car. For example, one of the hardest things with mousetrap cars is steering, going straight doesn't happen without any effort. For speed cars you will want to find the best length for your lever arm; the peak speed should reach about 3/4ths of the track, and then the car can coast the rest of the way.

Measured Competitions

On competition day your car will do three trial runs for each measured competition. This way you will get a good average of your car's capabilities. After your competitions take time to figure out and experiment with what you can do to improve your car.

The distance competition is a little easier to do. Release your car at the starting line and record the distance it travels perpendicular to the starting point. You will run three distance trials to find an average distance your car runs. A good distance mouse trap car will run 20 to 30 feet.

The speed competition is based on the time it takes your car to travel five feet. When timing your car one person will start two stopwatches simultaneously as soon as the car is released. The first stopwatch should stop and record the time to travel five feet and the second stopwatch should stop and record the time to travel ten feet. The ten feet measurement is not part of the speed competition, but simply used to calculate acceleration on the worksheet.

The last day of competitions all cars will be set on display. All students will pick a favorite car, write it on a piece of paper, and submit it to the teacher. Your instructor will tally up the votes and announce the winner (who will receive 10 bonus points).

Calculations

You will be provided a worksheet to record your measurements and do calculations. The first section on the worksheet is the distance table; simply record the distance your car runs over three trials. The second section on the worksheet is your first speed table. Simply record the time your car travels over 5 feet for three trials. Then Calculate your speed on each trial by using the formula Speed = Distance(5ft)/Time. The average speed is calculated by adding your three speeds and dividing by three.

	Total Distance
Trial 1	26.5 ft
Trial 2	30 ft
Trial 3	29.8 ft

	Distance	Time	Calculated Speed
Trial 1	5 ft	1.1 s	4.5 ft/s
Trial 2	5 ft	1.1 s	4.5 ft/s
Trial 3	5 ft	1.1 s	4.2 ft/s
			Average Speed: 4.4 ft/s

The third section of your worksheet is probably the hardest. In the time column record the time it took your car to go 10 feet. In the column that reads "Time: 10ft-5ft" subtract the time it took your car to travel 10 feet by the time it took your car to travel 5 feet. In the column that reads "Calculated Speed: 10ft-5ft" calculate your speed using the formula Distance(10ft)/Time:10ft-5ft. The average time is figured by adding the times from the Time:10ft-5ft column and then diving by three. The average speed is calculated by adding the speeds and dividing by three.

	Distance	Time	Time; 10ft-5ft	Calculated Speed 10ft-5ft
Trial 1	10 ft	4.6 s	3.5 s	2.9 ft/s
Trial 2	10 ft	4.2 s	3.1 s	3.2 ft/s
Trial 3	10 ft	4.1 s	2.9 s	3.4 ft/s
Average Time 10ft – 5ft:			**Average Speed 10ft – 5ft:**	

There is one final calculation question on the worksheet: Calculate the Acceleration from 5 ft to 10 ft. Acceleration = Average Speed/Time. Simply just use the provided formula.

Assessment

Section	Requirement	Points Possible	Points Earned	Instructor Signoff
Engineering Journal	Table of Contents	5 pts		
	Daily entries	5 pts per day		
	Preliminary Sketches	5 pts		
	Research Done	20 pts		
	List of Materials used	10 pts		
	Design Changes	5 pts		
	Final Sketch	10 pts		
	Observations and Conclusions	15 pts		
Mouse trap Cart	Correct use of mousetrap	20 pts		
	Ability for mouse trap to go at least five feet	20 pts		
	Distance Winner	10pts extra		
	Speed Winner	10 pts extra		
	Class Favorite	10 pts extra		
Worksheets	Calculations for speed, acceleration, and Distance Worksheet (Show your work)	20 pts		
Total Points	*There will be a Team evaluation; grade may be adjusted as teacher sees fair.	_____pts		

Worksheets

Group members' names:

_____

Distance Table

	Total Distance
Trial 1	
Trial 2	
Trial 3	

Speed Tables (Speed=Distance/Time)

	Distance	Time	Calculated Speed
Trial 1	5 ft		
Trial 2	5 ft		
Trial 3	5 ft		
Average Speed:			

	Distance	Time	Time; 10ft-5ft	Calculated Speed 10ft-5ft
Trial 1	10 ft			
Trial 2	10 ft			
Trial 3	10 ft			
Average Time 10ft – 5ft:			**Average Speed 10ft – 5ft:**	

Calculate the Acceleration from 5 ft to 10 ft. Acceleration = Average Speed/Time:

Questions:

1. Your mousetrap car uses potential energy. Where is this energy stored? Be specific.

2. How did the cars designed for distance differ from those designed for speed?

Constraints

- The mouse trap car may only contain 3D printed parts (not including mousetrap, extender, string, rubber bands and wooden axels)
- The body of the mouse trap car will have overall dimensions of 19cm x 6cm x .635cm
- The front wheels of the car will have a diameter of 3.8cm and a thickness of .635cm
- The back wheels of the car will have a diameter of 8.89cm and a thickness of .635cm
- Both the body and wheels of the mouse trap car must have a 0.3175 cm hole for the axel