**SPH3U0-Winter 2019 Kinematics Project: Mousetrap Car**

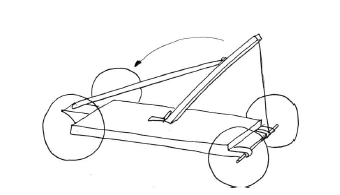
Partners Names:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Testing Date:\_\_\_\_\_\_\_\_\_\_\_\_ Report Due:\_\_\_\_\_\_\_\_\_

**Overall Learning Goal:** *To design and build a model car powered by the elastic energy of a standard mousetrap spring. Once you have optimized your design, you will record the motion of the car and analyze the motion characteristics of the car.*

*The design and construction is a team effort, but each member will prepare their* ***OWN written report!***

**Objective:**

1. **To build a mousetrap car that will travel a minimum distance of 3.0 metres with a target distance of 5.0 metres.**
2. **To build an efficient car that can achieve a top speed over the 3.0 metre distance.**
3. **To describe and analyze your car’s motion based on its acceleration characteristics.**

**Background**: You will build an originally designed vehicle powered solely by the energy of one standard-sized mousetrap.

One way to power your car is to tie a string to one end of a lever attached to the mousetrap spring and the other end of the string to one axle of the car. The string is wound around the axle and when the mousetrap spring is released, the motion of the level pulls the string and turns the axle.

**Parts Provided to each group**: 1 mousetrap

1 wooden block (for the car body) if desired

4 eyelet screws (for axle supports)

2 wooden dowels for axles

Choice of 4 wheel options (large/small/CD disc inserts)

Parts that each group must provide: string, lever options, glue, straws for axle casings, CD’s for wheels etc.

**Car requirements:**

• No other power source may be used other than the standard mousetrap.

• The mousetrap spring may not be modified or bent but you may cut, bend or add a lever arm to the U-shaped “snapper” piece.

•The car must be powered solely by the mousetrap- no push start allowed.

• Cars will be tested with the front wheels placed on the start line. The displacement will be measured to the final resting point of the front wheels.

**Mousetrap Car Testing and Analysis**

**Part I: Initial Acceleration**

1. Place the motion sensor on the ground and point it at your car. Place the motion sensor switch to the “cart” setting.
2. Record the motion of your car over a 1.0-1.5 m distance using the motion sensor. Make sure the car is started from rest and that the motion sensor records the motion from the starting position.
3. Use the motion sensor “linear fit” analysis function to find the slope of the velocity-time graph during the acceleration phase to find the acceleration rate of the car.
4. Repeat your recording TWO more times to find 3 independent acceleration values. Calculate the average acceleration of your mousetrap car.
5. Screenshot and store the best trial for inclusion in your report.

**Part 2: Overall Motion Characteristics:**

1. Using a tape measure and stopwatch, record the total displacement of your car and the total time taken to determine the average velocity over that trial. Organize your observations in chart form.
2. Repeat this analysis TWO more times and find the OVERALL average velocity of the car for all three trials.
3. Record a video of the car’s overall motion.
4. Perform a detailed analysis of the car’s motion from the video.
5. Note the motion characteristics of your car from the video. Things to include in your analysis:

-direction (straight path or curved?)

-nature of the velocity (how does the velocity change over the full path?)

-nature of the acceleration (does it speed up initially and then move at a constant velocity or is there continuous acceleration over the full path?.

**Mouse Trap Car Performance Competition:**

1. Each car entered in the race must be able to travel a minimum distance of 3.0 metres.
2. The top two fastest cars of each heat will be entered into a class final race.
3. Points will be awarded based on the car’s speed performance.
4. Points will also be awarded based on the car’s distance performance.

**Mouse Trap Car Report**

**Prepare a final report sharing the design, building, testing and analysis phases of your car project.**

**The report should have the following headings and components.**

**Design: [ 5 marks]**

**•** Purpose

**•** Materials List

**•** Design Diagram: (An accurate, labelled diagram showing top/side and/or 3D view of the

car drawn with ruler or computer drawing program)

**•** Description of Design Features

**Building and Optimization: [ 5 marks]**

**•** Describe the construction phase and challenges overcome.

**Observations and Testing Results: [10 marks]**

**\**All results and observations should be INTRODUCED AND EXPLAINED!***

**•** Screen shot of ONE acceleration Trial

* Video of one motion trial

• Table for Acceleration Data with average acceleration calculation

• Table Displacement and Time Data for Velocity Analysis

**•** Qualitative video observations and discussion of overall motion characteristics

• Results of competitive testing

**Discussion of Results: [5 marks]**

• Discuss your car performance based on your acceleration, average velocity and motion

characteristics.

• Explain how the car performed against other cars.

• Suggest factors that limited your car performance and ways that the car performance

could be improved.

**Mark Scheme: Total Marks: Application: \_\_\_\_\_\_/25 Communication:\_\_\_\_\_\_/25**

• Car Construction and Design **Level: \_\_\_\_\_\_\_ \_\_\_\_\_/20 marks (Application**)

*A working car with sturdy construction and an efficient design has been produced.*

• Car Competitive Performance **Level:\_\_\_\_\_\_\_**  **\_\_\_\_\_/5 marks (Application)**

• Design and Testing Report **Level:\_\_\_\_\_\_\_\_** **\_\_\_\_\_/25 marks (Communication)**

*Each group will submit ONE video of their car’s motion recorded on the test day.*

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**Testing Results: [10 marks]**

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* Video of one motion trial

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• Table of values for velocity analysis & average velocity value calculated

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