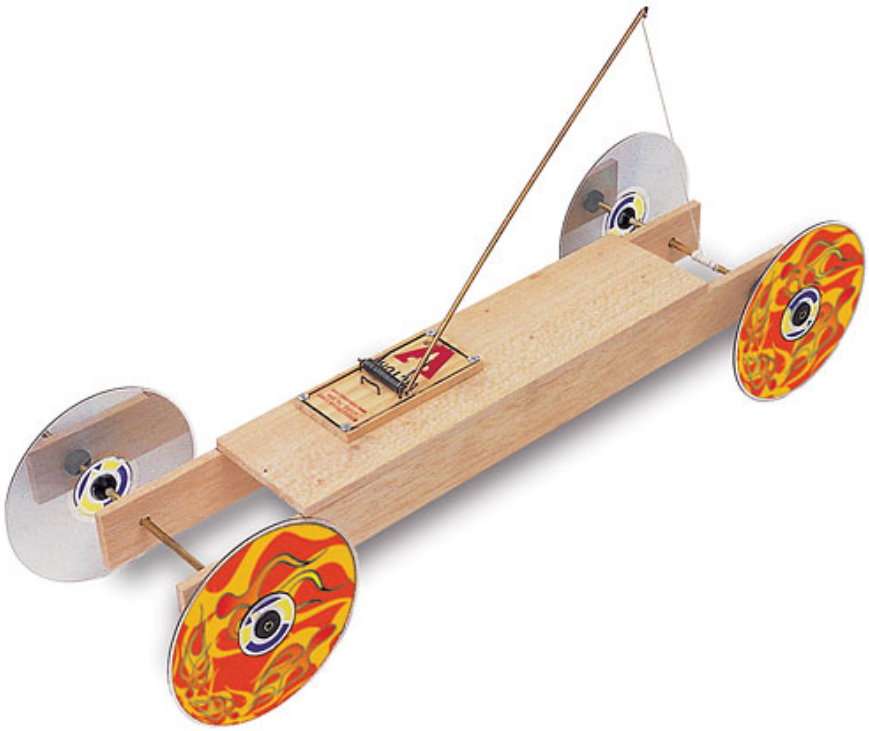
Trap Motion Vehicles



Design Brief

Each Student will create a mousetrap car for SPEED (15 Foot Race) OR DISTANCE, using one standard 5 x 10 cm mousetrap, the exact same mousetrap that is supplied to the entire class. The trap must remain intact; the spring cannot be modified or moved from the base of the mouse trap. Screws and nails, zip ties for example - can be used to attach the mousetrap to the car chassis, but wood cannot be cut or removed from the base. No launching ramps are allowed; all parts of the vehicle must move forward as a whole. The only energy source allowed at the start of the race is that which is stored in the mousetrap spring. You may not hold the vehicle during release or push the vehicle. If a student builds a successful (basic) mousetrap car, he/she may construct one using multiple traps or modifying them to increase speed or distance.

Together As A Class

UNDERLINE KEY POINTS IN THE DESIGN BRIEF

Day 1

A basic mousetrap car is powered by attaching a string to the "snap" lever on the trap, looping the other end to a small hook on the axle, winding the string around the axle of the car pulling back on the lever and arming it. After your teacher plays the video How To Make A Mousetrap Car answer the following questions.

1. **Where is the mousetrap located on the car front or back?_____**
2. **Why is there an arm (dowel rod) attached to the mouse trap?**

   _____
3. **What do you do with the string attached to the arm?**

   _____
4. **Once the mousetrap is released and the car starts rolling is the string attached to the axel still - YES OR NO**
   a. **Explain why or why not_____**

Explain the role of each part of the car

Mouse Traps _____

Drinking Straws _____

Washers _____

String _____

Cds _____

Dowel Rods _____

Cable Ties _____

A 4" x 8" Piece of cardboard or foam board_____

Exit Ticket - What part is the most challenging and why?

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Day 2

(Individual) Step 1. Identify the Problem, Opportunity, or Goal: Briefly explain the problem you are going to try to solve?

(Individual) Step 2: List Criteria and Constraints for the solution

Criteria (the requirements)	Constraints (the restrictions)
1. 2. 3. 4. 5.	1. 2. 3. 4. 5.

You will be split into teams and each team will research one concept assigned to them, be prepared to share out in 10 minutes. Explain how your concept relates to this challenge. Explain why we need to learn it to be successful in this challenge?(Car chassis, Energy source, traction, power source, Axle, lever arm, tying a loop, gears, friction, & weight *)*

Notes

Exit Ticket:

What Prior Knowledge do you have about mouse trap cars, levers, or gears?

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Day 3 (Individual) Step 1

Generate 3 ideas about your project

Feel Free to express yourself by writing or drawing a picture, it is recommended that larger paper is used. ***YOUR Teacher will display some examples***, but you can do some research also, keep in mind you are only drawing the top view of your car!!!!!

Step 2 Select your Choice

Evaluate the 3 ideas you generated. It is important to select what appears to be the best idea that solves the problem. Use the decision matrix below to evaluate your 3 ideas. Rank each design based on the design factors listed below. Rank your ideas 1 being the worst and 3 being being the best

Design Factor	Idea 1	Idea 2	Idea 3
Will it achieve your goal of speed or distance?			
Can you make it out of the supplies supplied by the teacher?			
Can you construct it in 3 class periods?			
Is it designed to be a strong chassis ?			
Will it have limited friction to travel easy?			

1. CIRCLE the idea that appears to be the best based on the results (highest number)
2. Do you agree that this idea is best? Yes or No, Why or Why Not?

STOP - NEEDS TEACHERS SIGNATURE TO CONTINUE: _____1 2 3 4 Number of Checks_____

ONCE Completed The Teacher Will Let You Pick YOUR TEAMMATE

Day 4 (Team)

Step 1 - Understanding how a car works

1. **Why did the person in this video use CDs? _____**
2. **Explain in your own words how the mousetrap is propelled down the road?**

   _____

   _____

   _____
3. **How did the person use the plastic to support their frame, please explain -**

   _____

   _____

   _____
4. **Does the string come off the back axle? YES OR NO, Explain Why**

   _____

   _____
5. **What are the parts you will need?**

   a. **b.**

   C. **d.**

   E. **f.**

   G **h.**

Step 2 - Wheels and Axles

How many wheels and axles do you plan on having?_____

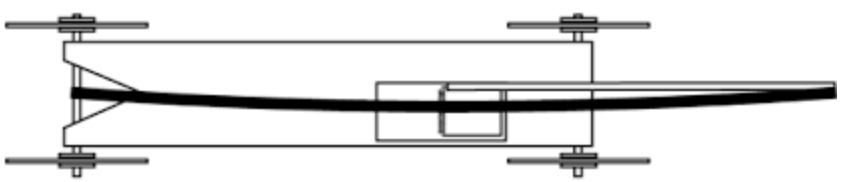
Do you plan on bringing in wheels different than the teacher is providing?_____

Why do you think it is harder to make a 3 wheel vs a 4 wheel car?

_____

Step 3 - Final Sketch - AS A TEAM

You should do the final sketch of the top view of your entire mouse trap car, you must include all the parts, here is an example below. You will use a full size paper Include measurements



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Day 5 (Team) - STRING AND THE ARM

Step 1 - AS THE INSTRUCTOR PLAYS THE VIDEO

In groups of 2, get one of the 8” pieces of string off of the desk and tie a 1” loop at the end of the string.

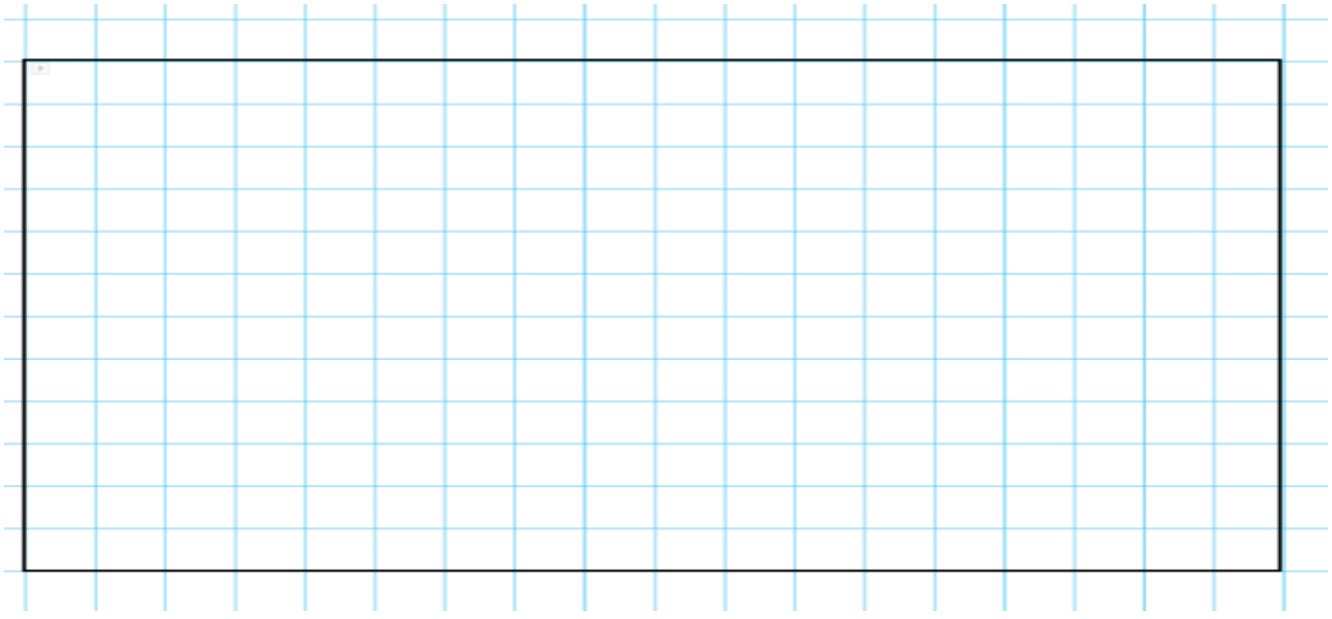
Now Take a pen or Pencil and a knot at the other end to secure the pencil to the string.

Let’s do some research. The longer the lever arm is, what happens to the mechanical advantage?

If you want speed do you want a short or long arm? Why?_____

If you want distance do you want a short or long arm? Why?_____

Exit Ticket: Deciding where to put your mouse trap and the length of your arm (Get Your TOP View Back Out)



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Day 6 (Team)

Step 1 - Tips in Construction

List 3 Key points in the design of this mousetrap car.

1.
2.
3.

What makes some of the cars unique on the video?

From this point forward, you should plan with your performance goal and design & material choices in mind. On a piece of blank or loose-leaf paper, sketch your final design. The instructor will project some different designs. ***THE MORE DETAILS BETTER - Measurements, Labels, Directions!!!!***

As a team, list your first 5 steps in the construction of your car and be sure to include the material in your description, what teammate (or both) will be responsible. Once complete you will receive the supplies for each step.

When a particular step is completed you will get the material for the next step.

1.
2.
3.
4.
5.

STOP - NEEDS TEACHERS SIGNATURE TO CONTINUE: _____ 1 2 3 4 Number of Checks_____

IF NEEDED WALK THROUGH ONE LAST TIME (UNDERLINE KEY POINTS)

Pulling String

String is often used to transfer a force from one point to another. Choosing the proper string is critical. If you use a string that cannot handle the pulling force, it will snap as you release the mouse trap. If you use a string that is too thick, it will not wind around the drive axle smoothly, causing the pulling force to be inconsistent. DO NOT USE THREAD. ***The string must not be tied to the axle.*** If the string is tied to the axle, it will begin to rewind itself and will cause your car to come to a sudden stop. In order to achieve maximum performance from your mouse-trap car, it is important that the pulling string does not slip off the drive axle prematurely. A release hook can be constructed to allow the string to remain connected to the axle during the pulling phase and then release once the pulling has stopped.

Lever Arm

The distance from the turning axis to the point of contact is called the lever arm. By adjusting the length of the mouse trap's lever arm, you can vary the force that is applied to the wheels of your car. Long lever arms decrease the pulling force while short arms increase the pulling force. The longer the length of the lever arm that you use, the more string you can wind around the drive axle. Therefore, a greater overall travel distance can occur as the string is pulled off the drive axle. Lever arms should not extend past the axle when in the lowered position. For correct lever arm length make sure the lever reaches the axle. If the lever end is L-shaped then it will center the string on the axle. When cutting the mouse trap hammer to add length to the lever arm be sure you remove the side (arm of the hammer) that does not attach to the long arm of the spring.
Eliminating all forms of friction is the key to success no matter what type of vehicle you are building. Minimizing surface friction on a mouse-trap car allows its wheels to spin with less resistance, resulting in a car that travels faster, farther and wastes less energy. The most common area where surface friction will occur is between the axle and the chassis. Look your car over with a scrutinizing eye in order to reduce the total amount of friction acting on your vehicle.

Student Reflections

1. What were the key challenges you faced in designing the product?

2. How did the criteria and constraints shape your decision-making process in selecting the final product idea?

3. What did you learn from the process of creating the product and the overall project?

4. How did your research and what you learned in class impact your design?

5. Reflecting on the entire project, what new insights did you gain about problem-solving and innovation, and how might these insights be applicable to real-world scenarios beyond the context of the movie?

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Evaluate Yourself in each category

Categories	5	6 / 7	8 / 9	10
Design Process	Little evidence of a systematic design process, lacks planning and organization	Limited evidence of a design process, some planning and organization	Demonstrates a basic design process, with clear planning and organization	Shows a thorough and well-organized design process, with clear planning and execution
Problem Solving	Struggles to identify and address problems, limited troubleshooting skills	Identifies some problems and attempts to solve them, shows some troubleshooting skills	Identifies most problems and effectively solves them, demonstrates good troubleshooting skills	Identifies all problems and solves them creatively, demonstrates excellent troubleshooting skills
Innovative Designer	Shows little creativity or innovation in design, relies heavily on existing solutions	Demonstrates some creativity and innovation in design, attempts to think outside the box	Shows creativity and innovation in design, attempts to create unique solutions	Demonstrates exceptional creativity and innovation in design, creates truly unique and groundbreaking solutions
Collaboration with Teammates	Struggles to communicate and work with teammates, limited contribution to the team	Communicates and works with teammates to some extent, makes a modest contribution to the team	Communicates and works effectively with teammates, makes a significant contribution to the team	Communicates and works exceptionally well with teammates, makes a substantial and positive contribution to the team