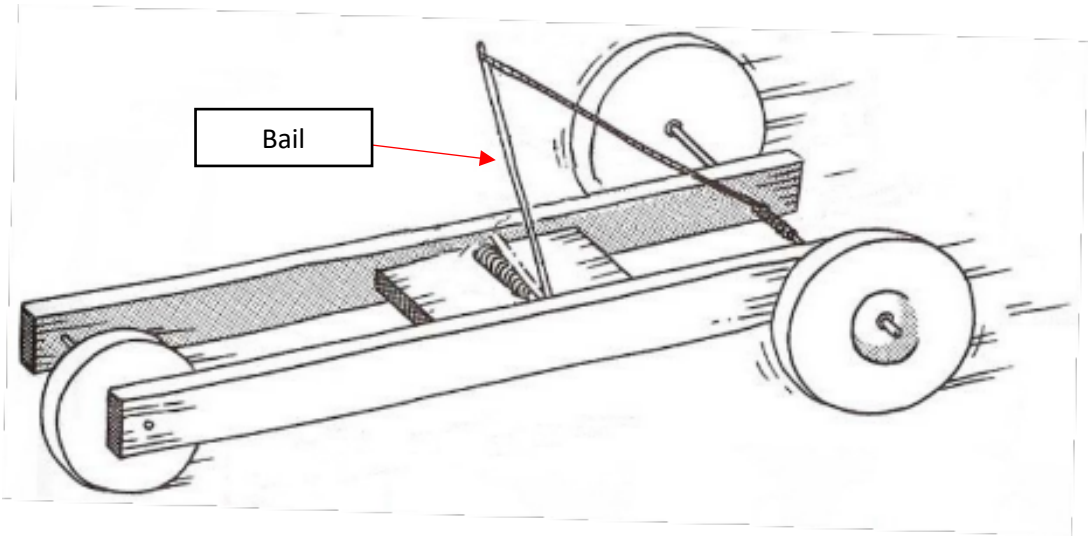
Mousetrap Car (MTC) Design Competition – All Divisions

Competition Description:

MISSION: STEM student teams will design a mousetrap car that can travel the longest distance while carrying a ping pong ball for the entire run.

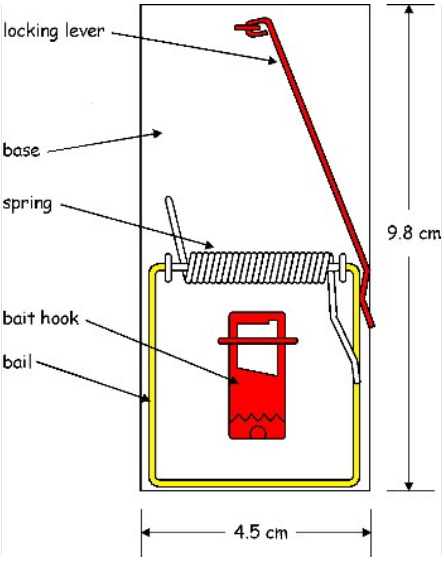
Each MISSION: STEM team is also required to create an **engineering notebook** and a **technical drawing** as part of the design process.

Teams will consist of 3 students. At least one student per team must be present on competition day to compete.



Competition Requirements:

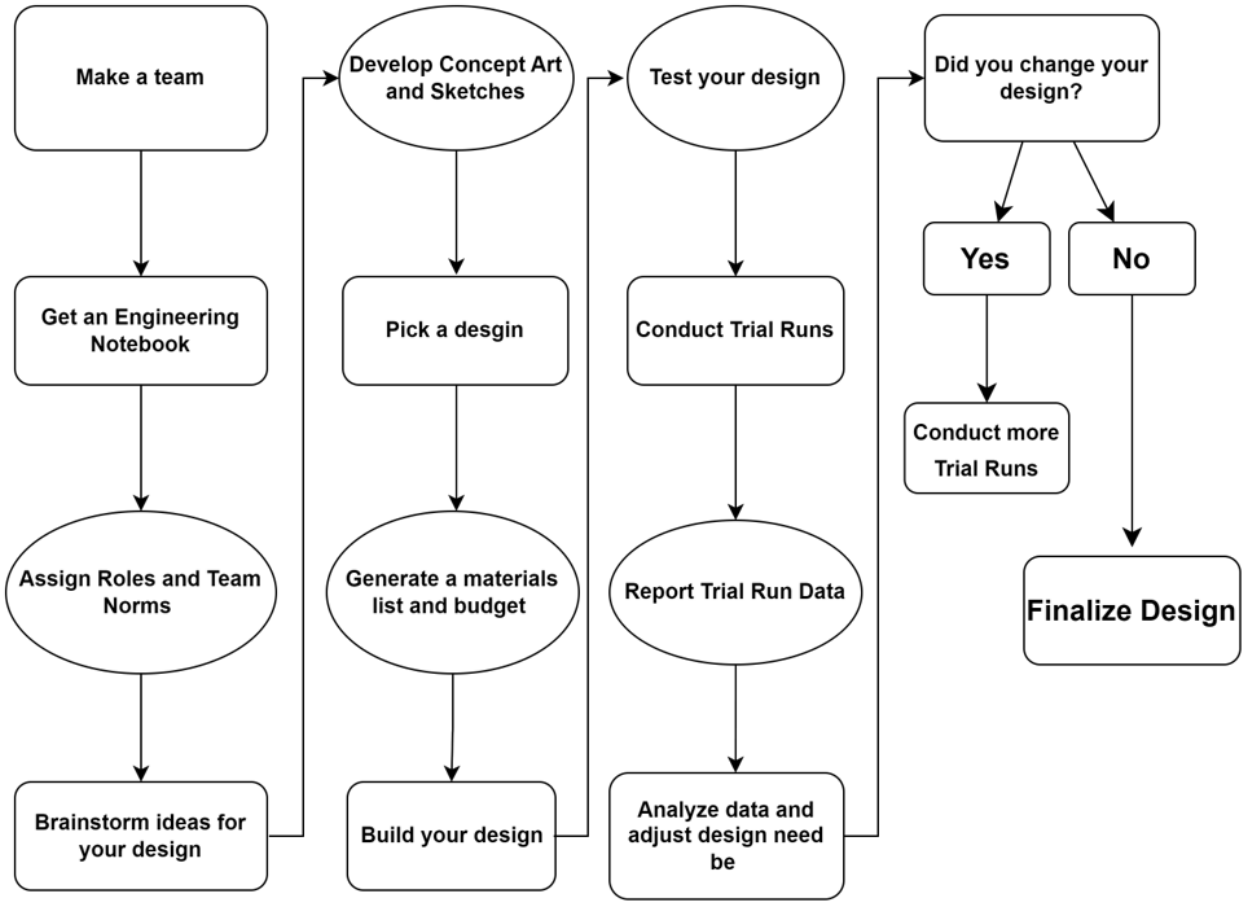
1. Materials
    - Teams **MUST** use a standard mousetrap with dimensions of 9.8 cm (3.86 in) by 4.5 cm (1.77 in) and has only ONE spring
        i. You **CAN REMOVE** the locking lever and baithook and you **CAN ALTER** the bail



    - Teams **CANNOT** use 3D-printed materials of any kind in their mousetrap cars.
    - Teams **MUST** include pictures of their materials in their engineering notebook.
    - **All DONATED** materials **MUST** list where the materials were obtained.
2. Construction
    - The spring from the mousetrap is the **ONLY** power source for your team's mousetrap car.
    - The original mousetrap spring and wood base MUST remain intact. These two components may **NOT** be cut or altered in any way.
    - Only the locking lever and bait holder (and the staples that hold them on) may be removed from the base, if desired.
    - The bail may be straightened from its original bent configuration. It must remain as a component of the completed car.
    - The mousetrap car must have a minimum of 3 wheels.
3. Design Challenge
    - The mousetrap car shall transport a ping pong ball without losing it for the entire run.
    - Teams may **NOT** use glue, tape, Velcro, or otherwise permanently affix the ping pong ball to the mousetrap car.
    - Teams may **NOT** wedge the ping pong ball between the bait hook and the spring
    - The car shall be designed to allow for the purposeful removal of the ping pong ball with minimal effort so that the judge can examine it.
4. Cost
    - The **TOTAL** cost of the mousetrap car should not exceed **$10.00.**
    - **DO NOT** include the cost of the basic mousetrap in your materials list.

- Recycled and donated materials should **NOT** be included in the total budget but **DO** show documentation of how you obtained the material.

Design Process Map:



Mousetrap Car Runs and Performance Calculation:

Mousetrap cars will be tested on a smooth flat surface. Distance will be measured from the front of the front wheel(s) at the starting point to the front of the front wheel(s) at the stopping point of travel, utilizing a straight line to connect the two points (total displacement and not the path traveled).

The ping pong ball must remain in the mousetrap vehicle for the entire run in order to receive a qualifying score. If the ping pong ball falls off during the run, that run is disqualified. In the instance that the ping pong ball is dislodged as a result of a collision with an obstacle, the run is not disqualified, as long as the distance is measured only to the point of collision (which will be measured from the front of the front wheel(s) at the starting point to the front of the front wheel(s) at the stopping point or the point of collision).

There will be two runs for each car and the run with the highest distance score will be used for the final scoring of the mousetrap car's performance.

$$\text{Distance Score} = \left(\frac{\text{team distance}}{\text{max distance}}\right) \times 100\%$$

The mousetrap car should reflect this year's efforts by your student teams. During the competition, ONLY the students on the same team can adjust (or make alterations) to their mousetrap car. If anyone other than MISSION: STEM student teammates (includes but not limited to Coordinators/Coaches, Parents, etc.) adjusts their mousetrap car, or there is evidence of this, the team will automatically be disqualified and will not be able to compete.

Engineering Notebook Requirements:

The MISSION: STEM Engineering Notebook will allow your team to document your work over the course of the year. The engineering notebook must be completed in a physical notebook (for example, a composition notebook). The requirements are listed below.

Cover Page

- Team Name
- Competition and Team's Division (E, M, H)
- Each team member's name and grade
- School Name and School District
- Name of team's MISSION: STEM Coordinator/Teacher

Table of Contents

- Include headings for:
    - Date
    - Page numbers
    - Description
    - Team members who contributed

MISSION: STEM Team Norms and Team Roles

- Each team needs to create a set of Team Norms and Team Roles that should be placed directly after the table of contents
    - Team norms are a set of rules or operating principles that shape team member's interactions
    - Create 5-10 team norms
    - Example: Treat each team member with respect
- Team Roles should be assigned based on each team member's strengths.
    - Team Lead: This team member is responsible for overseeing management of the project and its success. The team lead will make sure the team is on track to complete the project on time and under budget. They communicate with their coordinator/instructor for all questions and concerns.
    - Scribe/Data Analyst: This team member is responsible for keeping the Engineering Notebook up to date and taking any meeting notes as well as recording all data for the team's mousetrap car and trial runs. This team member is also responsible for recording the dimensions of the mousetrap car and documenting the materials list. The data analyst will use the materials list to collaborate with the team lead on the budget. This person should have clear and legible handwriting.

- Engineering Lead: This team member is responsible for maintaining the team's original mousetrap car design and creating any relevant technical drawings for the Engineering Notebook.

Brainstorm

- Include ALL ideas your team considered in the brainstorming process

Concept Art/Sketches

- Any preliminary sketches that were used in the developmental stages of your design process
- Sketch of your final mousetrap car design

Materials List and Budget

- Provide a list of materials used in your design
- Include cost of **ALL** materials **EXCEPT** recycled materials
- For recycled materials include documentation of where you obtained it
- Include a copy of receipts for **ALL** purchased materials
- Include final cost of all materials

Trial runs

- Please include documentation of each trial run and notes/observations from each of the trial runs of the mousetrap car design.
- Indicate which version of your mousetrap car design you used for each trial run. (For example, Trial Run – Design 1 – Test 1)
- Include **ALL** mousetrap car design trial runs. See below section for additional details.

Meeting Notes

- Include **ALL** meeting notes for the mousetrap car design.
- **ALWAYS** include the **DATE** and **TIME** of each meeting for mousetrap car design.

Trial Runs:

Your team will use the distance traveled to understand the performance of your mousetrap car design. Your team will be able to use this data to evaluate the effects of changes made to your mousetrap car design. New trials must be documented each time a new design change is made to the car.

When documenting your mousetrap car trial runs, record your mousetrap car's:

1. Distance traveled measured in centimeters (where forward motion is denoted as positive distance and backward motion is denoted as negative distance)
2. Include notes about the mousetrap car's performance
3. Include a hypothesis (or prediction) of what your team thinks will happen during the trial run given the new changes made by the team

Additionally, your team will need to include a statistical analysis of your mousetrap car's performance. Include the following data from your team's tests:

- Average distance traveled from trial runs.
  - $\overline{d} = \frac{d_1 + d_2 \ldots + d_n}{n}$
  - $\bar{d}$ is the average distance traveled from trial runs measured in centimeters
  - d is the distance traveled from a trial run measured in centimeters
  - n is the number of trial runs performed by the team's mousetrap car

Technical Drawing Requirements:

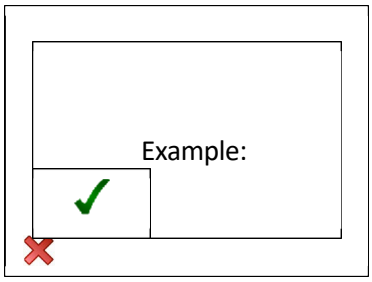
As part of the Mousetrap Car Design Competition, each team must prepare a scaled drawing depicting the vehicle they have designed and built. The requirements are listed below.

Paper Requirements

- The engineering paper is required to be 17" x 22" in size
- The engineering paper must be a plain, non-grid, 16-pound vellum sheet
- There must be a 1" border on all sides of the paper (this can be hand-drawn)

Drawing Requirements

- The drawing should cover the area inside the 1" border
- The drawing is required to show the front, side, and top views of the mousetrap car design
- Label all parts of mousetrap car design
- Label all relevant dimensions of the mousetrap car design (for example, length, width, or height)
- Label all units of mousetrap car measured in centimeters
- The technical drawings must be hand-drawn to illustrate the team's actual vehicle; ink pens, pencils, or markers may be used
- No mounting or frames allowed
- A ***legend*** is to be drawn in the bottom left corner of the drawing inside the 1" border with the following information:
  - **Competition Division (E, M, or H)**
  - **Student Team Name**
  - **Official School Name**
  - **Official School District Name**
  - **Team Members' Names and Grade Levels**
  - **School Coordinator's Name**



TECHINICAL DRAWINGS WILL BE JUDGED ON THE FOLLOWING CRITERIA:

1. Engineering paper requirement
2. Resemblance (between the final version of the vehicle and the technical drawing)
3. All views of the vehicle are present (front, side, and top)
4. Naming/labeling of all parts of the vehicle
5. Appearance/neatness

Submission Requirements and Scoring:

An overall winner will be judged upon the following criteria (based on 100 points):

1. Longest Distance Traveled – 50%
2. Engineering Notebook – 30%
   - The notebook will be evaluated by judges at the competition. You must bring your physical notebook to receive a score.
3. Technical Drawing – 20%
   - The drawing will be evaluated by judges at the competition. You must bring your drawing to receive a score.