Robogals Science Challenge

Minor Challenge Set #4
STEM Field: Mechanical Engineering
Level: Intermediate / Senior
Challenge Name: Build a Mousetrap Car
Project Cost: 0-20 USD
Materials Required:

- 2 pieces of heavy cardboard of size 4x10inches (10x25cm)
- 4 DVD's or CD's. Alternatively, you can use 4 jar lids of the same size or VERY carefully cut 4 perfect circles of the same size out of cardboard.
- 4 - 1/4L (19/32") Beveled faucet washers: You can find these washers at most hardware stores in the plumbing department.
- 2 dowels with a diameter of about 3/16inches (or 0.5cm) that are 6 inches (15cm) long (you can cut take out chopsticks to this length)
- 1 dowel with a diameter of about ¼ inch (0.6cm) dowel that is 10 inches (25cm) long (about the size of a take out chopstick which would work well)
- 2 drinking straws
- Masking or duct tape
- Zip ties: An assortment of 10cm (or 4") will work
- String
- Hot glue
- Scissors
- Ruler

Safety:

- Adult supervision is recommended when cutting chopsticks and handling the mousetrap

Duration:

- This challenge will take approximately an afternoon to finish, however, the time guideline is an estimation only, and students and mentors can complete the tasks around their schedules

Introduction:

A mousetrap car is a toy car you will build yourself that is powered only by the spring force of a mousetrap to achieve as much forward motion as possible. This means that we will want to create a method to transfer the energy of the mousetrap snapping shut to turn the wheels of your car.

What should we also consider when building the mousetrap car? First, all the components must weigh as little as possible, while being strong enough to power the car. Second, the wheels must be rigid, and not slip when the car is accelerating. As you build the mousetrap car, you may find other variables to consider.

In this project, we will attach one end of a string to the mousetrap, then wrap the other end around the axle wheels. When the mousetrap snaps shut, the string will be pulled, then turning the wheels. This is shown in figure 1.

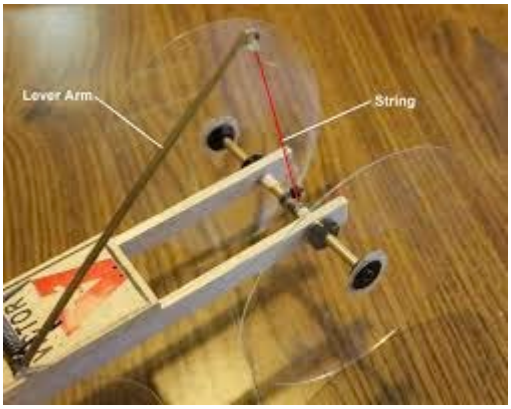

Figure 1: When the string is pulled, the mousetrap snaps shut and turns the wheels

Instructions:

1) Cut a rectangle that is about 1x2 inches (2.5x5cm) on a short side of both pieces of cardboard so that they overlap. Then tape them together so you have one thick piece of cardboard.

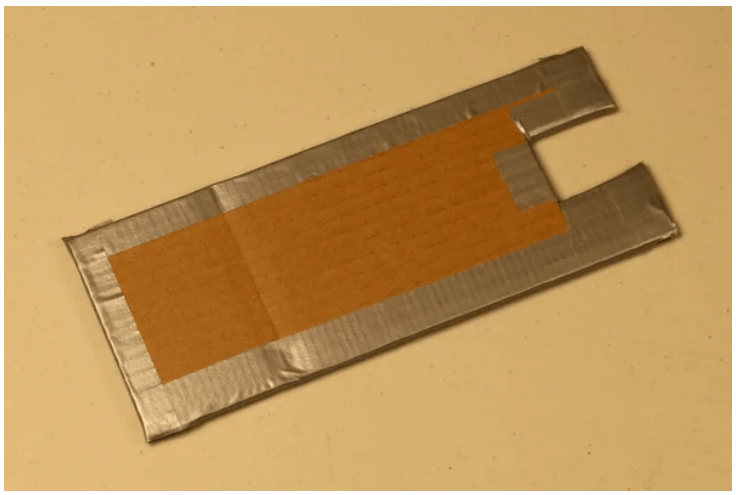

Figure 2: The body of the car

2) Measure the length of cardboard on each side of the rectangle you cut out and cut one straw so you have two pieces which match these lengths.

3) Measure the width of the rectangle on the side opposite to where you cut out your rectangle and cut your other straw to match this length.

4) Hot glue these pieces of straws in place. These will hold your wheel axles.

5) Get your mouse trap and remove the small pieces that make up the release trigger.

6) Using 2 or 3 zip ties, secure the 1/4inch (0.6cm) dowel (or chopstick) to the snap arm (the metal bar that swings shut on the trap).

7) Using another zip tie, attach your string to the other end of the dowel you just attached to the mousetrap.

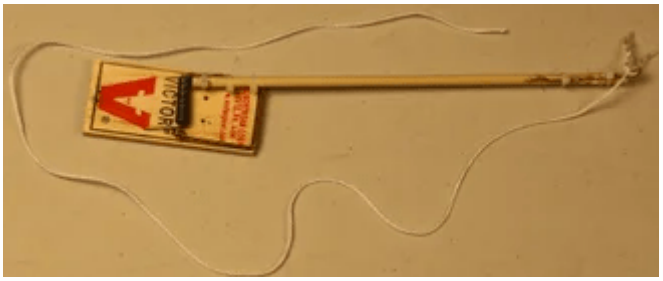

Figure 3: The mousetrap with the dowel and string attached

8) Now to get our wheels ready! If you are using CDs place tape over the holes in the centre as shown in figure 4.

Figure 4: An example of a wheel for your car

9) Slide the 3/16” (0.5cm) dowels through the straws you glued onto your cardboard in step 4.

10) Attach one wheel to each of the 4 ends of the dowels by creating small holes in the centre of each wheel. Use hot glue to prevent the wheels from sliding off the dowels. Your car should look something like that in figure 5.

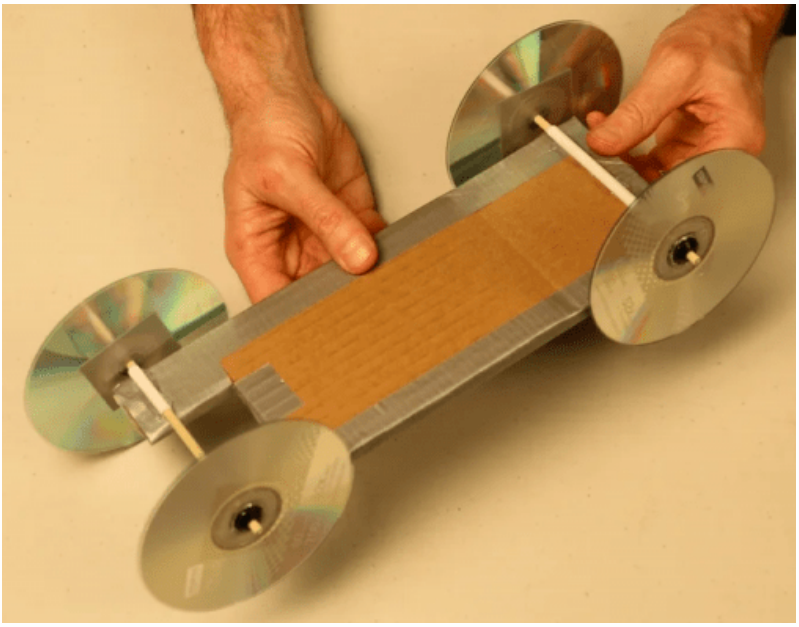

Figure 5: The underside of a car with the wheels and axles attached

11) Once you have attached all four wheels, do a test run and see if your mousetrap car rolls straight. If it doesn't, you may need to straighten your straws.

12) Attach a zip tie to the centre of the axle that is peaking through the rectangle you cut out and cut the excess down to about 1/4inch (0.6cm). Use a dot of hot glue to keep it in place.

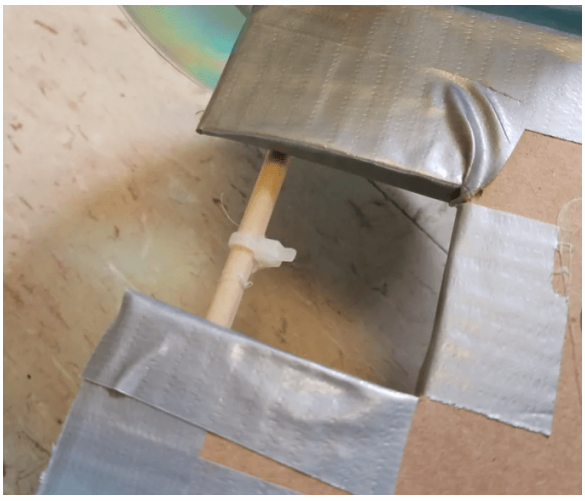

Figure 6: The rear axle with the zip tie attached

13) Now gently hot glue your mousetrap to the top of your car so the dowel is pointing towards the rectangular opening in the cardboard.

14) Trim your string and tie a loop in it such that the loop just reaches the hook you made out of a zip tie on the axel.

15) Attach the loop in the string to the hook and roll the car backwards so that the string wraps around that axel pulling the mousetrap arm back.

16) Let go of your car and watch it go!

17) Measure how far your car travelled. Measure the time the car took to travel that distance.

Extension

Let's discuss how to optimise the mousetrap car design. To optimise the car, you can analyse the performance of each part and determine what can be improved. Here are some suggestions on the parts that can be improved:

- Spring location
- Wheel diameter
- Material and mass of the car
- Axle diameter

Choose a part and make improvements on that part. Then test your car again to see if the change has improved the performance of the car.

Reflection Questions:

- Are there any improvements you would make to this challenge?
- What real world application/s can you apply this challenge to?
- What are the key science and engineering concepts that relate to this challenge?

- How far did your car travel? From the time and distance measurement, can you estimate the velocity the car was travelling at?
- How do you think bigger wheels would change this experiment?
- Do you think it would matter if the wheels were larger at the front or if they were larger at the back?

Submission Guidelines:

- Submit a photo of the mousetrap car. Include a short summary that addresses the reflection questions.

> Note: Remember, if you want to upload pictures of your Minor Challenge that also include you, please check if it is OK with your parent or guardian first.

- The submission form is on the Minor Challenges page: https://sciencechallenge.org.au/index.php/minor_-challenges/ Fill out the details and make sure you upload your submission.

Learn More! Resources:

- If you enjoyed this challenge, you may like to read more on what automotive engineers and mechanical engineers work on:

  Automotive engineers:
  https://careerdiscovery.sciencebuddies.org/science-engineering-careers/engineering/automotive-engineer
  Mechanical engineers:
  https://careerdiscovery.sciencebuddies.org/science-engineering-careers/engineering/mechanical-engineer

Bibliography:

- Anderson, J., 2020. *Engineering at Home: Build a Mousetrap Car*. [online] Engineered Mechanical Systems. Available at: <https://www.engineeredmechanicalsystems.com/build -a-mousetrap-car/> [Accessed 10 April 2022].
- Real-world-physics-problems.com. n.d. [online] Available at: <https://www.real -world-physics-problems.com/mousetrap -car-physics.html> [Accessed 10 April 2022].
- Franklin, D., n.d. [online] Mr. Franklin's Science Lab. Available at: <http://franklinscience.weebly.com/uploads/1/3/6/4/13649887/whiteboxlearning_-_mousetrap_cars_-_background_research.pdf> [Accessed 10 April 2022].