The Amazing Floating Train: How Much Weight Can A Maglev Train Hold?

https://www.sciencebuddies.org/science-fair-projects/project-ideas/Phys_p093/physics/maglev-train-weight (http://www.sciencebuddies.org/science-fair-projects/project-ideas/Phys_p093/physics/maglev-train-weight)

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Experimental Procedure

Building Your Train

This video and the following written instructions will show you how to assemble your train. **Attention to detail and patience are needed for this project. After building, you will need to make adjustments to get it working perfectly. The train floats above the tracks well once everything is lined up carefully.** See the FAQ (#help) if you have trouble getting your train to work.

Assembly instructions for your maglev train.
https://www.youtube.com/watch?v=KQH2UhHss6c (https://www.youtube.com/watch?v=KQH2UhHss6c)

1. Peel the paper backing off the two short magnetic strips and attach them to one side of the wooden block, as shown in Figure 2. The edges of the strips should line up with the edges of the block. This block will be your train car. Note: if the magnetic strips are not sticky enough to stick to the wood on their own, use clear double-sided tape.

Figure 2. Magnetic strips attached to the wooden block.

2. Cut one of the long sides off your cardboard box. This will serve as the base for your train track.
3. Using one of the long plastic angle pieces as a straightedge, draw five lines lengthwise on the piece of cardboard as shown in Figure 3.
    a. Draw a center line down the middle of the cardboard.
    b. Draw one line 5 mm to each side of the centerline.
    c. Draw one line 20 mm to each side of the centerline.

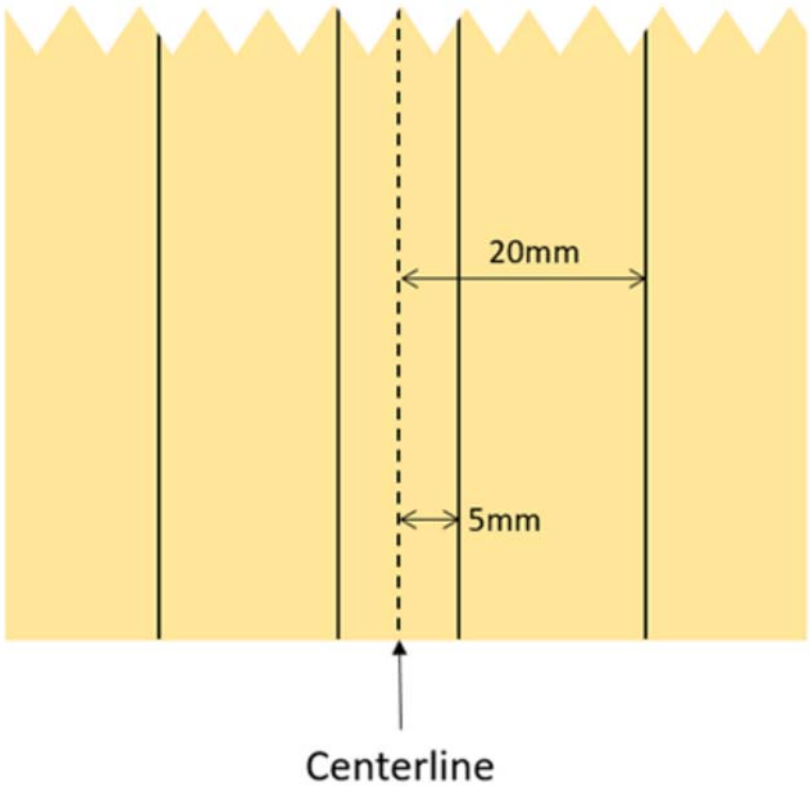

Figure 3. Dimensions for lines you will draw on your piece of cardboard.

4. Attach the long magnetic strips and plastic angle pieces to your cardboard, as shown in Figures 4 and 5. Pay close attention to the spacing, it is important for getting your train to work properly.
    a. Peel the paper backing off the long magnetic strips. Carefully place them on the cardboard so their *inside* edges line up with the lines 5 mm from your centerline, so the strips are 10 mm apart. Note: if the magnetic strips are not sticky enough to stick to the cardboard on their own, use clear double-sided tape. Make sure you press down firmly so they stick in place.
    b. Use double-sided tape to attach the plastic angle pieces to the cardboard so their *inside* edges line up with the lines 20 mm from your centerline, so they are 40 mm apart.

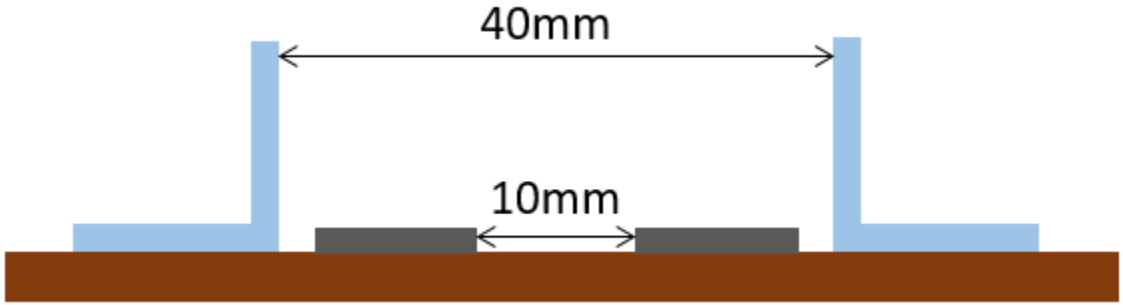

Figure 4. Cross-sectional view of the spacing for the magnet strips and plastic angle pieces.

Figure 5. Picture of a completed track.

5. Place your train on the track with the magnetic strips facing down. It should hover parallel to the tracks as shown in Figure 6, and you should be able to slide it back and forth without getting stuck. If your train does not hover as shown in Figure 6, see the FAQ (#help) for troubleshooting information.

Figure 6. Train hovering parallel to the tracks.

Collecting Your Data

1. Create a data table in your lab notebook, like Table 1.
    a. *Note*: Most kitchen scales display results in units of ounces or grams. In the metric system, scientists use **grams (g)**, which are technically a unit of **mass**, not weight. Make sure you refer to "mass" and measure in grams when you do a science project. It is incorrect to say "weight in grams."

Mass (g)	Distance (mm)

Table 1. An example data table.

2. Use a ruler to measure the distance between the train and the track (between the *top* of the magnet strips on the track and the *bottom* of the magnet strips on

the train), as shown in Figure 7. Record this value in your data table and write "0" in the mass column, since you have not added any weight to the train yet.

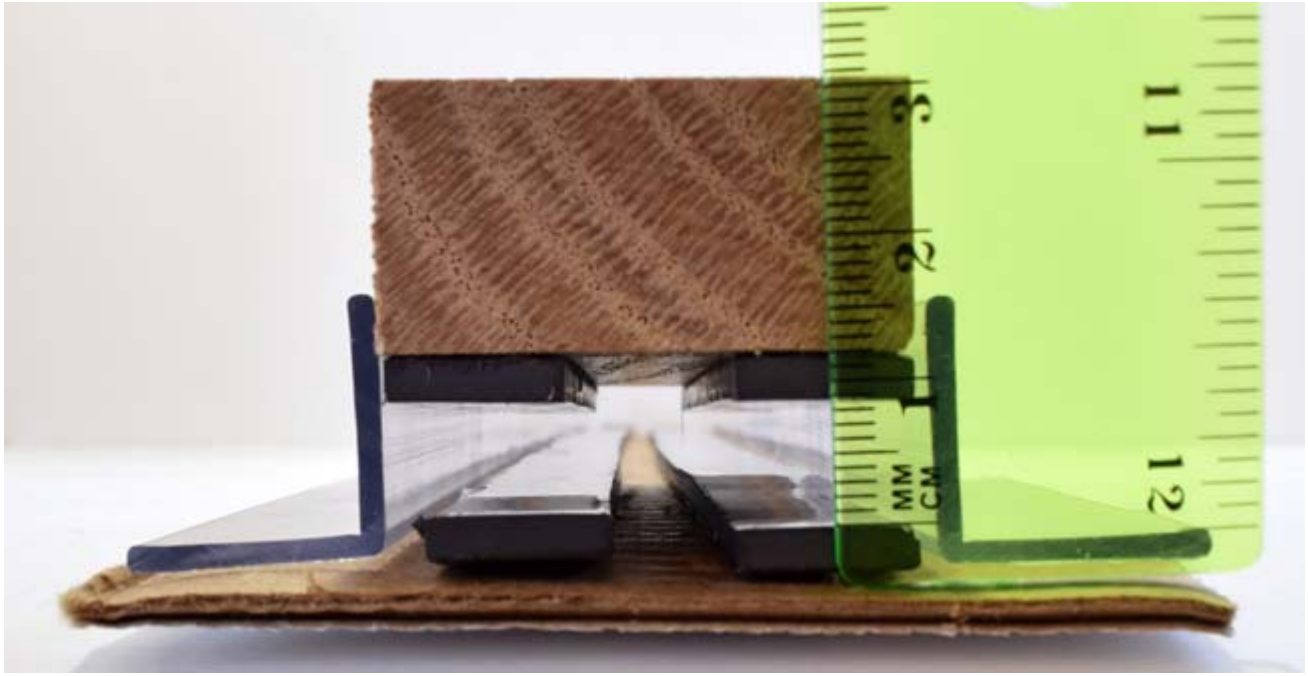

Figure 7. Use a ruler to measure the distance between the train and the track.

3. Now, place a paper or plastic cup on top of the train and add some coins to it, as shown in Figure 8. Make sure the cup is centered on the train so it remains parallel to the tracks and does not tilt, as shown in Figure 9.

Figure 8. Train with weights added on top.

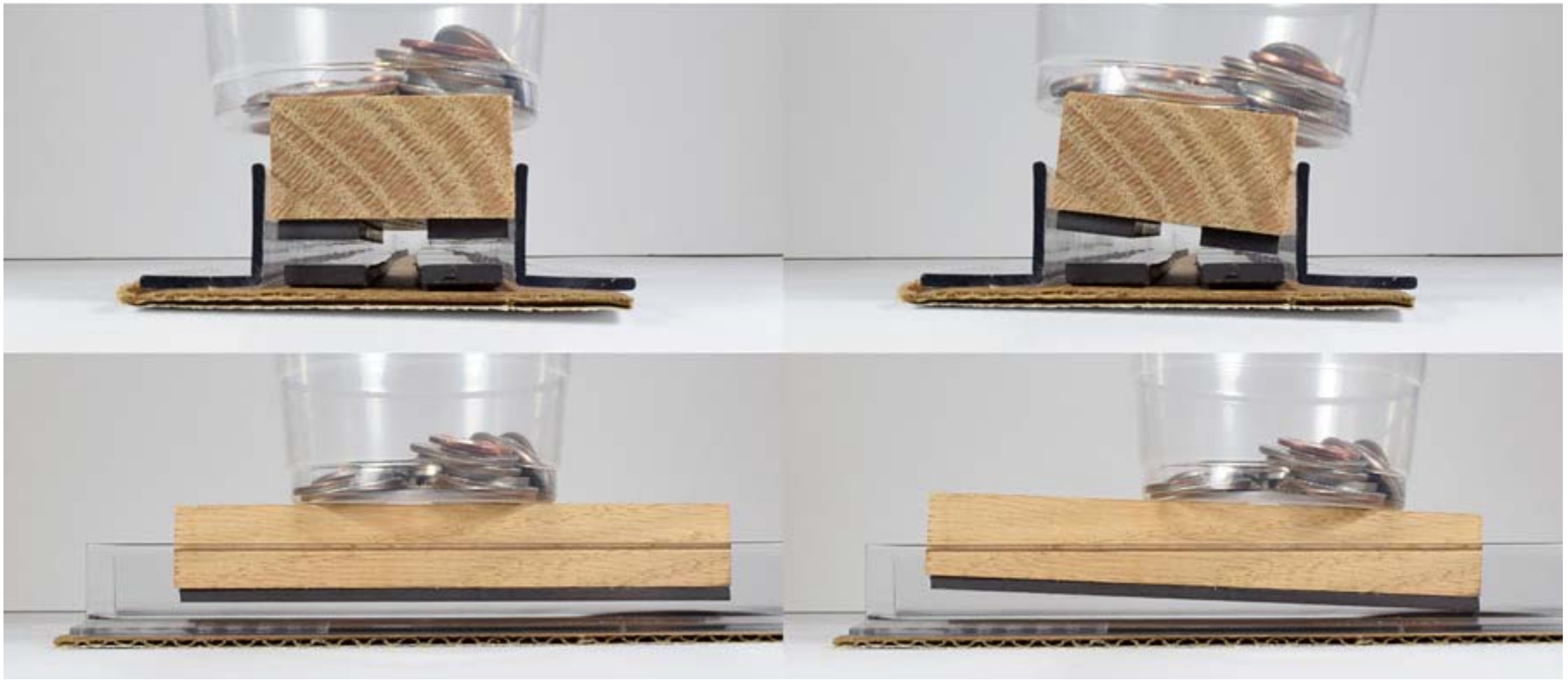

Figure 9. Check the train from both the front and the side to make sure it is still floating parallel to the track, as shown in the left two images. If the train is tilted, like in either of the right two images, then shift the location of the cup to balance the train.

4. Measure the new distance between the train and the tracks. Record this distance in your data table.
5. Use a kitchen scale to measure the mass of the coins, including the cup. Record this mass next to the new distance in your data table.
6. Add more coins to the cup. Repeat steps 3–5 until the train touches the tracks (the distances is zero). Remember to measure and record the distance each time you add coins.
7. Repeat the entire experiment two more times, for a total of three trials. For each trial, make a new data table, empty the cup, and start over again with no weight added to the train.
8. Make a scatterplot of your data, with added mass on the horizontal (x) axis and distance on the vertical (y) axis.
9. Analyze your results.
    a. How does the distance between the train and the tracks change as you add weight to the train?
    b. How do your results compare to your prediction?
    c. How can you connect your results to real-world maglev trains? For example, would there be a limit to how many passengers a real-world train can carry?

Frequently Asked Questions (FAQ)

FAQ for this Project Idea available online at https://www.sciencebuddies.org/science-fair-projects/project-ideas/Phys_p093/physics/maglev-train-weight#help (http://www.sciencebuddies.org/science-fair-projects/project-ideas/Phys_p093/physics/maglev-train-weight#help).