

Simple Magnetic Levitation (Maglev) Train

- William Beaty

A truly levitated maglev train is a very complex device. Permanent magnets alone cannot suspend a train car; you also need coils, amplifiers, and negative feedback.

However, there is a way to make a simple permanent-magnet maglev train. Instead of using coils and electronics, you can just put guide rails on the sides of the track. The guide rails will lightly touch your train and keep it centered.

Because real science involves striking out into the unknown, I'm not going to give detailed plans here, just enough info to get you started.

Materials

- small square ceramic magnets* (32 per foot of train track) for the lifter-rails, *PLUS* 4 for the "car"
- permanent marker
- duct tape (optional)
- cardboard or wood for base (no iron or steel)
- wood for guide rails
- cardboard for "car"

*Radio Shack stores in the US sell 1" x 3/4" ceramic magnets (with a hole in the center) which work well.

Procedure

Mark Your Magnets

Mark one pole on all of your magnets so you later can lay them down with the same pole facing upwards:

- Stick your magnets all together in one long stack.
- Use the marker to make an "X" on the flat face of one end of the stack.
- Pull the marked magnet off the stack, make an "X" on the next one, etc., until you're out of magnets.
- Be sure to mark every magnet on the same side (pole).

Build a "Test Bed"

Before building a long track (if you're planning to do so), make a "test bed" about 1 foot long:

- Use a 1-foot piece of cardboard or wood for the base.
- Cut two 1-foot strips of duct tape.
- Stick 16 magnets to each duct-tape strip. **Note:** Position each magnet carefully on the tape so the row is very straight.
- Flip one strip over onto the base and rub the tape down to hold the magnets underneath. **Note:** Be sure to leave enough space on the outer side of each row for the guide rails (to be added after making the "car").
- Flip the second strip over and position it parallel to the first row, with about 5cm of space in between.

Note: Make sure the magnet rows are perfectly parallel. It might help to measure with a ruler and draw lines on the base before positioning the rows.

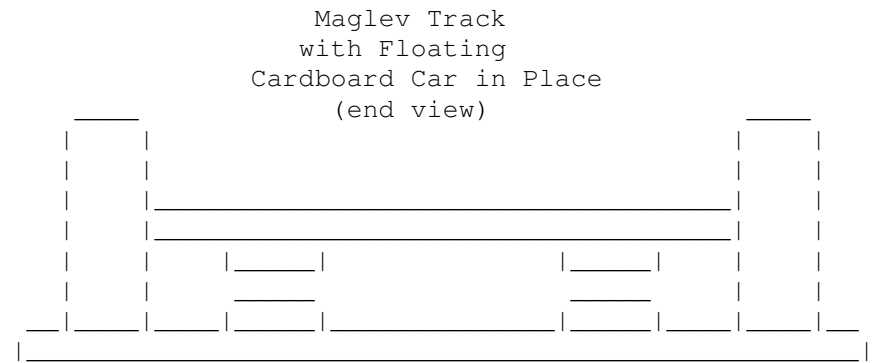
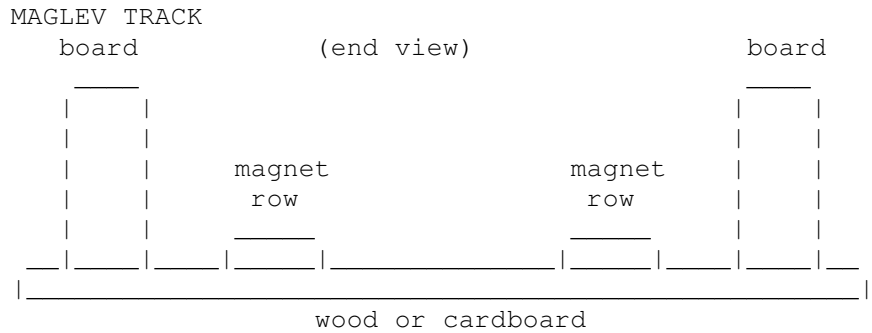
Make the "Car"

- Cut out a piece of cardboard about 9cm x 15cm.
- Determine which side of each of the four remaining magnets repels from the magnets in the tracks, and mark it with an "X" using the permanent marker.
- Tape a magnet to each corner of the cardboard car, with the "X" facing away from the car.
- Position the magnets on the cardboard car so they line up exactly with the magnets on the track.

Add the Guide Rails

Place the cardboard car on your magnet track, and you'll find that it twists or flips over and falls, and does not hover. But if you gently hold it by its sides, you can keep it floating in position. Guide rails will keep it in position without you holding it:

- Secure a 1-foot-long board to each side of your track.
- Position the boards so that the sides of the car touch them (keeping the car from slipping sideways), but not so close that the boards stop the car from slipping down the track.



Running Your Maglev Train

How can you drive your train forward? There are only two ways to move a hovering object:

- One way is to grab something on the ground and pull or push forwards (this includes tilting the rail to become a ramp, using gravity to pull the car forward).
- The other way is to force something out the back, which drives the car forward. Could you use the car to launch marbles rolling down a tiny ramp? Use a propeller? Squirt water? Get creative!

Optional Ways to Expand Your Maglev Project

- Once you get the Test Bed working, you can build a much longer track if you wish.
- Try building a better car (for instance, one that looks like a train). **Note:** You'll have to find very lightweight construction materials.
- Think of ways to reduce the car's friction with the guide rails:
 - Sand the wood smooth and paint it with something hard and shiny
 - Try using aluminum angle strips for the guide rails instead of wood.

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