

# Maglev Instructions

## General

This is a proof of concept exercise. You will build a small, not very pretty version of a moving part to use in your city model. This is called a Proof of Concept or POC. It gives you experience in working with the materials. You also have parts to make a larger version. For the maglev you will have enough magnets to build a very long maglev or several shorter ones. Cardboard and wood were used because they were available and were otherwise going to be thrown away or put in recycle. Some ideas for other materials

### WARNING

The magnets are brittle. They may break if dropped or allowed to slam together. They will leave metal dust on your hands. Wash your hands after the work shop so you do not ingest any of the dust.

A stack of magnets has a very strong magnetic field, it will pull metal objects from across the table, especially other magnets. Pay attention to where you place magnets and metal objects around them, like scissors.

All of the parts and supplies you need are in your team's brown bag or on the table. Leave scissors and tape on the table when you leave the room. Review the Parts List and Receipt before starting the exercise.

The magnets all have dimples on the N side of the magnet. Being aware of polarity is required to make the maglev work.

Take the parts out of the bag and arrange them neatly on the table. You will only need 19 magnets for the POC. Separate 19 magnets and put the rest back in the bag to use for a large maglev in your model city. The magnets have a dimple on the N pole side. For the Maglev to work all of the magnets need to be oriented correctly. Fasten the S pole to the wood for both pieces. That is the flat side with new dimple is facing up while your are doing the assembly. If you accidentally place a magnet incorrectly, you can pry it off and reset. Ask for help if needed, the engineer in the room will have additional tools to make removal easier.

## 1. Assemble Maglev Train

### 1.1. Parts needed

1.1.1. 7/8"x3.5"x0.5" Plywood

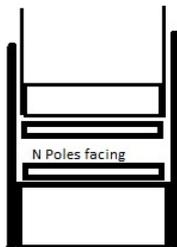
1.1.2. 2 pieces of 3.5"x1" thin cardboard

1.1.3. 4 Magnets

1.1.4. In addition, you will have to use some of the double-sided tape and the scissors on the table.

1.2. Using double sided tape, fasten the magnets to the 7/8" x 3.5" piece of wood. Take care to get the magnets exactly centered.

1.3. Cut a 3.5" of just



3.5" length of double sided tape. Then cut it in half lengthwise. Use it to fasten a x 1" one piece of think cardboard to the side of the wood piece. Use the other piece of tape and think cardboard on the other side. If you did not get a clean lengthwise cut, cut another piece of tape.

## 2. Build the Maglev Tracks

### 2.1. Parts needed

2.1.1.. 1"x 0.75" x 13.25" Wood piece

2.1.2. 2 pieces of 13.25" x 2.5" Cardboard

2.1.3. 15 magnets

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- 2.2. Using double sided tape, fasten 15 magnets to the 7/8" x 13.25" piece of wood. Take care to get the magnets exactly centered and the N pole facing upward on all of them.
- 2.3. Using double sided tape fasten a piece of the 13.25" x 2.5" to each side of the wood. See the diagram above

### 3. Test maglev

- 3.1. Slide the maglev Train into the channel of the Maglev tracks. It should float and barely touch the side pieces of cardboard. Lightly tap one end of the train, it should float to the other end. Send it back
- 3.2. Trouble shooting.
  - 3.2.1. Train Drags on the side pieces of the track  
Lightly press on the side pieces of the track to push them wider.  
Test the train again.  
Repeat until it floats freely.
  - 3.2.2. Train flips over  
This happens when the magnets push the train above where the sides keep it aligned.  
Check your build against the diagram are all of the side pieces on the track and train aligned correctly?
  - 3.2.3. Train is pulled down to the tracks  
One or more of the magnets have the wrong polarity. You should see the dimples on all of the magnets. If you don't then the magnet was placed upside down. Pry it off and reset it correctly.

### 4. Things to experiment with and modify

- 4.1. The width of the track bed and space between the walls will depend on the actual width of the train that you build. You will have to make some adjustments due to materials used.
- 4.2. The height of the side walls on both the track and train.
- 4.3. Spacing of magnets on the track and train
5. Make the model better
  - 5.1. Use clear plexiglass for one or both of the track sidewalls so the float will be visible
  - 5.2. Use creative shape, color and design for the train
  - 5.3. An electromagnet placed at just the right location at the end of the track can be used to get the train going without touching it.

### Parts List and Receipt for Parts

Source for magnets [www.amazon.com/gp/product/B01MU5GO36/](http://www.amazon.com/gp/product/B01MU5GO36/)

You will need to include the cost of magnets used in your model on the expense form for the competition

	Unit Cost	Measure	Total per Team	Cost
Round Magnets with North Pole Marking - Ceramic Thin Magnets - Craft Magnets Size is 22 mm (7/8)	\$0.10	each	37	\$3.70
7/8"x3.5"x0.5" Plywood	\$0.00		1	\$0.00
1"x x 0.75" x 13.25" Wood	\$0.00		1	\$0.00
13.25" x 2.5" Cardboard	\$0.00		2	\$0.00
3.5" x 1" cardboard	\$0.00		2	\$0.00