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The Maglev Train

Prep Instructions

Part I - Designing the Track

The WOWLab train track uses 834 3/8 in. cube magnets to produce a four magnet wide oval track, measuring approximately 3 ft. long and 1.5 ft. wide. Depending on the available magnets and the desired size, it is possible to design a track to suit different needs. The WOWLab track has rounded corners, allowing the train to follow the track while changing direction. The train follows the track because the magnetic flux changes less along the length than along the width. It was determined that a width of four magnets best allows the train to stay on the track while turning corners.

These parameters were used to create the WOW Lab train track and, although they provided the best results, they can easily be modified. In the extreme case, if time and money are limited, a straight track that is two magnets wide can be used.

When deciding on the track size, it is often helpful to first estimate the dimensions based upon the quantity and size of the available magnets. It is advisable to underestimate the track size to ensure sufficient magnets. Another option is to draw a rough sketch of the track on the metal base before laying down the magnets.

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Part II – Labelling the Magnets

The following items will be required for the prep of this part of the activity:

- 3/8 in. magnetic cubes
- permanent marker

In order to establish the magnetic field lines necessary to levitate the train and guide it along a predetermined path, the magnetic cubes must be properly oriented within the track. This orientation is dependent on the location of the poles on each magnetic cube. The required orientation can be seen in **figure 1**. The first stage is to find and label the location of the poles on each individual cube.

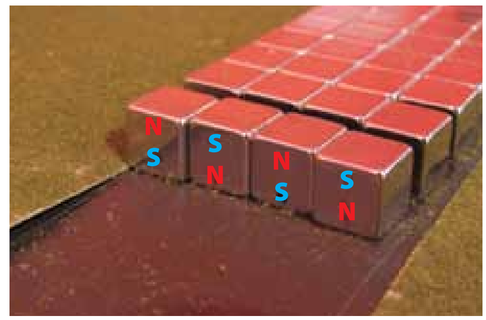

Figure 1

The magnets will naturally drift into a north-south-north-south configuration as shown in **figure 2**. This is the easiest orientation for labelling the magnets. However, the magnets can attach occasionally with the configuration shown in **figure 3**. Applying The Twist Test as described in **figure 4** is a good way to ensure the magnets are in the **figure 2** configuration.

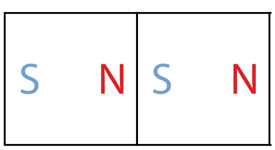

Figure 2

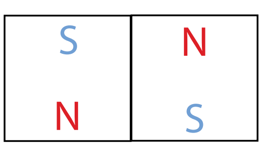

Figure 3

The Twist Test

Call the line that passes through the centre of both magnets the 'long-axis' (see the figure below). If it is possible to easily rotate one of the magnets about the long-axis while keeping the other magnet still, then the magnetic poles must be in the orientation shown in **figure 2** (The labelling of one pole as north instead of south in **figure 3** is completely arbitrary). Nevertheless, it is important to stay consistent in labelling. If the magnets resist the twisting motion, then the poles must be in the orientation shown in **figure 3**. Using this test, ensure all the magnets fall into the **figure 2** orientation.

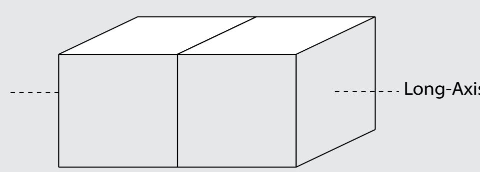

Figure 4

Step 1

Place approximately 40 magnets into one long string of magnets. Use The Twist Test described in **figure 4** to ensure that the magnets are in the proper configuration.

Step 2

Label the ends of each magnet in the string, alternating between N and S as shown in **figure 5**. Repeat Steps 1-2 until all the magnets are labelled.

Part III – Constructing the Track

The following items will be required for the prep of this part of the activity:

- 3 ft. x 4 ft. sheet of metal
- magnetic cubes
- hammer
- wooden ruler

Step 1

Attach four magnets together with the orientation shown in **figure 5**. Place them flat on the metal sheet. Using a hammer and wooden ruler, tap the set of magnets into the desired position.

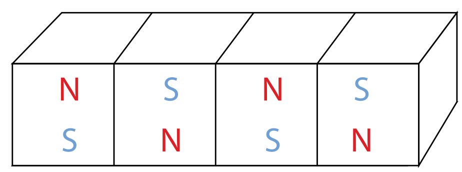

Figure 5

Figure 6

Step 2

Place another four magnets together with the same configuration as the last set. Place this set onto the metal sheet and tap them into place right beside the last set. Try to get the two sets of magnets as close to each other as possible. The sets of magnets will repel each other, making this process difficult.

Step 3

Continue this process, building the track one set of magnets at a time and pushing the sets as close together as possible (**Figure 6**). Eventually, enough magnets will be in place that the combined friction between the table and the magnets will be large enough to overcome the forces repelling the magnets. At this point, the magnets will sit close together.

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Step 4

Once a corner section is reached, continue with the same process as in Steps 1-3 while corbelling the magnets to minimize the gaps, creating an arch-like curve (**Figure 7**). Any gaps will act as a speed bump for the train. Be patient as this is a tricky process.

Figure 7

Part IV – Constructing the Train

The following items will be required for the prep of this part of the activity:

• model train body
• flat head screwdriver
• Dremel rotary tool
• 4 in. x 2 in. x 1 in. piece of Styrofoam
• superconductor discs

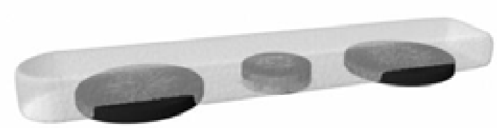

Figure 8

Step 1

If the train engine has wheels and a plastic base, remove the base with a flat head screwdriver **(Figure 8**).

Step 2

Using a Dremel rotary tool, cut out three indentations from the bottom of the Styrofoam so that the superconductor discs fit very snugly. The discs should be lined up along the base and not stacked one on top of the other. It is important to centre the discs on the train (**Figure 9).**

Figure 9

Step 3

Cut the Styrofoam, creating an insert on which the engine body can rest snugly (**Figure 10)**.

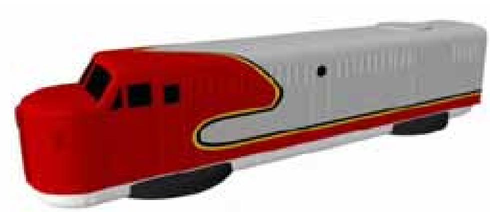

Figure 10