Magnet Magic

For well over 100 years, inventors have dreamed about using magnets to hover above the ground. Magnetic levitation trains, or maglevs (mag-lehvz), have turned that dream into a reality.

Maglev trains use specially designed magnetic tracks, called guideways, that look like low walls. Magnets are also attached to the train. The maglev train moves forward because the magnets in front are attracted to the guideway while the ones in the back are repelled. Electricity continuously switches the north and south poles in the guideway magnets so the train keeps moving.

In this activity, youth will demonstrate the principles of magnetic levitation.

Materials (per group)

- ○ 1 new pencil, sharpened
- ○ 1 piece of ½”-1” foam, approximately 4”x10” (old flipflops work well!)
- ○ ½ of a wide craft stick
- ○ 1 thumbtack
- ○ 6 strong (neodymium or ceramic work best) ring magnets with North and South poles marked

  Note: The center opening needs to be just big enough to slide the magnet onto the pencil. A standard pencil is about 7/32” in diameter, so look for magnets that have an inner diameter of 9/32” or larger.

  Note: Ideally the magnets are all the same dimensions. If that is not possible, use 2 smaller identical magnets for the pencil and 4 larger identical magnets for the foam base.
- ○ 4 small rubber bands
- ○ Magnet Magic Recording Sheet
- ○ The facilitator will also need a Magnet Magic template and a craft knife.

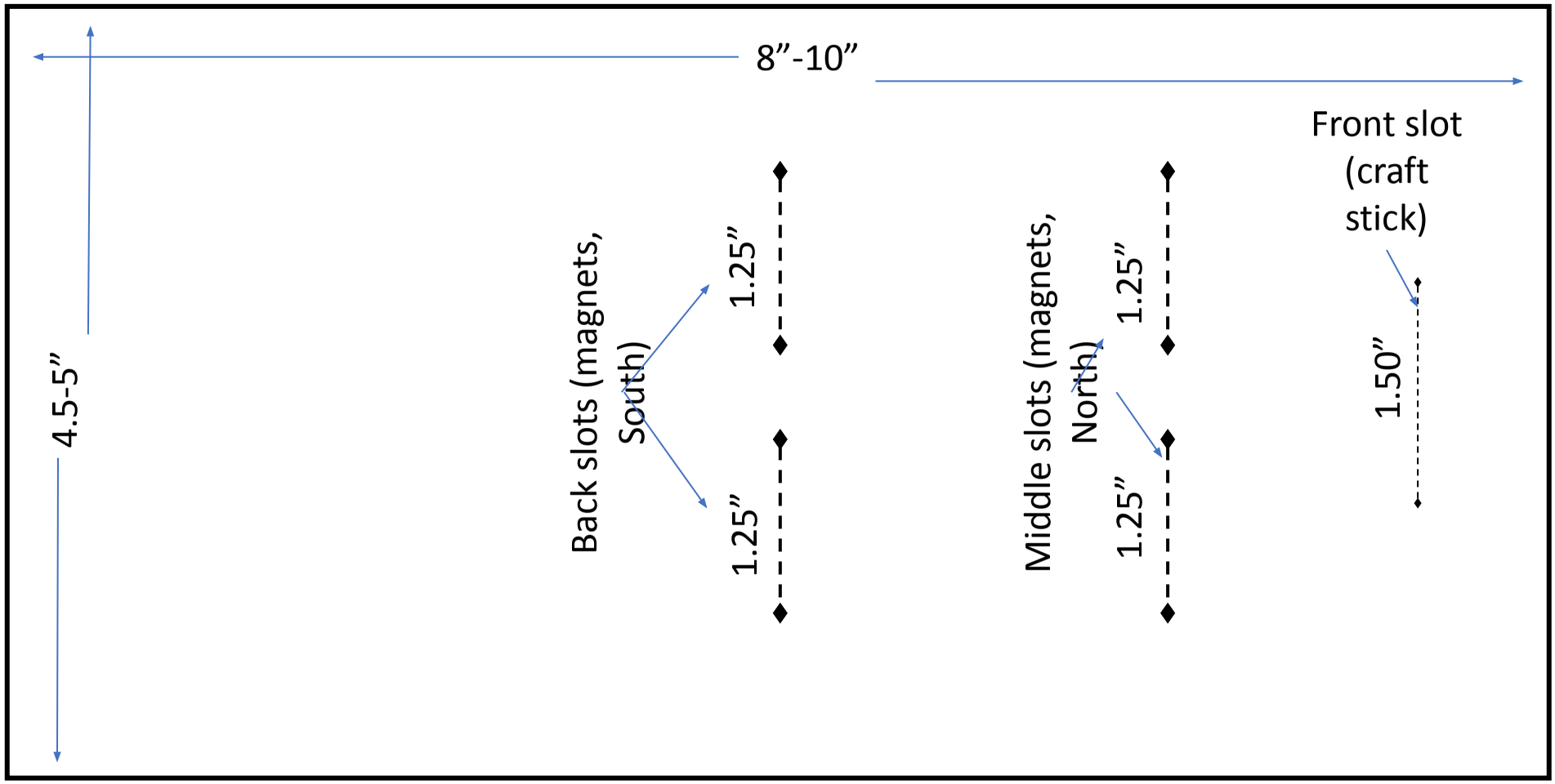
Setting Up

Prior to the meeting, use the Magnet Magic template and craft knife to cut slots into the foam. The slots should be deep enough to hold the magnets steady, but they should not go all the way through the foam.

If your magnets are not marked, you can figure out which pole is which by placing a compass close to the magnet. The needle that usually points “North” will swing around to face the “South” pole of the magnet. You can then use paint or even dots of nail polish to mark the magnets.

Magnet Magic Foam Base Template

Use ½” to 1” thick craft foam, Styrofoam, or layers of cardboard.



Magnet Magic

To Do

1. Use the thumbtack to make a dent in the craft stick, a little below the curved end.
2. The exact distance will vary depending on the size of your magnets. You will be embedding four of the magnets into the foam and sliding two onto the pencil. Make sure that your dent is high enough to leave a little space between the magnets on the pencil and the ones in the foam.
3. Slide the flat end of the craft stick into the small slots at the top of the foam.
4. Slide 2 rubber bands onto the pencil.
5. Place the point of the pencil into the dent on the craft stick.
6. Move the rubber bands so that one is just behind the middle slots (closest to the craft stick) and the other is just in front of the back slots farthest from the craft stick.
7. Take 2 of the ring magnets.
8. Slide one ring magnet onto the front of the pencil. Move it up to the rubber band.
9. Slide a rubber band on the front of the pencil and move it to the magnet, North pole facing up. The rubber bands should stop the magnet from slipping.
10. Slide one ring magnet onto the back of the pencil up to the rubber band. The back magnet should also be positioned with the North pole facing up.
11. Slide the remaining rubber band onto the back of the pencil to secure the second magnet.
12. Place two of the remaining magnets into the middle slots. The North pole should face up on each.
13. Place the last two magnets into the back slots. The South pole should be facing up on each.
14. Place the point of the pencil back into the dent on the craft stick and let go.

Note: You may need to adjust the magnets on the pencil. The front magnet should be a little behind the magnets in the middle slots, while the back magnet should be aligned with the magnets in the back slots.

If your magnets are leaning or moving around in the foam, you can use double-sided tape, a glue gun, or even some modeling clay to help secure them.

Hint: an easy way to place the magnets correctly is to "hang" the base magnets from the magnets on the pencil. For the middle slot, place the magnets into the slot exactly the same way that they are hanging from the pencil. For the back slots, flip the magnets 180° before placing them into the slots.

Magnet Magic: Design Challenge!

Name(s):	

Goal: Levitate a pencil using magnets.

Before you Begin

What do you know about magnets? Write down as much as you can.

You will need

- ○ 1 new pencil, sharpened
- ○ 1 piece of ½”-1” foam with precut slots
- ○ ½ of a wide craft stick
- ○ 1 thumbtack
- ○ 6 strong (neodymium or ceramic work best) ring magnets with North and South poles marked
- ○ Note: If your magnets are not the same size, use the smaller ones with the pencil.
- ○ 4 small rubber bands

Make a Prediction!

How might you use the magnets to make the pencil levitate?

Magnet Magic: Design Challenge!

Build the Magnetic Levitation Device

1. Use the thumbtack to make a dent in the craft stick, a little below the curved end.
2. The exact distance will vary depending on the size of your magnets. You will be embedding four of the magnets into the foam and sliding two onto the pencil. Make sure that your dent is high enough to leave a little space between the magnets on the pencil and the ones in the foam.
3. Slide the flat end of the craft stick into the small slots at the top of the foam.
4. Slide 2 rubber bands onto the pencil.
5. Place the point of the pencil into the dent on the craft stick.
6. Move the rubber bands so that one is just behind the middle slots (closest to the craft stick) and the other is just in front of the back slots farthest from the craft stick.
7. Take 2 of the ring magnets.
8. Slide one ring magnet onto the front of the pencil. Move it up to the rubber band.
9. Slide a rubber band on the front of the pencil and move it to the magnet, North pole facing up. The rubber bands should stop the magnet from slipping.
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14. Place the point of the pencil back into the dent on the craft stick and let go.

Magnet Magic: Design Challenge!

Record Your Observations

Draw a picture of your device. Remember to label your North and South poles!

My Magnetic Levitation Device

Did your device work as you expected it to?	◯ Yes	◯ No
Explain		

Troubleshooting Tips

You may need to adjust the magnets on the pencil. The front magnet should be a little behind the magnets in the middle slots, while the back magnet should be aligned with the magnets in the back slots.

If your magnets are leaning or moving around in the foam, you can use double-sided tape, a glue gun, or even some modeling clay to help secure them.

If you are still having problems, try switching the poles for some of the magnets.

Magnet Magic: Design Challenge!

What's Going On?

Explain how your device works. Make sure to talk about magnetic forces and poles in your explanation.

Evaluate Your Device

What could you change to make your device even better? Explain.
I could...

Apply Your Learning

Imagine ways that you could use a magnetic levitation device in your life. List your ideas in the space below.
I could...