

Levitation Station

OBJECTIVES

Children will:

- Investigate the properties of magnetic levitation by constructing a levitation chamber to test the various movements of the magnet wires.
- Evaluate the positive and negative attributes of a Maglev train and draw conclusions specific to levitation using their findings from the experiment.

BACKGROUND KNOWLEDGE

Before this activity, ask the children what they think the word *levitation* means. They may not be familiar with the term, or perhaps they associate the word *levitation* with magic or having a supernatural power. Explain that *levitation* is the act of rising or hovering, especially in the air or from a suspended object.

In electromagnetism, there exists a concept called *magnetic levitation* which is a method by which an object is suspended with no support other than that of a magnetic field. Magnetic levitation is used in high speed Maglev trains throughout the United States, Europe, and Asia. These trains can float over a guideway that is supported by magnets and magnetic force. This magnetic force is used to counteract the effects of gravitational acceleration.

READING CHECK

Have each child make a list of the positive and negative attributes of a Maglev train. Then, ask them to show you their lists and explain why they chose the attributes that they did. Challenge them to research Maglev trains in greater detail and pay special attention to the characteristics they put on their lists. Have them use their research to evaluate whether their lists are consistent with current research and use of Maglev trains. (This activity uses the skill of drawing inferences and evidence from informational texts to support analysis and reflection.)

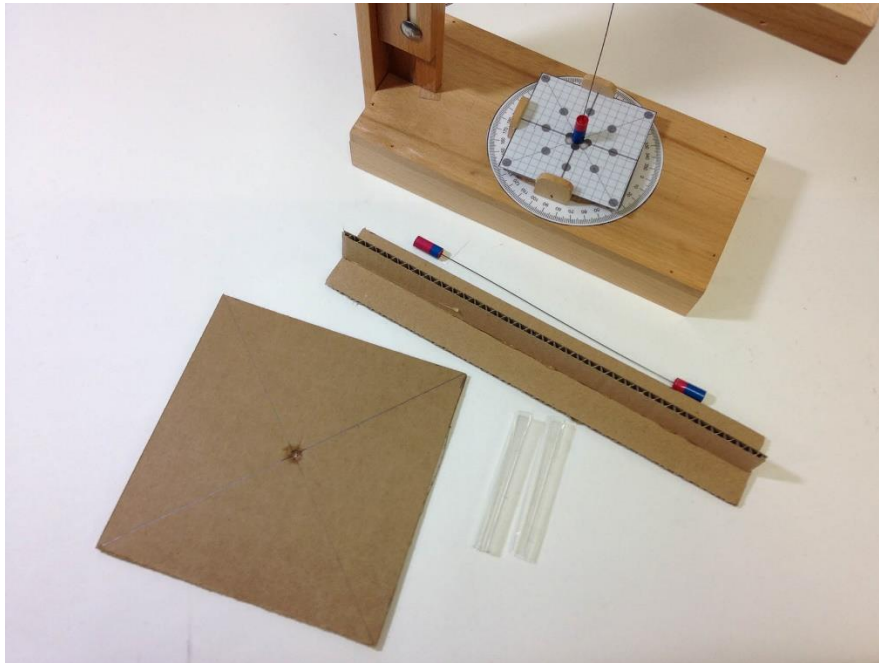
BUILD IT

MATERIALS

- 2 Red/Blue magnet wires (6mm)
- 1 Piece of cardboard or heavy mounting board (12" x 12")
- 1 Piece of transparent acetate or clear, heavy packing tape (6" x 6")
- Roll of clear tape (if you're using the non-sticky acetate from the bullet above)
- Pencil
- Scissors or utility knife (caution—sharp points)
- Thick-bodied pen (3/8"D or slightly wider diameter)
- Dry-erase marker or highlighter
- Hot glue gun (with a low-temp setting) and low-temp glue sticks (caution—hot)

- Wave Wires wooden station
- Station base grid paper

**Conversion Note: For the purposes of this activity, note that inches (in) can be converted into centimeters (cm) using the following conversion: 1 inch = 2.54 cm.*



Support stand construction/assembly

1. Cut a $6\frac{3}{4}$ " x $6\frac{3}{4}$ " piece of cardboard.
2. Draw 2 diagonal lines from corner to corner to find the center of the cardboard.
3. Cut or poke a hole (slightly bigger than $\frac{3}{8}$ "D) in the center of the cardboard.
4. Cut a 2" x 10" piece of cardboard.
5. Using your pencil, mark the center (lengthwise) with a line.
6. Cut a 1" x 10" piece of cardboard.
7. Hot glue the 1" x 10" piece on the center line of the 2" x 10" piece.

Levitation chamber construction/assembly (clear tubes)

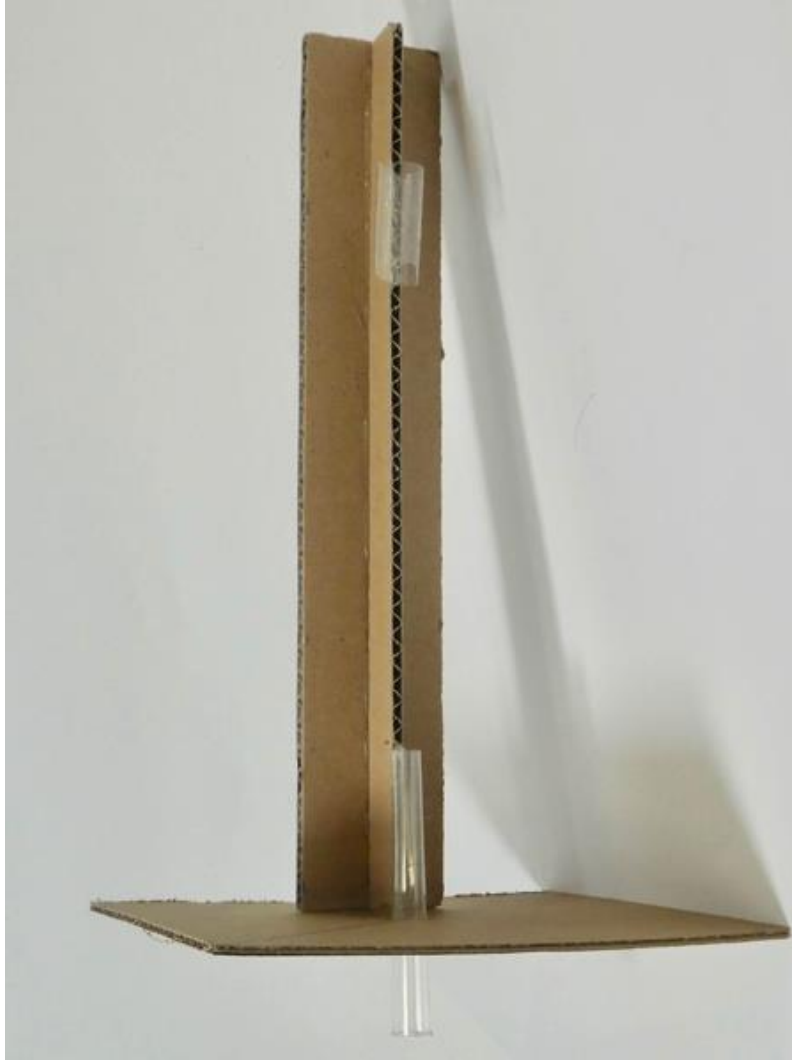
8. Cut a 2" x 2" piece of clear acetate or heavy packing tape. (It must be clear, so you can view the levitation.)
9. Being careful that the sticky side is on the outside of the shape you're rolling (if you're using tape), shape the clear acetate/tape around a thick pen that is roughly $\frac{3}{8}$ "D (or slightly wider in diameter). If you don't have a thick pen, you could use the barrel of a thick marker, the handle of a wooden spoon, etc.
10. Apply another (small) piece of clear tape to the acetate/packing tape just to hold the shape of the roll. (The pen/marker/wooden spoon handle should not be

taped. The cylindrical object should be removed once the acetate/tape is rolled into shape and taped.)

11. Cut a 2" x 2 3/4" piece of clear acetate or heavy packing tape (be sure it's clear).
12. Repeat steps 9 and 10.

Final assembly

13. If you have not already assembled the Wave Wires wooden station, follow the assembly instructions on pages 6–7 of your Teacher's Guide.
14. Place the steel base plate in the base of the station, place the grid paper on the base plate, and put one 6mm red/blue magnet wire on the center of the grid paper/base plate.
15. Adjust the height of the stem/tray support of the station to the lowest position.
16. Being careful not to crush the long clear tube, poke it through the hole in the large cardboard square. You may need to widen the hole to prevent crushing the tube.
17. Place the cardboard/tube assembly into the station tray support, so the clear tube is centered on and over the magnet on the top of the magnet wire that is standing on the base plate. Adjust the long tube, so it completely covers (and extends above) the magnet on the top of the magnet wire.
18. Place the cardboard "T" support you made behind the tube, so the "T" support is resting on top of the large cardboard square. Then, hold all pieces in place, check to make sure everything is square and level, use a pencil to mark the location where the long tube touches the cardboard, and use the glue gun to glue the tube to the cardboard.
19. Once the glue is cooled/dry, place another 6mm red/blue magnet wire in the tube with the same (color) poles facing each other. The magnets on the ends of the wires should repel each other.
20. Place the small clear tube over the magnet that is at the top of the top magnet wire, allowing at least 1/2" of open space in the tube above the top of that magnet.
21. Use a pencil to mark the location where the small tube touches the cardboard "T" support, remove the top magnet wire, and use the glue gun to glue the clear tube to the "T" support.
22. Once the glue is cooled/dry, place the top magnet wire (with same poles facing one another) into the tube. The magnet on the bottom of the top magnet wire should move freely in the tube and bounce and levitate. If it does not, check to make sure the same (color) poles of the magnets are facing, and/or adjustment the tubes to make sure they are square and in-line with one another.





EXPLORE IT

1. Observe the levitation station with only one magnet wire inserted into the bottom tube (and stuck to the steel base plate). Record your observations.
2. Insert the second/top magnet wire into both tubes, making sure that same (color) poles are face one another.
3. Keep hold of the top magnet wire, so it is 1" above the top magnet of the other magnet wire. Drop the second/top magnet wire. Record your observations.

ANALYZE & INTERPRET

1. What did you observe during this experiment? [Answer: I observed that the top magnet wire bounced and levitated.]
2. What steps could be eliminated to make this experiment more effective and/or easy-to-follow for a child who struggles with it? [Answer: Answers will vary. A child may say that a teacher, parent, or guardian could cut the materials ahead of time since some children may have difficulty using a ruler or scissors.]
3. Briefly summarize how this experiment demonstrated the concept of magnetic levitation. [Answer: I made a levitation chamber, placed magnets inside of it, and magnetic repulsion caused the magnets to levitate when suspended within the chamber.]

DIFFERENTIATING INSTRUCTION

Below level: Pause between the construction phase, the final assembly phase, and the demonstration phase to discuss each phase in detail. This will help ensure that children are on track to understand the purpose of this experiment and how their setup will demonstrate the concepts associated with magnetic levitation.

Advanced level: As children are grasping the setup and assembly of this experiment, ask them guiding questions to assess their full understanding as they are working. One of the most effective ways to assess understanding is to challenge a child to teach *you* the material. If a child can correctly teach you and explain the inner workings of an experiment or a scientific concept without the use of their step-by-step procedure, then they are usually grasping the activity or information.

This online lesson was written for use with one of the following Dowling Magnets products:

- [731111 Kinetic Magnetics® Wave Wires® Magnet Station](#)
- [731112 Kinetic Magnetics® Wave Wires® Magnet Station Pack](#)