Rail Accelerator

Overview We're going to be making a tiny set of wheel zip down a track. This is how roller coasters and fast trains move down the rail, powered only by magnetism.

What to Learn Two magnetic fields at right angles (perpendicular) interact to each other to causes things to move, spin, rotate, and roll out of the way.

Materials

- Cardboard or poster board
- Aluminum foil
- Hot glue or double-sided sticky tape
- Scissors
- Wire coat hanger
- Two very tiny, neodymium metal-coated disc magnets (www.kjmagnetics.com Part #D21)
- 9V battery with clip
- 2 alligator clip leads
- Stopwatch
- Ruler or measuring tape

Lab Time

1. You can experiment with different length of track as shown in the data table, or just make one (in that case, you won't be using the data table).
2. Cut out two strips of aluminum foil (refer to data table for length). The width is approx 2-3" wide.
3. Using glue or tape, stick the aluminum strips down on your poster board a finger's-width apart (about a half inch). If you're using tape, tape only to the underside of the foil, not the topside.
4. Cut a 2" long straight piece from your wire coat hanger using vise grips.
5. Place the wheel at each end, placing the wire in the center. They should stick by themselves. Make them as centered as possible.
6. Attach the clip to your battery.
7. Attach one alligator wire to the wire from your 9V battery. The other end of this wire clips onto one side of the aluminum track.
8. Attach a second alligator wire to the other wire from your 9V battery. The end of this wire clips onto the other side of the aluminum track.
9. Set your wheels gently on the track and see if they take off. If they don't, try these things:
    a. If you drop your wheels from too high up, you'll knock the axle off-center and the wheels won't roll.
    b. If your wheels still don't roll, flip one of the magnets around. The magnets must be in opposite directions for this to work.
    c. Make sure you've got a fresh 9V battery.
    d. Do you have a good electrical connection between your clips and the track? No tape in the way?

10. **Do NOT** leave the wheels on the track if they are not moving. This will short circuit your battery and toast it (not a good thing).
11. Complete the table if you're trying different track lengths.

Rail Accelerator Data Table

Lab Group Name	**Length of Track** *(feet, cm, inches…?)*	**Time to Travel Length** *(seconds)*	**Average Speed** *(Speed = Length ÷ Time)*

Reading

This rail accelerator is really just two of the motors from *Quick 'n' Easy DC Motor* connected together. Instead of wire, we are using an aluminum rail. The magnetic field in the rail creates a force perpendicular to the tiny magnet's magnetic field. These two magnetic fields interact, causing the little wheels to roll.

If you have the wheels on 'backwards' (or your battery connected backwards), your wheels will roll toward (instead of away) from you.

Troubleshooting: If you drop your wheels from too high up, you'll knock the axle off-center and the wheels won't roll. If your wheels still don't roll, flip one of the magnets around (they must be in opposite directions for this to work!). Also, make sure you've got a fresh 9V battery and good electrical connection between your clips and the track.

Exercises

1. Do the magnets need to be opposite in order for this to work?
2. Why do the wheels move?
3. Which track works the best?

Answers to Exercises: Rail Accelerator

1. Do the magnets need to be opposite in order for this to work? (Yes, they must be perpendicular to the track and to the direction of the current flow.)
2. Why do the wheels move? (When electricity flows through the aluminum rail, the magnetic field in the rail creates a force perpendicular to the tiny magnet's magnetic field. These two magnetic fields interact, causing the little wheels to roll.)
3. Which track works the best? (Refer to your data table.)