# Synopsis: Exploring Eddy Currents

In this activity we will use tubes and strong magnets to see that:

- a moving magnetic field produces an electric field which produces a current in a conductor.
- a moving electric field (current) produces a magnetic field.

## Standards

***4th Grade***

**1c.** Students know electric currents produce magnetic fields and know how to build a simple electromagnet.

**1f.** Students know that magnets have two poles (north and south) and that like poles repel each other while unlike poles attract each other.

***9-12th Grade***

**5f.** *Students know* magnetic materials and electric currents (moving electric charges) are sources of magnetic fields and are subject to forces arising from the magnetic fields of other sources.

**5g.** *Students know* how to determine the direction of a magnetic field produced by a current flowing in a straight wire or in a coil.

**5h.** *Students know* changing magnetic fields produce electric fields, thereby inducing currents in nearby conductors.

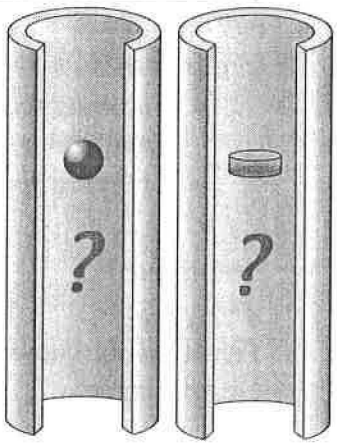
## Driving Questions

1.) How do we know current produces a magnetic field?
2.) How does an electromagnet work?

## Learning Objectives

1.) Students will explore a dramatic example of the dynamic interplay between electric and magnetic fields.

## Exploring Eddy Currents




Work in groups of two.

**Procedure**

Make sure you have access to the following:

- Eddy current kit:
  - Strong neodymium magnets
  - Tubes: Al, Cu, Plastic
- Stop watches
- Test magnets from Magnet kit.
- Marbles

***Part A: Drop and Wonder***

1.) Label the pole of both of the strong neodymium magnets in your eddy current kit.
2.) Lay your three tubes flat on the table. Test each with the neodymium magnet.
   a. Are any of them magnetic?
   b. Which tubes conduct electricity?
3.) Make a data table with the following columns:

| Object | Cu Tube (time) | Al Tube (time) | Plastic Tube (time |
|---|---|---|---|
| Small neodymium disk, North pole up. | | | |
| Small neodymium disk, North pole down. | | | |
| Marble | | | |
| Steel Plug | | | |

4.) Hold the copper tube vertically. Drop the marble down the tube. Anything interesting happen?
5.) Carefully time how long it takes the marble to drop down each of the tubes.
6.) Repeat step 4.) for a series of magnets.
   a. Small neodymium magnet (from Eddy current kit) with:
      i. the North pole up
      ii. the South pole up
   b. Large neodymium magnet (from Eddy current kit) with:
      i. the North pole up
      ii. the South pole up

*Follow up questions:*

1. What trends do you see?
2. Does the time it takes for the magnet to drop depend on the magnetic field strength?
3. Draw a sketch of the forces acting on:
   a. The marble as it falls through the copper tube.
   b. A magnet as it falls through the copper tube.

c. A magnet as it falls through the plastic tube.

*Thought Challenge:*

- Develop a testable hypotheses to explain what you have observed.
  - eg. this magnet slows down because it is attracted to the wall
  - eg. the stronger the magnet the slower it will fall

## Instructor Notes: Exploring Eddy Currents

This activity is really cool to watch. Timing the falling marble and the magnet in the plastic tube may be difficult.

***Safety***

This activity has little to no risk associated with it. The neodymium magnets are very strong. Take care not to get pinched.

**Materials**

- Eddy current kit:
  - Strong neodymium magnet
  - Tubes: Al, Cu, Plastic
- Stop watches
- Test magnets from Magnet kit.
- Marbles

**Notes**