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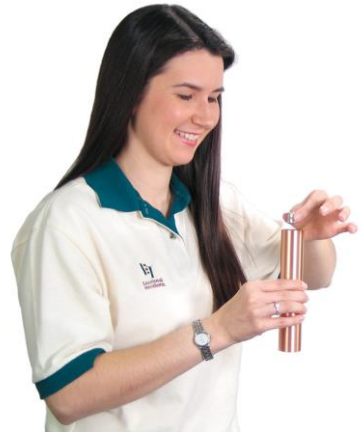
Educational Innovations, Inc.®

Eddy Current Tubes

ED-100 / 125 / 140

What is an Eddy Current Tube?



An eddy current is a current set up in a conductor in response to a changing magnetic field. Lenz's law predicts that the current moves in such a way as to create a magnetic field opposing the change; to do this in a conductor, electrons swirl in a plane perpendicular to the changing magnetic field.

Because the magnetic fields of the eddy currents oppose the magnetic field of the falling magnet; there is attraction between the two fields. Energy is converted into heat. This principle is used in damping the oscillation of the lever arm of many mechanical balances. At the end of the arm a piece of flat aluminum is positioned to move through the magnetic field of a permanent magnet. The faster the arm oscillates, the greater the eddy currents and the greater the attraction to the permanent magnet. However, when the arm comes to rest, the attraction is negligible.

Things to keep in mind:

- If a single neodymium magnet has the same mass as a single cow magnet, the neodymium magnet will fall at a slower rate because its magnetic field strength is greater.
- Two neodymium magnets fall at a slower rate than one because the magnetic field strength has increased. The time of fall within the tube increases with the addition of other magnets. There is a point where the effect of the increase in mass becomes greater than the increase in magnetic field strength. Then, the group of magnets falls faster.
- Thicker tubes increase the falling time due to stronger eddy currents from the greater number of conducting electrons. Suggest an experiment to determine the thickness of the tube by determining the rate of fall of a magnet within the tube.
- Determine the time for one magnet to fall through the 7-inch copper tube and measure the time for the same magnet to fall through the 15-inch aluminum tube. The falling times should be approximately the same. Relate the length of the tubes to the conductivity of the metals.

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Student Activity

Areas for investigation:

1. How will magnets of different magnetic field strengths affect falling time? Try dropping two cow magnets that have the same mass but different magnetic field strengths down the same tube one at a time.
2. How does the falling time of neodymium magnets compare to the falling time of cow magnets?
3. Allow multiple neodymium magnets to attract together. How does changing the number of magnets affect the falling time?
4. Do both single and multiple neodymium magnets fall down the tube at a constant velocity?
5. How does changing the thickness of the tube affect falling time?
6. How does changing the length of the tube affect falling time?
7. How does changing the material of the tube affect falling time?
8. How does cooling the tube down with liquid nitrogen affect falling time?

Take Your Lesson Further

As science teachers ourselves, we know how much effort goes into preparing lessons. For us, "*Teachers Serving Teachers*" isn't just a slogan—it's our promise to you!

Please visit our website for more lesson ideas:

TeacherSource.com/lessons

Check our blog for classroom-tested teaching plans on dozens of topics:

http://blog.TeacherSource.com

To extend your lesson, consider these Educational Innovations products:

Magnetic Field Viewer Film (M-560)
This micro-encapsulated film enables students to view a static magnetic field, such as found around permanent magnets or DC electromagnets. Simply place the film directly on the surface of the magnetic material in question and instantly reveal a magnetic field of any shape or pattern. You can easily identify the poles. The film is highly flexible and quite durable. It can be laminated.

Eddy Current Rods (ED-185)
Invert the apparatus and observe magnets simultaneously sliding down three different rods! The velocity is inversely related to the conductivity of the materials: copper, aluminum, and rigid plastic. A recreation of an old, hand-made apparatus found in a university physics storeroom, this is great for demonstrating Lenz's Law!

Neodymium Magnet Experimenter's Set (ED-175)
This set includes a fantastic assortment of our most popular neodymium magnets which work well with all of our Super-Large Eddy Current Tubes. Each has different characteristics along with slightly different fall times. A must for every teacher or student experimenting with eddy current tubes!

Magnetic Field Viewer Card (M-555)
You can use this amazing viewer card to locate the poles of a magnet. It shows exactly where and how many magnetic poles are on any small magnet. The card is ideal for conveying the concept of magnetic poles! Great for identifying magnets!