

# Educational Innovations<sub>LLC</sub>

#ED-100	Thick Copper Tube, 18 cm (7")
#ED-125	Thick Aluminum Tube, 36 cm (15")
#ED-140	Thick Copper Tube, 60 cm (24")

## Eddy Current Tubes

1. 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.

2. 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.
3. 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.
4. 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.
5. 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: THE EDDY CURRENT TUBE



### Areas for investigation:

1. How will magnets of different magnetic field strengths affect falling time? Try dropping 2 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?

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