Giant Neodymium Magnet

P8-1124

BACKGROUND:

The magnet in your possession is one of the most powerful magnets in the world. It is made out of a neodymium-iron-boron material, or $Nd^2Fe^{14}B$, of which iron is the main component. Its field strength has been measured at 12.5 kilogauss, or 1.25 Tesla (tens of thousands of times stronger than the earth's magnetic field). This incredible strength makes it a constant source of wonder as well as an ideal demonstrator of the force of magnetism in traditional, and some not so traditional, experiments. As you may already know, this is not an ordinary magnet and cannot be handled as such - please read the cautionary notes below.

PRECAUTIONS

- **Never allow the magnet to come together with metal or another magnet abruptly! The attraction is so strong that the magnets may chip or break, launching tiny chips into the air!**
- Take care that your finger or a sensitive fold of skin does not get caught between this magnet and another. A blood blister or minor abrasion could result.
- *Never* allow the magnets near computer disks, recording tapes of any kind, credit cards, bank cards, or any other device which uses magnetic tape to record information.
- It is very difficult to separate the magnet from a surface that it is attracted to. Separate them by sliding apart rather than a direct pull.
- Storage is not a problem (no keeper is needed), but do not store near magnetically sensitive materials.
- Do not heat the magnet over 150°C. It will lose some of its magnetism permanently.

ACTIVITIES:

1. Test the magnet on substances you "know" are not magnetic — pencils, crayons, aluminum foil, bits of clay, paper, and anything else you can think of. See what happens when one of the magnets is brought close to a dollar bill. Can you think of a way to determine whether the attraction is from the printing ink or the paper itself? Could you if it weren't your dollar?

2. Gently roll a magnet across a wooden table. It should align itself with the earth's magnetic field.

3. Test the "lead" (graphite) of a mechanical pencil for magnetism. Balance the lead on a non-magnetic item and observe whether the lead is attracted or repelled by the magnet.

4. Obtain a straight copper tube 1 inch in diameter and about 2-3 feet in length. Holding the tube vertically, observe the magnet drop through the tube. Can you explain the resulting phenomenon?

5. Move the magnet across a plate of aluminum. Vary the speed and force you apply to the magnet. The opposing force will amaze everyone. Next, try rolling the magnet down the plate at an incline. What happens when it reaches the edge?

6. Set up a rotating balance apparatus. A pin mounted on the center of a wire (try a section of coat hanger) works well. Then balance the point of the pin on top of an upside down cup so that the "arms" (the wire) can rotate around the pivot. Pull the ends of the wire down below the pivot point so that the center of gravity makes it easier to balance. Test for "diamagnetism" in food. Stick a grape on each end of the wire (more balancing may be required). Use both magnets stacked to repel the grapes (the balance will rotate.) Notice that both poles repel the grapes.