

Magnetic Free Fall

The parts just snap together

Materials

wooden dowel, 1/4 in diameter, 12 in long

2 plastic film can lids

2 small ceramic refrigerator magnets, donut or rectangular shape, approximately 1 in across

drill and 1/4in drill bit

hot-glue gun and hot-glue sticks

pillow, or sweatshirt, or foam rubber to drop device on so that impact is cushioned

Assembly

Drill 1/4 inch holes in the center of each of the film can lids. The film can lids should slide along the dowel when you move them, but should not slide of their own accord. If they do, then get new lids and use a slightly smaller drill bit. Slide the upper lid onto the dowel in approximately the position shown in the Figures 1 and 2 below. Be sure the flat surface is facing upward. Hot-glue the lid in place on the dowel, and hot glue a magnet to the underside of the lid, inside the inner rim, as shown in the Figures below.

Slide the other magnet and lid onto the bottom of the dowel in approximately the position shown in Figures 1 and 2. Be sure the flat surface of the lid is facing upward, as shown. Also be sure that the lower magnet is oriented so that the two magnets will attract each other, as shown in Figures 2 and 3. Do not glue the lower lid or the lower magnet.

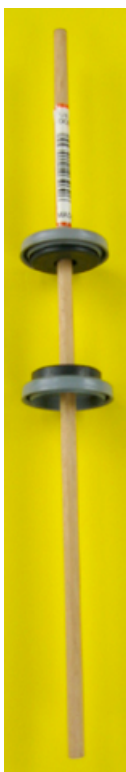


Figure 1



Figure 2

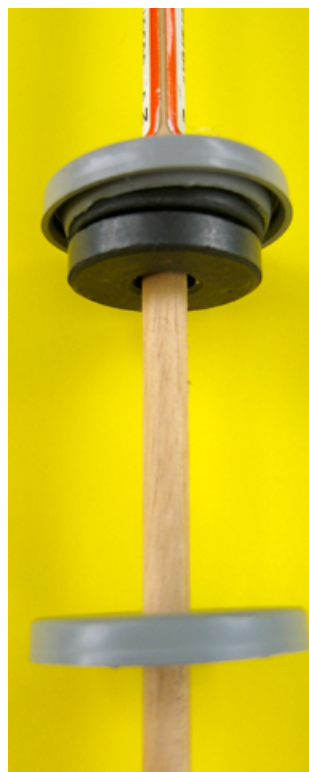


Figure 3

To Do and Notice

Hold the device by the top of the dowel so that dowel is hanging vertically, with the lower magnet resting on the lid, as in Figure 1.

Adjust the position of the bottom lid and magnet upward until the bottom magnet snaps together with the top magnet. Then lower the bottom lid a couple of centimeters.

Hold the device by the top of the dowel, with the bottom magnet resting on the bottom lid, so that the assembly is about 4 ft above the pillow, sweatshirt or foam rubber. Then drop it. Observe what happens to the magnets in free

fall. They should snap together. If they don't, adjust the gap between the magnets until they snap together while falling.

What's Going On

There is a magnetic force of mutual attraction between the two magnets. This force acts downward on the top magnet, and upward on the bottom magnet. The gravitational force on both magnets acts downward.

When you drop the whole device, the magnetic and gravitational forces on the top magnet are both downward, but on the bottom magnet the gravitational force is downward and the magnetic force is upward.

The top magnet (along with assembly to which it is attached) falls with an acceleration slightly larger than normal gravitational acceleration. The bottom magnet (which is not attached to the assembly) falls with an acceleration slightly smaller than normal gravitational acceleration.

The greater acceleration of the top magnet and assembly closes the distance between it and the bottom magnet as they fall. Since magnetic force increases dramatically as distance between the magnets decreases, the force rapidly becomes large enough to snap the magnets together.

Going Further

- Adjust the gap between the magnets so that you can get the magnets to snap together either just after being dropped, or just before they hit the floor.
- Reverse the orientation of the bottom magnet so that the two magnets repel.
- Hold the assembly horizontal, with the magnets oriented so that they attract, but separated enough so they don't snap together. Drop the assembly. Repeat with the magnets oriented so they repel.