

MYSTERIOUS MAGNETIC MOVEMENTS

Explore magnetic attraction **and** repulsion

Curriculum topics:

- Magnetism
- Symmetry
- Conservation of Momentum
- Modeling
- Problem Solving

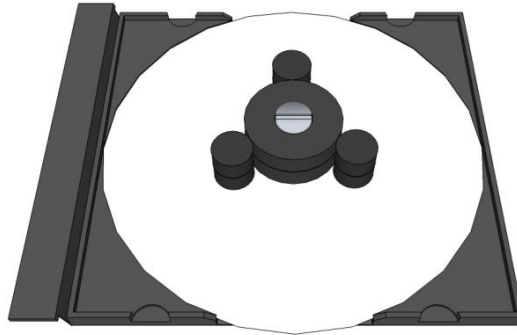
Subject:

Physical Science

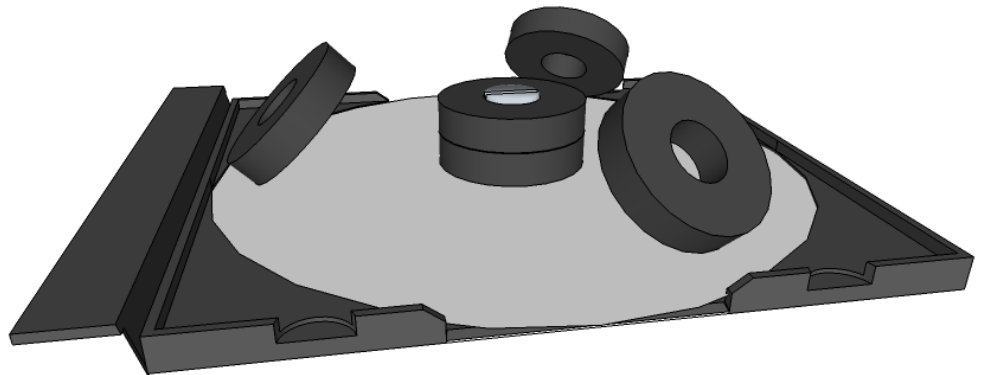
Grade range: 3 – 12

Who we are:

Resource Area for Teaching (RAFT) helps educators transform the learning experience by inspiring joy through hands-on learning.



A variety of scientific and gravity “defying” demonstrations can be done by combining pill and ring magnets in unique ways to create a multipurpose demo unit.



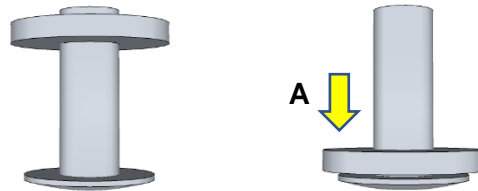
For more ideas visit
<https://raft.net>

Materials required per student

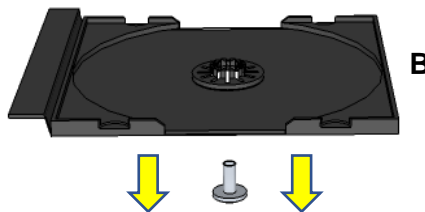
- Aluminum screw and post fastener, 1/2" long, 3/8" diameter (x1)
- Washer, non-magnetic, 1/2" OD, 3/8" ID (x1)
- CD Media Tray, with open center hole (x1)
- White paper disc, CD size (x1)
- Ring magnets (x5)
- Pill magnets (x12)
- Jumbo craft stick (x1)
- Small sticker (x1)

Set Up

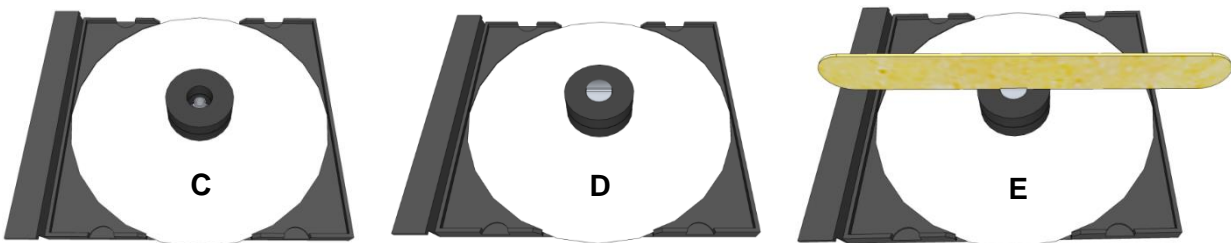
- 1 Place the washer over the post (the part of the fastener with internal screw threads) and push downward toward the head of the post (**A**).



- 2 Lower the media tray (CD side up) over the post and washer. Align the washer so it fits into the tray's circular indentation (**B**). Place the white paper disc into the CD section of the media tray.



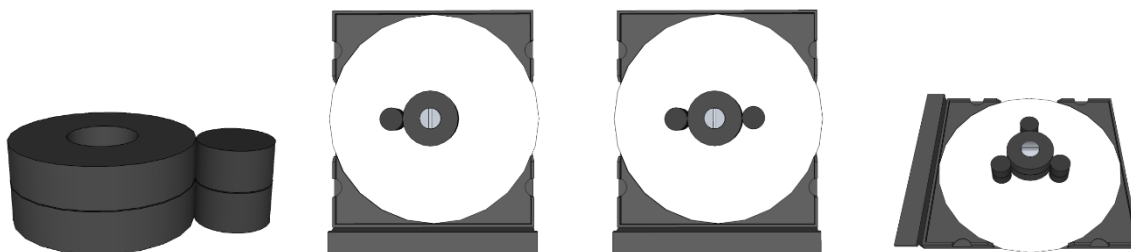
- 3 Stack two ring magnets over the end of the post (**C**) oriented so they attract each other.
- 4 Insert the screw into the threaded post and carefully twist the two parts together (**D**). The post and screw should thread together easily, if not unscrew and try again. If needed, reposition the magnets so that the head of the screw and the magnets are centered.
- 5 Use the narrow edge of the jumbo craft stick as a "screwdriver" and turn the screw clockwise to tighten (**E**). Hold the post, if needed.



To do and notice

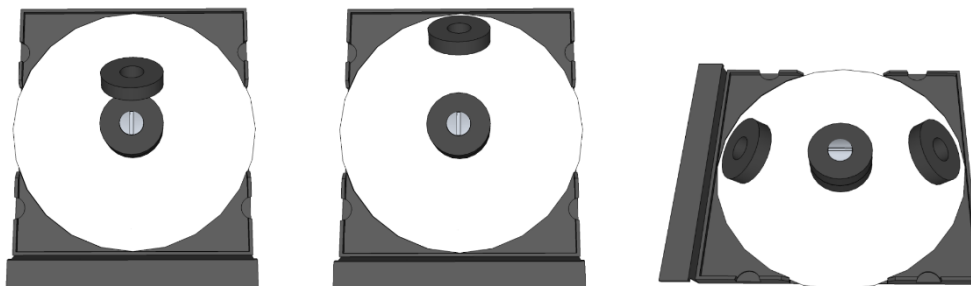
Modeling with pill magnets

- 1** Orient 2 stacked pill magnets so the sides of the pill magnets are attracted to the ring magnets.
- 2** **Model orbiting planets or moons:** Rotate the pill magnets around the rim by moving the tray in a “hula-hoop” type motion. Add a 2nd pair of pill magnets and repeat the “hula-hoop” motion and note how one pair of pill magnets repels the other pair. Add more pairs of pill magnets and continue observing their motion around the rim.
- 3** **Model the regular patterns in crystal:** Note that as more pill magnet pairs are added the pill magnet pairs will move to be evenly spaced around the ring magnets.
- 4** **Model the flow of electric current:** Place all 6 pairs of pill magnets around the rim. Move 1 pair of pill magnets to cause the others to move around in a “circuit.” Move the pill magnets either clockwise or counterclockwise to model DC (direct current) flow. Wiggle a pair of pill magnets back and forth to model AC (alternating current).



Tilting Ring Magnets

- 5** Remove any pill magnets. Place a third ring magnet on top of the pair of ring magnets, oriented so the third magnet is attracted.
- 6** ↑ Lift the 3rd magnet off the stack and lower to the media tray, keeping the bottom face tilted towards the stack. Slide the magnet until the back edge is at a point near the edge of the circle.
- 7** Position the magnet so that the magnet will not fall when released. If the magnet “jumps” to the stack of magnets, move it a little farther away and release. If the magnet falls flat, move it closer to the stack before releasing. Repeated trials may be required for success.
- 8** Once one magnet is able to remain in a tilted position, without being held, add a 2nd magnet on the opposite side. Once 2 ring magnets are stable add a 3rd ring magnet between the two! Note how the magnets move to be equal distance from each other.



Content Standards:

NGSS

Forces and Motion:

3-PS2-1
3-PS2-2
MS-PS2-2

Magnetic Forces and Interactions:

3-PS2-3
3-PS2-4
MS-PS2-3
MS-PS2-5

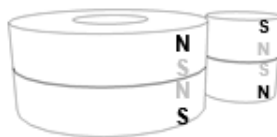
Energy Transfer and Conservation:

4-PS3-2
HS-PS3-3

The science behind the activity

Modeling with Pill Magnets

The pairs of ring and pill magnets are positioned so their opposite poles are attracting each other. The magnetic poles of the pill magnets are oriented opposite the poles of the ring magnets to also be attracted. The pill magnet pairs will repel each other since the pill magnets share the same orientation of their poles when attached to the ring magnet (like magnet poles repel each other).



Tilting Ring Magnets

Initially the 3 stacked magnets are attracted but when the top magnet is pulled off and tilted it is repelled. At a certain distance from the stack the magnet can be oriented so that the repelling force of the magnet counterbalances the attractive force of gravity, so the magnet does not fall when released.



Learn more

- Set up two tilting ring magnets. Touch one tilting magnet to make it bounce up and down. Note what happens to the other tilting ring magnet.
- Use the stacked pill or ring magnets to move or activate a mechanical device.
- Explore the effects that this set-up may have on a magnetic compass.

Visit <https://raft.net> to view the following related activities!

Amazing Magnetic Worms
Floating Garden of Magnets
Magnetic Field Line Viewer
Magnetic Perturbations
Mini Magnet Wands
Where is the Magnet?

Resources

- Magnetic field line images - <https://bit.ly/2VsbT4E>
- YouTube video (5:53), Magnetic Fields - <https://bit.ly/2V4HIS4>