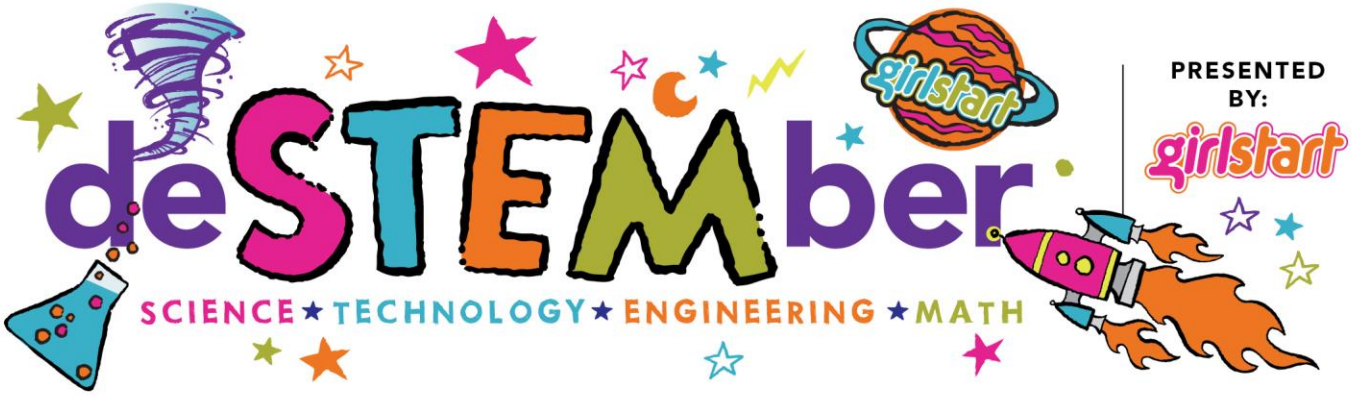

Balancing Pencil

Do you think you can balance a pencil using only magnets and tape? Discover how you can make a pencil stand on its tip by harnessing the power of magnets! Magnets are either attracted to each other (that's how they hold things up on a refrigerator!) or repel each other. Arrange the magnets so that they repel each other and make your pencil spin!

TEKS:

3.6C: The student is expected to observe forces, such as magnetism and gravity, acting on objects.
4.6D: The student is expected to design an experiment to test the effect of force on an object, such as a push or a pull, gravity, friction, or magnetism.

Materials:

- One ring magnet (can be purchased here)
- Plastic cup (12 ounce or larger)
- Sharpened pencil
- Tape
- Three bar magnets (can be purchased here)

How To:

1. On a flat surface, arrange the three bar magnets in a triangle shape so that they repel each other equally. They should not be sticking together!
2. While keeping the magnets in this repelling arrangement, tape the magnets to the top of the inside of the cup. They should be about equally spaced.
3. Stand your pencil up next to the cup, pencil tip down. Wrap tape around the pencil at about the same height as the magnets in the cup. Wrap the tape thick enough to hold the ring magnet on the pencil without letting it slide down.
4. Slide your ring magnet onto the pencil. The height of the ring magnet should be slightly above the magnets that are taped to the cup. The ring magnet should repel the bar magnets equally. If it seems to be attracted to the bar magnets, try sliding the ring magnet off the pencil, flipping it over, and sliding it on again.

5. Now, balance your pencil in the center of the cup. It should stay standing up! If not, try adjusting the height of your ring magnet or the positions of your bar magnets.
6. Try spinning your pencil in the cup! Does it spin for a long time? What happens when it stops?

STEM Explanation:

The pencil stays standing up in the center of the cup because the magnets repel each other. Magnets have north poles and south poles. Opposite poles attract and like poles repel. When you positioned your magnets, you arranged them so that the like poles were facing each other. This position causes the magnets to repel each other. The magnetic field the magnets produce as they repel each other pushes on the pencil from all sides, causing the pencil to stand up. At any given point in a magnet's magnetic field, the field has a magnitude (or strength) and direction. When the bar magnets repel each other on the inside of the cup, the magnetic field lines all come in towards the center of the cup and create a high pressure magnetic vortex. When the ring magnet's static magnetic field is placed within this magnetic vortex, it creates motion and causes the pencil to spin. In a perfect system, with the magnetic forces equally balanced and friction between the pencil and the cup eliminated, the pencil would be able to spin continually on its own.

Career Connection:

Physicists are scientists who do research in physics, which involves the study of matter and its motion through space and time, along with related concepts such as energy and force. More broadly, it is the general analysis of nature conducted in order to understand how the universe behaves.

Resources:

https://www.ligo.caltech.edu/LA/system/media_files/binaries/260/original/11-20_Magnetic_Spinning_Pencil_(updated).pdf?1448309002
http://frugalfun4boys.com/2016/02/10/spinning-pen-magnet-science-experiment/
https://www.youtube.com/watch?v=b-MSiQTXIG0