Western Engineering

Outreach

Perpetual Motion Machine

Grade 3-5

Meet Today's ENG HERO!

Firouz Badrkhani Ajaei - Assistant Professor with Western Engineering

Dr. Ajaei is an Assistant Professor with the Department of Electrical and Computer Engineering at Western University. His research interests include Protection and Control of Power Systems with a focus on Renewable Energy Systems, Microgrids, and DC-AC Grids. He is currently supervising the Power Systems Protection Laboratory at Western University. He is a member of the IEEE Power and Energy Society and a reviewer of several IEEE Transactions journals. To learn more about Dr. Ajaei, please visit: https://www.eng.uwo.ca/electrical/faculty/ajaei_f/index.html

Learning Goals:

- Grade 3 : 2.2 investigate forces that cause an object to start moving, stop moving, or change direction
- Grade 4: 2.4 use technological problem-solving skills and knowledge acquired from previous investigations, to design and build devices that use forces to create controlled movement
- Grade 5: 2.3 use technological problem-solving skills to design, build, and test a device that transforms one form of energy into another.

Materials:

- 2 pieces of Cardboard (10 x 10cm)
- 1 Pencil
- 4 Ring Magnets
- Construction Paper
- 1 Coin
- Tissue Paper
- 3 Skewers
- Popsicle sticks
- Scissors
- Glue
- Pompoms
- Tape
- Pencil Sharpener

Engineering and Science Connections:

Background:

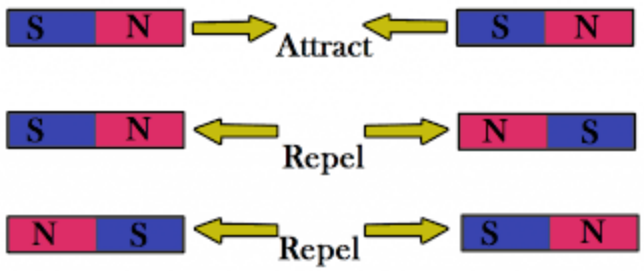
Perpetual motion machines are theoretically machines that once put into motion, will move forever without an energy source. In order for something to continue moving constantly all forces acting upon it must add together to equal zero (Newton's First law). These machines are impossible to make perfectly on Earth because of air resistance, and other external factors. However, scientists can create machines that are *almost* Perpetual Motion Machines.

One of the main techniques to creating this impossible machine is with magnets because magnets exert their own forces (push/pull) through attraction and repulsion. The biggest challenge that scientists currently face when creating these machines is eliminating all forms of resistance (ie. air resistance, surface resistance)

Learn more abut perpetual motion by watching the video below!

Video Recommendation: https://www.youtube.com/watch?v=4b8ZsFszE8I

Magnets have a North and South end, this can also be referred to as negative and positive. When two magnets are brought close together, if the North pole of one is facing the South pole of the other the magnets will attract. If the magnets are oriented such that North is facing North, or South is facing South the magnets will repel each other. Attraction and repulsion will cause the magnets to move: attraction pull them together, repulsion pushes them apart.



What we are making is NOT a perpetual motion machine, but it pretty close.
Why not:

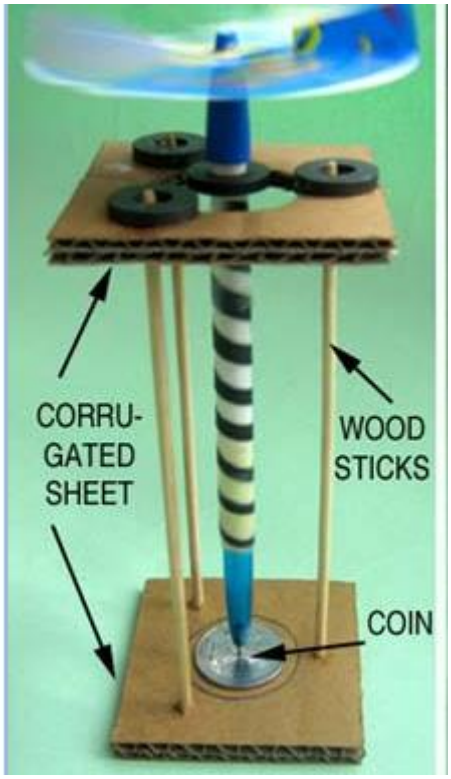
1. We can't eliminate all resistance
2. The magnets will eventually lost their magnetism

Perpetual Motion Machine

Activity:

Intro:

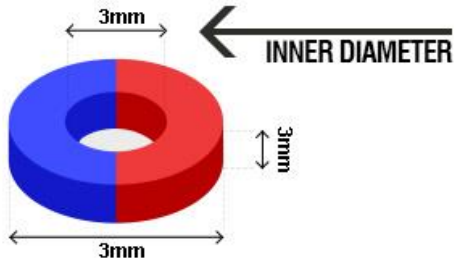
What it should look like at the end:



Let's get started!

1. Sharpen your pencil and then cut out the following cardboard pieces. The first piece of cardboard is a solid 10x10 cm square, the second piece of cardboard will be a 10x10cm square with a circle cut out of the center (with a diameter of about 5cm).
    - Note: the cardboard with the circle will be the top piece, and the whole piece of cardboard will be the bottom piece.
2. Poke three holes in both pieces of cardboard and insert the skewers. The skewers need to be ~0.5 cm away from the circle's edge and can stick out the top piece of cardboard.
3. Glue the coin in the center of the bottom piece of cardboard, it needs to be directly below the circle in the top cardboard piece.

4. Now put the structure aside, and grab the four ring magnets. Ring magnets are divided into halves with opposite polarities.

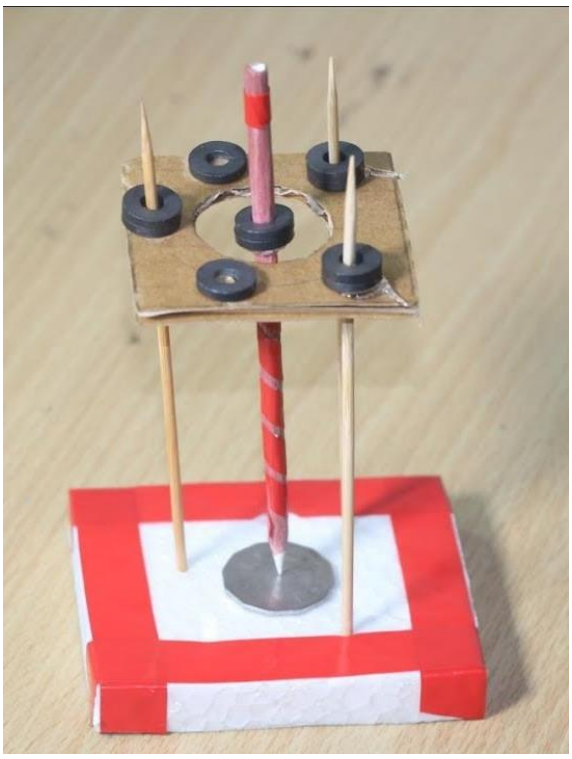


5. Set up the four magnets with three in a triangle and one in the center. The magnets should be oriented such that all the outside magnets repel the center magnet. (see https://www.youtube.com/watch?v=F2lKo4Opufk at 52 seconds)
6. Once the magnet orientation has been set transfer the three magnets to the skewers sticking out of the top cardboard piece and glue them down. Be careful not to adjust the orientation of the magnets (again, the video explains this very well)
7. Take the construction paper and cut a long triangle

8. Wrap the piece of paper around the pencil and secure it (with tape or glue)
9. Now take the fourth magnet and slide it onto the pencil, if it is too loose use glue to secure it in place.

10. Take the pencil and place it tip down in the cardboard-skewer structure, if constructed properly it should stand straight up. If it doesn't stand straight up adjust the three glued magnets so it does (the magnets should be easy to take off since hot glue was used)
11. Once the pencil is 'free' standing in the structure give it a slight twist, the pencil should continue spinning for quite some time.
12. You can now add something to the end of the pencil sticking up. (ie. a propeller, a dancer) using the additional craft supplies packed
    - It is important that if you add something large it is evenly balanced so the pencil can still stand straight up freely).

More examples of final product:



What Did You Learn?

- About magnets and how they attract or repel each other.
- The forces acting on the pencil and how we can not eliminate all forces but we did eliminate friction to some degree.
- What perpetual motion machines are.

Future Learning

- What are some other examples of perpetual motion machines?
- Investigate these further by learning about how these other machines work and see if you could make a similar machines by minimizing the forces that would stop motion.

Share your creations!

We would love to see what you made. Email as at discover@uwo.ca or tag us on social media.

Instagram: @westernueng

Twitter: @westernueng

Facebook: @westernueng

Thanks for discovering with us!