

Magnetic energy

Take home message: There is type of energy that called magnetic energy. This is the type of energy associated with magnets.

Supplies:

Magnets: 3 or so /group	tape
Pencils	D battery (1/group)
Worksheets	iron filing inside ziplock bag (1/student)
Paper clips (10 or so/group)	3" nails (1/student)
thread	razor (several for tutors emergency use)
magnet wire- varying lengths	plain white paper
	rulers

Exercise 1: 5 minutes (~4:10)

Fill out the worksheet on the different types of energy we have discussed so far.

Exercise 2: 10-15 minutes (~4:25)

Supplies: magnets, paper clips, thread, tape, rulers

Play with 2-3 magnets with paper clips. I will bring a variety of magnets from my lab/home. If you can bring magnets from your home as well please do. You can ask questions such as- "Which magnet is stronger? Why do you think it is stronger?" "How can you change magnetic energy into moving energy?" (optional: Try to get some magnets which you can use to show magnets have poles (sides that attract and sides that repel) if you would like to show this.)

To test how "strong" the magnet is, test how far away it can be from a paper clip and still hold one up in the air. For this experiment, tie one end of a piece of thread to a paper clip and tape the other end to the table. Then practice holding up the paper clip in the air (with thread taut) and see if you can measure the distance between the paper clip and the magnet. See how large you can make this distance before the paper clip falls. For my magnets from home the magnets that work well are the "lego" magnets and the "tot lok" magnet. There will also be some stronger magnets from lab. It may help for the tutor to hold the magnet steady and the student to measure the magnet/clip distance. Feel free to trade magnets with other groups.

Worksheet: Fill out chart on magnet v. distance to hold up paper clip.

Exercise 3: 10 minutes (~4:30)

Supplies: Iron filings inside a ziplock bag, magnets

Explain to the students that in the bag are tiny magnets called iron filings. Magnetic energy is stored is something we call a "field". We can't see the magnetic field, but we can use the iron filings to see it. Play with the magnets and the "force visualizer". Do different magnets produce different patterns? i.e. different field shapes?

Worksheet: Have the student draw the iron filing pattern for their favorite magnet.

Exercise 4: Electromagnets part,

Supplies: Wire, 1 D battery/group, paper clips, 3" nail, tape

Warnings: tutors should connect the electromagnets. Wires can get hot. Disconnect the magnet whenever not in use as the magnet drains the battery life quickly.

Note: If the wire does not get hot and magnetism is not observed, check the ends of the wire. The stripped ends should look gold. Sometimes there is some residual insulation (red). There will be some razor blades to scrap this off.

Have a student wrap the wire around the nail 30 times. Demonstrate how to wrap it around first. Have one student wrap 30 times, one student wrap 60 times. Connect each students coil to the battery terminals using tape. See how many paperclips can be held at the pointy end. **Record your answers on a chart.** (you could try picking up a chain connected nails)

If time, repeat for 90 windings. Can you student predict the number of paper clips he/she will be able to pick up? If there is still time, let them decide how many windings they want to do! **put your answers in the chart.**

Ask the students "What is holding up the paper clips?" (answer- magnetic force/energy)
"Where does this energy come from?" (answer- battery or electric energy) You can also see if you can see the field lines using the iron filings.

One can explain that inside the nail are tiny magnets. The magnetic field created by the electricity running through the coil causes these tiny magnets to align to create more field.

If there is extra time to explore feel free to go back to previous activities or continue with the current one. Variations can include- what happens if you use two batteries? What happens if you disconnect the battery? Reverse the terminals? Note that it takes time for the nail to magnetize/demagnetize. When the nail stays partially magnetized, what happens if you drop the magnet a few times?

Wrap up discussion: 4:55-5:00

Ask the students what type of energy we studied today. Ask them where we find this type of energy (permanent magnets, electromagnets). Ask them what their favorite experiment was.