Exercises

Lesson 1: Magnets

1. What happens when you break a magnet in half? Can you separate the north and south poles?

2. What causes magnetism?

3. Why does your refrigerator magnet stick to the fridge door?

4. Is aluminum magnetic, electrically conductive, or both?

5. What elements would you guess to be in a magnet? Can you name three?

6. What causes (or creates) magnetic fields?

7. Name the biggest magnet you can think of.

8. Where is the magnetic south pole?

9. What happens when you heat a magnet?

10. Why is a grape repelled by a magnet?

10. If you drop a magnet down a ramp, why does it go slowly?

Exercises

Lesson 2: Electromagnets

Don't be misled by the number of questions here—if you can answer these accurately, you've mastered the lesson.

1. How does a moving magnet make electricity?

2. What's an electromagnet?

3. How does the DC motor you built work?

4. What is a reed switch?

5. How does a magnet make sound?

Answers to Magnets Exercises

1. You get two smaller magnets, each with their own north and south poles. You cannot separate the north and south poles of a magnet.

2. Electrons. More accurately, a majority of electrons moving in a similar direction creates a magnetic field.

3. Electrons move on their own. They move around the nucleus and they spin. It's the electron spin that tends to be responsible for the magnetic field in those "permanent" magnets (the magnets that maintain a magnetic field without electricity flowing).

4. Aluminum conducts electricity, but is not magnetic as detectable by the human eye (called ferromagnetic). Aluminum is technically paramagnetic (very weakly attracted to both poles of a magnet).

5. Iron, nickel, and cobalt are ferromagnetic (attracted to both poles of the magnet).

6. A magnetic field is something I can't tell you about—it just is (like gravity). The best thing I can do is tell you that a field is an area around an electrical, magnetic, or gravitational source that will create a force on another electrical, magnetic, or gravitational source that comes within the reach of the field.

7. The Earth. On a universe-scale, magnetars (magnetized neutron stars) are the biggest known magnets out there.

8. Off the coast of Antarctica in the ocean.

9. When you heat a magnet past the Curie temperature, the magnet loses its magnetism. Once cooled back down, it will regain magnetism.

10. The grape contains sugar water, which is diamagnetic (repelled by both poles).

11. The eddy currents in the metal plate created by the moving (sliding) magnet slow down the magnet and counteract gravity.

Answers to Electromagnets Exercises

1. If you moved that magnet back and forth along a wire-wrapped nail fast enough you could power a light bulb. (However, by fast enough I mean like 1000 times a second or more!)
2. A magnet that you can turn on and off using electricity. An example is a nail wrapped in a coil of wire and powered by a battery pack.
3. The coil is magnetized (becomes an electromagnet), is momentarily attracted to the permanent magnet, and starts to align itself with it, but as it does, it breaks the connection and the coil becomes just a piece of unmagnetized wire which continues to rotate from the previous pull (when it was magnetic). As it does, the coil energizes again, now repelling itself and pushing itself away as it tries to align itself with the magnet again. As it realigns itself, the electricity goes off again, allowing the coil to rotate freely (and not get stuck in one position). And on it goes.
4. It's a switch that connects (turns on) when a magnet is close by. The two small steel plates hit each other and allow electricity to flow.
5. Magnetism can create electricity and electricity can create magnetism. Sound is vibrations. To make a speaker, we need to somehow make something vibrate. The radio provides the electricity that gets pumped through the wires. The radio very quickly pumps electricity in one direction and then switches to pump it in the other direction. This movement of electrons back and forth creates a magnetic field in the coil of wire. Since the electricity keeps reversing, the magnetic field keeps reversing. Basically, the poles on the electromagnet formed by the coil go from north to south and back again. Since the poles keep reversing, the permanent magnet you have taped to the cup keeps getting attracted, then repelled, attracted, then repelled. This causes vibrations. The speaker cone (or cup, as in the speaker we're going to make) that's strapped to the coil and magnet acts as a sound cone. The magnet causes the sound cone to vibrate and, since it's relatively large, it causes air to vibrate. This is the sound that you hear.

