

ELECTRICITY & MAGNETISM

TEACHER RESOURCE · HANDS-ON CLASSROOM EXPERIMENTS

These 3 experiments let students see how electricity and magnetism are connected - from a lemon-powered LED to a moving battery car and the hidden pole patterns inside refrigerator magnets.

SUPPLIES

- 3 lemons
- 3 zinc nails
- 3 copper strips or wires
- 4 alligator-clip leads
- LED
- AA battery
- 2 disc magnets
- Sheet of aluminum foil
- 2 rectangular refrigerator magnets

QUICK TIP

Use fresh, juicy lemons and clean metal surfaces. LEDs are polarized, so reversing the LED leads may be necessary.

EXPERIMENT 1

LEMON BATTERY

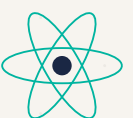
- 1 Push one zinc nail and one copper strip into each lemon. Keep the two metals from touching.
- 2 Connect the copper on lemon 1 to the zinc on lemon 2 with an alligator-clip lead.
- 3 Connect the copper on lemon 2 to the zinc on lemon 3.
- 4 Connect the two remaining free electrodes to the LED.
- 5 If the LED does not light, reverse its leads. Observe the light produced by the three lemons in series.

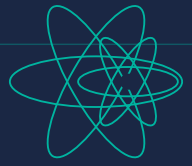
TEACHER EXPLANATION

The zinc and copper act as two different electrodes, and the lemon juice acts as an electrolyte. At the zinc electrode, a chemical reaction releases electrons. Those electrons travel through the external wires and LED, while ions move through the lemon juice to complete the circuit. Connecting three lemon cells in series adds their voltages.

CLASSROOM NOTE

Students will often expect the lemons themselves to contain stored electricity. Emphasize that the lemon battery works because the two different metals and the electrolyte create conditions for a chemical reaction and a current.





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EXPERIMENT 2

BATTERY CAR

- 1 Place one disc magnet on each end of an AA battery.
- 2 Lay a sheet of aluminum foil flat on a table.
- 3 Set the battery-and-magnet assembly onto the foil so both magnets touch the foil.
- 4 Observe the battery car move. If it does not, flip one magnet and try again.

TEACHER EXPLANATION

The magnets act as electrical contacts, allowing current to flow from the battery through the magnets and aluminum foil. A current-carrying conductor in a magnetic field experiences a force. The interaction between the current and the magnets' magnetic fields pushes the battery assembly across the foil.

SAFETY

This demo uses a very low-resistance circuit, so the battery, foil, or magnets can warm quickly. Run it only briefly, disconnect between trials, and stop immediately if any part becomes hot.

EXPERIMENT 3

KITCHEN MAGNET SLIDE

- 1 Place two rectangular refrigerator magnets face-to-face so the magnetic surfaces touch.
- 2 Slide one magnet across the other in one direction and notice how easily it moves.
- 3 Now slide it in the perpendicular direction. You should feel stronger catching, pulsing, or resistance.
- 4 Rotate one magnet 90 degrees and repeat. Compare how the direction of easy and difficult sliding changes.

TEACHER EXPLANATION

Many flexible refrigerator magnets are not one large north pole on one face and one large south pole on the other. Instead, their surfaces are magnetized in narrow alternating north-south stripes. Sliding along the stripes changes the pole alignment very little, so the magnets move smoothly. Sliding across the stripes repeatedly moves north and south poles past one another, creating alternating attraction and repulsion that you can feel.

CURRENT MAKES MAGNETISM

Electric current creates a magnetic field around a wire.

FIELDS CAN CREATE FORCE

Magnetic fields can push on magnets or current-carrying conductors.

FRIDGE MAGNET STRIPES

Rectangular refrigerator magnets often contain alternating N-S pole bands.

IT LOOKS LIKE MAGIC. IT'S JUST SCIENCE.