Fields at Work

Trace how current and magnetic fields move energy through machines.

PHS.9 "Students will explore basic principles of magnetism and electricity (e.g., static electricity, current electricity, and circuits). Use digital resources and online simulations to investigate the basic principles of electricity..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline two statements that link electric current and a magnetic field, then circle the energy input and output named for the motor and generator to track how each device works.

Inside a Recycling Plant

1. At a recycling plant, a conveyor belt carries mixed scrap past a sorting station. A permanent magnet can pull some iron and steel pieces toward it without a wire or power supply. A nearby electromagnet works differently: electric current in a coil creates a magnetic field. When workers switch off the current, the field weakens and the lifted scrap falls into a bin. A battery can supply current in a closed circuit, but an open switch breaks the path. Rubbing two materials can leave a buildup of static charge; that buildup is not the steady current used by the electromagnet.

2. A motor at the same plant drives the conveyor belt. Current flows through coils, and the magnetic field of those coils interacts with another magnetic field to make a shaft turn. The motor changes electrical energy into motion. A generator reverses that energy transfer: motion turns a coil near a magnet, or turns a magnet near a coil, so a changing magnetic field drives current in a closed circuit. The plant's backup generator might use a fuel-powered engine to turn its shaft during an outage. A magnet supplies a field, but by itself it is neither a motor nor a generator.

3. An online circuit simulation lets you test these relationships without moving heavy scrap. Build a battery, switch, and coil circuit, then use the simulation's field display to compare the magnetic field with the switch open and closed. If the simulation has an adjustable current control, change only the current and watch how the field around the coil changes. To investigate a generator, move a magnet through a coil connected to a meter; compare the meter reading when the magnet is still and when it moves. Record which changes cause an effect so your model links evidence to the direction of energy transfer.

2 ANSWER WITH EVIDENCE

Use the passage

1. Why can workers release scrap by switching off the electromagnet, while a permanent magnet needs no switch to attract scrap?

2. Trace the energy transfer in the conveyor motor and the backup generator. How do their roles differ?

3. In the circuit simulation, what would you compare to test whether current affects the coil's magnetic field? What change do you expect when the switch opens?

4. In the generator test, how should the meter readings differ when the magnet is still and when it moves through the coil? Explain why.

3 YOUR TURN

Your own words

Design a model of a wind-driven generator powering a small fan motor. In four sentences, explain the role of magnetic fields and current in each device, then describe one simulation test and the observation that would support your model.

Fields at Work

PART 1 · READ AND MARK

Underline two statements that link electric current and a magnetic field, then circle the energy input and output named for the motor and generator to track how each device works. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Why can workers release scrap by switching off the electromagnet, while a permanent magnet needs no switch to attract scrap?	**The electromagnet's field depends on current, which the switch interrupts. The permanent magnet attracts scrap without current.**
2	Trace the energy transfer in the conveyor motor and the backup generator. How do their roles differ?	**The motor changes electrical energy into motion to drive the belt. The generator uses motion to produce electric current.**
3	In the circuit simulation, what would you compare to test whether current affects the coil's magnetic field? What change do you expect when the switch opens?	**Compare the field display with the switch closed and open. Opening the switch stops the current, so the coil's field weakens.**
4	In the generator test, how should the meter readings differ when the magnet is still and when it moves through the coil? Explain why.	**A still magnet should produce no sustained reading; moving it through the coil should produce a reading because the changing magnetic field drives current.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Wind turns the generator's shaft, moving a magnet near a coil. The changing magnetic field drives current through a closed circuit to the fan motor. In the motor, current creates a magnetic field that interacts with another field and turns the fan blades. In a simulation, I would stop and start the generator shaft; a meter reading only while it turns would support my model.

Accept models that correctly connect changing magnetic fields to generator current and current-driven magnetic interactions to motor motion. Simulation tests should change one condition and name an observable result.