

# Charge to Crane

Trace how charge, current, and magnetic fields produce useful effects.

**PS.9** "The student will investigate and understand that there are basic principles of electricity and magnetism. Key ideas include an imbalance of charge generates static electricity; materials have different conductive properties..."

NAME \_\_\_\_\_

DATE \_\_\_\_\_

## 1 READ AND MARK \_\_\_\_\_ Read it twice

**YOUR JOB** Find the five sentences that contain *so*, *because*, or *causing*, number them 1-5, circle the signal word, write C above the clause naming the cause and E above the clause naming the effect, remembering that in a *because* sentence the cause comes after the word.

### Energy in Motion

- ① On a dry day, Maya pulls a sweater over her head and hears tiny snaps. Rubbing the fabrics moves electrons from one material to another. The sweater may lose electrons, while her hair gains them. This imbalance of charge creates static electricity, so some hairs repel one another and stand up. A metal doorknob can provide a path for extra electrons to move quickly, causing a small spark. The spark is not electricity being created. It is charge moving to reduce the imbalance.
- ② Materials do not all let electrons move equally easily. Copper has mobile electrons, so it is a good conductor for wires. Rubber and plastic hold electrons more tightly and act as insulators. In a closed circuit, a cell or battery transfers energy to charges that move through a complete path. The moving charges transfer energy to a lamp, making its filament or LED produce light. If a switch opens the path, current stops because charges can no longer travel around the circuit.
- ③ Magnets create magnetic fields in the space around them. A paper clip made of iron is pulled toward a magnet because the field can line up magnetic regions in the iron. Electric current also makes a magnetic field around a wire. Wrapping the wire into a coil strengthens the field, and placing an iron core inside the coil can strengthen it further. In an electromagnet, turning off the current makes the magnetic effect fade. This relationship is used in doorbells, motors, speakers, and recycling cranes.

**2 ANSWER WITH EVIDENCE** \_\_\_\_\_ Use the passage

**1** How does rubbing the sweater and hair lead to static electricity?

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**2** Why is copper useful for wires, while rubber and plastic are useful as insulators?

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**3** Describe the energy transfer in the closed lamp circuit. What changes when the switch opens?

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**4** Why does an electromagnet's magnetic effect fade when its current is turned off? Name one technology that uses this relationship.

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**3 YOUR TURN** \_\_\_\_\_ Your own words

Design a classroom tool that uses an electromagnet. Write four sentences that name its circuit parts, explain how energy moves when the switch closes, explain how current creates its magnetic effect, and tell what happens when the switch opens.

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**PART 1 • READ AND MARK**

Find the five sentences that contain *so*, *because*, or *causing*, number them 1-5, circle the signal word, write C above the clause naming the cause and E above the clause naming the effect, remembering that in a *because* sentence the cause comes after the word. Accept any marking that follows this job and points at the right text.

**PART 2 • ANSWERS**

| # | QUESTION                                                                                                                          | ANSWER                                                                                                                                                                                       |
|---|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | How does rubbing the sweater and hair lead to static electricity?                                                                 | <b>Rubbing moves electrons from one material to another. The resulting imbalance of charge creates static electricity.</b>                                                                   |
| 2 | Why is copper useful for wires, while rubber and plastic are useful as insulators?                                                | <b>Copper has mobile electrons and conducts well. Rubber and plastic hold electrons more tightly, so they act as insulators.</b>                                                             |
| 3 | Describe the energy transfer in the closed lamp circuit. What changes when the switch opens?                                      | <b>A cell or battery transfers energy to charges moving through the complete circuit, and the charges transfer energy to the lamp. Opening the switch breaks the path, so current stops.</b> |
| 4 | Why does an electromagnet's magnetic effect fade when its current is turned off? Name one technology that uses this relationship. | <b>The magnetic field is produced by electric current, so it fades when the current stops. Accept doorbell, motor, speaker, or recycling crane.</b>                                          |

**PART 3 • YOUR TURN (SAMPLE ANSWER)**

A classroom sorting tool uses a battery, switch, wire coil, and iron nail to make an electromagnet. When the switch closes, charges move through the complete circuit, and the battery transfers energy to them. Current in the coil creates a magnetic field that lets the nail lift paper clips. When the switch opens, current stops, so the magnetic effect fades and the paper clips fall into a bin.

For the marking job, the five target sentences begin with "This imbalance," "A metal doorknob," "Copper," "If a switch," and "A paper clip." Accept equivalent wording in student responses when it accurately connects charge movement, energy transfer, current, and magnetic fields.