The Turning Compass

Trace how electric current creates and changes magnetic fields.

PS.9.e "electric current and magnetic fields are related; and"

NAME ______________________ DATE ____________

1 READ AND MARK

Read it twice

YOUR JOB Underline each sentence that explains how electric current affects a magnetic field or a compass. In the margin, number the changes in current that cause a change in the magnetic effect.

Current Makes a Field

1 At a repair shop, a technician holds a compass near a straight copper wire. Before the switch closes, the compass needle points north and south because Earth has a magnetic field. When charges begin moving through the wire, the needle turns. The moving charges make a magnetic field around the wire. This new field combines with Earth's field at the compass, so the needle no longer points in its usual direction. Electric current is the organized movement of electric charges.

2 The magnetic field is not equally strong everywhere. It is strongest close to the wire and becomes weaker farther away. Increasing the current makes the wire's magnetic field stronger, which can cause a larger compass deflection. Reversing the current reverses the direction of the magnetic field around the wire. A compass responds by turning the opposite way. These observations let scientists use a compass as evidence that current and magnetic fields are connected in a circuit.

3 Engineers use this relationship in electromagnets. They wrap insulated wire into a coil and send current through it. The fields from many loops add together, making a stronger magnetic field than one straight section of wire can make. Placing an iron nail inside the coil can strengthen the electromagnet because the iron becomes magnetized. Opening the circuit stops the current, and the electromagnet's field greatly decreases. Scrap-yard cranes and some doorbells use electromagnets that can be switched on and off.

2 ANSWER WITH EVIDENCE

Use the passage

1. What happens to the compass needle when charges begin moving through the straight wire?

2. How does increasing the current affect the wire's magnetic field and the compass?

3. What two changes occur when the direction of current is reversed?

4. Why can a coil of wire make a stronger magnetic field than one straight section of wire?

3 YOUR TURN

Your own words

Create a three-panel sketch of an electromagnet with a battery, switch, wire coil, and iron nail. Show the switch open in Panel 1, current in one direction in Panel 2, and reversed current in Panel 3. Use arrows and write a caption for each panel that explains the magnetic effect.

ANSWER KEY **The Turning Compass** GRADES 7-8 · PS.9.e

PART 1 · READ AND MARK

Underline each sentence that explains how electric current affects a magnetic field or a compass. In the margin, number the changes in current that cause a change in the magnetic effect. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	What happens to the compass needle when charges begin moving through the straight wire?	**The needle turns away from its usual direction because the current creates a magnetic field around the wire.**
2	How does increasing the current affect the wire's magnetic field and the compass?	**The magnetic field becomes stronger, and the compass can show a larger deflection.**
3	What two changes occur when the direction of current is reversed?	**The magnetic field around the wire reverses direction, and the compass turns the opposite way.**
4	Why can a coil of wire make a stronger magnetic field than one straight section of wire?	**The magnetic fields from the many loops of wire add together.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Panel 1: The switch is open, so no current moves through the coil. The electromagnet's field greatly decreases. Panel 2: The switch is closed, and current moves through the coil in one direction. The coil makes a magnetic field around the iron nail. Panel 3: The battery connections are reversed, so current moves through the coil in the opposite direction. The electromagnet's magnetic field reverses direction.

Accept answers that connect moving electric charges to a magnetic field and accurately describe stronger current, reversed current, or multiple coil loops. In the sketch, accept any consistent arrow directions, as long as the student shows that reversing current reverses the magnetic field.