Lesson 10: Magnetic Compasses

Grade: 3rd-8th

Duration: 30-45 minutes

Standards:

- *NGSS Physical Science* – Magnetism is a force that can act on things from far a distance and can be used as a problem-solving tool when applied scientifically.
- *NGSS Engineering Design* – Define a simple problem and design a tool within given constraints.
- *NGSS Earth Science* – Earth has a magnetic field that can be mapped through space.

Objective:

- Students will explore the properties of magnets and use them to create a simple navigation tool, the compass.

Key Vocabulary:

- compass, navigate, navigation, magnet, magnetic field

Recommended Prior Knowledge:

- cardinal directions

Materials:

- small handheld compasses, cork, water, clear cups or jars, small ceramic disc magnets, paperclips, iron filings, strong bar magnet, white paper, brass fasteners

Additional Resources:

- See attached diagram for magnetic compass construction

Procedure:

1. At the beginning of class, work with students to label the walls of the classroom north, south, east, and west. After deciding on the final orientation, ask students to think about how we know which way is north? Is north always the same anywhere you are on Earth?
2. Pass out compasses to partners or small groups of students so that each student is able to see and interact with a compass. If possible, allow each student to hold a compass.
3. Demonstrate how to properly hold a compass so that it is parallel to the ground, in front of the body. Have students hold the compass in their hands and spin slowly around in the circle while watching the needle. Ask students what observations they made of the needle in the middle of the compass. *Caution*: Holding compasses near each other will cause them to misread.
4. Explain that the needle in the middle of the compass has a north and south point and the side

that indicates north is always pointing north, no matter which way you are facing when you hold it. However, the needle needs to be able to spin freely in the container for it to work correctly.

5. Ask students if they can think of anything else that has a north and south pole? Explain that a magnet does!
6. Pass out small ceramic disc magnets and ask students to put the magnet near their compass. Ask students to observe as the compass needle spins to meet the magnet.
7. Demonstrate magnetic fields by pouring iron filings on a piece of white paper and putting a strong bar magnet underneath. Have students observe what happens to the iron filings when this is done. Can students see little hairy lines of iron filings form? Explain that this is the magnetic field that surrounds each magnet. Since Earth is a big magnet, it has invisible magnetic field lines surrounding it out into space. The compass picks up on the magnetic field lines and the needle always spins to point north and south along those field lines.
8. Explain to students that compasses are a very old technology and early navigators including sailors and aviators relied on low-tech compasses to help them get where they wanted to go.
9. Introduce the activity to make a simple compass using just a magnet, some metal, and a cup of water to float our compass.
10. Help students construct homemade compasses. (See the attached diagram for one way to make a simple magnetic compass.) Unfold the first bend of a paperclip and poke the end into a cork. Stick two small ceramic disc magnets together with the folded part of the paperclip between them, just below the cork. Use brass fasteners to make the compass needle, attaching them to the sides of the disc magnets so that they are pointing in opposite directions. Fill a tall clear cup or jar with water and set the apparatus inside. The compass should be able to float without touching the sides or bottom of the container so it can orient correctly with one brass fastener facing north the other south.
11. After the compass is built, have students identify which side points north and which points south. Students can bend the brass fastener that points south to help identify it.
12. If time allows, challenge the students to follow instructions using their compasses. For example: Walk 5 paces North, 3 paces West, 2 paces South, and 1 pace East, etc.
13. End with discussion about why compasses are important for travelers.

Magnetic compass construction diagram: