

GALLOPING GALVANOMETER

BENCHMARKS and TASKS

SC.B.1.2.1 The student knows how to trace the flow of energy in a system (e.g., as in an ecosystem).

SC.B.1.2.2 The student recognizes various forms of energy (e.g., heat, light, and electricity).

SC.B.1.2.4 The student knows the many ways in which energy can be transformed from one type to another.

SC.C.2.2.1 The student recognizes that forces of gravity, magnetism, and electricity operate simple machines.

- The student constructs an electromagnet and conducts experiments to observe the relationship between electricity and magnetism.
- The student designs and creates electric circuits used to operate machines (e.g., spin art, galvanometer).

KEY QUESTION

What is a galvanometer?

BACKGROUND INFORMATION

A galvanometer is a device that detects and measures small electric currents. Johann Schweigger, a German physicist, constructed the first galvanometer shortly after Oersted's discovery of the link between electricity and magnetism. Schweigger's galvanometer was comprised of a magnetized needle surrounded by a coil of wire. When an electric current was present in the coil, it produced a **magnetic** field that deflected the needle. When the current to the coil was reversed, the needle was deflected in the opposite direction. The polarity of the magnetic field depends on the direction of the current in the wire.

MATERIALS

Teacher

masking tape
1 AA-cell
sewing thread
2 straws
1 piece of insulated wire about one meter long, cut into strips
1 chunk of modeling clay
1 flashlight bulb and holder
2 small bar magnets (each about 2.5 cm long)
wire cutters
optional: battery holder and switch

Per group

50 cm of insulated wire, stripped 3 cm from the ends
1 D-cell
1 magnetic compass
wire strippers
1 battery holder

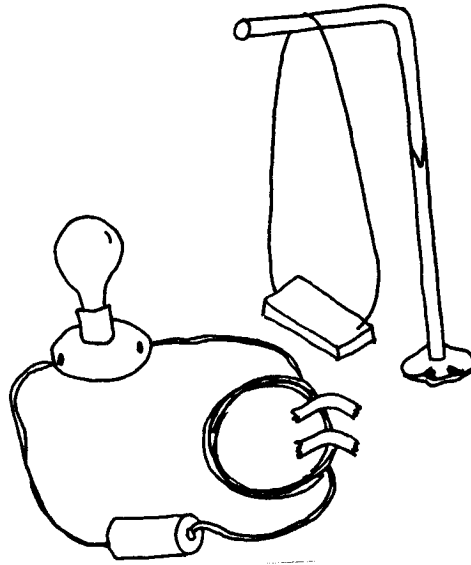
Per student

science journal

TEACHING TIPS

1. Any magnetic compass will work for this activity.
2. Construct the electromagnetic swing ahead of time and use for a class demonstration. The swing will help to demonstrate the relationship between electricity and magnetism.

3. To construct the swing follow these directions:



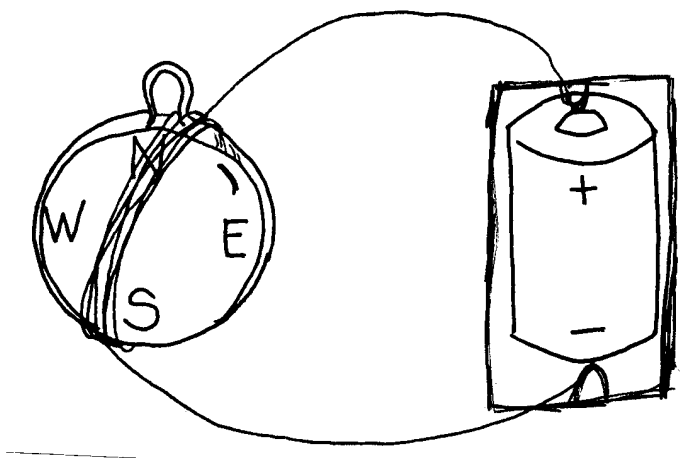
- Form a base with the modeling clay.
- Insert one straw into the other straw about one centimeter and place the extended straw into the clay base. The top one-third of the straw should be bent at a ninety-degree angle.
- Attach sewing thread to the magnet with a piece of tape, tying the thread over the straw overhang so the magnet swing rests approximately 1 cm above the table.
- Construct a circuit using the wire, battery, flashlight bulb, and bulb holder.
- Tape the battery in place and cut the wire so there is a short piece that connects one battery terminal to the holder and a long piece that connects the holder to the opposite battery terminal.
- Strip the ends of both wires, arranging the long wire so that it loops two to four times.
- Connect the circuit with tape, leaving one terminal open.
- Test the circuit by touching the stripped wire to the open terminal. After testing the circuit, leave it open.
- Adjust the setup until the magnet hangs just above the wire on one side of the loop.
- Once everything is in place, firmly tape the circuit to the work surface. One option that will ensure stable connections is to use a battery holder and a switch.
- Close the circuit. In order to keep the swing going and to send it even higher, the circuit must be opened and then closed again whenever the magnet hangs directly over the wire loop.

ENGAGE

1. Demonstrate the swing for the students. Ask:
How does this resemble an “ordinary” swing?
What is causing the magnet to swing back and forth?
2. Challenge students to think of another method to set the magnet swing in motion.
3. Make the swing accessible to students so they can explore on their own.

EXPLORE

1. Distribute materials to each group. Have students build a galvanometer:



- Students should wrap wire around the compass in a North/South orientation, leaving about 10 cm free at each end.
 - Have student align the compass so the needle points north.
 - Students should then place the D-cell in the battery holder and thread the ends of the wire through the loops on the battery holder.
2. Ask students to observe what happens. Record students' responses on the board or chart paper.
 3. Tell students to reverse the D-cell and attach the ends of the wires again.
 4. Ask students to make observations and record their responses.

EXPLAIN

What happened when the D-cell was attached to the galvanometer? (The compass needle was deflected.)

What caused this to happen? (The current in the coil of wire produces a magnetic field that interacts with the magnetic field of the compass.)

What happened when you reversed the D-cell? (The needle was deflected in the opposite direction.)

What does this demonstrate? (The direction of the current determines the polarity of the magnetic field.)

EXTEND/APPLY

Students can continue to experiment with the galvanometer by using various gauges or lengths of wire and more than one cell.

EXTENSION

Follow directions for making a simple electric motor.

ASSESSMENT

Have students respond in their journals to this question: *What does a galvanometer measure and how does it work?*