FLOATING COMPASS

Let a steel needle point the way!

Curriculum topics:

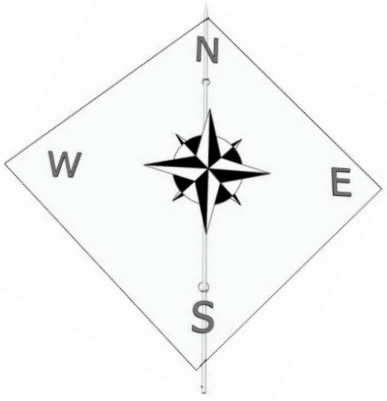
- Magnetism
- Geography
- Orienteering
- Magnetic Poles
- Magnetic Fields
- Properties of Materials

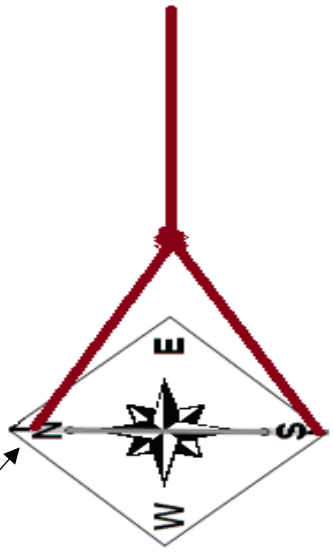
Subject:
Physical Science, Earth/Space Science

Grade range: 4 – 12

The floating compass is a useful tool for detecting the magnetic fields of magnets and of the Earth. Make a simple compass with a magnetized needle that demonstrates the properties of magnetic materials and shows that magnets have north and south poles. Using the floating compass provides a visual example of how like poles repel each other

Top view: Centered needle through compass rose





Thread in slits, compass parallel to floor

Floating Compass (hanging version)

Who we are:

Resource Area for Teaching (RAFT) helps educators transform the learning experience by inspiring joy through hands-on learning.

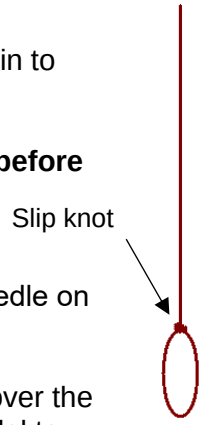
For more ideas visit
https://raft.net/resources-2/

Materials required per compass

- Steel blunt-tip needle (x1)
- Thread, 1" – 1 ½" length (x1)
- Plastic portion cup (x1)
- Magnet w/ one pair N and S poles (x1)
- Scissors
- Pushpin (x1)
- Water
- Optional: Flat foam piece
- Compass Rose Blackline Master, printed and cut from transparency (x1), visit https://bit.ly/2x6fZY9

Set-Up

1. **Hanging Version:** Cut the compass rose from the transparency if not pre-cut. Use a pushpin to poke one small hole through each of the two printed circles on the compass rose.
2. Make two short slits starting at the "N" and "S" corners by cutting towards the center. **Stop before reaching the letters**.
3. Insert the steel needle point first into the hole by the "S" starting from the **underside** of the compass rose. Push the needle across to the "N" hole and insert the needle. Center the needle on the compass rose (see title page).
4. Make a 4" slip knot in a 1" - 1½" length of thread (shown at right). Place the loop of thread over the ends of the needle and hold the other end of the thread. Adjust the needle so that it is parallel to the floor in all directions (see title page).
5. **Water Version:** Insert the needle point first into the hole by the "S" starting from the **topside** of the transparency. Push the needle across to the "N" hole and insert.
6. Center the needle on the compass rose. The compass rose will curve **downward** with the needle below the compass rose (right).
7. Optional: Wedge a flat piece of foam between the needle and compass rose to aid in flotation.



To do and notice

1. Magnetize the needle by briefly touching the south pole of a strong magnet to the pointed end of the needle, and then touch the north pole of the magnet to the "eye" end of the needle.
2. **Hanging version**: Suspend the compass by holding the end of the thread. Note the direction the "N" corner of the compass rose points. If the "N" is not pointing north, re-magnetize the needle making sure the south pole of the magnet touches the pointed end of the needle.
3. **Water version**: Fill the portion cup with enough water to float the compass rose. Put the magnetized compass rose in the water. If the compass sinks, dry it off and try it again. Note the direction the "N" points. Re-magnetize as mentioned above for the hanging version if the "N" is not pointing north. The compass might touch a side of the portion cup. Lightly tap the cup or reposition the compass so that it is free and centered in the cup.
4. Predict how the compass will react when a magnet's north or south pole is facing the compass. Can the needle be made to spin? Try it!

Content Standards:

NGSS

Magnetic Interactions:
3-PS2-3
MS-PS2-5

Strength of Magnetic Forces:
MS-PS2-3

Patterns of Earth's Features (Studied using orienteering):
4-ESS2-2

The science behind the activity

Everything is made up of extremely tiny parts (electrons, protons, etc.) that have an electrical charge. When charged particles move about they create magnetic fields. In most cases, these fields cancel each other out at the sub-atomic level. In magnetic materials, like iron, these fields do not cancel out (due to the structure of the atoms). In these materials, groups of atoms can be thought of as tiny bar magnets, which are usually oriented in different directions, canceling any net magnetic field.

Touching the steel needle (made from iron) to a magnet causes most of the groups (domains) of iron atoms to align, magnetically, in the same direction. The magnetic fields combine, "pushing and pulling the same way"; into a strong enough force to create a temporary magnet from the steel needle!

Magnetic material (not magnet)

Magnetized magnetic material (magnet)

The north pole will point northward while the south pole points southward. This can be a source of confusion when students learn that like poles repel each other. Why does the north pole of a compass needle point toward the Earth's North Pole? Well the answer is that magnets were labeled before people knew why they pointed north or had a "north seeking" pole. The Earth's North Pole is a geographic north pole, not a magnetic north pole. The Earth acts as if it had a south magnetic pole in the North Polar Region (near but not at the pole) and a north magnetic pole in the South Polar Region. The Earth's magnetic poles have (and will) moved about and have even switched places over time!

Learn more

- Magnetize the needle with magnets of various strengths and observe differences in compass motion.
- Create a large compass to test the effect of size on the ability to magnetize the needle.
- Use either the water-based or thread version of the compass in a simple orienteering exercise.
- Brainstorm and design a game that uses the compass to find hidden items inside or outdoors.

Visit https://raft.net/ to view the following related activities!

Amazing Magnetic Worms
Floating Garden of Magnets
Mini Magnet Wands
Magnetic Field Line Viewer

Resources

- Compass rose history - https://bit.ly/2y2Zvji
- Navigation with Maps and compass - https://bit.ly/2Rm5ruw