PRACTICE 13: CONSTRUCTING A COMPASS

Scientific basis: Earth has magnetic fields like that of a bar magnet with a pole at each end.

How do you magnetise a needle?
Iron, nickel and cobalt contain tiny regions called magnetic domains, in which electrons align in the same direction. These domains point in different directions so tend to cancel each other out.
When one of these metals is exposed to a strong magnetic field the domains are encouraged to align, which turns it into a temporary magnet.
This is how a steel needle (which contains iron) becomes magnetised when stroked by a permanent magnet.

Why does a compass point North?
Once the needle is magnetised it naturally wants to align with the Earth's stronger magnetic field.
Scientists believe this field, called the magnetosphere, is created by electrical currents that are generated by a churning molten iron core deep inside the planet.
It means the Earth acts as if it has a bar magnet running through it with the magnet's south pole located near the planet's geographic north. Since opposites attract the north pole of a magnetised needle is attracted towards it.

Material:

- Sewing needle
- Plastic bottle cap
- Bar magnet
- Sticky tack/tape
- Shallow dish of water

Procedure:

NOTE: Be careful when handling sharp needles and using knives or scissors.

1. Magnetise the needle by stroking it with one end of the bar magnet 50 times from tail to tip.

2. Stick the magnetised needle to cap with some tack/tape, this will keep the needle floating on the water.

3. Float the cap in a dish of water. Water creates an almost frictionless surface which allows the cork to rotate until the north pole of the needle points towards the magnetic north pole.

4. You can then check that the result is correct using a field compass or a smart phone with a compass tool. The needle will slowly lose its magnetic charge over time.

QUESTIONS:

Once you have your compass working, approach the magnet to the needle, and then put it away again. Explain what happens.

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Compare your compass with those of the other groups. Do they point in the same direction? Why or why not?

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The Earth is a giant magnet. Why? Could you draw a diagram of the Earth with the magnetic poles indicated?

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ELECTROMAGNETISM

Your teacher is going to show you how electricity and magnetism are two faces of the same phenomenon. Watch the demonstration, and then answer these questions:

The piece of metal in the shape of a prism is initially: ☐Magnetic ☐Not Magnetic

Can the piece go through the hole inside the copper coil initially: Why or why not? Identify the forces acting on the prism.

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Once the electric current is flowing through the copper coil, what happens to the prism when the teacher puts it down the hole? Why? Identify the forces acting on it?

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Finally, what happens to the small pieces of hardware when approached to the prism when electric current is flowing? And when it stops?

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Could you think of at least one use of an electromagnet in our society? Write it down:

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