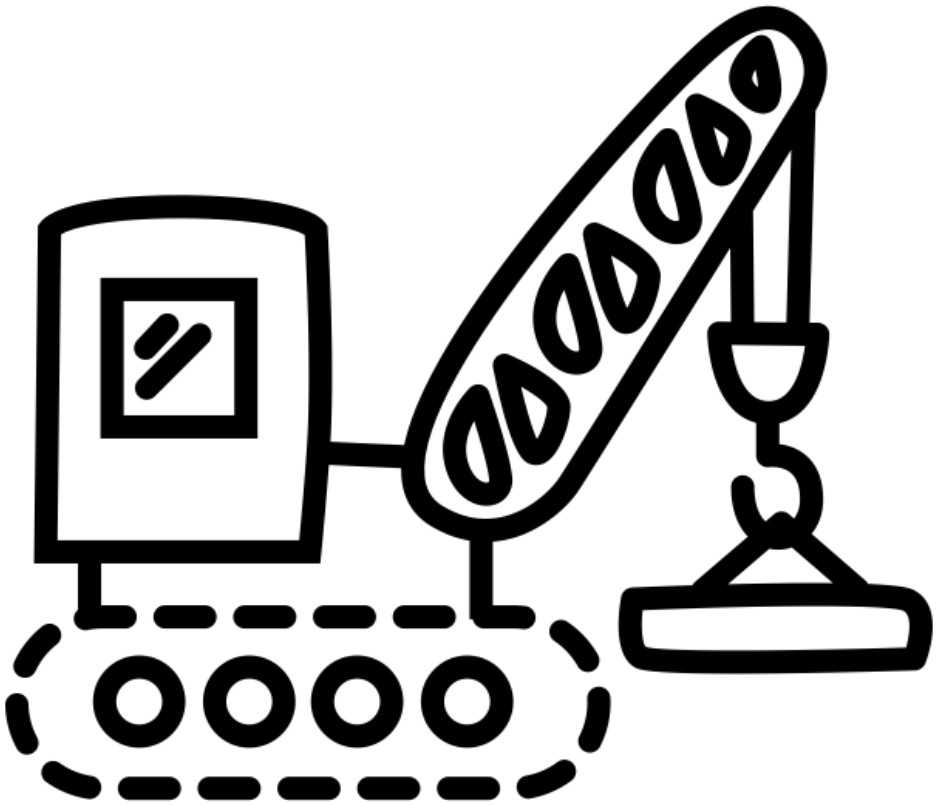
Magnets and Electromagnets



Name _____

Class _____

Teacher _____

L1 Magnetism

Magnets are objects that can attract or repel certain materials, like iron, nickel, and cobalt. They have two ends called poles: a North pole and a South pole.

- Attraction and Repulsion: Opposite poles (North and South) attract each other, while like poles (North and North or South and South) repel each other.

- Magnetic Materials: Only materials with specific properties can be attracted by magnets.

Magnetic Fields

What Is a Magnetic Field?

A magnetic field is an invisible area around a magnet where magnetic forces can be felt. Imagine it like a bubble around the magnet where it can affect other objects.

Visualizing Magnetic Fields

- Field Lines: You can think of magnetic field lines as lines that show the direction and strength of the magnetic field. They start from the North pole and curve around to the South pole.

- Strength: The closer the lines are to each other, the stronger the magnetic field in that area.

Everyday Examples

- Fridge Magnets: These are small magnets that stick to the metal surface of your fridge.

- Compasses: A compass needle is a small magnet. It aligns itself with the Earth's magnetic field, always pointing towards the magnetic North.

Application

- Navigation: Magnets help in navigation (like compasses).

- Technology They are used in many gadgets, from speakers to hard drives.

- Medicine: MRI machines use magnets to look inside your body without surgery.

Independent practice

1. What are the two types of poles found on a magnet?

2. What happens when you bring the North pole of one magnet close to the South pole of another magnet?

3. What is a magnetic field?

4. Which materials are typically attracted to magnets?

5. How can you visualize the magnetic field around a bar magnet using iron filings?

6. Describe what would happen if you cut a bar magnet in half. Will you end up with isolated North or South poles?

7. How does a compass work, and why does it always point North?

8. Name three everyday objects that use magnets and explain their use.

9. Why do like poles of magnets repel each other?

10. Drawing Task: Draw the magnetic field lines around a bar magnet, indicating the direction of the field lines from the North pole to the South pole.

L2 Magnetic Fields Practical

1. Place the bar magnet flat on the surface. Make sure it is stable and won't move during the demonstration.

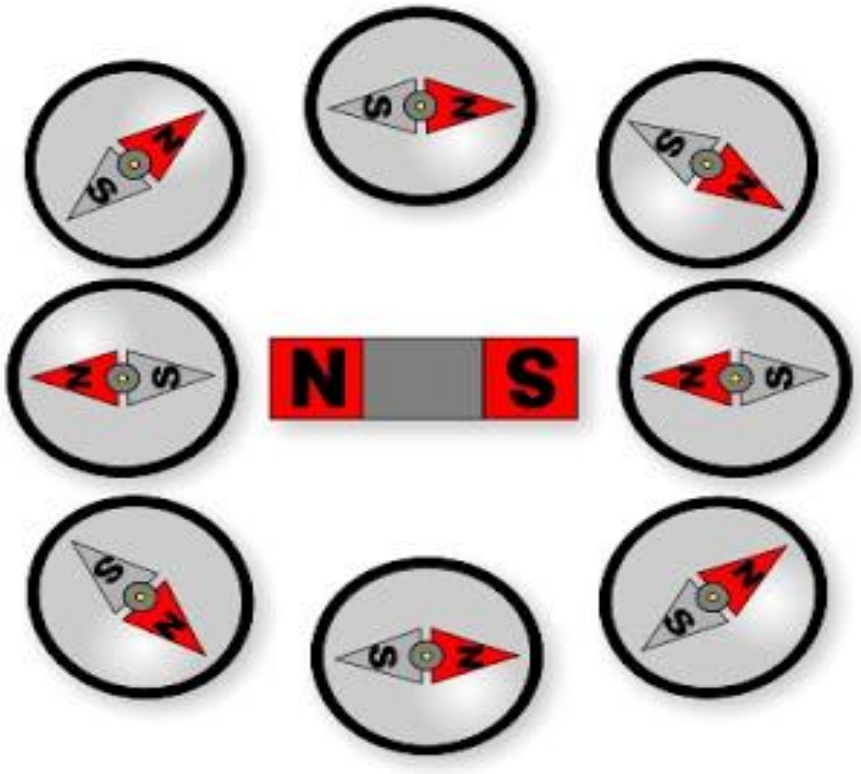
2. Start by placing a compass at one end of the bar magnet, near the North pole. Gradually place more compasses around the magnet, spacing them evenly. Ensure they are all at the same distance from the magnet. Place compasses at both ends (North and South poles) and around the sides of the magnet.

3. **Observe the Compass Needles : Look at the direction each compass needle points. The needle's North end will point towards the South pole of the magnet, and the South end will point towards the North pole of the magnet.

- Notice how the needles align themselves in a curved pattern around the magnet.

4. Use a marker or pencil to draw the lines on the surface that connect the directions of the compass needles. These lines represent the magnetic field lines.

- You will see that the lines start from the North pole of the magnet, curve around, and end at the South pole. The field lines are closer together near the poles, indicating a stronger magnetic field.



Independent practice

Describe the practical and explain what you have observed.

L3 Earths Magnetic Field

The Earth's magnetic field is similar to that of a giant bar magnet tilted at an angle of about 11 degrees from the planet's rotational axis. This magnetic field extends from the Earth's interior out into space, where it interacts with the solar wind—a stream of charged particles emanating from the Sun.

Structure of the Earth's Magnetic Field

1. Magnetic Poles:

- The Earth has a North Magnetic Pole and a South Magnetic Pole, which are not the same as the geographic North and South Poles. The North Magnetic Pole is actually a south magnetic pole because it attracts the north pole of a compass needle.

- The magnetic poles move over time due to changes in the Earth's core.

2. Magnetosphere:

- The magnetosphere is the region around the Earth dominated by its magnetic field. It extends thousands of kilometres into space and acts as a shield against the solar wind.

- The magnetosphere is shaped like a teardrop, compressed on the side facing the Sun (the dayside) and elongated on the opposite side (the nightside).

How the Earth's Magnetic Field is Generated?

- The Earth's magnetic field is generated by the movement of molten iron and nickel in the outer core. This movement creates electric currents, which in turn produce magnetic fields. This process is known as the geodynamo.

Importance of the Earth's Magnetic Field

1. Protection from Solar Wind:

- The magnetic field deflects most of the solar wind, preventing it from stripping away the atmosphere. This protection is crucial for maintaining life on Earth.

2. Navigation:

- Compasses work because of the Earth's magnetic field. The compass needle aligns itself with the magnetic field lines, helping in navigation.

3. **Auroras:**

- The interaction between the Earth's magnetic field and charged particles from the solar wind causes auroras, such as the Northern Lights (Aurora Borealis) and the Southern Lights (Aurora Australis). These light displays are most commonly seen near the magnetic poles.

Visualizing the Earth's Magnetic Field

Field Lines:

- Imagine lines that emerge from the South Magnetic Pole, curve around the Earth, and enter at the North Magnetic Pole. These lines represent the magnetic field. The density of the lines indicates the strength of the magnetic field, which is strongest at the poles and weaker at the equator.

Independent practice

1. What causes the Earth's magnetic field?

2. What are the names of the Earth's magnetic poles?

3. How are the Earth's magnetic poles different from the geographic poles?

4. What is the magnetosphere?

5. How does the magnetosphere protect the Earth?

6. Describe the shape of the magnetosphere and explain why it has this shape.

7. What is a magnetic field line, and how do they help visualize the Earth's magnetic field?

8. How do auroras form, and where are they typically seen?

9. How does the Earth's magnetic field aid in navigation?

10. Explain the difference between the North Magnetic Pole and the South Magnetic Pole in terms of magnetic polarity.

11. How can you visualize the Earth's magnetic field using a compass?

L4 Magnetic Effect of a Current

When an electric current flows through a conductor (such as a wire), it generates a magnetic field around the conductor. This phenomenon is known as the magnetic effect of a current or electromagnetism. Here's a detailed explanation:

1. Magnetic Field Around a Straight Conductor:

When current flows through a straight wire, it creates a magnetic field that forms concentric circles around the wire. The direction of the magnetic field can be determined using the **Right-Hand Rule**: if you point the thumb of your right hand in the direction of the current, your fingers will curl in the direction of the magnetic field lines.

2. Magnetic Field in a Loop or Coil:

- When the wire is formed into a loop or coil (solenoid), the magnetic field lines inside the loop become concentrated and more intense. The field lines form closed loops, entering one end of the coil and exiting the other, creating a magnetic field similar to that of a bar magnet with a defined North and South pole.

How an Electromagnet Works

An electromagnet is a type of magnet where the magnetic field is produced by an electric current. It consists of a coil of wire (often wound around a core of ferromagnetic material like iron) through which an electric current flows.

Components of an Electromagnet:

1. Coil of Wire (Solenoid): The wire is typically wound into a tight coil to amplify the magnetic field. The more turns in the coil, the stronger the magnetic field generated.

2. Ferromagnetic Core: A core made of ferromagnetic material (like iron) is often placed inside the coil. The core becomes magnetized when current flows through the coil, significantly increasing the strength of the magnetic field.

3. Power Source: A battery or other power source provides the electric current that flows through the wire.

How It Works:

1. Current Flow: When the power source is connected, electric current flows through the coil of wire.

2. Magnetic Field Creation: The flowing current generates a magnetic field around each loop of the coil. These fields combine to produce a strong, concentrated magnetic field along the length of the core.

3. Magnetization of the Core: The ferromagnetic core enhances the magnetic field. The magnetic domains in the core align with the magnetic field produced by the coil, resulting in a much stronger overall magnetic field.

4. Controllability: The strength of the electromagnet can be controlled by varying the amount of electric current flowing through the coil. Turning off the current causes the magnetic field to disappear, demagnetizing the core.

Applications of Electromagnets

Motors and Generators: Electromagnets are key components in electric motors and generators.

Relays and Solenoids: Used in various electrical devices to control switches and mechanical movements.

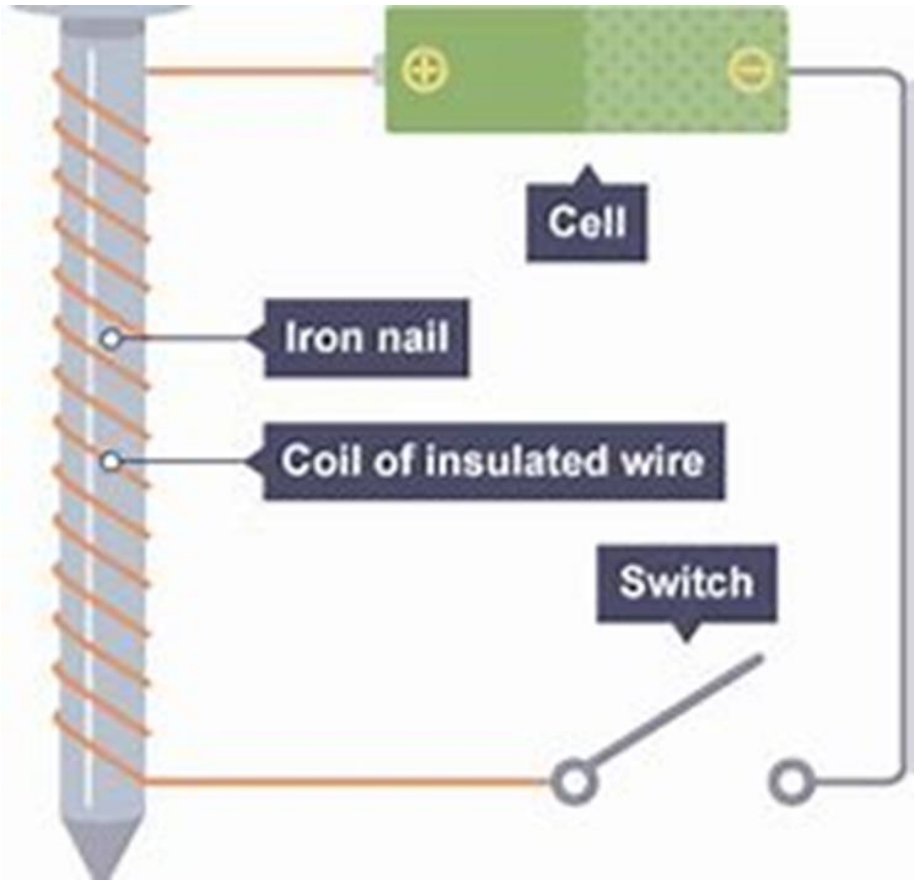
Magnetic Lifting Devices: Used in industries to lift heavy ferrous materials.

Magnetic Resonance Imaging (MRI): Powerful electromagnets are used in medical imaging devices.

Independent practice

1. What happens when an electric current flows through a conductor?
2. Describe the magnetic field created around a straight wire carrying current.
3. How can you determine the direction of the magnetic field around a current-carrying wire?
4. What is the shape of the magnetic field around a loop or coil of wire?
5. What factors affect the strength of the magnetic field in a solenoid?
6. What materials are typically used as the core in an electromagnet, and why?
7. How does the presence of a ferromagnetic core affect an electromagnet's strength?
8. Explain how an electromagnet can be turned on and off.
9. How can the strength of an electromagnet be controlled?
10. Describe one application of electromagnets in everyday life.
11. What is the role of electromagnets in electric motors?
12. How does an electromagnet differ from a permanent magnet?

L5 Electromagnets Practical



Independent practice

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L6 Title

Insert explanation.

Independent practice

Insert 14 questions including two extended writing questions.