ELECTRICITY & MAGNETISM GALLERY

Activity Sheet

Primary Level

Name:____________________________

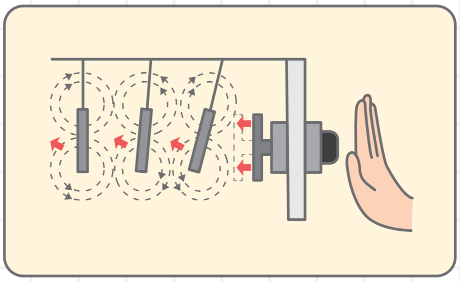
Class:____________________________

Maglev Trains

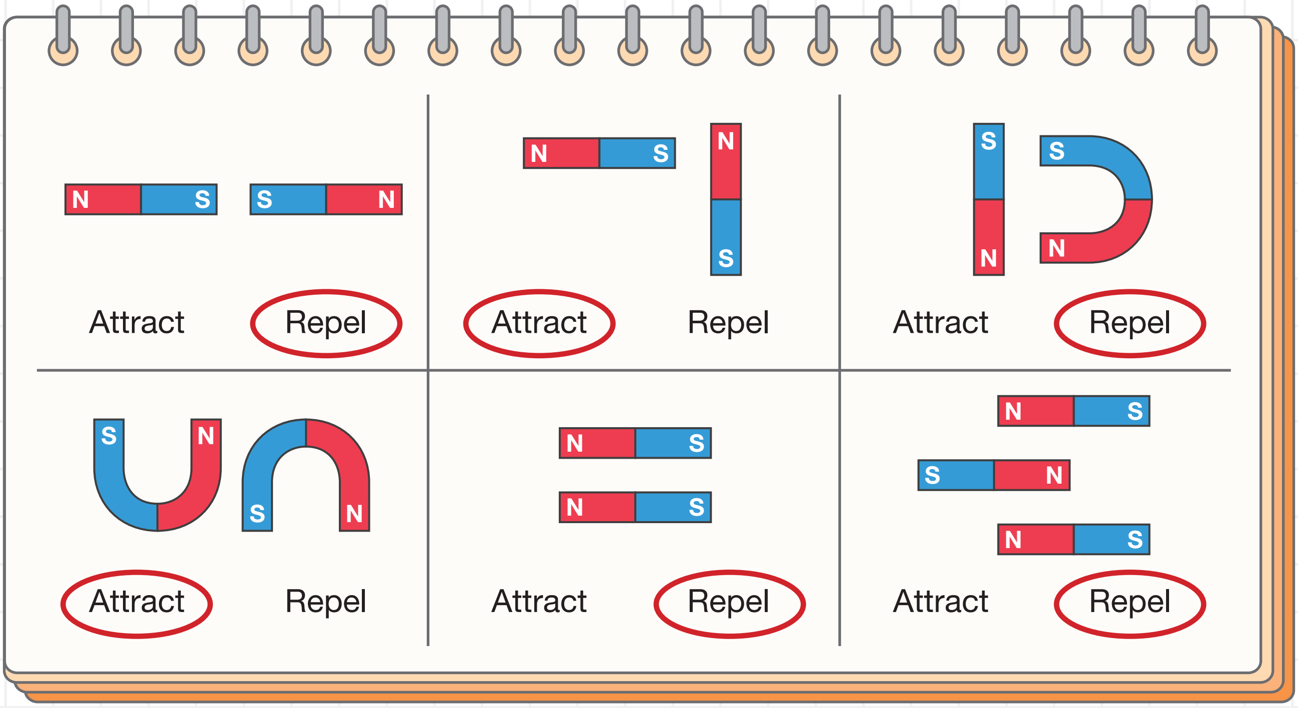
Explore the related exhibits in the gallery and understand the science behind maglev trains step by step.

1 What make the maglev trains float?

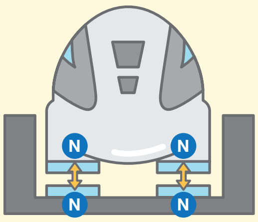
Magnets have two poles: a north pole (N) and a south pole (S). The opposite poles attract each other, whilst the like poles repel each other. Try the exhibit "**Invisible force**". Can you move the magnets without touching them?



Will the following magnet sets attract or repel each other? Circle the correct answers.



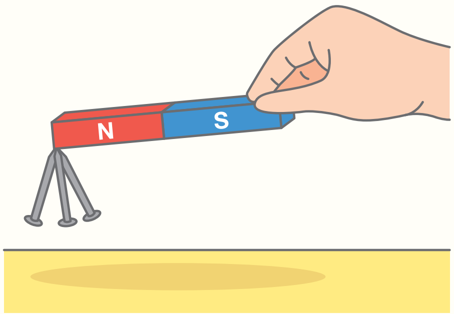
Maglev trains make use of the repulsive force between same pole to push the train up and levitate.



2 Electromagnets

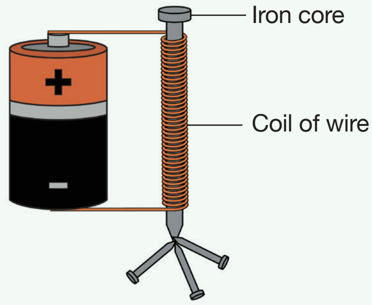
There are two main types of magnets:

Permanent magnets



- Have persistent magnetic property
- With fixed magnetic poles

Electromagnets



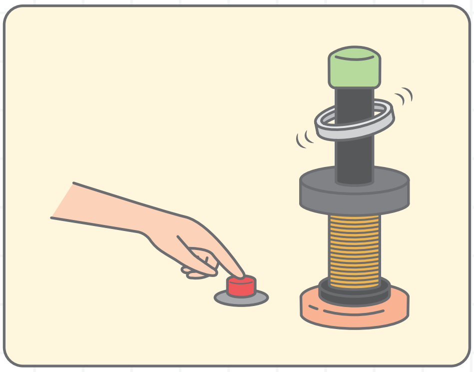
- Become magnetic when ___electricity___ flows through
- Magnetic poles can be switched by changing the ___direction___ of the electric current

Maglev trains make use of electromagnets to levitate and move. Experience the exhibit "**When the current flows, things are magnetised**". What can you observe?

- When I turn the hand wheel, the light bulb ___lights up___. This shows a ___closed___ circuit is formed.
- As electric current flows through the coil, the coil can be ___magnetised___ to become an ___electromagnet___, attracting the iron filings.
- When I stop turning, the light bulb ___goes out___. No electricity passes through, causing the coil to lose its magnetic effect, and the iron filings drop.

Electromagnet is fascinating! We can control when to turn on or off the magnetism. We can also manipulate its strength simply by adjusting the amount of current flowing through it and number of turns in the coil.

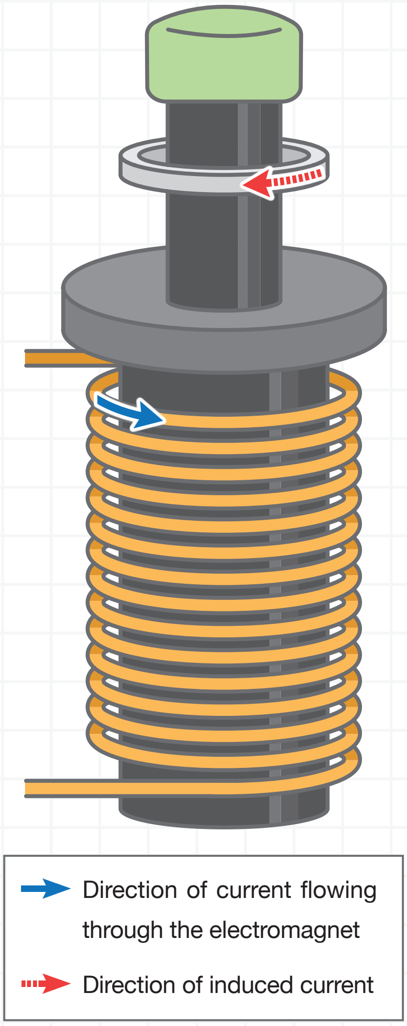
3 Floating in the air



Maglev trains use electromagnetic forces to levitate and propel the train, without any physical contact with the tracks.

Try the exhibit "**Jumping ring**". Why can the ring float in the air? Arrange the following events in sequence.

1	The circuit is completed when pressing the button.
8	Magnetic repulsion causes the ring to jump up and float in the air.
3	The electromagnet generates a magnetic field.
6	The induced current in the ring, in turn, creates its own magnetic field.
5	Electric current is induced in the ring to oppose the change.
7	The two magnetic fields oppose each other, similar to two like poles facing one another.
4	The metal ring experiences a sudden change in magnetic field.
2	Current runs through the coil, turning on the electromagnet.
9	When the current of electromagnet is switched off, gravity makes the ring fall.



Maglev trains, which have no wheels and do not make contact with the track, are able to run at very high speeds due to the friction-free nature of magnetic levitation.

4 Make your own maglev train

Materials for preparation:

- Copper wire
- A rod with diameter slightly larger than the neodymium magnets
- Neodymium magnets with diameter slightly larger than the battery
- 2A battery

1. Wind the copper wire along the rod into a coil. Remove the coil from the rod and stretch it slightly out to ensure each winding does not touch one another.

2. Orient the magnets so they repel each other, and stick the like poles to each side of the battery.

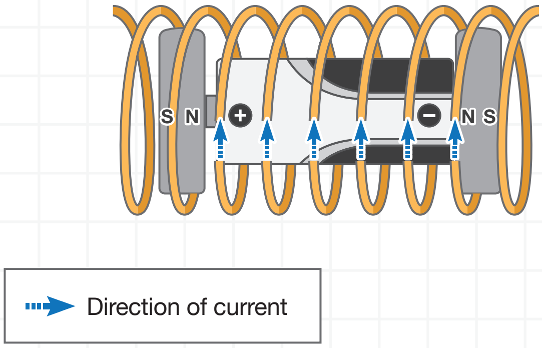
3. Slide the “magnet-battery train” into the coil and watch it go!

Visit the exhibit “**Maglev train**” to observe how the train moves and watch the video that explains the phenomenon.

Science behind

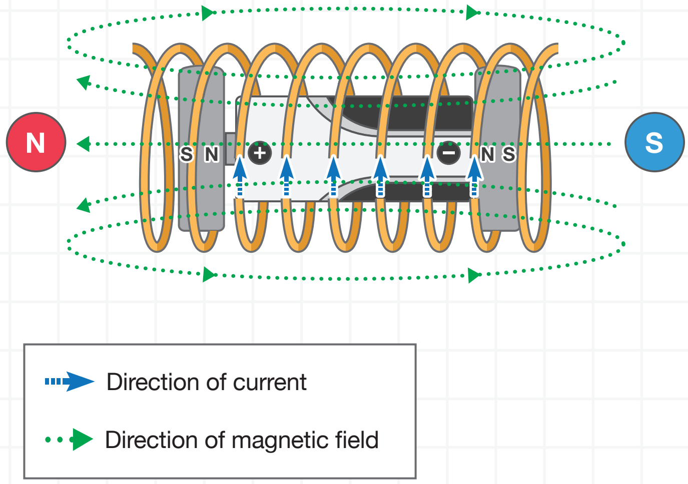
1. Forming a closed circuit

Neodymium magnets are conductors. The magnets attract to the battery, and their diameter is larger than that of the battery. When the “magnet-battery train” comes into contact with the copper coil, a closed circuit is formed.

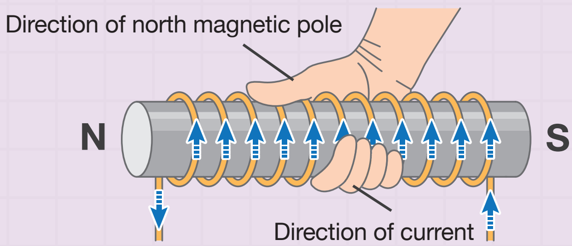


2. Creating a magnetic field

An electrical current flows from the positive terminal ⊕ of the battery, through the neodymium magnet, to the copper wire, and then to the negative terminal ⊖. The current generates a magnetic field around the coil, with the north magnetic pole pointing towards the positive terminal of the battery.



***Supplementary**: The direction of the magnetic field can be determined using the right-hand rule: hold your right thumb up and wrap the other four fingers in the direction of the current. Your thumb will point towards the north magnetic pole (refer to the figure below).*



3. Like poles attract, Unlike poles repel

At the positive terminal of the battery, the north pole of the “magnet-battery train” attracts the south pole of the neodymium magnet. At the same time, the south pole of the train repels the south pole of the neodymium magnet at the battery’s negative terminal. This “pull-and-push” motion propels the battery train forward.