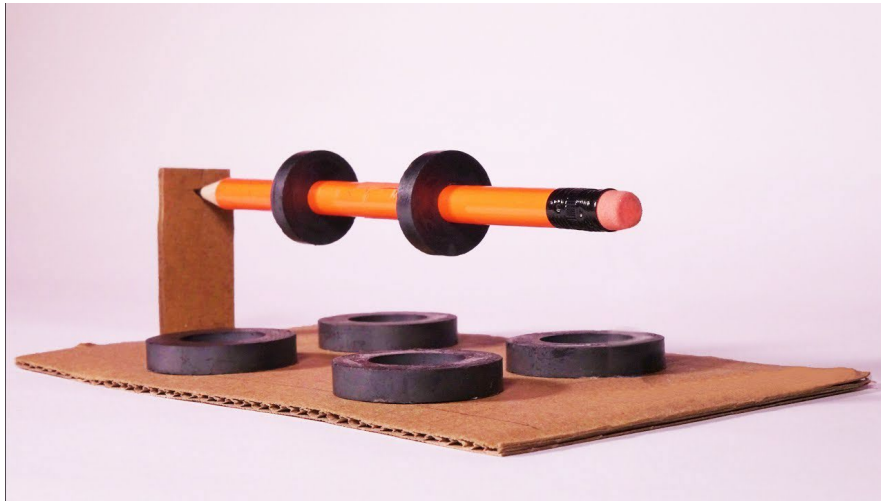


Magnetic Levitation



<https://youtu.be/DAkHZEzfx4s>

<https://youtu.be/nEVo22GH4aw>

Magnetic levitation or **MAGLEV** is a method by which an object is suspended in air with the support of magnetic field. The two primary issues involved in magnetic levitation are **lifting forces**: providing an upward force sufficient to counteract gravity, and **stability**: ensuring that the system does not spontaneously slide or flip into a configuration where the lift is neutralized.

Objective: In this science project you'll discover how to place magnets so they either attract or repel one another and then use that information to levitate a pencil.

Basic Information:

1. Magnets have two poles - North pole and South pole
2. When two magnets are placed together, LIKE poles repel and UNLIKE poles attract.
3. An invisible magnet field surrounds a magnet.
4. The north pole of a magnet points closely towards the Earth's north pole and the South pole points towards the Earth's south pole, this is because the Earth itself has enough magnetic materials in it to be considered one enormous magnet.
5. You can turn an unmagnetized piece of iron into a magnet by simply running a magnetised object over a few times, this process is called magnetization.

Materials needed:

CARDBOARD

RING MAGNETS (6)

PENCIL (1)

DOUBLE SIDED TAPE

IMPORTANT: Ring magnets are easily available in stationary stores and amazon. Approx dimension of ring magnet: 0.7 inch outer diameter, 0.3 inch inner diameter and 0.12 inch thickness

Lesson procedure:

Ask the students the following questions:

1. What is force?

---> A force is a push or pull.

2. What are some different types of forces?

---> Gravity, Air resistance, friction, magnetism etc.

Show the image of levitating pencil and ask:

3. How is it possible that this pencil is floating?

---> Students may respond: magic, string, illusion , magnetism

4. What do you think what are the forces involved to create this levitation?

---> Gravity, Friction, attractive and repulsive forces of magnets

5. Do you think you will be able to levitate the pencil?

---> Yes

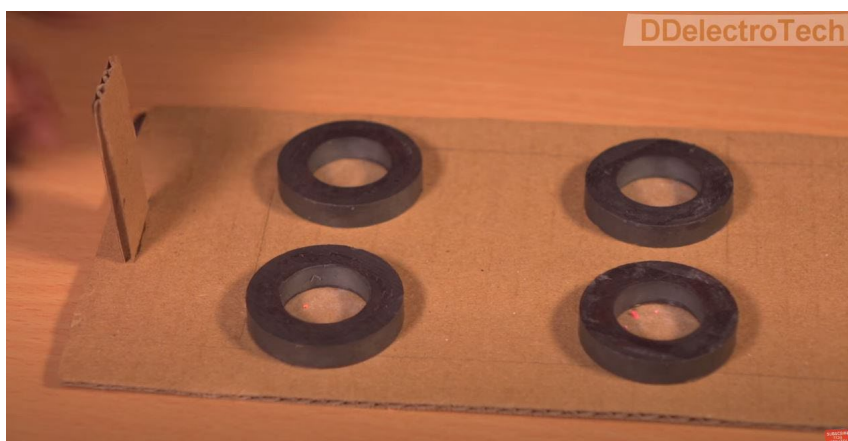
Divide the students in 2 or 3 person per group and give the following materials to position the magnets in
* such a way that it levitates the pencil.

Step 1: Making the Base

1. Cut a cardboard sheet slightly bigger than the size of pencil.
2. Draw the layout as shown in the images below
3. Mark equidistant points from both the ends

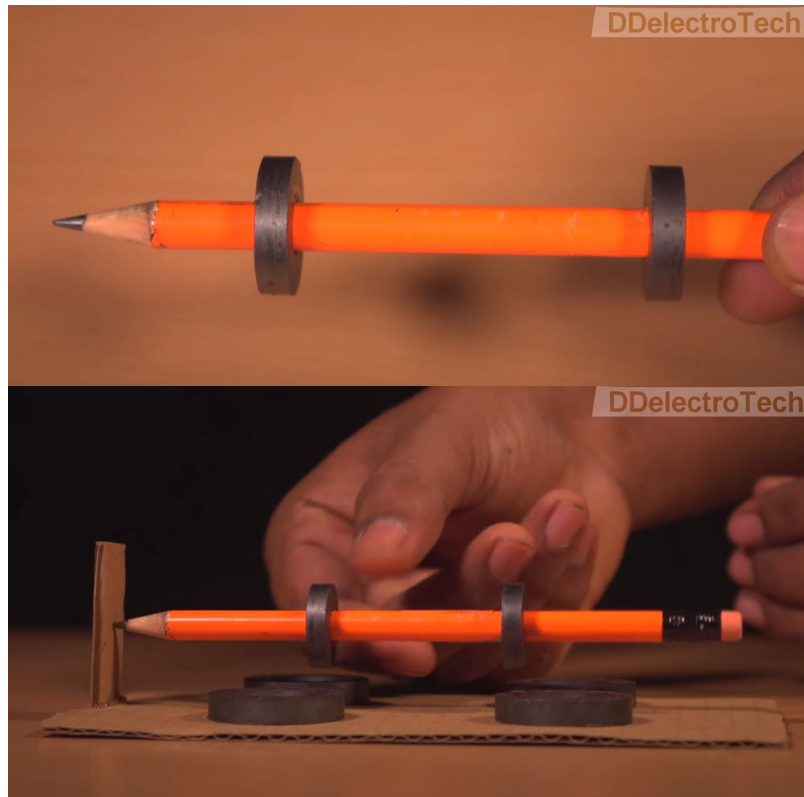


4. Establish North and South poles of 4 magnets
5. Using double sided tape place the magnets as shown below
6. Tape a vertical piece of cardboard at the end of your base.



Step 3: Levitating the Pencil

1. Take one of ring magnet and insert at the bottom of pencil such that it should repel the back magnets on the base. The magnet should be in phase with the base magnets.
2. Take other ring magnet and insert on the top of pencil such that it should attract the front magnets on the base. The magnet should be slightly back from the base magnets.
3. Balance the pencil and try to rotate it freely. It will spin for a long time.



Step 4: Science Behind Levitating Pencil

In the configuration used in my project

Lifting force is provided due to repulsion between back magnets

Stability is due to attraction between front magnets and frictional force at the tip of the pencil.

Hence, the following forces are involved in levitation

1. Gravitational force of the pencil and magnets
2. Frictional force at the tip of pencil
3. Attractive force of magnets on the front part of pencil
4. Repulsive force between the back magnets.