

# Miracles of Magnetism

The Effect of Magnets on Seed Growth

# QUESTION

**What is the effect of magnets on seed growth?**



# HYPOTHESIS

**If magnets are placed near the seeds, then the influence of the magnetic field will cause the ensuing plant growth to increase**

## RISK ANALYSIS

- **There are no specific risks or necessary safety precautions needed to conduct this experiment**



# VARIABLES

- **Independent variable:** Magnets
- **Dependent variable:** Plant Growth
- **Control variables (constants):**
  - the type of seeds
  - the number of seeds per cup
  - the type of soil used
  - the weight of soil used in each cup
  - the amount of water given daily to each cup
  - the type of magnet



# RESEARCH

**In the experiment, the hypothesis is that magnets enhance the growth of a plant from a germinated seed.**

## Magnets

**Magnets are made up of ferromagnetic metals (Jessa). Metals such as nickel and iron are ferromagnetic metals (Jessa). Furthermore, magnets are objects that attract other magnets or metals to themselves (Mai). Interestingly, magnets can be rocks or metals (Mai). Moreover, magnets create a nonvisible force called a magnetic field. This magnetic field can exert forces (attraction or repulsion) on other magnets or magnetic objects, which causes rotation, or torque (Williams). Additionally, magnets also exert minor versions of the magnetic field called domains (Jessa). These domains can be arranged by each other to create a larger and stronger magnetic field (Jessa).**

# RESEARCH

## Germination

Germination occurs when an organism starts to develop and grow from a seed (*“Germination”*). For germination to start, certain conditions are necessary such as a suitable temperature (*“Germination”*). This process begins when the seed absorbs water through a micropyle that allows the seed to swell up (*“Germination”*). This swelling forces the seed to open up and get exposed to the specific enzymes to start the germination process. Eventually, the shoot and primary roots emerge from the seed. The roots grow downwards in the soil and the shoot grows upwards to the soil surface. Once the shoot, also known as cotyledon, comes out of the soil surface and gets unfolded to become the first leaves, the germination process is complete. (*“Germination”*).

In winter season, radish seeds appear to germinate very quickly due to indoor warm temperatures. It took only 6 days to germinate my seeds (*“How ”*). Radish seeds can germinate in temperatures that range from 55 degrees Fahrenheit to 75 degrees Fahrenheit (*“How ”*). As such, radish seeds need only standard room temperatures (68 degrees Fahrenheit) to germinate(*“How ”*).

# MATERIALS

- **Nine 9-oz Plastic Cups**
- **12 Ferrite magnets (18mm X 5mm, grade C5)**
- **Potting Soil**
- **9 Radish seeds**
- **A Digital Scale**
- **Tap Water**
- **10 mL Graduated Cylinder**
- **25 mL Graduated Cylinder**
- **50 mL Graduated Cylinder**
- **100 mL Graduated Cylinder**
- **12 in ruler**
- **A piece of string**
- **Table on which cups are placed**



Image of materials used in experiment

# PROCEDURE

- 1. Using 9 ounce cups, label three cups “No Magnets”, 3 cups “1 Magnet”, and 3 cups “ 3 Magnets”**
- 2. Using clear packing tape, at a height of 8 cm, tape one magnet to the outside of each cup labeled “1 Magnet”**
- 3. Using clear packing tape, at a height of 8 cm, tape three magnets, evenly spaced, to the outside of each cup labeled “3 Magnets”**
- 4. Measure 18.4 grams of potting soil using a digital scale. Add this amount to each of the 9 cups.**
- 5. Plant three radish seeds, evenly spaced, in each cup, at a depth of 1 cm.**
- 6. On the first day, use a graduated cylinder to measure 30 mL water and add to each cup.**
- 7. Transfer all the soil cups to a specific location on the table where they will remain for the duration of the experiment..**
- 8. On each subsequent day, add 10 mL water to each cup.**
- 9. On day 5, 10, and 15 measure the height of each plant and record.**

# OBSERVATIONS



Image of day 0 of the experiment



Image of day 0 of the experiment

# OBSERVATIONS



Image of radish seeds on day 5 of the experiment



Image of radish seeds on day 5 of the experiment

# OBSERVATIONS



Image of radish seeds on day 10 of the experiment



Image of radish seeds on day 10 of the experiment

# OBSERVATIONS

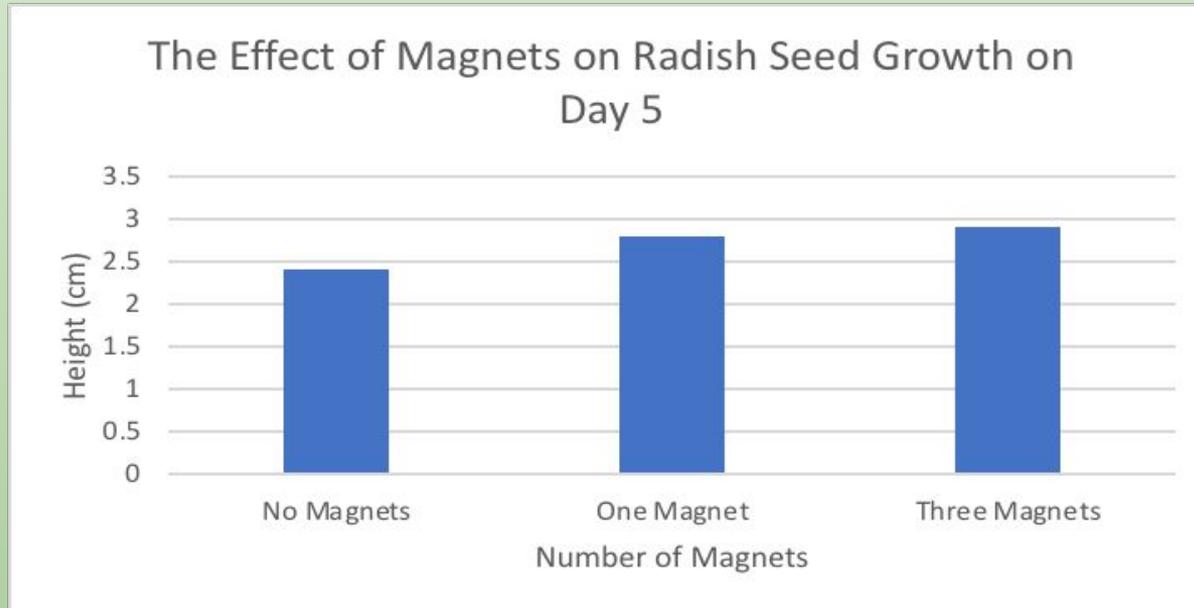


**Image of radish seeds on day 15 of the experiment**



**Image of radish seeds on day 15 of the experiment**

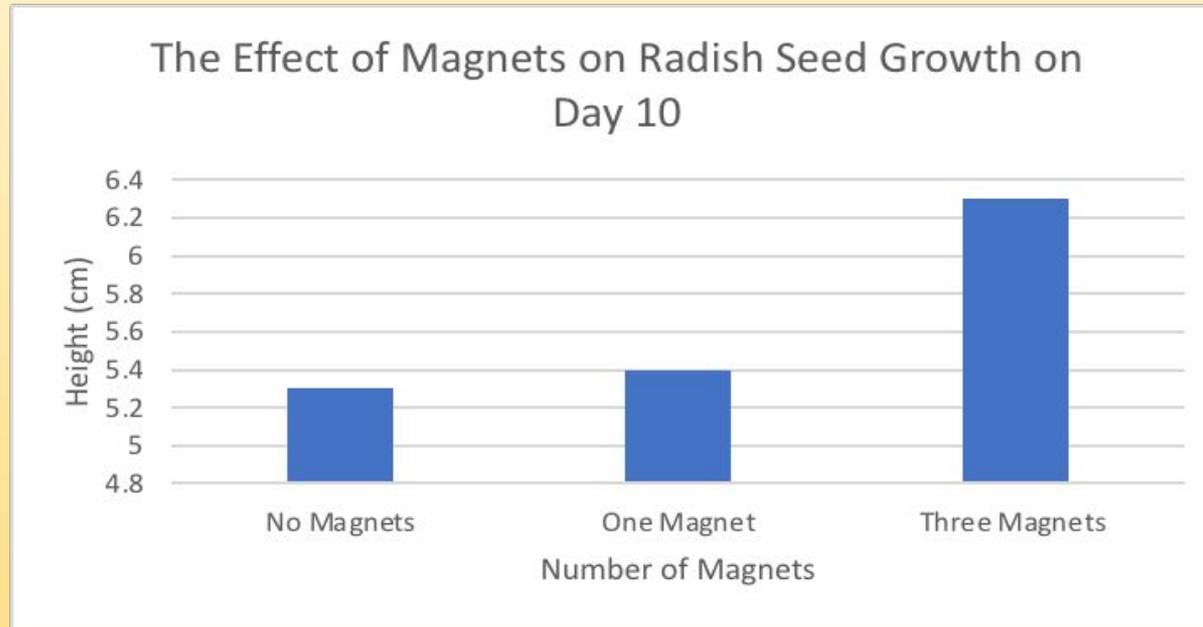
# DAY FIVE DATA TABLE & GRAPH



The Effect of Magnets on Radish Seed Growth on Day 5 (cm)

Magnets	Cup 1 seed 1	Cup 1 seed 2	Cup 1 seed 3	Cup 2 seed 1	Cup 2 seed 2	Cup 2 seed 3	Cup 3 seed 1	Cup 3 seed 2	Cup 3 seed 3	Mean Height
none	0	0	0	4.5	4	4.2	0	3.5	5	2.4
1 magnet	3.5	0.8	5	5	4.8	5	0	0	0.7	2.8
3 magnets	0	3	5	5.5	3.1	3.9	0	3.9	2.1	2.9

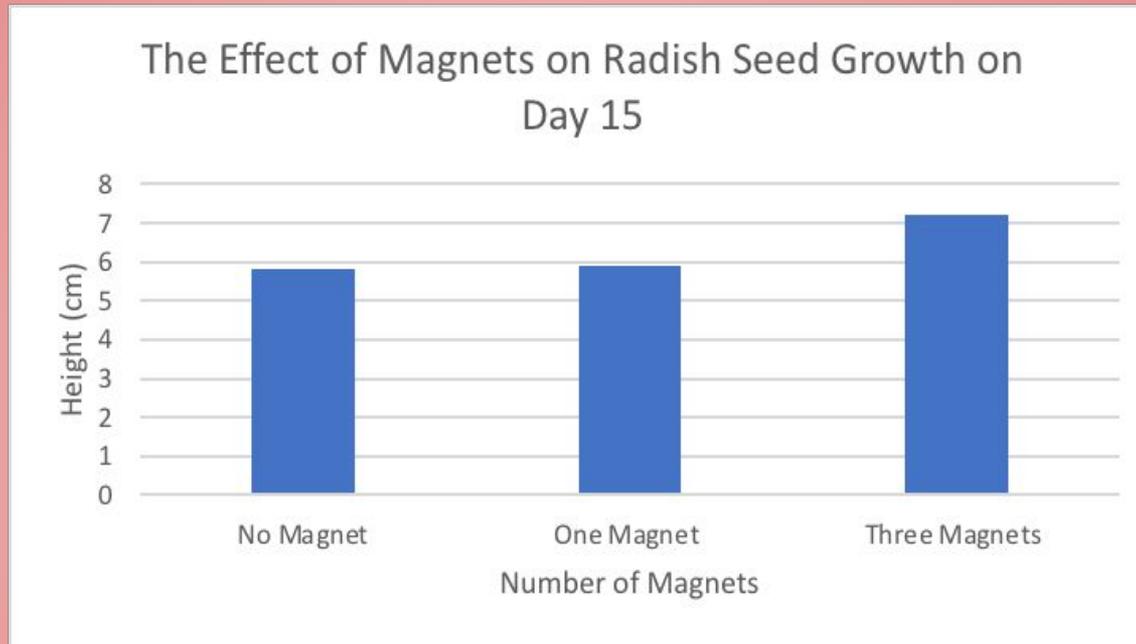
# DAY 10 DATA TABLE & GRAPH



The Effect of Magnets on Radish Seed Growth on Day 10 (cm)

Magnets	Cup 1 seed 1	Cup 1 seed 2	Cup 1 seed 3	Cup 2 seed 1	Cup 2 seed 2	Cup 2 seed 3	Cup 3 seed 1	Cup 3 seed 2	Cup 3 seed 3	Mean Height
none	5.5	9.5	0	7	5.5	6	0	7.7	6.2	5.3
1 magnet	6.1	6.0	8.0	7.5	8.2	7.5	0	0	5.1	5.4
3 magnets	0	6.0	8.0	7.1	5.1	7.2	5.3	8.5	9.5	6.3

# DAY 15 DATA TABLE & GRAPH



**The Effect of Magnets on Radish Seed Growth on Day 15 (cm)**

Magnets	Cup 1 seed 1	Cup 1 seed 2	Cup 1 seed 3	Cup 2 seed 1	Cup 2 seed 2	Cup 2 seed 3	Cup 3 seed 1	Cup 3 seed 2	Cup 3 seed 3	Mean Height
none	6.5	11.5	0	7.1	5.9	6.2	0	8.0	7.0	5.8
1 magnet	6.5	6.1	10	8.0	8.2	7.6	0	0	6.8	5.9
3 magnets	0	6.5	8.5	8.4	7.9	7.7	6.7	8.7	10.5	7.2

## CONCLUSION

**The hypothesis that magnets, through the magnetic field, increase plant growth is accepted.**

**At day fifteen of the experiment, the average height with three magnets was 7.2 cm, the average height with one magnet was 5.9 cm, and the average height with no magnets was 5.8 cm. Interestingly, the results seem to suggest there was little impact on plant growth with only one magnet but a meaningful difference with three magnets.**

**A possible explanation for these results could be that magnetic fields are affecting the properties of the water. Importantly, water is needed to be absorbed to start the germination process. It appears that as the number of magnets increase so does the bioavailability of the water (enzymes) in the water and this influenced the germination process and growth of the plant.**

# ERROR ANALYSIS

There are several random errors in the procedure. First, the method of measurement of the soil in each cup may have varied slightly from cup to cup. The measurement of the water given to each of the cups was difficult to keep consistent with a graduated cylinder. The measurement of the height of the stems was subject to the possible change in the depth of the soil. It is also possible that when measuring the seeds height with the “string and ruler” method, the tightness of the string could have made a difference in the height measurement.

Additionally, there were several possible systematic errors in the experiment. The digital scale used to measure the soil may not have been correctly calibrated. Another systematic error was that the positions of the cups never changed therefore the seeds may have received unequal distributions of sunlight. Also, in the cups with three magnets, the magnets may have not been equally placed apart, thus impacting the degree of magnetism that impacted the seeds. Lastly, the seeds may have not been placed in equal depths in the soil. The scale could have been calibrated and its accuracy verified at the beginning of the experiment. The cups could have been placed on a rotating platform so that in this way, they may have received a more equal distribution of sunlight. Accurate measurements could have been done in the beginning of the experiment to verify that the magnets were equally placed. Finally, the seed depth could have been checked with a more precise measuring tool.

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