

Team: Magneto Bf-D

Purpose of this Experiment:

The purpose of this experiment is to measure the Earth's magnetic fields with altitude.

Research:

According to the dynamo theory, the Earth's magnetic field is attributed to the dynamo effect of circulating electric current in the molten metallic core.¹

Dynamo theory describes the process through which motion of a conductive body in the presence of a magnetic field acts to regenerate that magnetic field. The Earth's magnetic field is somewhat similar to a bar magnet tilted 11 degrees from the spin axis of the earth—charged particles become trapped on these field lines, forming the "magnetosphere."

Here is an image of the instrument we will be using to measure the magnetic field:

This sensor, which uses a Hall Effect transducer, is sensitive enough to measure the earth's magnetic field. It can also be used to study the field around permanent magnets, coils, and electrical devices. The low amplification is used to measure relatively strong magnetic fields around permanent magnets and electromagnets. The high amplification is used to measure the magnetic field of the Earth and very weak fields. It is 20 times more sensitive than the low amplification.²



$$1 \text{ T} = 1 \frac{\text{V} \cdot \text{s}}{\text{m}^2} = 1 \frac{\text{N}}{\text{A} \cdot \text{m}} = 1 \frac{\text{Wb}}{\text{m}^2} = 1 \frac{\text{kg}}{\text{A} \cdot \text{s}^2} = 1 \frac{\text{kg}}{\text{C} \cdot \text{s}}$$

This SI unit is named after Nikola Tesla. As with all SI units whose names are derived from the proper name of a person, the first letter of its symbol is uppercase (T). When an SI unit is spelled out in English, it should always begin with a lowercase letter (tesla), except for at the beginning of a sentence or in capitalized material such as a title. Note that "degree Celsius" conforms to this rule because of the "d".³ Based on *The International System of Units*, section 5.2

¹ <http://www.magnetometer.org/mag-magnetic-field.php>

² <http://www.vernier.com/til/1420.html>

³ [http://en.wikipedia.org/wiki/Tesla_\(unit\)+tesla+\(unit\)](http://en.wikipedia.org/wiki/Tesla_(unit)+tesla+(unit))

Hypothesis:

1. Magnetic fields change with altitude.

- Test 1: Bring the magnetic sensor to outdoor conditions and test if the intensity of the field changes.
- Test 2: Bring the magnetic sensor to any nearby foothills with a higher altitude and compare the barometric pressure and magnetic field data with the previous test

2. The direction of the magnetic field sensor changes the reading.

- Test 1: Reverse the orientation of the sensor, and increase and decrease elevation to see if the results change.
- Test 2: Rotate the sensor in your hands for 10-15 minutes and see how the sensor's readings vary.

Proposed Experimental Method:

- We plan to run the project as stated above.
- Using a balloon, gondola, string, magnetic sensor, and a barometer
- We will run the tests in our hypotheses along with warm-ups to check our equipment.
- It will be important to be sure that all our equipment is secure and will have enough battery life to make the trip up and down.