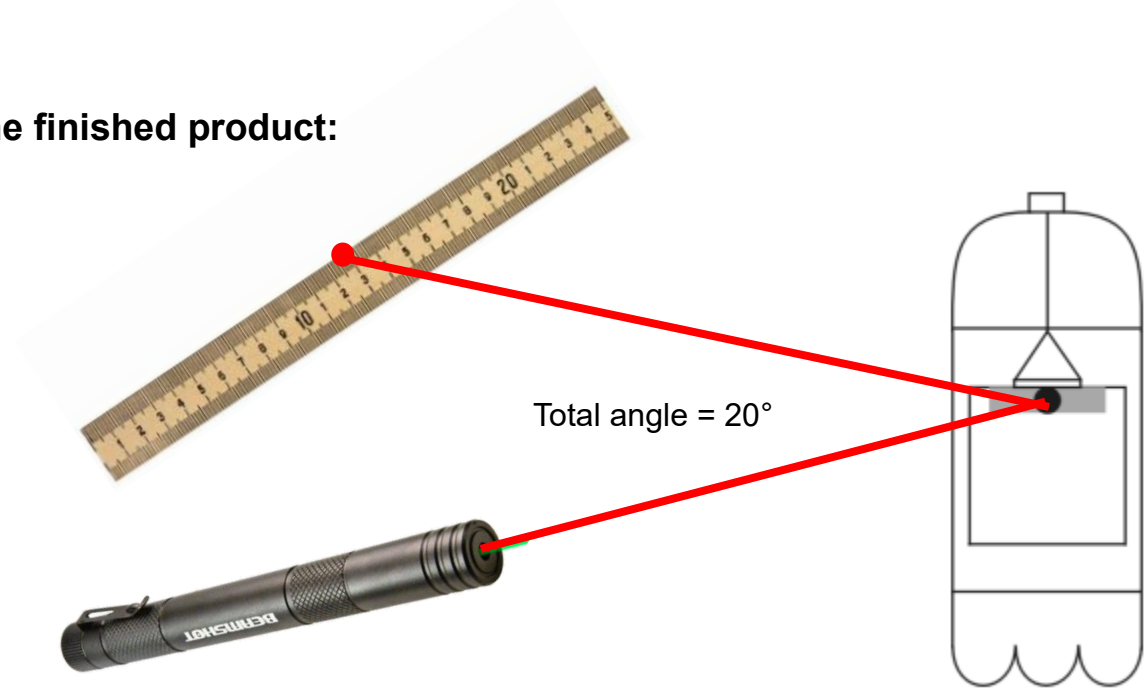
Homemade DIY (Do It Yourself)

Soda Bottle Magnetometer

The finished product:

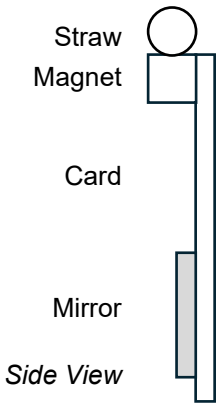


Materials Needed:

- Soda Bottle (empty) with Cap, no Label
- Ballast for bottle (Sand or Pebbles)
- Small Bar Magnet
- Small Mirror or Sequin
- Bright Light of Laser
- Measuring Stick
- Glue and Tape
- Thread
- Holder:
  - 3D Printed Holder, or
  - Plastic Straw
  - 3 by 3 File Card

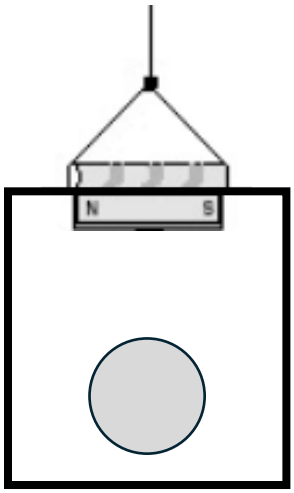
Assembly Instructions:

1. Poke or drill a small hole in the center of the bottle's cap.
2. Cut the bottle about 3 inches above the bottom of the bottle.
3. Put ballast in bottom of bottle.
4. Remove the lid from the soda bottle.
5. String the thread through the hole in the top of the bottle.
6. Continue to string the thread into the top park of the bottle.
7. Replace the cap on the bottle.



8. If using a file card:
    a. Cut a piece of straw about the size of your magnet.
    b. Glue the straw to one edge of the magnet.
    c. Cut the file card in half.
    d. Glue the file card to one side of the magnet.
    e. Glue a sequin or a mirror to the card.
    f. String the thread through the straw.
    g. Tie the end of the thread in a triangle.
9. If using the plastic holder:
    a. Glue magnet into the top part of the holder.
    b. Glue the mirror into the mirror cell on the holder.
    c. String the thread through the straw.
    d. Tie the end of the thread in a triangle.
    e. Make sure that magnet is hanging level.

Front View



10. Tape the top of the bottle to the bottom of the bottle.
11. Pull on the thread to raise the mirror above the taped part of the bottle.
12. Tape the thread to the outside of the bottle.
13. Fold the thread over the tape and put another piece of tape over the thread.

Setting up the Magnetometer:

1. The North end of the magnet will always point North.
2. Depending on which side of the mirror holder you placed your mirror, the target will be either to its East or West.
3. Set the measuring stick against your white target (wall or posterboard…).
4. Target should be either 57 inches or 57 cm from the mirror. If you use inches, then the measuring stick should be a yardstick. If you use centimeters, then use a meterstick.
5. Distance from the laser to the mirror is not important.
6. Adjust the position of the bottle and the light source until the reflected light hits just above the measuring stick, near the center of the stick.
    a. You want about a 20° between the incoming light and the outgoing light.
    b. Move the bottle and the laser if you are not near the center of the measuring stick.
    c. You may need to move the light source up or down to get the spot to hit the top edge of your measuring stick.

Getting Measurements:

1. The apparatus should be somewhere where it will not be bumped or moved.
2. It should be on a hard surface. (minimal vibrations)
3. We know that heavy trucks and steel roofs affect the data.
4. Ideally, taking hourly measurements would be perfect since some of the events are rather short. But once a day works well also. Do what works for you.

Some Helpful Observations and Suggestions:

1. I prefer the shape of a Coca Cola bottle.
    a. I cut it at the thinnest part of the bottle (its waist).
    b. I then make a second cut about an inch above that.
    c. When I reassemble the two pieces of the bottle, the top piece fits cleanly over the bottom piece.
2. Do not lift or carry the assembled magnetometer by the cap. The tape will let loose, and the ballast will cover the floor. This is why I prefer small pebbles over sand. It is easier to clean up.
3. Ideally, don't move any of the pieces once they are being used.
4. People have had issues with vibrations when they set their apparatus up on a table. It needs to be a very heavy table and a solid floor.
5. I had serious issues with the steel sliding roof on the observatory where I have it set up. The amount the roof is open impacts the reading on the measuring stick.
6. If you set up using the 57 inch or cm distance between your mirror and target, the deviations that you measure on your measuring stick will correspond directly to degrees of deviation. At 57 inches, each inch of deviation corresponds to 1 degree of deviation. At 57 centimeters, each centimeter of deviation corresponds to 1 degree of deviation.

Links to Resources:

1. If you have access to a 3D Printer and would like the STL File to print the mirror and magnet holder, please contact Aaron Clevenson at aaron@clevenson.org.
2. It is specifically designed to use this magnet: https://www.amazon.com/dp/B01MT1PF1P?ref=ppx_yo2ov_dt_b_fed_asin_title
3. It is specifically designed to hold a 1-inch mirror. I used this one: https://www.amazon.com/dp/B08XMXXVMP?ref=ppx_yo2ov_dt_b_fed_asin_title
4. Video of the Magnetometer Workshop: https://www.youtube.com/watch?v=5Idbhsux3Qo
5. Astronomical League Solar MAX Observing Challenge: https://www.astroleague.org/al-observing-challenge-special-observing-award/ scroll down to #11.
6. Information on sunspot activity, aurora projections, and Planetry K-Index values can be found on this website: www.spaceweather.com (left side)

Astronomical League: www.astroleague.org
Insperity Observatory: www.humbleisd.net/observatory