BAROMETER LAB

Development | How Does it Work | The Dirt

What Does It Measure?

The barometer, a widely used weather instrument measures atmospheric pressure (also known as the barometric pressure) –the weight of the air in the atmosphere.

How Does It Work?

Air pressure pushes down on the surface of the mercury, making some of the air rise up inside of the tube.

The greater the air pressure, the higher the mercury will rise.

The Dirt On E.T.

Torricelli was greatly inspired by the work of Galileo but stated that he didn't want the same "horrifying" fate as Galileo, who was taken to trial for proposing controversial theories. Galileo sent out a letter to Castillo but instead of Castillo reading and replying to the letter, E.T. replied to it instead!! And took the Castillo's job offer!

Purpose:

To discover the principles of the Barometer.

Driving Question...

The barometer can help predict the weather; high air pressure relative to average levels is associated with calm and sunny weather. Low air pressure is associated with bad weather, high winds and rain or snow. So you could tell whether it is warm and sunny by looking at your barometer and seeing if the air pressure is low.

The Five Why's

Who: Evangelista Torricelli

What: He invented the barometer and his work contributed to the understanding of geometry which then aided the eventual development of integral calculus.

When: Born on October 15, 1608. Later, the Italian physicist went on to invent the mercury barometer in 1643 at the University of Pisa in Rome, Italy.

Where: His birth place was located in Faenza, Italy. However, throughout his lifetime he resides in Florence.

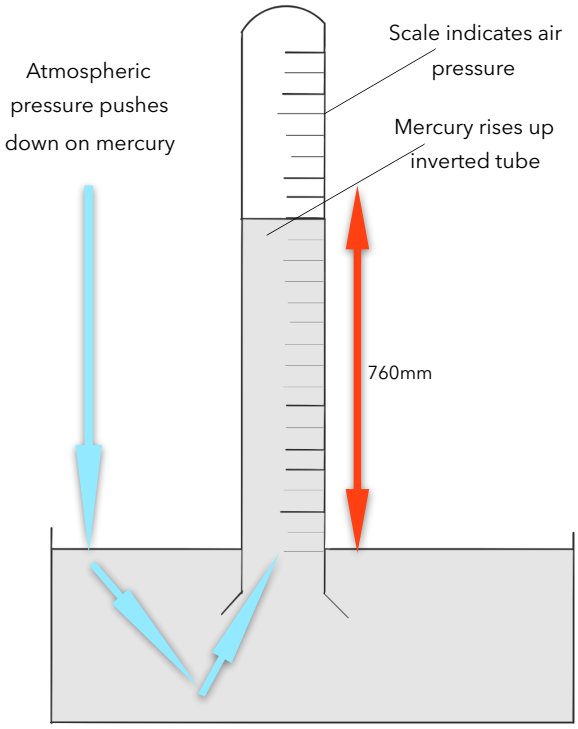
Why: To invent an instrument that could answer the question "*Does air have weight*?"

The Development of the Barometer

In early 16th century Italy there were scientists independently working on the principals of a vacuum and air pressure. But a young scientist, Evangelista Torricelli, was the first to detail his experiments. His experiment became known as the barometer.

The barometer uses the principal of a vacuum to measure the weight of the air. Like your everyday use of a straw to sip water. Torricelli had been associated with Galileo and studied his writings before Galileo's death in 1642. Using the findings to aid in the construction the first barometer.

The first barometer used water to measure the air pressure. Though Galileo is recognized as the first to experiment with a water type vacuum in early 1642, his primary objective was to prove the "vacuum theory". However, Galileo's vacuum principal was later to be instrumental in all barometers.



Hypothesis...

When the air is hot, the barometric pressure will then rise, causing the balloon to become swelled up at the top giving it the appearance of an egg or a dome-shape. When the air becomes cold, the barometric pressure will decrease; causing the balloon to appear like a crater.

A. Materials

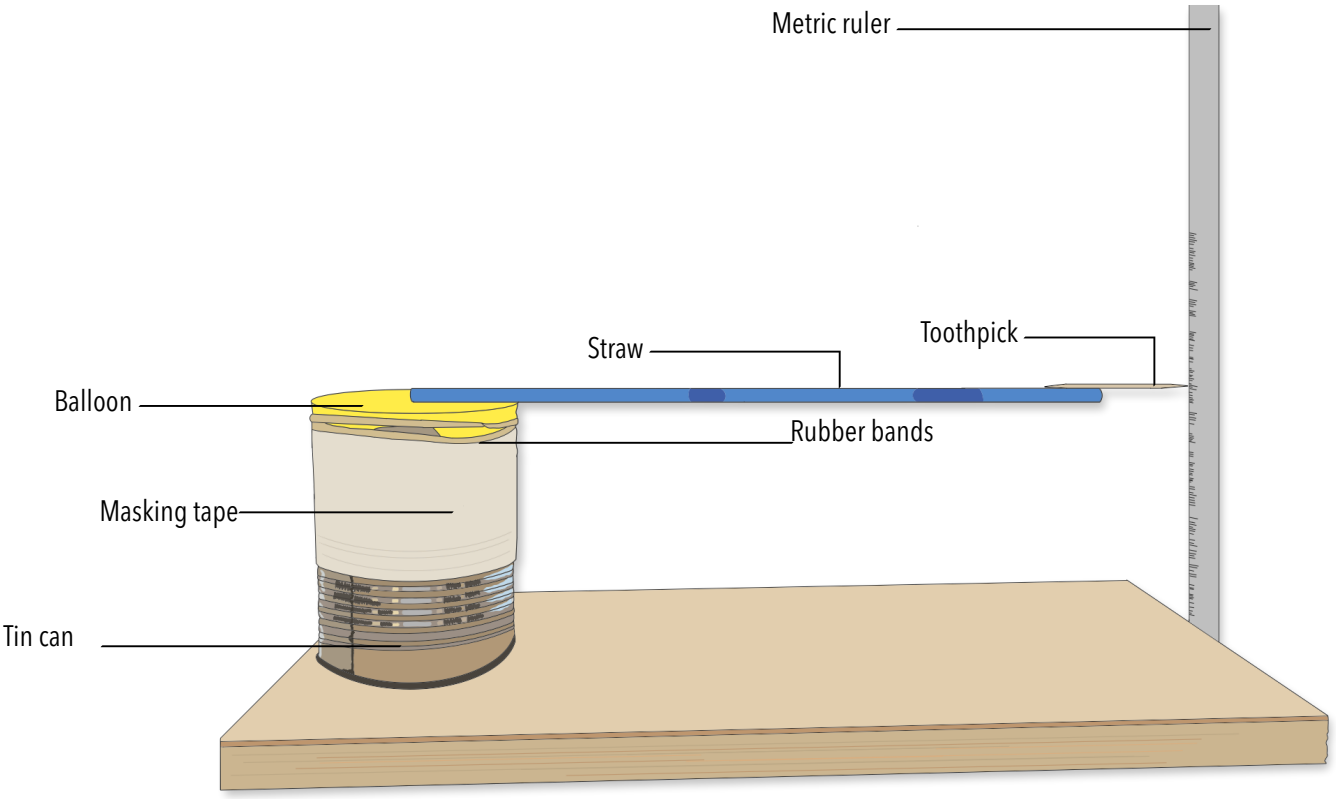
- A base (made out of wood)
- Tin can
- Balloon
- Metric ruler
- Straws
- Toothpick
- Rubber bands
- Masking tape
- Hot glue

B. Set Up

1. Begin with a tin can, the top should be taken off
2. Cut the balloon end off
3. Apply balloon on opening of tin can, make sure it's secure
4. Use rubber bands to secure the balloon to the tin can
5. For extra security, wrap masking tape over the rubber bands
6. Tape an end of the straw directly in the middle of the balloon
7. Tape the toothpick to the other end of the straw
8. Hot glue a metric ruler to the base

C. Experimentation

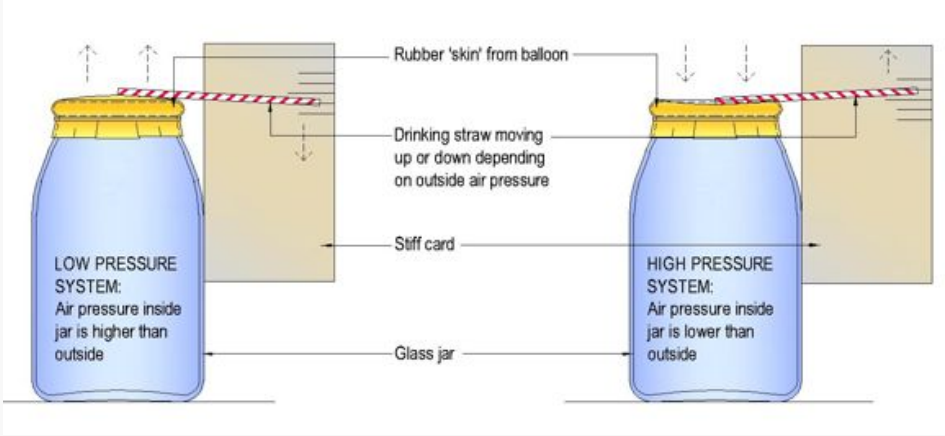
1. Go outdoors
2. Select where you will set your barometer down (grass or concrete)
3. Place your barometer down in your desired placement (the barometer must not be moved!)
4. Create a data table (this is where your data will be put into; make enough room for multiple data collections)
5. Record the time of the barometer Reading
6. Record outside temp. in F°
7. Record types of clouds that can be seen
8. Record cloud Coverage
9. Record your barometer reading
10. Record meta data if necessary (meta data is a disturbance within your barometer reading that you had no control over)
11. Repeat steps 5-10 every 5 to 10 minutes



How Does the Barometer Work?

At the time you sealed off the tin can, you captured air inside it. The air pressure inside the tin can is exactly the same as the air pressure outside of the tin can. However, as the weather changes, so does the air pressure in the atmosphere (the outside air).

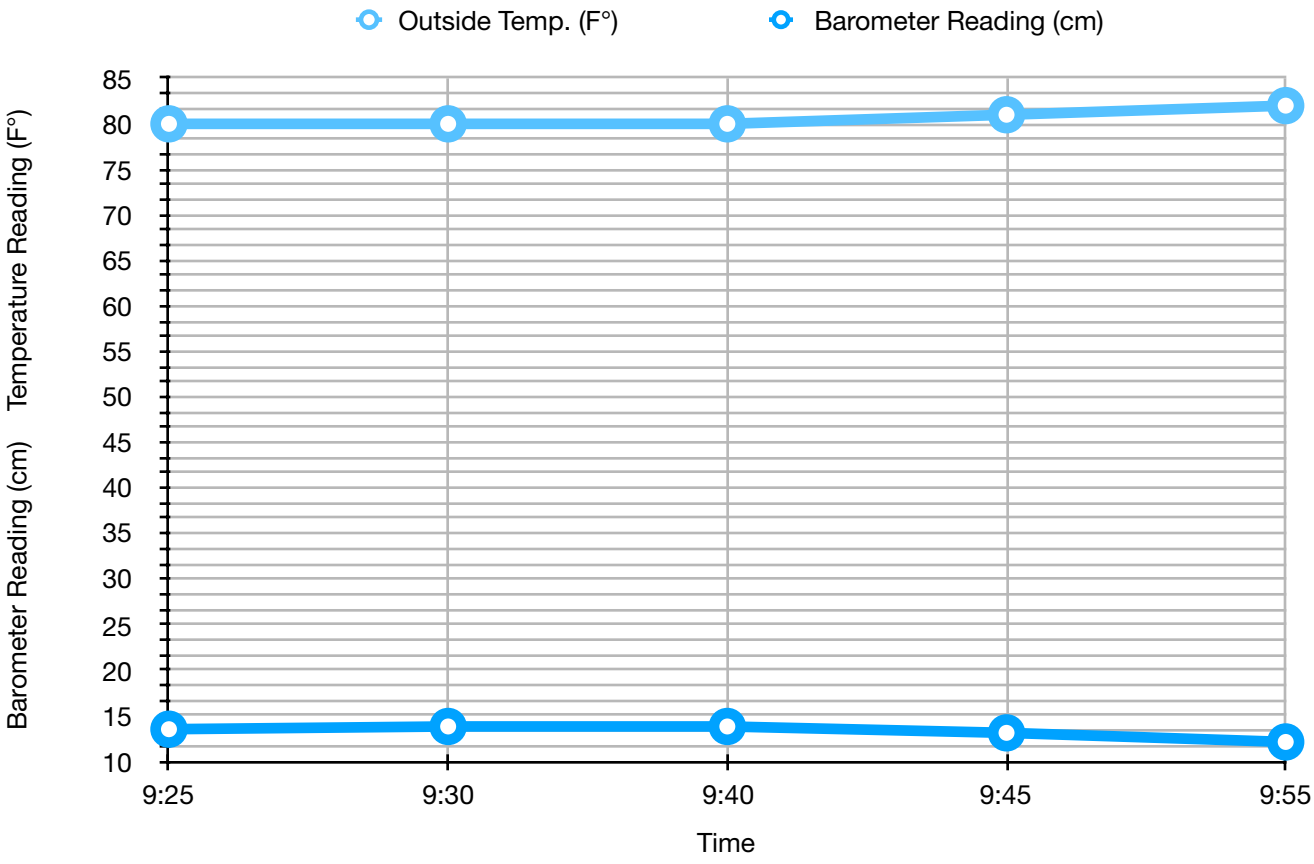
Since the tin can is sealed, the air pressure inside it does not change. However, the air pressure outside changes with the weather. So this causes pressure on the balloon cover to increase or decrease.



Barometer Data Tables and Charts:

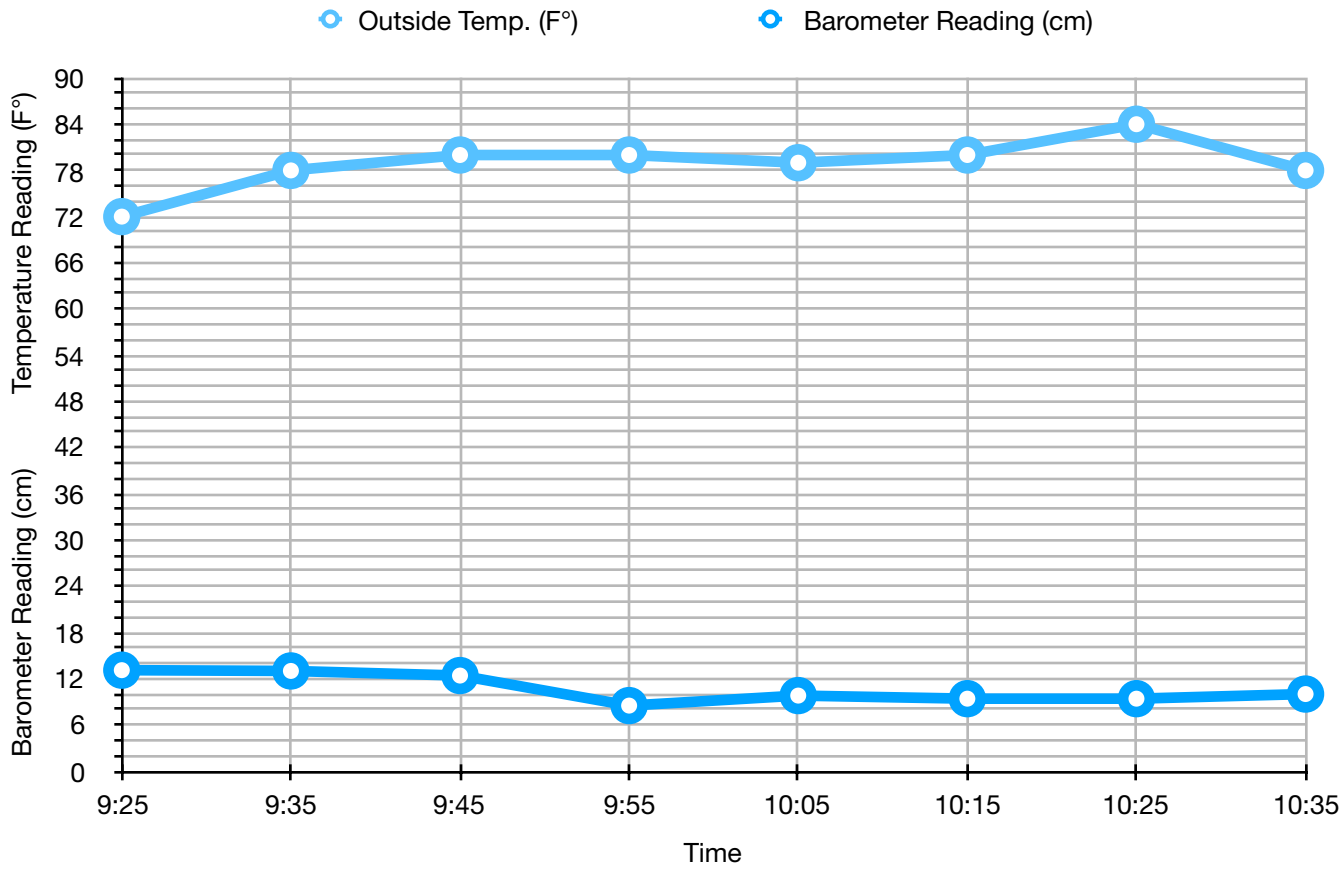
On Concrete, In the Shade 10/19/17

Time	Outside Temp. (F°)	Barometer Reading (cm)	Cloud Type	Cloud Coverage	Windspeed (MPH)	Meta Data
9:25	80	13.5	No clouds	No clouds	4	N/A
9:30	80	13.8	No clouds	No clouds	3	N/A
9:40	80	13.8	Altocumulus	Clear	7	N/A
9:45	81	13.1	Cumulus	Clear	4	N/A
9:55	82	12.1	Cumulus	Scattered	2	N/A



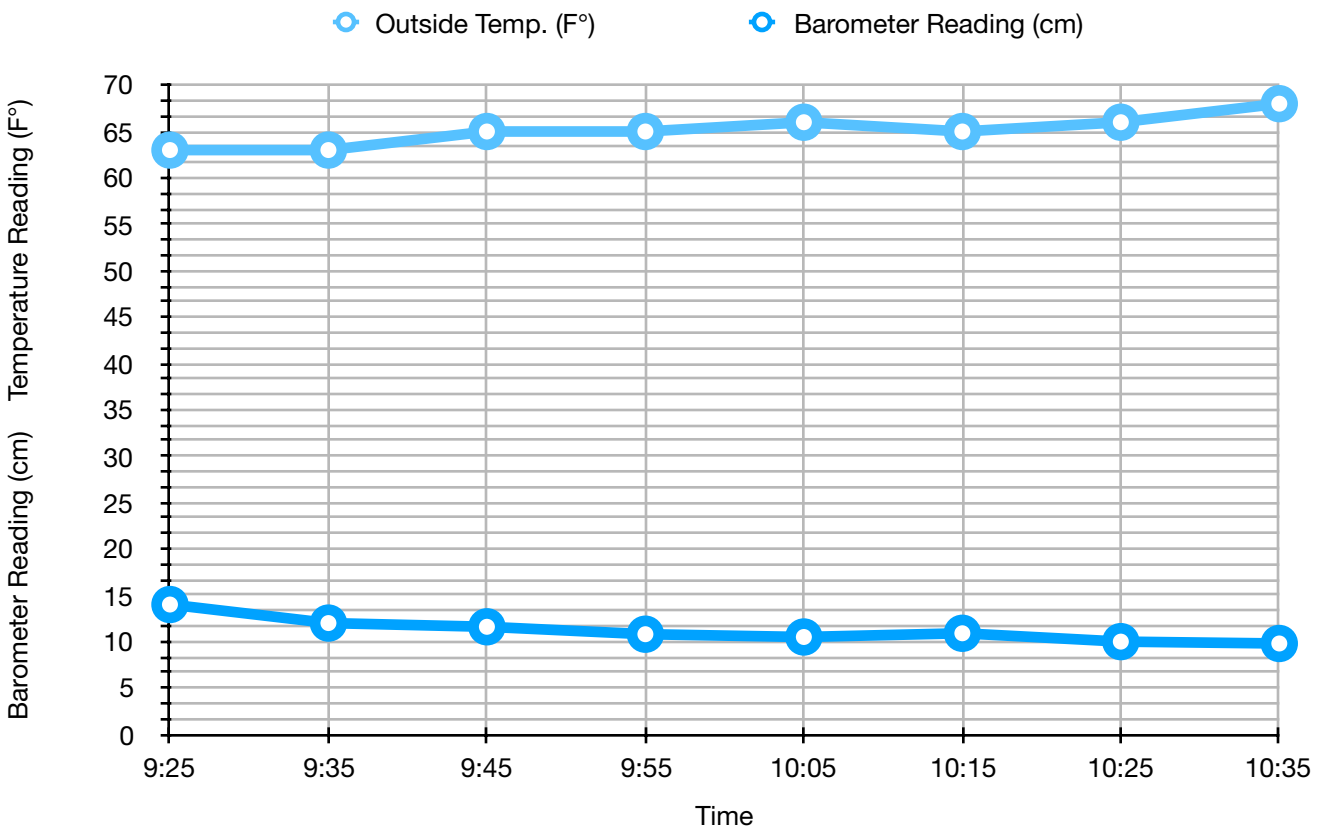
On Concrete, In the Sun 10/24/17

Time	Outside Temp. (F°)	Barometer Reading (cm)	Cloud Type	Cloud Coverage	Windspeed (MPH)	Meta Data
9:25	72	13.1	Altocumulus	Broken	3	N/A
9:35	78	13	Altostratus, Cirrocumulus	Broken	2	N/A
9:45	80	12.4	Stratus	Overcast	1	N/A
9:55	80	8.5	Stratus	Overcast	3	N/A
10:05	79	9.8	Stratus	Overcast	4	N/A
10:15	80	9.4	Stratus	Overcast	2	N/A
10:25	84	9.4	Stratus	Overcast	4	N/A
10:35	78	10	Stratus	Overcast	6	N/A



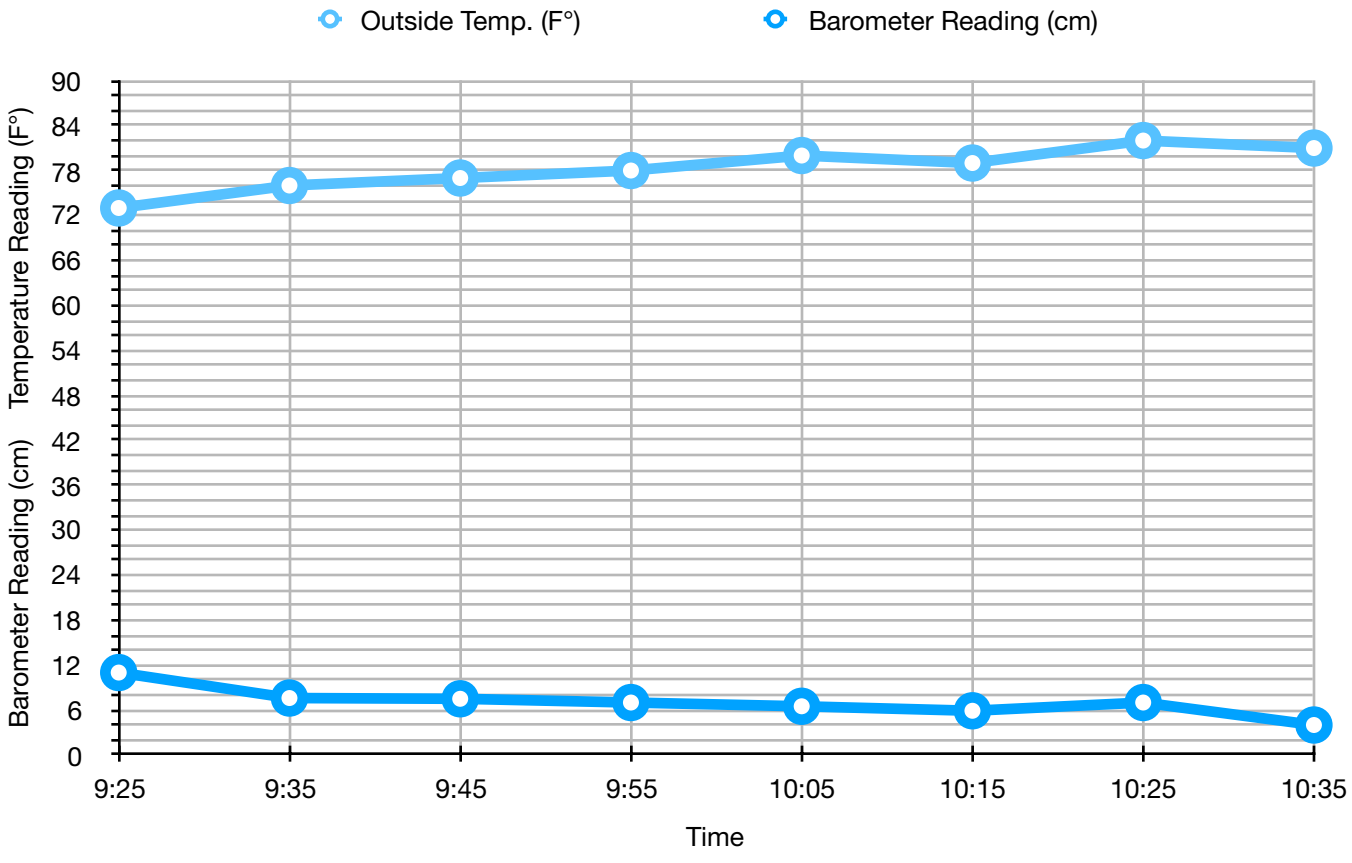
On Concrete, In the Sun 10/26/17

Time	Outside Temp. (F°)	Barometer Reading (cm)	Cloud Type	Cloud Coverage	Windspeed (MPH)	Meta Data
9:25	63	14	No clouds	No clouds	6	N/A
9:35	63	12	No clouds	No clouds	8	N/A
9:45	65	11.6	No clouds	No clouds	8	N/A
9:55	65	10.8	No clouds	No clouds	6	N/A
10:05	66	10.5	No clouds	No clouds	4	N/A
10:15	65	10.9	No clouds	No clouds	9	N/A
10:25	66	10	No clouds	No clouds	6	N/A
10:35	68	9.8	No clouds	No clouds	6	N/A



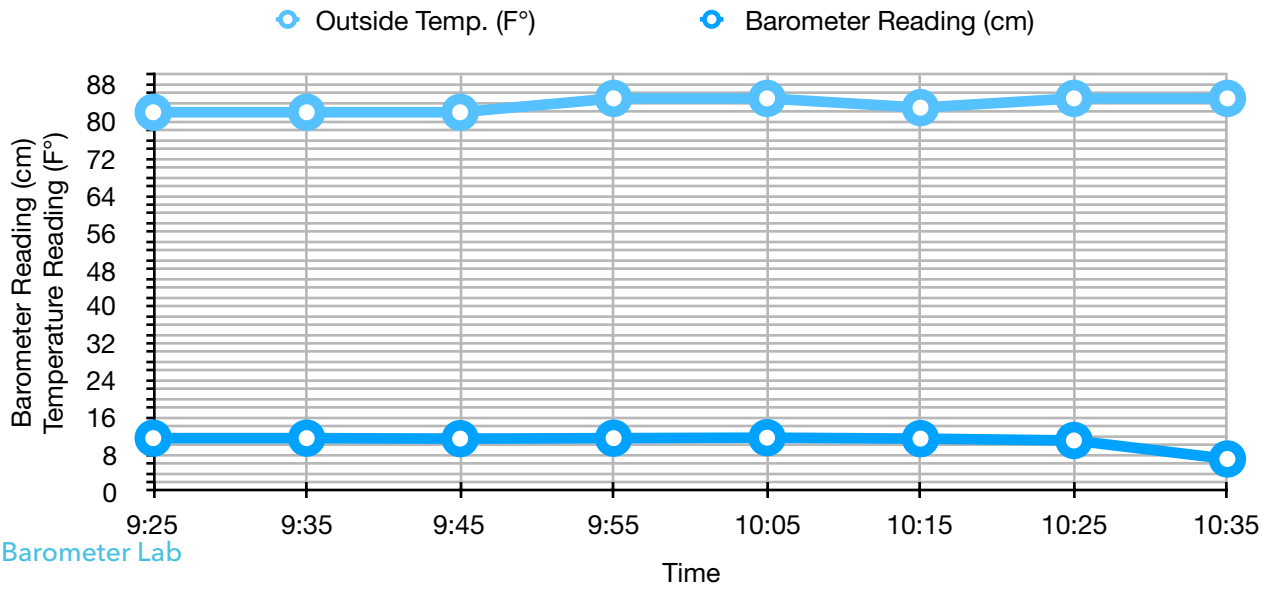
In the Grass, In the Sun 11/02/17

Time	Outside Temp. (F°)	Barometer Reading (cm)	Cloud Type	Cloud Coverage	Windspeed (MPH)	Meta Data
9:25	73	11	No clouds	No clouds	2	N/A
9:35	76	7.6	No clouds	No clouds	2	N/A
9:45	77	7.5	No clouds	No clouds	1	N/A
9:55	78	7	No clouds	No clouds	2	N/A
10:05	80	6.5	Altostratus, cirrostratus	Clear	3	N/A
10:15	79	5.9	Altostratus	Clear	4	N/A
10:25	82	7	Altocumulus	Isolated	1	N/A
10:35	81	4	Cumulus, Altocumulus	Scattered	2	N/A



In the Grass, In the Sun 11/09/17

Time	Outside Temp. (F°)	Barometer Reading (cm)	Cloud Type	Cloud Coverage	Windspeed (MPH)	Meta Data	Solar Radiance (W/M2)
9:25	82	11.5	Cirrus, cirrostratus	Broken	3	N/A	23,471
9:35	82	11.5	Cirrus, cirrostratus, cirrostratus	Broken	1	N/A	26,607
9:45	82	11.4	Cirrus, cirrostratus, cirrostratus	Broken	1	N/A	29,474
9:55	85	11.5	Cirrus, cirrostratus, cirrostratus	Broken	2	N/A	29,474
10:05	85	11.6	Cirrus, cirrostratus, cirrostratus	Broken	2	N/A	26,935
10:15	83	11.4	Cirrus, cirrostratus, cirrostratus	Scattered	3	N/A	29,474
10:25	85	11	Cirrus, cirrostratus, cirrostratus	Scattered	4	N/A	30,280
10:35	85	7	Cirrus, cirrostratus, cirrostratus	Scattered	2	N/A	30,775



Conclusion:

How does each of the these factors relate to the barometer reading?

-*Time of the day*: Depending on the time of day, generalizations can be made about the barometer reading. For instance, in the morning the atmospheric pressure is higher because of the temperature outside.

-*Outside temperature*: The higher the temperature of the air, the quicker it rises and loses density, decreasing the barometric pressure. The cooler it is, the denser the air becomes. This results in the barometric pressure to rise. Hotter temperatures generally mean lower pressure and cooler temperatures usually signify a higher pressure.

-*Wind speed*: Wind is air pressure converted to the movement of air, when wind stops it becomes air pressure. This means that higher wind speeds will show lower air pressure.

-*Cloud type*: Certain cloud types can alter the barometer reading based on the thickness or density of the cloud. When a cloud is thick, like a cumulus cloud, it can cover the sun which can result in a higher pressure system.

-*Cloud coverage*: When air pressure is high, air is sinking, and sinking air inhibits cloud formation. When air pressure is low, air is rising, and as it rises it cools and forms condensation, making multiple clouds; creating cloud coverage.

-*Solar radiance*: Measured in watts, it determines the amount of energy hitting the earth's surface.

Describe the learning in completing this investigation.

From this investigation, it is now known that certain atmospheric factors can alter a barometer reading.

What was the purpose of testing the barometer in grass concrete?

Testing the barometer in both the grass and concrete gave different results. The purpose was to discover the affect that the two surfaces had on the barometer reading.

What did the data reveal in comparing those two surfaces?

When the barometer was placed on the concrete, in the sun, the reading became more of a low pressure system because the concrete was absorbing more of the sun's energy. When placing the barometer in the grass, in the sun the reading remained a low pressure system but the dome was not as obvious because of the Photosynthesis involved within the grass. Instead, the solar energy was being converted into chemical energy.

Citations...

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