Measuring Weight Using PocketLab

Exploration

Barometric pressure is the pressure from the force or weight of air exerted on a surface. The PocketLab's barometric pressure sensor measures the force of the air molecules that push against the sensor.

Objective

In this exploration, students will:

1. Use the barometer to measure the weight of different objects.
2. Observe how pressure (force) inside a plastic bag is affected when weight is added to the plastic bag.

Materials

- PocketLab
- Sandwich bag with a zipper seal
- Two objects of known weight (Ex. 1 lb. and 4 lbs. weight)
- Two objects of unknown weight (approximately between 1 lb. and 4 lbs.)

Procedure

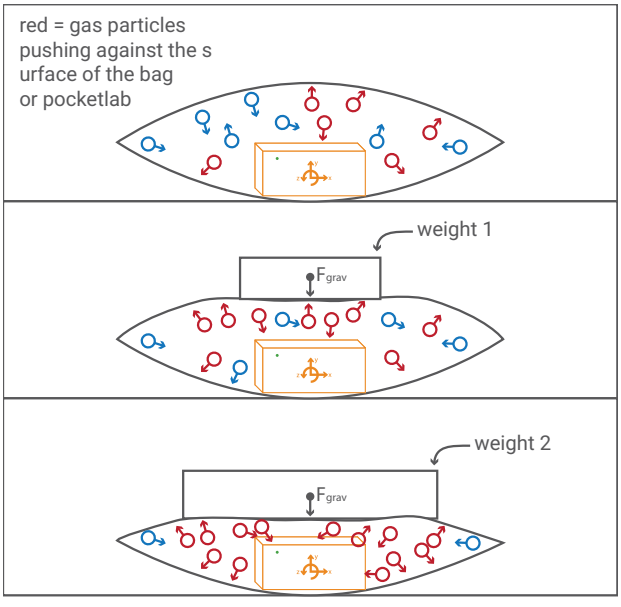
1. Place the PocketLab inside the plastic bag.
2. Partially seal the bag leaving a small hole.
3. Blow air inside the bag.
4. Carefully seal the bag, closed so the air is trapped inside the bag.
5. Record the pressure reading when no weight is on top of the bag. Call this P_1.
6. Place your first object of known weight on top of the bag.
7. Record the pressure reading for the known weight on top of the bag. Call this P_2.
8. Remove the object.
9. Place the second object of known weight on top of the bag.
10. Record the pressure reading for the known weight on top of the bag. Call this P_3.
11. Using the data collected to plot a pressure (mBar) vs weight (lb) graph.
12. Place your first object of unknown weight on top of the bag.
13. Record the pressure reading for the unknown weight on top of the bag. Call this P_4.
14. Remove the object.
15. Place your second object of unknown weight on top of the bag.
16. Record the pressure reading for the unknown weight on top of the bag. Call this P_5.

Predictions

- As weight is added to the bag, describe how you think the look of the bag will change.
- As the weight on the bag increases, how will the pressure of the air inside the bag change?

Data Analysis and Observations

- As weight is added to the bag, describe how the look of the bag changed. Did it match your prediction? Draw a before and after picture showing how the look of the bag changed when the different weights were added.
- As the weight on the bag increased, how did the pressure of the air inside the bag change? Did it match your prediction? Support your answer with data recorded from the PocketLab.
- Use your data to plot a pressure (mBar) vs weight (lb) graph.



- Use the three readings from P_1, P_2, and P_3 to create a calibration curve and plot the curve in your graph.
- Using the trend-line from the graph, estimate the actual weights of P_4 and P_5.

Conclusions

- Explain how and why the weight outside the bag affects the air pressure inside the bag. In your explanation, describe what is happening to the air inside the bag at a molecular level.
- Use the previous explanation to explain what the PocketLab's barometer is actually measuring.
- Maybe the bag is not perfectly airtight – if some air leaks from the bag during your experiment how would that affect the results?
- If you knew the weight of an object, could you predict what the air pressure would be inside your bag if you placed the object on the bag? Explain your answer.
- What variable would have to remain constant for your predictions in the previous question to be accurate?

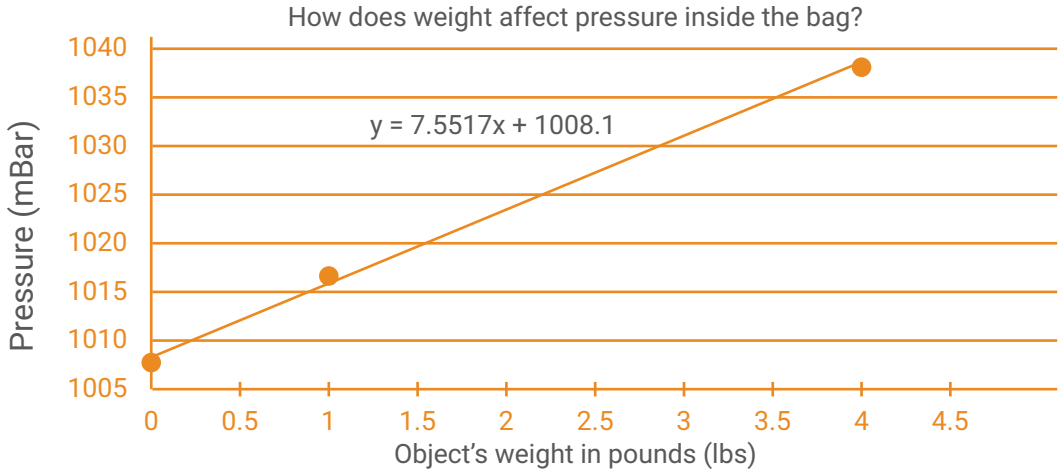
Measuring Weight Using PocketLab

TEACHER GUIDE

The data will only be accurate if the bag stays sealed. If the bag comes unsealed, students may have to recalibrate the relationship between pressure and weight by measuring the known weights over again. A ziplock bag with a zipper will help keep the seal.

During the predictions, make sure to push students to think about how the bag will change shape and how that will affect the pressure inside the bag. This will help them think more deeply about what pressure is really measuring and how it can relate to weight in this experiment.

During Data Analysis and Observations, students should note a direct relationship between pressure and weight. As the weight on the bag increased, the pressure of the air inside the bag should increase at an approximately consistent rate. They will observe this using P_1, $P_{2,}$ and P_3 as data points. Have them plot those data points, draw a trend line or line of best fit, and use the line to predict the weight of P_4 and P_5.



During the conclusion students should again think of the shape of the bag and how that changed as weight was increased. That should help students think about why the pressure increased as the weight was added.

Students should conclude that the amount of air in the bag always stays the same, so when weight is added, the molecules in the air get pushed closer together into a smaller volume of the bag causing the pressure to increase. Students should use the equation for the trend line or line of best fit to explain how they would predict the air pressure that would result from different weights.