

Characterizing the Atmosphere

Adapted from [Measuring the Pressure Around Us](#) (Prepared by David Rakestraw, Senior Scientist, Lawrence Livermore National Laboratory)

Goals:

- 1) Understand how a MEMS pressure sensor works
- 2) Assess the accuracy and precision of a pressure sensor
- 3) Determine the relationship between atmospheric pressure and altitude

Pre-lab:

- 1) Review the concept of pressure
 - a) What is the physics definition of pressure?
 - b) What is meant by “atmospheric pressure”?
 - c) Submit your answers to questions a) and b).
- 2) Install [phyphox](#) on your mobile phone.
- 3) Begin to characterize phyphox’s pressure measuring tool (refer to the [Measurement and Uncertainty note](#)):
 - a) Which PDA do its readings most likely sample (are these stable or not)?
 - b) Estimate the tool’s scale uncertainty.
 - c) Submit your answers to a) and b).
- 4) Review the concepts of accuracy and precision
 - a) Reread the relevant discussions on pages 2, 3, 5, and 10 of the [Measurement and Uncertainty note](#).
 - b) Answer problems 9 and 10 (page 11) of the [Measurement and Uncertainty note](#); submit
- 5) Review calculating means and standard deviations on page 4 of the [Measurement and Uncertainty note](#).
- 6) Review fitting data in the data analysis unit
 - a) Complete and submit the seventh computing task (in either [python](#) or [MATLAB](#))

Equipment:

- Lab notebook
- Smartphone
- [phyphox Sensor Database](#)

Tasks:

- 1) Determine the accuracy and precision of a smartphone pressure sensor
 - a) Measuring the same quantity with two or more devices, the standard deviation of all measurements relative to their average provides a measure of accuracy (consider the stability of the measurement, though)
 - b) The variation of the difference between the measurements of two devices provides a measure of precision
- 2) Design an experiment to measure how atmospheric pressure changes as a function of altitude
- 3) Present the experimental designs to the instructor for approval
- 4) Make and record measurements

- 5) Produce tables and/or graphs of the data and present these to the instructor for further guidance
- 6) Analyze the data to determine how atmospheric pressure changes as a function of altitude
- 7) Write a report and create a presentation documenting the experiment and its result