

# Lab 2: Ideal Gas Law

Due Date: February 14

## Background

You will go on an interstellar voyage to Kepler-186f, an Earth-size planet 500 light years away in the Cygnus constellation. Your crew consists of an atmospheric scientist, a chemical engineer, a mechanical engineer, and an astronomer. Kepler-186f is in the “habitable zone” where water would be in the liquid phase. To prepare for this mission, **characterize the Earth’s atmosphere** (find its molar mass). Your second task is to **calibrate the volume of your gardyloo** (a glass flask plus rubber tubing connected to the pressure sensor), a critical piece of equipment for further analyzing atmospheres.

## Available materials:

gardyloo	phone GPS	thermometer	pressure sensor
Logger Pro software	the atmosphere	stairs	Physical Sci Bldg rooftop

## Technical details

You must find a non-liquid-based calibration technique—a gardyloo will melt if exposed to liquid! At a given elevation, take multiple altitude measurements to get a feel for quantifying the uncertainty. Avoid strong winds affecting your pressure measurements.

## Lab report considerations

The gardyloo volume will ideally be solved via fitting a line to your data.

Provide a (percent) *error* for the molar mass and a (statistical) *uncertainty* for the gardyloo volume.

A photo of the lab setup must also be included (plus the fun AI-generated visual).

For the small range of altitude values  $y$  sampled, the atmosphere has the same temperature  $T$  and chemical composition (and hence the same molar mass  $M$ ), and the pressure  $P$  as a function of altitude  $y$  is  $P(y) = P(y=0) \exp(-Mgy/RT)$ .

## Teacher signatures

Please get either Prof. Dale or a TA to approve your experimental and theoretical plans before grabbing equipment. These approvals are worth 4% of the lab grade and will help to promote a successful experience.

