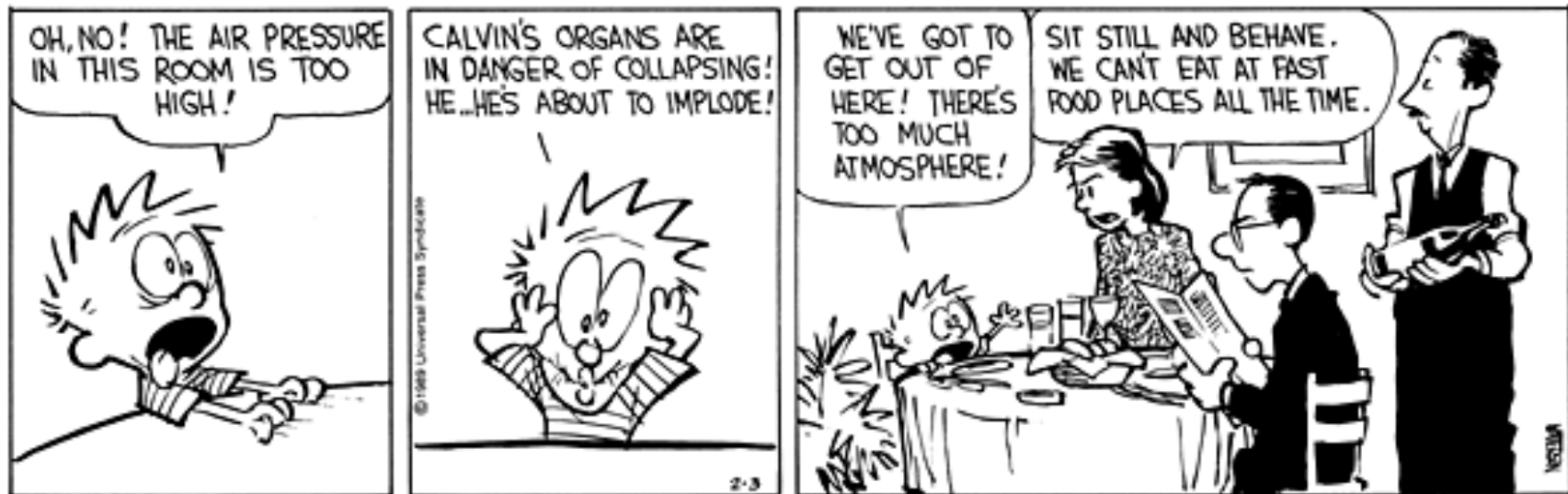


■ Theme Music: Mason Williams

Classical Gas

■ Cartoon: Bill Watterson

Calvin & Hobbes



Kinds of Matter

- Classify objects by how they deform.
 - *Solid*: don't change shape if you leave them alone or push on them (not too hard!)
 - *Gel*: look solid if you don't touch them but are “squishy” and change shape easily (jello, butter, clay,...)
 - *Liquid*: Have no shape of their own. Flow to fill a container but have constant volume.
 - *Gas*: Have neither shape nor volume but fill any container.
 - LOTS MORE!

Foothold ideas

Properties of solids



■ Density $\rho = \frac{M}{V}$

■ Stretch and squeeze:

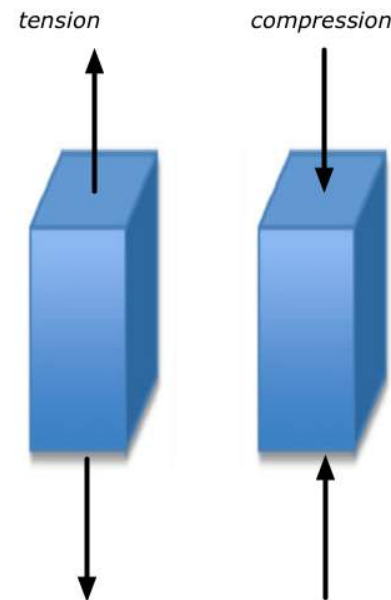
$$F = k\Delta L$$

$$\sigma = F/A \text{ (stress)} \quad \varepsilon = \Delta L/L_0 \text{ (strain)}$$

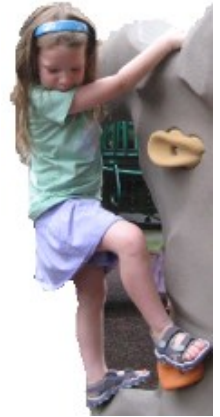
$$E = \sigma/\varepsilon \text{ (Young's modulus)}$$

$$k = E \frac{A}{L_0}$$

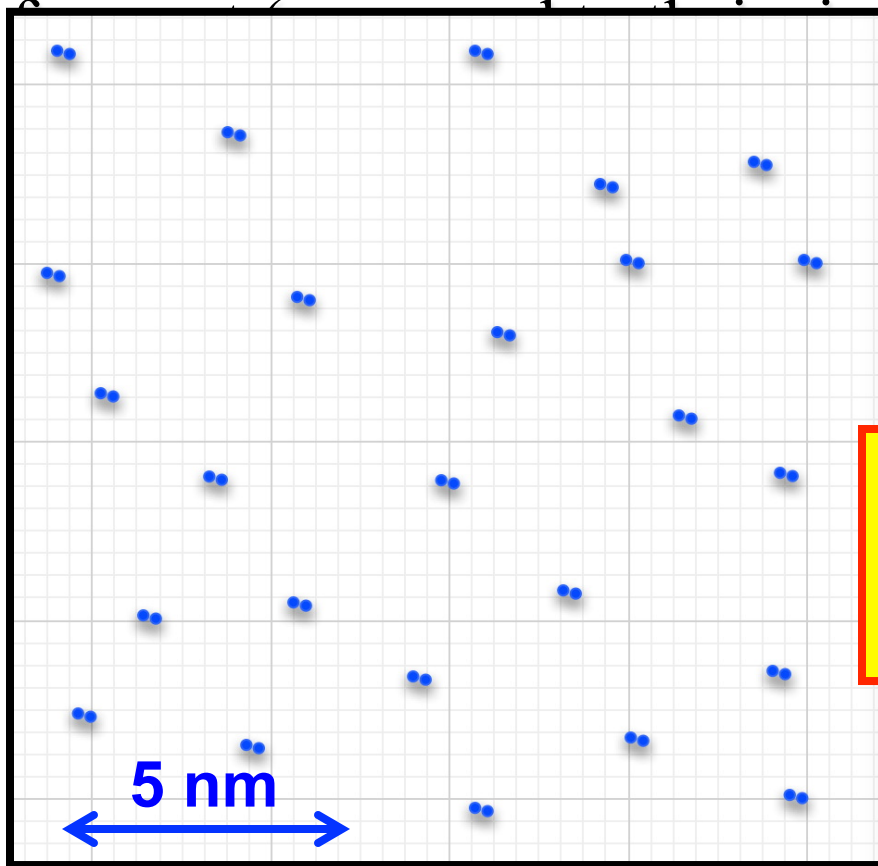
■ Breaking stress



Foothold ideas: Gases – Kinetic Theory I



- We model the gas as lots of tiny little hard spheres (of mass m) and moving very fast (with random velocities) and change directions very often (due to collisions). The average (the total momentum conservation) is a



This is a realistic size and scale for air at STP (speed ~400 m/s)

Gas Law,
$$pV = n_{\text{moles}}RT$$

PHET

Constant Parameter

- Volume
- Pressure
- Temperature
- None

Gas in Chamber

Heavy Species	279
Light Species	0

Gravity

0 ————— Lo

Tools & Options

<< Hide Tools

- Layer tool
- Ruler
- Species information
- Stopwatch
- Energy histograms
- Center of mass mark

Advanced Options >

Reset

Heat Control

— Add

0

— Remove

Gas in Pump

- Heavy Species
- Light Species

<http://phet.colorado.edu/en/simulation/gas-properties>

Magdeburg hemispheres

