Fluid

\[ \text{Imaginary box of fluid at rest} \]

\[ p \cdot A \]

\[ dy = dm = pA \text{dy} \]

\[ (p+dp)A \triangleq \text{bigger to support weight in box} \]

\[ (p+dp)A - pA - gAdy = 0 \]

\[ \frac{dp}{dy} = -pg \]

\[ p = p_0 - ggy \]

- sign... deeper, higher

Pressure.
\[
\frac{P_{\text{water}}}{P_{\text{Air}}} = 10^3 \quad \frac{P_{\text{mercury}}}{P_{\text{Air}}} \uparrow \quad \text{atmosphere is } 10^4 \text{ m tall}
\]

\[
\text{Manometer} \quad \text{vacuum} \quad \text{Mercury}
\]

\[
h \approx 1.4 \times 10^4 \text{ m}
\]

\[
h \approx \frac{10^4 \text{ m}}{1.4 \times 10^4}
\]

\[
\approx 7 \text{ m} \quad (760 \text{ mm})
\]

\[
p = p_0 + \rho_{\text{Hg}}gh
\]

**Buoyancy (Archimedes Principle)**

You feel "lighter" when in water. Why?

\[ \Rightarrow \text{It's the weight of the displaced water} \]

"Eureka!" Archimedes cried, as he exited his bath, ran naked to King
Imagine a uniform sphere with volume $V$. If you filled the hole with water, it would be in static equilibrium. But water feels gravity, what cancels this is called the 

**Buoyant Force** $B$

$$B - p_w V g = 0$$

$$B = p_w V g$$
\[ T + B = pVg \]
\[ T = (p - p_w)Vg \]

Note: \[ \frac{T}{T'} = \frac{(p - p_w)Vg}{pVg} \]
\[ \frac{T}{T'} = 1 - \frac{p_w}{p} \]
\[ \frac{p_w}{p} = 1 - \frac{T}{T'} \]

\[ p = \frac{p_w}{1 - \frac{T}{T'}} \]

Gold vs. Lead... Easy!