Two Intrinsic Quantities:

1) Density: $\frac{\text{mass}}{\text{volume}} \equiv \rho$

which weighs more, a ~~pound~~ 4.4 N of feathers or a ~~pound~~ 4.4 N of lead?

neither, but lead is more dense

$$\frac{g}{cm^3} \rightarrow \text{"cgs"} \Rightarrow \underbrace{\frac{kg}{m^3} \ \text{mks}}_{}$$

we use this

$$1 \ \frac{g}{cm^3} = \frac{10^{-3} \ kg/g}{(10^{-2} \ m/cm)^3} \times 1 \frac{g}{cm^3}$$

$$1 \ \frac{g}{cm^3} = 1000 \ kg/m^3$$

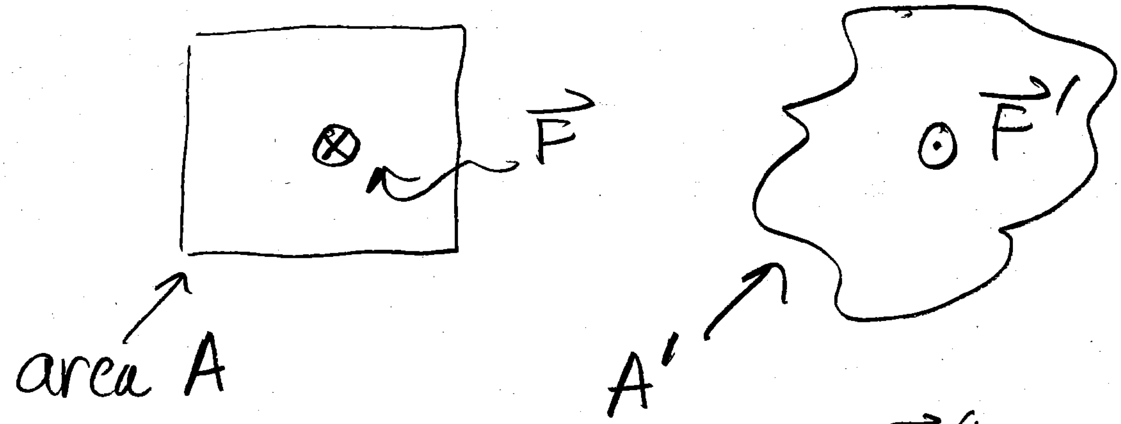
Air $\rho \simeq 1.2 \ kg/m^3$ (!)
(roomful $\simeq 72$ kg!)

Liquids $\rho \sim 10^3 \ kg/m^3$

Solids: Lead $\simeq 11 \ kg/m^3$ Gold $\simeq 19 \ kg/m^3$

2) <u>Pressure</u>: $PV = nRT$

$\frac{\text{Force}}{\text{Area}}$ → $\boxed{\text{direction of force is } \perp \text{ to area}}$



$$P = \frac{|\vec{F}|}{A} \qquad P' = \frac{|\vec{F}'|}{A'}$$

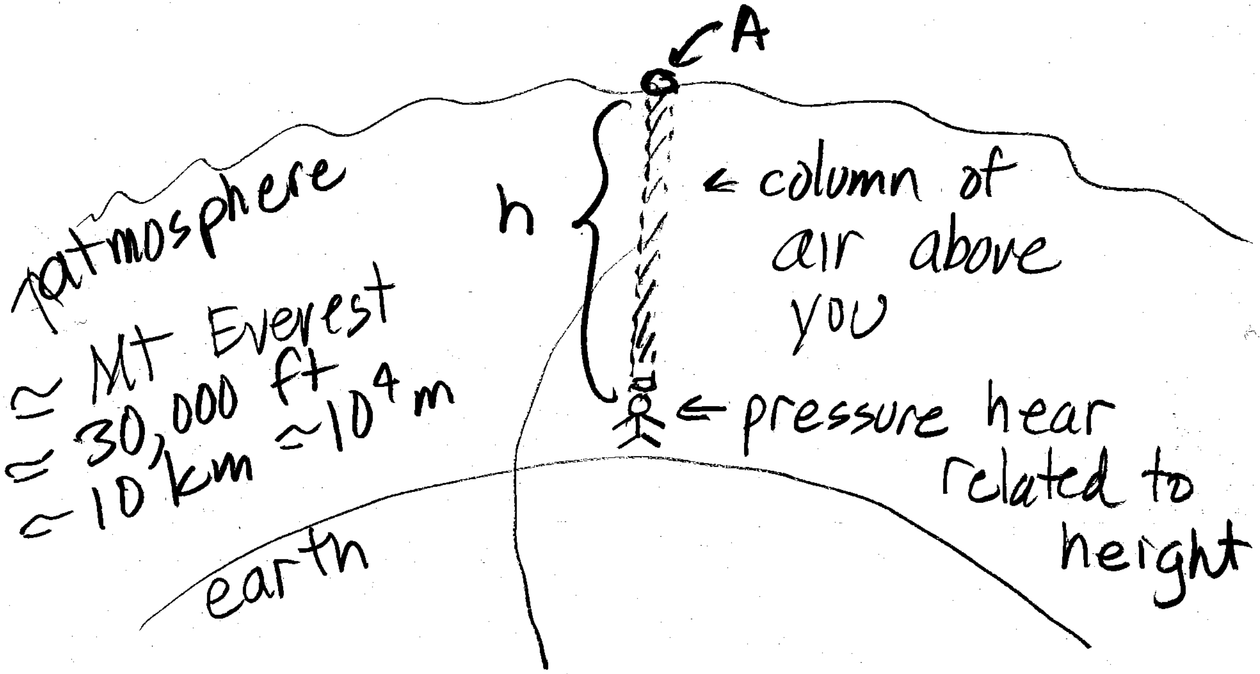
<u>units</u>: $\frac{N}{m^2} \equiv$ Pascal, "very small"

$$1 \text{ atm} \cong 10^5 \text{ Pa} \simeq 1 \text{ "bar"}$$
$$\simeq 15 \ \frac{\text{lbs}}{\text{in}^2}$$

$\boxed{\text{Pressure versus depth in a fluid}}$

Swimming -- go deep, your ears hurt!

Qualitative :

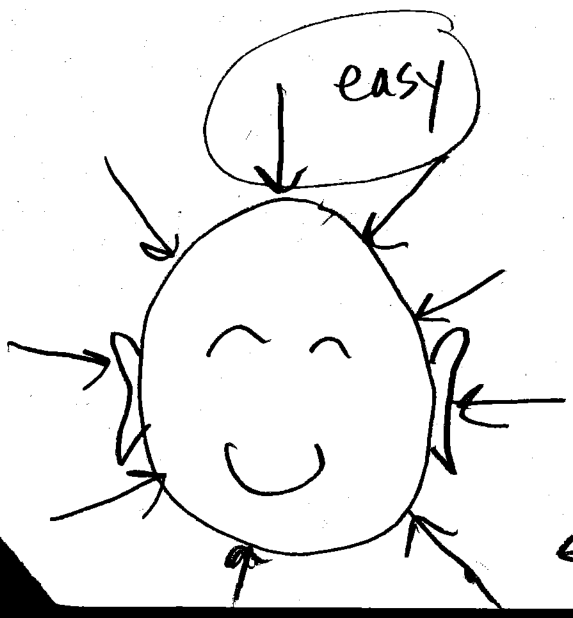


Estimate

$$W = \underbrace{\rho (Ah)}_{\text{mass}} \cdot g$$

top of head $\quad P \simeq \frac{W}{A} \simeq \underset{kg/m^3}{1.2} \cdot \underset{m}{10^4} \cdot \underset{m/s^2}{10}$

$$P \simeq 1.2 \cdot 10^5 \, \frac{N}{m^2}$$



Pressure "Turns Around" in Ideal Fluids

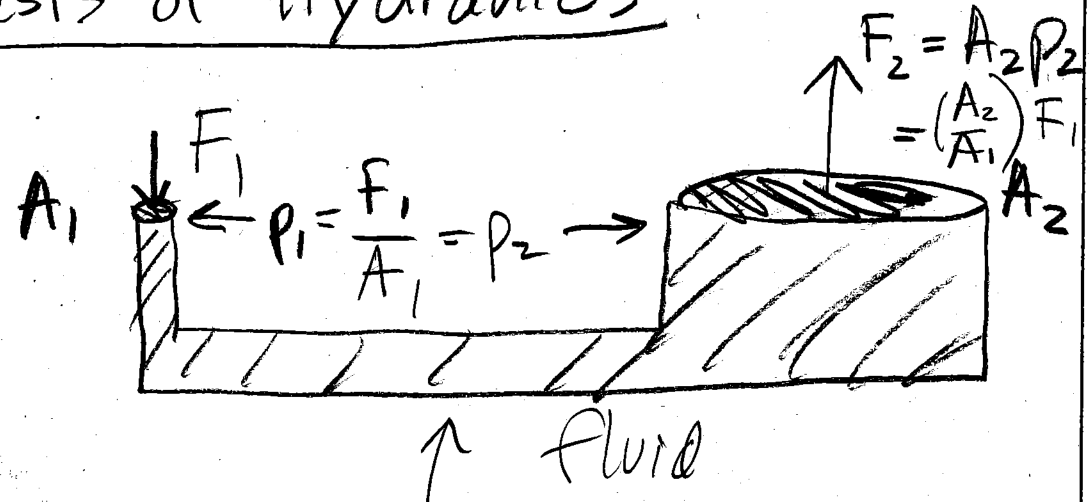
← in fact... a little higher!

<u>Atmosphere</u> : compressible gases.

<u>Water</u> : incompressible (nearly)

<u>Pascal's Principle</u> : <u>Additional</u> pressure applied to an incompressible fluid is transmitted undiminished to every portion of the fluid

<u>Basis of Hydraulics</u> :



What about work?