Temperature: what is it?

- read off a thermometer
- your intuitively understand hot + cold

\[ T_A = 110^\circ C \quad \text{hot block} \]
\[ T_B = 0^\circ C \quad \text{cold} \]

touch

Just \( \Rightarrow \) Heat flows from \( A \) to \( B \)

(not temperature)

Due to the heat transfer, A cools off, B heats up.

Heat flow stops when \( T_{Af} = T_{Bf} \)

between \( 110^\circ + 0^\circ \)
When $T_A = T_B$, two systems are said to be in thermal equilibrium.

"transitire" $A$ in eq. with $B$

then... $B$ in eq. with $C$

**Temperature Scales**

1. $^\circ F$: water freezes $32^\circ F$
   - boils $212^\circ F$

2. $^\circ C$
   - freeze $0^\circ C$
   - boils $100^\circ C$

3. $K$
   - $OK = -273.15 ^\circ C$
   - $\Delta T (K) = \Delta T (^\circ C)$

What? Meaning of $OK$... where a volume of gas has 0 pressure...
Empirically

\[ P \]

- Volume of gas \( V_0 \)
- Put at a temperature \( T \), vary

\[ PV_0 = nRTK \]
\[ P = \left(\frac{nRT}{V_0}\right)T \]

- Gas could suck?

What really is temperature?

→ random motion of molecules
  (heat = energy = random directions, velocities)

→ randomness ↔ mathematically defined by entropy
Example: all air molecules could suddenly collect on left side of room, just probability is unbelievably small.

\[ T \propto \frac{1}{\frac{\partial (\text{entropy})}{\partial (\text{energy})}} \]

\[ \text{absolute} \]

\[ T \text{ never } 0 \]

\[ T \text{ can be negative (very weird, but possible)} \]

**Thermal Expansion**

Linear "rules"

\[ \Delta L \propto L_0 \quad \text{(initial length)} \]

\[ \propto \Delta T \quad \text{(K or °C)} \]

\[ \Delta L = \alpha L_0 \Delta T \]

\[ \uparrow \text{ depends on material} \]