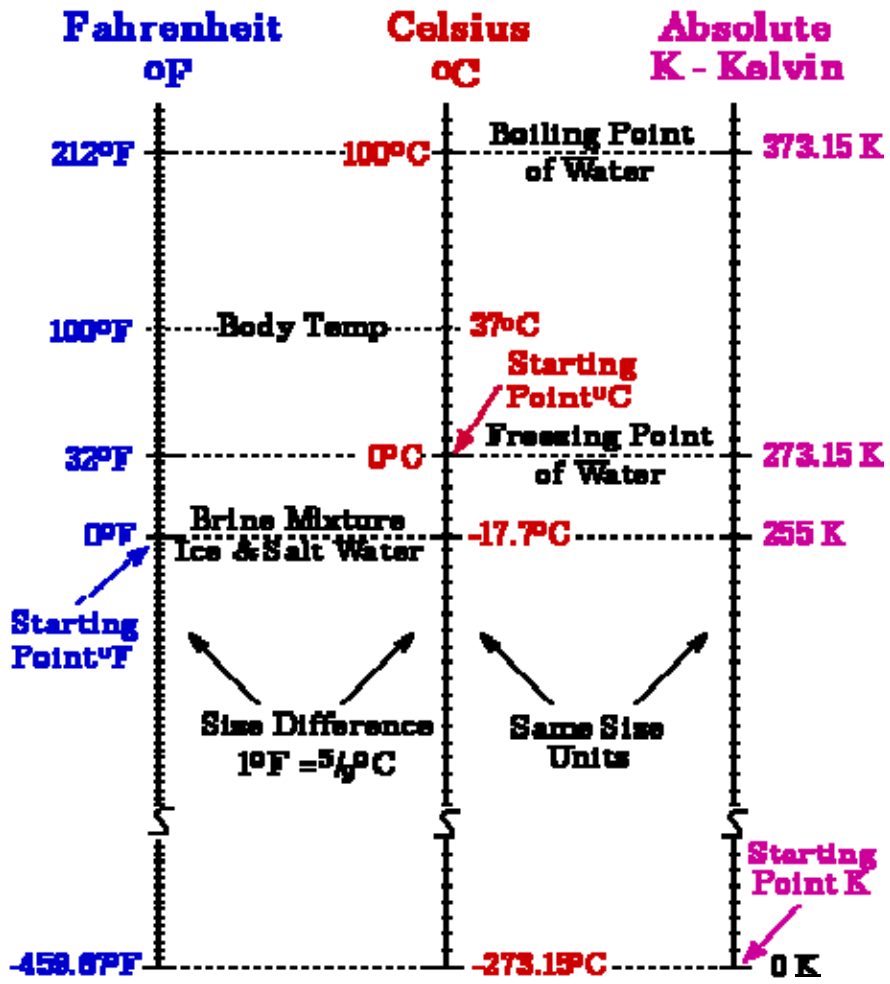
Temperature

Temperature

Temperature of an object indicates average internal energy due to molecular motion.

Absolute zero is minimum temperature at which molecular motion ceases.

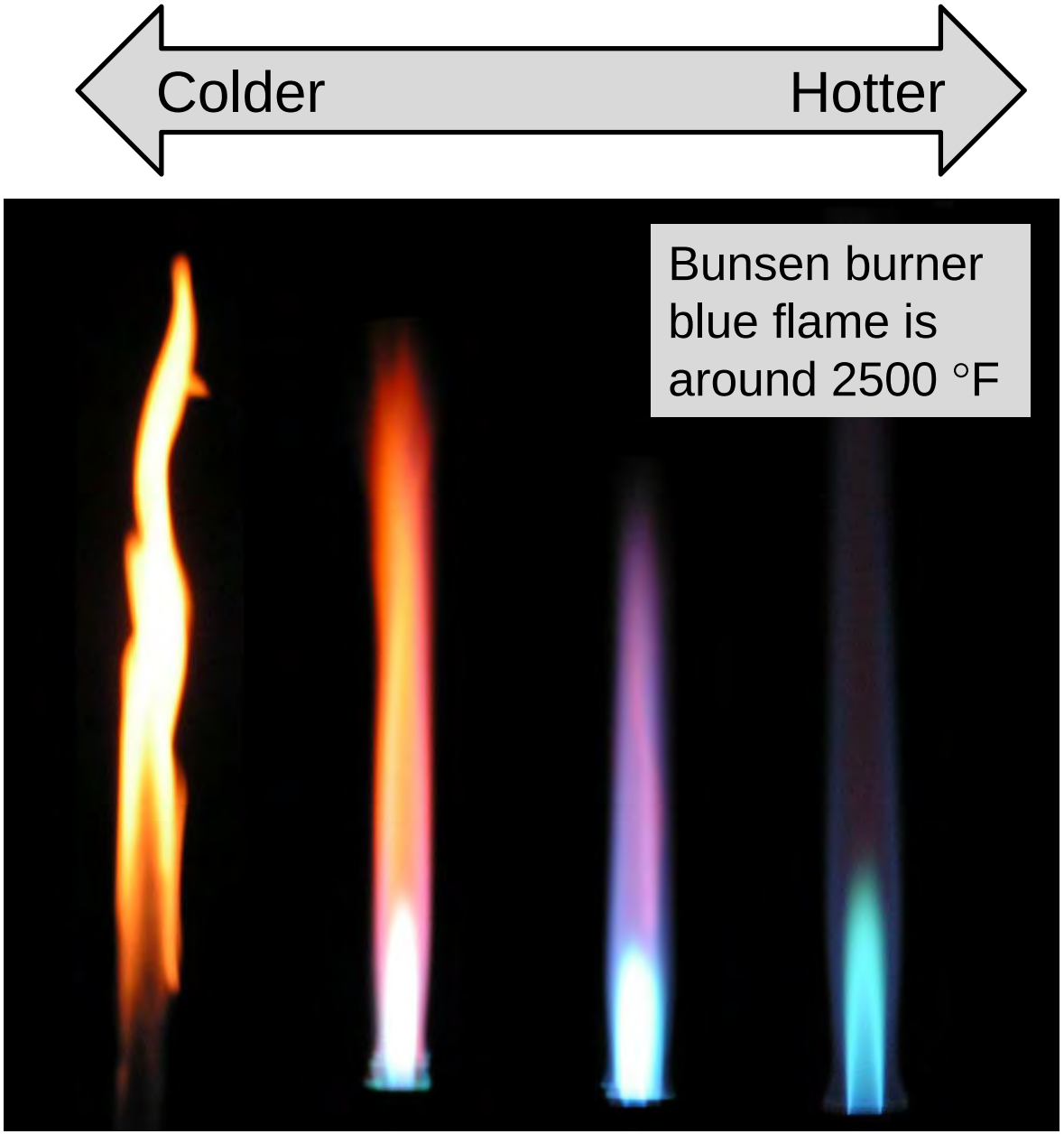


Temperature Scales

Flames

Chemical energy released in a burning flame produces high temperatures.

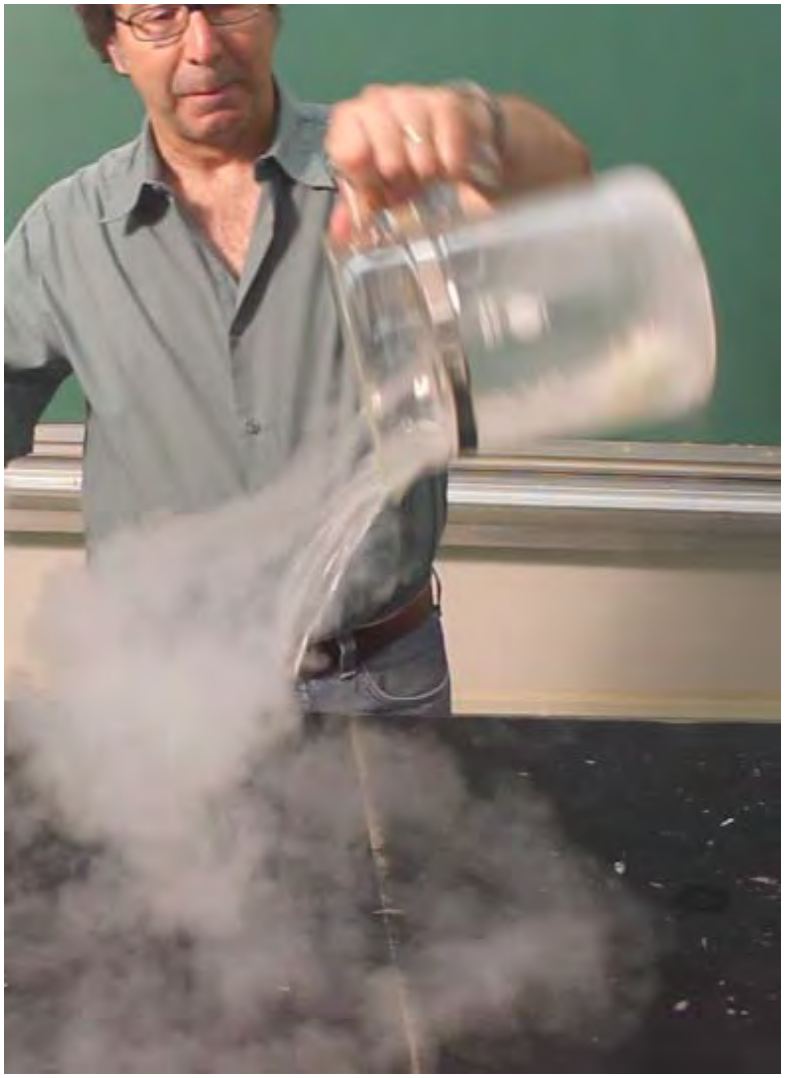
The higher the temperature the “cooler” (bluer) the color of the flame.



Liquid Nitrogen

Nitrogen gas in air becomes a liquid if the temperature is lowered to around -320 ºF.

Lowest possible temperature (Absolute Zero) is -460 ºF



Materials & Temperature

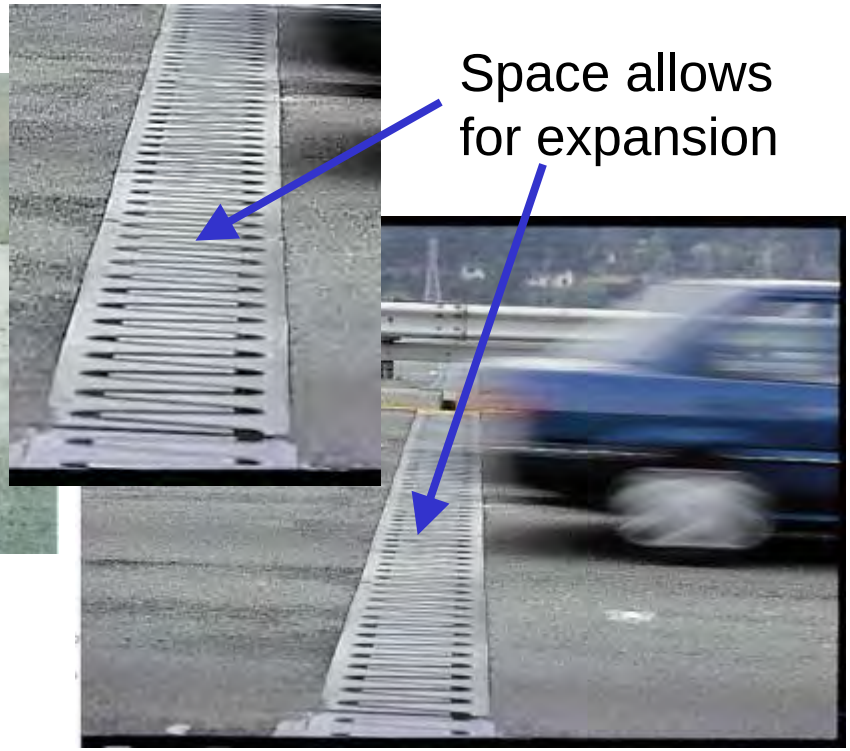
Various properties of materials change with temperature.

* Changes of phase (solid, liquid, gas) occur as temperature rises.
* Most materials expand when heated and contract when cooled.
* Many materials become brittle at very low temperatures.

Thermal Expansion

Due to increased molecular motion, most materials expand as temperature increases.

Sidewalk buckles and cracks due to expansion on a hot summer day



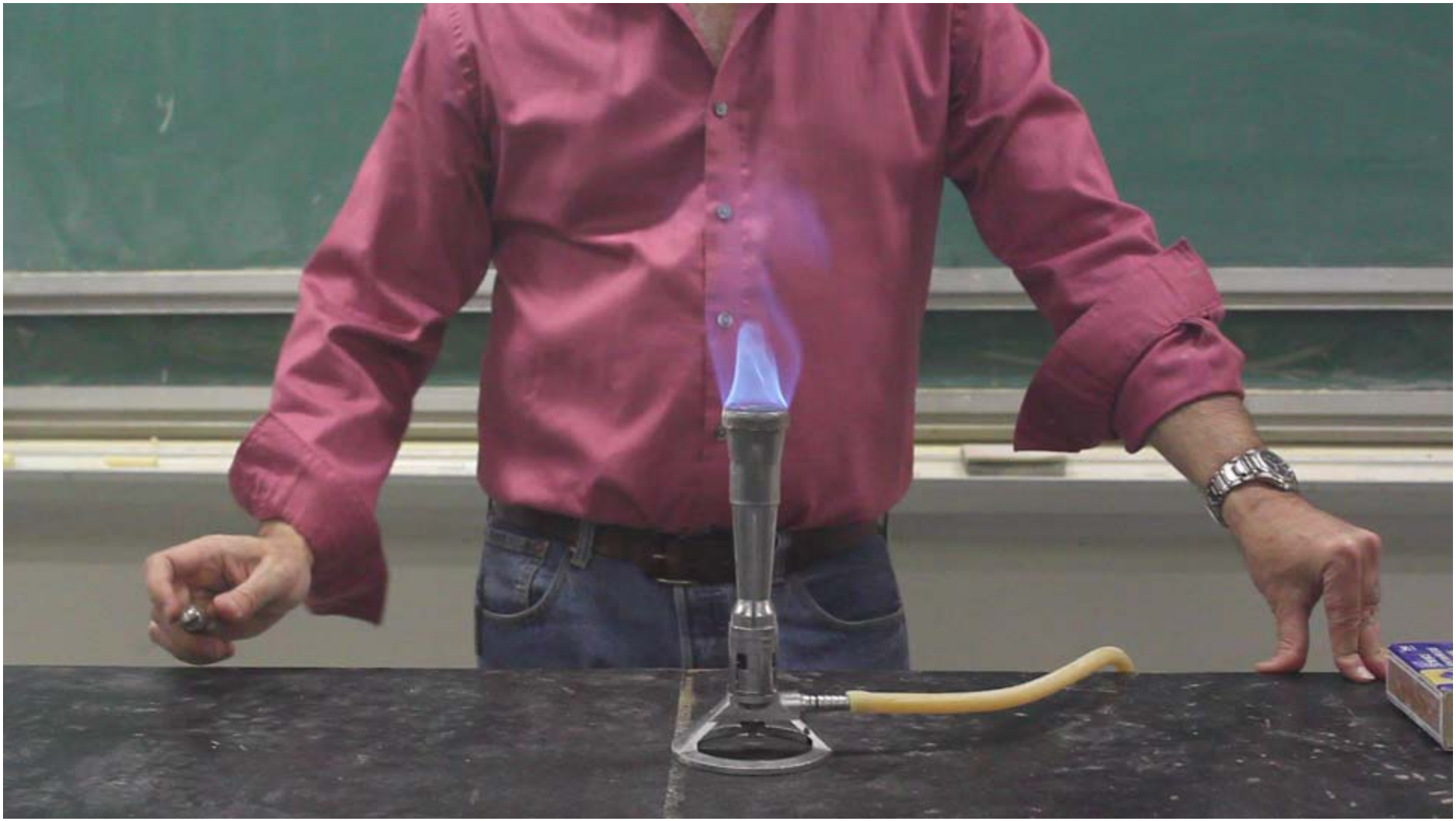
Bi-metallic Strip

Different materials have different rates of expansion.

Bi-metallic strip is steel on brass

Brass expands more than steel when heated

Bi-Metallic Strip



Balloon in Liquid Nitrogen

Balloon in Liquid Nitrogen

Cool balloon using liquid nitrogen

Air molecules slow down and pressure goes down

Balloon slowly warms up, restoring energy

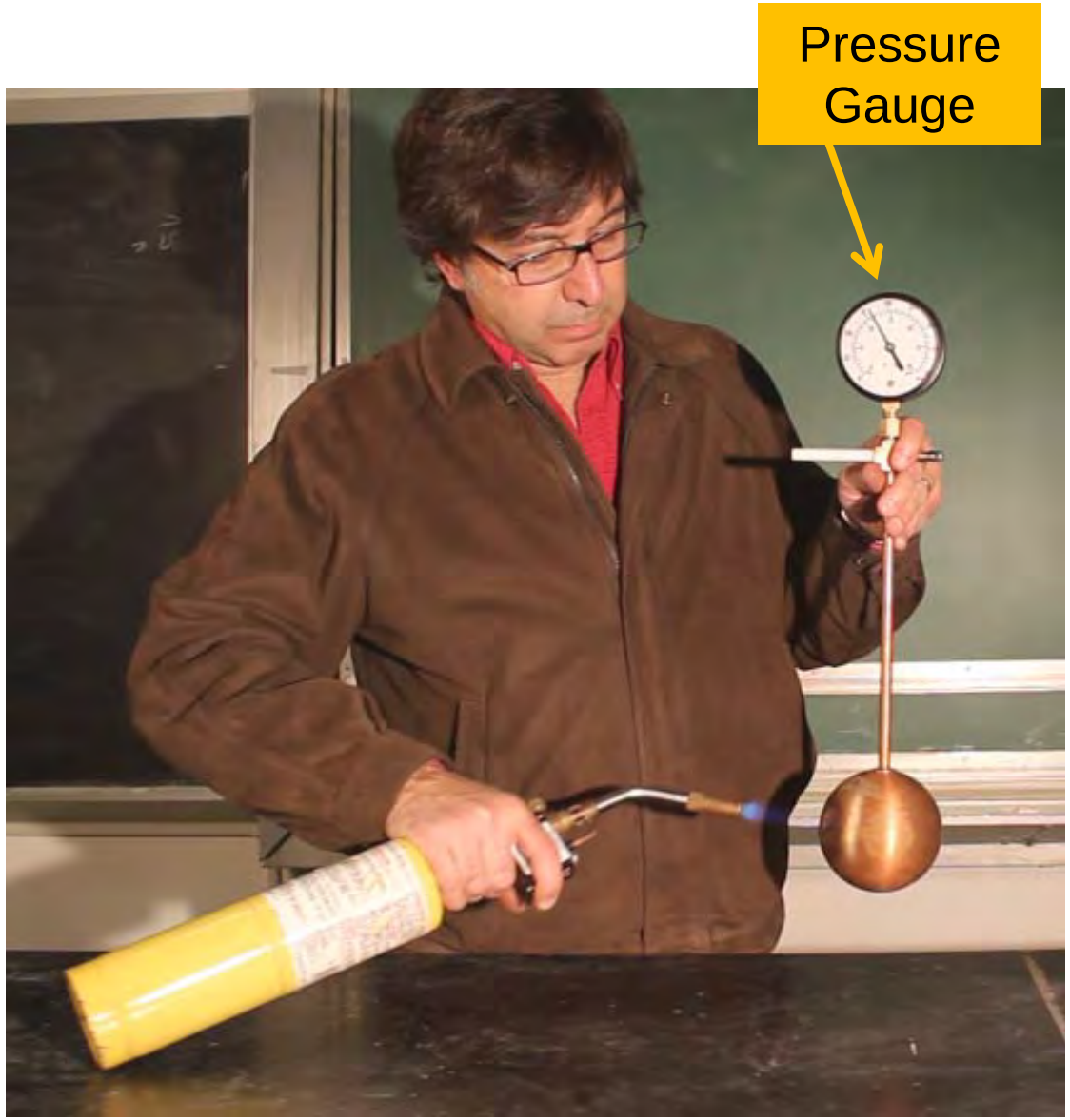
Balloon returns to its original state

Long Balloon in Liquid Nitrogen

Gay-Lussac's Law

As temperature increases, the pressure in a sealed air tank, increases.

Heat the air tank and observe the pressure gauge.



Gay-Lussac's Law

Watch the pressure gauge as the air tank is heated with a blow torch.

Freezing in Liquid Nitrogen

Many solid materials become brittle at very low temperatures, such as when frozen with liquid nitrogen.

Shattering a bike lock

http://tinyurl.com/c92bqho

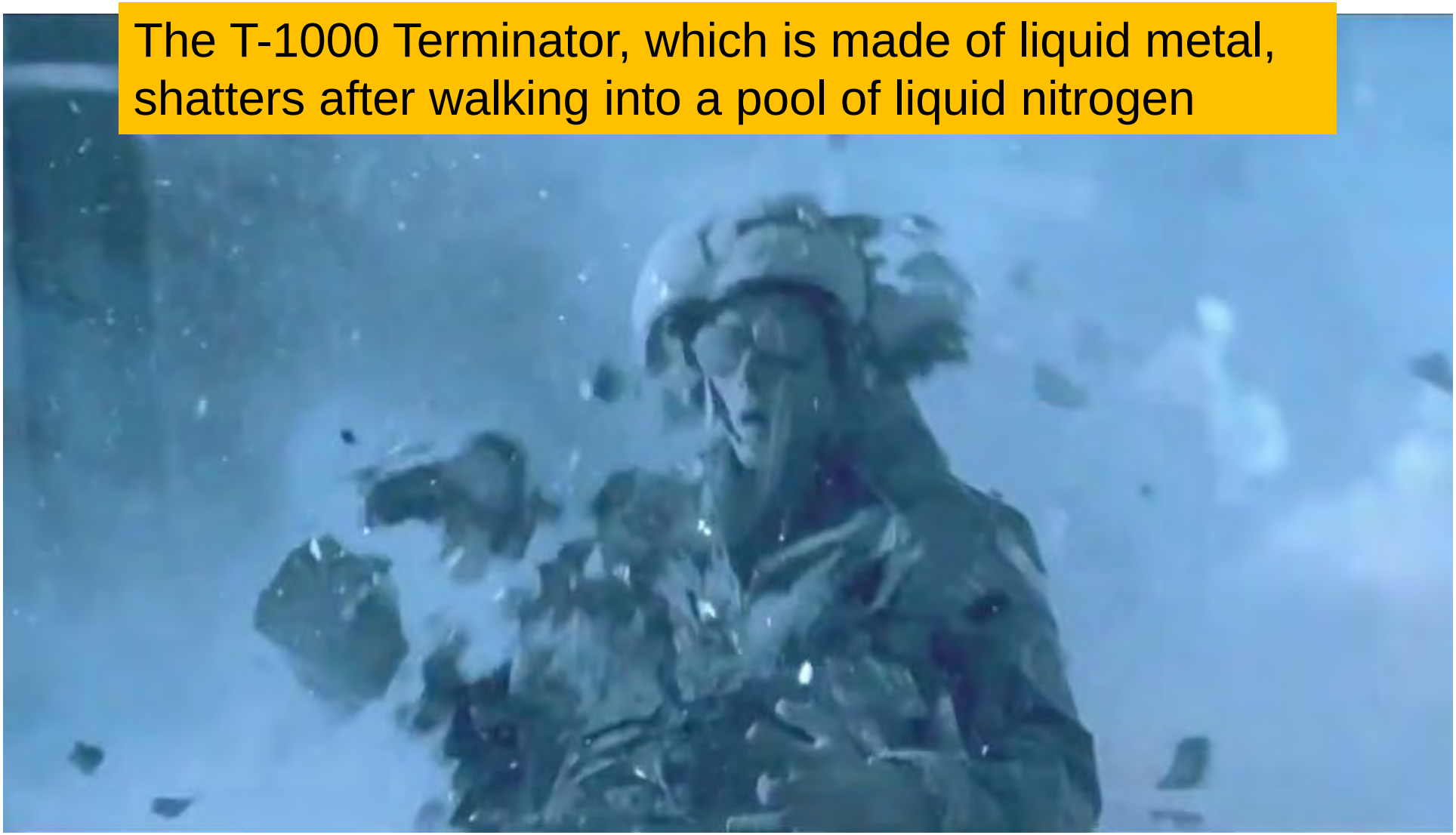
Frozen Pickle

Frozen Flower

Frozen Onion

Terminator 2: Judgment Day (1991)

The T-1000 Terminator, which is made of liquid metal, shatters after walking into a pool of liquid nitrogen



Summary

- Temperature indicates average internal energy due to molecular motion.
- Absolute Zero is the lowest possible temperature (around -460 °F).
- Most solids expand slightly in volume as temperature increases.
- Pressure in a gas increases/decreases as temperature increases/decreases.
- Many solids are brittle at extremely low temperatures.