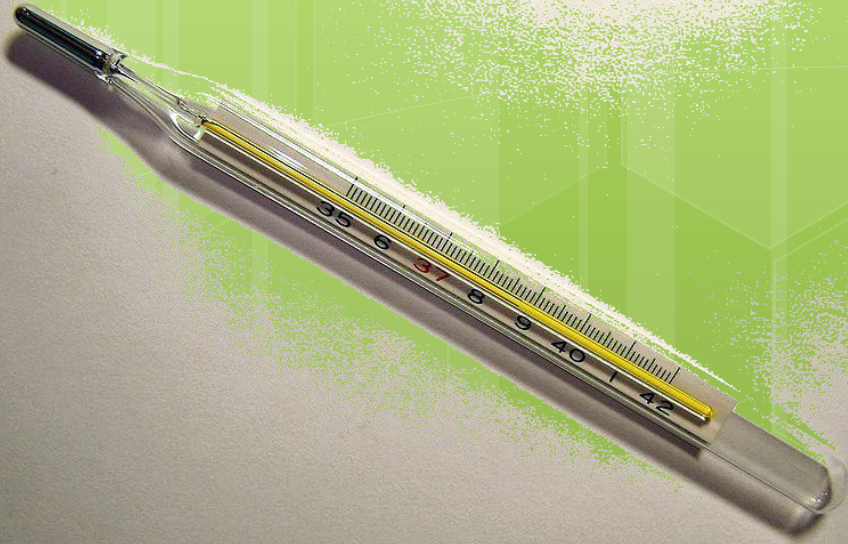


Thermometer



Temperature

- Temperature is the degree of hotness and coldness of an object.
- S.I. Unit for temperature is kelvin (K).

Thermometer

- Thermometer is a device used for measuring temperature, especially of the air or in a person's body

How did people measure temperature?

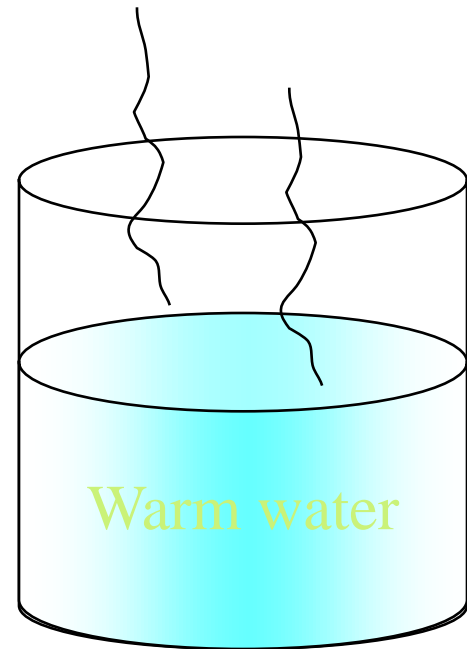
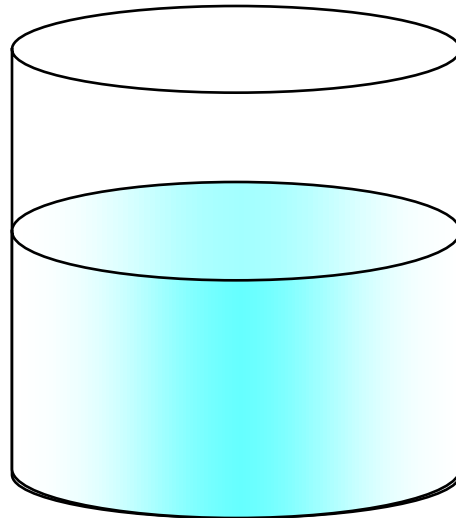
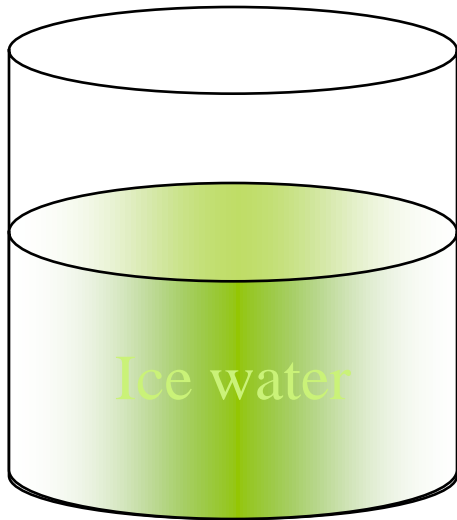
- Using our sense, especially our skin we can measure the temperature.
- Sense organ is a part of the body which makes it possible to experience the physical characteristics of a situation
- Your ears, eyes, tongue, nose and skin are your sense organs.

Limitations of sense

- Sense can not give us the value of accurate temperature.
- Sense is influenced by environment
- Sense especially our skin, just detect how cold and how hot something.
- Sense cannot be used to measure extremes temperature

Activity 1

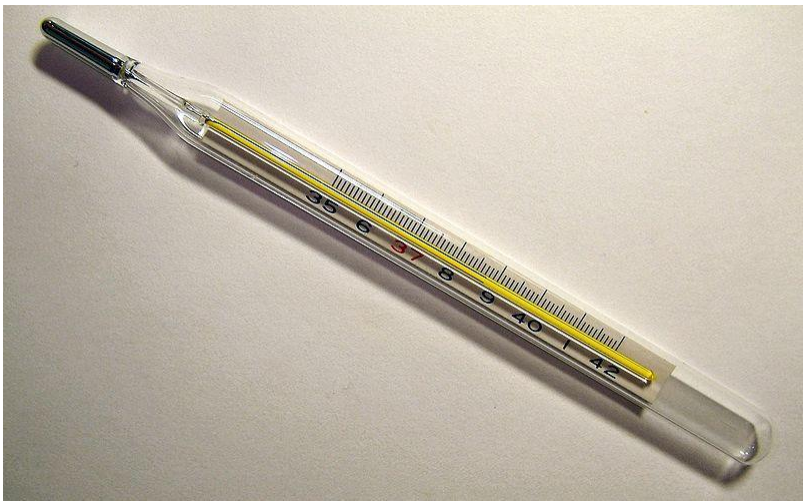
- Using your sense to measure temperature.



Developing of thermometer

- Attempts of standardized **temperature measurement** have been reported as early as 170 AD by **Claudius Galenus**.
- The modern scientific field has its origins in the works by Florentine scientists in the 17th century.
- Early devices to measure temperature were called **thermoscopes**.
- The first sealed thermometer was constructed in 1641 by the Grand Duke of Toscani, Ferdinand II.
- The development of today's thermometers and temperature scales began in the early 18th century, when **Gabriel Fahrenheit** adapted a thermometer using mercury and a scale both developed by **Ole Christensen Rømer**.
- Fahrenheit's scale is still in use, alongside the **Celsius scale** and the **Kelvin scale**.

The commonly thermometer



Thermometers and Temperature Scales

- Thermometer is made use the fact that some **physical properties** of matter change proportionate to temperature change.
- Especially expansion and contraction of liquid

How liquid expansion can be used to make thermometer?

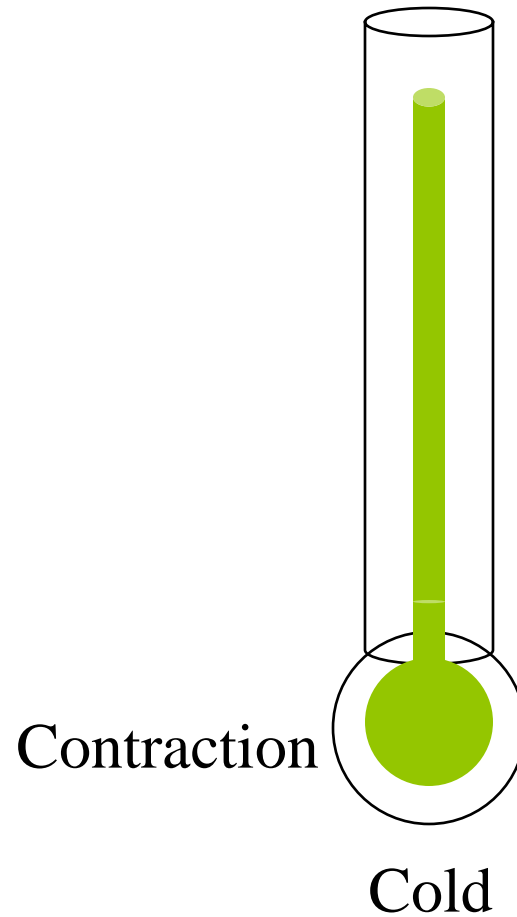
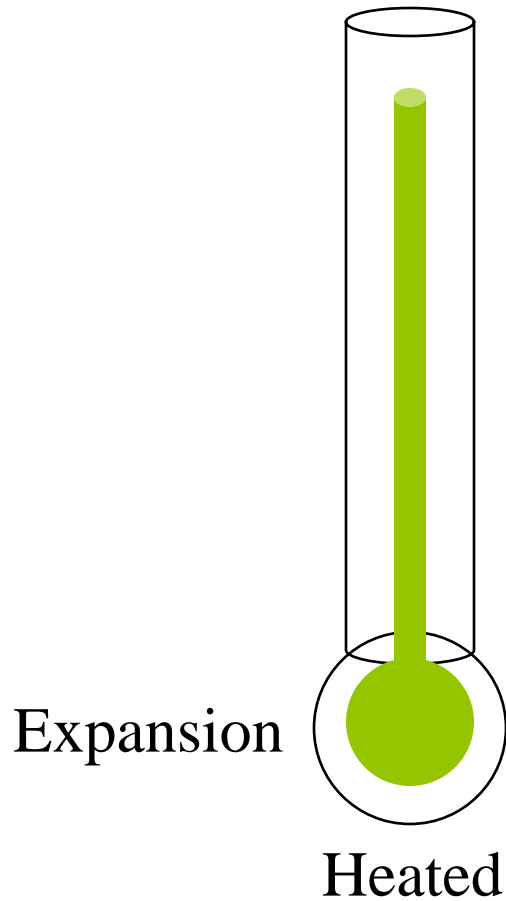
- The basic principle of liquid thermometer is liquid expansion.
- Liquid will expand if it is heated, and contract if it is cold.
- The expansion and contraction of liquid are used to make sign.
- The process make sign on the thermometer is namely calibration.

Make Liquid thermometer.

- Liquid thermometer is made by capillary pipe,
- In the bottom of capillary pipe there are bigger container to save liquid.
- The liquid that usually used to fill thermometer is **mercury or alcohol**.
- Why are mercury or alcohol used to fill thermometer?
- Can water used to fill thermometer?



Make Liquid thermometer.



Calibration

- Thermometers can be calibrated either by:
 - comparing them with other certified thermometers or
 - checking them against known fixed points on the temperature scale.
- The best known of these fixed points are the melting and boiling points of pure water.

Calibration Activity

The traditional method of putting a scale on a liquid-in-glass or liquid-in-metal thermometer was in three stages:

- 1. Make lower point.

Immerse the thermometer in a mixture of ice and water and mark the point at the thermometer as lower fixed point.

- 2. Make upper point.

Immerse the thermometer in a steam at one standard atmosphere ($101.325 \text{ kPa} = 760 \text{ mm Hg}$) and again mark the point indicated as upper fixed point.

- 3. Make Scales.

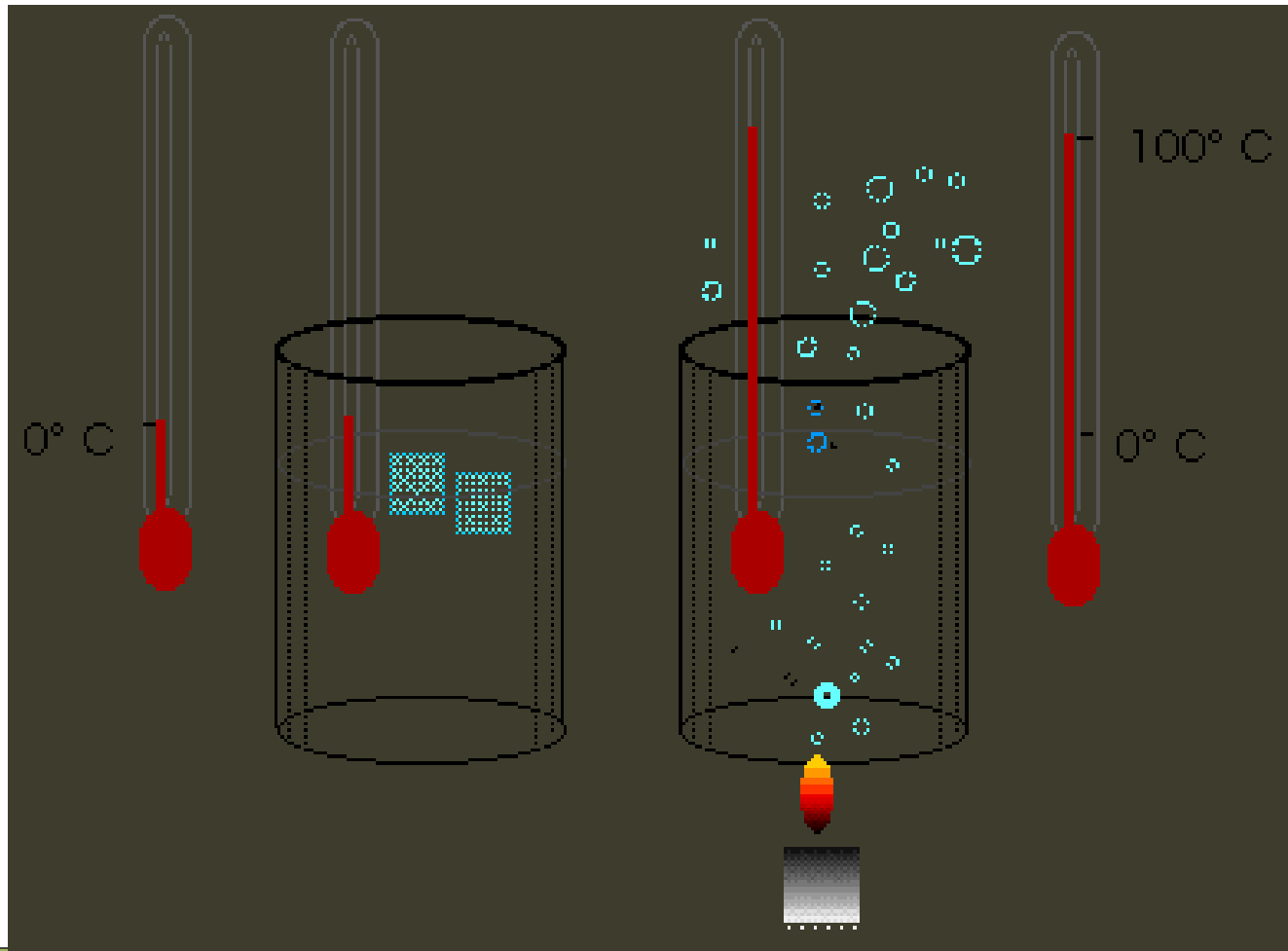
Divide the distance between these marks (lower point and upper point) into equal portions according to the temperature scale being used.

Thermometer scale

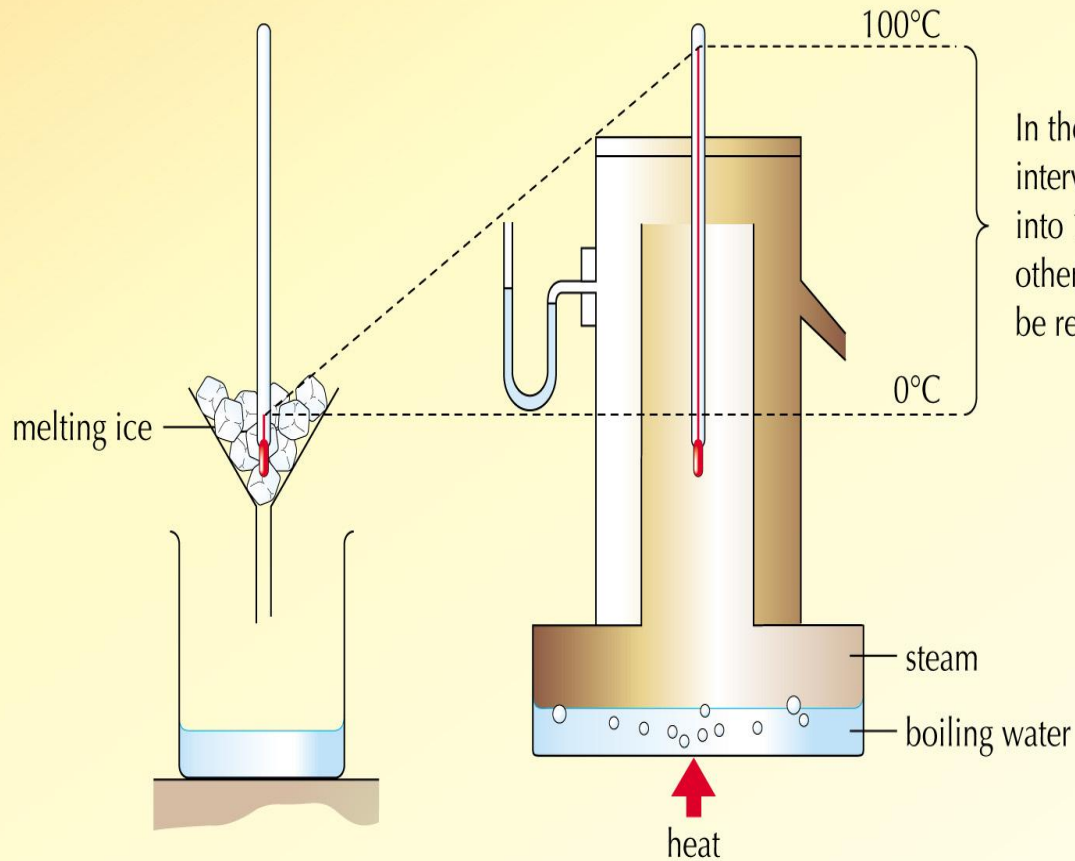
Ice Point and Steam Point

- The *lower fixed point* or ice point is the temperature at which pure ice melts at standard pressure. (0°C).
- The *upper fixed point* or steam point is the temperature at which pure water boils at standard pressure. (100°C).

Calibration



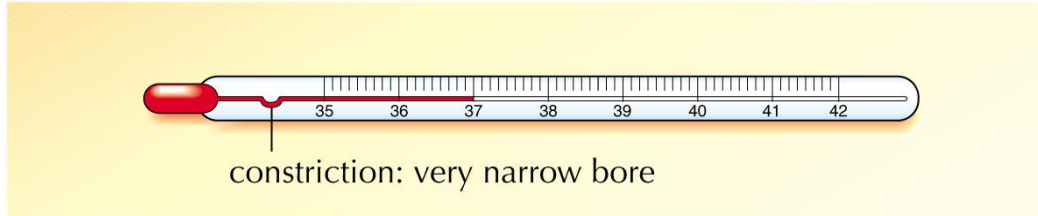
Calibrating a thermometer



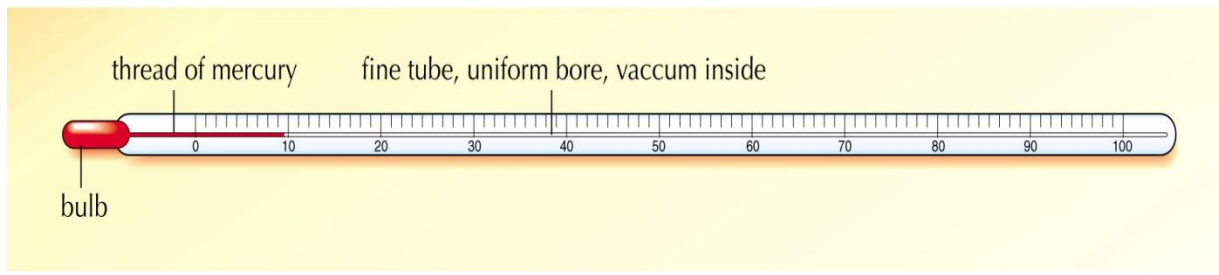
In the Celsius scale, the interval is divided equally into 100 divisions so that other temperatures can be read from the scale.

Thermometers and Temperature Scales

- Household liquid-in glass thermometer



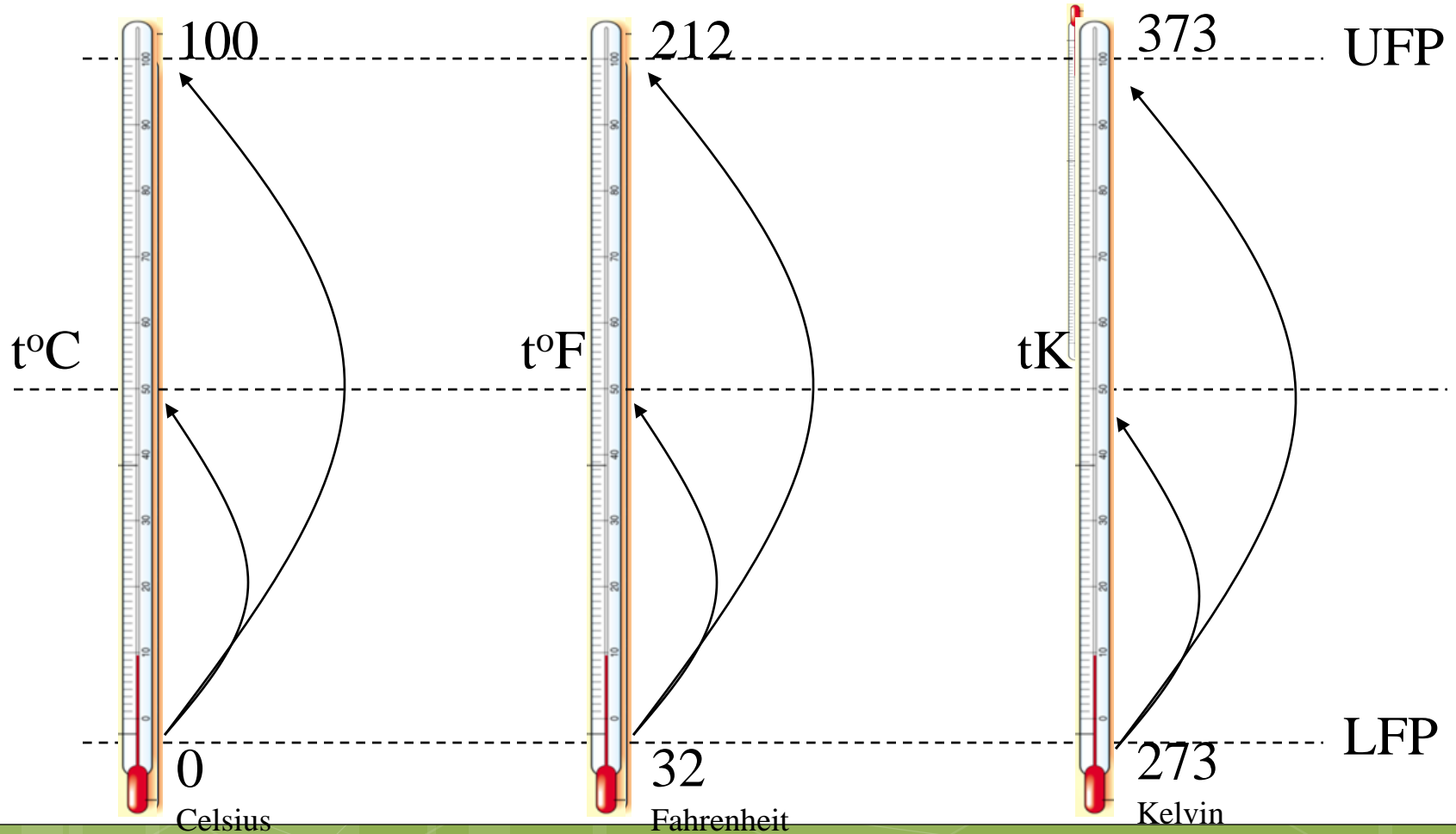
- A liquid-in-glass laboratory thermometer



Ice Point and Steam Point

- Different scales can be used in the measurement of temperature, such as:
 - Kelvin
 - Celsius scale
 - Fahrenheit scale.

Comparison between thermometer scales



The Relationship scale

$$\frac{C - 0}{100 - 0} = \frac{F - 32}{212 - 32}$$

$$\frac{C}{100} = \frac{F - 32}{180}$$

$$\frac{C}{5} = \frac{F - 32}{9}$$

$$\frac{C - 0}{100 - 0} = \frac{K - 273}{373 - 273}$$

$$\frac{C}{100} = \frac{K - 273}{100}$$

$$C = K - 273$$