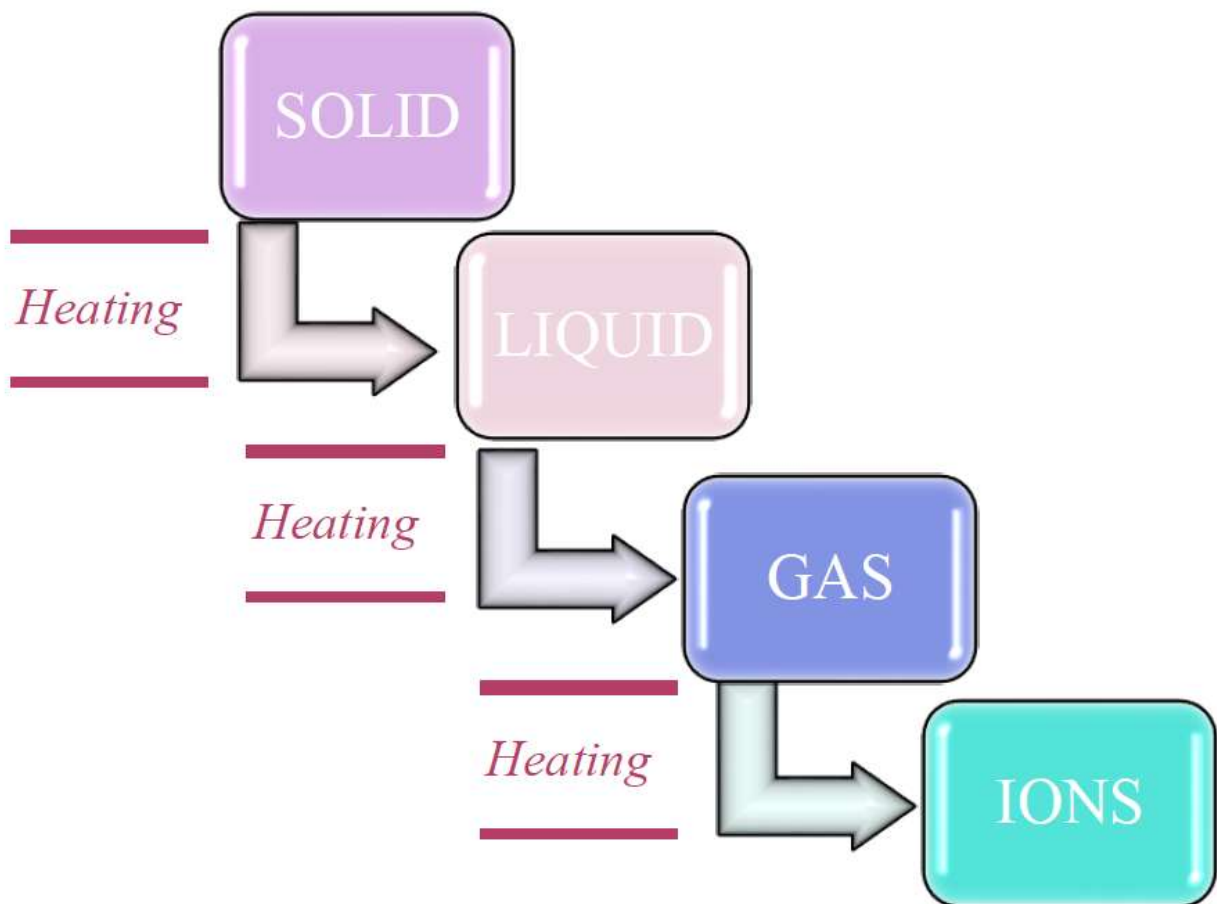


Heat and Cold in medicine

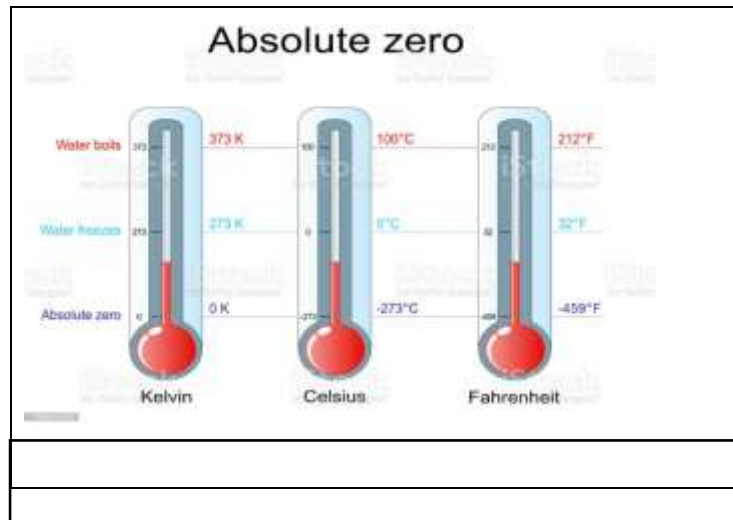
Physical Basic of Heat and Temperature

Heat: is defined as the energy transferred from hot subjects to the cold subjects caused rising the temperature of cold one.

**In general, matter is composed of molecules that are in motion. when the molecules move that means they have kinetic energy and this kinetic energy is related to the temperature ($KE \propto Temp.$).*



Temperature scales : There are three types of Temperature Scales



1. Fahrenheit ($^{\circ}F$) scale

- Water freezes at $32^{\circ}F$ and boils at $212^{\circ}F$
- Normal body T (rectal) is about 98.6°

2. Celsius ($^{\circ}C$) scale

- Water freezes at $0^{\circ}C$ and boils at $100^{\circ}C$
- Normal body T (rectal) is about $37^{\circ}C$

3. Absolute ($^{\circ}K$) scale

- Water freezes at $273.15^{\circ}K$ and boils at $373.15^{\circ}K$
- Normal body T (rectal) is about $310^{\circ}K$

The relationships between the different temperature scales are:

$$^{\circ}K = 273.15 + ^{\circ}C$$

$$^{\circ}C = (5/9) \times (^{\circ}F - 32)$$

$$^{\circ}F = (9/5) \times ^{\circ}C + 32$$

Example: - The temperature of the human body is normally about 98.6°F. calculate the temperature of the body in °C and °K?

$$^{\circ}\text{C} = (5/9) \times (^{\circ}\text{F}-32) = 5/9 (98.6-32) = 37^{\circ}\text{C}$$

$$^{\circ}\text{K} = 273.15+^{\circ}\text{C} = 37+273=310.15^{\circ}\text{K}$$

Types of Thermometers in Medicine

1. Glass-liquid thermometer → This is used to know the temperature of the body .It is composed of:

1. Capillary tube with alcohol or mercury.

2. Magnifying glass that is surrounds the capillary tube in the front.

3. An opaque white backing on the back.

The principle behinds this thermometer is that: an increase in the temp. of different materials causes the mercury to expand more than the glass and this produce an increase in the level of the mercury which is related to the temp.

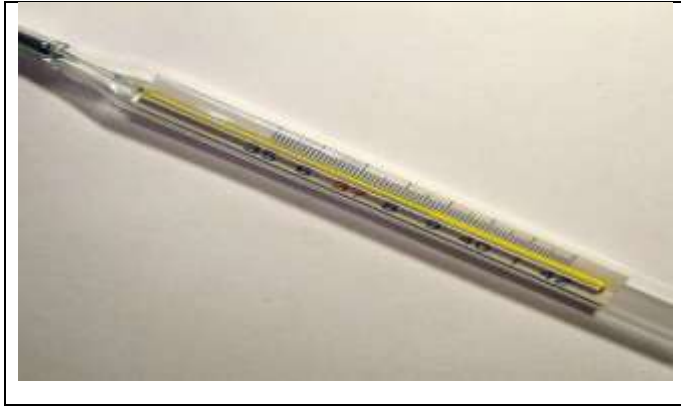
Two things increase the visibility of the capillary?

- The glass case acts as magnifier
- An opaque white backing is used

Why mercury is used instead of alcohol or other liquids in thermometer?

- a) It can be seen easily because it has a clear color.**
- b) It is expanded uniformly with increasing temp.**

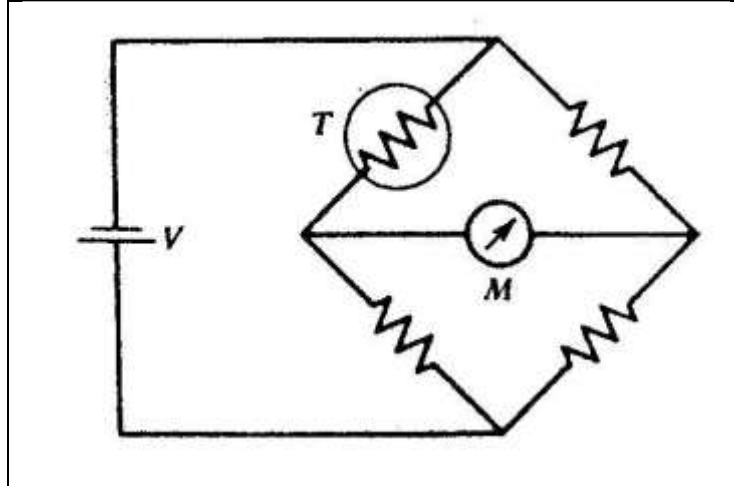
c) Mercury has low adhesion force with the wall of the glass and has high adhesive force



2. Thermistor → Initially the four resistors are equal, that is, the bridge is balance by symmetry, and the voltages at each end of the meter are equal and no current flows through the meter.

- It's a special resistor that changes its resistance rapidly with temp ($\approx 5\% ^\circ C$).
- The principle behind this thermistor is that a temperature change causes the thermistor resistance to change.
- Because it is very sensitive and very fast for measuring temp change, it has been used to monitor the breathing rate of the patient, This is called “pneumograph”.

Pneumograph: is a device for recording velocity and force of chest movements during respiration.

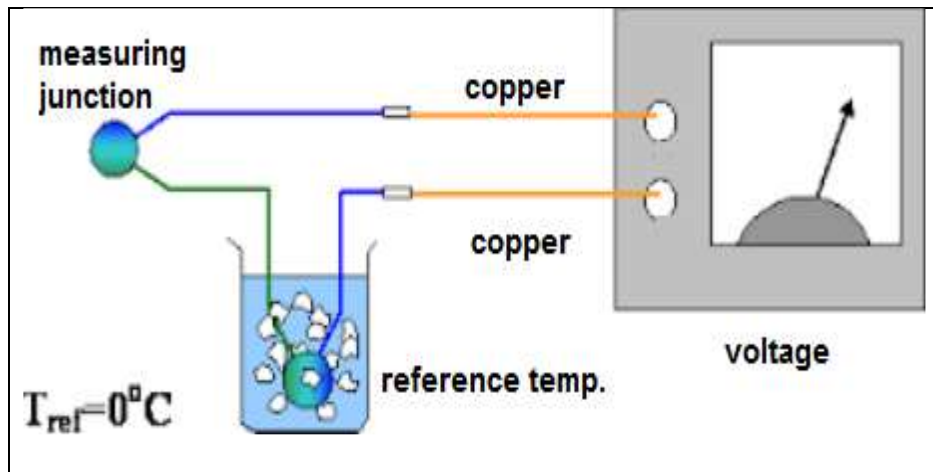


3. Thermocouple

- A thermocouple consists of two different metals.
- This thermocouple can be used to measure temp. from -190 to 300°C
- For a 100°C temp. difference, the voltage produced is only about 4 mV
- Thermocouple can be made small enough to measure the temp. of individual cell

Why Use thermocouples to Measure Temperature?

- They are inexpensive.
- They can be used over a wide temperature range.



The human body temperature depends on:

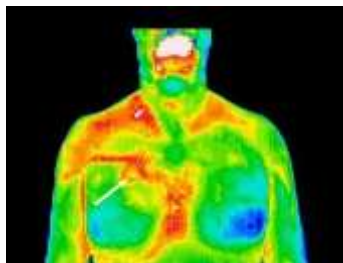
1. The amount of recent physical activity.
2. The temperature of the environment.
3. The health of the individual.
4. The extent of insulation of body heat by clothes.

Thermograph

Mapping the Body's Temperatur

The body surface temperature varies from point to point depending upon:

1. External physical factors
2. Internal metabolic factors
3. Circulatory processes near the skin (blood flow near the skin is the dominate factor).



Using of thermograph

1. It is used in the detection of breast cancer and other types of cancer (In breast cancer, surface T above tumor is about 1°C higher than that above nearby normal tissues, then a very sensitive temp).
2. Studying the circulation of blood in the head.
3. Detection of circulatory problem in the foot of diabetics that reducing leg amputation.
4. In the Dentistry

In the Dentistry Dentists recommend the use of medical thermograph in monitoring control in the inflammation process into oral cavity and reaction of the regional lymphatic nodes, maxillary joint disease and other chronic disease of the bones, nerves located in the maxilla facial area

It is a surface T map that is done by measuring the radiation emitted from the body.

The steps for Breast cancer detection that must be followed respectively:

- 1. Thermograph**
- 2. Palpation: difficult to detect a small tumor (less than 1 cm in diameter).**
- 3. Mammography (low energy x-ray): successful but radiation hazard.**
- 4. Biopsy: invasive, some cancer tissue may be missed.**

Heat Therapy

Heating of tissue may be beneficial to damaged tissues. So that heat has two therapeutic effects:

1. Increase in metabolism resulting relaxation in capillary system (vasodilatation)
2. Increase in blood flow when blood moves to cool the heated area

1-Conductive heating:

• Which transferred by conduction from the warmer object to the cooler one. (Hot bath, hot pack, electric heating pad, hot paraffin, etc.)

The total heat transferred will depend upon:

- a) Contact area
- b) Time of contact
- c) Temperature difference
- d) The thermal conductivity of materials

2-Radiant (IR) heating:

Used for surface heating of the body. IR produced from glowing wire coil, incandescent lamp, sun, etc.

- 1-IR wavelength used: 800 to 40,000 nm (1 nm = 10⁻⁹ m).
- 2 -Waves penetrate the skin by 3 mm and increase the surface T.
- 3-Excessive exposure causes reddening (erythema), swelling (edema),
- 4-Most of the energy is deposited in the surface of fatty layers.
- 5-Used for the same conditions that used in the conductive method

3-Short-wave diathermy:

- 1.In this method the body to be treated becomes part of the electrical circuit.
- 2.It is done by two methods :(capacitance method and inductance method .
- 3.Heat from diathermy is useful for internal heating because it penetrates deeper than radiant & conductive heating.
- 4.It has been used in the relieving muscle spasm, pain from protruded intervertebral discs, degenerative joint disease, bursitis, and neuralgia.

4-Microwave diathermy:

- It is a form of electromagnetic energy that produced by a special tube called magnetron and emitted from the antenna.

•It is effective in therapy; it causes more uniform heating around the bony regions, It is used in treatment of fractures treatment of inflammation of the skeleton.

5-Ultrasonic diathermy:

- ultrasonic waves used for deep heating of body.
- The vibration of the particles in the tissues producing heat. It is useful for depositing heat in bones, because the bones absorbed ultrasonic energy more effective than soft tissues, treatment of cancer by heat.

Use of Cold in Medicine

Cryogenics: the science and technology of producing and using very low temperature.

Cryobiology: the studying of low-temperature effects in biology and medicine.

Cryosurgery

Cryosurgery: cryogenic methods to destroy cells with the following advantages:

1. Less amount of bleeding in the destroyed area.
2. Volume of tissue destroyed can be controlled by the temperature of the cryosurgical probe.
3. Little pain sensation since low T desensitizes nerves.

1.Treatment of Parkinson's disease. Destroy a part of the thalamus in the brain

2.Treatment of tumors.

3.Eye surgery.

Uses of cryosurgery

Parkinson's disease (shaking palsy)

It is the disease associated with the basal ganglion of the brain. its caused uncontrolled tremor in the arms & legs

Advantages of cryosurgery in the treatment of Parkinson's disease

1. The destroyed area doesn't interfere with normal body function.
2. The patients always show immediate benefit.
3. The post-operative recovery period is very short.
4. Percentage of successful is more than 90%.

