

Heat

- The measure of degree of hotness of a substance is called its temperature.
 - The device that is used to measure the temperature of a substance is called thermometer.
 - Thermometers are of two types - clinical (used for measuring temperature of human body) and laboratory (used for measuring temperature of common objects).
 - The temperature range of clinical thermometer is 37- 42 °C and that of laboratory thermometer is -10 °C to +110 °C. The unit for temperature is °C.
 - The normal temperature of human body is 37 °C or 98.6 °F.
 - There are three commonly scales used in temperature
 - Celsius scale of temperature
 - Fahrenheit scale of temperature
 - Kelvin scale of temperature
 - Kelvin is the SI unit of temperature.
 - The SI unit of heat is joule (J)
 - Other common units of heat are calorie (cal) and kilocalorie (kcal).
 - 1 kcal = 1000 cal
 - 1 cal = 4.2 J
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- The temperature of a body increases on heating; however, the temperature falls on removing heat from a body or by cooling it.
 - The addition of a sufficient amount of heat to a substance, or the removal of a sufficient amount of heat from it, can change the state of the substance.
 - Substances expand on heating and contract on cooling.
 - The physical and chemical properties of substances are altered on heating.

All substances expand on heating.

The order of expansion of solid, liquid and gas is:

Gas > Liquid > Solid

- Due to expansion of solids, rail tracks have spaces in them and electric wires are kept loosen
- Due to the expansion of air, hot air balloon moves up

Apart from raising the temperature of the substance, heat has additional effects as well.

Expansion of solids on heating

On heating, generally solids expand in all directions, i.e. in its volume. So, it is also known as cubical expansion or volume expansion.

Advantages of expansion of substances on heating:

1. **Bimetallic strips** are used as heat-operated switches in circuits of automatic equipments, like iron box, fire alarms, microwave oven, etc.
2. Many thermometers work on the principle of expansion of liquids.
3. Expansion of gases is useful in automobile engines.

Disadvantages of expansion of solids by heating and their solutions-

1. **Breaking of thick glass tumbler by pouring boiling water into it-** If boiling water is poured into a thick glass tumbler, it cracks immediately. The heat from the boiling water expands the inner wall of the glass but it is not transferred to the outer wall. Thus, the outer wall fails to expand and this uneven expansion breaks the glass.

Similarly, the thick glass tumbler cracks when ice is put in it.

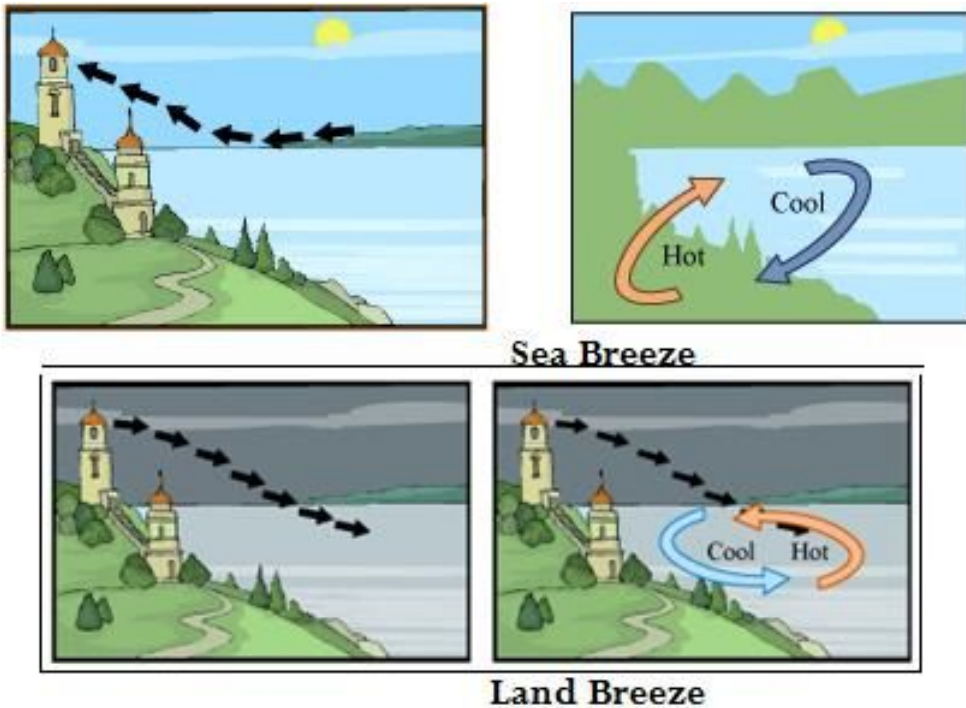
Thus, a very thin glass tumbler with low expansion capacity (like pyrex or borosilicate) should be chosen.

2. Narrow spaces are left between small stretches of **cemented roads** so that they do not bend and cause problem to vehicles and people.
3. The **metal pipelines** used to transfer hot water or molten liquid in industries are provided with metal loops at regular intervals. So, the expansion of pipeline causes the size of the loop to increase slightly and prevent the pipe from breakage.
4. The **iron tyres of cart wheels** are made a little smaller than their wooden wheels in order to prevent them from expanding in summers and loosening of the tyres.
5. **Railway tracks** are made up of steel, leaving small spaces in between them in order to prevent the tracks from bending and derailing trains. The spaces get closer in summers and wider in winters and prevent the rail from bending.
6. The **telegraph wires** between two poles are never strongly tightened as they sag in summer and get tightened in winters.

The transfer of heat takes place from a hotter object to a colder object. There are three ways by which this transfer can take place. One of the ways is conduction.

- **Conduction:** The transfer of heat in solids usually takes place by this method.
- Substances that allow heat to pass through them quite easily are called conductors and those that do not, are called insulators.

Convection: The transfer of heat in liquids and gases takes place by convection. Land breeze and sea breeze are a result of unequal heating of air present over land and sea by the sun.



Radiation: Transfer of heat by radiation requires no medium. Heating of earth by sun is an example of heat transfer by radiation.

Thermos flask: It is keep thermally insulated and keeps hot liquids hot and cold liquid cold.

