Science Form 1

Unit 7

Heat

Part I (7.1-7.3)

7.1

HEAT AS A FORM OF ENERGY

Heat

Heat is energy that makes an object hot.

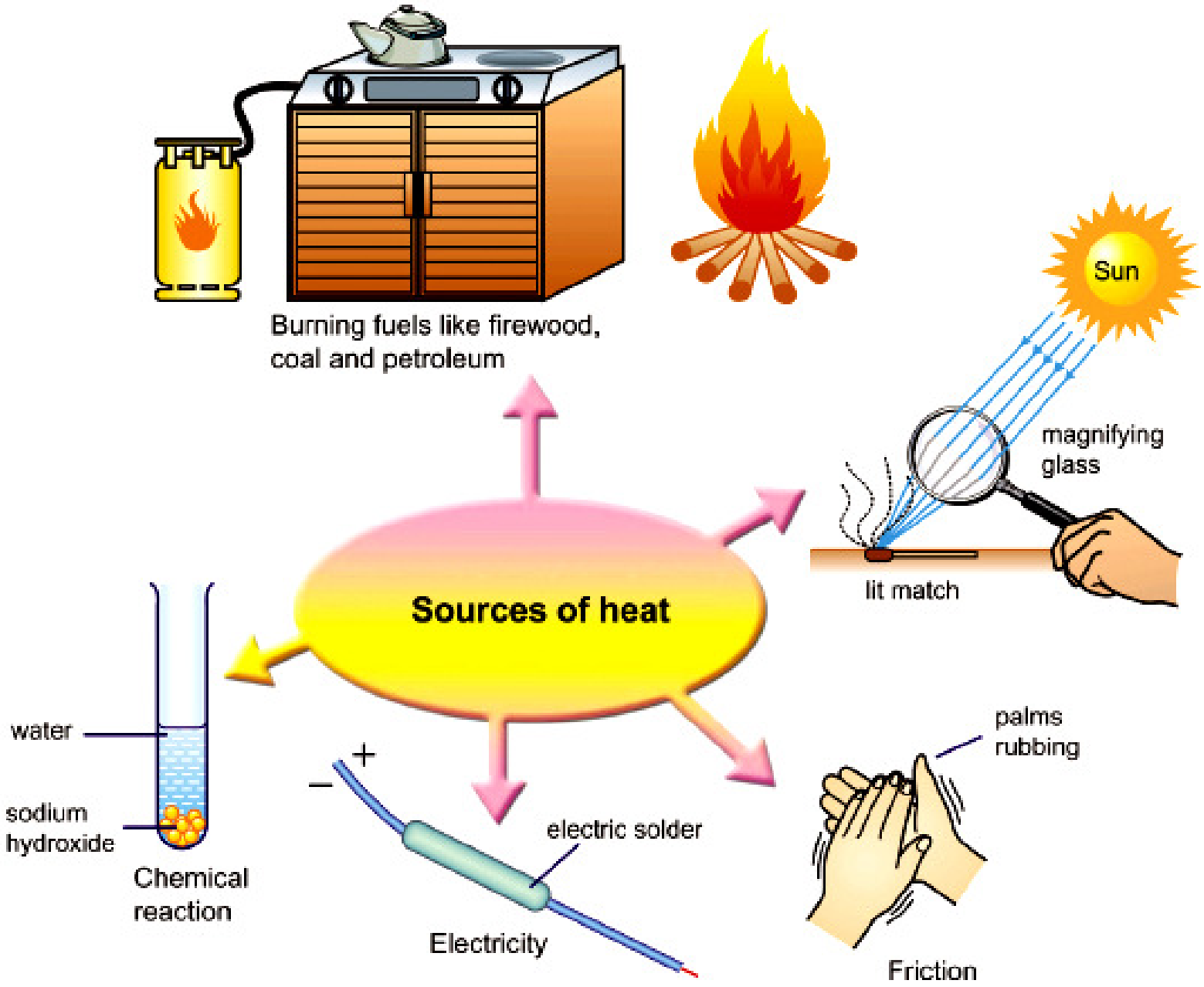
a. The Sun is the primary source of heat energy.

b. Heat can be used to do work.

c. Heat energy is also called as thermal energy.

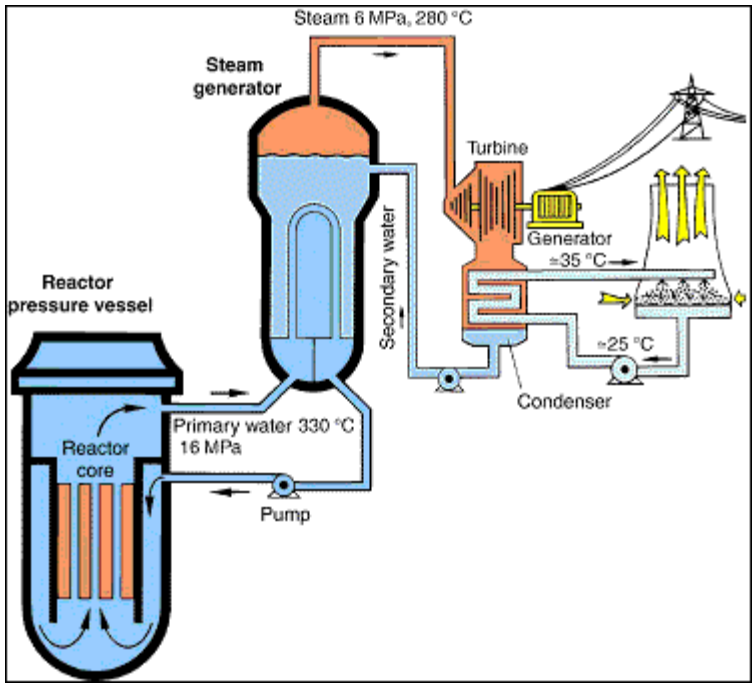
d. Heat can be produced in various ways from different forms of energy:

i. All forms of burning
ii. All hot objects
iii. Friction
iv. Electricity
v. Chemical reaction


Burning fuels like firewood, coal and petroleum
Sun
magnifying glass
lit match
Sources of heat
water
sodium hydroxide
Chemical reaction
+
−
electric solder
Electricity
palms rubbing
Friction

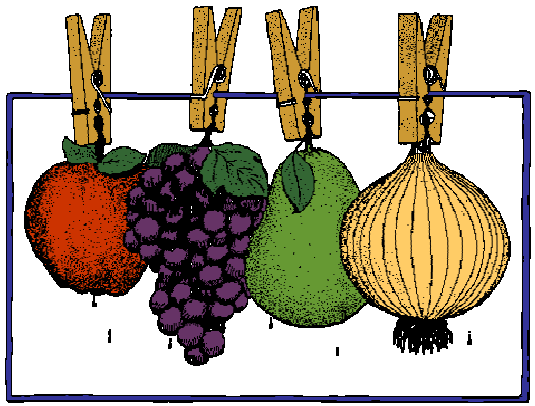
Uses of Heat energy in our daily life

1. To cook food and boil water for drinking.
2. To dry clothes and hair.
3. To drive steam generators that produce electricity.



Uses of Heat energy in our daily life

4. To evaporate sea water to produce salt and to dry tea leaves.
5. To warm our body during cold weather.
6. To sterilise instruments.



Differences between Heat and temperature

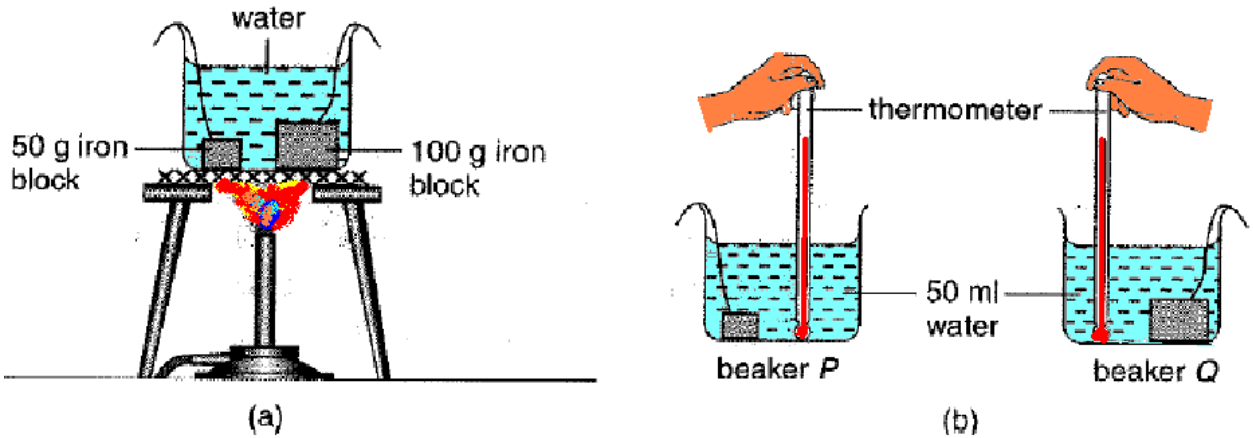
Heat

- Heat is a form of energy.
- Heat energy is the total amount of energy of all the particles in the substance.
- The unit of measuring heat energy is the joule (J).
- An object becomes hotter when it absorbs heat and becomes cooler when it loses heat.

Temparature

- Temperature is the measure of the degree of hotness or coldness of an object by using a thermometer.
- It is not a measure of the quantity of heat in a substance.
- The two common temperature scales are the Celsius(°C) and Kelvin (K) scales.
- Temperature is also a measure of the average value of the kinetic energy of each particle in a substance.

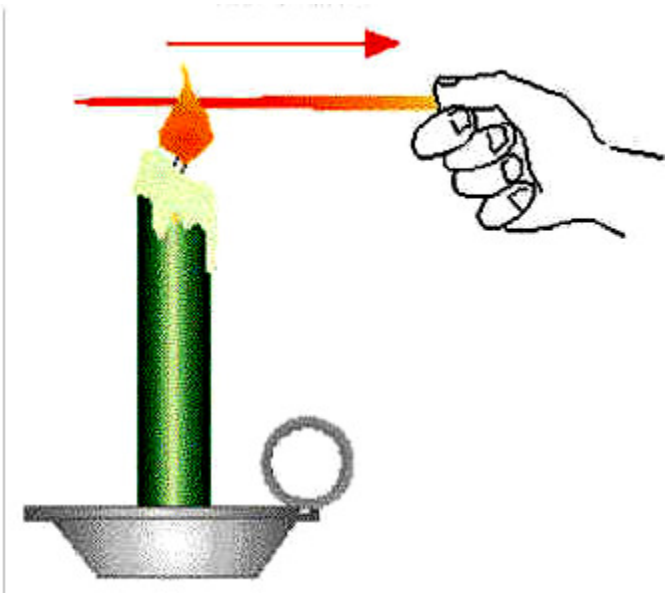
Experiment 1: Heat as a Form of energy



- Two different blocks of iron was heat up at the same temperature.
- The 50 g iron block is transferred to beaker P. The 100 g iron block is transferred to beaker Q. The water in beaker Q is hotter than the water in beaker P.

Conclusion:

- The two blocks of iron have the same temperature, but they have different amounts of heat. This is because they have different masses.



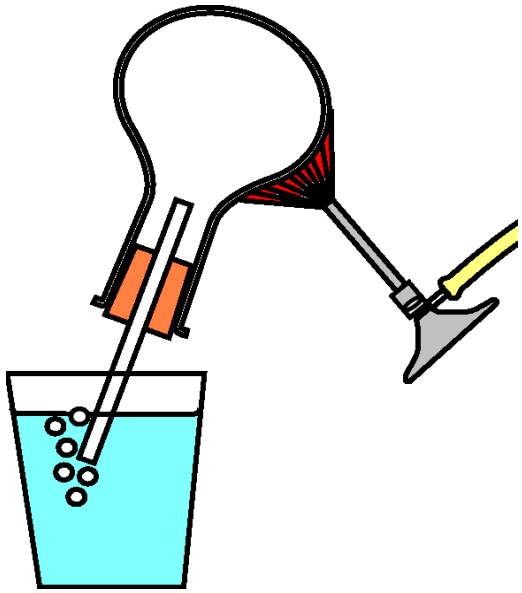
7.2

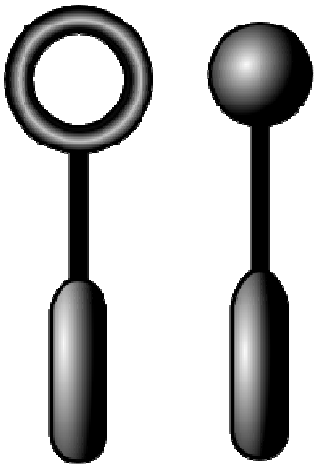
THE EFFECTS OF HEAT FLOW ON MATTER

A. Expansion and Contraction of Matter

1. Expansion – The volume of the object generally increases when the object is heated.

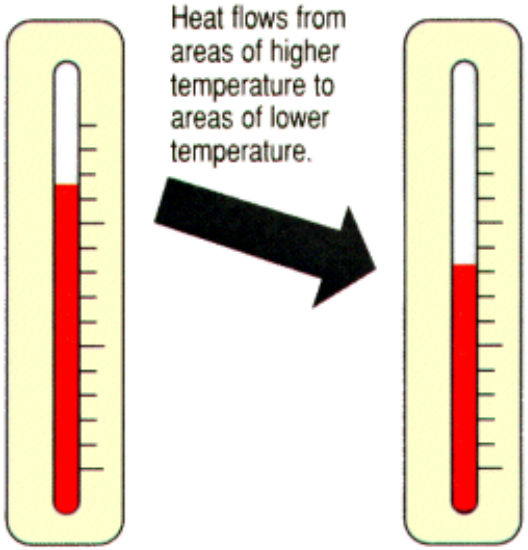
2. Contraction – The volume of the object generally decreases when the object is cooled. generally decreases when the object is cooled.





B. Heat Flow

1. Heat energy moves from an area of high temperature to an area of low temperature.



a. The rate of heat transfer depends on the difference in temperature between the two objects.

b. The greater the difference in temperature, the faster heat flows.

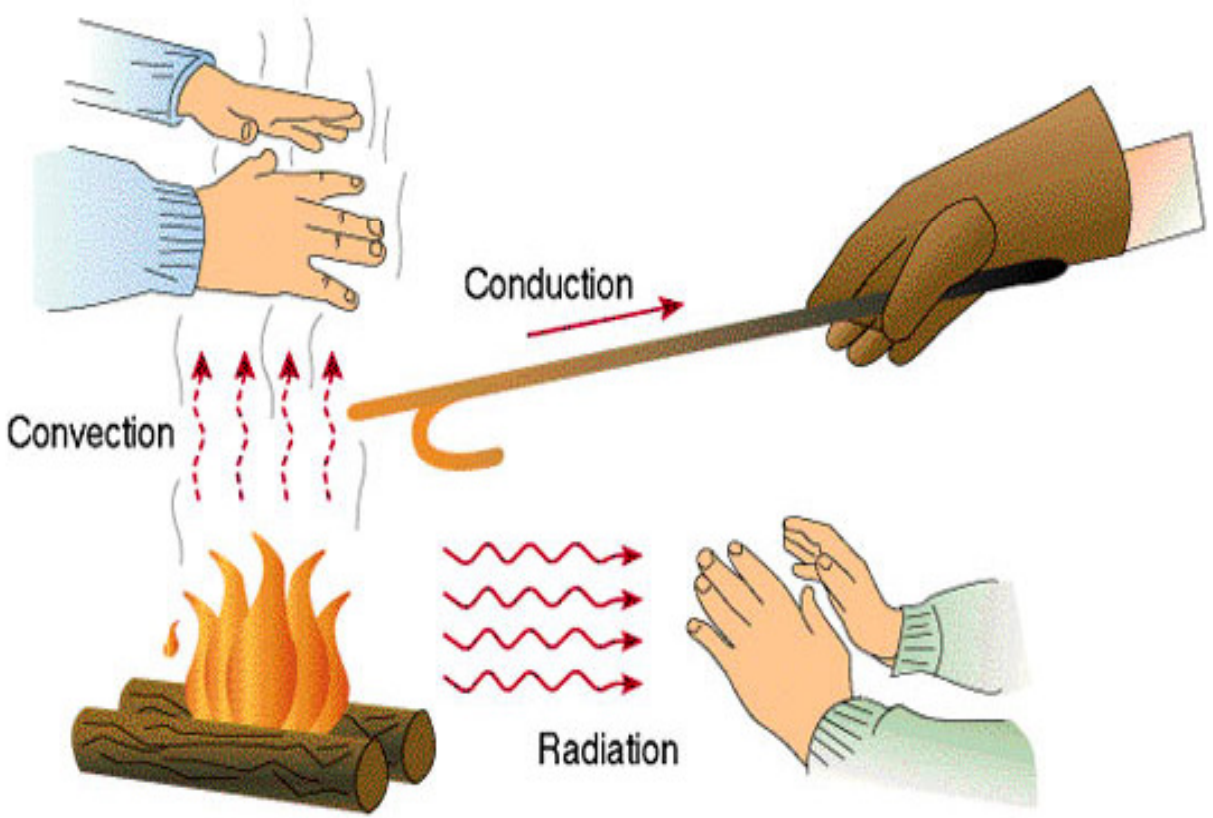
B. Heat Flow

2. Heat can travel in three ways.

   a. conduction

   b. convection

   c. radiation



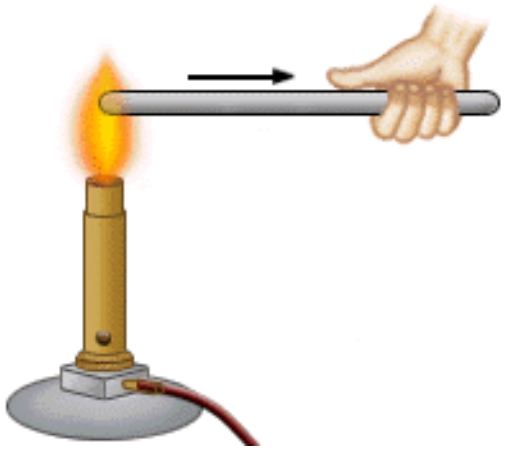
Conduction

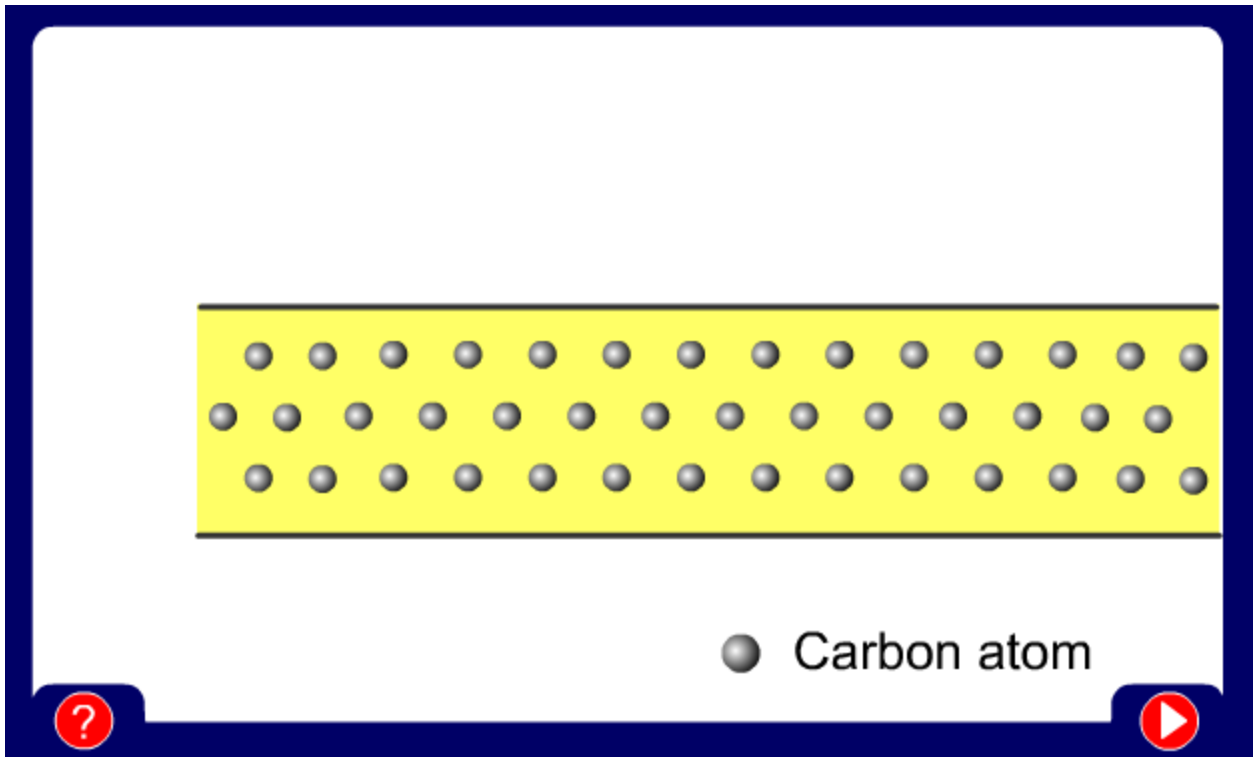
a. Conduction is the flow of heat through solids.

b. The particles in the medium do not flow.

c. Heat is transferred from the hotter end of the object to the cooler end by the vibration of particles in the object.

d. Metals are very good conductor of heat.





As you heat the metal, the particles vibrate, these vibrations make the adjacent particles vibrate, and so on and so on, the vibrations are passed along the metal and so is the heat.

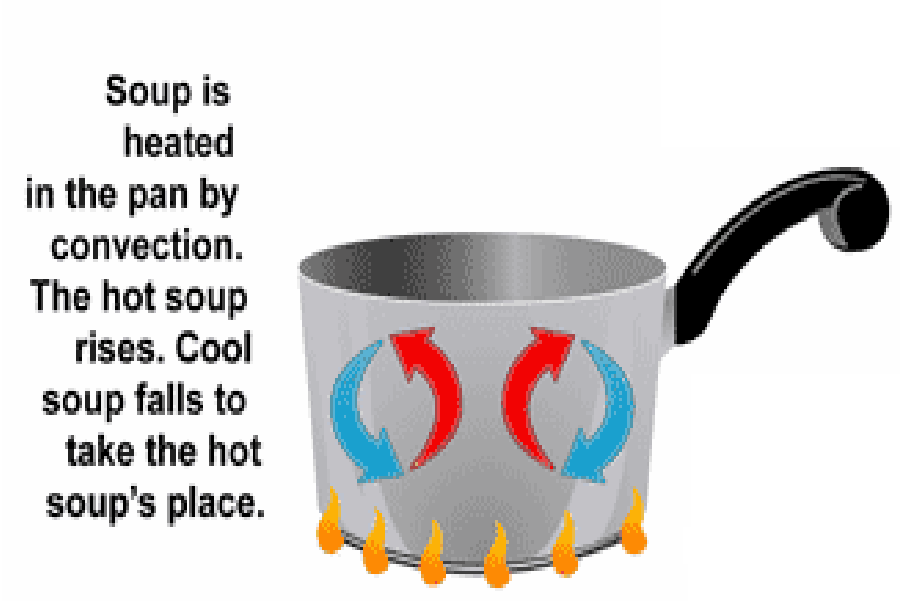
We call this? Conduction

Convection

a. Convection is the transfer of heat from one part of a fluid (substances which can flow) to another by the circulating movement of that heated fluid.

b. Liquids and gases are fluids.

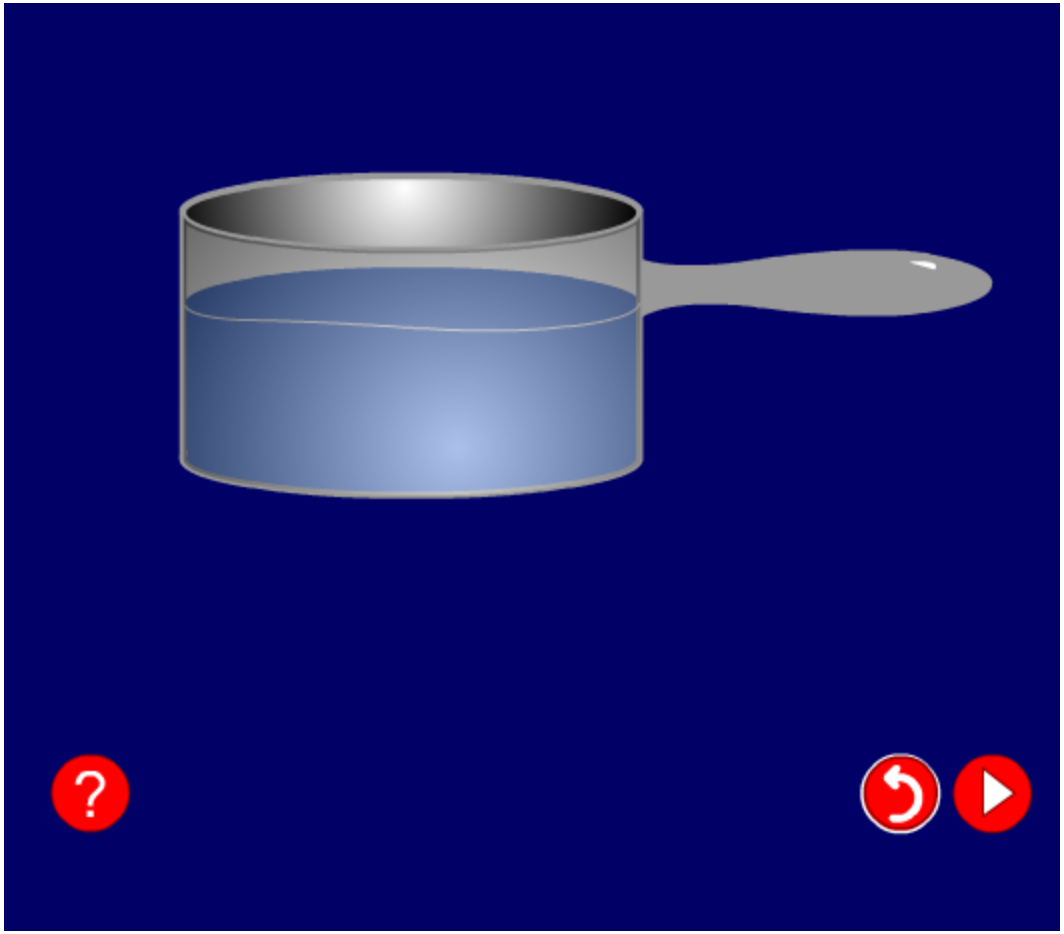
c. This circulating movement is called a convection



Cools at the surface

Convection current

Cooler water sinks

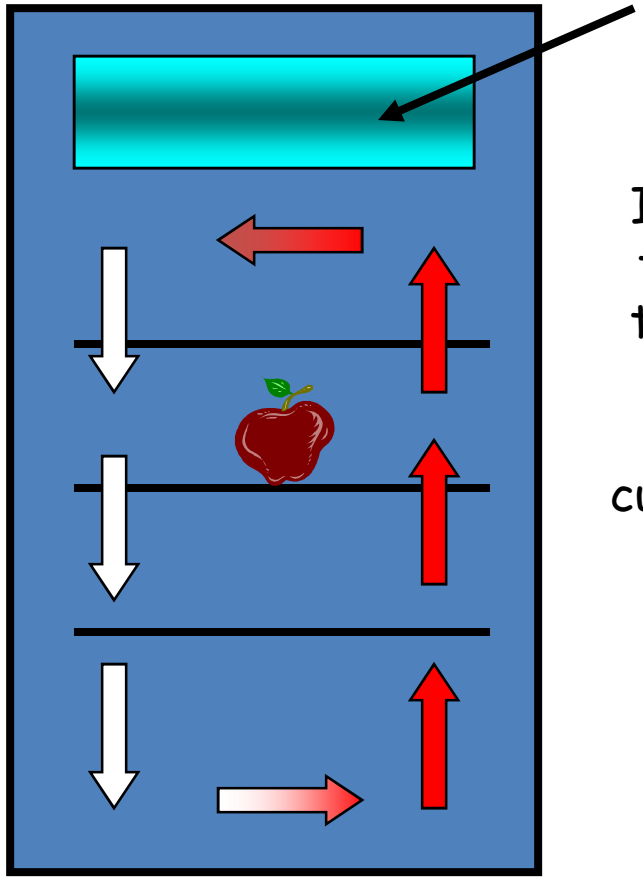


Hot water rises

Cold air sinks

Where is the freezer compartment put in a fridge?

It is put at the top, because cool air sinks, so it cools the food on the way down.

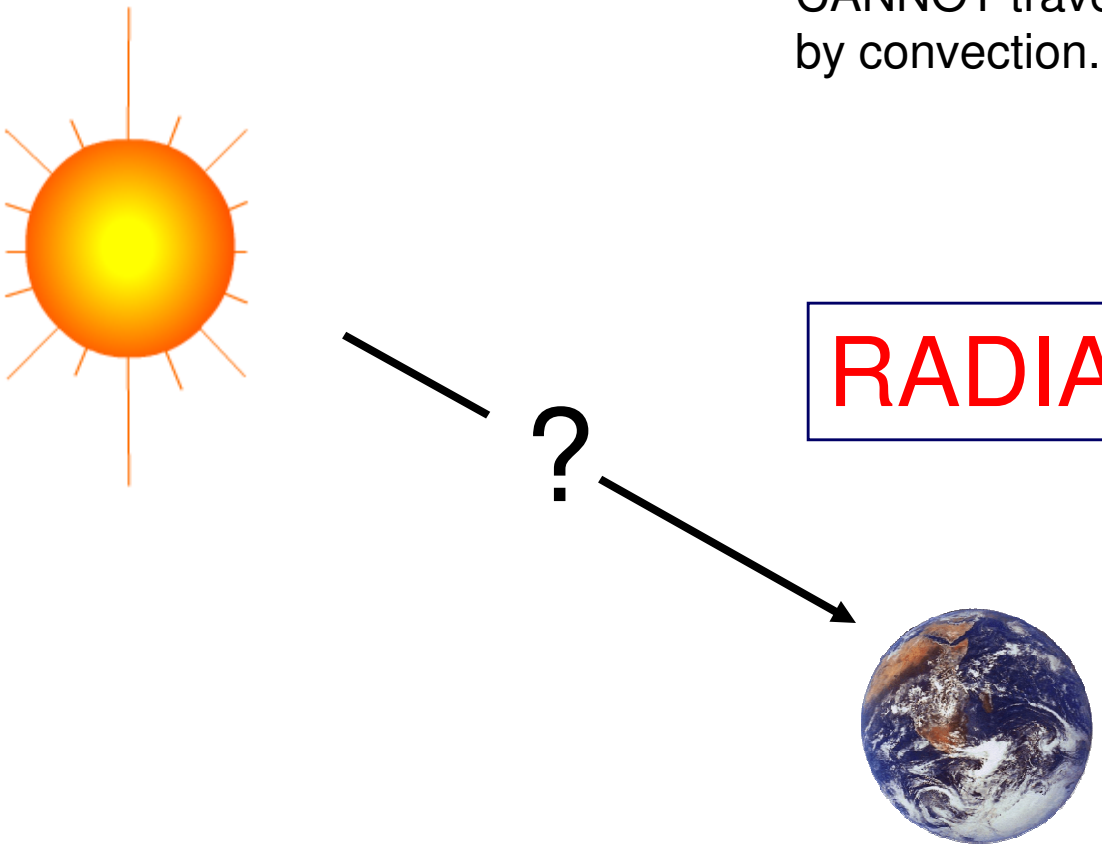


It is warmer at the bottom, so this warmer air rises and a convection current is set up.

The third method of heat transfer

How does heat energy get from the Sun to the Earth?

There are no particles between the Sun and the Earth so it CANNOT travel by conduction or by convection.



RADIATION

Radiation

a. Radiation is a process of heat transfer that does not require a medium.

b. Radiation can take place in a vacuum.

c. Properties of radiant heat:

i. Travels as electromagnetic waves

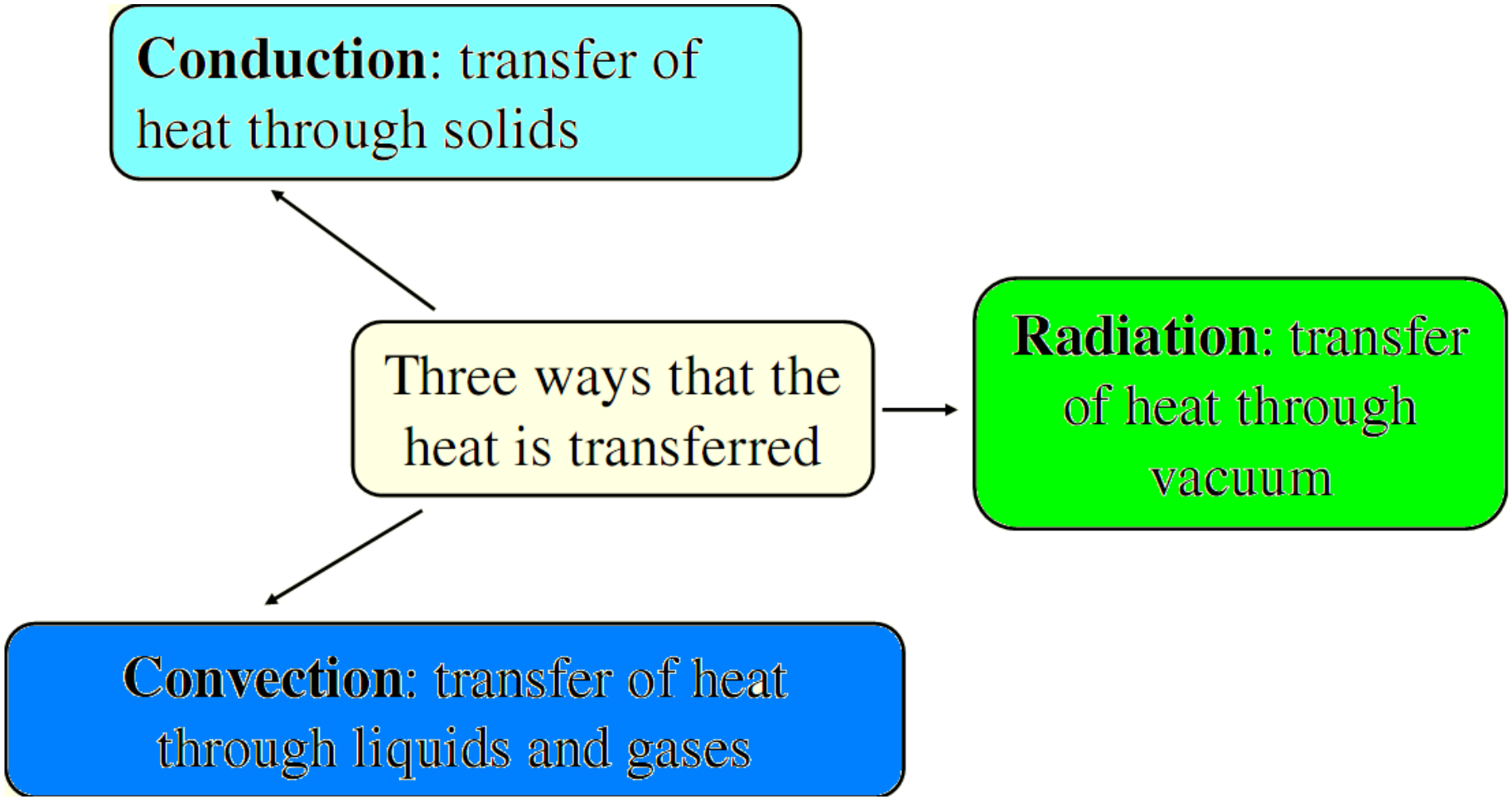
ii. Travels at the speed of light

iii. Travels in a straight line

iv. Travels through a vacuum

v. Can be absorbed or reflected

The Effects of Heat Flow on Matter

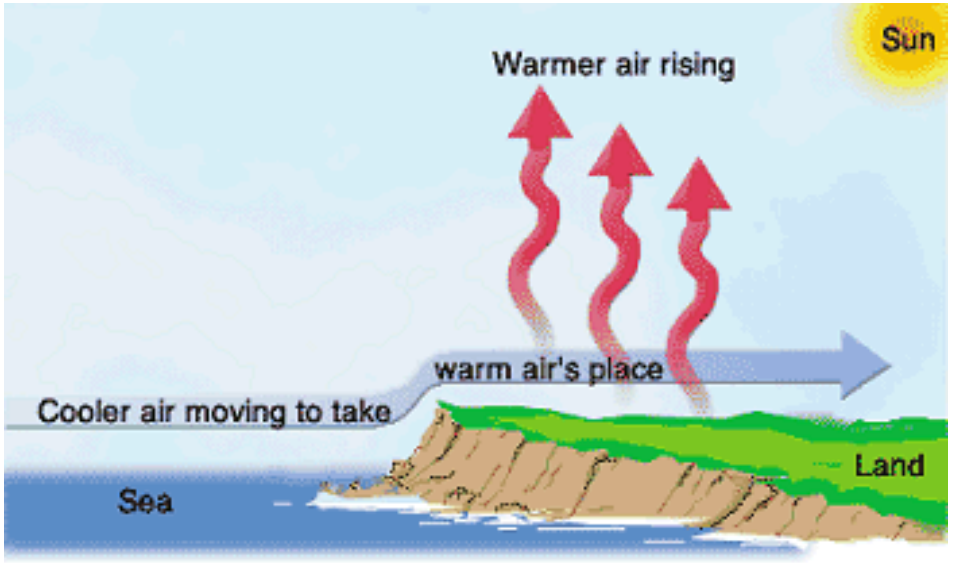


Comparing Conduction, Convection and Radiation

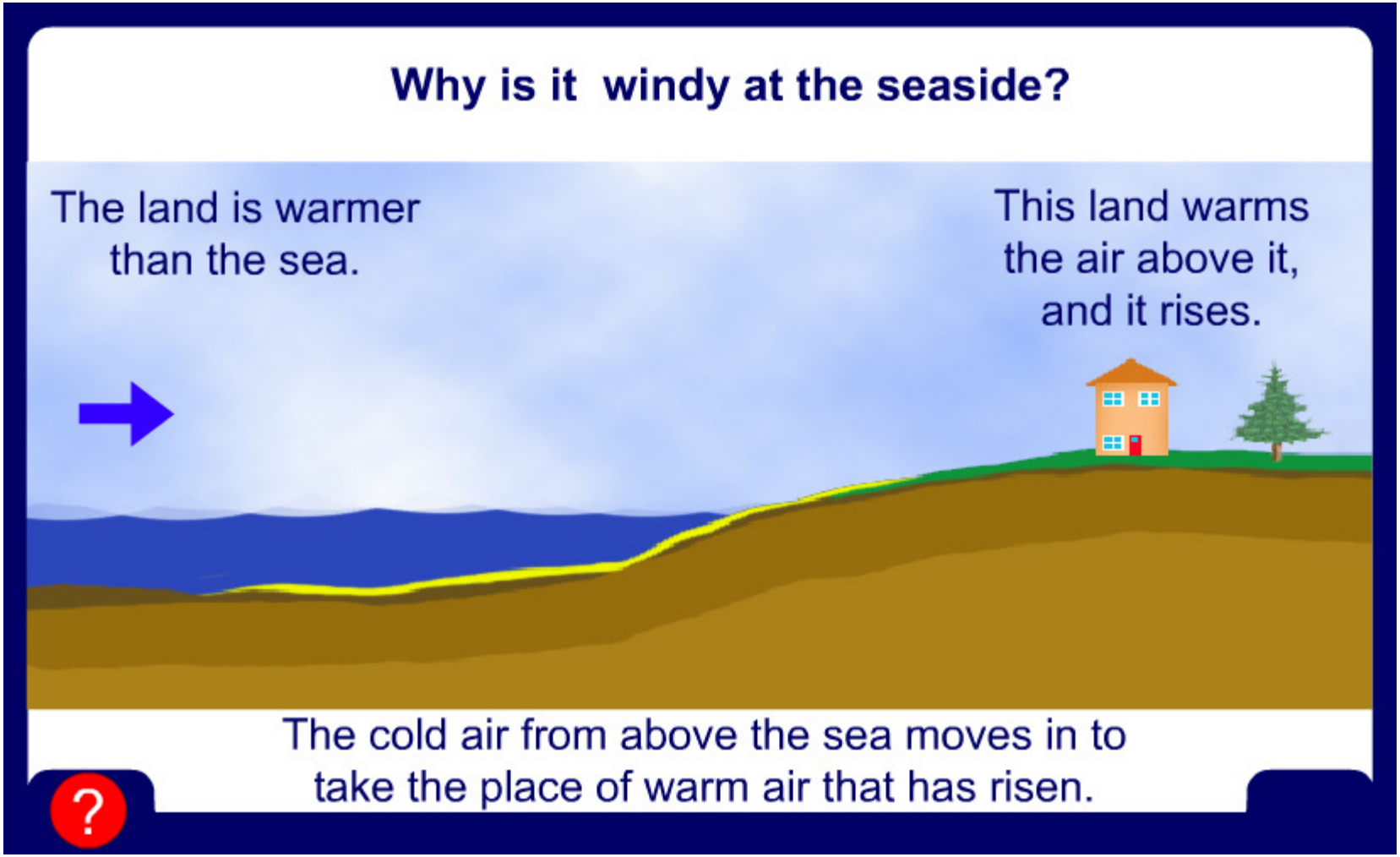
	Conduction	Convection	Radiation
Medium required	**Solids**, liquids and gases	**Fluid** (liquids and gases)	No medium is required (**vacuum**)
How heat is transferred	By **vibrating** particles at fixed position	By heated particles move (**convection current**)	Transferred in the form of **electro-magnetic waves**
Rate of transfer	Fast	Slower than conduction	At the speed of light
In a vacuum	Cannot take place	Cannot take place	Can take place

Heat Flow in Natural Phenomena

1. Sea breeze
   a. During the day, the land becomes hot faster than the water.
   b. The air above the warm land is heated by conduction and becomes less dense and rises.
   c. The cooler and denser air from over the sea flows in over the land to fill the place left by the heated air.



Why is it windy at the seaside?

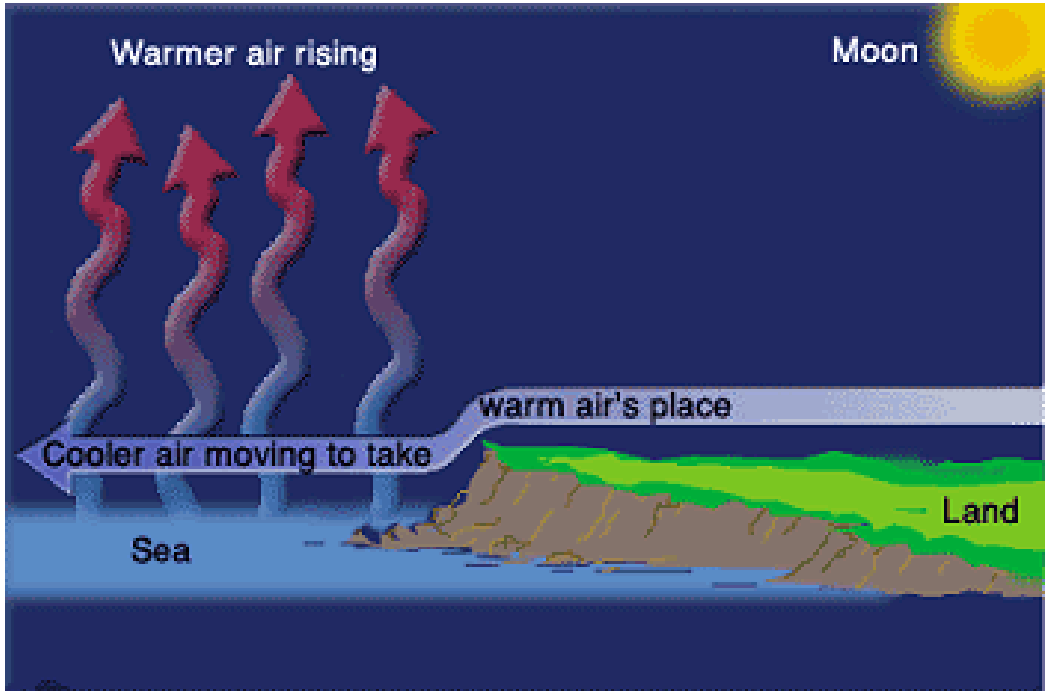


Heat Flow in Natural Phenomena

2. Land breeze

   a. At night, the land cools faster than the sea.

   b. The hot air above the sea rises and the cool air above the land flows out towards the sea.



The Effects of Heat Flow on Matter

1. Conductors

a. A conductor is a material that allows heat to move through it easily.

b. A good heat conductor becomes hot or cold easily.

c. Generally, metals are very good heat conductors.

d. Example: silver, mercury, copper, iron, etc.

The Effects of Heat Flow on Matter

2. Insulators

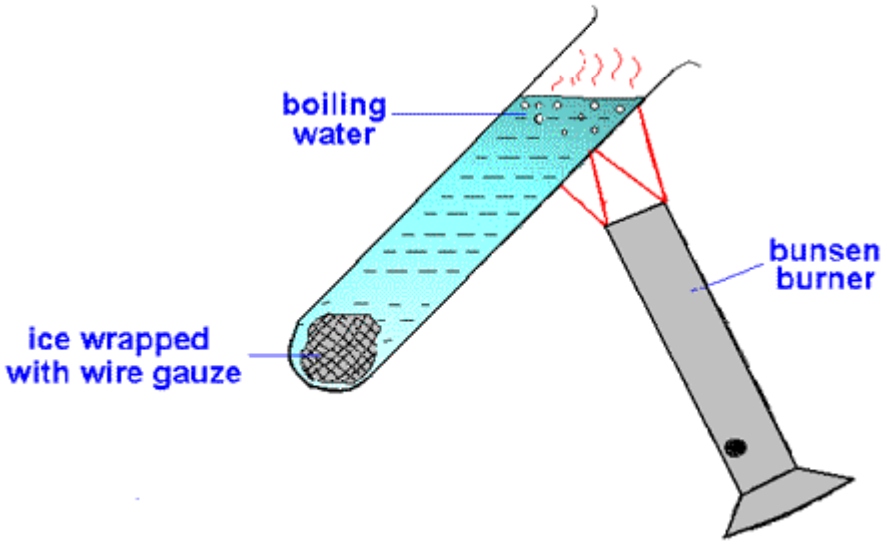
a. Insulators or poor heat conductors conduct heat much more slowly.

b. Generally, non-metals are good insulator.

c. Example: air, water, glass, asbestos, polystyrene, etc.

d. A vacuum is the best insulator.

- Water, a poor **heat conductor**



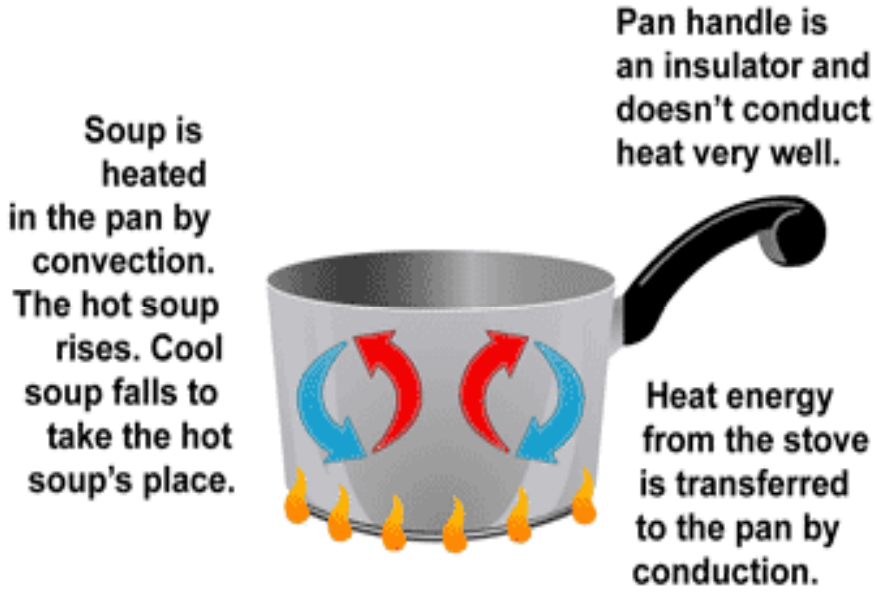
Uses of Heat Conductors in daily life

1. **Cooking utensils**

a. Handles of cooking utensils are made of insulators like wood or plastic.

b. In this way the handles will not get too hot for us to hold.

c. To prevent table tops from being burnt by hot kitchenware, table mats are used as heat insulators.



Uses of Heat Conductors in daily life

2. **In laboratory**

a. Asbestos sheets or tiles to prevent the table from being burnt.

Uses of Heat Conductors in daily life

3. Woolen blanket

a. It is used to keep the body warm.

b. The wool traps air which is an insulator.

c. The woolen blanket and the air layer prevent heat loss from the body.

Uses of Heat Conductors in daily life

4. Sawdust

a. It is used to cover ice blocks to slow down melting.

b. Sawdust prevents heat from reaching the ice.

Uses of Heat Conductors in daily life

5. Sleeping bags

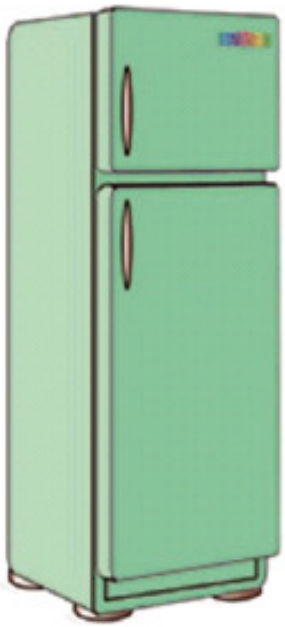
a. Sleeping bags are made of thick cotton which keeps the body warm.

b. The cotton and air in the bags are good heat insulators.

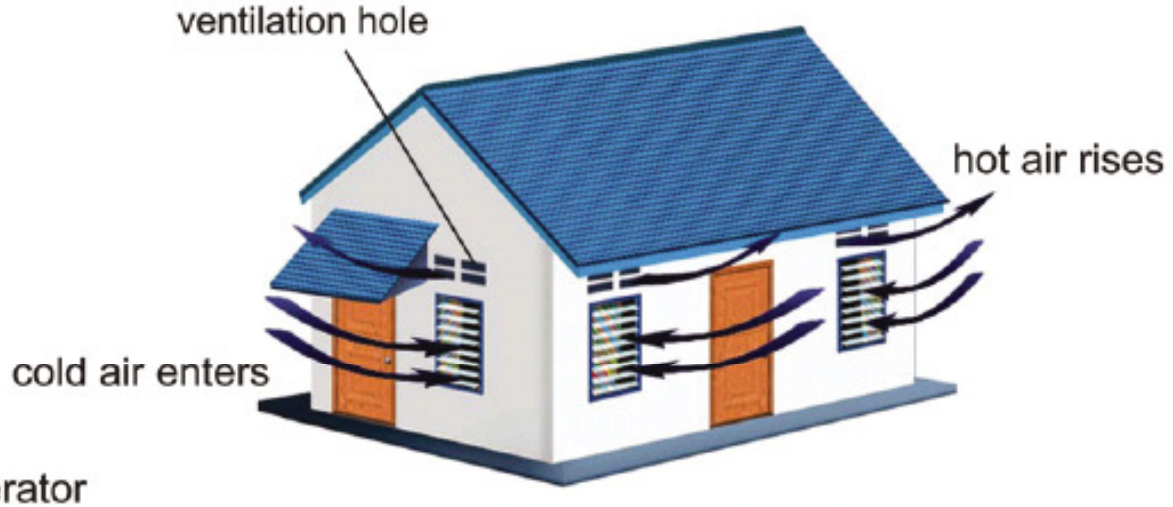
Uses of Heat Conductors in daily life

6. **Styrofoam food containers** keep food warm.

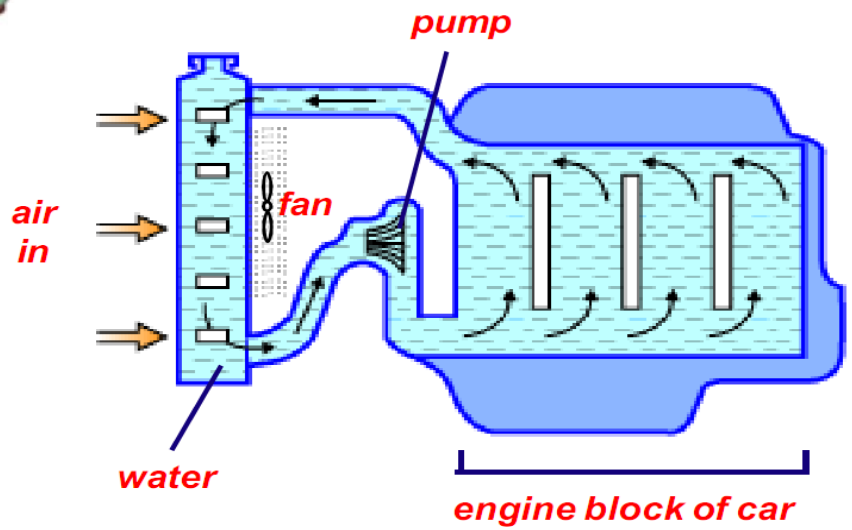
Applications of heat flow



Refrigerator



Ventilation of building

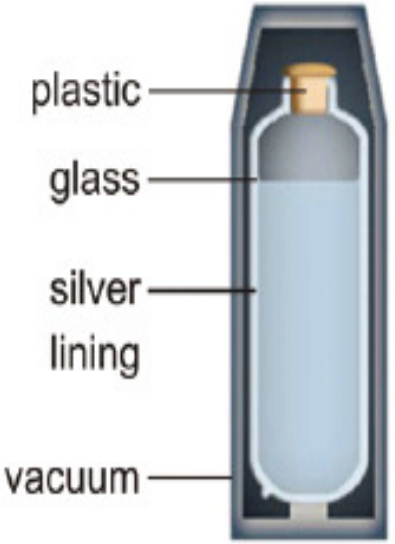


Applications of heat flow

Cooking utensil

Electric iron

Thick and dark clothes



Thermos flask

7.3

EFFECT OF HEAT ON MATTER

A. Effect of heat on matter

1. Matter undergoes a change of state when amount of heat energy in it changes.

2. When a substance is heated, it absorbs heat.

3. When a substance cools down, it release heat

4. The physical processes involved in the changes of state of matter are

a. melting,

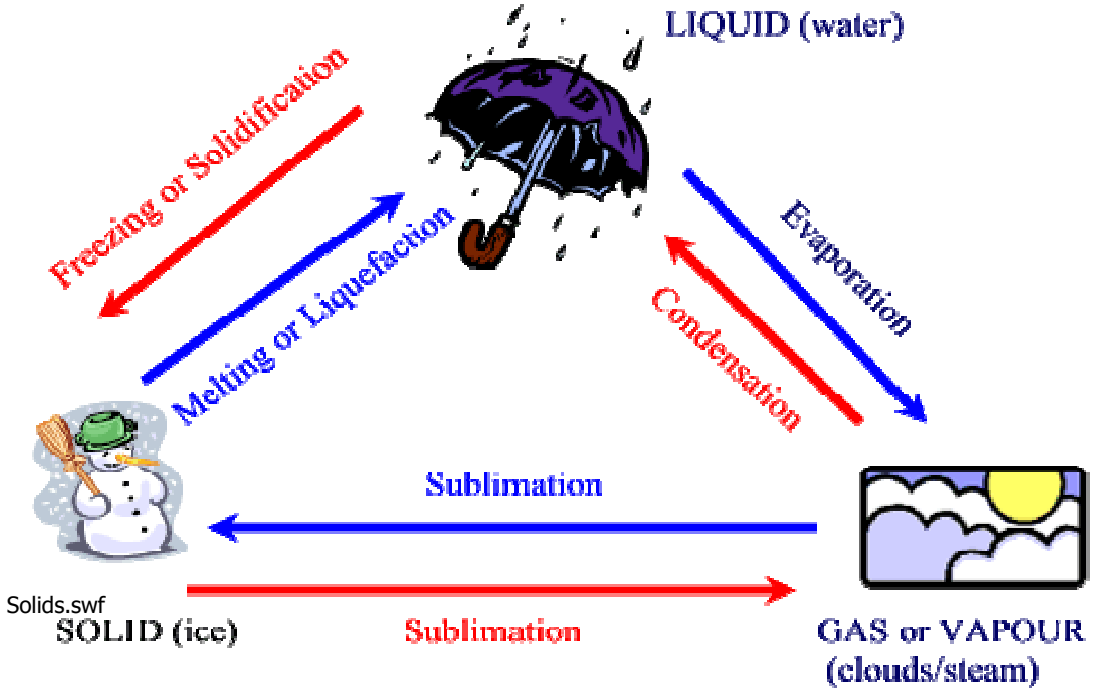
b. boiling,

c. evaporation,

d. condensation,

e. freezing and

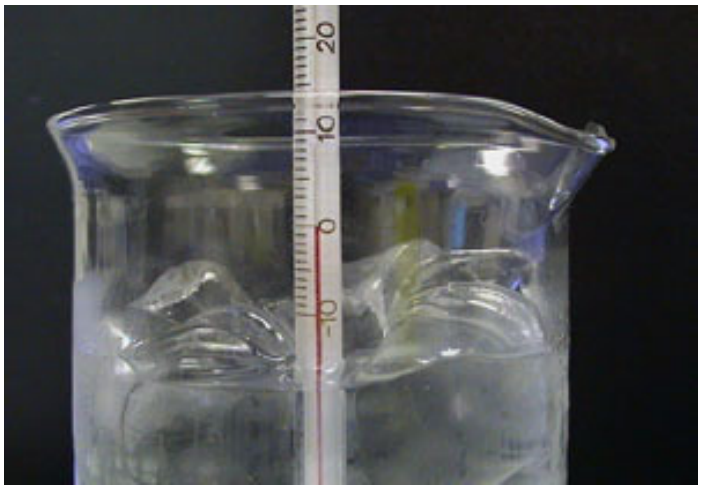
f. sublimation.



B. Melting and Freezing

1. **Melting** is a process in which a substance changes from being in a solid state to being in a liquid state.

2 . The temperature at which a pure substance melts is called the melting point of the substance.



B. Melting and Freezing

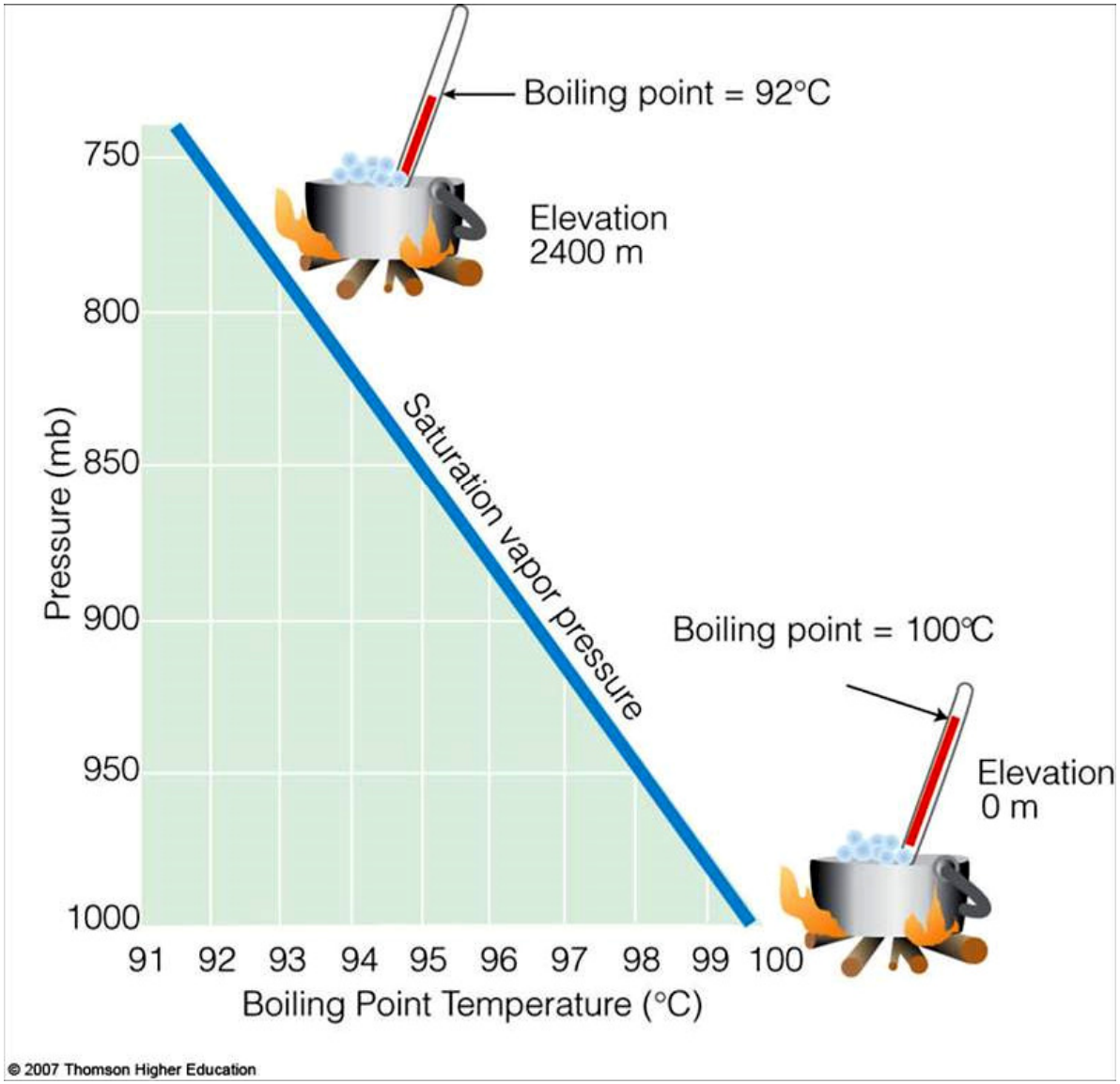
3. Freezing is a process when a liquid becomes a solid.

4. The temperature at which a pure substance freezes is called the freezing point of the substance.

C. Boiling and Condensation

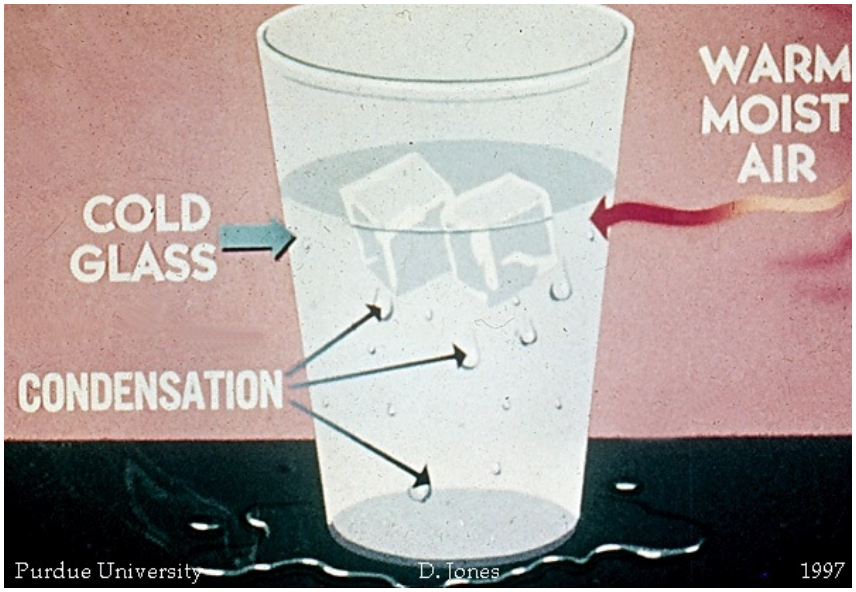
1. Boiling is the process by which a substance changes from a liquid state to a gaseous state.
2. The temperature at which a substance boils is called its boiling point.

When will water boil?



C. Boiling and Condensation

3. Condensation takes place when a substance changes from a gaseous state to a liquid state.



D. Evaporation

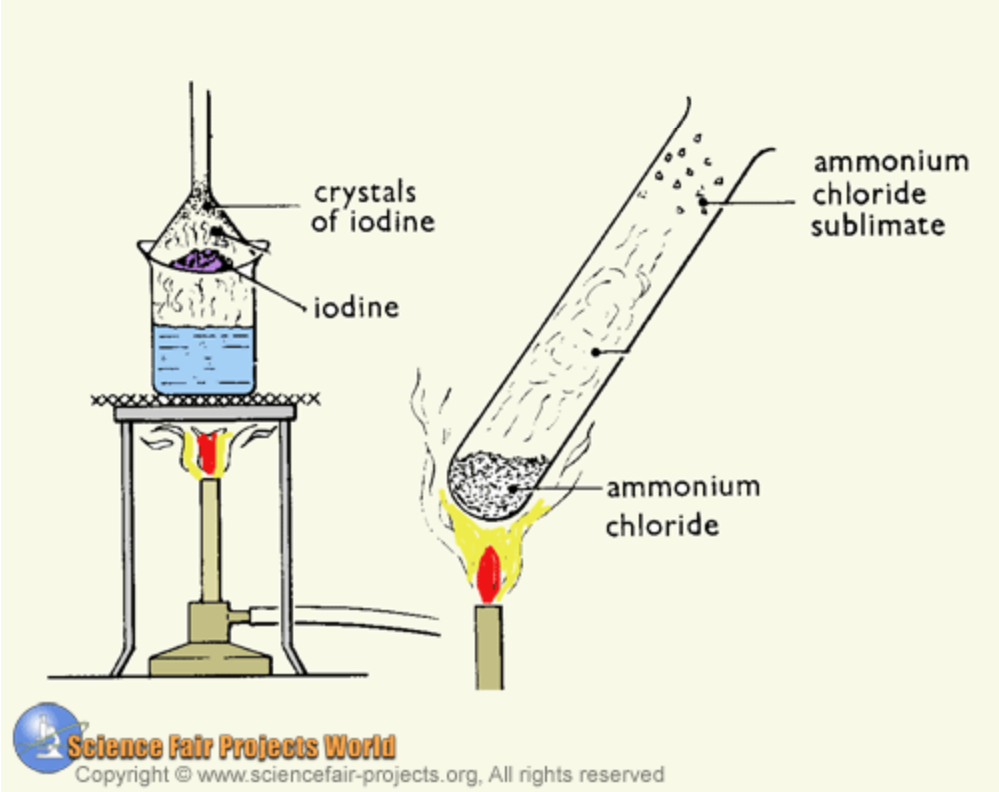
1. Evaporation is a process in which a liquid becomes a gas without boiling.
2. Evaporation takes place at any temperature an heat is absorbed from the surroundings.
3. It only occurs on the exposed surface of a liquid.

E. Sublimation

1. Sublimation is the process in which substance changes directly from a solid to a gas or from a gas to a solid without having changed into a liquid first when is heated or cooled respectively.
2. A piece of dry ice (solid carbon dioxide) will absorb heat from its surroundings and quickly become carbon dioxide gas.

3 . The mothballs in the cupboard and some air fresheners also undergo sublimation.

4. Substances in the laboratory that can be used to demonstrate sublimation are iodine crystal, sulphur, ammonium chloride and naphthalene.



Experiment

- To find out boiling temperature of pure water and melting temperature of pure ice.