About the Campaign

Capacity Building and Awareness Workshop on Climate Change is one of four components of a multifaceted programme "Radio Programme on Traditional Knowledge System, Brain Storming and Capacity Building on Climate Change Issues in Manipur and Nature Camps" implemented by Manipur Science & Technology Council, Science & Technology Complex, Takyelpat, Imphal. The programme is supported of Vigyan Prasar, Department of Science and Technology, Government of India, Noida. The main objectives of the programme are;

1. To bring awareness amongst farmers, women, panchayat members, officials and students about climate change related issues;
2. Capacity building and training on environment, dynamics of nature including climate change to various stake;
3. To teach how to reduce and to adapt to the changing climatic conditions;
4. Preparation of resource material on climate change and related issues;
5. Involving students and teachers in hands-on-activities on understanding dynamics of nature and climate change.

Vigyan Prasar (VP) is an autonomous organization under the Department of Science and Technology, Government of India. The principal objective of VP is to serve India's science popularization agenda. This is achieved through several strategically important two – way stakeholder specific approaches to communicate about principles and practice of science and technology and implications for development and quality of life. VP has consistently delivered scores of knowledge products, reached out to millions of fellow citizens and added value to a large number of national programmes.

The Manipur Science and Technology Council (MASTEC) is an autonomous organisation of Department of Science and Technology, Government of Manipur. It is an advisory body for the state in the field of Science and Technology. The main objectives of MASTEC are: to identify areas in which Science, Technology and Environment can be utilised for the achievement of the socio-economic objectives of the State; to initiate, promote and co-ordinate R&D projects; to promote and undertake activities for the popularisation of Science and Technology and the spread of a scientific temper and attitude among the people of the State; to interact with other State, National and International Science and Technology bodies having similar or related objectives etc.

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LEARNING BY DOING

(An Experimental Kit)

Software developed for the campaign

"Climate Change Issues in Manipur"

Science Communicator
Ningthoujam Shyamkishore Singh

by

Manipur Science & Technology Council (MASTEC), Imphal

Supported by

Vigyan Prasar, Department of Science & Technology
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PREFACE

Book "Learning by Doing" based on hands-on laboratory science describes a range of pedagogical approaches to teaching. Its core premises include the requirement that learning should be based on doing some hands-on experiments and activities. The idea of activity based learning is rooted in the common notion that children are active learners rather than passive recipients of the information. If the child is provided the opportunity to explore by their own and provided an optimum learning environment then the learning becomes joyful and long lasting. We know that every country needs scientists and it is the endeavour of the educators to discover and develop the science talent in the young generation of a nation. This can be achieved by providing stimulating material of sustained interest in the hands of our youths for developing in them the right attitudes and skills

Pedagogy and hands on experiments which will be introduced newly in different level of classes are integral parts of New Education Policy-2020. The book titled as "*LEARNING BY DOING*" based on experiments abounds in carefully selected activities in the five main branches

Sciences viz, Physics, Chemistry, Biology, Mathematics and Environment Science. They are aimed at exciting the curiosity of the young readers and inspiring them to acquire constructive skills in making working models of gadgets, teaching aids and in preparing industrial utility products for themselves, thus filling their leisure with absorbingly amusing and joyful activities of scientific nature.

The inquisitiveness is aroused in the young learners when they come across mysterious phenomena or miraculous performances. One can imagine the joy, confidence and satisfaction one acquires on gaining the capability of mastering them. Initiative is developed only on meeting a challenge. The moment one tries one solution after another to solve the problem or makes preparation to meet the challenge, one at once assumes the role of a discover or that of an explorer.

The value of puzzle problems is very great in developing a spirit of investigation and research. It is with this aim in view that the section of the explanation of miracle performance and tricks based on scientific principles has been incorporated in this book.

N. SHYAMKISHORE SINGH
Author

FOREWORD

The booklet "Learning by Doing – An Experimental Kit" is the outcome of the State Level Brain Storming Session on Climate Change Issues in Manipur, a programme supported by Vigyan Prasar, Department of Science and Technology, Government of India, Noida. This booklet contains hands on experiments develop/design with low cost materials based on the issues of Global Warming and Climate Change. I hope this booklet will be very much helpful in the MASTEC-Vigyan Prasar statewide campaign on Climate Change Issues in Manipur in teaching and explaining the issues of Global Warming and Climate Change to students and general public.

I take the privilege to congratulate Shri Ninthoujam Shyamkishore Singh, Science Communicator and Officials of MASTEC for their untiring effort and contribution in the successful publication of this booklet.

Dr. L. Dinachandra Singh
Director
Manipur Science and Technology Council

LISTS OF ACTIVITIES ON CLIMATE CHANGE AND GLOBAL WARMING

1. Importance of forest for soil conservation
2. Deforestation causing soil erosion
3. Global warming
4. Experiment on: CO_2 causes Global warming
5. Simple experiment of global warming
6. To compare carbon footprint of two persons
7. Testing of CO_2 present in the atmosphere
8. Simple experiment for preparation of carbonic acid
9. Effect of ocean acidification to oysters and coral
10. Effect of ocean acidification to egg shell/powder of oyster shell
11. Effect of ocean acidification to egg shell/powder of oyster shell using COCA COLA
12. Effect of ocean acidification using CHALK
13. Air circulation
14. Cloud formation in the bottle

1. IMPORTANCE OF FOREST FOR SOIL CONSERVATION

REQUIRED MATERIALS:

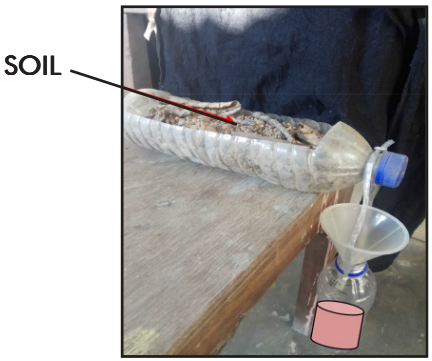
1. 2 Empty bottles 2. Soil 3. 1 Funnel and thread

HOW TO CONSTRUCT:

1. Remove a piece of 10 cm x 3 cm from an empty bottle of 1.5 litre
2. Fill the bottle with soil and grow grasses in it.
3. A bottle mounted with a funnel is hanged over the neck of the bottle in which grasses are growing with the help of a thread.
4. Pour/sprinkle water of about ½ litre above the bottle of the growing grasses.
5. Water is flowing through the neck of growing grass bottle and it is collected to hanging bottle.

Water collected in the hanging bottle will be seen very clean but not yet a little soil is flowing along with water because roots of the plants hold soil very tightly as our fingers grasp an object tightly. This activity is helpful to show that forest help to conserve soil. It maintains moderate temperature as it is the green lungs of Earth.

2. DEFORESTATION CAUSING SOIL EROSION



REQUIRED MATERIALS:

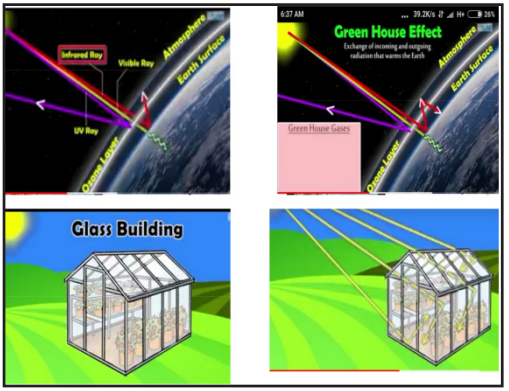
1. 2. Empty bottles 2. Soil 3. Grass 4. 1 Funnels and thread

HOW TO CONSTRUCT

1. Remove a piece of 10 cm x 3cm from an empty bottle of 1.5 litre
2. Fill the bottle with soil.
3. A bottle mounted with a funnel is hanged over from the neck of the bottle filled with soil.
4. Pour/ sprinkle water of about ½ litre above the bottle filled with soil.
5. Water is flowing through the neck of bottle filled with soil and it is collected to hanging bottle.

Water collected in the hanging bottle filled with soil will be seen very dirty because a lot of loosed soil is flowing along with water through the neck of bottle filled with soil. This activity is helpful to show that deforestation leads to cause soil erosion and land slide frequently. At length, environmental problems like climate change and global warming are caused due to the deforestation.

3. GLOBAL WARMING



GLOBAL WARMING: It is the unusually rapid increased in Earth's average surface temperature over the past century primarily due to the greenhouse gases released by people burning fossil fuels. (Global warming, the phenomenon of increasing average air temperatures near the surface of the earth over the past one to two centuries)

REQUIRED MATERIALS:

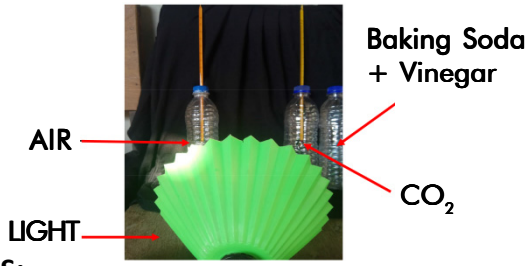
1. One poster 2. Picture of Sun and Earth 3. Disco light 4. Switch

HOW TO CONSTRUCT:

1. Fix the pictures of Sun and Earth to a poster.
2. Join the earth and sun with disco light in the pattern of the rays emitted from the source of light and reflected rays which do not escape through different layers of atmosphere so called the envelope of EARTH.

WORKING: Partially, infra red rays are absorbed by the surface of the earth and parts of radiations are reflected back. As the solar radiation cannot escape penetrating through different layers of atmosphere, temperature on earth will rise and it causes climate change and global warming. This vivid activity can explain phenomenon of causing the climate change and global warming.

4. EXPERIMENT ON : CO_2 CAUSES GLOBAL WARMING



REQUIRED MATERIALS:

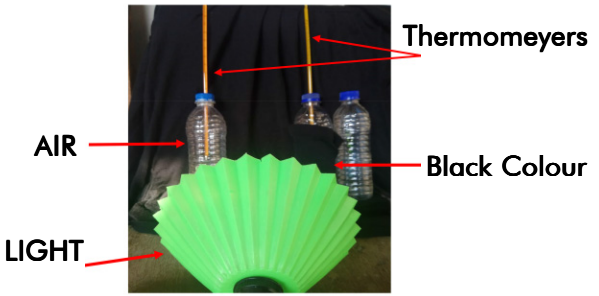
(1) Three plastic empty bottles. (2) Two thermometers. (3) Vinegar (Acetic Acid) $C_2H_4O_2$ (4) Baking Soda (Sodium Bicarbonate-N_aHCO_3) (5) One bulb fixed to holder and reflector (6) Protractor

HOW TO CONSTRUCT:

1. One thermometer is inserted through the cape of one empty plastic bottle and closed the bottle along with the thermometer.
2. Another thermometer is also inserted through hole of the cape of one of the two remaining bottles and closed it as we did previously.
3. The remaining plastic bottle is joined with one of the two bottles in which thermometers are already fixed with the help of one empty ball pen.
4. Now 2 gm of N_aHCO_3 is put in the bottle which is no thermometer and pour $C_2H_4O_2$ of about 15 ml. to release CO_2.
5. Make an angle of at least 60^0 with origin (say A). Now place the electric bulb along with the reflector at A and place the two bottles fixing thermometers on the arms of the angle at the same distance from A.
6. Pass the electric current and heat the two bottles for about 20 minutes.

Observe very carefully to the thermometers inserted in the two bottles and read the temperature recorded in the thermometers. We will see that temperature recorded in the thermometer inserted in the bottle containing CO_2 is higher in temperature than that of the thermometer inserted in the bottle containing AIR. This shows that CO_2 is one of the giant gases causing climate change and global warming.

5. SIMPLE EXPERIMENT OF GLOBAL WARMING



REQUIRED MATERIALS:

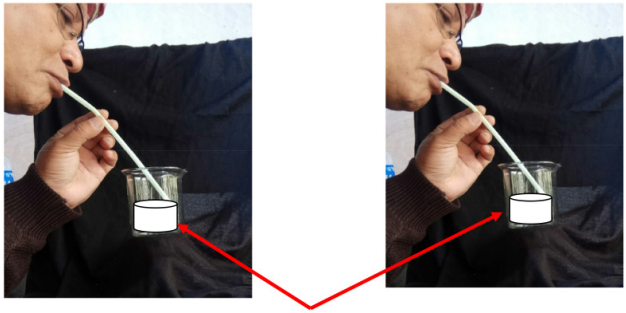
(1) Three plastic empty bottles (2) Two thermometers (3) Black sheet of paper (4) Protractor (5) One bulb fixed to holder and reflector

HOW TO CONSTRUCT:

1. One thermometer is inserted through the cape of one empty plastic bottle and closed the bottle along with the thermometer.
2. Another thermometer is also inserted through hole of the cape of one of the remaining bottles and closed it as we did previously.
3. One of two bottles inserted thermometers will be wrapped with the black sheet of paper.
4. Make an angle BAC of at least 60^0 with origin (say A). Now place the electric bulb along with the reflector at A and place the two bottles fixing thermometers on the arms of the angle at the same distance from A.
5. Pass the electric current and heat the two bottles for about 20 minutes.

Observe very carefully to the thermometers inserted in the two bottles and read the temperature recorded in the thermometers. We will see that temperature recorded in the thermometer inserted in the bottle wrapped with black sheet of paper is higher in temperature than that of the thermometer inserted in the normal bottle containing AIR. This shows that infra –red ray emitted from the bulb can absorbed more heat by the bottle wrapped with the black sheet than that of the normal bottle and air inside the bottle wrapped with the black sheet is becoming hot. This is also one of the simple experiments of climate change and global warming.

6. TO COMPARE CARBON FOOTPRINT OF TWO PERSONS



LIME WATER + CO_2 TURNS INTO MILKY

CARBON FOOTPRINT: It is the amount of carbon dioxide (CO_2) which is released due to the anthropogenic emission during a time frame.

REQUIRED MATERIALS:

(1) Two Beakers (2) Two Straws (3) Lime Stone (calcium carbonate-$CaCO_3$) (4) Water (5) Stop Watch

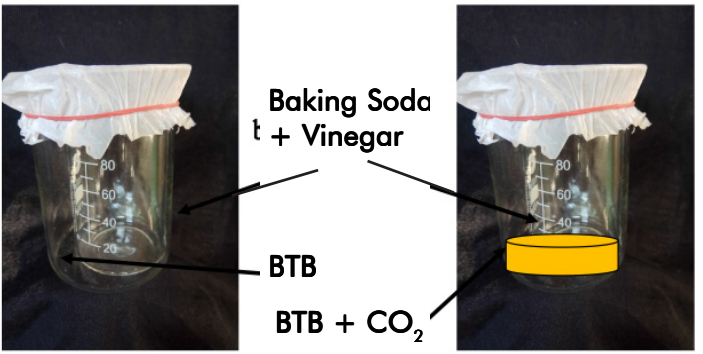
HOW TO CONSTRUCT:

1. Take 400 ml of water in a beaker and add 100 gm of lime stone in it to form calcium hydroxide CaOH.
2. Now pour lime water into two beakers equally i.e. 100 ml in each beaker and immerse two straws in two beakers separately.
3. Select two boys to blow to the beakers containing lime water simultaneously through the straws for about 5 minutes and see time recorded by stopwatch. Observe very carefully that which one of the lime waters in the two beakers turns into milky.

We can come to the conclusion that carbon footprints are different for different persons and it depends on different behaviors and life styles of different persons.

Examples: Those people who eat meat produce more carbon dioxide (carbon footprint) than those people who eat vegetables.

7. TESTING OF CARBON DIOXIDE PRESENT IN THE ATMOSPHERE



REQUIRED MATERIALS:

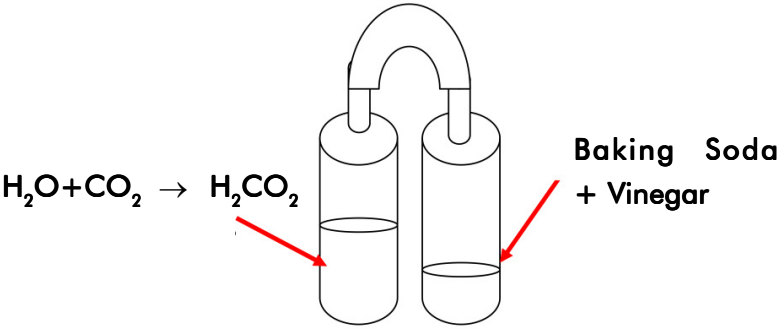
(1). Vinegar (Acetic Acid) $C_2H_4O_2$ (2) Baking Soda (Sodium Bicarbonate- N_aHCO_3) (3) Bromothymol blue (BTB). (4). One big beaker and one small beaker (5) Cellotape

HOW TO CONSTRUCT:

1. Put 10 ml of BTB in the big beaker and the small beaker is attached in the inner wall of the big beaker with the help of cellotape
2. Put 2 gm of baking soda in the small beaker and again pour 6 ml of vinegar to release CO_2.
3. Now close mouth of the big beaker with polythene very tightly.

As the CO_2 gas is released from the small beaker, BTB in the bigger beaker will change gradually as yellow colour. This yellow found in this experiment shows that CO_2 is present in the atmosphere.

8. SIMPLE EXPERIMENT FOR PREPARATION OF CARBONIC ACID



REQUIRED MATERIALS:

(1) Two Plastic Bottles (2) One Small Pipe (3) Vinegar (Acetic Acid) $C_2H_4O_2$ (4) Baking Soda (Sodium Bicarbonate- N_aHCO_3), (5) Water

HOW TO PREPARE:

1. Take two plastic bottles and two capes of two bottles are joined with a small pipe.
2. Put two tea spoonful of baking soda in one of the two bottles and add 40 ml of vinegar.
3. Close the bottle with the cape fixing pipe and other end of the pipe is immersed into the other bottle containing water to pass CO_2 through pipe.
4. After passing CO_2 into the water, pour a little water containing CO_2 i.e. carbonic acid in a test tube and 3/4 drops phenonphethalene to test its acidic property changing its colour to pink.

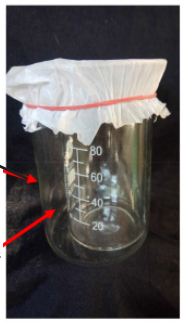
This shows that CO_2 is dissolved in the water forming carbonic acid i. e. H_2CO_3.

9. EFFECT OF OCEAN ACIDIFICATION TO OYSTERS AND CORAL

Baking Soda + Vinegar

$H_2O + CO_2 \rightarrow H_2CO_3$

H_2CO_3 Shell of Snail $\rightarrow CaCO_3 + H_2 \uparrow$



REQUIRED MATERIALS:

(1) Oysters and corals (2) Vinegar (Acetic Acid- $C_2H_4O_2$) (3) Beaker and Water (4) Baking Soda (Sodium Bicarbonate- N_aHCO_3) (5) Cello tape

HOW TO CONSTRUCT:

1. Take a little water of about 500 ml in a beaker and place one oyster or snail in the water.
2. Attach one small beaker in the wall of the bigger beaker using cello tape and put baking soda and vinegar in the small beaker so that CO_2 gas will be released from the reactants.
3. After putting baking soda and vinegar in the small beaker, close the mouth of bigger beaker tightly.

CO_2 released from the small beaker reacts with the water in the bigger beaker forming carbonic acid.

$$CO_2 + H_2O \rightarrow H_2CO_3$$

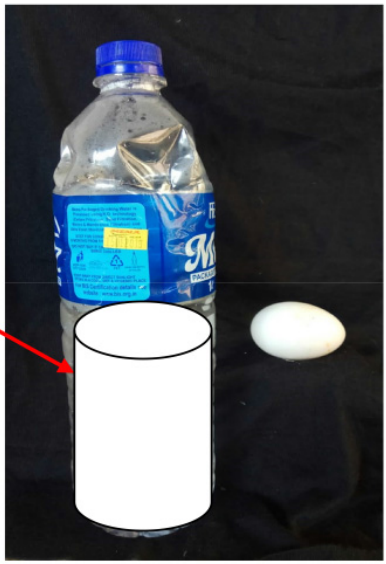
Again, hard outer shell of oyster or snail i.e. calcium reacts with carbonic acid.

$$Ca + H_2CO_3 \rightarrow CaCO_3 + H_2$$

As a result of this fact, hard shell of oyster and snail are becoming thin degree by degree and breakable frequently. So, there is a doubt that oysters and snails may be disappeared from the surface of earth after some years if the present rate of carbon dioxide (CO_2) is released from different sources consistently.

10. EFFECT OF OCEAN ACIDIFICATION ON EGG SHELL/ POWDER OF OYSTER SHELL

VINEAR + EGG SHELL POWDER



REQUIRED MATERIALS:

(1) Powdered egg shell/ powdered oyster shell (2) Vinegar (Acetic Acid - $C_2H_4O_2$) (3) Emptied glass bottle

HOW TO CONSTRUCT:

1. Take an empty bottle and pour vinegar of about 10 ml in it.
2. Add a little powder of egg shell or oyster shell in the bottle.

A lot of bubbles evolving from the reaction of calcium carbonate and vinegar will be seen. Calcium carbonate is dissolved in the vinegar and so ocean acidification affects marine creatures like oysters and corals.

11. EFFECT OF OCEAN ACIDIFICATION ON EGG SHELL/ POWDER OF OYSTER SHELL USING COCA COLA

COCA + POWDER OF EGG SHELL

or

SHELL POWDER OF SNAIL

REQUIRED MATERIALS:

(1) Powdered egg shell/powdered oyster shell (2) Coca Cola

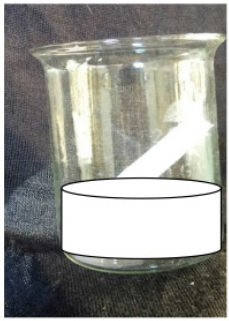
HOW TO CONSTRUCT:

1. Take a half bottle of coca cola.
2. Add a little powder of egg shell or oyster shell in the bottle.

A lot of bubbles evolving with a small pressure from the reaction of calcium carbonate and coca cola will be seen. Calcium carbonate is dissolved in the coca cola and so ocean acidification affects marine creatures like oysters and corals.

12. EFFECT OF OCEAN ACIDIFICATION USING CHALK

WATER + CHALK



Dil. Vinegar + CHALK

Con. Vinegar + CHALK

REQUIRED MATERIALS:

(1) Chalk (2) Three transparent glasses (3) Water (4) Vinegar

HOW TO PREPARE:

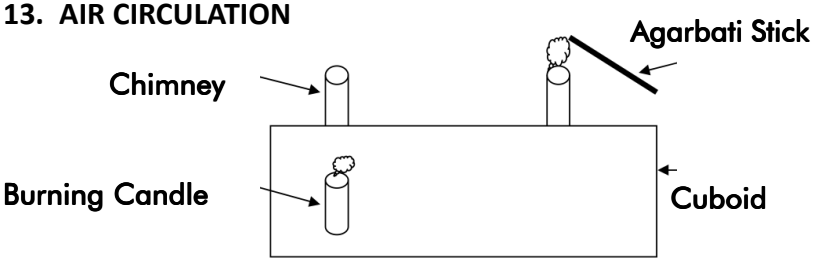
1. Take three transparent glasses marking 1, 2 and 3.
2. Pour water up to the brim of glass – 1, pour dilute vinegar up to the brim of the glass-2 and pour concentric vinegar up to the brim of the glass – 3.
3. Put at least two chalks in each glass and keep all the three glasses for a while without any disturbance.

We will see the flowing situations:

1. There is no change in the glass 1 i.e. two chalks immersed in it will not be dissolved.
2. Two chalks which are immersed in the glass 2 will dissolve very slowly whereas two chalks immersed in the glass 3 will dissolve so fast to compare with the chalks immersed in the glass 2.

This activity can also prove that carbonic acid affects to marine life like the creatures which have the scale of calcium carbonate.

13. AIR CIRCULATION



Air is moving from higher pressure to lower pressure. This movement of air is known as wind. We know very well that hot air is lighter than the cold air. When the hot air rises upward cold air is moving towards the gap in which the hot air occupied previously. Thus continuous current of air circulation is going on all the time.

REQUIRED MATERIALS:

(1) Two chimneys (2) One empty cuboid (3) One candle and scent stick

HOW TO CONSTRUCT:

1. Two holes are made to the upper face of the cuboid.
2. One burning candle is fixed just below the left hole of cuboid.
3. Fixed two chimneys to the two holes very tightly.

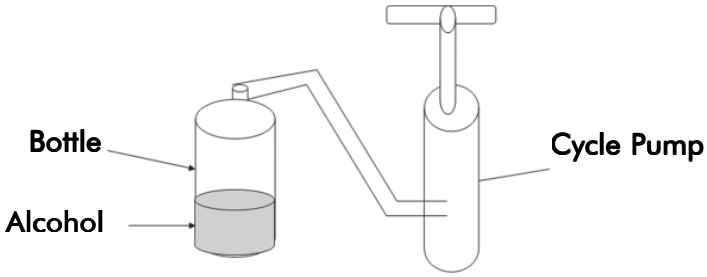
Working:

Light/ ignite the scent stick and bring the burning scent stick on the top right chimney. Smoke produced by the burning scent stick, instead of going upwards, would start travelling downwards.

Scientific reason:

The air above the candle becomes hot and moves upward. Then, the air inside the box escapes from the left chimney. Now, the gap or vacuum in the box has to be filled and as there is no inlet for the air except the right chimney, the air comes in through right hole, creating a force of suction which draws smoke along with it. Thus air is circulating.

14. CLOUD FORMATION IN THE BOTTLE



Cloud: A visible mass of condensed watery vapour floating in the atmosphere, typically high above the general level of the ground. Though they look different, all clouds are condensed water droplets in the air.

They form when warm, moist air rises upward. As the warm air rises, it cools. Cool air can't hold as much water as warm air. Water in the air condenses around dust particles that are floating around. As these droplets build up in the sky, they form a cloud.

Scientific principle for the formation of cloud is condensation. Condensation is the process by which water vapor in the air is changed into liquid water. This change is caused by a change in pressure and temperature of the substance (Liquid).

REQUIRED MATERIALS:

(1) One cycle pump fixing a valve tightly (2) One bottle (3) Alcohol

HOW TO CONSTRUCT:

1. Take a transparent empty bottle and pour a little alcohol in the bottle and rub the inner wall of the bottle.
2. Now fix the nozzle of the hand pump to the mouth of the bottle and put air in the bottle using pump to increase the pressure in the bottle. Then, pull away the nozzle of the pump from the mouth of the bottle quickly. At once, cloud forming in the bottle will be seen.