Assessment

Point of Assessment

Interest/Attitude/ Motivation	Scientific thinking	Technique	Knowledge and understanding
Is s/he interested in guessing the result with their experiences? Does s/he cooperate with friends to do the activity? Is s/he interested in finding the results from the activity? Is s/he interested in other objects in our life?	Is s/he able to think how balance functions? Does s/he think of weight and volume separately? Does s/he think of difference of weight between sugar and salt or between oil and water? Can s/he imagine the existence of air although it is not visible? Can s/he connect the activities with the existence of air? Can s/he imagine that air has weight? Does s/he think of differences among solid, liquid and gas?	Can s/he use the balance properly? Can s/he make the rank of object with using the balance repeatedly? Can s/he present the result of prediction and real activities?	Does s/he understand that solid has weight and volume? Dose s/he understand that weight of solid does not change even when it breaks? Does s/he understand that same volume of solids does not mean the same weights? Does s/he understand that liquid has weight and volume, but not definite shape? Does s/he understand that same volumes of liquids does not mean the same weights Does s/he understand that air has volume and weight, but not definite shape?

Oral Assessment/Group Discussion

1. Mention how we can prove the solid has volume
2. Mention how we can prove the solid has weight
3. Mention why salt and sugar (wood and iron) have the different weight even when they have the same volume.
4. Mention how we can prove the liquid has volume
5. Mention how we can prove the liquid has weight
6. Mention why water and oil have different weight even when they are in the same size of containers.
7. Mention how we can know the gas (air) has the volume.
8. Do you think the air has weight? How can we measure the weight of air?

Written assessment

1. Write down any property of the solid object
2. Write down any property of the liquid object
3. Write down any property of the gas
4. Do water and oil have the same weight when they have the same volume? Answer and explain
5. What would you answer if you are asked "which is heavier, milk or water?"
6. Explain why it is very difficult to measure the weight of air?
7. Mention good examples to prove that air exists.

Messages to teachers

- Let us make sure that all of children are actively participating in the activities? In the group work, it can happen that only a few members do the activities but the rest do nothing and watch.
- The activities are basic and fundamental to think about matters in 3 states. Let us try to clearly explain the meanings of each activity.
- Prepare the balance by yourself when it is not available. There is a huge difference between the illustration on the blackboard and the equipment they can see and touch with their eyes and hands. To make the balance is not difficult and expensive. We can use anything around us.
- It is interesting to think about the density by using the materials we have in our lives. Let us encourage pupils to use their imagination as much as we can.

Topic 6: Changing states of matters

1. Key concept

Matter can change its state

2. Learning objective

General objectives

To be able to understand that matter can change its state.

Specific objectives

1) Be able to explain that one state of matters can transform into another state
2) Be able to explain how a candle keep its fire
3) Be able to find examples of evaporation in our lives
4) Be able to find examples of condensation in our lives

3. Activities involved

Heating ice
Heating naphthalene
Lightening the candle
Why "Thanakar lotion" becomes dry after applied
Finding evaporation in our lives
Which evaporates faster?
Finding condensation in our lives
Cup and saucer

4. Activity purpose

It is expected that after getting interest in these activities the children will develop their scientific way of thinking as well as the lesson's concept

Before Getting Started

Self-check list for Teachers

- ☐ Do I understand the states in matters can be changed?
- ☐ Can I define Evaporation and Condensation?
- ☐ Can I distinguish Evaporation and Condensation?

Background information for teachers

States of matter

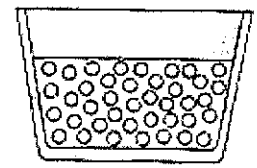
The difference between solid, liquid and gas are in ease of flow, maintenance of shape, and volume. Here are examples of each state:

Solid	Liquid	Gas
Water ice wax	oil vinegar	carbon dioxide oxygen
iron wood	liquid water melted wax	wax vapor water vapor

Solid: Keep their shape
do not flow easily
can be cut
liquids: take the shape of a container
flow easily
can not be cut
Gases: fill any space they are in
flow very easily

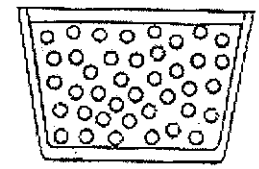
In terms of volume, most materials expand when heated. This means that generally a substance in its liquid state has a slightly larger volume than in its solid state. An important exception to this is water. Water in the form of ice has a significantly greater volume than liquid water. The expansion of water on freezing explains why, in water, ice floats.

Fig: liquid water



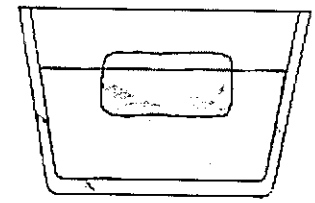
In their liquid state, water molecules are packed more closely together than they are in their solid state, ice

Fig: Solid ice



The solid is lighter for its size than the liquid, which is why ice floats in water

Fig: why ice floats in water



Reversible changes

Some changes can be reversed. Melting, evaporating, freezing and condensing are normally reversible.
In the water cycle, water evaporates from sea, lakes, plants and animals. This water vapour is invisible. Water vapour condenses to form clouds. Clouds are tiny drops of liquid water. The water drops get heavier and fall from the clouds as rain. Your breath makes clouds on a cold winter's day.

Melting points and Boiling points

Every material has specific melting point and boiling point. Melting point is the point where the material changes from solid to liquid.
Boiling point is the point where the material changes from liquid to gas.

Material	Melting point(Celsius)	Boiling point(Celsius)
Water	0	100
Aluminum	660	2450
Lead	327	1750
Oxygen	-219	-183
Helium	-270	-269
Ethanol	-114	78
Carbon dioxide	-56.6	-78.5

Permanent change

When food is cooked it changes. These changes are not reversible. For instance, dough changes into bread, raw egg changes into fried, scrambled or boiled egg, cake mix changes into cake.
When materials burn the fuel combines with oxygen. Wood, wax, oil and gas are fuels. All are hydrocarbons because they are compounds of hydrogen and carbon. For example, CH_4 is the chemical composition of methane or natural gas. This means that it is four parts hydrogen and one part carbon.

Why does a candle burn?

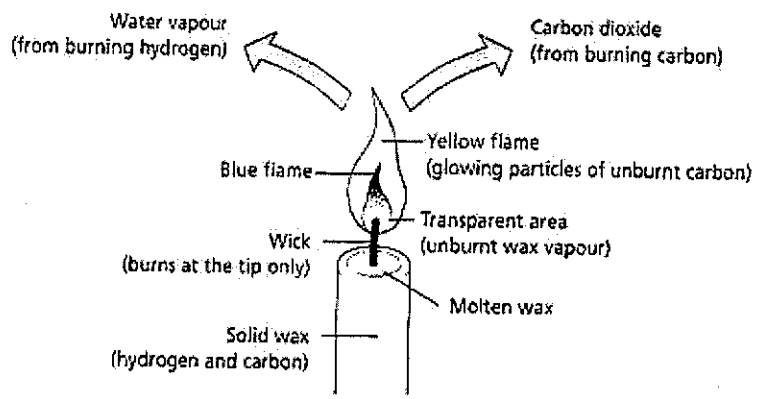


Fig: Process at work when a candle burns

As a candle burns many interesting changes take place. When you light a new candle, the heat of the match set the wick burning. Then the flame dies down before leaping up as the heat of the burning wick starts to vaporize the wax, and the wax vapour starts to burn. From then on the heat of the burning wax vapour continues to vaporize more wax. Wax is the fuel.

Evaporation

Listen to the children's ideas about where the water goes when washing dries, puddles evaporate or sweat dries from their skin. Let the children wet three or four paper hand towels will dry and slowly.
Look at a variety of containers, some wide and shallow and others tall and thin, filled with equal quantities of water. Listen to the children's ideas about which container's ideas about which container's water will evaporate the quickest. Water will evaporates quickly if:

the air is warm, the air is moving
the air has low humidity, the water as a big surface area.

Water does not need to boil to evaporate. Even cool water will evaporate rapidly if the air is dry. Leaves some water in the fridge – it will evaporate quite quickly

Condensation

Take several cans from the fridge. Let the children examine the condensation on the cans and talk about where it comes from. Breath on mirrors and other shiny surfaces (metal and glass are best). Talk about where the children see condensation in every day life. What do they do they get rid of it?
If air that is already humid (has plenty of water vapor in it) is cooled, water will condense out of it either on to a cold surface or as droplets of water. A cool shower room will often have clouds of stem and condensation on the walls for this reason.

Lesson Planner

Suggested periods (6)	**Period 1**	**Period 2**	**Period 3**
Lesson topic	Change of states	How a candle keep fire	Evaporation
Sample lesson plan	6-1	6-2	6-3
Specific objectives	Be able to explain that one state of matters can transform into another state	Be able to explain how a candle keep its fire	Be able to find examples of evaporation in our lives
Introduction	Recall the prior knowledge from the previous lessons: 3 states of matter; solid, liquid, and gas.	Do you know why a candle keeps its fire for a long time?	Remind previous lesson
Development	Activity 1	Activity 2	Activity 3, 4
Assessment points	Are they participating in the learning process? such as: doing the Exp: thinking & sharing the ideas express their findings communication with each other Do they understand the states in matters change when it heated?	Are they participating in the learning process? such as: doing the Exp: thinking & sharing the ideas express their findings communication with each other Do they understand the states in matters change when it heated?	*Observation of activities.* Do the children participate in the learning process? Do they get the meaning of experiments? Do they discuss well? Do they draw conclusion? Do they positively discover anything from experiments?
Adaptation of curriculum	We can use a lot of different experiments in this chapter such as locally available sugar cane, jaggery etc. which are easy to understand matter can *change states and states change by evaporation and condensation.*		

Lesson Planner

Suggested periods	**Period 4**	**Period 5 6**
Lesson topic	Condensation	**Assessment/Review**
Sample lesson plan	6-4	
Specific objectives	Be able to find examples of condensation in our lives	
Introduction	Remind previous lesson	
Development	Activity 6	
Assessment points	Observation of activities. Do the children participate in the learning process? Do they get the meaning of experiments? Do they discuss well? Do they draw conclusion? Do they positively discover anything from experiments?	
Adaptation of curriculum	We can use a lot of different experiments in this chapter such as locally available sugar cane, jaggery etc. which are easy to understand matter can change states and states change by evaporation and condensation.	

Activity 1 Changes of 3 states

Teaching/learning material

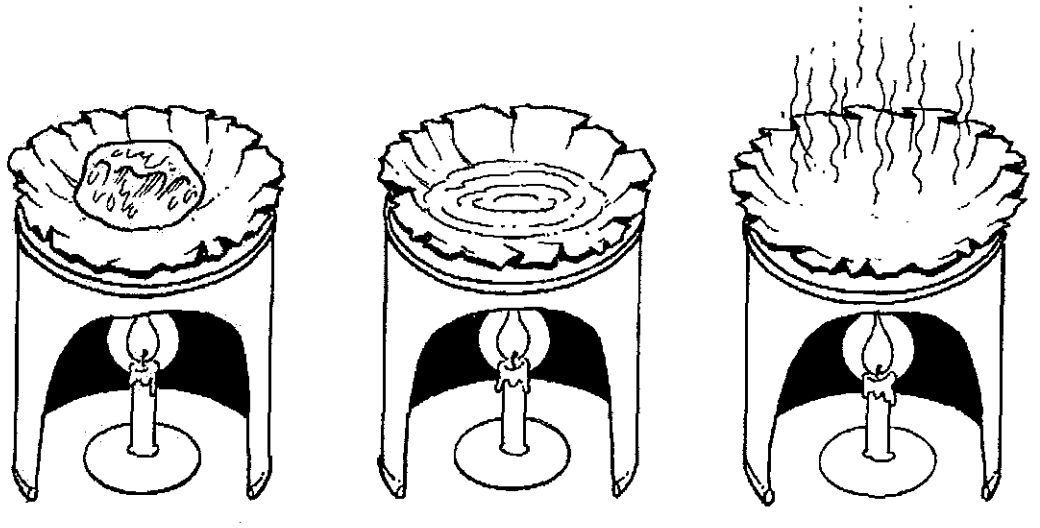
Sprit lamp (Kerosene lamp, or candle), tin, iron plates or aluminum foil, ice (or water), butter, naphthalene

Concept States of matter change by heating and cooling.

This is activity is to heat several materials and observe how they change and observe the material when they are getting cooler as well.

1. Let us use a tin to make a stand for a heat source (lamps or candles)
2. Put the heat source under the stand.
3. Cover the stand with a metal plate or aluminum foil.
4. While lighting the heat source, let us put a piece of ice on the metal plate.
5. Observe what is happening with the ice. (Never get too closer to the heat source and the plate)
6. Let us try the same activity with another piece of materials.
7. Let us observe what is happening. When you use a piece of naphthalene, make that piece so small, like smaller than the half of rice. (Never get too closer to the heat source and the plate)
8. Stop heating while liquid of naphthalene is becoming gas. (Never get too closer to the heat source and the plate)
9. Leave it and observe how it changes. (Never get too closer to the heat source and the plate)

Although the piece of material is small, a lot of gas will goes off which could be bad for the health of children. Make the piece as small as possible and remind children to keep a distance (1m-2m) from the heating source and the plate. Let us carry this activity in the class room whose windows are fully open.



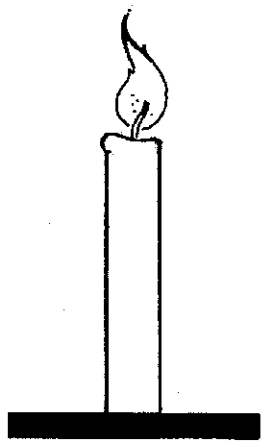
Activity 2 Burning of a candle

Teaching/learning material

Candle, match

Concept Gas of a candle burns at its top.

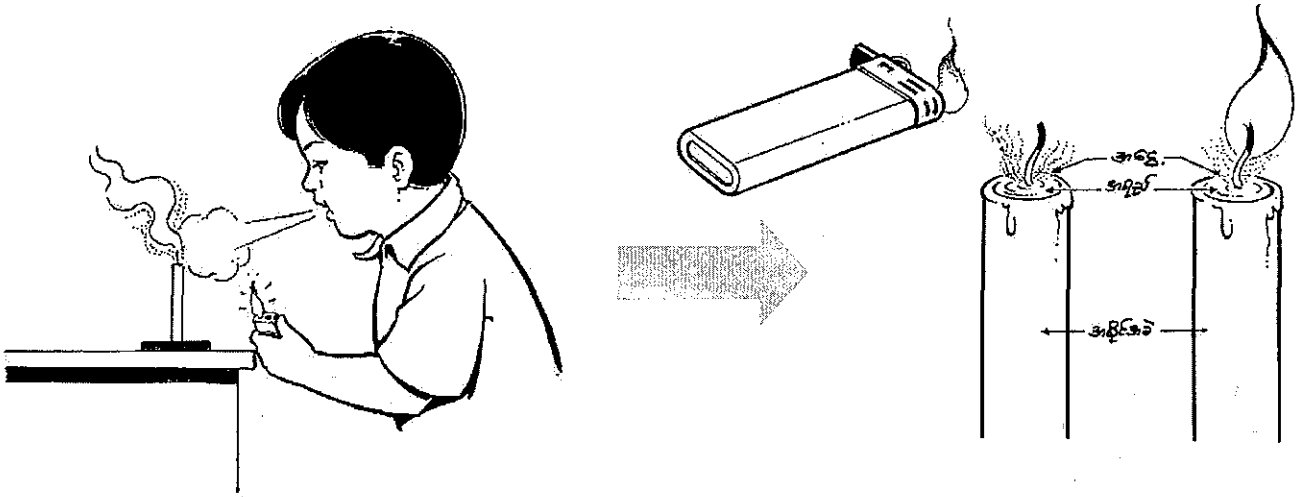
Let us think why a candle can keep flame for a long time.
Let us light the candle and observe its burning
Is the cotton in the candle burning?
Is solid of candle burning? Do you see the liquid of candle under the flame?
Is that liquid of candle burning?



In fact, because of the heat from the flame, the liquid of the candle is becoming gas, and then the gas of the candle is burning.

In order to prove that the gas is burning, let us put off the flame, light a match and place it 5cm above from the candle. What happens? Although the candle was put off, the flame appears again at the cotton of the candle.

After putting off the candle, there is still gas of candle going off. When the flame of the match comes to the gas, the gas starts to burn again and settles at the cotton of the candle. When the candle is put off, there is smoke coming out which is not the gas of candle. The gas of candle has no color.

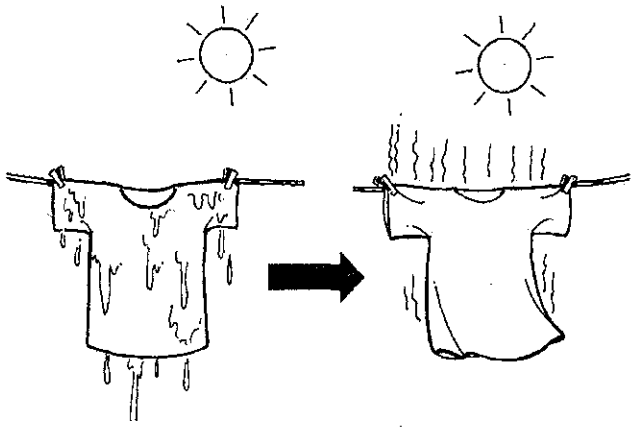


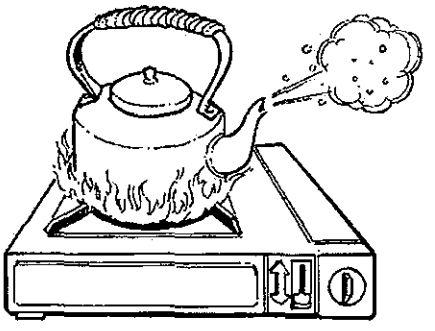
Activity 3 Find evaporation

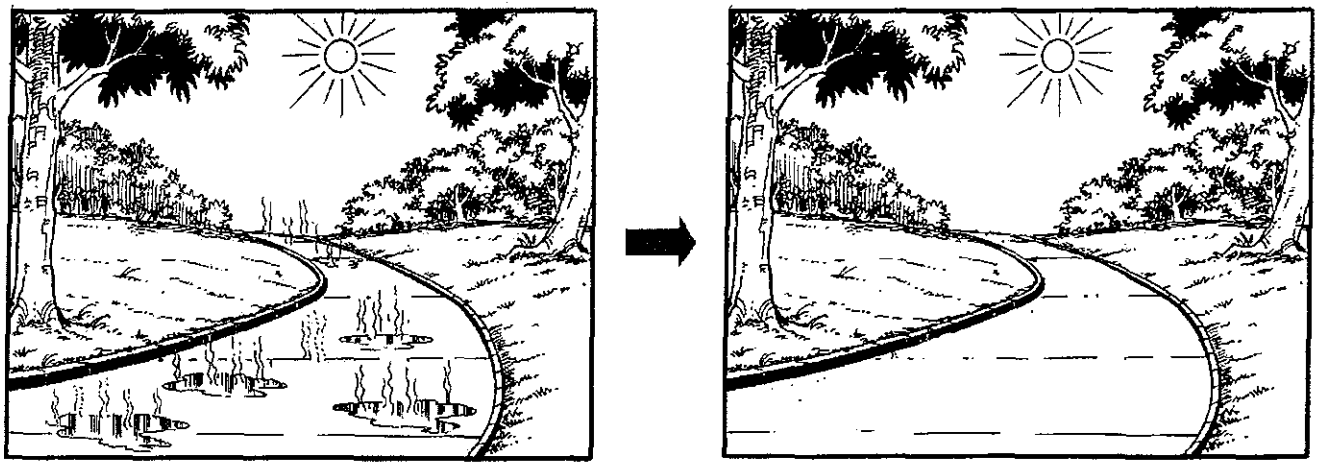
Teaching/learning material

Concept Evaporation can be found in our lives.

We can find evaporation around our lives. Let us look around and find the evaporation. Illustrations below are common examples. Show several examples only and encourage children to think and speak out.







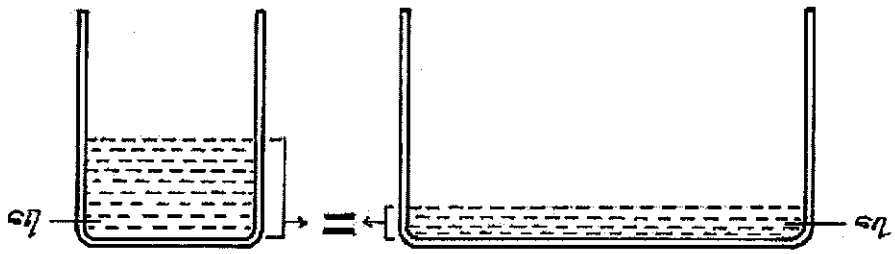
Activity 4 Conditions of evaporation

Teaching/learning material

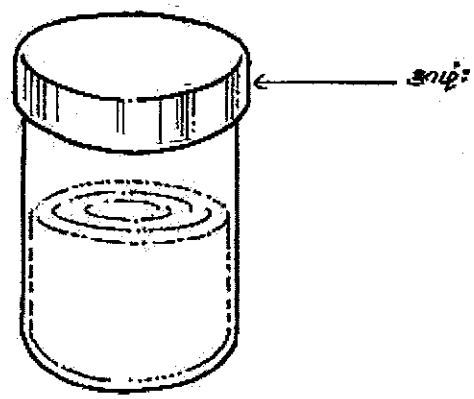
Wide tray, narrow tray, plastic bag, water

Concept The degree of evaporation changes due to some conditions.

We now realize that we can find many types of evaporation happening around our lives. There are some conditions which influence the degree of evaporation. Let us see the example below. When the same quantity of water is put into the different trays, which water can evaporate more quickly? How about if we use the same trays and put one outside and the other inside? How about under sunlight and shadow? How about sunny day and rainy day?



Let us think about the factors influencing the evaporation with children.
Encourage children to find the factors by themselves before mentioning the answers.
The factors are surface contacting air, temperature, humidity, sunlight, wind and so on.



Activity 5 Evaporation of alcohol

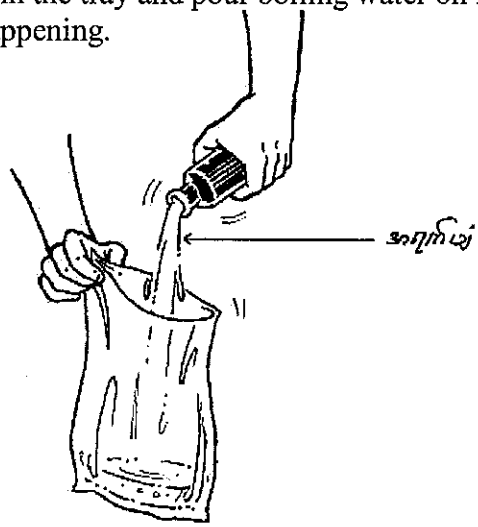
Teaching/learning material

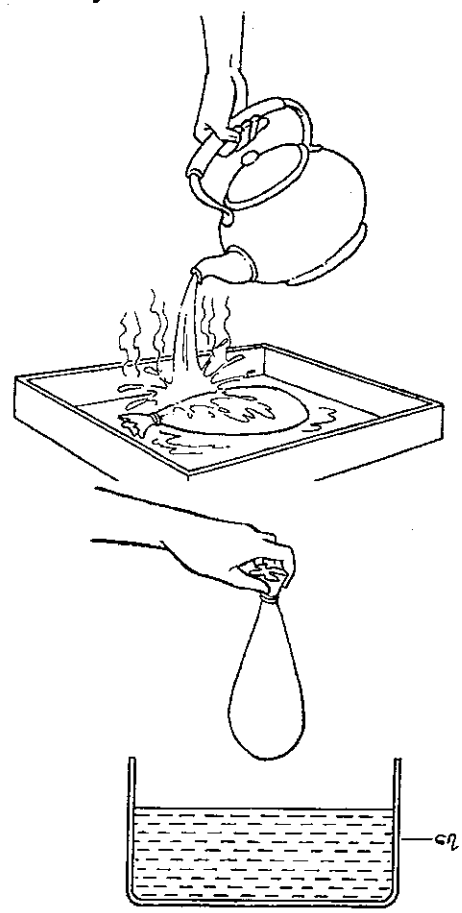
Plastic bag, tray, boiling water, water(cool), alcohol (or sprit)

Concept Liquid evaporates (liquid become gas)

Liquid such as alcohol can evaporate as well as water. Let us observe the evaporation of alcohol today.

Put the alcohol into the plastic bag. (100 cc is enough)
Remove the air from the plastic bag and close it with a rubber band.
Put the plastic bag in the tray and pour boiling water on it little by little.
Observe what is happening.





After pouring, some alcohol become gas as a result the plastic bag is boosted.

Then,
Put the boosted bag into the cool water.
Observe what is happening.

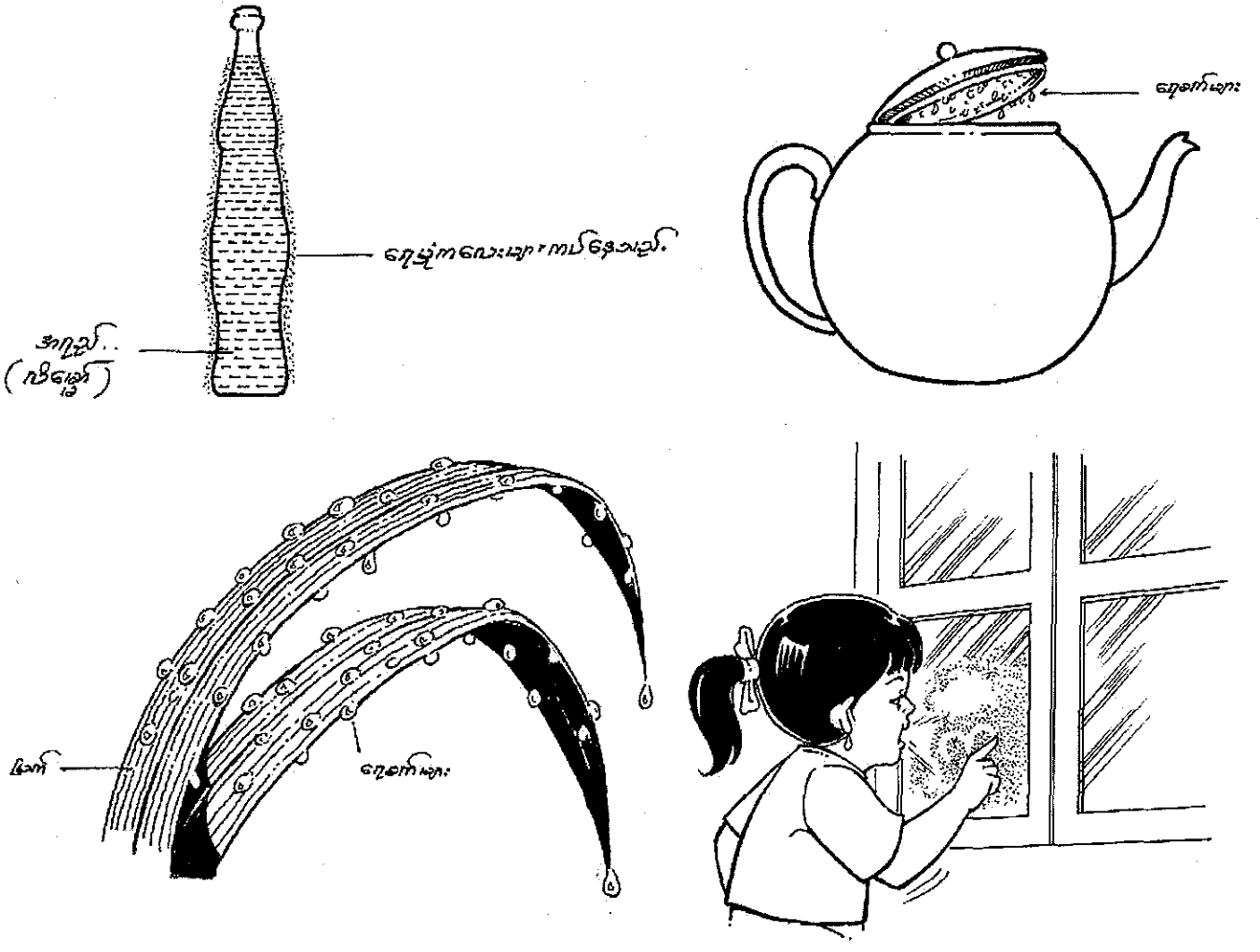
Boosted bag started to shrink since the gas of alcohol is becoming liquid again.
Before carrying out this activity, let us explain what we do and encourage children to guess what will happen after pouring. It is interesting for children to compare their guess and the result.

Activity 6 Find condensation

Teaching/learning material

Concept Condensation of water can be found around our lives.

We can find condensation around our lives. Let us look around and think of condensation. Encourage children to find condensations in their lives. We have water (vapor) in the air. Vapor becomes liquid when the air is cooled down. There are some examples of condensation introduced below. Let us show only 2 examples to children and encourage them to find the condensation by themselves. Give much time to children to find condensation. This activity could be homework as well.



Activity 7 Sublimation

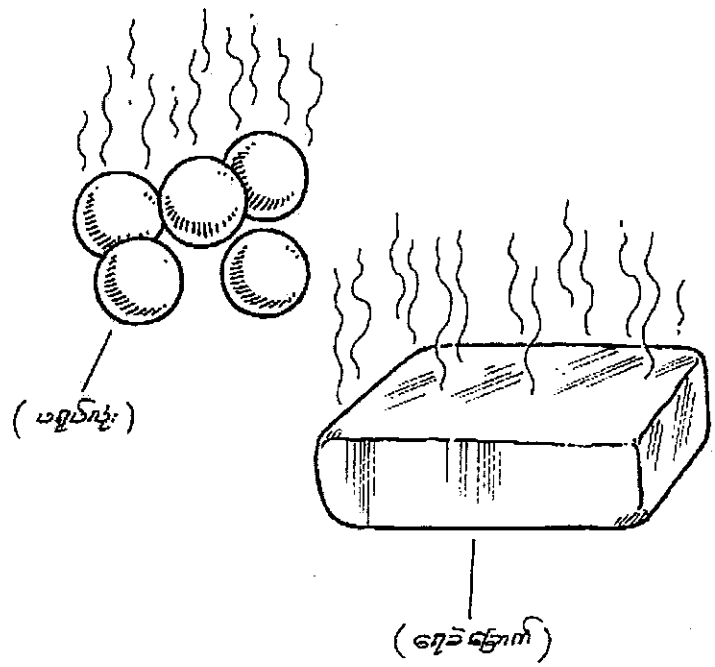
Teaching/learning material

Naphthalene, dry ice

Concept Some material can sublimate. (Changing from solid to gas directly)

Sublimation is the change from solid to gas. Some materials such as dry ice (solid of carbon di-oxyside), naphthalene become gas from solid without being liquid. When those materials are left in the air, they disappear after some time.

Dry ice is the best example to show sublimation, but it is difficult to get. Let us ask children their experience with naphthalene in cloth cases in their house. Naphthalene ball is getting smaller as time goes by. It is also good that we get the naphthalene ball in the classroom and leave it for sometime and check the change in size.



Lesson Plan 6-1

Lesson topic: Changing states of matters
Learning objectives: Be able to explain that one state of matters can transform into another state.
Teaching/learning materials: Ice block, naphthalene ball, candle, stove made of can, lighter, Aluminum cup (or) cup made by cutting the lower part of a juice can.
Teaching period: 70 minutes
Learning procedure

Learning Activities	Time	Teaching/ Learning Materials	Important points
Introduction Let children recall the matters in the environment that they know as the lesson on the matters in the environment has already been taught. Ask how many states the matters have. - (3) states Ask what these are. - (Solid, liquid, and gas) Have them differentiate the above matters whether these are solid, liquid or gas.	5	Blackboard, chalk	To note down the children's answers on the blackboard. Solid | Liquid | Gas - | - | - - | - | - - | - | - Teacher has to record.
Development **Activity A (refer to Activity 1)** By showing the ice block, the teacher has to ask the following questions. "What is it?" "Which state is it?" - (Ice, Solid) Where is the ice mostly kept? (Refrigerator, Ice flask, In the husks, ...) What will happen to the ice if it is put outside? Why? - (Due to the melting, because it is hot outside) What will happen if the water melted from the ice is heated? Have the children guess and tell. Have the children raise their hands for their guesses and write down their guesses as follows: Answer | Number of children 1. | 2. | - |	15	Ice block, candle, stove made of can, lighter, cup made of aluminum foil or aluminum cup or lower part of a cut juice can	Instruct carefully the children not to play with lighter and to be free from the danger of fire while experimenting. Let them notice the ice block is solid.
Let us experiment to check the guesses if these are correct or not. Teacher will distribute the materials for the experiment to the children by group. Teacher will tell the procedure of experiment. Put the cup made of aluminum foil onto the stove made of can. Put the ice block into the cup. Light the candle and heat the cup with the candle flame. Observe on what the ice block happens. Children will carry out the experiment. After the experiment, ask, "What is the state of the ice block before heating?"	5		Make them notice it changes into liquid state. Let them notice it changes into gas. Matters change from one state into another due to the heat.

Learning Activities	Time	Teaching/ Learning Materials	Important points
Ask, "What do you find happens to the ice block when it is heated?" "Which state is it?" Ask, "What do you find continues to happen?" "Which state is it?" Have the children discuss on their findings after thinking by groups. Have each group present its discussion to the class and teacher has to write the results on the blackboard. Water Solid $\xrightarrow[\text{heat}]{}$ Liquid $\xrightarrow[\text{heat}]{}$ Gas	5		
Activity B (refer to Activity 1) By showing a naphthalene ball, teacher has to ask the following questions. What is it? Which state is it? - (A naphthalene ball, Solid) Have you ever found the place where it is put? (In the cupboard, among the clothes,) What happened to the naphthalene ball, which had been put among the clothes? - (Became smaller/disappeared) Why? Where did it go? - (It evaporated) Ask what will happen if the naphthalene ball is heated. Have the children guess on it. Write the guesses of the children on the blackboard. Answer | Number of children 1. 2. -	15	Pieces of naphthalene, stove made of can, candle, lighter, aluminum foil or aluminum cup or cup made by cutting the lower part of a juice can.	**DO NOT** provide a big piece of naphthalene. Only a small piece (half size of rice) is enough. Gas of naphthalene is not good for health. Do this activity with all windows open. Let the children notice it is solid. Make them notice its changes into liquid. Let them notice its changes into gas.
Let us experiment whether it is correct or not. Teacher has to tell the procedure of the experiment and distribute a pack of small pieces of naphthalene (approximately the size of a rice grain) to the children. - Put the cup on the stove. - Put a piece of naphthalene into the cup and heat it up.. - Observe carefully what happens to the piece of naphthalene in the cup. Children will carry out the experiment. After the experiment -	10	Matters are able to change one state to another such as solid, liquid, and gas when heated or cooled	

Learning Activities	Time	Teaching/ Learning Materials	Important points
Ask what is the state of the piece of naphthalene. What do you find happens to the piece of naphthalene first when it is heated? Which state it is? What do you find next? Which state is it? Have the children think and discuss their finding of the experiment by groups. Let each group present its discussing points to the class and teacher has to write the results on the blackboard. Naphthalene Solid $\xrightarrow[\text{heat}]{}$ Liquid $\xrightarrow[\text{heat}]{}$ Gas	10		Matters change from one state to another due to the heat.
Conclusion Teacher has to ask how many experiments are carried out. - (Three) What materials are experimented? - (Ice block, Naphthalene ball, candle) Have the children present their findings of the experiments by the group. Solid $\xrightarrow[\text{heat}]{}$ Liquid $\xrightarrow[\text{heat}]{}$ Gas Teacher has to conclude the lesson with the main concept as follows: Matters can change one state into another. Teacher will ask the children to write the summary of the above lesson.	5		

Lesson Plan 6-2

Lesson topic: Why a candle keep burning (Changing states of matters)
Learning objectives: Be able to explain how a candle keep its fire
Teaching/learning materials: Candle, match
Teaching period: 35 minutes
Lesson procedure

Learning Activities	Time	Teaching/ Learning Materials	Important points
Introduction Teacher may start asking "Do you know why a candle can keep fire for a long time? Do you know what is really burning?" Encourage children to speak their ideas.	5	Candle, lighter	It is the guessing stage.
Development (refer to Activity 2) Let us experiment whether the guesses are correct or not. Teacher has to distribute the candles to each group and tell the procedure of the experiment. 1) Light the candle. 2) Observe carefully the top of the candle being on fire. 3) Blow the candle flame out. 4) Observe carefully the top of the candle when blowing its flame out. 5) Right after the fire goes off, light the match and approach it closely to the top of the candle. 6) See what happens.	15		To observe the top of the firing candle. Make sure that children notice wax(candle) is solid and becomes liquid. 5) is slightly difficult. Let us try until you can do it successfully.
After the experiment, - Ask which state the candle is before heating. - What do you find the top of the candle that is on fire happens when it is heated? Which state is it? - Ask if the candle is on fire or not when it is lighted without touching the lighter with the wick after blowing the candle flame out. - Ask, "Why is the candle on fire unless the lighter touch with the wick. Make sure that children think and discuss about the findings of the experiments by group. Ask them to present the discussing points of each group to the class and teacher has to write the results on the blackboard.	10		Facilitate the children to notice the changes of candle from liquid into gas and how the gas is burning.
Conclusion In the burning of the candle, we can observe changes of states of matter. Candle (wax) changes from solid to liquid. Then liquid becomes gas due to heat. **Although the gas of wax is not visible, it is the one which burns.** Even when the fire of candle is put off, there is gas of wax around the candle. That is why fire appears again when lit match approached to the top of the candle.	5		When you try to blow many candles on the birth day cake, it is sometimes difficult. This is because fire can appear again if all fires of candles are put off at once.

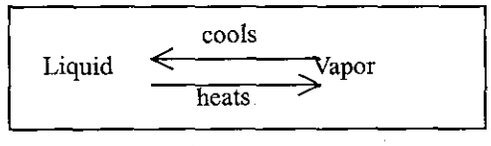
Lesson Plan 6-3

Lesson topic: Evaporation and condensation
Learning objectives: Be able to find examples of evaporation in our lives
Be able to find examples of condensation in our lives
Teaching/learning materials: Blackboard, chalk, Thanakhar lotion, piece of cloth, two cups with different sized opening (a plate, cup) hot water, water.
Teaching period: 35 + 35 *minutes*
Learning procedure

Learning Activities	Time	Teaching/ Learning Materials	Important points
Introduction: It has been taught in the previous lesson that matters transform from one state to another. Children will be asked what they know and remember. Solid $\xrightarrow[\text{heat}]{}$ Liquid $\xrightarrow[\text{heat}]{}$ Gas	5	Blackboard Chalk	
Development Teacher will ask each group each question from the followings. Question (1) If a soaked handkerchief is squeezed out water and dried out in the sun what will happen to the handkerchief? Why? Question (2) What will happen to the applied Thanakhar a moment later? Why? Question (3) What will happen to the water inside a small stream and inside a small pond when it reaches summer? Why? Question (4) If you wipe the table with the cloth from which water is squeezed out what will happen a moment later? Why? Question (5) When equal volume of a cup of water is poured into a plate and a cup, which one is fast in evaporating ? Why? After asking the above questions to children let them think, guess and present by groups. Teacher will put heading on the blackboard as ' **Evaporation** ' Children will be asked to do the experiment as follows to check if their guessings are right or not.	10		Teacher can ask other questions alike in relation with the lesson topic. Children's group-wise answers will be recorded on the blackboard.
Activity A Each group will be given a cup of Thanakhar lotion. Will ask children to apply on their hands. The findings will be asked to discuss and present.		Thanakhar lotion	
Activity B Each group will be given a piece of cloth from which water is squeezed out. (1) Let them wipe the writing table. (2) Let them wipe the blackboard and the findings will be asked to discuss and present in groups.		Cloth from which water is squeezed out	

Learning Activities	Time	Teaching/ Learning Materials	Important points
Activity C (refer to Activity 4) Each group will be given a plate and a cup. Teacher will fill the plate and a cup with each cup of water with similar volume. Encourage them to predict which is fast to evaporate. Since it take long time to see the result of this activity, leave both containers until tomorrow.	5	Two cups with different openings a cup filled with water	It is important for children to predict by themselves.
Activity D (Refer to Activity 3) Let us find evaporations around our lives. Teacher can mentions some examples of evaporations in activity 3 and encourage children to find evaporation by themselves.	10		
Conclusion: After activities, teacher can summarize the lesson with the following sentences. Evaporation can be easily found in our lives. The degree of evaporation varies according to some conditions, such as temperature, surface areas touching with air, with/without sun, etc.	5		

Lesson procedure (Condensation)

Learning Activities	Time	Teaching/ Learning Materials	Important points
Introduction: Teacher can ask to children "Have you seen a very cold soda in bottle?" "When you leave the cold bottle outside, what do you see the outside of bottle?" Children will answer that that is water or liquid,,,," Teacher say " today's lesson is to know where it comes from". Teacher will also ask each group the following questions. Question (1) When the cover of cooked rice pot, curry pot, and boiled water pot is opened, what will you find on the cover? Why? Question (2) Ice cubes are put inside a cup. After a while, if you see the surface of the cup what will you find? Why? Teacher will put the heading on the black- board as **'condensation'**	5		Teacher can ask other questions alike in relation with the lesson topic After the above questions have been asked to children that they will be asked to think, guess and present.
Development **Activity A** Each group will be given a cup and a saucer. Teacher will fill the cup with hot water and let the saucer covered on that cup with its face downwards. Do not let open the saucer covered on the cup. Teacher will do like-wise to every group After 4 minutes, remove the saucer covered on the cup to open. Children's guessings and the findings from experiments will be asked to discuss and present group-wise.	10	Blackboard chalk cup saucer hot water (Glass, plastic cup, steel cups, metal cups can be used)	Children's group-wise answers will be recorded on the blackboard. Notice will be given not to touch with hot water. Do not put too much hot water
Activity B Let's put ice cube or very cold water to the cup. Let's wait for a while and observe outside of the cup What do children see? Where is it coming from?	10		Let them know that when steam is exposed to cold objects (saucer) the vapor is transformed into liquid.
Activity C (refer to Activity 6) Also let us find condensation around our lives. (refer Activity 6)	5		Water outside of cup was in the air as vapor(gas), but it is cooled down by the cup and become liquid.
Conclusion: Teacher can mention that when the vapor is cooled down, it turns into liquid again. This transformation is called "condensation"  Teacher can also mentions that condensation is opposite to evaporation which we learned.	5		

Assessment (Change of State)

Point of Assessment

Interest/Attitude/ Motivation	Scientific thinking	Technique	Knowledge and understanding
Is s/he interested in given materials? Is s/he interested in predicting the result? Is s/he motivated to reflect their lives to find evaporation or condensation?	After doing experiment with ice (water), does s/he think about melting and boiling of other materials? Can s/he think that gas can be liquid and solid when it is cooled? Can s/he think what kind of factors influence evaporation? Can s/he think that condensation of water can happens when air is cooled down?	Can s/he follow the explained steps? Can s/he handle the candle without danger? Can s/he properly observe what is going on while doing experiment? Can s/he discuss with friends in groups?	Does s/he understand that the state of any material can changed when it is heated or cooled? Does s/he understand what is happening around the fire of a candle? Does s/he understand that evaporation and condensation are very common in our lives?

Oral Assessment/ Group Discussion

1. Explain why fire on the candle can burn for a long time?
2. When you breathing out on to the mirror what will happen? Why?
3. After heavily playing what will happen? Why?
4. What can you find on the grasses in the early morning during winter? And why you can find it?
5. How the crack or fissure of the fields is formed during summer? Why?
6. Find evaporations and condensations in our lives.

Written assessment

1. Explain how to catch water (vapor) in the air?
2. When you open your lunch box what will you find inside the cover of the lunch box? Why does it appear?
3. How will you get coconut's cream from coconut?
4. What will happen to the water bottle after taken out of from the fridge? Why does it happen?
5. Write down evaporations and condensations you can find in your life.

Message to Teachers

It is likely that children think that metals will be always solid even when heated and air will be always gas even when cooled down.
Let us stress that state of any material can be changed.

Encourage children to find evaporation in their lives, which should be easy if they fully understand what evaporation is.

Assessment (Evaporation/Condensation)

Point of Assessment

Interest/Attitude/ Motivation	Scientific thinking	Technique	Knowledge and understanding
Is s/he interested in the experiment? Is s/he motivated to carry out activities? Does s/he enjoy experiments?	Is s/he able to predict and find out the answer from experiment? Is s/he able to think that evaporation occurs when solid or liquid is heated and condensation occurs when vapor is cooled down?	Is s/he able to carry out experiment? Is s/he able to communicate with the teacher and peers in relation with that topic?(The ability to present predictions and the ability to listen to what others say)	Is s/he able to understand differently evaporation and condensation?

Oral Assessment/Group Discussion

1. When a wet handkerchief is squeezed out water and dried in the sun what will happen to it? Why?

2. What will happen to a table when it is wiped with a cloth, which is squeezed out water after a while? Why?

3. What do you find inside the cover of lunch box when you open it at lunchtime? Why?

Written Assessment.

1. Ice blocks will be put inside a cup; when you see the surface of the cup after a while what will you find? Why?

Message to Teachers

1. The handkerchief will dry because the water inside the handkerchief evaporates by the heat of the sun.

2. The table will dry because the water evaporates by the temperature of the room.

3. The water drops are found to transform into water because the hot vapor inside the lunch box when touches the cold cover of the lunch box transforms from vapor into liquid and condensation occurs.

(To answer)

Topic 7: Solubility of solid in water

1. Key concept	What is solubility?
2. Learning objective	
General objectives	1) Be able to identify that some solids have the property of solubility. 2) Be able to identify that some solids do not have the property of solubility.
Specific objectives	1) Children are able to tell own prediction from their experience what materials have the property of solubility. 2) Children are able to indicate the fact by experiments that sugar, salt and ink are soluble and flour is not soluble. 3) Children are able to identify property of solubility (once dissolved it is stable and once dissolved it is transparent). 4) Children are able to identify solubility by its properties.
3. Activities involved	In order to help children understand correct sense of solubility, teachers must give good examples of solubility.
4. Activity purpose	Children should carry out their activities by themselves. "Learning by Doing" and exploring the sense of solubility are important.

Before Getting Started

Self-check list for Teachers	☐ Can I identify mixture; solution, suspension and colloid (emulsion)?
Background information for teachers	
Solution	A solution (things are soluble) forms when one substance dissolves in another. The solute (the substance that dissolves) breaks up completely into ions or molecules, and spreads throughout the solvent (the substance that it dissolves in). Solutions are transparent and homogeneous mixtures under constant conditions, the substances in them do not separate out. Other mixtures where the particles are larger are said to be heterogeneous. In a suspension, for example, tiny, solid particles are spread throughout a liquid, but they will eventually sink if the suspension is left to stand.
Suspension	A mixture in which fine particles of a solid substance are dispersed, but not dissolved, in a liquid. Suspensions are always cloudy and, if they are left to stand, the solid particles will eventually settle out. Chalky water is an example of a suspension.

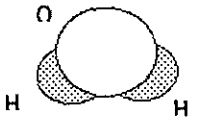
Colloids & Emulsions

Colloids and emulsions are examples of heterogeneous mixtures. In a colloid, particles of one substance are dispersed throughout another. The dispersed particles are larger than those of a solution but smaller than those of a suspension. For examples milk is a colloid. It consists of fat globules dispersed throughout water.
If the substances in a colloid are both liquids, the mixture is known as an emulsion. To prevent the liquids from separating, another substance, called an emulsifier, is often required. Soap water, for example, is an emulsion, in which can hold oily dirty and water together by soap particles.

Molecule

A molecule is a group of atoms joined together by covalent chemical bonds. All molecules of the same compound have the same set of atoms, linked together in the same way. Water molecules, for example, each consist of two hydrogen atoms linked to one oxygen atom.
Some elements also consist of molecules. These contain atoms of that element only. Oxygen gas, for example, has molecules made up of two oxygen atoms.
Most gases and liquids, and many non-metallic solids, consist of molecules.

WATER MOLECULE



The way that the atoms are joined determines water-molecule.

Lesson Planner

Suggested period (6)	***Period 1***	***Period 2***	***Period 3***
Lesson topic	What materials are soluble?	Property of solubility 1	Property of solubility 2
Sample lesson plan	7-1		
Specific objective	Children are able to tell own prediction from their experience what materials have the property of solubility. Children are able to indicate the fact by experiments that sugar, salt and ink are soluble and flour is not soluble.	Children are able to identify property of solubility (once dissolved it is stable)	Children are able to identify property of solubility (once dissolved it is stable). Children are able to identify property of solubility (once dissolved it is transparent).
Introduction **(Motivation/Create interest/Active prior knowledge)**	Checking children's ideas (NOT TEST) Activity 1	Remind previous lesson with (Activity 2)	Remind previous lesson with (Activity 3 and 4)
Core/Development **(Active engagement with test/task**	Activity 1 and 2	Activity 3 and 4	Activity 5
Assessment points	**Observation of activities:** Do they participate in the learning process?; Do they get the meaning of experiments?; Do they discuss well?; Do they draw conclusion?; Do they positively discover anything from experiments?	**Observation of activities:** Do they participate in the learning process?; Do they get the meaning of experiments?; Do they discuss well?; Do they draw conclusion?; Do they positively discover anything from experiments?	**Observation of activities:** Do they participate in the learning process?; Do they get the meaning of experiments?; Do they discuss well?; Do they draw conclusion?; Do they positively discover anything from experiments?
Adaptation of curriculum	We can use a lot of materials for these experiments in this chapter. However make it easy to understand "solubility, simple material such as sugar and salt are easier to use." Do not confuse children about solution and colloid, for example soap water is colloid. Be sure to use easy to understand material when making solution.		

Lesson Planner

Suggested periods	**Period 4**	**Period 5 6**
Lesson topic	Definition of solubility	**Assessment/Review**
Sample lesson plan		
Specific objectives	Children are able to identify solubility by its properties.	
Introduction	Remind previous lesson with (Activity 5)	
Development	Activity 6 Discussion Activity 7	
Assessment points	**Observation of activities:** Do they participate in the learning process?; Do they get the meaning of experiments?; Do they discuss well?; Do they draw conclusion?; Do they positively discover anything from experiments?	
Adaptation of curriculum	We can use a lot of materials for these experiments in this chapter. However make it easy to understand "solubility, simple material such as sugar and salt are easier to use." Do not confuse children about solution and colloid, for example soap water is colloid. Be sure to use easy to understand material when making solution.	

Activity 1 What is soluble? 1

Teaching/learning material

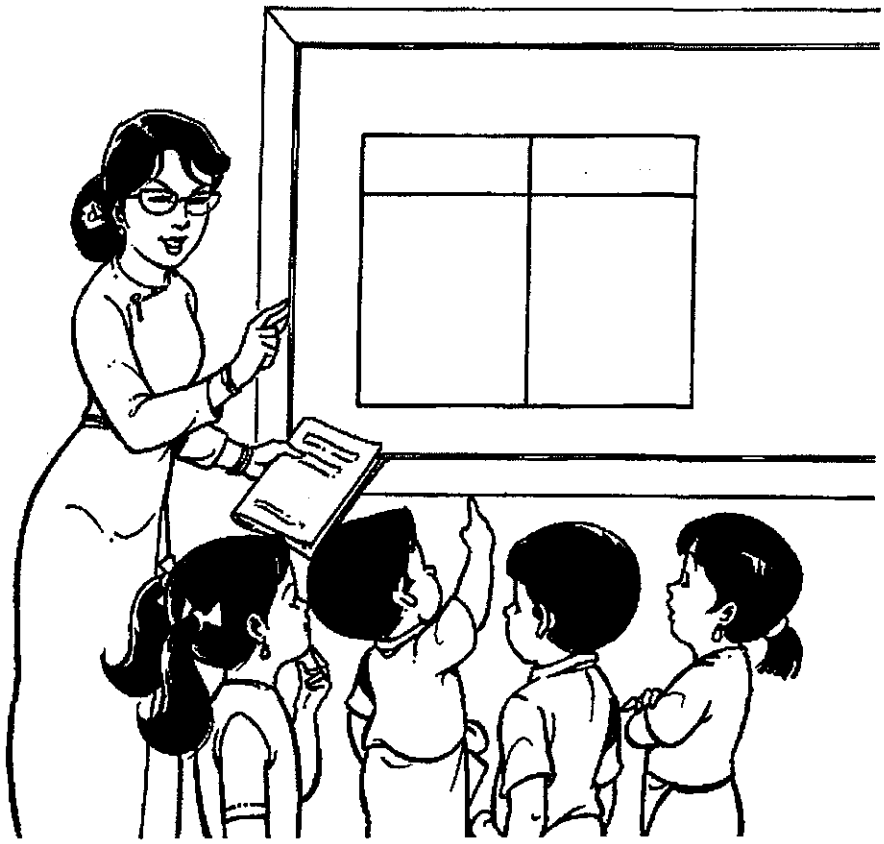
Blackboard

Concept What is soluble?

Ask children what materials are soluble in water and what are not. Write down on the board. Do not correct children's wrong answers this time. They will know the truth through experiment.

Do you think that we can recognize what are soluble and what are not only through observation? If you think so, categorize from what kind appearance we can recognize "solubility."

What condition do you describe as "solution"?



Activity 2 What is soluble? 2

Teaching/learning material

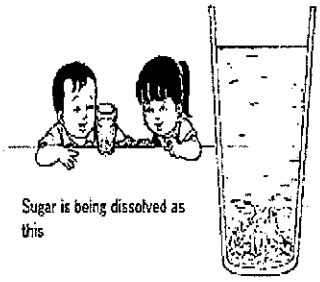
	Sugar, salt, chalk dust, flour, glass, spoon, and magnifying lenses
Concept	What is soluble? Checking solubility of material by experiment to define clearly "what is soluble."

We try to figure out what is soluble in water using the materials mentioned above. Before experiment, ask children what they think is soluble and what is not. (Prediction phase)

	Soluble	Not soluble
Sugar		
Salt		
Four		

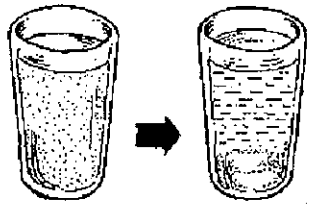
Let children discuss their ideas with others. **(Discussion Phase)**

Then take one spoon of sugar. Before stirring, look at it with magnifying lenses from the side of the glass. Observe the sugar dissolving into water.



Try to dissolve salt and flour into water.

Ask children the result.



What do you mean when you say "this is soluble" ? What kind of materials do you consider as soluble?

Activity 3 What is soluble? 3

Teaching/learning material

Sugar, flour, water, glass cups and spoons

Concept Meaning of solubility: once dissolved, it will not come out again.

Before experiment

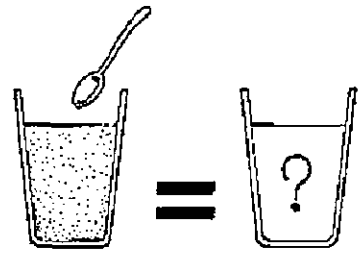
First ask children what do they think if we put sugar and flour into water and leave them until tomorrow morning?

Let children choose an answer from following answers. **(Prediction phase)**

a. Everything will be on the bottom

b. Everything will be dissolved

c. Something else

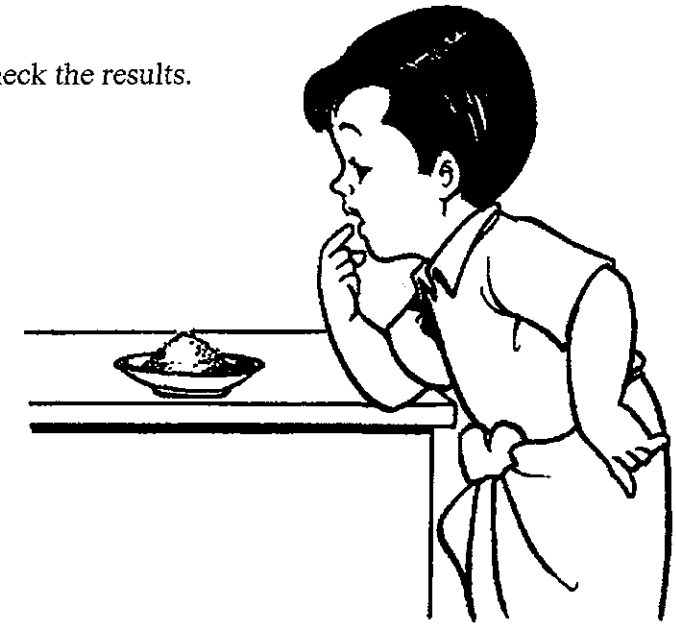


Let children discuss their ideas. **(Discussion phase)**

After discussion, begin the experiment

Dissolve all materials into water.

In the next morning, children can check the results.



Activity 4 Solubility 1

Teaching/learning material

Blue ink, glass cup, and spoon

Concept Meaning of solubility: once dissolved, it will not come out again.

Before experiment

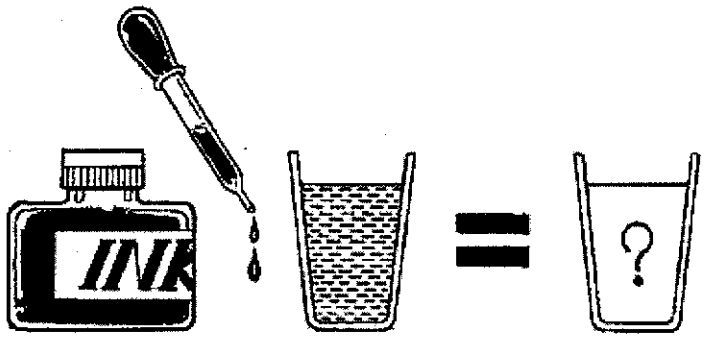
First ask children what they think if we put ink into water and stir. What will happen if we leave it to tomorrow morning?

Let children choose an answer from the following. (**Prediction phase**)

a. Deep blue color will be on the bottom.

b. It will stay same.

c. Something else



Let children discuss their ideas. (**Discussion phase**)

After discussion, start the experiment

Dissolve blue ink into water.

In the next morning, children can check the result.

Activity 5 Solubility 2

Teaching/learning material

Salt, water, glass cup and spoons

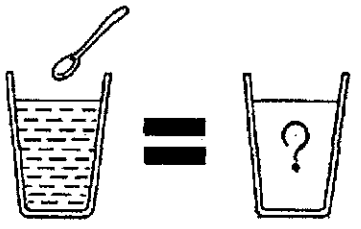
Concept Meaning of solubility: once dissolved, it will not come out again.

Before experiment

First ask children what they think if we put salt into water and stir. What will happen if we leave it till tomorrow morning ?

Let children choose an answer from the following. **(Prediction phase)**

a. Salt appears from solution.
b. It will stay same.
c. Something else



Let children discuss their idea. **(Discussion phase)**

After discussion, start the experiment

Dissolve all material into water.

In the next morning, children can check the result.

Activity 6 Solubility 3

Teaching/learning material

Blue ink, instant coffee, milk, soap, glass cup and spoon

Concept What is solubility? Look for definition

Dissolve all materials into water. Put the glass on the textbook. Let children see through glasses.

If children can clearly see the text through the bottom, then the material is soluble.

Activity 7 Definition of solubility

Teaching/learning material

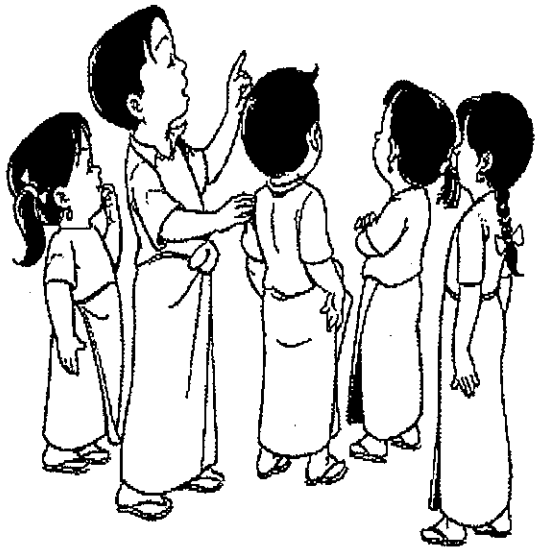
Black board

Concept Definition of solubility

Ask children and discuss, what does "this is soluble" mean? What condition do you consider as soluble? Let children talk freely about their opinions.
After sometime, children will understand.

If things are dissolved, solution is clear,
transparent and uniform (homogeneous).

Explain these concept using easy terms for children.



Reference

"What is Solubility in Molecule level?"

Lesson Plan 7-1

Lesson topic: Soluble and not soluble

Learning objectives: Children are be able
1) To identify that some solids have the property of solubility.
2) To identify that some solids do not have the property of solubility.
3) To find out chemistry theory through simple experiment by themselves.

Teaching/learning materials: Glass cups, sugar, flour, water, piece of paper, salt, Ink, spoon, and vase

Teaching period:

Teaching/Learning procedure

Learning Activities	Time	Teaching/Learning Materials	Points to be Noticed
Introduction Teacher asks children, "what is soluble in water?"	5		
If children give a wrong answer, the teacher does not have to correct it. Children can get the right answer about solubility after experiments.			This question is not a test, It is checking children's ideas.
Development/Core 1. Teacher explains about the materials. 2. Teacher asks children to predict what is soluble and what is not.	5		
3. Teacher asks children to raise their hands. Teacher writes down the number of children for each answer on the board as follows		Glass cups with water, Sugar Flour	Process 1- 5 are the prediction Phase, it is important for children to make predictions before experiments so that all experiments make sense to children. (They can expect what would happen if I do this?)
Children think:			
4. Teacher asks children to discuss why they think so.	10		
5. Teacher asks children if they changed their opinion. Teacher counts again the number of children who think something is soluble or not soluble.			
6. Teacher distributes experiment materials to children			
7. Teacher tells children the process of activities. Put sugar in the first glass, flour in the second glass, and ink in third glass. (see Figure) Observe the glass. (if possible with magnifying lens.)			Teacher needs to encourage children to observe the way sugar is dissolved into water, the way flour settles like sediment. Ink spreads into water.

	Soluble	Not Soluble
Sugar		
Salt		
Flour		
Ink		

Learning Activities	Time	Teaching/Learning Materials	Points to be Noticed
Stir the liquid. Observe inside of the glass cups. Leave the glass cups for sometime and observe the results.			Children also need to compare three cups. Children can observe well from the side.
8 Children carry out experiment. 9. Children express what is soluble what is not. Sugar is soluble or not. Salt is soluble or not. Flour is soluble or not. Ink is soluble or not. Teacher writes down the answers on the board.	10		Teacher should also ask why children indicate some of substances are soluble and some are not.
Evaluation/Conclusion Children realize what solubility means. Solubility - Transparency - Uniformity Teacher asks children what kind of interesting discovery they found during experiments. Teacher asks children to clear the tables.	5		Open question, do not focus on right or wrong. Important to find children's interest and wonder and encourage them to discover.. Make children aware of the importance of maintenance of experiment material for future activities.

Assessment

Point of Assessment

Interest/Attitude/ Motivation	Scientific thinking	Technique	Knowledge and understanding
Is s/he interested in experiments? Is s/he motivated to *carry out activities?*	Is s/he able to predict and find out the answer from experiments? Is s/he able to think sugar, salt and ink disappear into water because they are soluble? Can s/he think of limitation that liquid allow the soluble material to dissolve? Can s/he find the commonalities in soluble material?	Is s/he able to carry out experiments? Is s/he able to *communicate (express* prediction and listening to others) about this topic with teacher and peers?	Is s/he able to understand 'what is solubility?' *Is s/he able to identify* the characteristics of things that are soluble ?

Oral Assessment/Group Discussion

1. If you put salt into water, what do you see?
2. If you put sugar into water, what do you see? Why that is happening?
3. If you put blue ink into water, what do you see?
4. If you put wheat flour into water, what do you see?
5. If you put chalk-dust into water, what do you see?
6. If you put oil into water, what do you see?
7. If the above materials are soluble, what condition do you see?
8. If the above materials are not soluble, what condition do you see?
9. Explain how you separate water and non-soluble material when they are already mixed.

Message to Teachers

1.2.3. Let children think what is soluble and what is not. When they see soluble things, what 'condition' do they observe. Important points are **transparent, clear, uniform (homogeneous).**

4.5. Let children find difference from condition of solution.

7. 8. Conclude Solubility: **transparent, clear, uniform (homogeneous).**

Check children's understanding of solution. Be sure once solution is formed it will stay same condition.

Written assessment

1. If you dissolve blue ink into water and leave it, what do you see in the following morning?
2. If you put flour into water and leave it, what do you see in the following morning?
3. If you dissolve salt into water and leave it, what do you see in the following morning?

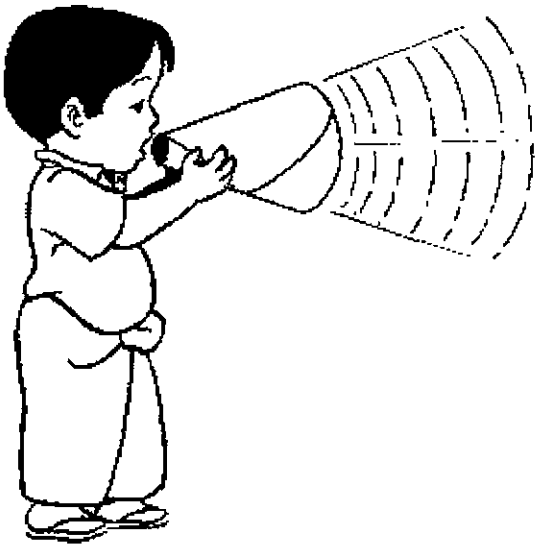
1. Staying same

2. Flour is on the bottom.

3. Staying same

Grade 3

Chapter 3 Energy



Topic 8 : Heat

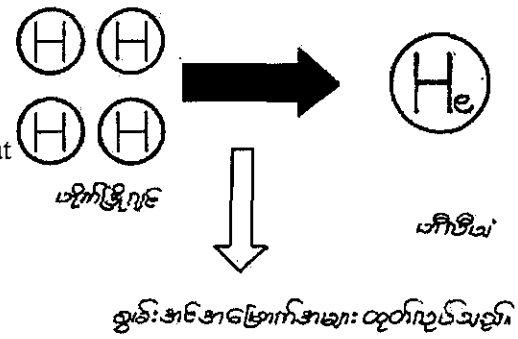
1. Key concept	There are different sources of heat. Heat may be used in different ways.
2. Learning objective	
General	1) Be able to understand that there are different sources of heat 2) Be able to understand that there are different uses of heat
Specific	1) Be able to describe that there are various sources of heat and explain how they generate heat. 2) Be able to describe that heat is produced from friction 3) Be able to describe that various ways to utilize heat from sun, fire and electricity 4) Be able to explain how to make charcoal
3. Activities involved	Thinking about the daily activities which require heat. *Making heats* Finding utilizations of heat
4. Activity purpose	To promote understanding of the topic. To attract interests of children To stimulate imagination and creativity of children

Before Getting Started

Self-check list for Teachers	☐ Do I know that heat is imperative for our life? ☐ Do I know several sources of heat? ☐ Do I know how those sources emit heat? ☐ Do I know how to make heat? ☐ Can I find examples of heat utilizations?
Background information for teachers	
Sun is Earth's main energy source.	Sunlight provides heat and light which are two types of energy. Living things can live because the sun gives earth enough energy to survive. Practically, everything that happens on the earth depends on energy that originally came from the sun. Plants needs sunlight for its growth. Animals get energy to eat plants or other animals. Coal, oil, natural gas are all formed from the remains of plants and animals that grew thanks to sunlight, though it take a long time.

Sun (Nuclear fusion)

The sun consists of hydrogen and helium. The energy of sun is generated with the nuclear fusion at its core. Four atoms of hydrogen get together (fuse) to become helium which consists of 2 protons and neutrons.
In this process, some mass is lost and it turns out to be energy. Sun will continue to shine for billions of years, but in about five billion years, it will swell into a red giant.



Burning (Combustion)

Most of fuels, such as natural gas, petrol, diesel, and kerosene, we have in our life is hydrocarbon. Hydrocarbon can burn in air, which is around 20% of oxygen. When they burn completely, only carbon dioxide (CO_2) and Water vapor (H_2O) can be produced. This burning is so called "Combustion". When oxygen is not enough, toxic gas, carbon monoxide (CO) and soot (carbon) are produced.

Electrical stove/ Electric heater

Electricity does not have heat itself. However, when it currents through conductors such as metal wires, heat is generated. The amount of heat generated depends on the kinds of conductor. Electric heater, stove, hair dryer, toaster and others utilize specific metals to greatly get heated when electricity currents through them.

Our body is a source of heat

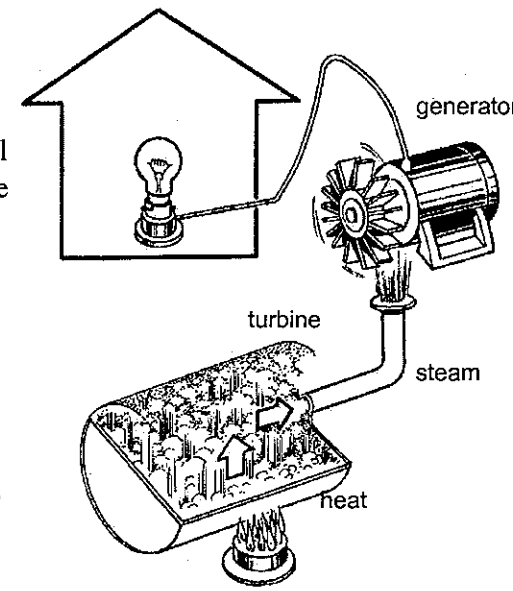
We drink water and eat foods to live. In other words, we are taking energy by eating. After taking, we convert those foods into heat energy and potential energy. It is said that heat emitted form an adult body is as much as the heat form a 60 watt bulb.

How about the core of the earth?

Earth can be a source of heat as well. Earth has crust, mantle, outer core, and inner core inside. Scientists have discovered the temperature in the cores to be nearly 4000 Celsius. Even the rocks beneath Earth's surface are often hot. The heat in those rocks are utilized to turn water into steam. The steam can be used to generate electricity.

How is heat changed to electricity?

There are many kinds of power station. Heat is needed to generate electricity in most of the power stations. Coal, natural gas, oil, and nuclear reaction are used to generate heat. Heat is used to turn water into steam, which rotates turbine of the generator. As a result, the electricity is generated.



Common generators we see at home, factory, and other places, use engine motors to rotate generators.

Diesel is commonly used for the engine motors. In fact, your bicycle has a small generator which can light the bulb. In this case, the kinetic energy from you is converted to electric and light energy.

Lesson Planner

Suggested period (6)	**Period 1**	**Period 2**	**Period 3**
Lesson Topic	Heat sources	Heat from friction	Utilization of heat
Sample lesson plan	8-1	8-2	8-3
Specific objective	Be able to describe that there are various sources of heat and explain how they generate heat	Be able to describe that heat is produced from friction	Be able to describe various ways to utilize heat from sun, fire and electricity
Introduction (Motivation/Create interest/Active prior knowledge)	Daily activities of children and relations to heat (Activity 1)	Remind previous lesson.	Remind previous lesson.
Core/Development **(Active engagement with test/task)**	Activity 2	Activity 3	Activity 4
Assessment points	**Observation of activities.** Do they participate in the learning process? Do they discuss well? Do they apply their ideas? Do they positively discover anything from the experiment?	**Observation of activities.** Do they participate in the learning process? Do they get the meaning of experiment? Do they discuss well? Do they draw conclusion? Do they positively discover anything from the experiment?	**Observation of activities.** Do they participate in the learning process? Do they discuss well? Do they apply their ideas? Do they positively discover anything from the experiment?
Adaptation of curriculum	For experiments, it is to use available materials in accordance with the region.		

Lesson Planner

Suggested period (6)	***Period 4***	***Period 5 6***
Lesson Topic	Making charcoal	***Assessment/Review***
Sample lesson plan	8-4	
Specific objective	Be able to explain how to make charcoal	
Introduction (Motivation/Create interest/Active prior knowledge)	Remind previous lesson.	
Core/Development **(Active engagement with test/task)**	Activity 5	
Assessment points	**Observation of activities.** Do they participate in the learning process? Do they get the meaning of experiment? Do they discuss well? Do they draw *conclusion*? Do they positively discover anything from the experiment?	
Adaptation of curriculum	For experiments, it is to use available materials in accordance with the region.	

Activity 1 Daily activities and heat

Teaching/learning material

Concept Our lives greatly depend on heat energy.

Encourage students to think about their daily lives and list up 10 - 15 daily activities

For example,

1. Wash face
2. Take breakfast
3. Brush teeth
4. Go to School by bus
5. Study in the classroom
6. Have a lunch
7. Go back home by bus
8. Play with friends
9. Have a tea
10. Eat dinner
11. Talk with family members
12. Listen to radio
13. Take a bath
14. Study for tomorrow
15. Go to bed and sleep

Then, ask students which activity is related to heat and mark it.
Among 15 activities, 2, 4, 6, 7, 9, 10 and 13 are related to heat. In other words, doing those activities become very difficult without heat. These activities are effective for children to realize how heat is essential to our life. After doing these activities, let's imagine the life without heat.

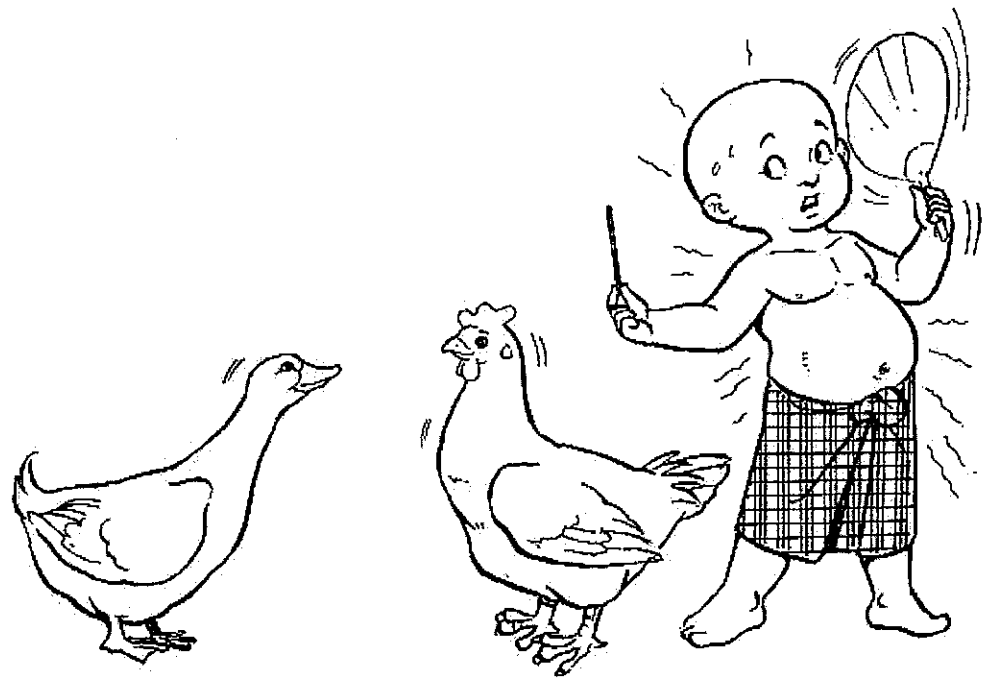
Activity 2 Heat sources

Teaching/learning material

Concept There are various heat sources.

Teacher asks children to name heat sources. After listing up their ideas, let us think why/how they generate heat.

Heat sources	How it gives heat
Candle	Burning
Charcoal stove	Burning
Kerosene	Burning
Our body	By eating food and drinking water
Electric stove	Electricity goes through the resistance
Sun	Nuclear fusion
Electric bulb	Electricity goes through the bulb



Activity 3 Heat from friction

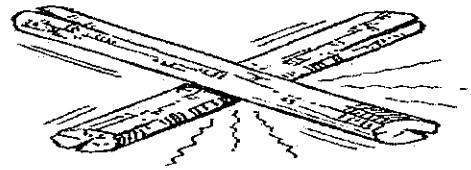
Teaching/learning material

Wooden sticks, rulers, stone, match

Concept Children experience that materials are rubbed heat is generated.

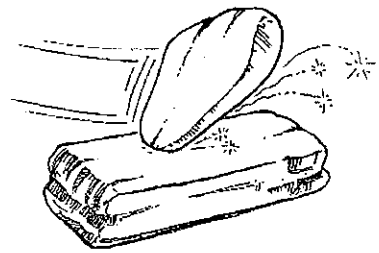
Let us rub several materials and find how hot they become.

1. Chop sticks (bamboo or wood)



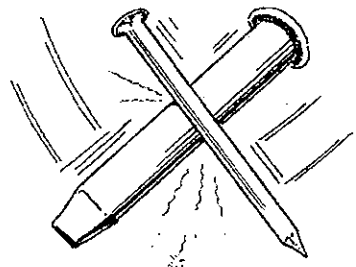
Before starting rubbing, encourage children to think what will happen after rubbing. Then, rub 2 chop sticks repeatedly for 1 minute and touch both of sticks. (do not stick your fingers to sticks since they can be very hot)

2. Stones



Children might think that stones can not be hot by rubbing. Before starting rubbing stones, ask children what will happen to stones when rubbed.
Take 2 stones and rub them for 1 minute and touch both of them for a moment. (do not stick your fingers to stones since they can be very hot) When you strongly rub/hit specific type of stones each, we can see sparks. This is also because of friction.

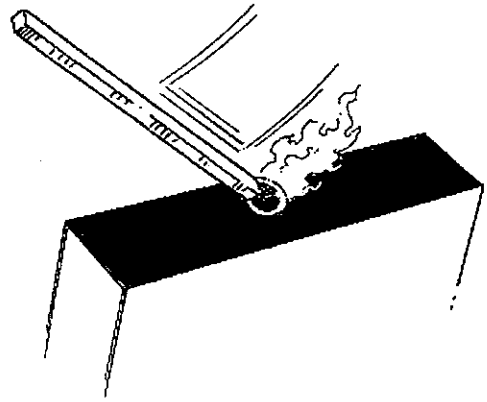
3. Metal



Metal can be heated by rubbing as well. Children rub metals and touch them.

How can a match be lit?

Let us ask children why we can light match easily.
Is that because of chemical which is put on the top? If it is only because of chemical, we should be able to light it when we touch the top of a match and the side of match box. Well, let us try to do it. Can we light it just by touching?



In fact, this is also related to friction. When we rub the top of the match with the side of box, a little amount of heat is made because of friction. The generated heat can ignite the chemical of the match. Let us feel and realize its friction when we light the match.

Activity 4 Utilization of heat

Teaching/learning material

Concept There are various ways to utilize heat.

Heat from different sources is utilized for different ways.
Let us find applications utilizing heat for our life.
Teacher encourages children to think about their life and find the applications.

The followings are the examples.

1. Heat from Fire

2. Heat from Sun

3. Heat from electrical energy

Children in group present their results of discussion.

Activity 5 Let's make charcoal

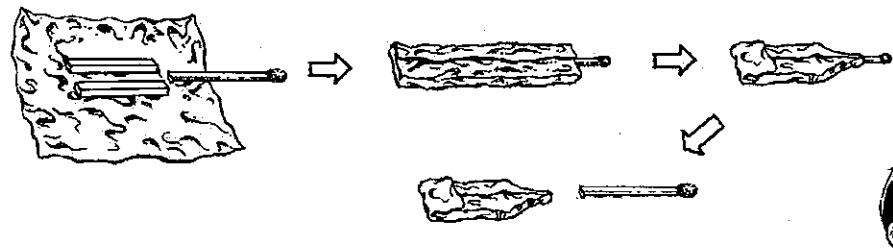
Teaching/learning material

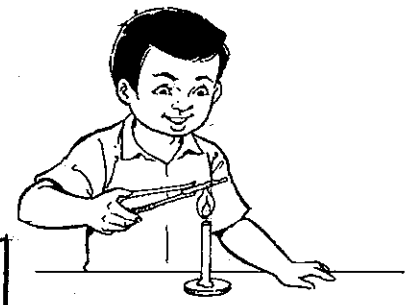
Candle, Chop stick (wood), Match, aluminum foil and forceps

Concept Making charcoal

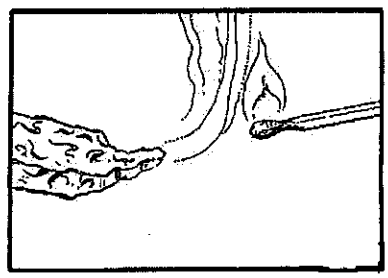
When wood is indirectly heated, it can become charcoal which is different from ash.
Wood can burn and remain ash. Let us make charcoal and compare it to ash. Be careful that heating and burning are different. In order to do the activity, teacher needs to explain the following procedure.

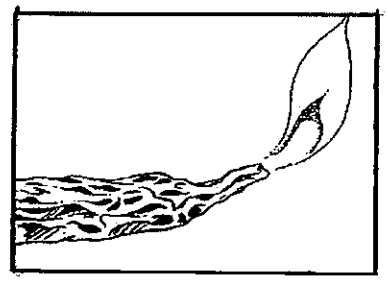
1) Ask children what will happen to wood when it is wrap with metal and heated by a candle fire
2) Let us write children ideas on a black board
3) Let us wrap the small piece of wood with aluminum foil
4) One side needs to be closed tight and the other side needs to be open. (use a match to make one side open as the diagram shows below)



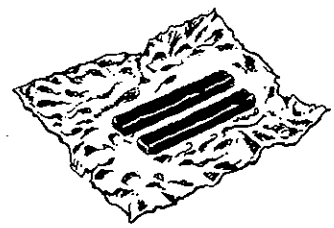


5) Pinch it with forceps and heat it with a candle fire.
6) Observe what is going on while heating
7) When you find white gas coming out, approach a lit match to it





8) Finish heating when white gas stops coming out from the foil
9) Wait until the heated object gets cooler
10) Let us open and observe how wood has changed
11) Compare it to ash (the burnt match)



When you heat, you will see the white gas coming out. This gas can burn with a red flame. Even when you burn wood, you see fire because of this white gas. In order to compare charcoal and ash, let us touch both and try to ignite both. You can see clear difference between charcoal and ash.

***When aluminum foil is not available, let us use earthenware/ceramics/china to heat wood and bamboo.**

Lesson Plan 8-1

Lesson topic: Heat sources
Learning objectives: Be able to describe that there are various sources of heat and explain how they generate heat.
Teaching/learning materials:
Teaching period: 35 minutes

Teaching/Learning procedure

Learning Activities	Time	Teaching/ Learning Materials	Points to be Noticed
Introduction (refer to Activity 1) *Ask children to think of their daily activities from morning to night.* Each student thinks about at least 12-15 activities and makes the list like below. 1) wash the face 2) brush the teeth 3) eat breakfast 4) go to school by bus 5) learn the lessons 6) eat lunch 7) play with friends 8) come back from school by bus 9) take a bath 10) eat dinner 11) watch TV 12) study 13) go to bed	10		Each child is supposed to write down their activities in his/her notebook Let them recognize that foods can be cooked and eaten by the heat
Development Then, teacher ask children which activity among above requires heat. Children are supposed to count the activities which are related to heat. For example, among 13 activities in the list above, 3) 4) 6) 8) 9) and 10) require heats. If it is in very cold area, 1) also requires heat and they always need heat stove for most of the activities. *Through this activity, children realize that heat is essential for human life.*	10		
The teacher will continue to ask children the following question. Question: From which places can heat be obtained? **(refer to Activity 2)** Tell the materials that can get heat from one's environment. Let the children think and guess the above question in groups and let them express their opinions. Then the following table is made and let the children bring out the answer.	5		

Learning Activities	T	Teaching/ Learning Materials	Points to be Noticed

The place where heat is obtained (heat source)	How heat is produced?
1. Sun	Nuclear fusion
2. Candle	Burning of wax
3. Kerosene stove	Burning of kerosene
4. Electric stove	Conduction of electricity
5. Charcoal stove	Burning of charcoal
6. Bulb	Conduction of electricity
7. Firewood fire	Burning of firewood
8. Human body	Chemical reaction
-	--
-	-
-	-
-	-

5

Conclusion.

Our life is greatly dependent on heat and there are various heat sources in our life. It is also important for children to know how those heat sources generate heat.

5

Lesson Plan 8-2

Lesson topic: Friction makes heat
Learning objectives: Be able to describe that heat is produced from friction
Teaching/learning materials: Wooden rods, pebbles, matches
Teaching period: 35 minutes

Teaching/Learning procedure

Learning activities	Time	Teaching /learning materials	Points to be noticed
Introduction.	5		
You have already known the various sources of heat in the previous lesson. Tell as much as you remember.			Each child will be asked.
Development (refer to Activity 3)			
This lesson will make experiments on why the heat is produced. If the two wooden rods are rubbed at the same place for several times, what will happen to the place where it is rubbed?	5		Children's answers will be recorded.
Children will give various answers such as ('it will become hot'.....) The teacher continues to ask, if the place where it is rubbed becomes hot 1. will only one wooden rod become hot? 2. will both wooden rods become hot? 3. what else can happen? Let the children think and guess the above questions and let them express their opinions.			
Then the teacher will ask to do the following experiments.			It is much better if the wooden rods are chopstick sized.
Activity A *Teacher will give the wooden rods through group leaders* and tell the requirements. - hold and feel the two wooden rods before they are rubbed. - rub these two wooden rods several times. - hold and feel the place where the two wooden rods are rubbed. How do you feel? Why?	5	Chop stick-sized wooden rods.	In rubbing the two wooden rods it is to rub at the same place closely for several times. Let the children recognize that the two places where they are rubbed and become hot.
Then, the children will be asked to do experiment and let them present their findings according to group. Findings - If the two wooden rods are rubbed, the places where they are rubbed become hot. Therefore, heat is produced when objects are rubbed.			

Learning activities	Time	Teaching/ Learning materials	Points to be noticed
Activity B Teacher will distribute the pebbles through group leaders and tell the requirements. - hold and feel the pebbles before they are rubbed. - rub the two pebbles several times. - hold and feel the places where they are rubbed. How do you feel? Why? Then, have the children do the experiment and let them present their findings according to group. Findings. When the two pebbles are rubbed, the places where they are rubbed become hot. Smells come out and sparks occur at times. Therefore, heat is produced when objects are rubbed.	5	Pebbles	The pebbles must be firm and hard. In rubbing the two pebbles, it is to rub at the same place closely for several times. Let the children recognize that the two places where they are rubbed become hot.
Activity C Teacher will distribute box of matches through group leaders and tell the requirements. - Have the tip of the matchstick rub against the lateral lip of the matchbox. What will happen? Why? Then, children will be asked to do experiment and let them present their findings group-wise. Findings - When the tip of the matchstick is rubbed against the lateral lip of the matchbox, it will become hot and then it will catch fire.	10	Box of matches	The two lateral lips of the matchbox and the tip of the matchstick are made up of flammable chemical substance When the tip of the matchstick is rubbed against the lateral lip of the matchbox, it will become hot and it will catch fire due to the flammable chemical substances. When the tip of the matchstick only touches the lateral lip of the match box the heat won't come out and the flammable chemicals won't catch fire. Do not light a match near the face and do not play with fire, as it is dangerous. Let the children recognize the above facts.
Conclusion Heat is obtained from rubbing one object with another object. In the ancient times man use fire by this method. According to the findings from activities and discussion, make sure that children understand **Heat is obtained by rubbing one object with another object.**	5		

Lesson Plan 8-3

Lesson topic: Utilization of heat
Learning objectives: Be able to describe various ways to utilize heat from sun, fire and electricity
Teaching/learning materials:
Teaching period: 35 minutes

Teaching/Learning procedure

Learning activities	Time	Teaching/ Learning materials	Points to be noticed
Introduction As you know, we greatly benefit by utilizing heats from various sources. Today, let us think how we utilize them in our daily lives.	5		
Core/Development (refer to Activity 4) Let us do this as group work. Each group discuss about three questions below and make lists of the utilization.			
1. Let us start to think about utilization of heat from fire since it is so common to us.	5		Encourage children to speak their ideas.
Each group select the presenter from them. The presenter reports the result of the group discussion.	5		Encourage children not to copy what other group say.
2. Then, let us mention utilization of heat from sun. This is very common as well.	5		
Each group select the presenter from them. The presenter reports the result of the group discussion.	5		
3. How about the utilization of heat generated by using electricity?	5		
Each group select the presenter from them. The presenter reports the result of the group discussion.	5		
Conclusion Teacher is supposed to put all ideas from children together and fill them into the table shown right. Make sure that children realize that there are so many various utilizations of heat around our life. It is good for children to describe those examples of utilization as well.			

Utilization of heat from fire	*Utilization of* heat from sun	*Utilization of* heat made with electricity

Lesson Plan 8-4

Lesson topic:	Making charcoal
Learning objectives:	Be able to explain how to make charcoal (Understanding difference between ash and charcoal)
Teaching/learning materials:	Candle, chopstick(or tooth pick), match, aluminum foil, candle, forceps (or anything which can pinch things)
Teaching period:	35 minutes

Teaching/Learning procedure

Learning activities	Time	Teaching/ Learning materials	Points to be noticed
Introduction Today, we are going to make charcoal which is one of very common heat sources. Have you ever seen somebody making charcoal? How was she/he making it?	5		Encourage children to speak whatever they know.
Development (refer to Activity 5) In order to make the piece of wood (toothpick or chopstick) into charcoal, we use these materials (candle, aluminum foil and wooden stick).			Instead of wooden stick, we can use bamboo stick as well.
Teacher explains and shows how to conduct the activity with those materials. The steps for the activity are the followings. 1) Wrap the wood rod with aluminum foil 2) Close one end of the foil and open the other end. 3) Light the candle and Hold the wood with the forceps 4) Heat the wood with fire of candle. 5) Observe what is coming out from the opened end of foil while heating (white gas is coming out) 6) Approach the fire of candle to the gas coming out from the opened end. 7) Observe what is happening 8) Stop heating when no more gas is coming out. 9) Cool it down enough in the air and open it 10) Observe what is inside.	5 10	Wood stick (about the size of a tooth pick) Aluminum foil, candle, lighter, and forceps. If aluminum is not available, local earthenware/ ceramics can be used instead.	Teacher better demonstrate in front of children before they try. Children will conduct the activity after careful explanation/demonstration of teacher. If the wooden rod is lit with the fire of candle, it will burn and become ashes. If it is covered with metal and heated with the fire of candle, it becomes charcoal. (Inside rod is strongly heated, but does not burn.)
Let us compare ash (for example, used match) and what remained inside of the foil. Both are black in color, but they look different. Let us burn both. Nothing will happen with ash, but burning will be started with charcoal (what is remained).	10		White gas from the wood can burn, which does not, however, mean that the wood inside is burning.
Conclusion Teacher concludes this lesson by saying that **wood/bamboo become charcoal when it is strongly heated.**	5		Usually, to make charcoal, big oven is used. **Do not get confused with heating and burning. They are different!!**

Assessment

Point of Assessment

Interest/Attitude/ Motivation	Scientific thinking	Technique	Knowledge and understanding
Is s/he interested in heat and its utilization? Is s/he motivated to create utilization of heat? Does s/he has attitude to try to save limited energy? Does s/he appreciate the benefits from sun and other heat sources?	Does s/he think of close relation between our life and heat? Does s/he think of huge amount of heat energy from sun? Does s/he find heat sources in our life? Does s/he compare the charcoal and ash to find differences?	Does s/he properly rub materials and detect the heat made from friction? Can s/he heat the materials with properly using forceps? Can s/he precisely observe the experiment and record it?	Does s/he understand there are various heat sources? Does s/he understand we utilize heat in many ways?

Oral Assessment/Group Discussion

1) What is the most important heat source to human?
2) Mention your daily activities which require heat.
3) If you do not have anything to ignite, how would you make fire?
4) How is heat from fire used?
5) How is heat from the sun used?
6) Mention how we need to utilize heat from fire.

Written Assessment.

1) Write down the various heat sources and explain how they generate heat.
2) What will happen to you when sun burns out?
3) What will happen when a plastic ruler is rubbed on a table at the same place for several times? Why?

Message to Teachers

Encourage children to answer questions by thinking with knowledge they obtained in this topic. Let us avoid giving questions just to test if they memorize something or not.