Topic 5 : Properties of matters

1. Key concept	Matters expand when heated, and contract when cooled down
2. *Learning objective*	
General	To be able to understand that matters expand when heated, and contract when cooled down
Specific	1) To be able to explain that the volume of solid expands when it is heated and contract when it cools down. 2) To be able to explain that the volume of liquid expands when it is heated and contracts when it cools down. 3) To be able to explain that the volume of gas expands when it is heated and contracts when it cools down.
3. Activities involved	Experiment on heating and cooling of a metal ball. Experiment on heating and cooling of water. Experiment on heating and cooling of air inside the bottle.
4. Activity purpose	It is expected that while carrying out the experiment the children will develop their scientific way of thinking and techniques. Moreover they will understand the concept of matter expands when heated and contracts when cooled down.

Before Getting Started

Self-check list for Teachers	☐ Do I understand reversible change in matters? ☐ Do I understand expansion and contraction of matters?
Background information for teachers	Substances expand when they are heated- their volume increases as temperature rises. This effect is reversible, since substances contract when they are cooled.
Solids	A meter-long iron bar expands by around one- hundredth of a millimeter for each degree Celsius rises in temperature. One kilometer of railway line expands by almost 50 centimeters when a hot day follows a frosty night. This is why railway line must have occasional sliding joints to prevent the rails from buckling. Rapid heating can cause glass dishes to crack as they expand unevenly.

Liquids

For a given change in temperature, most liquids expand or contract around one thousand times more than solids. Water is unusual-it contracts as the temperature rises from 0 C to 4 C. This is due to a change in the structure of water.

Gases

Gases compress more easily than liquids and solids. This is because there is more space between their particles. For this reason, the volume of a gas is measured at a fix pressure, usually the average pressure of Earth's atmosphere at sea level. When this is done, most gases expand by the same amount for each degree rises in temperature. In fact, the increase in proportion to its temperature above absolute zero, or -273 C.

As day and night alternate, Earth's atmosphere heats and then cools. Hot air rises because its density is less than cold controls Earth's weather patterns.

Lesson Planner

Suggested 8 period	Period 1	Period 2 and 3	Period 5 and 6	Period 4 7 8
Lesson topic	Expansion of Solid	Expansion of Liquid	Expansion of Gas	
Sample lesson plan	5-1	5-2	5-3	
Specific objective	To be able to explain that the volume of solid expands when it is heated and contract when it cools down	To be able to explain that the volume of liquid expands when it is heated and contracts when it cools down	To be able to explain that the volume of gas expands when it is heated and contracts when it cools down	Assessment/ Reiew
Introduction (Motivation/Create interest/Active prior knowledge)	Recall their prior knowledge from G3, there are3 states in matters: solid; liquid; & gas. Find out the matters in the environment exist in three states, especially *solid.*	Recall their prior knowledge from G3, there are3 states in matters: solid; liquid; & gas. Find out the matters in the environment exist in three states, especially *liquid.*	Recall their prior knowledge from G3, the existences of air. Find out the air or gas which is existences in the surrounding environment.	
Core/Development (*Active engagement with* test/task)	Teachers explain how to carry out the experiment. Let children think after heating what will happen to the ball. Children carry out the experiment. Find out why the metal ball can not go through the ring. *Activity 1*	Teachers explain how to carry out the experiment. Let children think after heated what will happen to the water level (liquid)? & keep tally. Children carry out the experiment. Find out why the water level rises? Find out why the water level is getting low? Activity 2,3,4, and 5	Teachers explain how to carry out the experiment. Let children think what will happen to the bottle (air inside)? & keep tally. Children carry out the experiment. Find out why the air bubbles come out from the orifice of the bottle? Find out why the water enter the bottle. Activity 6 & 7 or 8 & 9.	
Assessment points	Do they participate in the learning process such as predicting what will happen to the ball after heating ? Doing experiment and find out what will happen to the heated ball? Do they understand how to carry out the experiment? Do they understand when solid is heated, its volume expands? & *contracts when it cools* down?	Do they participate in the learning process such as predict what will happen to the water level? Find out why the water level rises or falls? Do they understand how to carry out the experiment? Do they understand when liquid is heated, its volume expands and when *liquid is cooled down its* volume contracts?	Do they participate in the learning process such as predict what will happen to the bottle? Find out why the air bubbles come out from the bottle and why does the water enter into the bottle? Do they understand how to carry out the experiment? Do they understand when *air (gas) is heated its* volume expands and when air (gas) is cooled down its volume contracts?	
Adaptation of curriculum	Any Experiment which is relevant to the matter expansion and contraction can be used.			

Activity 1 Expansion and contraction of Solid

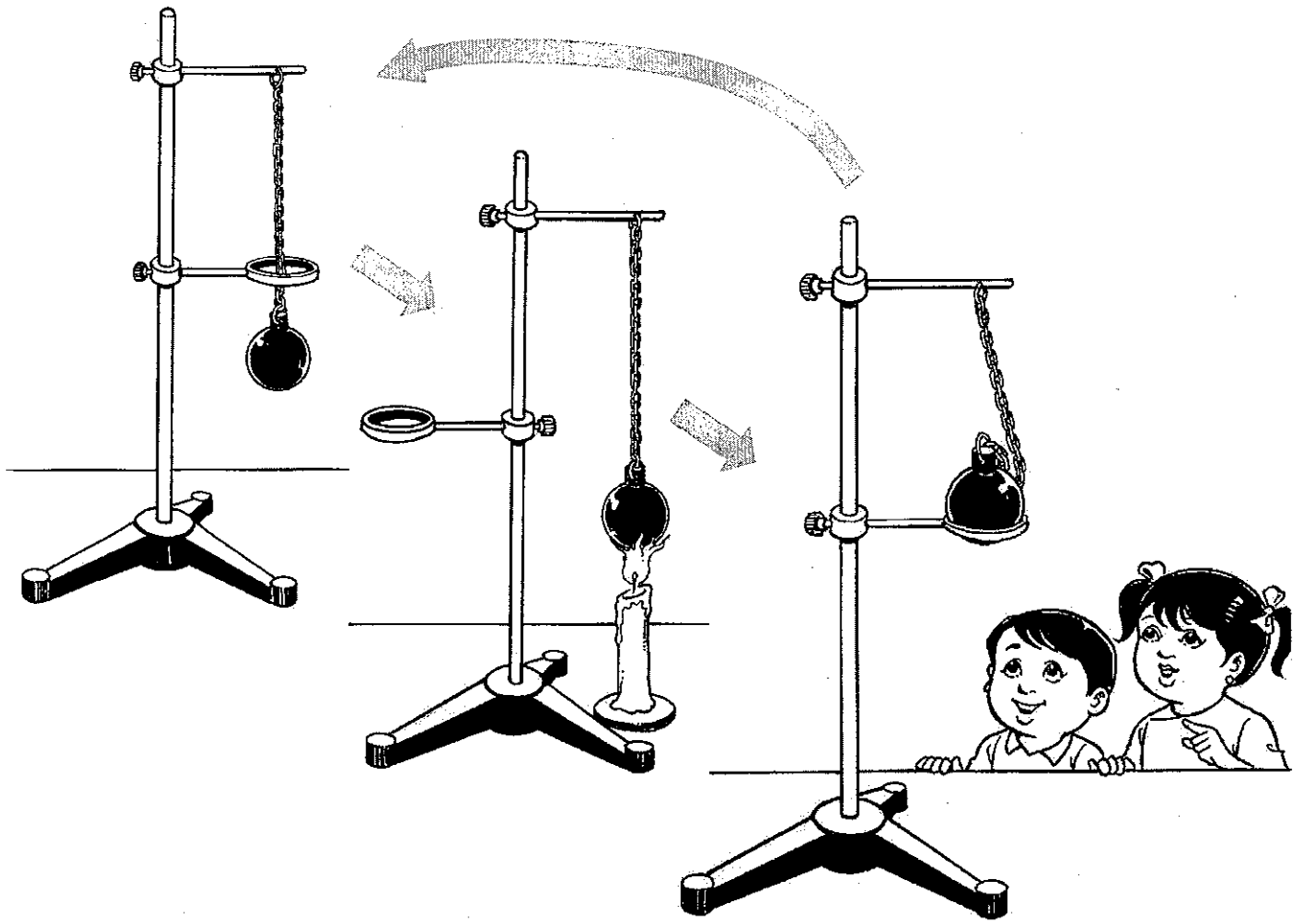
Teaching/learning material

	A metal ball and metal ring with the stand, and candle (any heat source)
Concept	Solid can be expanded when it is heated and contracted when it is cooled down.

Let us heat the metal ball and observe if it expands its volume.

1. Make sure that the metal ball can go through the metal ring smoothly
2. Let us heat the metal ball with a candle for 5 minutes. Do not touch the metal ball since it becomes very hot.
3. Try to pass the ball through the ring. Does it go through the ring? If not, we can say that the ball gets bigger after being heated. If the ball still goes through the ring, let us heat it again for another 5 minutes or you may use stronger heat source.

4. Be careful with the heated ball and wait for it cooling down.
5. Make sure that the temperature of the ball becomes normal and try to get the ball through the ring again. Does it get through? After cooling down, the expanded ball returns to the size before being heated. As a result, the ball can go through the ring again.



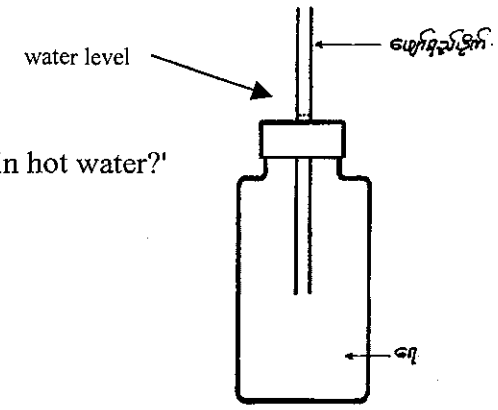
Activity 2 Expansion and contraction of Liquid 1-1

Teaching/learning material

A small bottle, straws , coffee cups, warm water

Concept Let children predict what will happen if liquid is heated or cooled down

Let us prepare the activity material.
1. Make a hole at the center of the cover(cap) of the bottle.
2. Get the straw through the hole and fix it with glue.
3. Put water in the bottle to the full and close it with the cover with straw. (make sure that there is no air inside of the bottle after closing)



BEFORE EXPERIMENT
Teacher explains that put two bottles into hot water
Teacher asks children 'What will happen if you put them in hot water?'
Teacher writes following answer on the black board

- Case with water -
1. Water level in the straw rises
2. Water level stays the same
3. Water level goes down

Teacher asks children to raise hands for the answer they predict.

Teacher writes down the number of children.
Teacher asks the reason why they think so, individually.
After that teacher asks again about children's prediction. Teacher writes down the number of children.

Teacher asks children 'Then what will happen if you put them into cold water?'
Teacher writes following answer on the blackboard

1. Water level in the straw rises
2. Water level stays the same
3. Water level goes down

Teacher asks children to raise hands for the answer they predict.

Teacher writes down the number of children. Teacher asks the reason why they think so, individually. After that teacher asks again about children's prediction.
Teacher writes down the number of children.

Activity 3 Expansion and contraction of Liquid 1-2

Teaching/learning material

A small bottle filled with water, straws, coffee cups (two for each group), warm water

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Concept Liquid can expand when it is heated and contracted when it is cooled down

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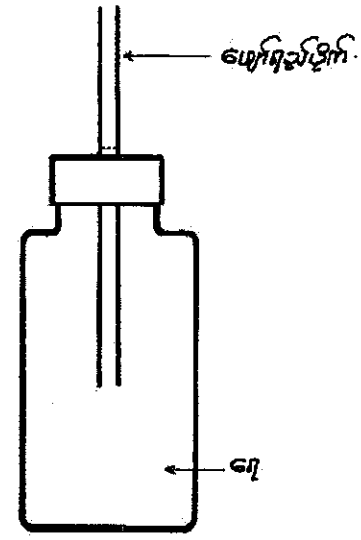
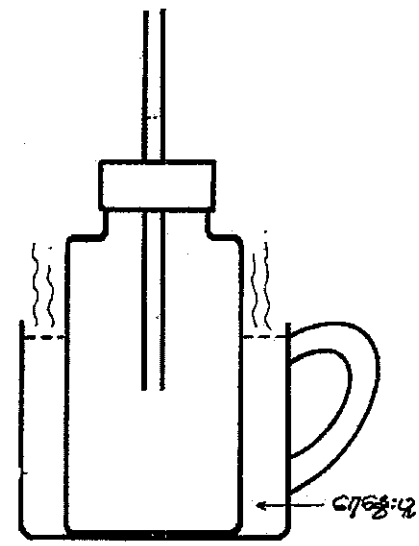
Teacher distribute the bottles with straws to students



Teacher asks children to put the bottle into hot water in the Coffee cup. Children wait for 5-10 minutes and observe the water level in the straw. After experiment, teacher asks the result. (The water level goes up, because the volume of water is expanded.)

Next teacher asks children to put the bottle into cold water. Children wait for 5-10 minutes and find the result. After experiment, teacher asks the result.



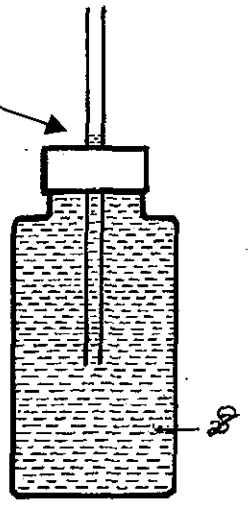
Activity 4 Expansion and contraction of liquid 2-1

Teaching/learning material

Small bottle, straws, coffee cups, warm water, cooking oil

Concept Let children predict what will happen if liquid is heated or cooled down

Let us prepare the activity material.
1. Make a hole at the center of the cover (cap) of the bottle.
2. Get the straw through the hole and fix it with glue.
3. Put oil in the bottle to the full and close it with the cover with straw. (make sure that there is no air inside of the bottle after closing)



BEFORE EXPERIMENT
Teacher explains that put two bottles into hot water
Teacher asks children 'What will happen if you put them in hot water?'
Teacher writes following answers on the black board.

- Case with oil -
1. Oil level rises
2. Oil level stays the same
3. Oil level goes down

Teacher asks children to raise hands for the answer they predict.

Teacher writes down the number of children.
Teacher asks the reason why they think so, individually.
After that teacher asks again about children's prediction.
Teacher writes down the number of children.

Next teacher asks children 'Then what will happen if you put them in cold water?'
Teacher writes following answers on the black board.

1. Oil level rises
2. Oil level stays the same
3. Oil level goes down

Teacher asks children to raise hands for the answer they predict.

Teacher writes down the number of children.
Teacher asks the reason why they think so, individually.
After that teacher asks again about children's prediction.
Teacher writes down the number of children

Activity 5 Expansion and contraction of Liquid 2-2

Teaching/learning material

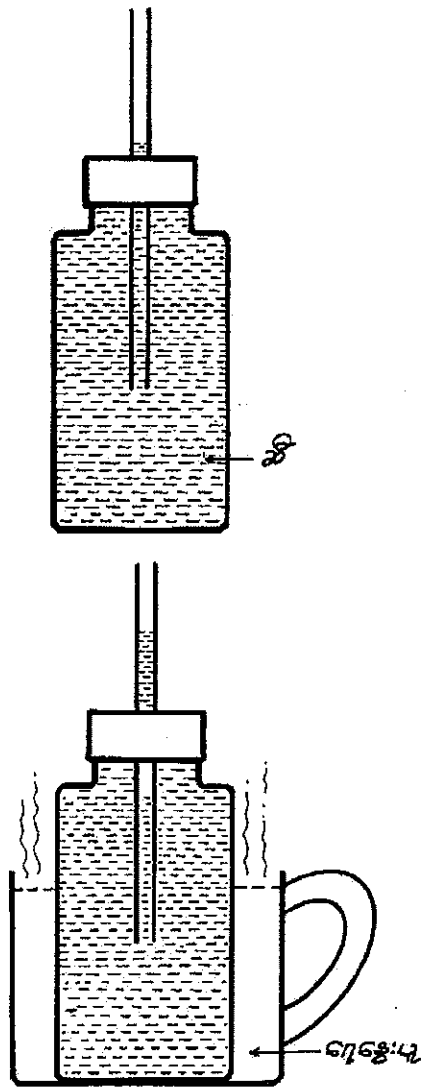
A small bottle (one for each group) filled with cooking oil, straws, coffee cups (two for each group), and hot water.

Concept	The volume of liquid can expand when heated and contracted when cooled down

Teacher distribute following things.

Teacher asks children to put bottle into hot water.
Children wait for 5-10 minutes and find the result.
After experiment, teacher asks the result.

Next teacher asks children to put bottle in cold water.
Children wait for 5-10 minutes and find the result.
After experiment, teacher asks the result.



Activity 6 Expansion and contraction of Air 1-1

Teaching/learning material

	Empty bottle, hot water, towel, water, 2 coffee cups
Concept	Let children predict what will happen if air is heated or cooled down (prediction)

BEFORE EXPERIMENT
Teacher asks children
'What is in the bottle?'
'What will happen if you cover the bottle with the hot towel?'
'Will air become hotter?'
'Then what will you see after sometimes?'
Teacher writes the following answers and picture on the black board.

1. Bubbles will come out
2. Water level rises
3. Nothing happens

Teacher asks children to raise hands for the answer they predict.

Teacher writes down the number of children.
Teacher asks the reason why they think so, individually.
After that teacher asks again about children's prediction.
Teacher writes down the number of children.

Next, teacher asks children
'What will happen if you pour cold water over the bottle?'
'Will air become cooler?'
'Then what will you see after sometimes?'
Teacher writes the following answers and picture on the black board.

1. Bubbles will come out
2. Water level rises
3. Nothing happens

Teacher asks children to raise hands for the answer they predict.

Teacher writes down the number of children.
Teacher asks the reason why they think so, individually.
After that teacher asks again about children's prediction.
Teacher writes down the number of children.

Activity 7 Expansion and contraction of Air 1-2

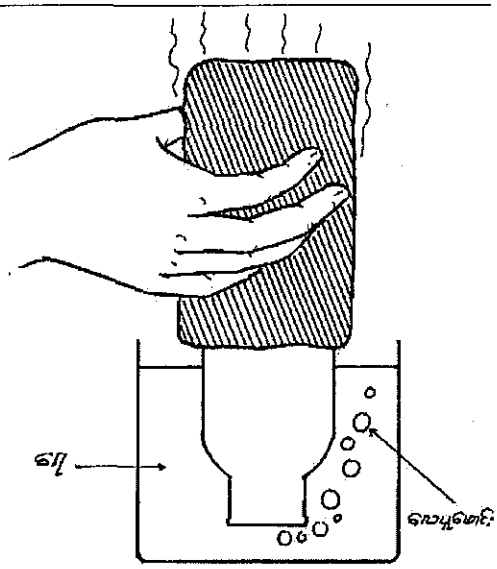
Teaching/learning material

Empty bottle, hot water, towel, water, 2 coffee cups

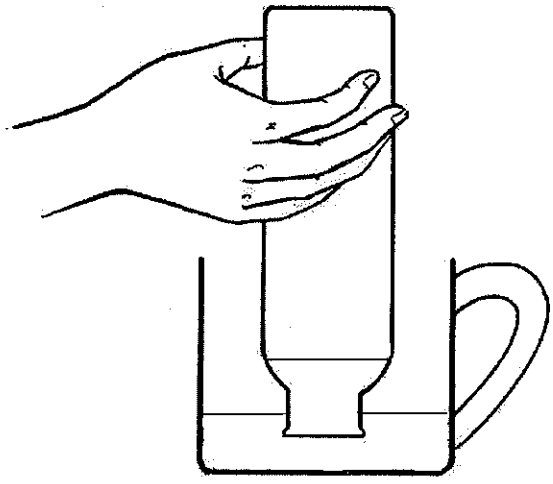
Concept	The volume of gas can expand when heated and contracted when cooled down

Teacher distribute following things.

Teacher asks children to put bottle into water as the diagram shows.
And wrap the bottle with the towel soaked in the hot water.
Children observe what will happen to the bottle.
After experiment, teacher asks the result.



Next teacher asks children to remove the towel and keep the bottle as it is. Then, pour cold water onto the bottle. Children observe what happens to the bottle.
After experiment, teacher asks the result.



Activity 8 Expansion and contraction of Air 2-1

Teaching/learning material

Soap water (washing powder water), bottles, coffee cups, hot water, cold water

Concept

Let children predict what will happen if air is heated or cooled down (prediction)

Teacher prepares an empty bottle, soap, hot water and water in coffee cups.

BEFORE EXPERIMENT
Teacher explains that covering bottle with hot water
Teacher asks children
'What is in the bottle?'
'What will happen if you cover the bottle with hot towel?'
'Will air become hotter?'
'Then what will you see after sometimes?'
Teacher writes the following answers and picture on the black board.

1. Bubbles will come out
2. Water level rises
3. Nothing happens

Teacher asks children to raise hands for the answer they predict.

Teacher writes down the number of children.
Teacher asks the reason why they think so, individually.
After that teacher asks again about children's prediction.
Teacher writes down the number of children.

Next, teacher asks children
'What will happen if you cover the bottle with cold towel?'
'Will air become cooler?'
'Then what will you see after sometimes?'
Teacher writes the following answers and picture on the black board.

1. Bubbles will come out
2. Water level rises
3. Nothing happens

Teacher asks children to raise hands for the answer they predict.

Teacher writes down the number of children.
Teacher asks the reason why they think so, individually.
After that teacher asks again about children's prediction.
Teacher writes down the number of children.

Activity 9 Expansion and contraction of Air 2-2

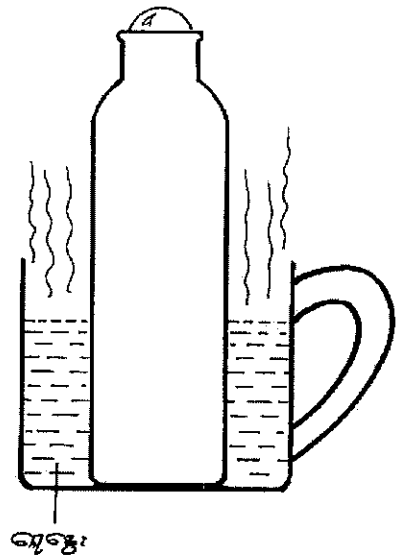
Teaching/learning material

Soap water (washing powder water), bottles, coffee cups, hot water, cold water

Concept

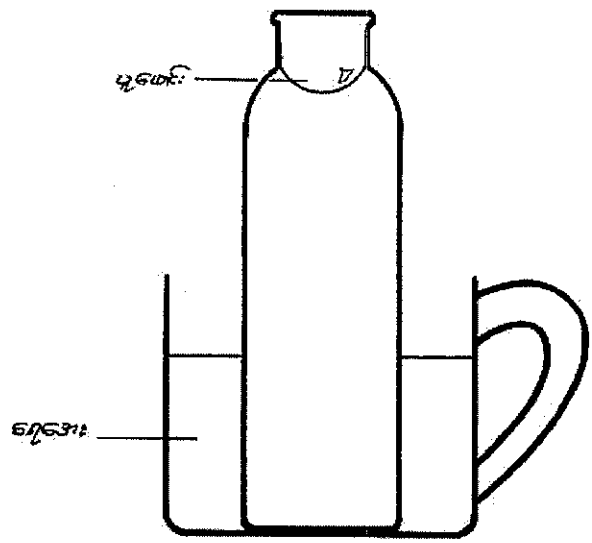
The volume of gas can expand when heated and contracted when cooled down

Teacher distributes all materials children need.



Teacher asks children to put soap water on the top of the bottle and make a film on the top. Teacher then asks children to put the bottle in the hot water in the coffee cup. Encourage children to observe what happens to the film of soap water. After experiment, let us ask children what happened and why that happened.

Make sure that there is still a film of soap water on the top. If not, make one on it again. Teacher asks children to put bottle in cold water. Let us see what happens.
After experiment, teacher asks children what happened and why that happened.



Lesson Plan 5-1

Lesson topic: Solid expansion and contraction

Learning objectives: *To be able to explain that the volume of solid expands when it is heated and contract when it cools down.*

Teaching/learning materials: A metal ball and a metal ring installed on a stand. Candle (objects that can give heat) and lighter.

Teaching period: 35 minutes

Teaching/Learning procedure

Learning activities	Time	Teaching/learning materials	Points to be noticed.
Introduction It will begin with the question. - It has already been taught in the third grade that objects in the environment exist in three states. - The question, 'do you know the three states,' will be asked. - It will bring out that objects in the environment exist in solid, liquid and gas states. - Ask them to tell some solids. Cork, plastic, rubber. - Which solid do you think will be hot when heated? - Which solids will expand when heated?	5		Teacher lets children discuss and waits for the answer. If they cannot answer teacher has to lead and bring out. Time must be given to think and discuss. Let the children raise their hands for the answers they think and count the number of children.
Development (refer to Activity 1) Teacher explains the procedure of experiments. Teacher puts the metal ball inside the metal ring. Teacher will ask, 'what do you think will happen to the metal ball when it is heated with a candle?' Teacher will describe three answers and let the children guess and select. (1) the metal ball will be bigger (2) the metal ball will be smaller (3) the metal ball will not change Teacher will ask children the reason why they think like that.	10	Metal ball and metal ring installed on a stand, candle.	Let each representative from the group answer. Not to touch the ball when it is heated since it is very hot.
Having to do experiment. Teacher distributes the materials to carry out experiment to children and tells the steps of the experiment. Make sure that the metal ball put into the metal ring before it is heated. **Heating** Take the metal ball away from the metal ring and heat it (for about 5 minutes) and let us try to let the ball enter the ring. - Ask, 'what do you find when the metal ball is put into the metal ring after it is heated'. - Ask, 'why can't the metal ball put into the ring'. Teacher will write the children's answer on the blackboard.	10		If the metal ball cannot pass into the ring, it is to heat again another 5 minutes. Let each representative of the group answer the fact found from experiment. Let each child tell his/her opinion.

Learning activities	Time	Teaching/learning materials	Points to be noticed.
Cooling - Cool down the metal ball. (Put it into the cold water) - After it is cooled down, the metal ball will pass into the metal ring. - The metal ball can pass after it is cooled down because it is getting small and ask 'why is it getting small' Teacher will write down the children's answer on the blackboard.	5	Water	Be careful for the heated ball.
Conclusion From all the answers obtained from children on the whole, teacher will ask children tell the correct concept. When a solid is heated, its volume expands. When it is cooled down, it contracts.	5		It is important for teacher to say that not only metals but also other solids can expand and contract.

Lesson Plan 5-2

Lesson topic: Before and after heating conditions of the matters

Learning objectives: To be able to explain that the volume of liquid expands when it is heated and contracts when it cools down

Teaching/learning materials: Small bottles with narrow orifice filled with water, straw, candles, lighter, empty tin to be used as a small stove, and bowls or cups filled with water

Teaching period: 70 minutes (2 periods)

Teaching/Learning procedure (First period – 35 Min.)

Learning activities	Time	Teaching/ Learning Materials	Points to be noticed
Introduction - Introduce with question - In Grade Three, it has already been taught that the matters in the environment exist in three states. - Ask," Do you know these three states?" - Find out the matters in the environment exist in three states of solid, liquid and gas.	5		Have the children discuss among them and wait for the answer. If they cannot answer, teacher has to lead to find out.
Development (refer to Activity 2 and 3) 1. Teacher tells that experiment on liquid will be carried out. - Teacher tells the procedure of experiment. - Show the water level found in the straw after filling the glass bottle with water. - Ask, "What do you think the water level will happen when the bottle is heated by the flame of candle? - Express three answers and have the children guess and choose the correct answer. (1) The level of water will rise (2) The level of water will become low. (3) The level of water will still be in its original position. - Teacher asks the children why they think so. 2. Have the children carry out the experiment - Teacher distributes the materials for the experiment. - Tell the procedure of the experiment. - Mark the water level in the straw before heating - Heat the bottle - Observe the water level in the straw while heating. - Ask the children what they found after the experiment. - If they answer the water level in the straw rises, ask," Why does the water level rise? - Write the answer of the children on the blackboard.	10. 15 3 2	Water- filled bottles with narrow orifice, straws, candles, a small stove made of empty tin Water-`filled bottles with narrow orifice, straws, candles, stove made of empty tin, lighter	Draw the picture on the black board Give children enough time to think. - Have the children raise their hands to express the answer they guess and count the number. Have one student of each group answer after discussing within the group. To blow the flame of candle out after children have observed the water level rising. Have each representative of each group answer the result of the experiment. Have each child tell his guess.
Conclusion - Teacher tells the correct concept covering the whole children's answers. - When liquid is heated, its volume expands. - Therefore, the water level of the straw put into the bottle rises.			

Learning activities	Time	Teaching/ Learning Materials	Points to be noticed
2nd teaching period (35 Min.) refer to Activity 4 and 5			
3. Have the children guess the answer before making the 2nd experiment. - Teacher tells the procedure of the experiment. - What will happen when the heated bottle in the 1st experiment cools down in the water of the bowl? - Have the children guess and choose the correct one after giving three answers. (1) Water level will rise. (2) Water level will become low (3) No changes. - Teacher asks the children why they guess so.	10 5	The heated water-filled bottle with narrow orifice into which a straw is put, water bowl	To draw the picture on the blackboard. To ask the children after giving enough time to think Have the children raise their hands to express the answer they guess and count the number.
4. Making experiments on their guess - Teacher distributes the water bowls to the children for the experiment. - Tell the points to be carried out. - Mark the water level in the straw put into the heated bottle - Put the bottle into the water of the plastic water bowl. - Observe the water level in the straw. - Ask the children what they found after the experiment. - If they answer that the water level in the straw becomes low, ask why the water level becomes low. - Write the children's answer on the blackboard.	15	Heated water-filled bottle with narrow orifice fixing a straw in it, plastic water bowl filled with water	Have one representative of the group tell after discussing in the group
Conclusion Teacher tells the correct concept overall the children's answers. -When the hot bottle cools down, the volume of the water inside the bottle contracts. Therefore, the water level in the straw becomes low.	5		Have each representative of the groups tell the result of experiment. Have the children discuss by the groups and let each child tell what s/he guesses.

Lesson Plan 5-3

Lesson topic: Before and after heating conditions of the objects

Learning objectives: To be able to explain that the volume of gas expands when it is heated and contracts when it cools down

Teaching/learning materials: Empty soda bottles, big plastic water bowl, flask, bucket or basin filled with water, thick towels, and glasses

Teaching period: 70 minutes

Teaching/Learning procedure **First Period (35 min.)**

Learning Activities	T	Teaching/ Learning Materials	Points to be noticed
Introduction - Show an open bottle to the children and ask the question. - What is inside the bottle? - *Find out until they answer "there is air in it".* - Find out that air can also be called gas. - Tell that it has already been taught in Grade three that there are many kinds of gas like air and the experimentation on the air in the bottle will be carried out.	5	An open empty soda- bottle	Have each child answer the question.
Development (refer to Activity 6 and 7) **1. Guessing** - Teacher tells the procedure of experiment. (a) Put an open bottle with narrow orifice into the water of the bowl in upside down position and hold it. But care should be taken not to touch the orifice of the bottle with the bottom of the bowl. - Immerse the thick towel in the hot boiled water and squeeze out the water and cover it over the bottle. Then ask, What will happen? (1) Water will enter the bottle. (2) Water will remain in its original position. (3) Air bubbles will come out from the orifice of the bottle. - Express three answers and have the children raise their hands to show the answer they guess and count *the number of students.* - Divide the children into three groups in accord with the answer shown by raising their hands respectively. - Ask each group for the answer they choose why they think so. (b) Have them continue guessing on the second experiment. - Ask, What will happen if cold water is poured onto the bottle covered with the hot towel in the 1st experiment. (1) Water will enter the bottle. (2) Water will remain in its original position. (3) Air bubbles will come out from the orifice of the bottle.	15	Draw three pictures on the blackboard	Have the children answer the question only after thinking. Have the children *discuss by groups and* each representative of the groups has to answer.

Learning Activities	T	Teaching/ Learning Materials	Points to be noticed
- Express three answers and have the children raise their hands to show the answer they guess and count the number of students. - Teacher divides the children into three groups. - Ask each group why they think so.	15	Draw three pictures on the blackboard	Have the children answer the question only after giving time to them for thinking.
2. Tell children to make the experiment for their guesses. - Distribute the experimental materials for every step of the experiment repeatedly. - Tell the procedure of experiment.	20		Have the children discuss by groups and each representative of the groups has to answer.
(a) Put the bottle into the water of the bowl in upside down position. - Care should be taken not to touch the bottle with the bottom of the bowl. - Cover the towel that is squeezed after immersing in the hot boiled water over the bottle and hold it. - Observe what will happen in the water bowl and in the bottle. - Ask what they found out - If they answer that air bubbles come out from the orifice of the bottle,		Bottles, big bowl filled with water, towel immersed in the hot boiled water	At first, teacher has to demonstrate the experiment. - Have them take the water bowl first. - Have them take the glass bottle next time. - Teacher has to distribute the towels immersed in the hot boiled water by him/herself.
(b) Continue making the second experiment. - Remove the hot towel from the bottle and pour the cold water onto the bottle. - Observe the bottle and water bowl. - Ask what they found after making them watch for sometime. - If they answer that water enters the bottle,		A plastic basin or bucket filled with water, small water cup, bottle and big bowls	- Have the children observe the experiment carefully.
3. Ask the reasons for both of the experiments. (a) When the bottle is made hot by wrapping with hot towel, why do the air bubbles come out? (b) Why does the water enter the bottle when the bottle is cooled down by pouring the cold water onto it?	10		To give the children enough time for group discussion. To write the answer of each student on the blackboard. To give the children enough time for group discussion.
Conclusion Tell two correct concepts according to the children's answers. (a) When the air in the bottle becomes hot, its volume expands and air bubbles come out. (b) When the air in the bottle cools down, its volume contracts and water enters the bottle.	5		To write the answer of each student on the blackboard.

Assessment (Solid expansion)

Point of Assessment

Interest/Attitude/ Motivation	Scientific thinking	Technique	Knowledge and understanding
Does s/he take interest in the experiments? Is s/he motivated to perform the activities? Does s/he like the experiments?	Does s/he able to guess and find out answers from the experiments? Does s/he able to think that the expansion and shrinking of the volume of solid is due to heat and cold?	Is s/he able to carry out the experiments? Does s/he able to communicate in relation with that topic to the teacher and colleagues (the ability to present guessing and the ability to listen to what others say)?	Is s/he able to understand that the volume of solid expands when it is hot and the volume shrinks when it is cold? Is s/he able to know discriminately the changes of solid due to heat and cold?

Oral assessment/Group discussion

1. What will happen when we heat the metal ball with a candle?

2. What will happen if we cool down the heated metal ball?

Message to Teachers

Let the children think properly the conditions that will occur in the experiment after the metal ball is heated or is cooled down.

Written assessment

1. When the metal ball is heated by candle, why does the metal ball expand?

2. Why does the metal ball is shrinking when we cool it down?

Let the children understand properly that when it is heated the volume of solid expands and when it is cold, the volume of solid shrinks.

Assessment (Liquid expansion)

Point of Assessment

Interest/Attitude/ Motivation	Scientific thinking	Technique	Knowledge and understanding
Does s/he take interest in the experiment? Is s/he motivated to perform the activities? Does s/he like to conduct the experiments?	Does s/he able to guess and find out answers from the experiment? Is s/he able to think the condition of changes of liquid depending upon heat or cold?	Is s/he able to carry out the experiment? Does s/he able to communicate in relation with that topic to the teacher and colleagues (the ability to present guessing and the ability to listen to what others say)?	Is s/he able to understand that when a liquid is heated its volume expands and when it is cooled down its volume shrinks? Does s/he able to know discriminately the changes of liquid due to heat and cold?

Oral assessment/Group discussion.

1. When the bottle is heated with the fire from the candle, what will happen to the water level?

2. What will happen to the heated glass bottle when it is cooled down in a bowl filled with water?

Written assessment

1. Why does the water level rise when the bottle is heated with the fire from the candle?
2. Why does the water level drop when the heated bottle is cooled down in a bowl filled with water?

Message to Teachers

Let the children think the condition of changes in the water level when the bottle is heated with the fire from the candle or when it is cooled down in a bowl filled with water.

Let the children understand properly that when a liquid is heated its volume can expand and when it is cooled down its volume can shrink.

Assessment (Gas expansion)

Point of Assessment

Interest/Attitude/ Motivation	Scientific thinking	Technique	Knowledge and understanding
Does s/he take interest in the experiments? Is s/he motivated to perform the activities? Does s/he like the experiments?	Does s/he able to guess and find out answers from the experiments? Does s/he able to think that the expansion and shrinking of the volume gas is due to heat and cold?	Is s/he able to carry out the experiments? Does s/he able to communicate in relation with that topic to the teacher and colleagues (the ability to present guessing and the ability to listen to what others say)?	Is s/he able to understand that the volume of gas (air) expands when it is hot and the volume shrinks when it is cold? Is s/he able to know discriminately the changes of gas due to heat and cold?

Oral assessment/Group discussion

1. What will happen when a thick towel dipped in hot water is covered on a glass bottle after squeezing out water?

2. What will happen when a glass bottle covered with hot towel is cooled down by pouring cold water?

Written assessment.

1. When the bottle is heated by wrapping with the hot towel, why do the bubbles come out from the orifice of the bottle?

2. Why does the water enter into the bottle when the bottle is cooled down by pouring cold water?

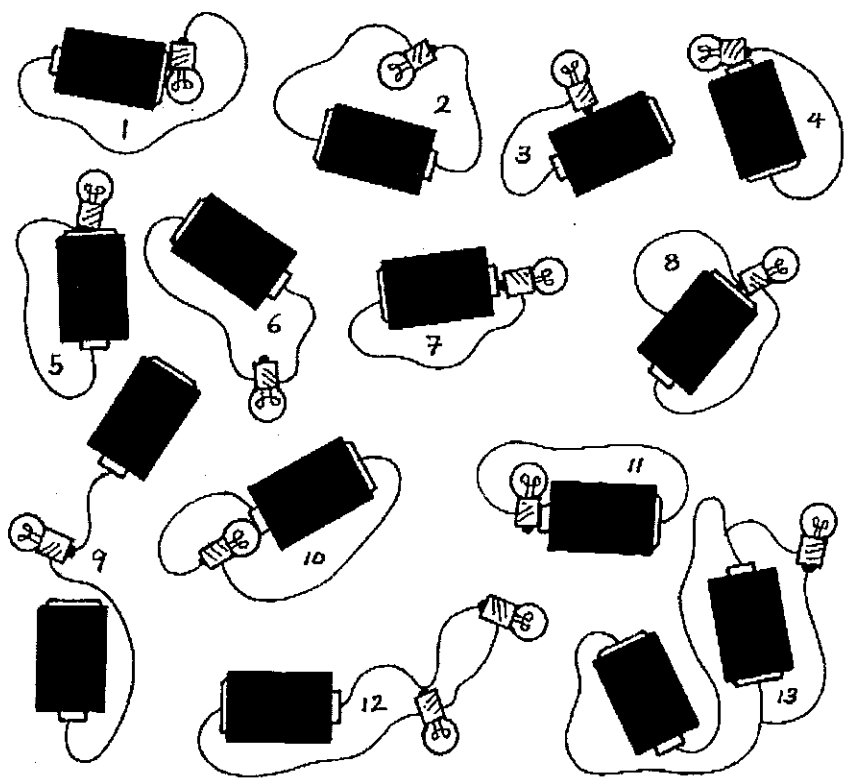
Message to Teachers

Let the children think properly the conditions that will occur in the experiment after the bottle is heated by using the towel or when it is cooled down by pouring cold water.

Let the children understand properly that when the air (gas) in the bottle is hot its volume expands and bubbles come out and when it is cold the volume shrinks and water enters into the bottle.

Grade 4

Chapter 3 Energy



Topic 6 : Light

1. Key concept	There are different sources of light. Light travels in a straight line.
2. Learning objective	
General	1) Be able to understand that there are different sources of light which emit the light and reflect lights. 2) Be able to understand that light travels in a straight line if a light way is blocked then there is shadow formed. 3) Be able to understand that the path of light can be changed by reflection.
Specific	1) Be able to mention sources of light 2) Be able to describe that light travels from one place to another in a straight line 3) Be able to explain that shadow forms when light is blocked 4) Be able to explain that the path of light can be changed with a mirror 5) Be able to explain that heat come together with light
3. Activities involved	Raising the sources of light in our lives. Making the ray of light and blocking it with a box Changing the path of sunlight with using several mirrors. Heating the water quickly with several mirrors.
4. Activity purpose	To promote further understanding of key concepts To attract interests of children To stimulate imagination and creativity of children

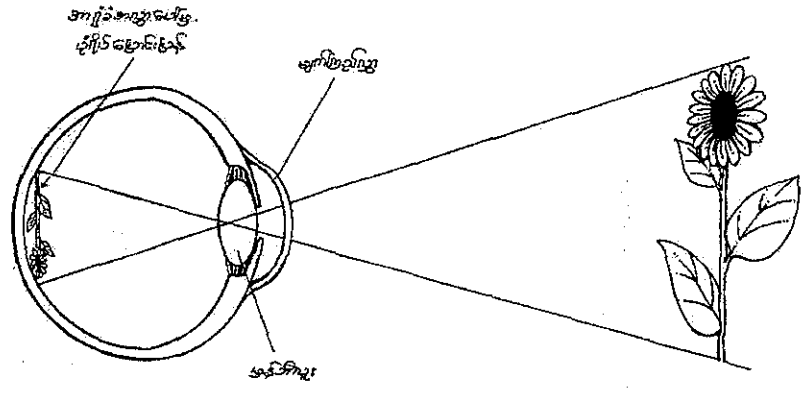
Before Getting Started

Self-check list for Teachers	☐ Can I mention the sources of light? ☐ Can I tell sources of light from sources reflecting light? ☐ Do I know any activities showing the light travels in a straight line? ☐ Do I know that sun provides light energy and heat energy together?
Background information for teachers	
What is light?	Light is an electromagnetic wave. There are many kinds of electromagnetic waves such as x-rays, ultraviolet waves, micro waves, radio waves, and infra-red waves. Most of these waves are not visible for us. The wave that is visible for us is the light. In other words, light is a form of energy which stimulates our sense of vision. Electromagnetic waves are classified with their wave length or frequency.

Pinhole camera

Pinhole camera is often used to demonstrate that light travels in straight lines. In the diagram of a pinhole camera below you can see how rays of light produced or reflected off a candle pass through the tiny pinhole and continue traveling until they hit the screen, where they form an image. The interesting thing is that the image we see on the screen is upside down. This is because the light rays travel in a straight line. (see the activity 3 as a reference)

In fact, the same thing is happening to our eyes. Inside of our eye(retina) gets the image upside down. Then, information of the image is transmitted to brain and the image is reversed again. This is why we can see things as they are.



Speed of light

Speed of light is so quick that it is impossible for us to see it travel from one point to another. The speed of light is 300,000,000 meter/second (187,500 mile/second) in vacuum. The distance light can travel in a second is more than 7 times longer than the circumference of the earth. Even so, it takes 8 minutes for light to travel from sun to earth, which means the sun is very far from the earth. Let us image the speed of the light.

Do you think which is quicker, light or sound? Thunder is a good example to think about it. When you see the lighting of the thunder, do you hear the sound at the same time? Usually, we hear the sound several seconds or more after seeing the lighting. This is because of difference of speeds of sound and light. In fact light is much faster than sound. The speed of sound is about 340 meter/second (0.21 miles/second) when air temperature is around 15 celsius. The sound and light are generated almost at the same time, the light comes to you much earlier. When you see the lighting, let us count seconds until your hear the sound. If you could count less than 3 seconds, that means you had the thunder falling very close to where you are. (about 1 – 2 km).

Lesson Planner

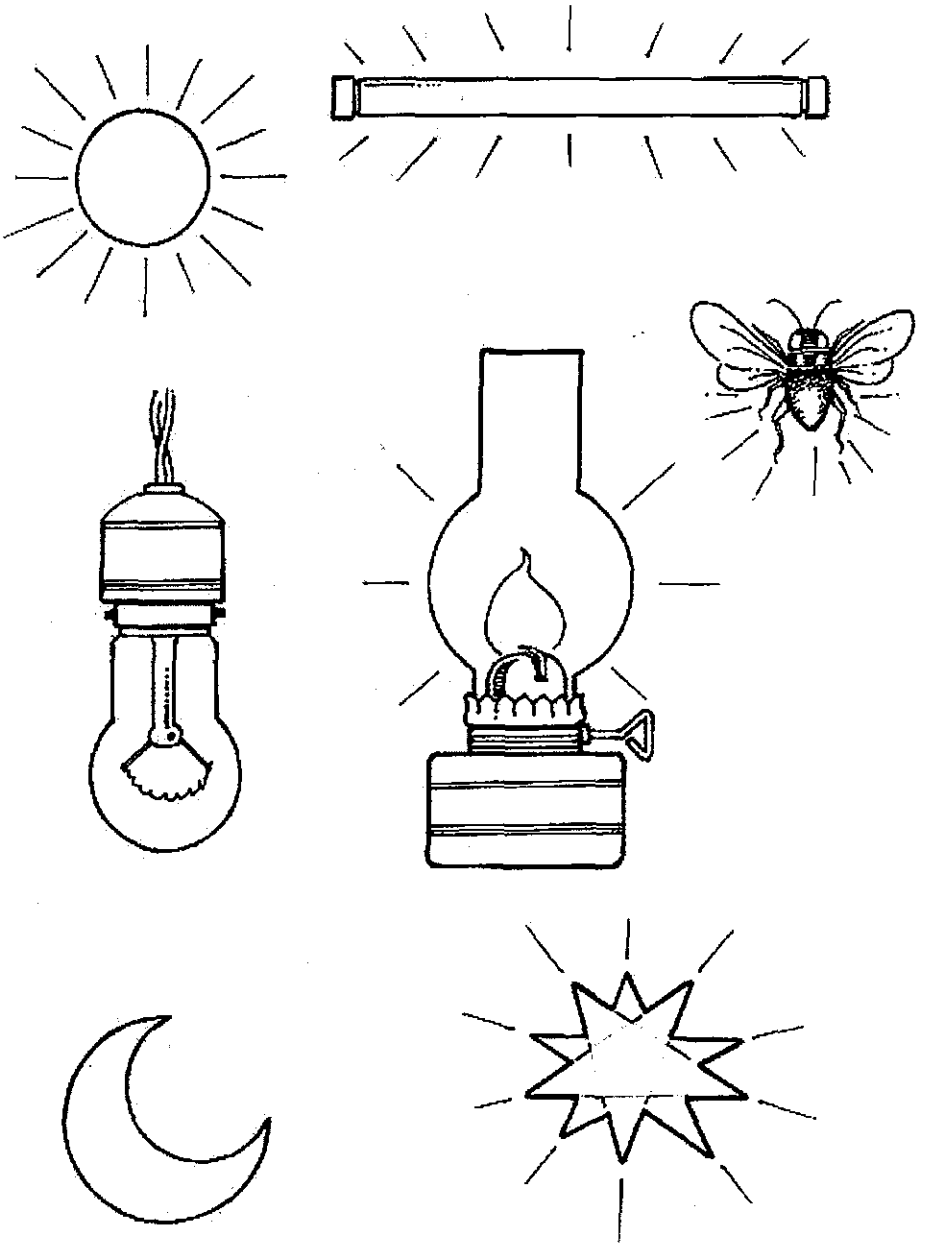
Suggested period (7)	Period 1	Period 2	Period 4	Period 5	Period 3 6 7
Lesson topic	Light travels in a straight line	Shadow	Change of light paths	Light and Heat	**Assessment/ Review**
Sample lesson plan	6-1		6-2	6-3	
Specific objective	Be able to mention sources of light Be able to describe that light travels from one place to another in a straight line	Be able to explain that shadow forms when light is blocked	Be able to explain that the path of light can be changed with a mirror	Be able to explain that heat come together with light	
Introduction (Motivation/Create interest/Active prior knowledge)	Think about light sources. Students think how the light produced from light emitting objects travel from one place to another.	Let make interesting shapes of shadow with a torch and hands.	Find out that light from the sun can be brought to a specified place by using a mirror.	The path of light can be changed, how about the heat coming with light?	
Core/Development (Active engagement with test/task)	Activity 1 and 2	Activity 4 and 5	Activity 6 and 7	Activity 8	
Assessment points	Do children participate in the activities to predict what will be seen by looking from the hole on the other side of the paper box? Do children understand how to carry out the experiment? Do children find out from experiment why the light from the flame of candle can be seen or not? Do children understand that the light travels from one place to another in a straight line?	Do children participate in making shadows? Do children create original shapes? Do children understand why shadow is formed? Do children think how longer and shorter shapes are made? Can children make longer and shorter shadows? Can children reflect on the experience with sun?	Do children participate in the activities to predict if the light from the sun can be brought to the place as one likes. Do children find out from experiment why the light from the sun can be brought to a specified place? Do children understand how the light travels straight to one place changes its direction to another place?	Do children participate in the learning activities to predict what will happen to the water inside the cup into which the light from the sun is fallen? Do children understand how to carry out the experiment? Do children find out from experiment why the water inside the cup gets hot? Do children understand that light and heat are obtained together from the sun?	
Adaptation of curriculum					

Activity 1 Think about light sources

Teaching/learning material

Concept There are various kinds of light sources.

There are many kinds of light sources around our lives. Encourage children to find those sources. There are light sources which are in fact reflecting lights, such as moon and start as well. Teacher categorizes those lighting and those reflecting with children.

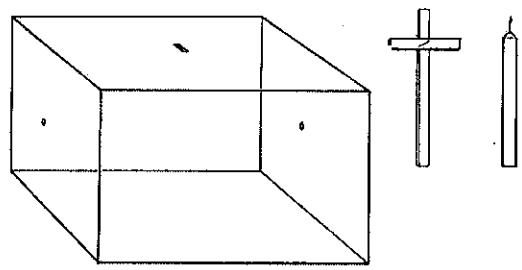


Activity 2 Light travels in a straight line

Teaching/learning material

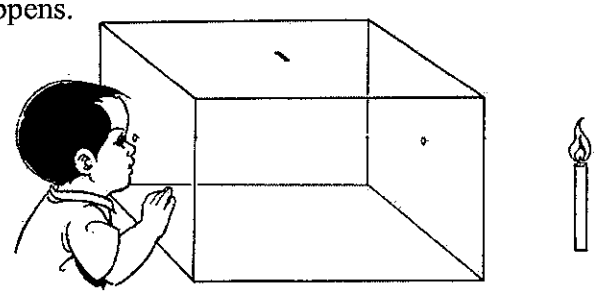
Box, a candle

Concept Light travels in a straight line

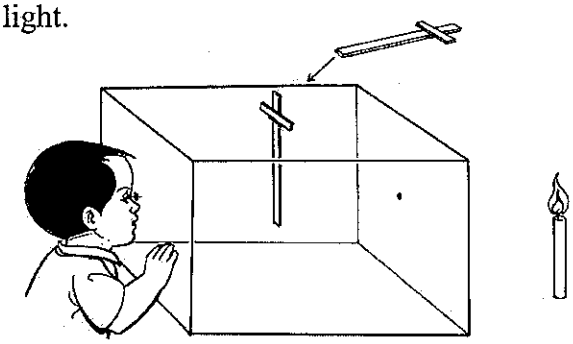


The followings are the steps for the activity.

1) Make a hole at the center of one side of the box
2) Make another hole at the center of the other side which is facing the side with a hole.
3) Cut 1.5 cm at the center of the upper side of the box.
4) Prepare 2 lines (shorter than height of box, width is 1.5) of paper, cross and fix them.
5) Make sure the crossed paper can be inserted to the cut hole on the upper side to block the lines between holes.
6) Suppose that we light the candle 10 cm away from one side with a hole of the box and try to see it from the other hole. Encourage children to think and predict.
7) Let us do it practically and observe what happens.



8) Suppose that we insert the crossed paper from the upper side and try to see the fire from the hole. Encourage children to think what will happen.
9) Let us do it practically and observe what happens.
10) The message which this activity indicates is that light travels in a straight line therefore when it is blocked we can not see the light.



Activity 3 Pinhole camera

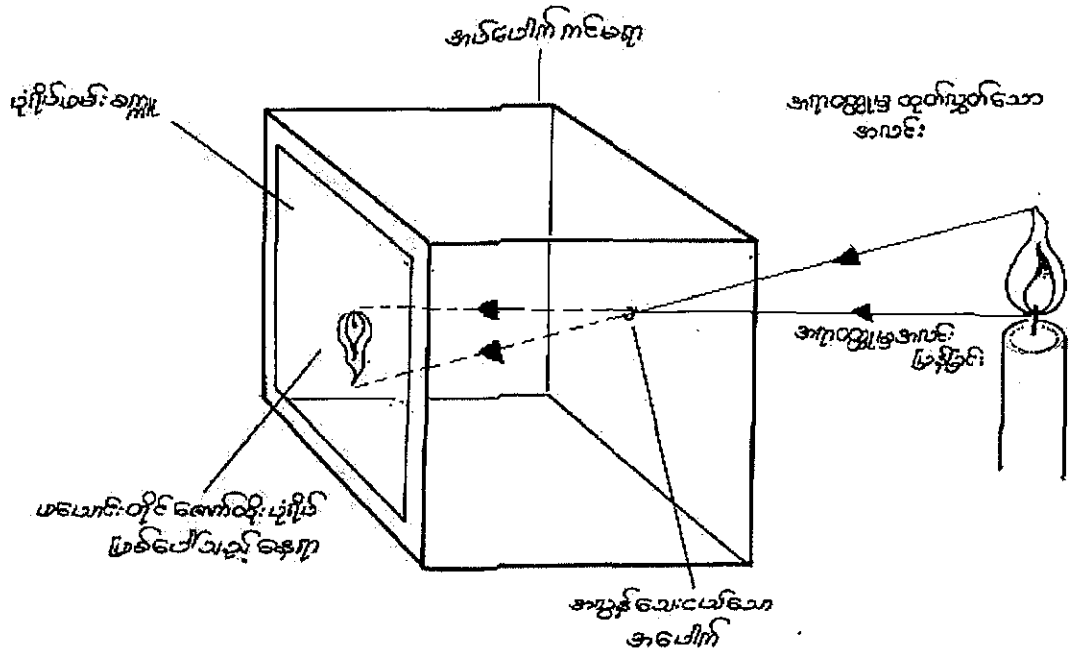
Teaching/learning material

Box, candle, half transparent paper (usual paper works as well).

Concept Light travels in a straight line

Although this content is introduced in higher grades, let us try to do it since it is very simple.

1) Take out the upper side of the box
2) Make a hole on one side of the box
3) Cut the main area out from the other side which is facing to the side with the hole.
4) Put paper(or half transparent paper) on the side which are cut out
5) Encourage children to think what kind of image will be shown on the screen when candle is located near the side with a hole.
6) Bring the box and a candle into a darker place and light the candle.
7) Adjust the distance from the box to the candle and observe the image of candle on the screen. (When you put half transparent paper, you can see the image from outside box. When you put just usual paper, you can see the image shown inside from above).



Activity 4 Making shadow

Teaching/learning material

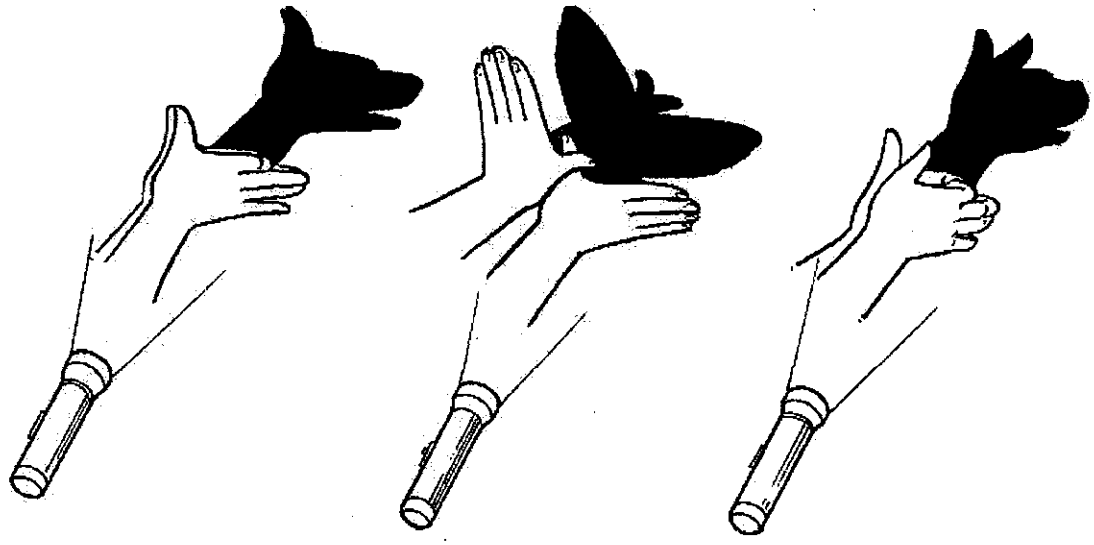
Torch

Concept When light is blocked, shadow is formed.

Using a torch and hands, let's make special shadow shown below.

Teacher can introduce shadows below as sample.

Teacher encourages children to create their original shapes of shadow.



After children create their shadows, let us ask them why we can make shadows. Although it is very natural to us, teacher can facilitate children to realize that **shadow can be formed when light is blocked.**

Activity 5 Longer and shorter shadows

Teaching/learning material

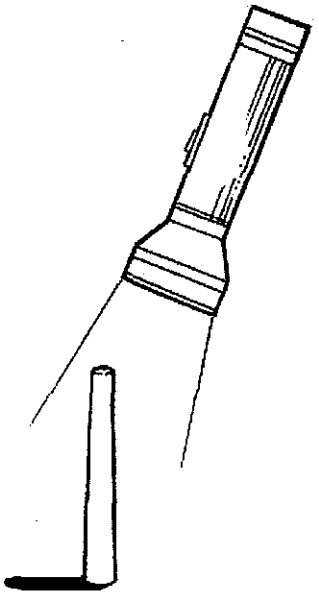
Torch, chalk (or pencil)

Concept	The shape of shadow can be changed when light comes from different angles.

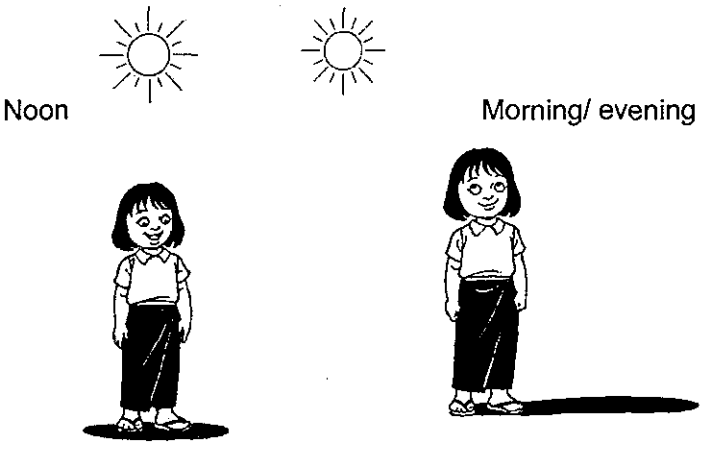
Teacher shows a chalk or pencil and asks children how we can make a shadow of the chalk. Children will easily answer " by using a light of a torch".

Then, let's ask children what we need to do if we want the longer shadow or shorter shadow. How do we need to keep the torch against the chalk? Children discuss in the group and present the result of discussion on
1. How to make the shadow longer. **2. How to make the shadow shorter.**

When we project the light to chalk from above, we can make the shadow shorter.
When we project the light to chalk from side, we can make the shadow longer.
(The distance from the torch to the chalk does not matter.)



In order to make sure that children understand the main point of this lesson, ask children about their experiences with sun. Encourage them to think when the shadow of their bodies become short and long.



Activity 6 Changing the path of light 1 (Collecting sun lights by using mirrors)

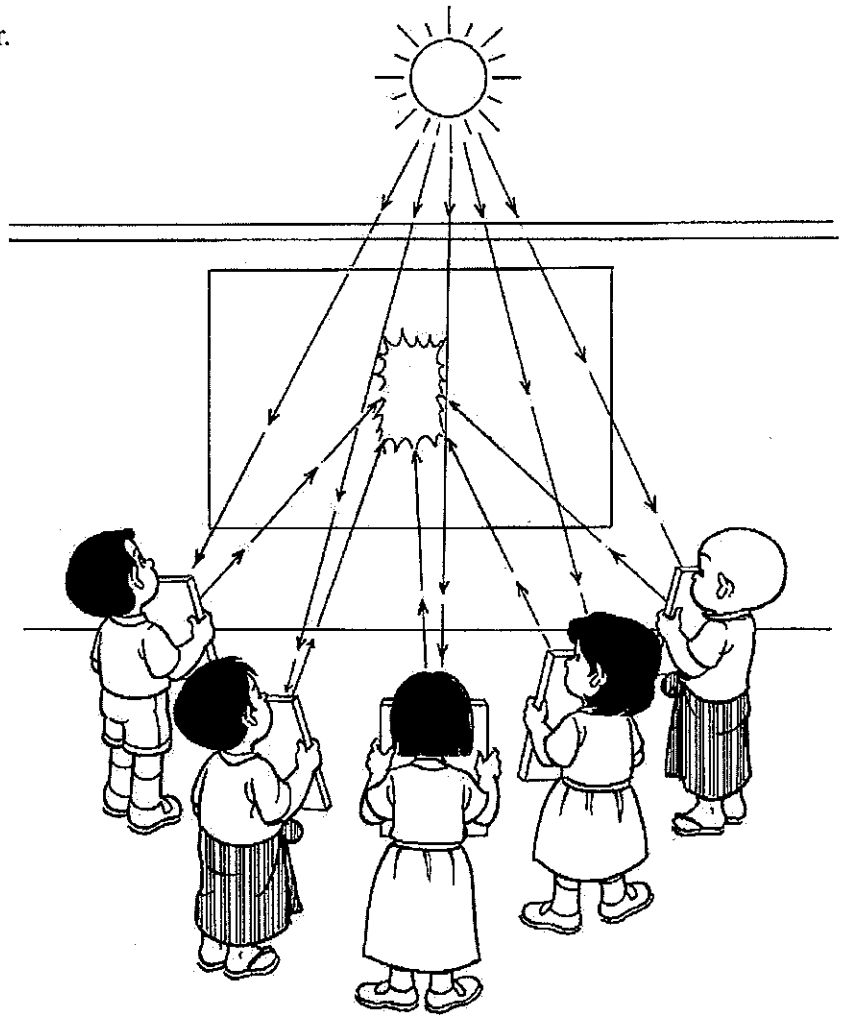
Teaching/learning material

Mirrors

Concept Path of light can be changed with a mirror

Let us use a mirror to change the path of sun light.

1) Children go out of the classroom with their mirrors.
2) Try to get sun light with mirrors.
3) Change the direction of sunlight and project it to the target prepared in advance by teacher.



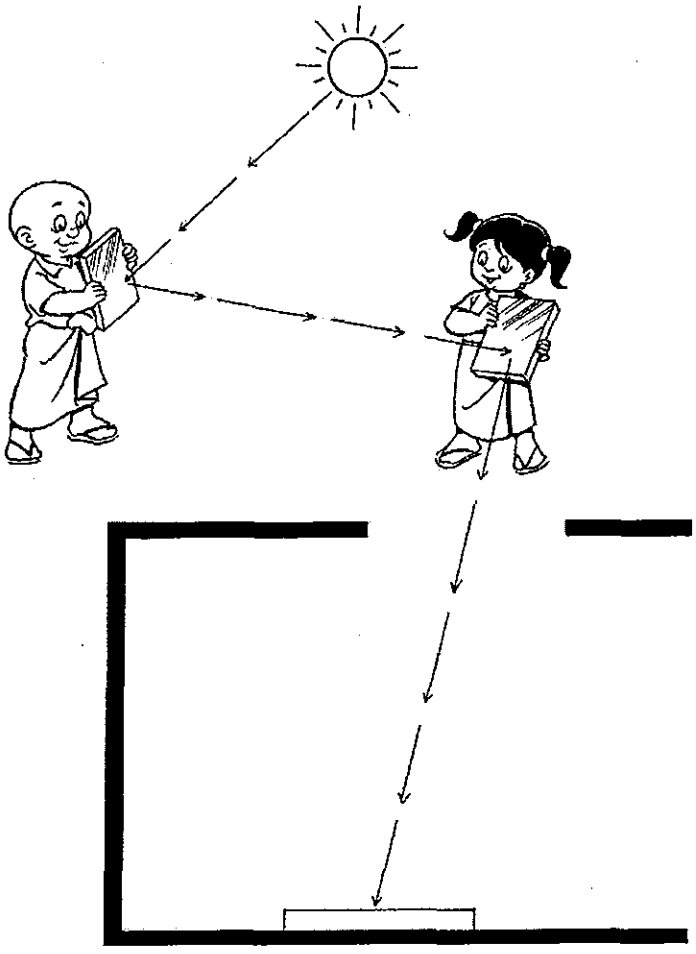
Activity 7 Changing the path of light 2 (Collecting sun lights by using mirrors)

Teaching/learning material

	Mirrors
Concept	Path of light can be changed with a mirror (Light travels in a straight line)

This activity is continuous to Activity 4. By using 2 mirrors, we try to bring the sun light to inside of classroom. One is outside to get sun light and send it to the partner at the entrance of classroom. The partner gets the sun light and tries to change the direction of light and project it to the target set inside of classroom.

After this activity, let us ask children how the light proceeds from the mirror. Children will realize that the direction of light can be changed with using mirrors and they also make sure that light travels in a straight line.



Activity 8 Light comes with heat

Teaching/learning material

4 mirrors, 2 bowls (plastic or glass), water

Concept Light comes with heat from sun.

The activity could be done with the following steps.

Put the same amount of water into two bowls

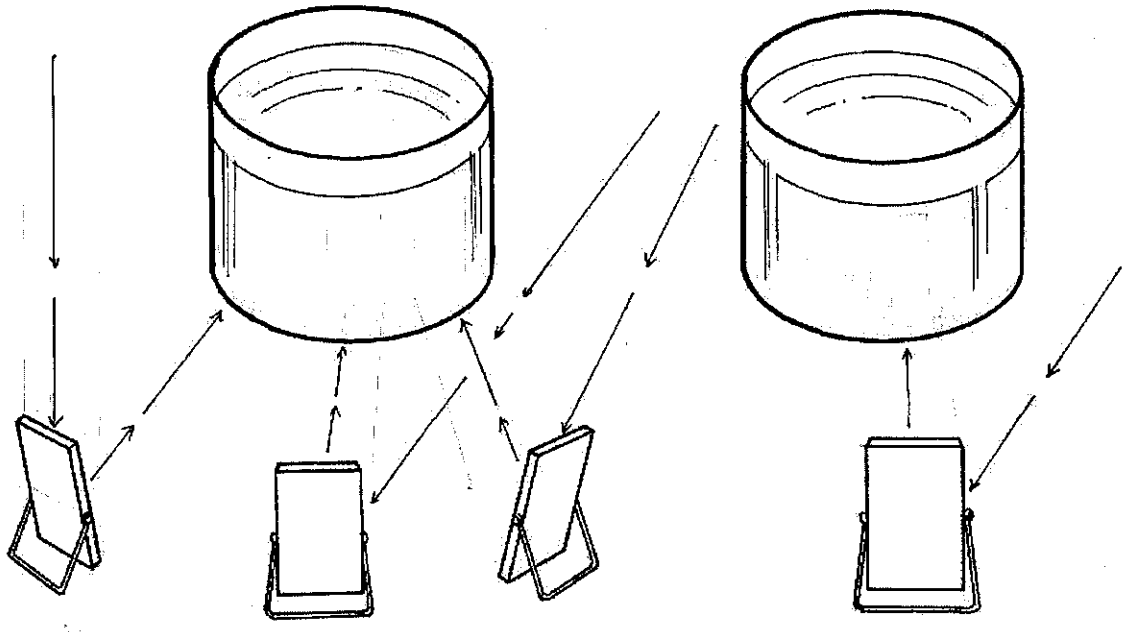
Place 3 mirrors and adjust them to project sun lights to one bowl.

Place 1 mirror and adjust it to project sun light to another bowl.

Keep them as they are for 20 minutes (Adjust mirrors to project light to bowls).

Check the temperatures of water in both bowls. (If children already know how to read a thermometer, let us use it. If not, put fingers in the water to check temperature).

Before putting this activity into practice, let us encourage children to think what will happen.



Lesson Plan 6-1

Lesson topic: Light travels in a straight line
Learning objectives: Be able to describe that light travels from one place to another in a straight line
Teaching/learning materials: Chart illustrating light sources, paper box, awl to make a hole, candle, lighter, knife, small and long paper card.
Teaching period: 35 minutes (1 period)
Teaching/Learning procedure

Learning Activities	Time	Teaching/ learning materials	Points to be noticed.
Introduction (refer to Activity 1) Children will be asked to retell as much as they remember on 'how light is obtained and where light comes from' that have been taught in the previous lesson. Then let them see the picture chart and tell the light emitting objects (light sources) containing in the picture. *Continue to ask 'how does the light produced from the light emitting objects travel from one place to another?'*	7	Picture chart	Let the children discuss among themselves and tell Record the children's answers on the blackboard.
Core/development (refer to Activity 2) Teacher says that we will learn how the light travels from one place to another. **Activity A** Before distributing materials, teacher needs to explain step by step what we will do by showing the materials. Then ask children to predict what will be seen from the hole. Children in group present their ideas. Teacher distributes materials and make sure the activity is done with the following steps. 1) Light the candle 2) Place the lit candle on a straight line with the lateral hole of the paper box. 3) Close one eye and look from the other hole of the paper box. Teacher asks children their findings If they answer, 'the light from the flame of candle is seen' Teacher asks, 'Why does light can be seen?'	5 10	Paper box, candle, lighter, knife, awl to make a hole.	Make a hole on either side of the paper box and on the middle of the cover. Make the holes on either side of the box on a straight line. Record children's answers on the blackboard.
Activity B Teacher explains again what to do next. "If a paper card is inserted from the middle of the cover of the paper box, what will happen? and Why? Ask them to predict what will happen again. 1. Light the candle 2. Insert a paper card from the hole of the upper part of the paper box. 3. Close one eye and look from the hole on the other side of the paper box.	5 5	Small and long paper card	Record the children's guessed answers on the blackboard. Not necessary to hear ideas from all groups, if they are similar.

Learning Activities	Time	Teaching/ learning materials	Points to be noticed.
Teacher asks children their findings. If they answer 'the light from the flame of candle can no longer be seen' ask 'why does the light can no longer be seen?"			Record the children's answers on the blackboard.
Conclusion According to the findings from experiment and discussions - let the children consider and conclude that Light travels in a straight line Children will be asked to write the above concept in their notebook. and draw the activity they have done.	3		Make sure that children recognize that the light travels straight from one place to another because the light that comes from one side of the paper box did not turn sideways to the paper card.

Lesson Plan 6-2

Lesson topic: Changes of light paths

Learning objectives: Be able to explain that the path of light can be changed by mirror (and light travels in a *straight line*)

Teaching/learning materials: Mirror, Target (Star mark on the paper)

Teaching period: 35 minutes (1 period)

Teaching/Learning procedure

Learning Activities	Time	Teaching/ learning materials	Points to be noticed.
Introduction			
Teacher starts "I want to give you, children one quiz. Suppose that there is no window and it is very dark in this class room. What we have is only a door in this room. When we have sun light outside and we would like to bring the sun light to inside of this room, what would you do? After listening to ideas of children, teacher can suggest "How about using *mirrors*?"	5		Encourage children to speak out. Appreciate their ideas and record whatever the children say.
Core/development			
Activity A (refer to Activity 6) Teacher distributes each mirror to children and asks them to go outside. Children gather one place and look at the target on the wall, which was prepared by teacher in advance. First assignment to children with mirrors is to get sun light with mirrors and project (reflect) it to the *target. (This is the practice in order to do the next activity)* Teacher needs to make sure all children tried this activity.	10	Mirror Mirror	Let the children recognize from the experiment that it can bring the light from the sun to a specified place because the light changes its direction from the first mirror to the second mirror and from the second mirror to the *specified place.*
Activity B (refer to Activity 7) Teacher gives two mirrors to each group. The followings are the steps to do this activity. 1) Select 2 children from a group and locate one under sun and the other at the entrance of the classroom 2) *The child under sun gets the sun light with mirror and reflects into* the child at the entrance of classroom. 3) The child at the entrance gets it with the mirror and tries to reflect it into the target prepared inside of classroom. To adjust the angles of mirror is challenging but fun. 4) Encourage all children in a group to try this activity.	12		Record whatever the children say.
After the experiment, teacher asks children to express their findings. Ask children how the light traveled from mirror to mirror/target as well. Encourage children to draw this activity and write their findings on their notebooks.	5		
Conclusion			
According to the findings and review from the experiment, children will make sure about 2 things. 1. The path of light can be changed with using a mirror. 2. Light travels in a straight line	3		Explain that materials with *glistening* surfaces can also be used to alter the direction of light in place of mirror.

Lesson Plan 6-3

Lesson topic: Light and Heat
Learning objectives: Be able to explain that heat comes with light
Teaching/learning materials: Mirror, a glass to put in water (or) plastic cup(bowl), water
Teaching period: 35 minutes (1 period)
Teaching/Learning procedure

Learning Activities	Time	Teaching/ learning materials	Points to be noticed.
Introduction Introduce the lesson with the following questions. As we all know, sun gives us light and heat energy. From the last lesson, we understood that we could change the direction of light. Today's question is that "Can we change the direction of heat coming from sun?" Do you think it is possible or impossible?	3		Let the children discuss among themselves and appreciate their ideas.
Core/development (refer to Activity 8) Today's activity is to reflect sun light into water in the cup and to check how water changes. This activity can be done outside of classroom. Teacher distributes children the materials and clearly explains the steps of experimental procedure in the classroom, then goes outside with children. 1) Fill water into 2 cups. 2) Check the hotness of water in both cups with a finger 3) Place 3 mirrors to reflect sun light into one cup and 1 mirror to reflect into the other cup. (refer to diagram of Activity 6) 4) Adjust the angles of mirrors in order for cups to get sunlight fully for 20 minutes. 5) After 20 minutes, let us put the finger into both cups to check the hotness of water, and go back to the class room.	23	Mirrors, cups(bowls), water	Give 4 mirrors to each group. If there is no mirror enough, use 2 mirror for one cup and no mirror for another. This activity is possible when weather is fine.
Teacher encourages children to say their findings from this activity. *Children are likely to say that water becomes hotter.* Teacher continues to ask children like, "Which of the cup become hotter?" "Why does water become hotter when the light from the sun falls into the cup?" "What is obtained from the sun with light?"	7		
Conclusion According to the finding and review from the experiment, children will conclude as follows: Heat comes with light from sun	2		

Assessment (Light travels in a straight line)

Point of Assessment

Interest/Attitude/ Motivation	Scientific thinking	Technique	Knowledge and understanding
Is s/he interested in think of what light is? Is s/he interested in knowing the properties of light? Is s/he motivated to do activities? Is s/he motivated to create some original shadows with hands?	Can s/he think that the light travels from one place to another in a straight line? Can s/he imagine the speed of light? Can s/he think why shadow forms? Can s/he think light energy and heat energy from sun? Can s/he think even heat energy from sun can be reflected by mirror?	Is s/he able to carry out the experiment? Is s/he able to communicate with the teacher and peers in relation with the lesson? Is s/he able to bring out the findings from experiment? Is s/he draw the diagram showing the activities?	Does s/he understand that light travels straight from one place to another? Does s/he understand that light can be easily blocked and shadow forms? Does s/he understand the difference between moon and sun? Does s/he understand the path of heat energy can be changed by mirror?

Oral assessment/Group discussion

1. Mention your experience to show light travels in a straight line.
2. Do you think which is faster light or sound? Explain why you think so.
3. Why the shadow of your body in the evening is longer than one in the noon?
4. Do you think light from candle fire can be reflected with mirror? If yes, how about the heat from fire? Explain what you think.
5. Do you think earth is reflecting light of sun just like moon?

Written assessment

1. Draw how shadow can form when a torch light up a standing pen at the angle of 45 degree.
2. Draw how shadow forms when a torch light up the pen from above.
3. Describe what you know about light.

Message to Teachers

Read "Before getting started" to get information about light.

Let us try 4. on the left column.

Give them assessment for which children need to think and reflect to answer.

Topic 7: Electricity

1. Key concept

When an electric circuit is complete, electricity flows.
There are different materials which may be conductors or insulators of electricity.

2. Learning objective

General

1) Be able to understand that if circuit is complete, electricity flows, for example: when electric circuit is complete the bulb in the circuit lights.
2) Be able to understand that there are different materials which may be conductors or insulators of electricity.

Specific

1) Be able to explain that electricity flows when an electric circuit is complete.
2) Be able to make an electric circuit.
3) Be able to explain how to connect 2 batteries in one circuit
4) Be able to explain the differences between series and parallel circuits
5) Be able to explain some materials are conductors and some are insulators of electricity
6) Be able to make a tester and check materials with it

3. *Activities involved*

Making an electric circuit with a battery
Making an electric circuit with two batteries.
Testing materials, conductor or insulator?

4. Activity purpose

To promote further understanding of key concepts.
To attract interests of children.
To stimulate imagination and creativity of children.

Before Getting Started

Self-check list for Teachers

- ☐ Do I know what the completed circuit means?
- ☐ Do I know the electric current?
- ☐ Do I know the difference between conductor and insulator?
- ☐ Do I know the difference between parallel and series connection?
- ☐ Do I know what voltage, current and resistance mean?

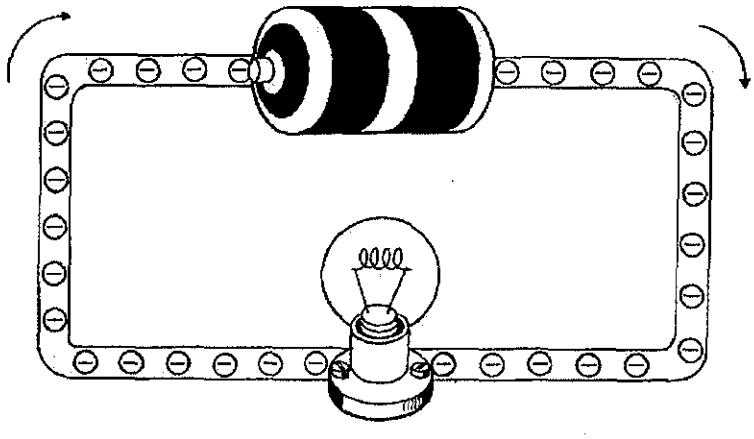
Background information for teachers

Key words

Batteries produce a flow of electricity.
Wires carry electricity round a circuit.
Switches break and complete circuits.
Bulbs light up when electricity flows through them.
Resistors reduce the flow of electricity in a circuit.
Motors spin when electricity flows through them.

Electric circuit

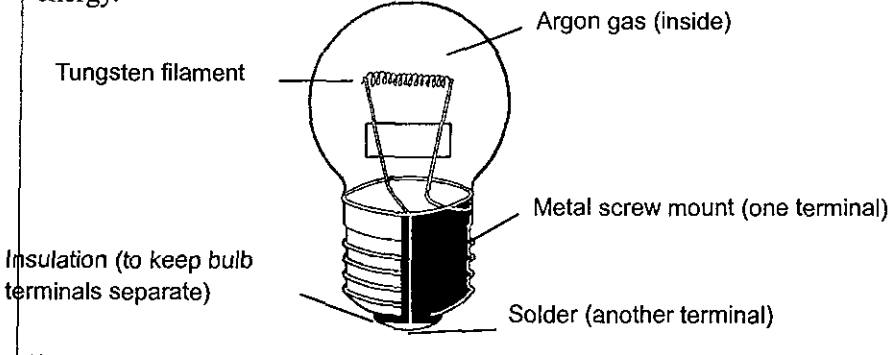
When a circuit is completed, electricity flows in the circuit. Conventionally, it is said that electricity goes from positive side to negative side. However, the flow of the electricity is caused due to the flow of electron which is negatively charged. The electron comes out from negative side and proceeds to positive side as the diagram below shows.



It is a bit confusing, but we still can say that the electricity (supposedly positive charged) flows from positive sides to negative sides. The electrons flow from negative sides to positive sides.

How a bulb works

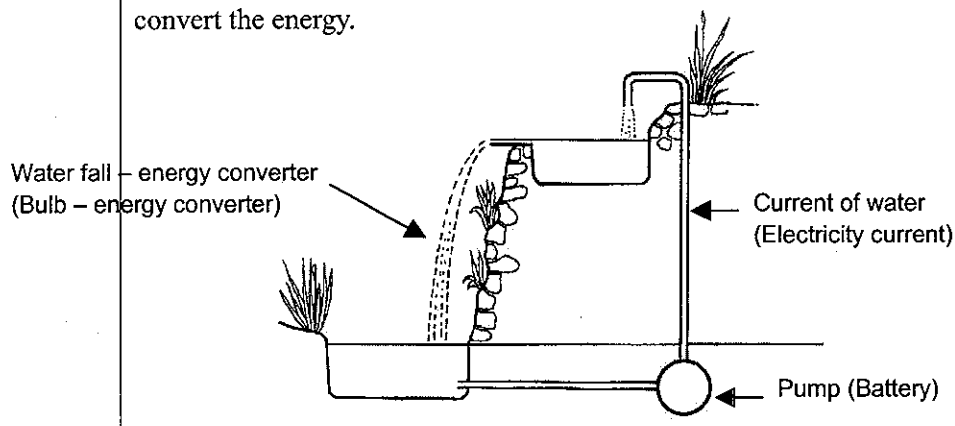
A bulb glows when electricity is made pass through the very fine filament, usually made from tungsten, inside it. The filament resists the flow of electricity, and the friction produced there makes it glow very hot and visible white light. A bulb is also a resistor which converts electrical energy into light and heat energy.



Edison is very famous to find a lighting filament for the first. The first filament was the charcoal of specific bamboo. Before finding it, Edison had tried more than 2000 kinds of materials to see if they are good as a lighting filament. Journalist asked Edison how difficult it was to fail more than 2000 times. Edison answered " I never failed even once and I have been successful to find 2000 materials which are not proper as lighting filament."

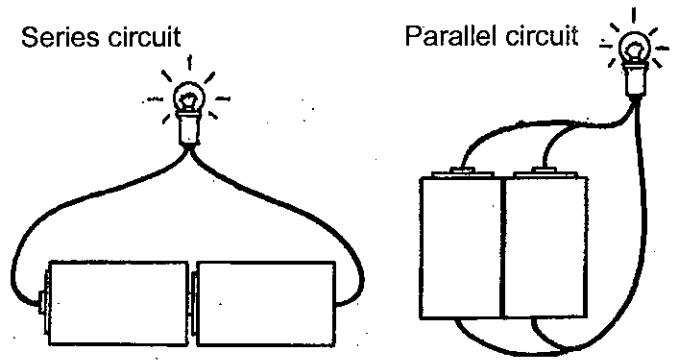
Electric circuit and water pump system

Let us compare a water current system to an electric circuit in order to understand the functions of each part in the electric circuit. The function of battery is the same as the pump in the water system. The current of electricity is the same as the current of water. The bulb (resistor) is the same as the water fall, which convert the energy.



Parallel and Series

There are two ways to connect batteries in electric circuits. One is parallel circuit and another is series circuit. They have different characteristics. In the case of a parallel circuit, the power of electricity is the same and the bulb is lit list like one battery used. The bulb can be, however, lit for longer time.



In the case of a series circuit, the power of electricity is 2 times higher than the power with one battery and the brightness of the bulb is stronger than brightness with one battery. However, the bulb can be lit for shorter time.

Conductors and Insulators

In general, metals are good conductors. Various metals have specific conductivities. Among metals, copper and sliver are better conductors. On the other hand, an extremely poor conductor is called an insulator. Good examples of insulators are rubber, glass, plastic, porcelain and many other ceramics. Air and other gases are insulators as well.

Lesson Planner

Suggested period (9)	**Period 1 and 2**	**Period 3 and 4**	**Period 6 and 7**	**Period 5 8 9**
Lesson topic	Electric circuit	Electric circuit (2 batteries)	Tester	**Assessment/ Review**
Sample lesson plan	7-1	7-2	7-3	
Specific objective	Be able to explain that electricity flows when an electric circuit is complete Be able to make an electric circuit	Be able to explain how to connect 2 batteries in one circuit. Be able to explain the differences between series and parallel circuits	Be able to explain some materials are conductors and some are insulators of electricity Be able to make a tester and check materials with it	
Introduction (Motivation/Create interest/Active prior knowledge)	Bring out that a dry cell has a positive pole and negative pole and it produces electricity.	Have you ever opened the torch? How many batteries are inside ?	Bring out that in the lessons taught a dry cell and electric bulb are connected with a wire to make an electric circuit to light a bulb. Bring out that in connecting an electric circuit it has to connect with the copper wire inside the wire because the plastic cannot conduct electricity and the copper wire conducts electricity.	
Core/Development (Active engagement with test/task)	Activity 1,2	Activity 3,4,5	Activity 6	
Assessment points	Do the children participate in the learning process? Do the children understand how to make an electric circuit to light an electric bulb? Do the children find from experiment why the electric bulb lights or not? Do the children understand the bulb lights when the positive pole and negative pole of a dry cell are connected with an electric bulb and wire to complete a circuit and to make an electricity flow.	Observation of activities. Do the children participate in the learning process? Do the children get the meaning of experiments? Do they discuss well? Do they draw conclusion? Do they positively find anything from the experiment?	Do the children participate in the learning process to predict which material conducts electricity and which does not? Do the children understand how to make an instrument to detect if the electricity flows or not and how to use it? Do the children find from experiment why the electric bulb lights or not? Do the children understand that when the given materials are examined with the detector the materials which cause to light a bulb conduct electricity and those do not light a bulb do not conduct electricity?	
Adaptation of curriculum				

Activity 1 Making the electric circuit

Teaching/learning material

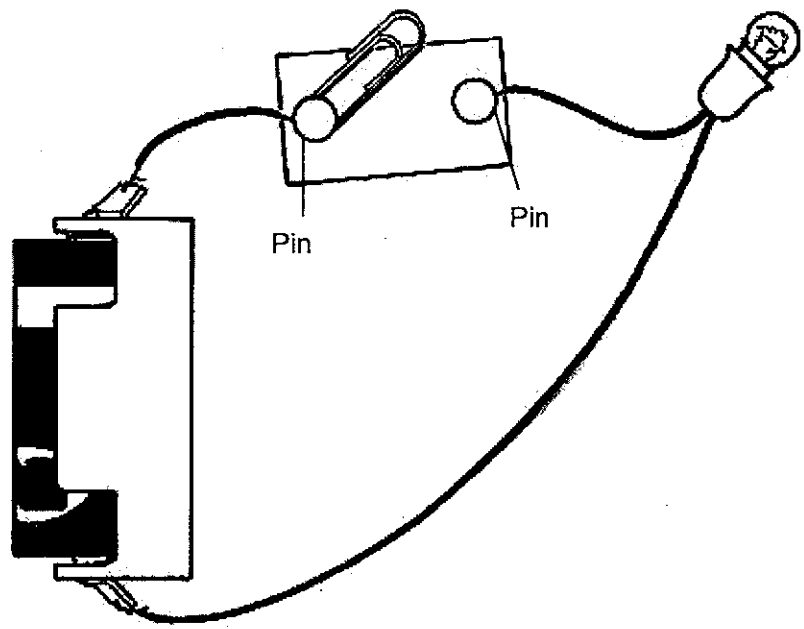
Bulb, wire, dry cell, battery box, pins, metal clip and Styrene foam

Concept Electricity currents when the circuit is completed.

Let us make a simple electric circuit shown below.

Children in groups try to connect all materials prepared and light the bulb.

It is important to make a switch in the circuit to see the difference between the completed circuit (switch on) and uncompleted circuit (switch off).

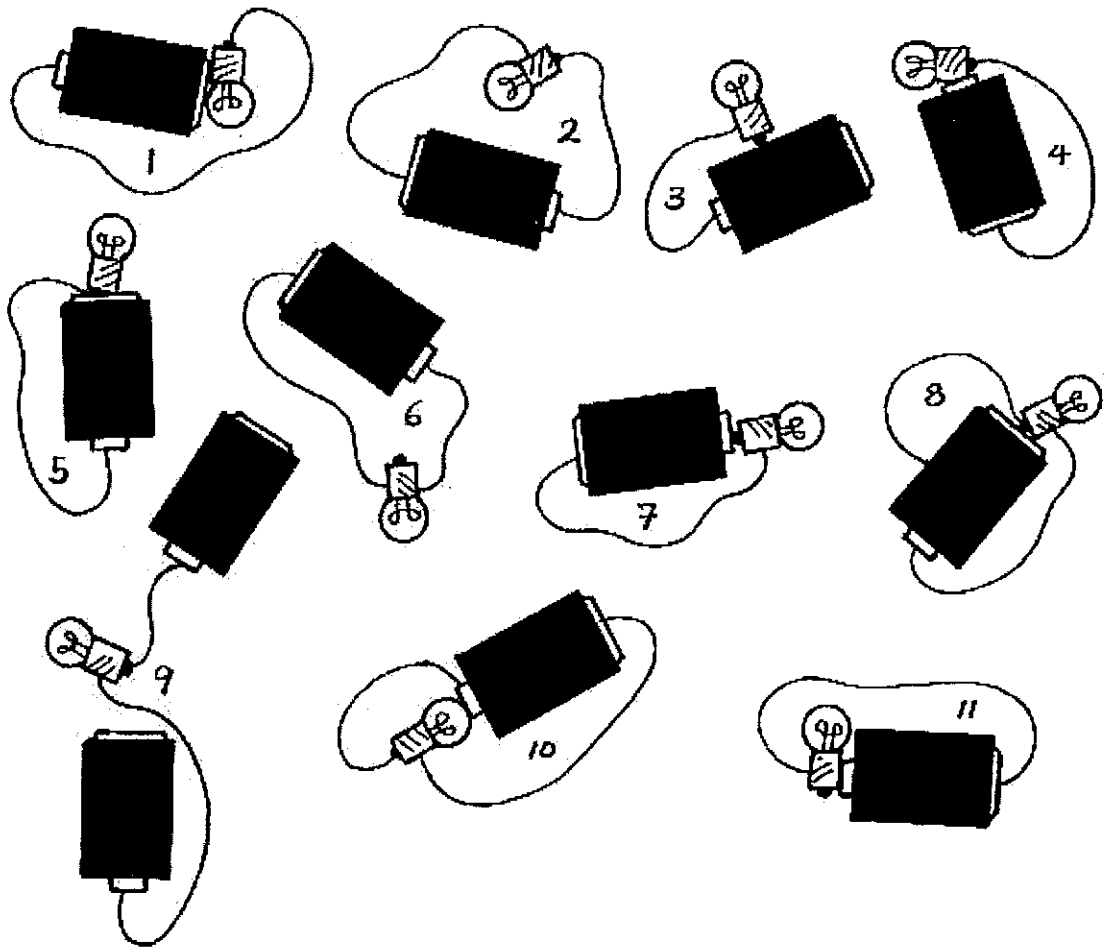


Activity 2 Which circuit is good to light? 1

Teaching/learning material

Concept Electricity currents when the circuit is completed.

Let us draw the diagrams below and ask children which circuit is good (completed) to light the bulb.



Activity 3 Making the electric circuit with 2 batteries

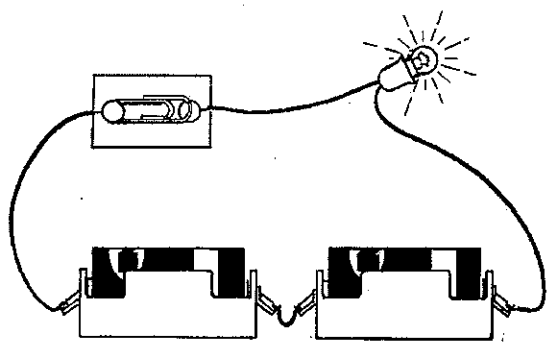
Teaching/learning material

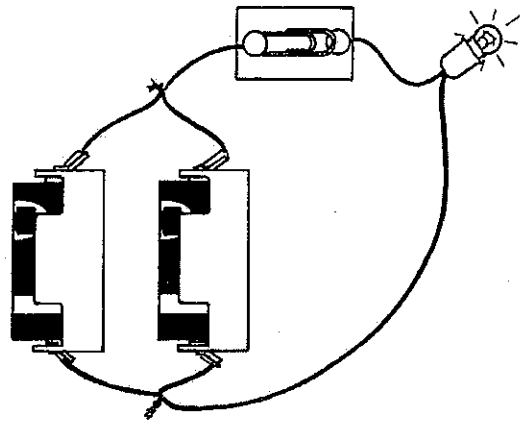
Bulb, 2 batteries, wires, 2 pins, metal clip, styrene foam (small piece), 2 battery boxes

Concept There are two ways to connect 2 batteries with the circuit.

Teacher draws several examples of electrical circuits with two batteries on the blackboard. (refer to the activity 5). Children choose the electric circuit which they think good to light.

Children make the electric circuit they select and find if it is good or not.
If the circuit they make is not good to light, they can try another circuit.
Teacher can give a hint like "have you ever opened the torch?"





After giving children enough time to try circuits, let us ask children to come to draw the electric circuits which are good to light on the black board. It is expected that children easily find series circuit but not parallel circuit. If that is the case, teacher needs to facilitate children to find the parallel circuit.

Activity 4 Making the electric circuit with 2 batteries (parallel and series connection)

Teaching/learning material	Bulb, 2 batteries, wires, 2 pins, metal clip, styrene foam (small piece), 2 battery boxes
Concept	Bulb is lit brighter when 2 batteries are connected in series, and bulb is lit longer when 2 batteries are connected in parallel.

This is the continuous activity to Activity 3.

We are going to compare series and parallel circuits.

Encourage children to mention their findings in looking at both circuits.

Let us think that which circuit is used in the torch we have.

Series	Parallel

Properties of both circuits are mentioned in "Before getting started" in this topic.

Activity 5 Which circuit is good to light? 2

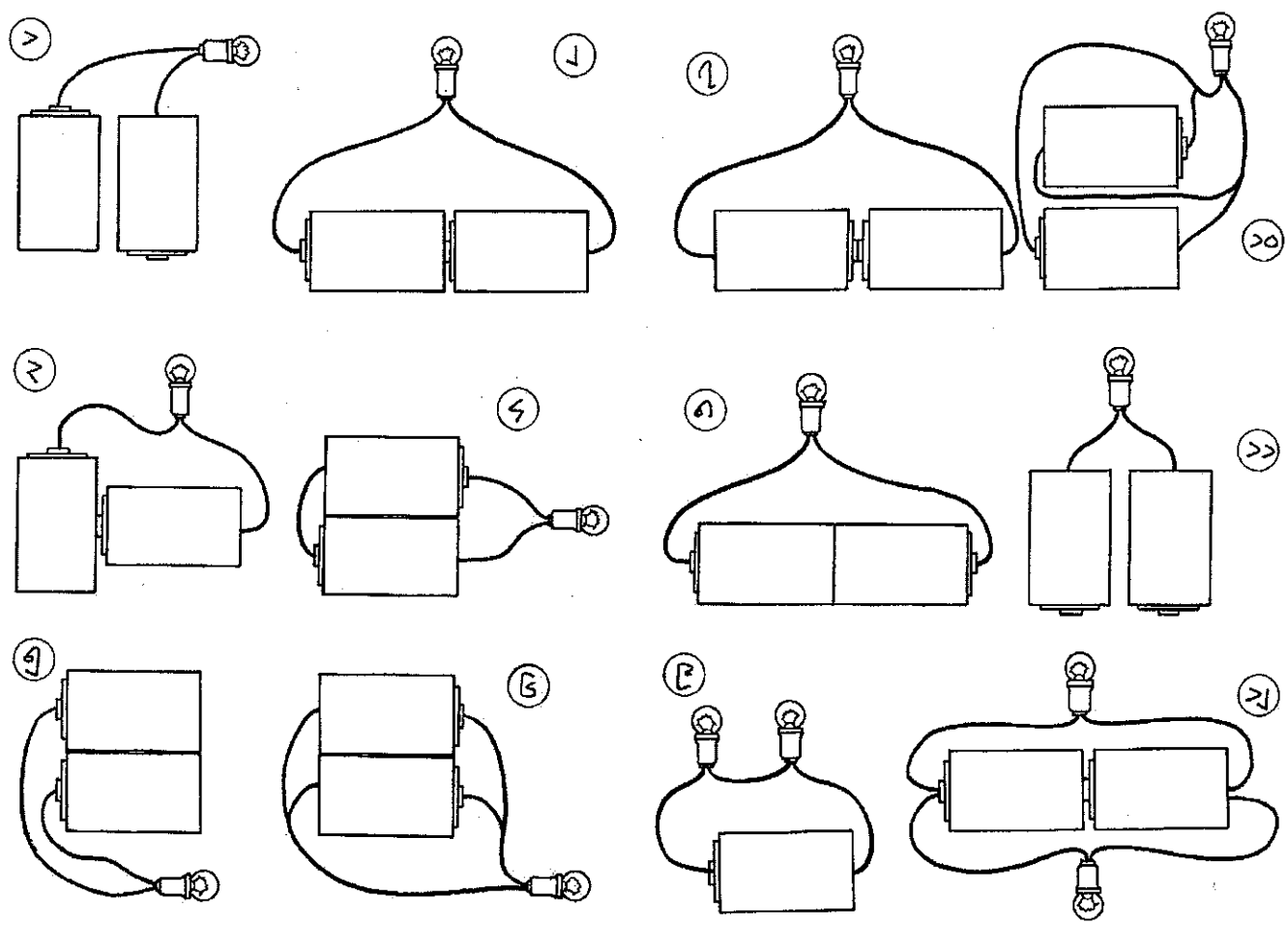
Teaching/learning material

Concept There are two ways to connect 2 batteries with the circuit.

Let us find out which circuit can light the bulb?

Let us remind children that "Electricity flows when the circuit is completed".

"Completed" here means that "connected properly".



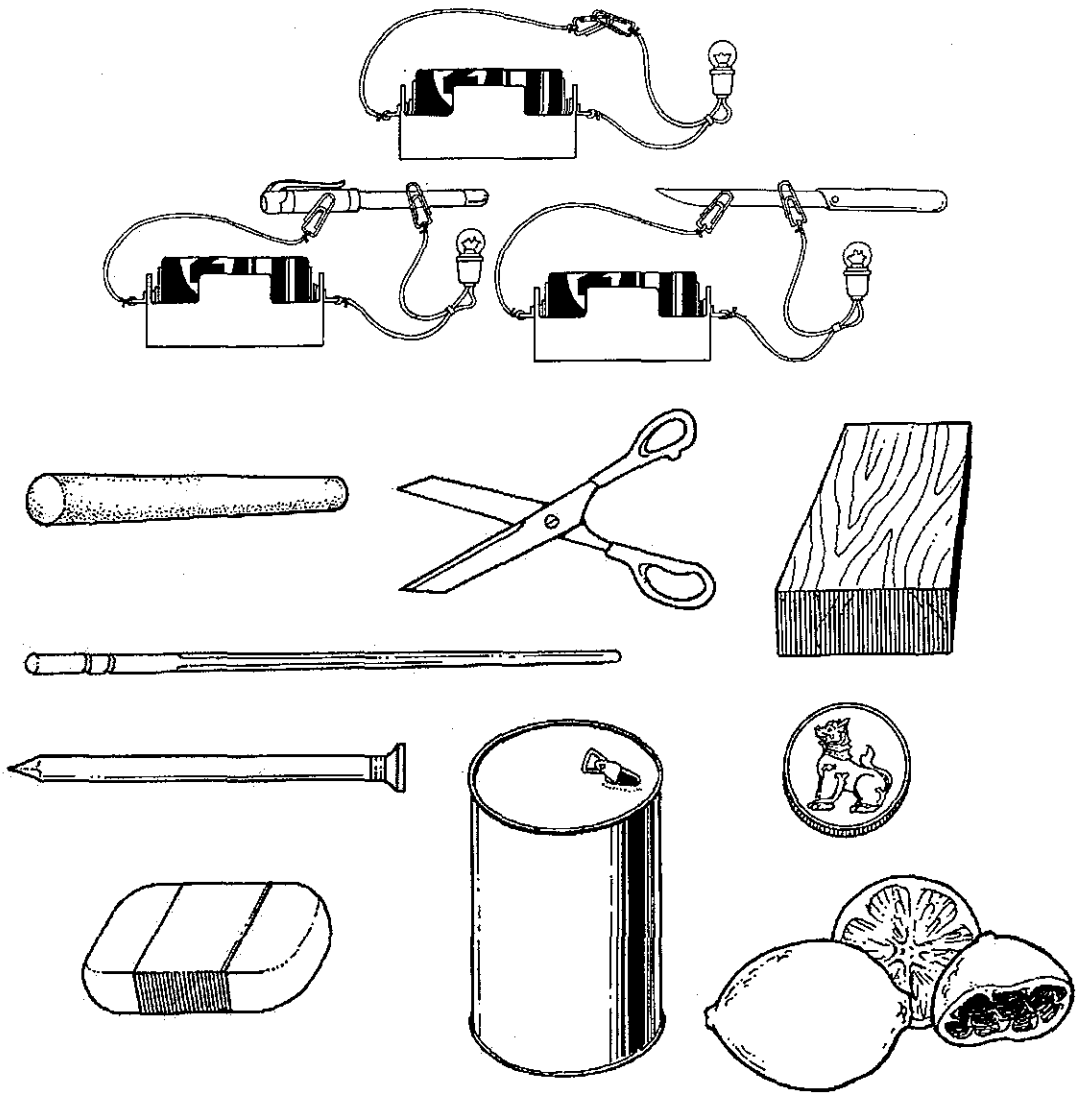
Activity 6 Tester (Conductor and Insulator)

Teaching/learning material	Bulb, wires, battery, 2 metal clips, materials to test (coin, iron bar, lemon, tomato, pencil, eraser, empty tin, a piece of wood, paper, milk, glass, etc.)
Concept	Some materials are conductors of electricity and some are insulators (non conductor/very poor conductor).

First of all, make the tester, which is very similar to the electric circuit with one battery. In the case of the tester, we use 2 clips instead of the switch we made with a clip and pin.

It is also important for children to predict which materials are conductor among the prepared.

After they make predictions, let us test if they are conductor or not as the diagrams below shows.



Lesson Plan 7-1

Lesson topic: Electric circuit
Learning objectives: Be able to explain that electricity flows when an electric circuit is complete
Be able to make an electric circuit
Teaching/learning materials: Small electric bulb, dry cell, wire, pins, metal paper clip, bulb holder with two wires attached, timber board with loose texture or styrene foam (2"X3"), battery box, knife and tape.
Teaching period: 70 minutes (2 periods)
Teaching/Learning procedure

Learning Activities	Time	Teaching/ learning materials	Points to be noticed.
Introduction Teacher has to tell children that today's lesson is very useful. Then, introduce the lesson with the following questions. By showing a dry cell, ask, what is this? Have you ever seen this? Teacher lets children study the dry cell and has them tell whatever they see. In which place is the dry cell used? What is obtained from the dry cell?	10		Let the children discuss among themselves and tell. Teacher has to accept whatever the children's findings.
Core/development (refer to Activity 1) Teacher continues to ask children what materials are necessary to light a bulb and how to make it. Praise the children if they answer an electric bulb and wires have to be connected with the positive pole and negative pole of a dry cell. Tell children that experiment will be carried out to see if the electric bulb lights or not.	5		Help the children to express what they think.
Activity A Teacher gives children small electric bulb, dry cell and wires to make practically an electric circuit to light a bulb. Praise the children who could connect to make the electric bulb light. If the children cannot make teacher has to explain the procedure as follows: - Put the dry cell into the battery box and connect each end of the battery box with each wire. - Put the bulb into the bulb holder and each wire from the bulb holder is connected with each wire from the battery box.	15	Electric bulb, dry cell, wire, battery box, bulb holder.	In connecting an electric circuit, let them connect with the copper wire inside the wire. Explain that the path in which electricity flows is the electric circuit. Make sure that children notice from the experiment that when the connection of electric bulb and wire with the positive terminal and negative terminal of the dry cell is complete electricity flows and the electric bulb lights.
After the experiment, ask the children 'How is it seen? Why?'	5		When an electric circuit is complete electricity flows and the electric bulb lights. Record whatever the children say.

Learning Activities	Time	Teaching/ learning materials	Points to be noticed.
Activity B (Making a switch with a metal paper clip) Teacher distributes materials to experiment to children and explains the procedure as follows. - Put the small electric bulb into the bulb holder - Put the dry cell into the battery box and connect each end of the battery box with each wire. - Coil the paper clip with the end of the wire attached to the positive pole of the dry cell as shown in the figure. - After that put a pin into the paper clip and press it into the timber board or styrene foam.	15	Small electric bulb, bulb holder, dry cell, battery box, (3) wires with (8 inches in length), (2) pins, metal	Let the children do the experimental steps as explained by the teacher
- One end of the next wire is coiled round the second pin and presses it into the timber board and the remaining end of wire is connected with the wire from the bulb holder. - The remaining wire from the bulb holder is connected with the base (negative pole) of the dry cell. Let the children observe by touching the metal paper clip with the two pins.	5	paper clip, timber board (styrene foam) (2"X2")	.Let the children notice from the experiment that the disconnection of electric circuit between the two pins is made to connect with the metal paper clip so that the electricity flows and the electric bulb lights.
After the experiment, ask the children 'How do you find? Why?'			When electric circuit is complete electricity flows and the bulb lights. Encourage children to say their ideas
Again, let the children observe by moving the metal paper clip not to be touched with the second pin.	7		Let the children notice from the experiment that the disconnection of electric circuit occurs between the two pins so that electricity cannot flow and the electric bulb does not light.
After the experiment, ask children. 'What do you find? Why?'			
Explain children that when a metal paper clip is touched with a pin, it is like switching on so that electricity flows and the electric bulb lights, when a metal paper clip is not touched with a pin, it is like switching off so that electricity cannot flow and the electric bulb does not light.	3		If the electric circuit disconnects electricity cannot flow and the electric bulb does not light. *Encourage children to say* their ideas
Conclusion According to the finding from experiment, discussion and review, let the children conclude by reviewing as follows: Electricity flows when an electric circuit is complete. Let the children write down the above concept in the notebook.	5		

Lesson Plan 7-2

Lesson topic: Electric circuit with 2 batteries

Learning objectives: Be able to explain how to connect 2 batteries in one circuit.
Be able to explain the differences between series and parallel circuits

Teaching/learning materials: D sized batteries, Battery boxes, four wires of 5 inches in length, an electric bulb to which two wires of 5 inches in length are attached, torch

Teaching period: 70 minutes (2 periods)

Teaching/Learning procedure

Learning Activities	Time	Teaching/ learning materials	Points to be noticed.
Introduction What materials are required for an electric bulb to become light? (Battery, bulb, wire) How is it done to make a bulb become light by using batteries, a bulb and a string of wire? (If batteries, the bulb and the wire are connected, the bulb will become light.)	10		Each child will be asked.
Development (refer to Activity 3) What do you usually bring when you go outside in the dark at night? (Torch,……..) Why does the torch light on? (Because of the batteries put inside it, …….) How many batteries have you ever seen being put in a torch? (One, two, three, …….) In which position are batteries put inside? (The negative end of one battery is connected to the positive end of other battery.)	15	Torch	
After that, the teacher draws five diagrams (refer to Activity 5 and choose 5 circuits) of electric circuits made of two batteries on the blackboard.			The teacher shows how the batteries are put in a torch. The teacher draws the following five diagrams on the blackboard. No. 1,2,5,6 and 8 in Activity 5 would be recommended.
Which circuit out of them do you think will make the bulb light? Why? Let children think about and guess the above question and express their opinion by groups.			Take tally to record the children's answers on the blackboard.

Learning Activities	Time	Teaching/ learning materials	Points to be noticed.
After that, the teacher distributes two battery boxes with batteries, four wires of 5 inches in length and a bulb to which two wires of 5 inches in length are attached. Children carry out each experiment as shown in the figure.	30	D-sized batteries, Battery boxes, four wires of five inches in length, bulb to which two wires of five inches in length are attached	Make sure that children see that the bulb lights because electric current flows from the positive end to the negative end.
After doing the experiment, let's ask children which circuits among 5 are good to light? (They are likely to say No. 2 and No.6) Children draw two circuits on their notebooks and teacher asks two children to draw the circuits on the black board. Then, teacher makes two types of circuits and children observe both of them. Encourage them to speak out their findings.	10		The children will answer that the bulb is lighter in a series circuit or a parallel circuit. In the circuit No.2, two batteries are connected in series. The light of bulb in series connection is much brighter than that of bulb in the circuit of using only one battery. In the case of series circuit, the bulb lights brighter, which causes that the energy of batteries is spent more rapidly. In the circuit No.6, the brightness of the bulb in parallel connection is the same as that of the bulb in the circuit with only one battery. In case of connecting two batteries in parallel, bulb can light longer that the circuit with one battery.
Conclusion According to the findings from the experiment, the teacher concludes the lesson by saying as follows; It is possible to make an electric circuit with several batteries. There are mainly two ways to connect 2 batteries, one is series and the other is parallel. It is also recommended to mention characteristics of two types of circuits.	5		

Lesson Plan 7-3

Lesson topic: Tester, Conductor and Insulator
Learning objectives: Be able to explain some materials are conductors and some are insulators of electricity
Be able to make a tester and check materials with it
Teaching/learning materials: Small electric bulb, dry cell, bulb holder, wire, scissors, knife, cello tape, various materials to test
Teaching period: 70 minutes (2 periods)
Teaching/Learning procedure

Learning Activities	Time	Teaching/ learning materials	Points to be noticed.
Introduction By showing a wire, teacher asks children the following questions. - Where is a wire used? - Have you ever made an electric circuit with electric bulb, dry cell and a wire? - Will you connect with the plastic cover of wire or with copper wire inside to make a circuit? Why? - Which one is conductor and which one is insulator out of the two parts in a wire, plastic cover and copper wire?	7	Wire, blackboard and chalk	
Ask the children think and discuss the above questions by group and present after the discussion.			Teacher has to record on the blackboard.
Development/ Core (refer to Activity 6) 1. Teacher distributes the materials to the children groups and children observe those materials.	3		
2. Teacher asks the children to guess which thing is conductor and which one is insulator.	15		
Name of materials / Conductor / Insulator 1. Nail 2. Chalk 3. Steel spoon 4. Plastic ruler 5. Needle 6. Wooden stick 7. Coin 8. Eraser 9. Juice can 10. Lime 11. Pencil (core) 12. others,,		Various materials to test whether they are conductors or insulators	Take Tally to record. Teacher can change materials which is easily available.
Children discuss why they guess so. 3. Then, teacher tells the children that their guesses will be examined if they are right or wrong through making a tester, a device that identifies a thing if it is a conductor or not.			

<table>
<tr><th>Learning Activities</th><th>Time</th><th>Teaching/ learning materials</th><th>Points to be noticed.</th></tr>
<tr><td>4. Then, ask the children make a tester with a small electric bulb, a dry cell, and a wire.

- Put the electric bulb into the bulb-holder.
- Insert the dry cell into the dry cell- holder.
- Connect one end of wire with the positive terminal of dry cell and the other with the wire from the electric bulb.
- Connect one end of the 2nd wire with the negative terminal of dry cell and the other with a metal paperclip.
- Connect the remaining end of the wire from the bulb-holder with another metal paperclip.</td><td>10</td><td>two wires of 10 inches long, small electric bulb, dry cell, bulb holder, battery box</td><td></td></tr>
<tr><td>5. By putting the thing to be tested between two metal paperclips as shown in the diagram, let the children investigate if the electric bulb lights or not.
6. After examining all the materials, teacher asks the children to categorize these materials and to fill in the table.
<table><tr><th>Conductors
(Electric bulb lights)</th><th>Insulators
(Electric bulb does not light)</th></tr><tr><td></td><td></td></tr></table>
Teacher asks the children why it is described that some materials are conductors and some are insulators.
Have the children discuss the findings from the experiments and present by group.

Conclusion
Synthesizing the children's answers, teacher writes the main point of today on the blackboard according to what the children said.

Some materials can conduct the electricity and they are called conductor.
Some material can not conduct electricity and they are called insulator</td><td>15

15

5</td><td></td><td>If putting different materials between two cut ends, bulb will light or will not light according to the materials being put.

Children will be able to differentiate between the conductor and insulator through observing the bulb lights or not.

The presentation of the discussing points by group will be recorded.

Children will understand that insulators protect the danger of electricity.

In fact, there is no clear line between conductor and insulator. For example, water can not conduct electricity when only one battery is used. It however can when more batteries are connected to the tester.</td></tr>
</table>

Assessment

Point of Assessment

Interest/Attitude/ Motivation	Scientific thinking	Technique	Knowledge and understanding
Is s/he interested in each part of electric circuit? Is s/he interested in electricity? Is s/he motivated to make electric circuits? Is s/he interested in creating something original with bulb and batteries?	Is s/he able to predict the result? Can s/he imagine roles of each part in the circuit? Can s/he think of the difference between complete circuit and incomplete circuit? Can s/he think of difference between series and parallel circuit? Can s/he categorize conductors and insulators?	Can s/he properly connect each part of circuit? Can s/he check if the material is conductor or not with the tester? Can s/he communicate with the teacher and peers in relation with the lesson?	Does s/he understand that electricity flows when an electric circuit is complete? Does s/he understand that there are some materials which conduct electricity and some which do not?

Oral Assessment/Group Discussion

1. How can you tell the positive side and negative side of a battery?
2. What is the difference between complete circuits and incomplete circuits?
3. Supposed that there is a circuit with a battery. If you change the positive side and negative side of the battery, do you think the bulb still lights?
4. Why do we need to use copper as wires for circuit?
5. What kind of circuit is inside of a torch?

Written Assessment.

1. Choose a circuit which is good to light from the pictures of circuits. (refer to Activity 2, 5)
2. What is necessary to make a complete circuit with a bulb?
3. Draw the complete electric circuit with a bulb.
4. Differentiate the following materials into materials that conduct electricity and materials that do not conduct electricity.

   Bamboo, gold, silver, wooden ruler, rubber, chalk, iron rod, steel spoon, plastic cup, rubber ball, glass, book, ceramic plate, coins, orange and lime.

Message to Teachers

Ask children various questions to see if children understand main points of the topic.