The Thinking Classroom

Lesson Plans for Primary Teachers

SCIENCE: MATTER

The Thinking Classroom
A Guide for Teachers

Introduction
This module containing seven primary level lesson plans (LPs) will lead you towards transforming your classroom into a Thinking Classroom.

The Aims of Education
"To educate Pakistanis to be:
- Seekers of truth and knowledge who can apply both for the progress of society;
- Creative, constructive, communicative and reflective individuals;
- Disciplined, productive, moderate and enlightened citizens;
- Capable of effectively participating in the highly competitive global knowledge-based economy and the information age; citizens committed to creating a just civil society that respects diversity of views, beliefs and faiths."
(Ministry of Education, Government of Pakistan, 2006)

So with these aims, surely we need to change something in the way we teach!

Why we need Critical Thinking (CT)
Everyone thinks, but a lot of it is biased, distorted and uninformed. The quality of our life and what we create and build and the decisions we make depend on how we think. Poor thinking and lack of CT can lead us to many poor decisions.

What does CT entail?
- Assessing, analysing and reconstructing any problem, situation or content
- Making informed decisions
- Logical thinking and reasoning
- Being able to create and innovate; build something new and original
- Out of the box thinking and questioning deeply from different perspectives
- Thinking about thinking & how to improve it

Why it is difficult to be Critical Thinkers in our school system
- Too many facts
- Too much memorising and too little thinking
- Lecture and rote memorisation, which does not require critical thinking
- Students are not "trained" to think

Teaching Framework for the TTC Lesson Plans
You probably teach one new concept (or chapter) for one or maybe two weeks. We have developed these LPs on the premise that it is one five-day week. If it is two, or you carry on until the children have understood, you can explore the concept in more depth.

A suggestion for the Five-Day LP is that for the first three days you deliver the content from your textbook the way you always do and then spend the next two days on CT and active learning. Active learning is when children are engaged in hands-on activities and in making sense and meaning of the content themselves rather than listening passively to a teacher's lecture on a topic. Some examples of active learning are: classroom discussions, small group work, working with materials, debates on an idea, problem solving and listing ideas, making presentations. So, how about creating some excitement in your classroom with active learning.

Guidelines for You the Teacher
Young children are not too young for complex concepts
You may think that some of the ideas or concepts being introduced in these LPs are too difficult for such young children. In reality, however, we are introducing them to ideas that they are already familiar with because they have either heard their parents talk about them or have heard someone else either in person or on television or radio. What we are doing here is giving them the opportunity to explore these ideas, to think about them in a focused manner. Please remember, we are not expecting them to give us correct, accurate answers.

Listen to and accept children's answers no matter what
Let the children be inventive with their responses and if their answers sound amusing or strange, we still need to accept their answers and extend the conversation. Concepts are constructed gradually

over time by exploring their attributes and thinking critically about them and coming to our own understanding of them. Both children and adults go through this process when they encounter something new. The something new can be either concrete or abstract.

Engage with the children
It is important for teachers to create a climate of trust and comfort where the children don't feel threatened or inhibited. Talk to them conversationally, ask after them and show them that you are interested in them as individuals. When the activity says make a circle, you need to decide what will be most appropriate for that activity, whether to sit or stand in a circle and you should sit or stand with them.

Give children space and time to think
During discussions, remember that some children may need a little time and positive encouragement to express their thoughts and some may prefer to remain quiet for a few seconds or minutes. Do provide waiting time after asking a question to give less confident children an opportunity to formulate their responses. Remember to smile or laugh when something is funny. Your facial expressions should match what you are saying and remember to speak in a soft, natural, conversational tone.

Planning the lesson for the week ahead
As the teacher, you understand your local context, what your children can do and what their interests are. You also know how much space you have in your classroom and what resources are available to you, so it is up to you to decide how to implement the active learning CT LP in your classroom. Do please read through the entire LP carefully and decide before the new week begins, what to do each day for the week ahead and also prepare all the materials you will need.

Time required for the LP
We have not mentioned a time frame in each lesson plan but it will probably take about 80 to 90 and in some cases about 110 minutes, spread over two days. It depends on you, the number of children you have in class and your timetable. You may need more or less.

Group size
Some segments of the plan require the entire class and no small groups. When you need to divide them into groups, and the LP says divide the children into groups of five you can do this easily if you have 25 children present that day. If you have one or two children left, it is not a problem, just accommodate them into any group. If you have 36 children, you can divide them into groups of six.

Group roles
It is a good idea to assign roles to the members of each group so that everyone knows what to do. The entire group must participate and share their ideas and views and if the task calls for more roles then listed here, please go ahead and delegate the tasks. There must be:
A **timekeeper** who makes sure the work is done in the timeframe that you have given them.
A **note taker** who listens to what group members are saying and writes down everything based on the task you have given them.
A **presenter** who will present the group's work when everyone has finished and you give the signal to present.

Structure of The Thinking Classroom Lesson Plan
Each LP for Classes 1 to 5, ECE and Multi-age follow a similar structure. The ECE LPs have a couple of additional features that are not in the Primary Level LPs. These are differentiated with an * at the beginning. All the modules and topics are linked to The National Curricula, developed by the MoE, Government of Pakistan, 2006-07.

This is how the LPs have been structured:

1. Curriculum Link: The link is stated exactly as it is in the relevant curriculum. The Student Learning Outcomes (SLOs Primary Level) and Expected Learning Outcomes (ELOs ECE) and page numbers are mentioned so that you can find it easily in the document. In certain curriculum documents bullet points have been used to separate SLOs, in others letters and in some roman numerals have been used. We have used these exactly as they are in the respective curriculum. The SLOs and ELOs may not be in sequence, for example, i ii iii or a b c. This is because all the SLOs and ELOs for one topic or theme are not addressed in one LP. So only those that are being addressed are mentioned. So you may see, i iv & viii or a d & g.

2. Students' Learning Outcomes: These are the same as the objectives in a LP. We are familiar with objectives and have been taught that before we plan a lesson we have to be clear about our objectives for that lesson. We have to think about what we hope the children will learn when we have completed that lesson. So the SLOs are the objectives of the plan.

* **Expected Learning Outcomes:** These are also the objectives of the lesson plan. So why use the word 'expected' instead of student? The NC-ECE charts out learning outcomes that young children are *expected* to achieve. Given the diverse developmental levels, learning styles and pace of learning, many children may not achieve all the outcomes (objectives) at the end of the lesson or even in the one year that they are in the ECE/pre-primary class. Therefore, the outcomes for this age level have been termed as "Expected" and educators and supervisors should not be overly concerned about children completing all the activities or meeting each and every outcome. This however does not mean that teachers should not support children's curiosity and learning, but that they should not force them to learn something they are not yet ready to learn. It is the process and not a 'perfect' product that's more important at this age and stage.

3. Prior Knowledge: Studies show that learning progresses primarily from prior knowledge, and only after that from the materials we present to students. Think about this. We teachers spend so much time gathering materials, which is important no doubt, and necessary too for good teaching, but only if we build on children's prior knowledge. Many of us are also guilty of hurrying through teaching some concept or skill, and not taking the time to slow down or ask the children what they already know about the concept or topic. So if we want to ensure that children make important mental connections about the content we are about to teach, we must build on prior knowledge.

4. Resource Requirements & Preparation: This part of the LP will tell you what materials you will need to implement the lesson plan. To make it easier for you, it clearly indicates what you will need for the Three Phases of the LP: the Beginning, Middle and Conclusion (BMC phases) and what you need to prepare beforehand so that you don't waste any time during class. If the LP requires pictures of food, buildings, uses of water, anything at all, you can find pictures in calendars, diaries, newspapers and magazines. Don't forget to look online too. Whenever possible, please recycle! Save old magazines, newspapers, greeting cards and invitation cards and use these to make instruction cards and slips for group work. Empty biscuit and tea boxes and *gatta* are also handy for making resources. Empty shoeboxes are extremely handy for storage and they stack well too.

5. Methodology: Each LP is divided into three distinct phases based on a BMC Model. Here is a brief explanation on what each phase entails:

The **Beginning** Phase: In this phase, you can ask children to think about or ask questions about the topic. This phase will help you to:
- Informally assess what the children already know including any misconceptions
- Set the purpose for learning
- Focus attention on the topic

The **Middle** Phase: In this phase, you will lead children to explore the topic in more depth. They will engage in finding out, making sense of the material, answering their prior questions and finding new questions. This phase will help you and the children to:
- Revise expectations or raise new ones
- Identify the main points
- Make inferences about the material
- Make personal connections to the lessons

The **Conclusion** Phase: During this phase you will give children the opportunity to reflect on what they have learned, reflect on how their thoughts have changed and think about application of the new knowledge. This phase will help you and the children to:
- Summarize the main idea
- Share opinions
- Think about application

6. Assessment: This part will suggest ways in which you can assess what the children have learnt and evaluate whether the SLOs or objectives have been met. The assessment strategies suggested here are not traditional paper and pencil tests, but please do try out a different way of assessment.

* **Extension Activity:** In this section, you will find some activities you can engage the children in at a later stage. As the heading suggests, these activities will help children explore the ideas in the LP in different ways thereby helping them understand the concept better.

* **A Note for the Teacher:** Under this heading you will find tips to help you understand how to address the topic with young children or how you can work on the same concept throughout the year.

CT Questioning Techniques

Throughout the LPs you will see a reference to CT questioning techniques. In the questions below some names of girls and boys have been used. Needless to say, these are only examples; replace these names with names of children in your class. Try and make sure that you address each child over the course of a few days so that nobody feels left out. You can follow these steps to involve children in thinking critically.

Ask open-ended questions: These are questions that invite more than one plausible answer. They have no right answer and no wrong answer either. You need to listen to and 'accept' all answers. Open-ended questions allow the formulation of any answer, rather than a selection from a set of possible answers in the questioner's mind.

Ask follow-up questions: These are questions you will ask after one child has responded to a question, for example, "What can you add Nida?" or "What is your opinion, Omar?"

Provide feedback that neither confirms nor denies children's responses: If you provide this kind of feedback, then the discussion remains open. For example: "That is very interesting ... I hadn't thought about that before."

Survey the other children: This kind of questioning also takes place after a child has responded to a question. Rather than you saying that it is correct or incorrect, survey the children by asking, "Who agrees with Ali?" "Who disagrees with him?" "Why?" Tell them it is okay to agree or disagree as long as we don't hurt anyone's feelings and do it in a polite way. It does not mean we don't like the person we disagree with.

Encourage children to direct questions to other children: You can do this by saying, "Omar, ask Komal if she can add something to your response?"

Use think-aloud: When a child comes up with a solution to a problem that has been posed as part of the lesson, you can ask, "How did you figure out that answer Tariq?"

Call on all children: Involve the entire class, not only those who raise their hands. But move on quickly to another child if someone chooses not to answer.

Assure the children that there are no wrong answers: Encourage everyone to have a go at answering a question by saying, "There are many possible answers to this question. Come on, give it a try!"

Encourage the children to be imaginative: Quite a few LPs suggest this approach. You can use it in other LPs too. Just relate it to the topic and say, "Imagine what would happen if...?"

I Spy with my Little Eye

Curriculum Link: National Curriculum for Early Childhood Education, 2007.

Key Learning Area: Language and Literacy, Competency 2, pages 19 – 20.

Competency 2: Children will describe objects, events and their plans for the day.

Expected Learning Outcomes

By the end of the year children will begin to develop the attitudes, knowledge and skills to:

a. Name things in their environment

b. Describe and talk about pictures

Prior Knowledge

Young children are keen, curious observers and from the time they learn how to talk, they ask questions about what they see around them in their environment. They are able to identify various objects in their home, in the neighbourhood, in the shops and other places they go to with their parents and relatives. They know that there are certain objects that are too heavy for them to pick up or move from one place to another and that there are objects that they can lift and carry. They know that water or milk can spill if they are not careful and have observed water, tea and milk being poured into glasses, mugs and cups.

Teaching Material & Preparation
- Beginning: A pencil and other solid objects in the classroom

- Middle: A bottle of water, a carton of juice and a carton of milk (large or small). You can also bring in different kinds of oils, such as, hair oil and cooking oil. Some small cups, glasses and bowls and a large tray

- Conclusion: 'The Matter Song'

Methodology

• *Beginning:* For this activity children can sit either in their own places or on the floor in a circle. It is up to you. Tell the children that all of you are going to play a game called 'I spy with my little eye'. Explain to them that you will ask them a riddle and they have to guess what it is, but that it will be an object that is somewhere in the classroom and can be seen. You can begin by saying: "I spy with my little eye something that is long and thin and made of wood." One of the children may say, 'scale/ruler'. Then you can say, "Yes, the scale is long and thin and yes, it is made of wood, but I was thinking of something else. I was thinking of something that I can write with." When they have guessed the right object introduce them to the word solid. Just say simply, "Yes, and the pencil is a solid object."

Then say, "I wonder if we can change the shape of the pencil if we move it to another place?" "Do you think one of you could help me move it to the floor?" Let the children try and then say, "The pencil is a solid and it doesn't change its shape when we move it." Try moving it to another place in the classroom and let the children see if it changes its shape. Build some suspense and excitement when you are moving the solid to different places to see if it changes its shape. "No, it doesn't change its shape no matter where we move it."

Then ask, "I wonder if you can put your finger through the solid pencil." Let the children try. Then say, " The pencil is a solid, it doesn't change its shape when we move it to a new place and we can't put our fingers through it."

Continue the I Spy game with other solid objects in the classroom. And each time, end with reinforcing that the object that was guessed is a solid and that it doesn't change its shape when moved to a new place and that a finger does not go through it.

• *Middle:* Ask all the children to sit in a circle on the floor. Sit with them. When all the children are seated comfortably and everyone can see you, you can introduce them to liquids and some of the properties of liquids. Place the tray in front of you and put all the small cups and glasses and bowls on it. Picking up the bottle of water, pour some into the glass. Tell them that the water is a liquid. Let some children try and put their fingers through it. Then say, " Water is a liquid and we can put our fingers through it."

Next you can say, "I wonder if the water will change its shape if we pour it into the bowl. What do you think?" Wait for their answers and then pour it from the glass into the bowl and draw the children's attention to how the water has taken the shape of the bowl. "Oh! What happened?" The water does change its shape when we move it. The solids didn't do that!"

Let the children see if they can put their fingers through it. Again, have fun with this and show some surprise and excitement. Then say, " Water is a liquid, it does change its shape when we move it to a new place and we can put our fingers through it." Move the water to a cup and repeat the process.

Then you can carry out the same procedure with the juice and milk and also with the different oils. Make sure all the children in the class are involved in listening and that by the time you are done all of them have had an opportunity to try and put their fingers through the solids and liquids.

• *Conclusion:* Stand in a circle with the children and sing this song about 'Matter' to the tune of 'Wheels on the bus' from: https://www.superteacherworksheets.com/songs/matter-song.pdf

The 3 states of matter are solid, liquid, gas | Solid, liquid, gas, Solid, liquid, gas |The 3 states of matter are solid, liquid, gas | All day long.

The floor is a solid, you can jump up and down| Jump up and down, Jump up and down |The floor is a solid, you can jump up and down | All day long.

Water is a liquid you can drink right down | Drink right down, Drink right down | Water is a liquid you can drink right down | All day long.

The 3 states of matter are solid, liquid, gas | Solid, liquid, gas, Solid, liquid, gas |The 3 states of matter are solid, liquid, gas | All day long.

Extension Activity: Take the children for a walk outside the classroom and play the game with a slight difference. Before you leave the classroom tell them that this time you will play 'Whispering I Spy', so that you don't disturb the other classes. The children can move about and look around for the object they have to identify, but then come close to you to tell you what they have guessed. If you think the children are ready for it, you can bring some balloons and ask them if they know what is inside the balloon. Ask them what will happen if you open the string of the balloon or if you prick it with a pin. Some of them might have seen this happen. You can then introduce the word gas to them. Sing 'The Matter Song' again and include these lines after you have sung about solids and liquids:

Air is a gas you can breathe right in |Breathe right in, Breathe right in | Air is a gas you can breathe right in | All day long.

A Note for the Teacher: Use every opportunity to talk to the children about solids and liquids. Snack time is a good time to do this because there will be different kinds of 'matter' in each snack box and bottle. In this activity you have introduced two states of matter to young children and in the extension activity you have introduced a third. You don't have to talk about matter or atoms or molecules but when they get to class 1 they will be familiar with solids, liquids and gas and their properties.

Please make sure that nothing is wasted after the activities. Use clean utensils and hands for the activity with liquids so that the can be used later, for example the water can be boiled for tea, the oil can be used for cooking and the milk can be fed to a puppy or kitten.

Objects Around Us
Class 1

Curriculum Link: National Curriculum for General Knowledge, Grades I – III 2007, Objects around us, page 19.

Students' Learning Outcomes

- Recognise that the same object can be made from different materials
- Recognise that some objects are made of more than one material.

Prior Knowledge

By this age children are familiar with and can identify different objects in their homes, school and neighbourhood. They can name and group objects based on shape, size, texture and weight. They have some idea that objects are made of different materials such as wood, paper, rubber, and plastic. They are also aware of some of the basic properties of different materials such as, breakable, light, hard, and soft. They can identify objects made from different materials. However, they cannot recognise that different materials can be used to make the same object.

Teaching Material & Preparation

- Beginning: A variety of objects used in daily life, made of different types of materials such as plastic, mud, glass, rubber, wood and steel, for example, ruler (plastic, wooden and steel), cup or bowl, tray, pen, spoon, plate, ball, pencils, paper, eraser. The Table: All About Materials. Please see page 8

- Middle: Seven strips of paper with the 'What Would Happen If' Questions written on them. Please see page 8

- Conclusion: Board and chalk

Methodology

• *Beginning:* Introduce the activity by showing the children the objects you have collected. Tell them that they will be divided into groups and each group will be given some of these objects to think about and talk about. They will have to discuss the objects that you give them, including the material it is made of and its uses. Once they are done with the discussion in their small groups, they will have to share what they have discussed with the rest of the class. Repeat the instructions or address any questions the children may have.

Then divide the children into small groups and give each group some of the objects made from a variety of materials. Give them time to look at and handle the objects and talk about them. You can circulate between the groups and observe them. Encourage the children to focus on what that object is made of and what it is used for.

Before the groups start sharing their findings, draw the Table: All About Materials, given on page 8, in order to record their points. Now invite each group to share what they have discussed in their groups. As they share, write down their points in the respective columns on the table you have made. The table on page 8 is an example and the children will come up with their own ideas.

Once the table is complete, review it with the children and ask them if they want to add something in any of the columns such as the uses of different objects or if they have seen or used the same object made with a different material. Let them think through it and share their ideas.

• *Middle*: Introduce another group activity by saying, "Now I will give each group a question to think about and discuss. Then we will have a whole class discussion about the question and your responses."

After the children settle down in groups, give each group a paper strip with a question and ask them to discuss what they think would happen in the given situation. Ask them if they are clear on what to do. Wait for the children's response and repeat the instructions if they haven't understood. Some of the children may find it difficult to read or comprehend the question, so you need to go to each group and facilitate them as needed. Give them time to understand and discuss the question and the situation.

After all the groups are done, invite the presenter from one group at a time, to read aloud the question and share the group's response to the situation in the question. As they do that, ask further questions such as, "What would happen if we wore clothes made of paper?" Sum up the session by

sharing that different materials have different qualities, for example, hard, soft, light, heavy, strong, absorbent, clear. Depending on the qualities of the material and our needs and requirements different objects are made from them.

• *Conclusion:* To consolidate the session, introduce the individual task by saying: "Now, you will work individually. Look around for objects in the classroom that are made from more than one material. You can also think about the different objects that we use in our homes. Then each one of you will have to draw any three objects that you use in your daily life which are made from a combination of materials. You will also have to write the names of the materials used to make these objects." To start the children off, you can give examples of objects made of more than one material. Repeat the instructions and address questions if any.

Give children time to think about and carry out the task. These children are young and are developing their writing skills so they may face difficulty in writing the words. You can walk around the class and help them with spellings.

Assessment
When it is time for assessments, give children the opportunity to talk about their work individually. This will help you to assess their learning and understanding of the concept. You can ask them to bring objects from home made from a combination of materials, for example a frying pan, pencil with eraser, a kettle with a plastic handle and spoons with wooden or plastic handles or an umbrella to talk about.

Table: All About Materials

Material	It is used to ...	It is made of ...
Spoon	Eat food	Steel, plastic
Cloth	Cover ourselves	Cotton, wool
Ball	Play, bounce	Rubber, plastic

'What Would Happen If' Questions

1. What would happen if, your clothes were stitched with a metal wire?
2. What would happen if, the iron we use to press our clothes had a metal handle?
3. What would happen if, books were made of wood or metal?
4. What would happen if, spoons were made of paper or cloth?
5. What would happen if, balls were made of wood or steel?
6. What would happen if, your umbrella was made of paper?
7. What would happen if, your shoes were made of wood or steel?

Natural Materials and Human Made Objects
Class 2

Curriculum Link: National Curriculum for General Knowledge, Grades I – III 2007. Uses of Earth's Resources, page 25.

Students' Learning Outcomes

• Differentiate between the materials that are found naturally and the objects that are made from these materials by humans

Prior Knowledge

By this stage children are well aware of the objects in their daily lives and their uses. They can categorise objects based on shape, texture and even usage. They can recognise that objects are made of different materials and can group objects based on the materials they are made from such as, wood, paper, plastic, metal and so on. They can also recognise that some objects are made of more than one material. Earlier on in this class, they have also studied the different resources of the earth and how people use those resources to meet their needs.

Teaching Material & Preparation

- Beginning: Story "The Four Friends". Please see page 10

- Middle: Objects such as plastic and wooden spoons, cups or bowls made of clay and steel or aluminium, plastic bag, paper and cloth bag, pencil, eraser, paper, glue, plastic ruler, wooden and steel ruler, any cotton and woollen clothes, cotton, plastic and wooden chair, a leather bag and a pair of shoes. Board and chalk

- Conclusion: Paper and pencil

Methodology

• *Beginning:* Begin the class by telling the children that you will tell them a story today. If possible sit in a circle on a mat and read the story aloud. Vary the tone of your voice and your facial expressions to make the story interesting.

After you are done, have a whole class discussion and ask the following questions:

- How do you think the four friends help Ali on the farm?

- What do you think would happen if any one of those friends were missing?

- Do these four friends help us in other ways too, apart from farming? Can you tell me how?

- Can you think of some more friends other than these four? You know that they help us in many ways!

Help the children understand that animals are also our friends, because they help us in many ways. Ask them if they can think of the different ways in which animals help us. Accept all their responses and sum up the session by sharing that these friends are all natural materials that not only help us grow food, but also help provide us with many objects that we use in everyday life.

• *Middle*: Introduce the group activity by saying, "Here is some material for you to work with and for this activity you will be divided into groups. Each group will be given some objects to look at and discuss what they are made from and where that particular material comes from." Repeat the instructions or address questions if needed.

Divide the children into small groups and give them different objects. Give them a little time to look at the objects you've given them and discuss what it is, what it's made from and where that material comes from. You role is to go around the classroom and listen to each group. It will help you to assess their prior knowledge and understanding of the concept.

Next you need to draw three columns on the board with the headings: 'Object' 'Made Of' and 'Natural Resources'. When the children are done with the discussion, invite them to share the objects they have and which material those objects are made from.

As each group talks about their objects, fill in the columns on the board. Encourage them to compare objects with the same uses but made from different natural resources. For example, leather and cloth bags, metal, plastic and wooden spoons. Ask them the following questions and encourage them to give reasons for their answers.

- Why do you think wooden or metal spoons are used for cooking?

- Can you give an example of any material that changes with heat?

- Can you think of a bag that can be used to hold heavy objects?

- I wonder whether a wooden or plastic chair would be stronger? Any ideas?

• *Conclusion:* Introduce the next activity by saying, "Now move around the classroom slowly and look carefully at the different objects you see and think about the materials that they are made from. Each one of you will need to record your observations on a piece of paper. Make two columns in your notebook, in one column write the name of the object and in the next column write which material that object is made out of." Show them how you drew three columns on the board and tell them they have to draw only two columns. Give them time to move around and look at the different objects and talk about them.

After they are done, ask them to share their observations. As they share, pose the following questions:

- What is the most common natural material used in the classroom?

- Why is it the most common natural material used?

Let them share their views. Encourage them to give reasons for their answers to the questions. Sum up the session by telling the children that availability and usability of different material, is based on its properties such as soft, hard, rough, smooth, long-lasting (durability), inexpensive, readily available and so on.

Assessment
You can assess children's learning and understanding of the concept by asking them to write the names and draw pictures of different natural materials and the different objects made from those natural materials.

Story: "The Four Friends"

Far away from the noisy city there was a small and beautiful village. People in this village were mostly farmers and they used to plant vegetables in their fields. They grew many vegetables such as carrots, turnips, and beetroot.

People from the village were very loving, kind and hardworking. In the village, lived a boy whose name was Ali. He studied in the village school and helped his father plant seeds in the field.

One day, when the planting season was near, Ali's father asked him to help plant seeds in the field. Ali was very excited and happily went along with his father. It was very early in the morning, the sun was rising and a cold breeze was blowing.

Ali asked his father, "How can you grow all these vegetables alone?" His father smiled and replied "I do not grow all these vegetables alone. I have four friends who help me."

Ali questioned his father, "Where do your four friends live and when will they come?" His father replied, "They are all here and are always helping our plants to grow."

Ali looked around but couldn't see anyone else. He was very surprised. Ali asked, "Who are they?" His father replied "Air, water, soil and sun."

Ali laughed and asked his father "How can they help the plants to grow?" His father replied, "The soil hides the seeds inside itself and feeds them. When the water reaches the seed, a small plant comes out when it is ready. The second friend Air, which is always present (yet we cannot see it), helps the plants to breathe."

Surprised, Ali asked, "What about the sun?" Father explained, "The sun gives constant light to these small plants, which helps them make food for themselves and this nutrition helps the plants to grow."

Ali asked again, "When these plants are grown then do these four friends go away?"

On hearing this, Ali's father smiled and replied, "No dear son! These friends always help the plants to grow and then one day these plants give flowers and fruit to us to eat."

His father gave Ali some seeds to plant. Ali planted the seeds like he had seen his father do and then asked his father, "Will your four friends work with me too?" His father replied, "Yes, they will. All of these four friends always help us." In about a month he saw small saplings had sprung up exactly where he had planted the seeds. Ali was filled with a sense of wonder and joy and quietly said "Thank You" to the four friends.

Natural, Human & Capital Resources
Class 3

Curriculum Link: National Curriculum for General Knowledge, Grades 1 – 111, 2007. Natural, Human and Capital Resources, page 30.

Students' Learning Outcomes

By the end of this lesson children will be able to:

• Identify natural resources (plants, animals, water, air, land, forests and soil) human resources (farmers, builders, painters etc.), capital resources (trucks, computer, factory, buildings etc.)

Prior Knowledge

Children are well aware of the different objects in their environment. They are also aware of the different common materials, which are used to make objects used in everyday life. They can group objects based on the material they are made of and can differentiate between the materials that are found naturally and the objects that are made from these materials by humans. They can recognise that the same objects can be made from different materials. They understand that different materials have different properties such as hard, soft, stiff, strong, absorbent, smooth, rough, can melt easily, fragile and so on. As part of this unit on Matter, they have been introduced to the terms natural resources, human resources and capital resources.

Teaching Material & Preparation

- Beginning: Small strips of paper or cards with the names of different objects/items written on them. Please see 'Sample List of Objects for Passing the Parcel' on page 12.

A box or basket to keep these strips in. A musical instrument such as, a rattle or tambourine. Alternatively, music can also be played on a cell phone. Board and chalk

- Middle: No material required.

- Conclusion: Paper and pencils.

Methodology

• *Beginning:* Start the session by introducing the game, 'Passing the Parcel'. Tell the children, "Today we will play 'Passing the Parcel'. There are some strips of paper inside this box/basket. I will hand this box to one of you. When the music starts, you will have to pass the box to the child next to you and keep passing it until the music stops. When the music stops, the child who is holding the box, will pick up a strip from the box/basket. The child will have to read the name of the object written on it and will have to tell which natural material that object/item is made of. I will make two columns on the board. As you will tell me the name of the object and what it is made of, I will write it on the board. Is everybody clear so far on what to do?" Repeat the instructions just to make sure that everyone understands.

- Ask the children to sit or stand in a circle. Give the box to a child and start the music. As you stop the music, ask the child with the box to take out a strip of paper. Let the child read the name of the object and tell everyone what natural material the object is made from. When the child responds, ask the other children if they agree or not and why. Then write the name of the object and natural material in the respective columns on the board. Keep playing the game until all the strips have been picked up and talked about.

• *Middle*: Now, call children's attention towards the list of natural material on the board and discuss how these come from nature and are called natural resources. Now ask them to categorise these natural resources into sets, such as, plants, animals, water, sun, land and air.

Now ask the following questions:

- Why are natural resources important?

- How do human beings use natural resources?

- Do you think we can ever have a shortage of natural resources?

Give them time to think and respond.

Next, ask them:

- Do you think we can use these natural resources in a raw form?

- Which of the other resources do you think are involved in making different objects that we make from these natural resources? For instance, what resources are involved in making bread, paper, wool or cloth?

Listen to their responses carefully and bring their focus to human resources and capital resources.

Here, you need to reinforce the concept of human and capital resources. Use examples of one or two objects on the board and discuss what natural resource they are made from and what different human and capital resources are used.

• *Conclusion*: Introduce the individual task by saying, "Now each one of you will have to think about and write the names of any two objects that you use everyday such as clothes, books, shoes, toys, different foods, furniture and so on. Then write about which human and capital resources are used to prepare that object." You may need to repeat instructions and answer questions that children ask for clarification.

Give the children time to think and work. Your role is to circulate, observe and facilitate them as needed. After they are done, ask them to share and discuss their work with the child sitting next to them.

Assessment

The individual work done by each child can be used to assess his or her learning and understanding of the concepts. You can conduct a 'Show and Tell' session and ask children to bring an object from home. Ask them to share what that object is used for, what it is made from, and which human and capital resources are used to make it.

Sample List of Objects for Passing the Parcel

Cupboard

Petrol

Glass bottle

Leather shoes

Pencils

Bread

Bicycle tyre

Eraser

Glue

Tea

Sweater

Paper

Clothes

Butter

Clay pots

Matter and its States

Class 4

Curriculum Link: National Curriculum for General Science. Grades IV – VIII, 2006. Matter and Its States. Page 29

Students' Learning Outcomes

All the students will be able to:

• Demonstrate and explain how matter changes its state on heating

• Explain how one state of matter (solid, liquid, gas) dissolves in other

Prior Knowledge

By this age, children are able to group objects according to shape, size, texture and weight. They can differentiate between what is found naturally and the objects that can be made from them by human beings. At this level, they have studied matter, they understand what it is and they can identify the three states of matter in their environment. They can also compare solids, liquids and gases on the basis of shape and volume.

Teaching Material & Preparation

- Beginning: Strips of paper or card with the names of different items for the Solid Liquid or Gas activity. Please see page 14. A box or basket to keep the strips in. Board and chalk

- Middle: Ice cubes and a glass, some butter or *ghee,* a small bottle of spray perfume, some clay and water, a candle and a matchbox

- Conclusion: Chart paper and pencils

Methodology

• *Beginning:* Introduce the pair activity by saying: "In the previous classes we studied matter and the three different states of matter. Today we will discuss and investigate the states of matter a little more. We will look into different types of items/objects that we use in our everyday life and discuss which states of matter they are and why." Tell the children that for this activity, they will work with a partner (the child sitting next to them) and each pair will pick up one strip from the basket. These strips have names of different items written on them. They will discuss whether the item is a solid, liquid or gas with their partner and why they think so. Tell them that they will have to consider the different properties of the item to decide its state.

Pass the basket around to each pair so they can pick one strip. Let them discuss it among themselves. In the meanwhile, you can draw three columns on the board with the headings, Solid, Liquid and Gas.

After they are done, invite each pair to share their views. As each pair shares the name of the item and its state, ask them why they have classified it a certain way. For instance, if they say honey is a liquid, because it doesn't have a definite shape, ask them how they know that it doesn't have a definite shape. If they say CNG is a gas and it occupies space, again ask them how they know that. Encourage them to give a rationale for their answer and also ask the other children if they agree or not. Write the name of the items in the correct column. This exercise will help you to assess their prior knowledge and any misconceptions related to the topic.

• *Middle*: Next, introduce the group activity by saying, "Do you think matter can change its state? How? Then show the children the different items you have brought with you and say, "Here are a few items. Let's see how they change their states. What do you think will happen to them and why?" Encourage them to predict and listen to their responses.

Then say to the children, "Let us see how your predictions work out. We will keep the butter/*ghee* and ice cubes aside for some time. Till then you can work in groups with the other materials. You will have to see how materials change their states." Make three groups and give one group the spray perfume, clay and water to the second one and a candle and a matchbox to the third group. Give them some time to discuss and work. Make sure the group working with the candle and matchbox follow safety rules.

After they are done, ask them to share what they did and observed. As they share pose the following questions:

- What makes the solid candle turn into liquid and then why does it turn back into a solid?

- Can you now separate the clay and water after mixing them together?

- I wonder if the clay can change its state again. What do you think?

- Where did the liquid in the perfume bottle go after you sprayed it? Can you feel it?

Now, focus their attention to butter or *ghee*, and ice cubes. Let them observe those and then ask the following questions:

- Do you think the melted butter can go back to its original state? How?

- What should we do if we want ice cubes to change their state quickly?

- What would happen if you keep these ice cubes in a cool place?

- The cubes are inside the glass, where did the water come from on the outer surface of the glass?

As you discuss these questions with the children, talk about the different processes involved in changing states of matter such as, heating, evaporating, condensing and freezing.

Introduce the homework by saying: "For this homework, you will have to observe the different types of matter used in your homes to see how these matters change from one state to another. Also look into the processes that cause the change. Discuss it with members of your family.

• *Conclusion:* This phase is to be done after a day or two, so the children can complete their homework.

When children come back with their observations, ask them to get into groups and discuss what they observed. In order to share their observations with others, they will need to prepare a presentation. For that, they can write points and draw diagrams. Ask them to work in the same groups as they worked previously and divide their roles amongst themselves. One child can draw diagrams, another can write points while another can present the work in front of the class.

Let the children settle down in their groups and then give them some time to discuss and decide as a group how to share their observations, and work accordingly.

After they are done, invite each group to come forward and share their work with others. As they share, ask them some critical thinking questions. Encourage other groups to ask questions or comment.

Assessment

To assess children's understanding of the topic, give them time in class to write down their reflections. Ask them to think about the topic and write whatever they understand about matter. For instance, they can make lists of different states of matter and can give examples of some matters that change their states. Also ask them to think and write down what they don't understand or what they want to know more about.

List of Items for: Solid Liquid or Gas Activity

Clouds	Table	Nail
Honey	Leather	Brick
Rock	Marble	CNG
Oxygen	Blood	Glass
Toothpaste	Paper	Book
Butter	Petrol	Eraser
Chocolate	Yogurt	Glue
	Candle	Iron

Changing States

Class 5

Curriculum Link: National Curriculum for General Science, Grades IV – VIII, 2006. Matter and Changes in its States. Page 33.

Students' Learning Outcomes

All the students will be able to:

• Demonstrate and explain the processes that are involved in the change of states

• Describe the role of evaporation and condensation in the water cycle

Prior Knowledge

Children were introduced to the concept of matter and its three basic states in Class 4. They have been seeing objects and materials in the environment in the different states and can identify the differences between each state. They have been grouping and sorting objects based on different attributes and have even compared solids, liquids and gases on the basis of their shape and volume. In Class 2 they studied water and its importance in our daily lives, the different sources of water and the ways in which we use this resource. In the previous week, they have talked about the water cycle. They have recently studied the effects of heat on the three states, how one state of matter changes into another, but these concepts may still be vague. They are familiar with the basic processes of heating and melting, but again they need to make the connections between these processes and the different states of matter.

Teaching Material & Preparation

- Beginning: Board and chalk

- Middle: Any serving tray. Three transparent water glasses. Ice, broken into pieces small enough to fill ¾ of each glass. Some cold water and some hot water in different containers.

A black marker, board and chalk and notebooks and pencils. Ice & Water Prediction Table. Please see page 16.

- Conclusion: Notebooks and pencils

Methodology

• *Beginning:* To introduce the topic write the word '*Matter*' on the board and say to the children, "What do we know about this word?" You can ask them to state the different states of matter they have studied and also write some examples on the board of each state of matter.

Accept children's responses. If their responses are incorrect, guide them to the correct answer then say to them, "What would happen if matter did not change its state?" Give them time to think about the question and then say, "Let's look at water. What do you think would happen if water did not change its state?" Listen to what the children say, then based on their responses ask further questions to clarify their conceptual understanding.

• *Middle:* To begin this activity, take the tray with the three glasses for this activity and say to the children, "Today we will do an experiment with water. We will take three glasses and fill ¾ of each with ice." After filling each glass with ice say to them, "Now I will pour half a glass of water in two of these glasses. In one glass I will pour cold water and in the other glass I will pour hot water. The ice in the third glass will get no water." Check with the children if they have any questions.

As you finish demonstrating the experiment, say to the children, "I will mark the water level of the two glasses into which we have poured the water with a marker and after 10 minutes we will look at the three glasses to see if anything has happened." Ask them what they think might happen and to write down their predictions in their notebooks in a table similar to the one that you have made on the board. Repeat the instructions if necessary.

Make the Ice & Water Prediction Table on the board. Give children time to copy the table in their notebooks and fill it with their predictions. As children finish writing and begin sharing their predictions you will need to listen to their views and ask further questions based on what they say.

To end this activity say to them, "Let us look at what has happened to the ice in the three glasses." Let children take turns looking at the three glasses in small groups depending on the number of children in your class.

When all the children have had a look at the glasses say to them, "After observing the three glasses what do you think happened?" Let the children share their observations. You will need to bring their focus to the different processes and the reasons the ice turned into water.

Now ask the children the following questions:

- Did you observe the surface of the glass? How do you think it turned wet?

- Where do you think that water came from and how?

- What do you think I should do if I want to speed up the process of the ice changing into water?

- What should I do if I want to slow that process?

Listen to the children's responses encouraging them to be objective and critical before answering.

• *Conclusion:* Referring to the experiment ask the children, "What do you think will happen to the water if we leave a glass out in the sun?" Listen to the children's responses and say, "You have studied the water cycle, right? What do you think happens to the water in the rivers, lakes and oceans? Where does all that water go?" Wait for their responses then say, "What might happen to the water on the planet if there was no sun? What do you think you can do to slow the process of evaporation of water from the earth's surface?" Go over the terminology used in the water cycle.

Listen to their responses and encourage them to talk about the different processes involved in the water cycle and how water changes its states. Ask them to draw the water cycle in their notebooks. Tell them to show the different forms water is present in and how it changes its state. Using arrows and key words tell the children to show how one state changes into another. Name the different processes that are involved in changing one state to another. After they have finished their drawing, ask them to write a paragraph stating how the water changes from one state to another and which processes are responsible for the changing states. Repeat the instructions if necessary and then support those children who need some additional guidance.

Assessment

The work done in their notebooks in the 'Ice & Water Prediction Table' and on the water cycle can be used to assess children's understanding of the processes involved in the changing states of mater.

Ice & Water Prediction Table

Glass A | No Water	Glass B | Cold Water	Glass C | Hot Water

Changing States

Class: Multiage

Curriculum Link: National Curriculum for General Knowledge, Grades I – III 2007.

Class 1: Objects around us, page 19.

Class 2: Uses of Earth's Resources, page 25.

Class 3: Natural, Human and Capital Resources, page 30.

Curriculum Link: National Curriculum for General Science. Grades IV – VIII, 2006.

Class 4: Matter and Its States. Page 29.

Class 5: Matter and Changes in its States. Page 33.

Students' Learning Outcomes

All the students will be able to:

• Recognise that some objects are made of more than one material

• Differentiate between the materials that are found naturally and the objects that are made from these materials by human beings

• Demonstrate and explain how matter changes its states on heating

• Demonstrate and explain the processes that are involved in the change of states

Prior Knowledge

The younger children are familiar with and can identify different objects in their surroundings at home, in school and in their neighbourhood. They can name and group objects based on the shape, size, texture and weight. They have some idea that objects are made from different materials such as, wood, paper, rubber and plastic. Older children are also aware of the basic properties of different materials such as, breakable, light, hard, soft, rough, smooth and so on. They have studied matter in Class 4 and they can identify the three states of matter in their environment. They can also compare solids, liquids and gases on the basis of shape and volume. They are familiar with the basic processes of heating and melting, but they need to make the connections between these processes and the different states of matter.

Teaching Material & Preparation

- Beginning: Objects such as plastic and wooden spoons, cups or bowls made of clay and steel or aluminium, plastic bag, paper and cloth bag, pencil, eraser, paper, glue, plastic ruler, wooden and steel ruler, any cotton and woollen clothes, cotton, plastic and wooden chair, a leather bag and a pair of shoes. Board and chalk

- Middle: Strips of paper or card with the names of different items for the Solid Liquid or Gas activity. Please see page 19. A box or basket to keep the strips in. Paper and pencils.

- Conclusion: Classes 1, 2 & 3: 'What Would Happen If' questions. Please see page 19.
Classes 4 & 5: Any serving tray. Three transparent water glasses. Ice, broken into pieces small enough to fill ¾ of each glass. Some cold water and some hot water in different containers.
A black marker, board and chalk and notebooks and pencils. Ice & Water Prediction Table. Please see page 19.

Methodology

• *Beginning:* Introduce the group activity by saying, "Here is some material for you to work with and for this activity you will be divided into groups. Each group will be given some objects to look at and discuss what they are made from and where that particular material comes from." Repeat the instructions and answer the questions children ask you.

Divide the children into mixed-age groups and give each group a set of different objects. Give them a little time to look at the objects and discuss amongst themselves. The younger children can identify and name the objects and some of them can even identify the natural material they are made from. The older children can discuss the natural resources and the reasons behind using those materials to make particular objects. Encourage the older children to share with the younger ones what they know

about the natural resources that have been used to make the objects that their group has been given and give them the opportunity to handle the objects. Your role is to go around the classroom and listen to each group. It will help you to assess their prior knowledge and understanding of the concept.

Next you need to draw three columns on the board with the headings: 'Object' 'Made Of' and 'Natural Resources'. When the children are done with the discussion, invite them to share the names of the objects they have and which material those objects are made from.

As each group talks about their objects, fill in the columns on the board. Encourage them to compare objects with the same uses but made from different natural resources. For example, leather and cloth bags, metal, plastic and wooden spoons. Ask them the following questions and encourage them to give reasons for their answers.

- Why do you think wooden or metal spoons are used for cooking?

- Can you give an example of any material that changes with heat?

- Can you think of a bag that can be used to hold heavy objects?

- I wonder whether a wooden or plastic chair would be stronger? Any ideas?

• *Middle:* For the next activity, divide the children into groups. Children from Classes 1, 2 and 3 will be in one group while those from Classes 4 and 5 will be in another group.

Tell the younger children to move around the classroom and look at the different objects and discuss what they are made from. Ask them to make two columns on a piece of paper. In one column they are to write the names of the objects and in the next column they have to write which material the object is made from. Show them a sample. Give them time to move around and look at the different objects and talk about them.

Say to the older children "We have studied matter and the three different states of matter. Today we will discuss and investigate the states of matter a little more. We will look into different types of items/objects that we use in our everyday life and discuss which states of matter they are and why." Tell the children that for this activity, they will work with a partner and each pair will pick up one strip from the basket.

Pass the box/basket around to each pair so they can pick one strip. Say to them, "The strips have names of different items written on them. You have to discuss with your partner whether the item is a solid, liquid or gas and why you think so. Look into the different properties of that item/object to decide its state. "Ask the children to write the names of the items they discussed along with the state of matter they are in. After they are done, invite the children one by one to share their findings. Encourage them to give their rationale and also ask other children whether they agree or not.

• *Conclusion:* Divide the children from Classes 1 to 3 into pairs. Give each pair a situation to think about and discuss. They have to think about what would happen in the situation and later share with others whatever they have discussed. Give them the 'What Would Happen If' questions to think about and discuss. Repeat the instructions if necessary.

To begin this activity for classes 4 and 5, take the tray with the three glasses for this activity and say to the children, "Today we will do an experiment with water. We will take three glasses and fill ¾ of each with ice." After filling each glass with ice say to them, "Now I will pour half a glass of water in two of these glasses. In one glass I will pour cold water and in the other glass I will pour hot water. The ice in the third glass will get no water." Check with the children if they have any questions.

As you finish demonstrating the experiment, say to the children, "I will mark the water level of the two glasses into which we have poured the water with a marker and after 10 minutes we will look at the three glasses to see if anything has happened." Ask them what they think might happen and to write down their predictions in their notebooks in a table.

Make the Ice & Water Prediction Table on the board. Give children time to copy the table in their notebooks and fill it with their predictions. As children finish writing and begin sharing their predictions you will need to listen to their views and ask further questions based on what they say.

To end this activity say to them, "Let us look at what has happened to the ice in the three glasses." Let children take turns looking at the three glasses in small groups depending on the number of children in your class.

When all the children have had a look at the glasses say to them, "After observing the three glasses what do you think happened?" Let the children share their observations. You will need to bring their focus to the different processes and the reasons the ice turned into water.

Now ask the children the following questions:

- Did you observe the surface of the glass? How do you think it turned wet?

- Where do you think that water came from and how?

- What do you think I should do if I want to speed up the process of the ice changing into water?

- What should I do if I want to slow that process?

Listen to the children's responses encouraging them to be objective and critical before answering.

Assessment: To assess children's understanding and learning, assign them different tasks. Ask young children to draw the different objects made from a combination of different materials. Children of Classes 2 and 3 can be asked to write the names of the different materials used and also write whether those materials are natural or made by human beings. Older children can be asked to observe the different processes in their daily life and write about what the process is, which states of matter are involved and what are the effects of these processes.

Classes 4 and 5: List of Items for Solid Liquid or Gas Activity

Clouds	Table	Nail
Honey	Leather	Brick
Rock	Marble	CNG
Oxygen	Blood	Glass
Toothpaste	Paper	Book
Butter	Petrol	Eraser
Chocolate	Yogurt	Glue
	Candle	Iron

Classes 1, 2 & 3: 'What Would Happen If' Questions

1. What would happen if, your clothes were stitched with a metal wire?
2. What would happen if, the iron we use to press our clothes had a metal handle?
3. What would happen if, books were made of wood or metal?
4. What would happen if, spoons were made of paper or cloth?
5. What would happen if, balls were made of wood or steel?
6. What would happen if, your umbrella was made of paper?
7. What would happen if, your shoes were made of wood or steel?

Classes 4 and 5: Ice and Water Prediction Table

Glass A | No Water	Glass B | Cold Water	Glass C | Hot Water

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