

### **3. The New Textbooks - Philosophical Background**

#### **Think it over:**

- Who is the textbook for? Why?
- Are the contents of the textbook helping children develop scientific outlook and democratic attitudes?
- Are they giving opportunities for children to think on their own, question, and freely express their ideas?
- How does the textbook help children to learn by experimentation and to work in groups?
- Do the questions in the textbook need to be open giving scope for multiple answers? Are our textbooks conducive for that?

In the classroom, the textbook is as important as the teacher and the student. At present, all the teaching learning activities in the school are conducted based on the textbook only. In other words, activities like explaining the contents of the textbook, answering the questions are all done based on the textbook. We all know this. Now, let us see how the new textbook is useful; what its limits are; and the need for a new textbook.

#### **How are we using the present textbooks?**

- The present textbooks give preference to a lot of information.
- They are all filled with mountains of information in the name of syllabus.
- Since the syllabus and the school working days do not commensurate with each other, they cannot be finished within the time available.
- They encourage rote-memory.
- They are not favourable to adapt according to the latest changes and the new findings of research in different fields.

- Though they appear to have the nature of science, they do not give preference to awoke inquisitive thoughts and ideas in children. They do not give scope for questioning, and learning through experimentation.
- They are the root cause for the miserable state of teaching learning activities which are distanced themselves from the laboratory and the science classroom.
- The large amount of information makes it very difficult, even for the teachers, to understand the concepts and explain them.
- Since there is no time to explain and make children understand all the concepts in the textbook, teaching lesson has been reduced to a process of giving answers to the questions in the textbook.
- Since getting children ready for examinations has become the main objective of teaching, trying to secure good marks and good ranks have taken precedence over conceptual understanding (which is considered an unnecessary thing).
- The objective of teaching of science has been reduced to mere memorization of a few important questions instead of making children learn the whole lesson and understand it well.
- Question-banks and guides have become the most sought-after books making the textbook insignificant and unnecessary.

### **Why do we need new textbooks?**

The textbooks needed to be changed in accordance with the directions and recommendations of the National Curriculum Framework 2005, The Right to Education Act 2009, and the State Curriculum Framework 2011. Since the so called science textbooks in use do not facilitate learning by doing; learning through observation, investigation, problem-solving, inductive and deductive reasoning; and since they go on increasing the number of lessons in the name of syllabus, there has been an urgent need to revise the textbooks.

### **New Textbooks – Desirable Characteristics:**

The new textbooks are designed keeping the following components in view:

- The position paper on science, State Curriculum Framework 2011 has proposed a curriculum which is mutually interdependent, thoughtful and value-based.

Therefore, the syllabus, the lessons, the teaching-learning processes and the evaluation should reflect all the above components.

- The textbooks should enable the children to learn through interaction with their teachers, other learners, and the teaching-learning material.
- The components of lessons should be in the experiential orbit of the children and they should enable the children to construct new knowledge. Children in 8<sup>th</sup> and 9<sup>th</sup> classes can understand even abstract concepts, so concepts like motion, heat, reproduction, cells, etc., should be made clear by starting with what they knew and then moving on to their critical analysis.
- The activities should be so planned that they facilitate learning the science concepts through observation, deductive and inductive reasoning, and experimentation. (Unfortunately, working in the laboratory, field visits and project reports are looked down as trivial things.)
- Science melas, exhibitions and fairs are conducted only as rituals but not with the true spirit of encouraging scientific outlook among children. The present textbooks are not doing anything in this direction.
- It seems studying textbook in the classroom has been banned with the onslaught of question banks and guides.
- Though there are a few activities and experiments in the textbook that facilitate learning by doing, since the teachers do not take initiative to conduct them, the difference between a science class and other classes has become negligible.
- Most of the teachers read the lesson and explain or write important points / draw pictures on the blackboard and explain, so the main objective of the textbook is defeated.
- Instead of encouraging the children to write answers to the questions in the textbook on their own, the teachers give answers or mark the answers in the textbook or ask the children to copy them down from question banks or guides.
- The textbook has become a thing to memorize instead of an essential tool that helps children think analytically and learn important concepts.

- The children should be able to construct new knowledge by participating in activities / tasks, by experimenting and by testing the suitability of various alternatives to a problem.
- In the classroom, the teachers should not be the ones that thunder instruction reducing the children to mere passive listeners. They should ask a multiplicity of questions on the concepts that facilitate / call for deep thinking. To achieve this, the lessons in the new textbooks, instead of giving mountains of information, are so designed that they give a lot of scope for discussion, questioning and analytical thinking.
- Demystifying the false belief that ‘children should not study or look into textbooks while the teacher teaches’, these textbooks are so designed that they help children understand various concepts through in-depth reading of the textbook, detailed study and discussion.
- Though complex concepts are to be explained in higher classes, the new textbooks move forward with great ease as they are linked with real-life situations and the flora and fauna in which children live. This helps children understand that science helps society in many ways.
- Instead of questions/activities that have fixed responses, the topics for discussion, the questions, and various other activities in the textbook should be open-ended that will give scope for the children to think and write individually. Hence, the new textbooks have some activities under the heading ‘Think & Discuss’.
- Good understanding of a concept in a subject (like science ) demands some information and knowledge in other subjects like mathematics, social studies, and even languages, so lessons like Prevention of Disasters, The Space, The Stars, Agriculture – Crops are taught mixed with social studies.
- Questions are given in the middle and at the end of the lesson to facilitate self-assessment by the student
- Questioning help children a lot to analyze the content of a lesson, so lessons are prepared in such a way that they give a lot of scope for questioning and thinking.
- The activities are developed giving a lot of scope (on many occasions) for children to search for answers themselves.

- The activities in the new textbooks help children to check their assumptions and come to a conclusion.
- The activities are developed in such a way that the children can make observations as well as experiments either on their own or with the help of the teacher.
- To assess the progress of the children continuously, a multiplicity of questions are given in the middle and at the end of each lesson.
- Sections like ‘DO you Know’, ‘Read and Learn’, and ‘Annexure’ are planned and put in appropriate places so as to enable the children to observe and learn more in addition to the content of the lesson.

The new textbooks are developed in such a way that they help children learn even abstract concepts through observation and research. Therefore, as they learn through activities, they not only form clear concepts without any ambiguity, but also get required skills to apply them to solve problems they face in day to day life. The new textbooks help children grow with scientific and positive attitude towards nature and environment.

### **Key Elements in the New Textbooks:**

- The new physical sciences textbook and the biology textbook for classes 8<sup>th</sup> and 9<sup>th</sup> classes are prepared in accordance with the suggestions and directives of the National Curriculum Framework – 2005, The Right to Education Act -2009, and the Position Paper on Science, State Curriculum Framework – 2011.
- In the new textbooks, Physics and Chemistry sections are integrated into one without any bifurcation.
- Construction of knowledge through mutual interaction between teachers and children.
- Preparation of lessons from the experiential orbit of the children and their surroundings.
- Construction of knowledge by children through their analysis of the concepts of the lesson.
- Scope for clarification of doubts and construction of new knowledge through free talk and questioning.

- Gaining a good understanding of the concepts through reading the textbooks and related / supplementary books.
- Useful and helpful for children to relate and apply what they have learnt to their day to day life and nature or what they see around them.
- Learning by doing individually and in groups while during field visits and experiments.
- Activities and exercises are open-ended giving scope for the children to learn individually and to think creatively.
- Getting opportunities to participate and to find solutions to various problems in science.
- Exercises/activities have a lot of scope for the children to express themselves and to write their answers individually.
- Facilitate continuous comprehensive evaluation.

The curiosity to learn about nature has always been there in the mind of the human being. The reason for this may be the marvels and mysteries of the world around us. Close observation of the changes in the surroundings, assumptions made on their effects and results, exploration and thoughts of human beings ever since stone-age form the basis for the evolution of human culture. In this succession, useful relations between biotic and abiotic environment are being found by observing them carefully. As a part of this new devices / instruments are invented to interact with nature. This way, the modern science developed finding solutions to problems in daily life on the one hand and by inculcating scientific outlook on the other hand.

It is only the dynamic nature of science that paved way for it to branch out thus forming a number of other disciplines in no time. As the frontiers of science are ever-widening, the science taught in school for years together become meaningless by the time children finish school. This tells us that there is an urgent need to make changes in our syllabus and the teaching strategies in accordance with the passing time.

Science is the true, standardized knowledge gained through experimentation. It is not a compendium of mere concepts and facts. Science not only explores new phenomena but also analyses and compares the theories in practice with other theories. This is the reason why science is always dynamic and process –oriented. In other words, it gives preference to the process but not the product.

There are certain key components in learning science, in acquiring knowledge and in obtaining a good understanding of that knowledge. The first one is the way science is learnt in a science classroom. The second one is the way children think, their cognitive level and their likes and dislikes. When we take these into consideration, we know that learning is not receiving information but construction of new knowledge based on the previous knowledge.

In our state, there has not been any change in the form or content of the textbooks. They are prepared following the conventional fossilized methods. And it does not seem to take into consideration the new pedagogic principles that have evolved consequent to the changing needs of the society. Against this backdrop, the National Curriculum Framework-2005 and the Right to Education Act-2009 suggested that the education imparted should develop able and competent citizens that can face the challenges of the contemporary world. Taking the suggestions/directives into consideration, the State Curriculum Framework – 2011 was prepared. Based on this framework, the Position Paper on Science was prepared. The Position Paper on Science has proposed certain basic theoretical principles and has directed that the new textbooks should be prepared closely following them. Let us see what they are.

### **Propositions of SCF – 2011:**

1. India should come up as a society that creates new knowledge but should not remain as the one that only uses knowledge.
2. The textbooks should help children think and learn using their innate abilities.
3. The textbooks should not be filled with mountains of information. Instead, they should give room for children to analyze information.
4. The textbooks should facilitate knowledge construction among children. Also, there should be scope for children to use that knowledge in real life situations.
5. The textbooks should not limit the children to just textbooks but take them beyond to enable them to learn more through the use of reference books, magazines, newspapers, etc. and through interaction with teaching learning material as well as the members of the society.
6. The language used in the textbooks should be simple. It should not hamper comprehension and thus learning. Multilingualism should be taken into consideration while preparing the textbooks.
7. The textbooks should not give room for gender bias. They should develop in the children self-confidence, thinking skills like reflection, critical thinking, dialectical thinking, creative thinking, communication skills, and sensitivity to human rights.
8. Culture, productive activities, local arts and crafts, local issues should go into science lessons.

9. The activities and exercises should help children achieve the expected learning outcomes and the academic standards specified for the level.
10. The exercises should essentially consist of activities, tasks, projects, explorations, experiments, open-ended questions, games and puzzles which make children think.
11. The tasks/exercises should have room for children to work individually and in groups and help the entire class to learn.
12. Some lessons /tasks/exercises should be from subjects that come under co-curricular areas like art, health, work, human values, ethical values, etc.(SCF – 2011 listed them under curricular areas) so that children get the essence of them.
13. The textbooks should have scope for children to revise what was learnt in the previous class; to achieve academic standards specified for the class s/he is in; and link these to what s/he is going to learn in the next class.
14. The textbooks should be attractive with beautiful pictures and good printing on quality paper.

### **APSCF – 2011 Key Principles**

- To concentrate essentially on making children learn according to their innate talents and capabilities
- To respect the language of the child, the knowledge systems in society and to use them in learning
- To link knowledge with life outside the school
- To say not to rote methods and to substitute them with interactions, projects, explorations, experiments, analyses which facilitate meaningful learning
- To see that the syllabus has room for the comprehensive development of children and to make changes in textbooks so that learning is limited to textbooks.
- To simplify and make examinations a part and parcel of teaching learning activities by implementing continuous comprehensive evaluation and to reform the assessment in a way that it helps children learn but not assess them to know what they have learnt – assessment for learning instead of assessment of learning.
- To conduct teaching learning activities based on the principles of social constructivism and critical pedagogy by relating various components of the syllabus with one another so as to facilitate meaningful learning.



- To give priority to the culture and experience of children and their local issues/topics

The State Curriculum Framework – 2011 was developed taking the vision of the state and its guiding principles. SCF – 2011 proposed the following changes:

### **The Textbooks:**

So far the textbooks were changed once in ten years. But it can be said that the fundamental changes were insignificant and negligible. Moreover, neither the curriculum framework, nor the positions paper (which are essential to develop new textbooks) were prepared. Consequently there were changes only in the lessons but not in the tasks, exercises, and the structure which were routine and devoid of any variety. Also, the nature of the subject, the nature of the child, the expected outcomes of teaching various subjects in school were not given due importance and consideration in the development of textbooks. Added to this, the textbooks became more bulky and heavy with more information dumped in, in the name of ‘standards’. In the case of science and mathematics, some topics from higher classes found their way into lower classes putting additional cognitive burden on the young minds. However, there had been some changes in the textbooks because of the state initiatives and interventions through APPEP and DPEP. But still there is a need for comprehensive changes in textbooks to have concurrence with NCF-2005, RTE-2009 and APSCF-2011.

The State Curriculum Framework – 2011 made the following propositions to overcome the shortcomings mentioned earlier.

- There should be separate position papers for each subject to develop textbooks for subjects like language, mathematics, science and social studies.
- The textbooks should help children think and use their natural talents and capabilities
- The textbooks should not be made heavy with a lot of information. Instead they should give scope for the children to collect information and analyze it to make conclusions.
- The textbooks should help children construct knowledge and use it in their daily life.
- The textbooks should not limit children to just textbooks but take them beyond to enable them to learn more through the use of reference books, magazines, newspapers, etc. and through interaction with teaching learning material as well as the members of the society.

- The language used in the textbooks should be simple. It should not hamper comprehension and thus learning. Multilingualism should be taken into consideration while preparing the textbooks.
- The textbooks should not give room for gender bias. They should develop in children self-confidence, thinking skills like reflection, critical thinking, dialectical thinking, creative thinking, communication skills, and sensitivity to human rights.
- Culture, productive activities, local arts and crafts, local issues should go into science lessons.
- The activities and exercises should help children achieve the expected learning outcomes and the academic standards specified for the level.
- The exercises should essentially consist of activities, tasks, projects, explorations, experiments, open-ended questions, games and puzzles which make children think.
- The tasks/exercises should have room for children to work individually and in groups and help the entire class to learn.
- Some lessons /tasks/exercises should be from subjects that come under co-curricular areas like art, health, work, human values, ethical values, etc., so that children get the essence of them.
- The textbooks should have scope for children to revise what was learnt in the previous class; to achieve academic standards specified for the class s/he is in; and link these to what s/he is going to learn in the next class.
- The textbooks should be attractive with beautiful pictures and good printing on quality paper.

### **Teaching learning activities:**

Instead of stereotypes like rote memorization, repetition, copying answers from guides and question banks, reading mechanically, etc., good teaching learning activities should ensure meaningful learning. To achieve this APSCF 2011 made the following propositions:

- Interactions, self-expression and questioning should essentially be a part of teaching learning activities
- Experiments, explorations, activities, projects, games, etc., should form the core of the teaching learning activities.
- Teaching learning activities do not mean explanation of the lesson or reading it aloud by the teacher. Teachers should motivate children to learn and participate in the teaching learning process. They should use necessary teaching learning material and make it available to the children thus creating a good learning atmosphere.

- The teaching learning activities should be conducted in a way that help children learn individually, through other children, through teachers and through teaching learning material. The time available for learning should be utilized optimally.
- The teacher should use the language of the child and should create conducive atmosphere for the child to learn using his/her language.
- The teaching learning activities should be conducted based on the previous knowledge and experiences of the children.
- Local arts and crafts, productive components, experiences of manual laborers should be used as resources in the teaching learning activities.

### **Evaluation – Examinations:**

So far we have been depending on only examinations to evaluate children. They, in turn, instead of evaluating children, subjecting them to great pressure and anxiety by showing them as wrongdoers. One way, it can be said that examinations are ruling and dictating the education system. With this backdrop, the State Curriculum Framework – 2011 put forward the following propositions:

- Evaluation and examinations should not be limited to assessing the child. They should go beyond and help the child learn too – not only assessment of learning but also assessment for learning
- To implement continuous comprehensive evaluation as suggested by the Right to Education Act – 2009
- To use projects, assignments, portfolios, seminars, exhibitions, anecdotes, observations, etc., to assess children instead of restricting to examinations alone to do it.
- To make evaluation a part and parcel of teaching learning activities to achieve what was said above.
- To change the nature of questions in use: substituting questions that encourage rote memorization and questions that are restricted to the information in the textbooks with questions that have scope for children to think on their own and write, open ended questions, application oriented questions and questions that have room for children to express their own experiences.
- To make evaluation help teachers to assess how far children have been successful in using the knowledge they have gained.
- To have open and transparent evaluation system that enables children to do self-assessment, and the parents to know the progress of their children themselves.
- To give weightage in the board examinations for the continuous comprehensive evaluation conducted in school.

- To put the answer scripts at parents' disposal when asked and revalue them if needed/demanded
- To evaluate subjects in co-curricular areas like attitudes, values, work, health, games, etc. too in addition to the subjects in curricular areas.

## First Things First

The new textbooks are developed based on 'social constructivism' and knowledge construction-enabling 'constructivism'. Right from the picture on the cover page to the verse that incites scientific outlook, the preface, instructions to teachers as well as students, academic standards, table of contents, etc. - they all help the reader understand the philosophy behind the development of the new textbooks. Hence, let us have a keen look on the preface, the instructions to teachers and the instructions to students.

1. Why should we read the preface?
2. Discuss with your friends any five key components you noticed in the preface.
3. Which components in the preface do you think should be reflected in the structure of a lesson?

## Introduction

The nature is life source for all living organisms. Rocks, water, hills and valleys, trees, animals etc. embedded in it... each of them are unique by themselves. Everything has its own prominence. Human being is only a part of the nature. The aspect which distinguishes the humans from all other organisms and exclusive for them is their extraordinary thinking power. Thinking transforms a person as a unique entity from rest of the nature. Though it usually appears simple and normal, the intricacies of the very nature often challenges us to untie the tough knots of its hidden secrets, day in and day out.

The human being intuitively contemplates and searches solutions for all the critical challenges, all around, relentlessly. Curiously, the questions and answers are concealed in the nature itself. The role of science, in fact, is to find them out. For this sake, some questions, some more thoughts, and some other investigations are quite necessary. Scientific study is to move on systematically in different ways, until discovering concrete solutions. Essence of the investigations lies in inquiring i.e. identifying questions, asking them and deriving adequate and apt answers. That is why, Galileo Galilei, the Italian astronomer, emphasized that scientific learning is nothing but improving the ability of questioning.

The teaching of science has to encourage children to think and work scientifically. Also, it must enhance their love towards the nature. Even it should enable them to comprehend and appreciate the laws governing the nature in designing tremendous diversity found around here and everywhere. Scientific learning is not just disclosing new things. It is also essential to go ahead with deep understanding of the nature's intrinsic principles; without interrupting the harmony of interrelation and interdependence in the nature.

It is also necessary to step forward without interrupting the interrelationship and interdependency along with understanding of the nature's intrinsic principles. High School children possess cognitive capacity of comprehending the nature and characteristics of the transforming world surrounding them. And they are able to analyze abstract concepts.

At this level, we cannot quench their sharp thinking capability with the dry teaching of mere equations and theoretic principles. For that, we should create a learning environment in the classroom which provides an opportunity for them to apply the scientific knowledge, explore multiple alternatives in solving problems and establish new relations.

Scientific learning is not just confined to the four walls of classroom. It has a definite connection to lab and field as well. Therefore, there is a lot of importance to field experience/ experiments in science teaching.

There is a great need for compulsory implementation of instructions of the National Curriculum Framework- 2005 which emphasizes linking of the science teaching with local environment. The Right to Education Act- 2009 also suggested that priority should be given to the achievement of learning competencies among children. Likewise, science teaching should be in such a way that it would help cultivate a new generation with scientific thinking. The key aspect of science teaching is to make the children understand the thinking process of scientists and their efforts behind each and every discovery. The State Curriculum Framework- 2011 stated that children should be able to express their own ideas and opinions on various aspects. All the genuine concepts should culminate into efficacious science teaching, make the teaching-learning interactions in the classroom, laboratory and field very effective and really become useful for the children to face the life challenges efficiently.

We thank the Vidya Bhavan Society, Rajasthan, Dr. Desh Panday Rtd Prof. College of Engineering Osmania University and Sri D.R. Varaprasad former Lecturer ELTC Hyderabad for their cooperation in developing these new text books, the writers for preparing the lessons, the editors for checking the textual matters and the DTP group for cutely composing the text book.

Teachers play a pivotal role in children's comprehensive use of the text book. We hope, teachers will exert their consistent efforts in proper utilization of the text book so as to inculcate scientific thinking process and inspire scientific approach in the children.

Director,  
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### **Instructions to Teachers AND Instructions to Students**

1. What is the use of reading the instructions to teachers and the instructions to students?
2. In the instructions to teachers, which points do you want to focus on? Why?
3. How do the instructions given to students to use the new textbooks help teachers?

#### **1. Instructions to Teachers**

Dear teachers...

The new Science Text Books are prepared in such a way that they develop children's observation power and research enthusiasm. It is the primary duty of teachers to devise teaching- learning processes which arouse children's innate ability to learn. The official documents of National & State Curriculum Frameworks and Right to Education Act are aspiring to bring grass root changes in science teaching. These textbooks are adopted in accordance with such an aspiration. Hence, science teachers need to adapt to the new approach in their teaching. In view of this, let us observe certain Dos and Don'ts:

- Read the whole textbook and analyze each and every concept in it in depth.
- In the text book, at the beginning and ending of an activity, a few questions are given. Teacher need to initiate discussion while dealing with them in the classroom, attempt to derive answers; irrespective of right or wrong responses, and so try to explain concept.
- Develop/Plan activities for children which help understand concepts presented in text.
- Textual concepts are presented in two ways: one as the classroom teaching and the other as the laboratory performance.
- Lab activities are part and parcel of a lesson, so teachers must make children conduct all such activities during the lesson itself, but not separately.
- Children have to be instructed to follow scientific steps while doing lab activities. They should also prepare relevant reports present them.
- In the text, some special activities as boxed items- 'think and discuss, let us do, conduct interview, prepare report, display in wall magazine, participate in Theatre Day,

do field observation, organize special days 'are presented. To perform all of them is compulsory.

- 'Ask your teacher, collect information from library or internet' - such items must also be considered as compulsory. (A.S. indicates academic standards in improve your learning.)
- If any concept from any other subject got into this text, the concerned subject teacher has to be invited into the classroom to elucidate it.
- Collect info of relevant website addresses and pass on to students so that they can utilize internet services for learning science.
- Let there be science magazines and science books in the school library.
- Motivate every student to go through each lesson before it is being actually taught and encourage everyone to understand and learn independently, with the help of activities such as Mind mapping and exciting discussions.
- Plan and execute activities like science club, elocution, drawing, writing poetry on science, making models etc.to develop positive attitude among children environment, biodiversity, ecological balance etc.
- As a part of continuous comprehensive evaluation, observe and record children's learning abilities during various activities conducted in classroom, laboratory and field.

We believe, you must have realized that the learning of science and scientific thinking are not mere drilling of the lessons but, in fact, a valuable exercise in motivating the children to explore solutions to problems all around by themselves systematically and preparing them to meet life challenges properly.

## **2. Instructions to Students**

Dear Students...

Learning science does not mean scoring good marks in the subject. Competencies like thinking logically and working systematically, learned through it, have to be practiced in daily life. To achieve this, instead of memorizing the scientific theories by rote, one must be able to study them analytically. That means, in order to understand the concepts of science, you need to proceed by discussing, describing, conducting experiments to verify, making observations, confirming with your own ideas and drawing conclusions. This text helps you to learn in that way.

What you need to do to achieve such things:

- Thoroughly go through each lesson before the teacher actually deals with it.
- Note down the points you came across so that you can grasp the lesson better.
- Think of the principles in the lesson. Identify the concepts you need to know further, to understand the lesson in depth.

- Do not hesitate to discuss analytically about the questions given under the sub-heading 'Think and Discuss' with your friends or teachers.
- You may get some doubts while conducting an experiment or discussing about a lesson. Express them freely and clearly.
- Plan to implement experiment/lab periods together with teachers, to understand the concepts clearly. While learning through the experiments you may come to know many more things.
- Find out alternatives based on your own thoughts.
- Relate each lesson to daily life situations.
- Observe how each lesson is helpful to conserve nature. Try to do so.
- Work as a group during interviews and field trips. Preparing reports and displaying them is a must.
- List out the observations regarding each lesson to be carried through internet, school library and laboratory.
- Whether in note book or exams, write analytically, expressing your own opinions.
- Read books related to your text book, as many as you can.
- You organize yourself the Science Club programs in your school.
- Observe problems faced by the people in your locality and find out what solutions you can suggest through your science classroom.
- Discuss the things you learned in your science class with farmers, artisans etc.

The new textbooks start lessons with either real life situations / events or simple problems that we face in our day to day life. As children in high school stage can understand abstract concepts when introduced through what was familiar to them, activities to facilitate keen observation, experiments and field visits are developed. With the help of these components children can construct knowledge either with the help of the teacher or by working individually or in groups. Since observation, discussion, and proof are key the elements / factors in understanding scientific principles and theories, they should be used effectively in teaching learning activities. Therefore, it is essential for the teacher to understand the underlying philosophy of the textbooks to teach effectively in the classroom.



#### 4. Syllabus Themes – Lessons

The new textbooks for classes 8 and 9 are developed extending the syllabus for classes 6 and 7. The syllabus is designed in accordance with the aspirations of the State Curriculum Framework – 2011 reflecting social constructivism and constructivism which facilitate knowledge construction. For classes 8, 9, and 10 science subject is divided into two parts: Physical sciences (Physics and chemistry) and Biology. In each section the selection of lessons was made based on some themes. Let us see on what themes the lessons in physical science are based.

1. Materials
2. How things work
3. Moving things, People and Ideas
4. Natural resources
5. Natural phenomena

The lessons are selected based on the above themes. The lessons in 8<sup>th</sup> and 9<sup>th</sup> classes like different states of matter, artificial fibre, plastics, metals and non-metals, etc., are developed based on the lessons in 6<sup>th</sup> and 7<sup>th</sup> classes like materials around us, methods of separating substances, etc. In the same way, lessons like sound, electric conductivity, etc., are developed based on the theme ‘How things work’. Lessons like force, friction, velocity, acceleration, etc., are developed based on the theme ‘Moving things, People & Ideas’. The lesson ‘some natural phenomena’ is developed based on the lesson in the previous class ‘changes around us’. In this lesson, some precautionary measures to be taken at the time of natural disasters are discussed. The lesson combustion, fuels, fire teaches about natural resources like fuels. It is also useful to learn things like ‘how various substances form’ and ‘why do they behave like that.’ The lesson ‘stars and solar system’ help children discern the laws and principles hidden in the physical world around them. Let us have a look at what lessons are developed under various themes:

S.No	Theme	8 <sup>th</sup> Class	9 <sup>th</sup> Class
1	Materials	Synthetic Fibres and Plastics	Matter around us
			Is Matter Pure?
			Atoms and Molecules
			What is inside the atom?
2	How things work	Sound	Work and Energy
			Sound
3	Moving things, People & Ideas	Electric conductivity of liquids	Motion
		Force	Laws of Motion
		Friction	Floating Bodies
4	Natural Resources	Coal and petroleum	
		Combustion, Fuels and Flame	
5	Natural Phenomena	Some Natural Phenomena	Gravitation
		Stars and the Solar system	

NCF – 2005 stated that while selecting themes for lessons, it is important to keep in view the competencies of children, social needs, remarkable research being done in science and technology, human resources, future needs and changes in nature and environment. Since it is difficult to give information that is increasing in leaps and bounds through textbook, they can construct knowledge on their own by collecting information through various media.

Einstein's words that 'I have never tried to teach anything to my student. I have just taught them how to learn', are the guiding principles in teaching science.

Science includes assumptions, observations, experiments, conclusions, proofs, principles, theorems, etc. The new science textbooks are developed with the objective of developing scientific outlook and scientific temper. They are based on the interactive approach where children learn by interacting among themselves, interacting with teachers, teaching learning material, members of the society and nature. Children should construct knowledge on their own by interacting with various things around them and through dialectical thinking, critical thinking and creative thinking.

Knowledge is dynamic. This is always subjected to change. New experiences may replace old ones or may strengthen them. Children, by the time they enter school, will have already formed their own concepts and misconceptions. The teaching learning activities may strengthen the correct concepts and correct the wrong concepts, so the new textbooks are developed based on the principle that teaching learning activities should enable children gain knowledge.

Since learning means learning through listening, viewing and doing, the textbook should give priority to discussions, analyses, observations and hands on experience. Here listening does not mean passive listening but to listen actively and to learn by questioning, discussing and participating in group activities.

Since most laws, principles, and theories of science come from our experiences in daily life, each lesson in the textbook start with a real life situation. Since learning is not receiving information but to construct knowledge out of the information received, activities are developed incorporating information tables, thought provoking questions and tasks which help children improve their knowledge.

Since the lessons learnt in the name of science should be near to the real life experience of children, the selection of lessons follows thematic approach. This means the lessons are not like water tight compartments but related to one another making learning easy and meaningful.

## 5. Academic Standards

### Think it over:

1. What are academic standards?
2. What are the academic standards specified for science?
3. What components of the textbook help achieve the academic standards?
4. Is there any relation between achieving academic standards and the teaching learning process?

“Learning is to go on extending the experiential orbit” (James Carlyle). Teaching learning activities should be such that they help us either to form new concepts replacing the old ones or strengthen them. The study of science should develop in children the competence to understand the laws and principles of nature and surroundings and to use them when needed. This is the purpose of academic standards.

We all know that science is organized knowledge. By studying science, children should develop in them qualities like rational thinking, making hypotheses, guessing results, estimating, giving proof by experimentation, searching for points in common results that can be generalized, love nature and environment, showing sympathy and be empathetic with flora and fauna.

### Why Academic Standards?

We can see our children using many applications in mobile phones just like that effortlessly. How is it that they are able to do this? – No one teaches them. No tests. Then how are they able to acquire that competence? We all know the answer. It is nothing but ‘learning by doing’. This is learning science.

Sagar studied up to degree. When his fan is revolving slowly, his friend suggested changing the condenser. But he does not know where he can get it and how to fix it. Not willing to bother about that, he started to search for an electrician. There are many such Sagar among us. Restricting teaching of science to textbooks is the root cause for this state of affairs.

Robin Frasther laments, that we learn from newspapers that repeated boiling makes edible oil poisonous. But we eat things made from such oil. We hear that our environment gets worse if there are not enough trees. But to improve the elevation of our house, we cut trees in the street. Someone says that polythene covers are life-threatening, but we never stop using them. Instead, we heap them and set them on fire. We leave rain

water just like that and crave for potable water. We have innumerable experiences of this sort. Learning science means getting a good understanding of such things, but it never happens. Otherwise, we do not see doctors and teachers who suffer from sugar (except hereditary onset). This is true. There is no coordination between science and our behavior in day to day life. They do not synchronize.

We appear to be humans who lost sensitivity either to a plant full of flowers or to a plant withered due to lack of water. The prime goal of teaching science is to develop a society that is kind to animals and sensitive to nature treating every living being as equals. To get what we have lost in the name of culture and modernization, and to correct the mistakes thus made, humanitarian dimension should be attributed to science. Academic standards are developed only to accomplish this. Since these should not be viewed as something to learn as content and since there is a need to look at it with new perspectives, let us try to understand them through the philosophy underlying them.

### **Academic Standards:**

According to NCF-2005, RTE-2009 and APSCF-2011 children are expected to achieve the academic standards specified for the class. The following academic standards should be accomplished as learning outcomes in science education.

#### **1. Conceptual Understanding:**

This indicates how best the student has understood the concept. Conceptual understanding includes explaining, classifying, analyzing, giving examples, giving reasons and forming mental images.

##### **Explaining:**

- Explaining the concepts observed or studied by him/her, or explaining an incident / an activity happened using appropriate scientific terms.
- Understand information collected by him/her or received from others through rational thinking and explaining them adding his/her own conceptual understanding

##### **Classifying:**

- Ability to distinguish differences among things in a group
- Ability to identify similarities in things
- Classifying things based on a special property
- Explaining the basis and procedure followed to classify things

##### **Analyzing:**

- Elaborating an incident or a situation in one's own words

- Ability to give logical reasons behind concepts in an orderly way
- Analyzing principles, equations, experimental results, etc., and identifying underlying principles and relations and forming new relations

#### **Giving Examples:**

- When a child can not only repeat what the teacher says but also talk about similar things which are exemplary, then it can be said as 'giving examples.
- Giving examples based on common or distinctive features

#### **Giving Reasons:**

- Explaining experimental results, various concepts, phenomena, etc., with reasons
- Identifying relations based on causes for action and reaction
- Explaining observations based on reasons/causes

#### **Forming Mental Images:**

- To understand abstract concepts, which cannot be comprehended through direct experiences, through mathematical forms, logical reasoning and by forming mental images
- Using mental images thus formed in new situations when needed

### **2. Asking Questions and Making Hypothesis:**

- To have the ability to observe things with curiosity and enthusiasm (as children have the nature of questioning.) Asking critical questions on various concepts
- The ability to ask critical questions to do in-depth analysis of the selected topic
- The ability to design questions to collect information, to observe and to interview
- Since questioning is natural for children and since it is the key to exploration and research, this should be developed in them so as to enable them to make hypotheses
- To predict results by thinking in advance critically about solutions to problems
- Forming hypotheses and predicting results while doing experiments and observations

### **3. Experimentation and Field Investigation:**

Choosing required apparatus, setting it up, observation, recording, analyzing, concluding and generalization come under this.

#### **Observing:**

- The ability to acquire information through sensory organs
- Observing a thing, an event/incident or a phenomenon
- Discerning occurrences/events in a sequential order

**Recording:**

Recording observations in a table or in a notebook

**Analyzing:**

- Elaborating an incident or a situation in one's own words
- Ability to give logical reasons behind concepts in an orderly way
- Identifying the right and wrong notions based on proof
- Forming concepts through arduous observation of tables of information, graphs and reports

**Concluding:**

- Announcing the results of experiments conducted to verify the hypotheses is concluding

**4. Information Skills and Projects:**

- In the course of learning, children have to collect a lot of information using different methods. They should be able to classify the information thus collected; make tables of the classified information; and write their own report analyzing tables thus made
- Respecting other cultures, others' opinions, various living conditions while collecting information
- To be empathetic with the environment and to be ready to take responsibility
- Accepting his/her strengths and weaknesses. Showing initiative and participate
- Working with others, sharing and be helpful

**Project work:**

- Project is an activity in which children choose a problem and follow a systematic procedure to find solutions to it
- This is useful to make use of the innate abilities and creative talents of the children
- Waiting with patience and tolerance until the results are attained
- To act as a leader as well as a follower in a group
- Writing reports and exhibiting them
- Explaining analytically by showing reasons and giving examples
- To develop tolerance, patience, cooperative spirit and group work

**5. Communication through Drawing/Model Making:**

- Explaining by drawing pictures, expression through pictures, marking the parts of a picture come under this

- Drawing pictures showing the arrangement of apparatus and drawing pictures of what is seen through a microscope
- Drawing block diagrams, flow charts and classification tables
- Expressing innovative ideas / thoughts through creative pictures, models, and by creating alternative devices / implements /tools
- Expressing the information gathered graphically using bar graphs, pie charts, etc.

#### **6. Appreciation and Aesthetic Sense/Values:**

- Developing competitive spirit and the wisdom/courage to accept failure and success alike
- Developing characteristics like sense of appreciation and accepting reality
- Recognizing the importance of various elements of nature by discerning the relations among them through close observation
- Appreciating the uniqueness in biotic and abiotic components
- Appreciating the efforts and exertions of scientists
- Participating in science seminar and science clubs
- Designing pamphlets, writing slogans and poems

#### **7. Application to Daily Life/ Concern to Biodiversity:**

- Recognizing the importance of biodiversity in their surroundings
- Making efforts to protect environment and preserve biodiversity
- Recognizing the fact that every living being has the right to live
- To understand the harmful effects of our carelessness and exploitation on nature
- To have an awareness of nature and environment and behave responsibly
- Showing special attention on endangered species in nature
- Applying the acquired knowledge in new situations in day to day life
- To be conscious of the facts that nature is not the sole property of humans and that they are just a part of nature

While teaching non-language subjects, especially science, many teachers think that children should not look into books. But the present books are made to facilitate discussion, analysis and exploration. Unless children understand the content of the lesson, they will not be able to participate in the above activities. Moreover, studying lesson in science is not like studying lessons in languages. Every sentence carries a lot of information and elaboration based on which the essence should be grasped. Hence, it is mandatory for children to read the lesson beforehand and try to come to grips with the terminology and concepts. Then it will be possible for them to learn comprehensively through teaching learning activities. Therefore, children must read the science textbook in the science class.

## **6. The New Textbook – Structure of a Lesson – Explanation of Components**

The new science textbook is developed based on the new paradigm in education called ‘constructivism’. Scientific thinking means trying to discern the underlying principles and laws from things and situations with which we have close acquaintance, so the structure of a lesson in the new textbook is based on this foundation.

- Starting the lesson with real life situations within the children’s experiential orbit (Natural Experience)
- Motivating them to study the lesson by asking probing questions and questions that make them think well
- Explanation of content through various activities, experiments, information tables, collections and analyses (Analytical Exercise)
- Making additional information available to children so as to develop in them scientific thinking, scientific vision/outlook and curiosity (Out of Box Thinking)
- Including creative response in each lesson so as to enable children to add their thoughts and opinions and come out with their perspective of the content/concept.
- Accommodating interaction with students in the teaching learning process (Interactive Learning)
- Developing the contents of each lesson to facilitate the accomplishment of academic standards (Academic Standards)
- Improving learning through self-assessment (Improve Learning)

The lesson developed on the basis of various themes in the syllabus are arranged in the textbook in an orderly manner. Here, physics and chemistry, both put together, are considered as one component. Biology is taken as another component. Hence, lessons that are important and helpful to learn physical sciences are identified and arranged in the textbook in the order of priority of the themes. Regarding the structure of the lesson, it is important to look at each and every component of the lesson, right from a familiar situation to ‘Improve your Learning’, with the philosophical outlook. Let us have keen look at the various components of this science textbook which is based on the philosophy of constructivism.

1. Introductory situation / introduction through thought provoking questions
2. Activities / experiments
3. Think and discuss
4. Do you know this?
5. Lab activities
6. Filling in tables, Analyzing
7. Observing diagrams & pictures, Making Flowcharts
8. Making models and exhibiting
9. Studying stories, biographies, supplementary points



10. Key words
11. What we have learnt
12. Improve your learning
13. Who said? Who invented? (Reading to Learn)

Every lesson is developed based on the above constituents. Let us have a good analysis of the above and also see what steps are to be followed to conduct them in the classroom effectively.

### **1. Introduction:**

Lesson starts with an introductory situation based on the previous experience of children. Some lessons start with probing questions too.

#### **How to conduct:**

The previous knowledge of children is crucial to understand a science lesson, so the teacher should discuss the introductory situation with children. Mind mapping should be done on the key concept. For example the lesson 'Force' starts with an introductory remark and question 'many changes take place around us. Is there any reason behind them?' Hence, teacher should discuss the changes that take place around us and the reasons for them through thought provoking questions and then conduct Mind mapping on the concept.

### **2. Activities / Experiments:**

Many activities / experiments are developed to help children understand the concept and analyze it deep. These activities/experiments are so designed that the teacher can conduct them with locally resources / materials. Children can understand the concepts by doing them either individually or with the help of the teacher. At the end of these activities there will be some questions that facilitate inquiry and analysis of the activity.

#### **How to conduct:**

- The reason to conduct the activity should be discussed
- The objective of the activity should be written clearly in the form of a statement, question and problem
- Children should be asked to predict the results and should be written on the board
- Children should be asked to read the lesson intensively to know the requirements and procedure to do the activity.
- Teacher should give children all necessary tables and points for the observation of activity / experiment to facilitate recording of data
- The activity /experiment should be done by children individually / in groups /with the help of the teacher
- Observations should be recorded individually / in groups

- The results of the experiment/activity should be compared with the assumptions / hypotheses made
- The reports of the children should be exhibited and discussed with the help of thought provoking questions
- Children should read the explanations and conclusions given in the textbook and discuss their understanding
- New thoughts/ problems that have come out as a result of the activity/experiment should be discussed
- Ideas and experiences regarding alternatives and the usage of apparatus / tools should be discussed. New ones should be indicated / presented
- In a notebook, children should write in their own language their observations and what they have understood through the activity /experiment

### **3. Think and Discuss**

To help children have a deep understanding of the concepts some thought provoking questions are given under the heading ‘Think and Discuss’ here and there in the lesson. The aim of these questions is to make them think dialectically in different perspectives.

#### **How to conduct:**

Children should be made to think by asking the questions given under the heading ‘Think and Discuss’. They should be asked to talk individually.

- Since these questions are open ended, the teacher should not try to get a common answer. The teacher can ask some supplementary questions to direct their thoughts towards finding solutions to the problems logically, but s/he should not give answers and ask children to note them down.
- The questions / problems / contents under this heading can also be given as topics for seminars or elocution
- Children should be given chances to do supplementary / related experiments or make observations

### **4. Do You Know?**

To help children have a deep understanding of the concepts, and to explore them extensively some additional points for reflection / observation are given under the heading ‘Do You Know?’ For example, lesson ‘Synthetic Fibres and Plastics’ does not give any information regarding the research done by Becklind. This can motivate children to learn about the history of science and the stories behind some inventions and discoveries. Added to this, they develop scientific attitude and interest. They help them behave properly with aesthetic appreciation and love towards biodiversity.

**How to conduct?**

- As part of the teaching learning process, the teacher should motivate children to read what is given in the box by asking probing questions
- The children should be asked to read and individually and then discuss it
- They should be motivated to collect related / supplementary information through internet / library
- The material collected by the children (information, pictures, questions, books) should be displayed in the bulletin board / wall magazine
- Since these are not intended to test, there should not be any questions on the contents of this either in formative or summative assessment

**5. Laboratory Activities:**

Great importance is given to laboratory activities in the new textbook. The lab activities that should be conducted in each lesson are clearly given in the textbook. Though there are many activities in the textbook, the teachers should make children do the laboratory activities. These activities are marked with a special logo. These lab activities help children understand the lesson better. It is necessary for the teacher to ensure that all required apparatus, chemicals, activity sheets are available and then proceed to make children do the experiments.

**How to conduct?**

- Time should be allocated in the timetable to conduct lab activities
- The concepts that can be understood through experiments should be discussed beforehand. The children should be made to identify the objective of the experiment and the need to do it.
- Children should be given clear instructions about what they are expected to do individually / in groups.
- Teachers should get necessary apparatus ready and make children do the experiment giving them instructions wherever necessary
- The observations/ results recorded should be discussed and analyzed in the class
- The teacher should motivate children to accept the challenge of exploring ‘what will happen if the experimental conditions are changed’
- Children should be encouraged and given a chance to design alternative apparatus /tools and to use them
- The teacher should help children to learn on their own by working as a co-learner in the laboratory

**6. Filling in Tables – Analyzing:**

To develop in children various process skills to do activities, many learning activities are given in the new textbook. Activities like collecting information on their own, listing the information thus collected, analyzing it and making conclusions, etc., should be carried out in the classroom as important learning activities. In many lessons, tables are given to

improve the children's information gathering skills and analytical skills. Some tables which are already filled with information are also given. These will help children understand the lesson better. Knowledge construction can be facilitated by discussing the analytical questions given under the tables.

### **How to conduct?**

- Instructions should be given about the procedure to collect the required information to fill in the tables given in the textbook
- The children should be given enough time to collect information individually/in groups from library / internet /field visits
- The tables / information thus collected should be exhibited and discussed
- The teacher should ask the supplementary questions given in the textbook giving scope for children to deepen their understanding of the concepts
- If the table in the textbook cannot accommodate the information collected, the activity should be conducted by asking children to prepare an activity sheet with sufficient cells in their notebooks.
- Graphs and flow charts should be prepared based on the collected information, and exhibited in the class
- The information / items that should go into the table should be discussed
- Necessary instructions should be given when children fill in the tables
- The teacher should give examples
- The teacher should make children give their examples
- The teacher should see that children fill in the tables individually
- This activity should be conducted in the classroom as a constituent part of teaching a lesson
- The tables can be filled in at school, at home or at any other place where information is available when necessary
- Some tables need a lot of time to be filled in. For example to record the observations about the metamorphosis in frogs, it takes a long time. Hence enough time should be given depending on the task.
- Once the tables are filled in, they should be analyzed with the help of the questions in the textbook
- Some auxiliary / supplementary questions should be added
- Generalizations should be made based on the information in the tables
- The results should be compared with the hypotheses / assumptions as done in lab activities
- Some tables are given with full information. They should be analyzed with the help of questions

## 7. Observing diagrams & Pictures, Making flow charts

Diagrams and pictures help to give a lot of information in a concise form. In physical science as well as biology textbooks, many pictures given in the form of high quality photographs. However, those that depict the internal structure or the arrangement of apparatus are given as diagrams. Maps and drawings are also necessary in science, so some maps are given in the lessons like ‘Agriculture – the challenges before us’ and at other places wherever necessary. These make comprehending the information a lot easier.

### How to conduct?

- The drawings, pictures, flowcharts, Venn diagrams, pie diagrams, graphs, maps, etc., given in the textbook should be used according to the teaching learning situation
- Practice should be given to children in drawing pictures given in 2D form
- Children should be made to talk and comment on the pictures and graphs
- Children should be made to think based on the diagrams. They should be asked to observe them and then question
- The children should be made to recognize not only the parts of the diagram but also explain them
- Children should be asked to study the information given and draw diagrams,(based on their reading )showing the arrangement of apparatus and the procedure,
- The diagrams should be drawn in proportion with the real things
- Children should be asked to draw flow charts and graphs based on their reading/understanding of the lesson. For example they can be asked to draw the life cycle of frog in the form of a flow chart
- Children should be made to observe each stage in a flow chart; write their names and their speciality along with the time limit E.g. Classification of living things
- Children should be asked to make a flow chart of types of motion and exhibit it
- Children should be made to explain each stage; identify the order of the stages and the difference between them
- In some lessons incomplete diagrams are given. Children should be encouraged to think and complete them
- Diagrams should be drawn based on experiments and observations
- Children should be asked to study a lesson, understand it, and express their understanding through diagrams. E.g. Types of motion

## 8. Preparing models – Exhibiting:

Though 2 D diagrams, pictures and graphs help understand the concepts in physics and biology, some concepts like atomic structure, animal and plant cells need 3D models to facilitate good understanding. For this models are needed. When children are encouraged

to prepare models to represent the concepts mentioned above, they can understand them better.

### **How to use?**

Children should be given a chance to exhibit the models they have made in the classroom. They should be encouraged to explain their understanding the concept using the model prepared and using appropriate scientific terms.

- Children should be encouraged to prepare models based on the lessons either individually or in groups
- Write-ups on the model should also be made ready and exhibited in the classroom
- Children should be made to exhibit their models and talk about them
- When working models are prepared, their working mechanism and their applications should also be said
- The teacher should take necessary measures to preserve the models prepared or collected by children

## **9. Stories, biographies, supplementary materials:**

Children cannot have a good understanding of the concepts just with the information in the textbooks alone. Reading stories and historical background of the concepts in lesson help them understand better and motivate them to learn more.

### **How to use?**

- The concepts that can be understood through stories should be discussed in advance
- First of all, children should be motivated to read stories or biographies before they actually read them. Reading about the scientists John Shore, who invented tuning fork, and about Hertz, who invented photo electric effect, improve the children's understanding of the concepts in light and sound
- Children should be made to read the things given at the end of each lesson individually. For example the information on sanctuaries and natural reserves of biodiversity, the story of Archimedes, etc., After they have read, they should be linked with the lesson
- Children should be encouraged to read with interest the stories given in the textbook (history of classification, Ross's research, musicians, inventor of plastic, stories about Galileo), and supplementary components (letters, success stories)
- They should be discussed
- Such stories should be collected from various magazines, internet and from school library
- The material thus collected should be displayed on the bulletin board / wall magazine

- Children should be encouraged to gain/ obtain motivation from such stories and develop scientific concepts
- Children should be made to recognize the importance of biodiversity and appreciate it through reading stories
- Children should be made to appreciate the work done / efforts of scientists by reading their biographies /research and get inspired
- To understand some science concepts information is in the form of simple discourses like letters. Children should be asked to write their responses on them

### **10. Key Words:**

The important points in the concepts of the lesson are given as ‘Key Words’. The children will not only be able to form mental images of the concepts but also analyze them based on these key words.

#### **How to conduct?**

- Key words are concise concepts of the lesson
- While teaching a lesson, these key words should be understood through experiments and various activities
- To understand the lesson means to understand the key words, so children should be made to talk freely about them
- Children should be able to use the key words learnt in the previous lesson while learning the new lesson
- Teachers should not give their own definitions to key words
- Children should be able to do ‘Mind mapping’ based on the key words

### **11. What we have learnt?**

This is the constituent for recapitulation. Under this heading, the basic and fundamental concepts of the lesson are given in a concise form. These help to know various things discussed in the lesson. These will help teachers in writing the objectives of the lesson.

#### **How to conduct?**

- Taking the sentences one by one, the children should be asked to give their understanding of each concept
- They should be asked to write their notes based on this
- The points/ contents under ‘What we have learnt?’ are not just for revision. They should be used to discuss and analyze the concepts of the lesson one more time and thus serve as a practice session too.
- These should be used as a base for collecting additional information and to organize supplementary activities.
- Children should not be asked to memorize them

## 12. Improve Your Learning:

The main objective of the teaching learning process is to accomplish specified academic standards. It is necessary for the teacher to assess children and know whether they are able to achieve them or not. Though we evaluate children at every stage of the lesson through activities, the points / contents of ‘Improve Your Learning’ help teachers assess children’s understanding and application of the concepts. This is one perspective. The important aspect is this section is useful for children to assess themselves.

### How to conduct?

- The points under this heading help children make another attempt to learn the concepts of the lesson
- Though it helps to evaluate, the purpose is not to assess how far the learner is successful in learning
- As a part of continuous comprehensive evaluation, ‘Improve Your Learning’ helps to understand the lesson better (Assessment for learning)
- Direct answers to the questions under this heading cannot be found in the textbook
- Children should be encouraged to understand the concepts and write answers to these questions on their own
- This should be used to assess the children’s accomplishment of specified academic standards
- Some of the contents under this heading need to be done individually/in groups/whole class, so they should be done accordingly
- There are some puzzles and games too. Since these are also part of evaluation, and since these help to have a good understanding of the concepts, they should certainly be conducted without fail
- Supplementary / additional experiments should also be conducted and reports should be written in the notebooks
- Answers to components related to academic standards like interests, appreciation, biodiversity, application to real life situations, etc., should be written by each child individually and they should be given more importance.
- Questions related to field visits like collect, record need to be given enough time
- Questions given in the middle of the lesson should also be answered by children(individual/groups) as and when they appear in the lesson

## 13. Reading to Learn:

The textbook contains anecdotes from the lives of scientists, scientific inventions and discoveries, and stories that develop scientific thoughts. All these help children extend their experiential and conceptual orbit in joyful way. The items given under the



heading 'Reading to Learn' are supplementary materials which help children have a deep understanding of the concepts.

### **How to conduct?**

- These should be used to enable children to develop appreciation towards scientific inventions / discoveries and to recognize the importance of biodiversity.
- In addition to what is given in the textbook, teachers should collect essays and other interesting material from newspapers, magazines and make them available to children
- Since what is given under the heading 'Annexure' needs not only the textbook but also additional materials, children should be made to identify this and proceed accordingly
- Teachers should collect information(through internet, magazines) about the latest research being carried out on topics discussed in the lessons, use them in teaching the lesson, and add new things to the lesson according to the changing times. The conduct of the lessons should be a stereotype
- Since the purpose of this section is to develop scientific thinking, and interest on science, children should be asked to talk on this
- Children should be encouraged to collect news, articles, special features, pictures etc., which are related to the lessons, (from school library, internet, science magazines) and display them in the bulletin board / wall magazine
- The material thus collected should be used as indicators in continuous comprehensive evaluation

With a good understanding of the structure of the lesson, the teacher gets clarity on organizing various teaching learning activities in the classroom. By keenly observing various things given under different headings and by deciding on how to incorporate them in the teaching learning process, the teacher can teach meaningfully. It is very important for the teacher to have a clear understanding about the structure of the lesson since it helps him/her to plan a unit, to collect required material and to immerse children in the teaching learning activities.

## 7. How to Teach a Unit

However best the textbook may be made, the key factor for effective teaching is the method adopted by the teacher to teach it. The teaching learning activities designed by the teacher to achieve the targeted academic standards affect the learning process of the children. Hence, they should be designed in such a way that they make learning science an enjoyable activity. Let us see what a teacher should do in teaching a lesson and what a student should do in learning it.

### What should the teacher do before teaching a lesson?

The teacher should:

- Identify the targeted academic standards of the unit
- Get ready to conduct the activities given for the achievement of the targeted academic standards and also develop some supplementary activities if required
- Collect or ask children to collect required information/material to conduct the activities
- Collect additional information through internet and reference books and be ready with good understanding of the concepts
- Prepare required worksheets, tables, information, etc., related to experiments or field visits. S/he should identify the information centres, areas and people and be ready with phone numbers and mail addresses. Permissions from appropriate authorities should also be obtained beforehand.
- Develop interesting problems / thought provoking questions that motivate children to learn the lesson
- Allocate some periods (while allocating periods for the unit) for the practice session given towards the end of the unit

### What should the teacher do / bear in mind while teaching a lesson?

The teacher should:

- Conduct the class in such a way that children participate in all the activities in the lesson voluntarily and happily with a lot of interest
- Give priority to simple experiments, activities, field visits, etc., which develop thinking skills and observation skills in children.
- Link the concepts in the lesson with the real life situations / events
- Bear in mind the following while teaching a lesson

The teacher should:

- Write the name of the lesson on the blackboard and let children do mind-mapping
- Make children read individually the introduction(story, situation, question) of the unit
- Conduct discussion on the items given in introduction through probing questions

- Make children envisage solutions to the problems by encouraging them to read and discuss the activities
- Encourage children to do activities on their own to check the validity of their assumptions. The results of such activities should also be discussed
- Discuss the tables or worksheets meant for the collection of data/material and give children opportunities to fill them in individually
- Conduct discussion among children based on the analysis of the tables so as to enable them to make conclusions
- Encourage children to draw pictures, to mark the parts, to discuss what each part does, to elaborate a process, etc., wherever required
- Make children develop models / working models, wherever necessary, and encourage them to exhibit them. The required materials for this can be supplied by the teacher, or, the children can be asked to collect them.
- Make children read sections like ‘Think and Discuss’, ‘Do You Know’, ‘annexure’, ‘stories’, etc., and discuss their contents enabling them understand and appreciate science concepts
- See that children talk and elaborate the key words and concepts
- Discuss with children each item under ‘What we have Learnt’
- Encourage children to think, participate voluntarily and to respond individually to the items given under the heading ‘Improve Your Learning’. The projects can be given as a group work and enough time should be given to do them. The teacher should cooperate with the children by giving suggestions, guidance and by giving additional information through experiments and other things
- Use the information given in the annexure according to the situation

### **What should the teacher do after teaching a lesson?**

The teacher should:

- See that children do the activities and projects given at the end of the lesson
- See that children collect information related to the lesson from library, magazines, and their surroundings
- Record children’s thoughts, interesting things, doubts, etc., related to various concepts of the lesson
- See that the above items are exhibited on the wall magazine
- Give suitable instructions to children so as to enable them to apply what was learnt to real life situations
- Identify the concepts that children did not understand, and develop suitable activities to enable them learn those concepts
- See that all children achieve the targeted academic standards

## What steps should be followed while teaching a lesson?

To achieve the targeted academic standards in science, children should be made partners in learning activities. Process skills and scientific thinking should be developed in them by motivating them. They should be motivated towards learning the lesson by asking them some probing questions. Then they should be encouraged to do mind-mapping. Simple experiments, activities and projects should be conducted to help them have a good understanding of the concepts. Science concepts should be linked with the real life situations and events. Let us see what steps are to be followed while teaching a lesson.

Steps:

1. Mind mapping – Probing Questions
  - A. Greeting
  - B. Mind mapping
  - C. Motivating/Probing questions
2. Reading the textbook – Recognising the key words
  - A. Reading the lesson – recognizing the key words
  - B. Discussion in groups, teacher’s explanation on the board
  - C. Motivating children to ask questions on the lesson
3. Comprehension of concepts – Doing Activities – Discussion
4. Demonstration – Discussion
5. Conclusion – Evaluation

The importance of the lesson, the objectives of the lesson or the targeted academic standards of the lesson should be discussed only in the first period.

Targeted Academic standards: Efforts should be made to achieve the seven academic standards specified for science, so the objectives should be decided keeping in view the components the lesson focusses on.

Importance of the lesson: The importance of the lesson should be made clear to children answering the questions ‘Why should they learn this lesson?’ and ‘What use is it to them?’ This helps children understand why they are learning that lesson.

### 1. Mind mapping:

The teacher should write the title of the lesson on the blackboard and invite the children’s concepts, opinions, examples, characteristics, properties, etc. S/he should ask probing questions, make children think about the key concepts of the lesson and contribute to mind mapping through interaction. The teacher should motivate children and get them ready to learn the lesson through this activity

## **2. Reading the textbook – Recognising the key words**

The teacher should ask children to read that part of the lesson which is to be taught in that period according to the syllabus. As they read the lesson, the teacher should make them identify difficult to understand new concepts and terms, write them on the blackboard and encourage children to discuss them. S/he can explain wherever necessary.

## **3. Comprehension of concepts – Doing Activities – Discussion**

Children have to ask a lot of question to understand the concepts of the lesson and to clear their doubts. They have to make assumptions/hypotheses to solve problems and then do experiments to verify whether they are valid or not. They have to take up projects that call for process skills in collection as well as analysis of information.

Children should express their comprehension of the concepts in a multiplicity of ways: by drawing pictures and marking the parts, by drawing the arrangement of apparatus in the experiment and describing the process, by drawing flowcharts and pictures showing processes and observations, and by making models, alternative apparatus / improvised apparatus. These should be used to enable children to develop appreciation towards scientific principles, real life situations, scientific inventions / discoveries, recognize the importance of biodiversity and an awareness to protect the environment. The activities should help children apply the scientific knowledge acquired to real life situations. To make children comprehend concepts of the lesson, the following activities should be conducted in the classroom:

1. Experiments
2. Projects and field visits
3. Data collection and tabulation
4. Analysis of the data and making conclusions
5. Conduct of interview, quiz, seminar, symposiums
6. Writing reports on the observations/experiments conducted
7. Drawing pictures / graphs related to observations/experiments
8. Drawing diagrams, marking the parts and explaining
9. Making models
10. Reading stories, historical events, researches
11. Making posters, logos, cartoon and writing essays, songs, stories
12. Conduct of wall magazine, children's diary, school magazine, theatre day, meeting of the cultural society

(Note: The teachers should collect and get ready before hand with all apparatus, tools and other things required to conduct activities)

#### **4. Demonstration – Discussion**

Children participate in various activities to comprehend the concepts. They also design/develop/prepare a number of items. All these items should be discussed and displayed in the classroom. The main points should be written on the blackboard and children's work should be analyzed based on them. A number of thought provoking questions that help to do analysis and discussion should be written on the blackboard.

#### **5. Conclusion – Evaluation**

Towards the end of the lesson, the teacher should give scope for children to revise what they have learnt in the unit. This can be done in many ways. S/he can revise and conclude herself/himself or ask a student to do it individually. Alternatively, s/he can ask children to take turns and revise the items one by one.

Evaluation should be done in two ways – as an intricate part of the teaching learning process and at the end of the lesson.

- Evaluation should give scope for a wide variety of responses /answers
- The activities under the headings 'Discuss in groups', 'write what you have observed', 'Fill the table', etc. should be done as integral part of lesson(Formative Assessment) which means teaching a lesson and evaluation go hand in hand
- Evaluation should be done according to the situation but not according to a fixed schedule
- Children should be asked to give their opinions and conceptual understanding and explain
- The contents under the heading 'What we have learnt' regarding the lesson taught should be discussed in groups. Then children should be asked to write their responses individually
- The children should be asked to do the contents under 'Improve your learning' individually
- The notebooks and worksheets of children should be checked/verified either by the teacher or by the other students
- The teacher should design/develop some activities for homework

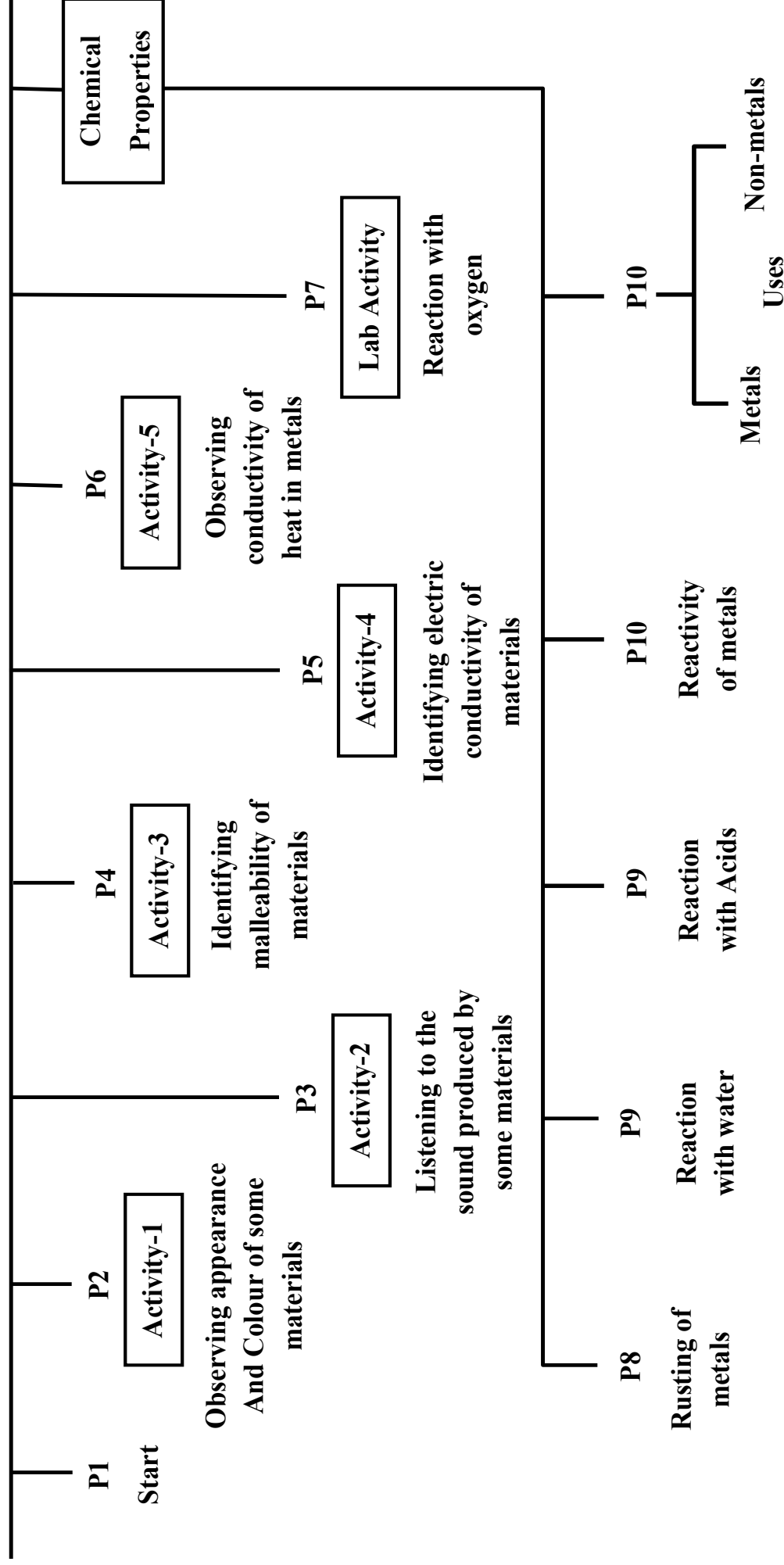
## 8. Analysis of a Unit – Model Lesson

So far we have learnt about the syllabus themes, the structure of a lesson, academic standards and the steps to be followed while teaching a lesson. Now let us take some units as examples and observe the nature of science, the pedagogy and the curiosity in learning a lesson. Also let us have a look at period-wise analysis of the concepts and the model lesson. While analyzing a unit the following elements should be born in mind.

The teachers should be asked to:

- Read the lesson with comprehension
- Identify key concepts of the lesson
- Identify the activities given for each concept
- Tell how the lesson has been introduced/started
- Explain the nature of activities
- Write important objectives of the lesson
- Check whether the activities are being done scientifically or not
- Explain what type of questions are there in the lesson
- Discuss the items under the heading ‘Think and Discuss’
- Identify pictures and examples in the lesson. Then, identify what other materials/resources are required for the lesson
- Prepare a proper plan to conduct the activities in the lesson
- Tell whether there is scientific method or not in conducting the activities
- Observe the contents of the sections ‘Key words’ and ‘What we have learnt’.
- Check whether the components under the heading ‘Improve your learning’ are according to the specified academic standards of the class

## Metals and Non-Metals (12 Periods)





## **Metals and Non Metals** (Class – 8)

**Analysis of the Unit:** 12 periods are allocated to this lesson - 10 periods for lesson and 2 periods for exercises.

### **Beginning:**

The lesson started with properties of materials and the way they are used in our real life experiences.

### **Activities:**

1. Observing the appearance and colour of some materials (Group)
2. Listening to the sound produced by some materials (I/G)
3. Identifying the malleability of materials (Group)
4. Identifying the electric conductivity of materials (Group/Lab)
5. Reaction with oxygen (Group / lab)
6. Observing heat conduction by metals (Comp/lab)

### **Questions:**

Some questions from daily life experiences and previous knowledge are given before a concept or an activity. Guessing Questions, Analysis and discussion Questions are also given.

### **Think and Discuss:**

Many questions are given on the activities conducted, on the concepts learnt and experiences gained to develop extended thinking.

### **Figures:**

Two dimensional pictures and some real photos are used and some are drawn.

### **Tables:**

There are 10 Tables. Some tables have yes/no questions. These can be filled by children while doing activities. Table-6 is a consolidated table for all previous activities.

### **What we have learnt:**

Key concepts in the lesson are given in sequential order under this heading.

### **Key words:**

Important elements are given as key words at the end of the lesson. We can learn the comprehension of the children by asking them to speak about them. These are given in

bold letters and their English equivalents are given within the brackets so as to enable children to follow these concepts in higher classes without much trouble.

### Improve your learning:

- Most components under this heading are such that they enable children give their own ideas based on the concepts they learnt in the lesson
- Some Questions given are based on real life experiences.
- Some higher order thinking questions are also given.
- Some questions are related to AS<sub>4</sub> and AS<sub>5</sub>. (AS stands for Academic Standards)

### Model Lesson:

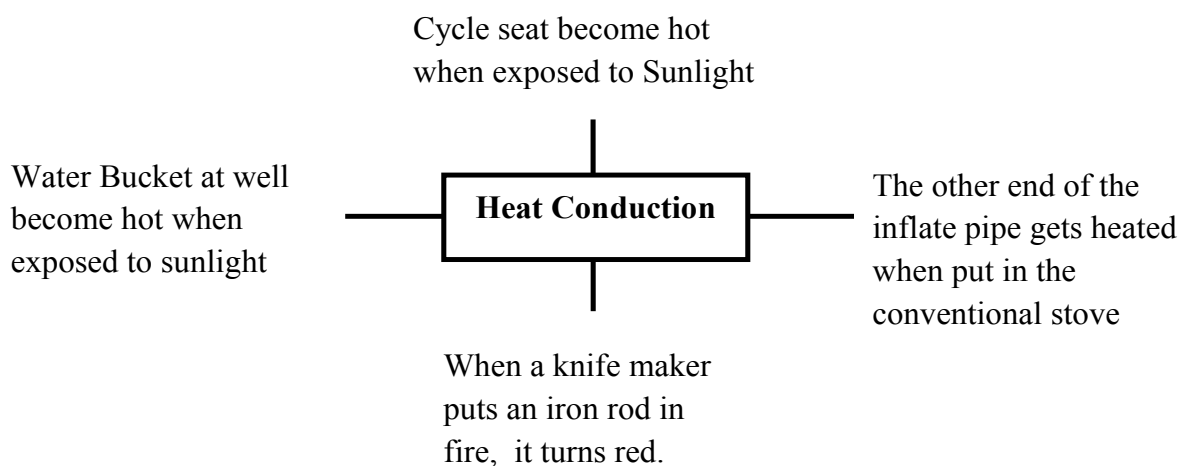
**Concept** : Observing heat conduction by metals

**Importance** : By learning how different metals conduct heat, children will understand which metal is useful for which purpose

### I. Mind mapping:

**Greeting:** Good morning children. So far we have learnt about sound propagation and malleability of metals and nonmetals, haven't we?

**Mind mapping:** We know that heat is a form of energy. Tell us what you know about how heat is transferred from one place to another place? (Teacher has to write 'Heat conduction' on the black board and conduct Mind mapping)



### Motivating / probing Questions

- How did your mother put down the Pan from the stove?
- Why did she use cloth? Why did not she do it with bare hands?
- Was the pan completely hot? What can be the reason?
- Name some more things that get hot completely when heated?
- What is the metal used to make such things?
- What process do you think is responsible for these things to get hot completely?
- To which characteristic of metals does this process belong?

## II. Reading:

- Children! Read the activity on page No.54 in your textbook. Identify the new words, new concepts and discuss them.
- Teacher has to write the words identified by children on the blackboard and explain them.
- You have read the lesson, haven't you? Ask me some questions if you want to know more about the lesson. Teacher has to write the children's questions on blackboard.

## III. Comprehension of Concepts – Discussion

### Conducting Activity 1:

Prepare a list of materials required for experiment. Arrange the apparatus as explained in the lesson. Ask children to divide into groups, take apparatus and do the activity. Different groups do the experiment separately as indicated in the lesson.

### Observations to be made by each group:

1. How much time did the pins take to fall off ever since the start of the heat supply?
2. Did all the pins fall off at the same time?
3. Did all the pins we arranged fall off?
4. Pins on which end of the rod fell off first?

## IV. Demonstration – Discussion:

The teacher has to write the following table on the blackboard and note down the observations of the groups in it through discussion.

Group	Q-1	Q-2	Q-3	Q-4
1				
2				
3				
4				

The teacher has to write the following questions on the blackboard. Then analyze them through discussion with the children.

1. How much time did the rod take to get heated?
2. Pins on which end started falling off first?
3. Did all the pins are fall off? Why?
4. What will happen if the length of the rod is increased?
5. Why did the pins fall off from the iron rod?
6. How did heat get transferred in the rod from one end to the other?
7. What happens if metals have no conductivity of heat?

Children display the diagram showing the arrangement of apparatus in the experiment.

### **V. Conclusion – Evaluation:**

The children should be asked to review the lesson with the help of important points in the lesson.

1. Can all metals conduct heat?
2. Which metals conduct heat more?
3. What metal is best for kitchen vessels?
4. What type of materials are used as heat insulators?

During the training programme, after the model lesson is finished, teachers should discuss the nature of science, teaching method, academic standards, and curious items in the lesson. They should make a list of items which make children learn the lesson with enthusiasm. E.g. Historical background, surprising things, science wonders, puzzles, cartoons etc...

At the end of the lesson, in the training, the teacher has to discuss on the nature of science, teaching method, educational values, and curious items in the lesson. Make a list of interesting items of the lesson for the children. E.g.: Historical items charts, Science fictions, Puzzles, Cartoons etc.

### **Nature of Science:**

It is proved that heat conduction takes place in metals. It is identified as a natural process. They appreciate this fact and apply it in their real life situations.

### **Pedagogy:**

They understand heat conduction in metals experimentally through scientific method following social constructivism.

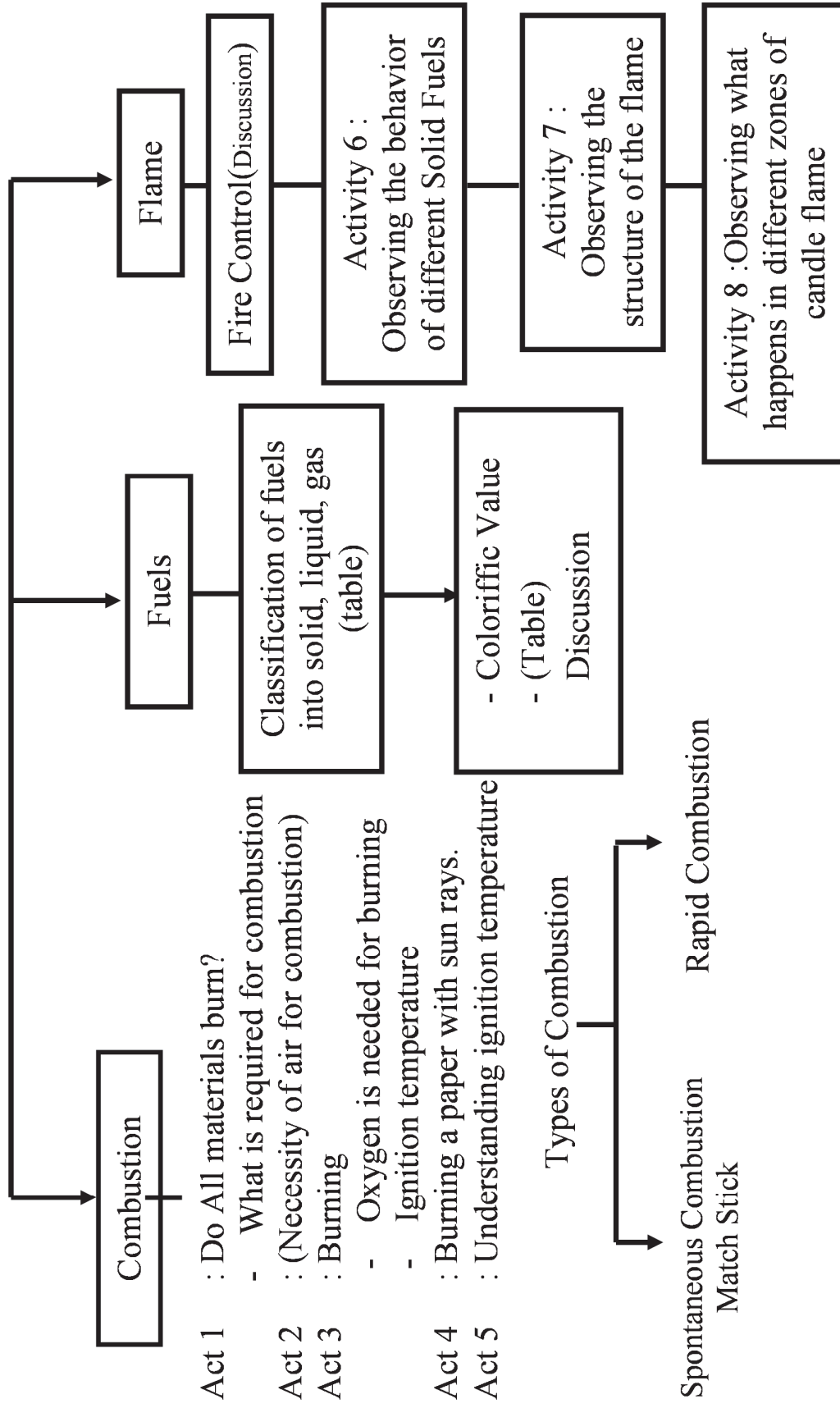
### **Academic Standards:**

In the activity, 'heat conduction by metals' conceptual understanding, questioning and application are presented. Skills of experimentation are developed through scientific process. Through drawing the arrangement of the apparatus, children's drawing skills are developed.

### **Curiosity:**

- Normally, heat passes through metals. But children are curious to know which metal conducts more and much quicker than the others?
- While conducting the experiment, children will be curious about the pins falling from the rod. They would like to see from which end the pins fall first.

## Unit-7 : Combustion, Fuels and Flame (8<sup>th</sup> Class, Chemistry)



## Combustion, Fuels and Flame

(8<sup>th</sup> Class Chemistry)

### Analysis of the Unit

1. **Beginning:** The lesson started with probing questions based on real life situations.

#### 2. Activities

1. Do all materials burn? (Individual / Group)
2. Combustion of materials, testing the necessity of air for burning (Individual)
3. To prove that oxygen is necessary for burning (Group)
4. Burning a paper with Sun rays (Group)
5. Learning about ignition temperature (Group)
6. Observing the behavior of different Solid fuels (Group)
7. Observing the structure of the flame (Group)
8. Observing what happens in different zones of flame. (Group)

#### 3. Tables

1. Table-1, Activity 1, Define and record observations.
2. Table2. Classify the fuels into solid, liquid, gas and write them in table -2.
3. Table 3 : Observing the behaviour of different solid fuels and record in the table-3
4. Under the section 'Do you know?' Discussion on the calorific values of fuels.

#### 4. Think- Discuss / Do you know (Box item) :

1. About Combustible, non-combustible Materials
2. If you lift the glass tumbler, which is placed over a burning candle, by 1 cm what will happen?
3. Oxygen helps burning; can we substitute  $\text{KMnO}_4$  with any other substance to release oxygen?
4. About Highly Inflammable materials and Explosion.
5. Discussion on Phosphorous, Kerosene stoves, how to light matches in rainy season?
6. About fuels, calorific values?
7. About candle, kitchen gas.
8. How does a candle burn and give flame?

#### 5. Figures

Figures of experiments, structure of flame, burning of different materials.

#### 6. Key words

Key words represent key concepts in the lesson. English terms for key words are given.

### 7. What we have learnt?

Key concepts in the chapter are given order.

### 8. Questions :

- Given to discuss before and after activities.
- Given to introduce the concept and to do lab activity.
- Given to discuss in the middle of the lesson.
- Given in the section 'improve your learning'.
- 

## Model Lesson

### Aim / Concept

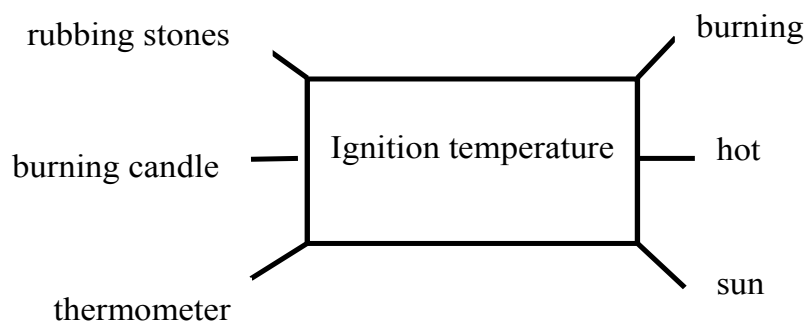
Comprehension of the concept of ignition temperature through an experiment.

### I. Mind mapping

a. **Greeting:** Good Morning Children.

### b. Mind mapping :

What do you know about ignition, spontaneous combustion and rapid combustion?  
[The teacher has to write 'ignition temperature' on the blackboard and conduct Mind mapping as shown below]



### c. Probing Questions:

1. Can we burn paper without using flame?
2. What makes matches to catch fire?
3. Can we identify ignition temperature through rubbing hands?
4. Are there any materials that burn on their own?

**II. Reading:**

- Children read the activities on page no.99 of the text book, note down the new words and concepts and discuss them.
- Teacher should write the words said by the children on the blackboard and explain them.
- You have read the lesson, haven't you? Ask me some questions if you want to know more about the lesson. Teacher has to write the children's questions on blackboard.

**III. Comprehension of Concepts – Discussion**

- Prepare a list of materials required for experiment.
- Arrange the apparatus as explained in the lesson and conduct the activity. Children divide into groups and do the experiment.

**IV. Demonstration – Discussion:**

The teacher has to write the following questions on the blackboard and discuss them based on the observations of all children in all groups

1. Which cup burns faster? Why?
2. Why didn't the cup with water burn immediately?
3. Does the water in the paper cup become hot like the water in a vessel?
4. Measure the time taken to burn the above two cups?

Teacher has to write the following table on the black board and summarize the answers given by the groups.

Groups	Qn-1	Qn-2	Qn-3	Qn-4
G1				
G2				
G3				
G4				

From the above experiment students understand which cup's ignition temperature is more/less. They draw a diagram showing the experiment they have done.

**V. Conclusion – Evaluation :**

The teachers has to get the procedure and result of the experiment from the children one by one and finally conclude the result.

Children have to write the answers at home for the questions given below.



1. In the above experiment, which cup's ignition temperature is high? Why?
2. What are inflammable substances? Name such material used in the above experiment.
3. Estimate the result when the experiment is repeated with less water in one cup and more water in the other cup?
4. There is a sign on a lorry saying 'Danger! Inflammable materials'. Give your responses/opinions on this.

In the training session, at the end of the model lesson, the teacher has to discuss on the nature of science, teaching method, educational values, and curious items in the lesson. Make a list of interesting items of the lesson for the children. E.g.: Historical items charts, Science fictions, Puzzles, Cartoons etc.

**Nature of Science:**

1. Through the experiment of ignition temperature, proving the characteristics of inflammable materials.
2. Giving opportunity to identify such materials by their characteristics and use them in real life situations

**Pedagogy:**

They understand the characteristics of materials experimentally through scientific method following social constructivism.

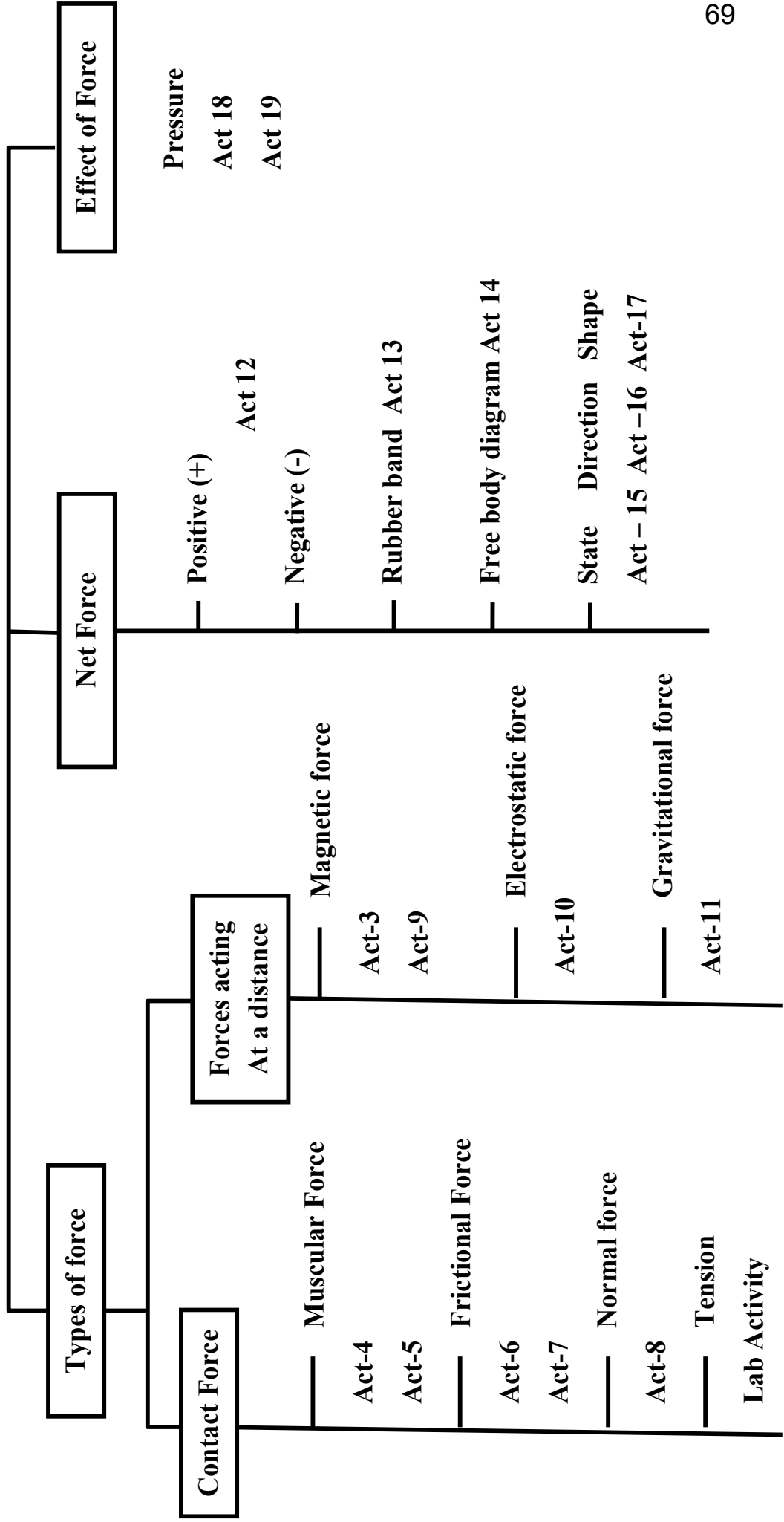
**Academic Standards:**

1. Understand, question, hypothesize about ignition temperature.
2. Development of skills of experimentation in scientific method.
3. Collect and display in the classroom, the information regarding the process of supplying highly inflammable materials.

**Curiosity:**

Normally paper cup burns quickly. But in the experiment, the cup with water takes more time to burn. To measure this time, student will do the experiment with curiosity. He will discuss the ignition temperatures of oil, crackers, etc. used in daily life.

# 1. FORCE



## Force

(8th Class Physics)

### Analysis of the Unit

#### Beginning:

1. Lesson started based on the changes around us and in nature.
2. Force is responsible for many happenings / activities in daily life.

#### Activities – Concepts:

1. Identifying Push or Pull in different actions- Fill in the table – 1 (I)
2. Because of contact force, tooth paste comes out from tube (I)
3. Identifying the change in the direction of the needle in a compass due the magnetic field of the bar magnet. (G)
4. Preparing a list of instances for use of muscular force (I) contact force.
5. Observing the changes in any muscle while working (I) Contact force
6. Observing the motion of a ball on different surfaces (G) Force of friction
7. Observing the motion of objects on an inclined plane (G) Force of friction.
8. Identification of gravitational force and normal force acting on a book (I) Normal force
9. Making needle magnets and floating them in a bowl of water (G) Magnetic force
10. Observing a charged balloon pull bits of paper (G) Electrostatic force.
11. Observing Gravitational force of different falling bodies (G) Gravitational Force.
12. Effect of net force acting on a table (+positive, - negative) (G) Net force.
13. Finding net force from the effects of stretched rubber bands on fingers.
14. Free body diagram.
15. Effect of force on the direction of motion and state of the body (I) (State)
16. Effect of net force on direction of moving object in carom board play. (Directional)
17. Effects of force on shape of an object (Shape)
18. Change in effect of force with area of contact (pressure)
19. Effect of pressure on surface area of the brick in contact with the lime powder (G) Effect of force.

#### Think and Discuss

1. Does the force of friction act on an object at rest?
2. Identification of contact forces, frictional forces and normal forces between two bodies.
3. Discuss the relation between mass and air resistance.
4. Pick out the magnet from two identical bars.
5. Estimate the resultant force in arm wrestling.
6. Does pressure has direction? Explain.

**Figures / Diagrams**

1. Diagrams of daily life actions.
2. Diagrams showing lab activities.
3. Diagrams showing the process of activities.
4. Cartoons showing different forces acting on a body.

**Tables**

1. Filling of table in Activity-1 about push or pull.
2. Filling of table 3 in activity 13 regarding change of shape: permanent/temporary.

**Keywords**

All key concepts are given as key words and English terms are also given.

**Probing questions:**

- Some questions are given in the introduction part of the lesson.
- Open-ended questions are given as an extension to activities.
- Thought provoking questions are given at the end of activities.
- Open ended questions are given at the end of lab activities.

**Improve your learning:**

Questions are given on the basis of academic standards and competencies.

## Model Lesson

**Aim**

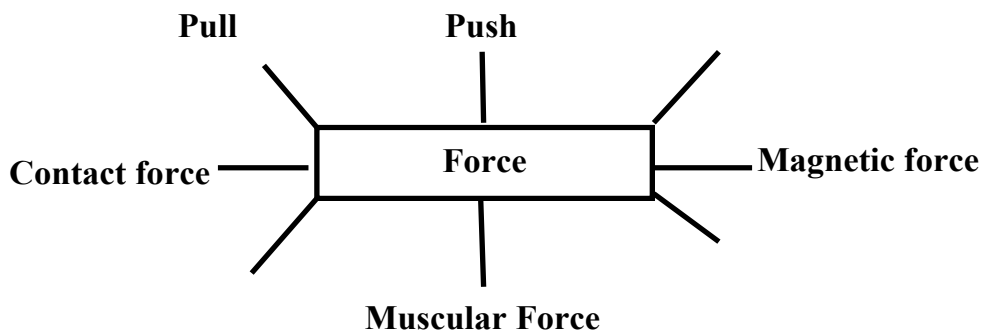
Understand the tension through practical experience.

**Objectives:**

Understanding / asking – Applications / Skills / drawing Educational Values

**1. Mind mapping :**

- a. **Greeting:** Good Morning Children
- b. **Mind mapping:** When force is applied on a body, it moves. Say what you know about force?



### c. Probing Questions :

1. What change did you observe in a piece of string when a stone is suspended at its end?
2. What will happen if you go on increasing the weight at its end?
3. Have you ever observed similar incidents in your experience?
4. When a weight is suspended with the help of a piece of string, what do you call the force acting in the string?

## 2. Reading the Lesson:

- Children read the topic tension on page 6. Notice the new words and concepts and discuss them.
- Teacher has to write the words identified by children on the blackboard and explain them.
- You have read the lesson, haven't you? Ask me some questions if you want to know more about the lesson. Teacher has to write the children's questions on the blackboard.

## 3. Comprehension of Concepts – Discussion

You have read the lesson, haven't you? Let us discuss what apparatus are required and the procedure to do the experiment on tension.

- Arrange the material required for the experiment / activity.
- With the help of teacher children have to arrange the apparatus and do the experiment.
- Every group has to note their result in the following table.

S.No	Name of the Group	Types of thread	Result : Trial1	Result : Trial2	Average Result
1		20cm long untwisted string			
2					
3					
4					

- Every group fill in the above table with their results.
- Teacher notes down all the results of the four groups on the blackboard and analyze it.
- Teacher has to observe the activities of the Groups and guide them to get the result. From the above experiment, children generalize the average the tension of untwisted thread.

#### **4. Demonstration – Discussion :**

Teacher has to write the following questions on the blackboard and discuss them.

1. What was the nature of the string?
2. How much weight could it bear?
3. What was the reading of the weight when the string was broken?
4. Is there any relation between the quality of the string and its load bearing capacity?
5. Do all strings bear weight alike?
6. Is tension the same for a piece of string and a piece of thread?
7. What are the forces acting on the string?

(Teacher has to note down the answers of the groups on the blackboard and make generalizations analyzing the results of the experiments.)

#### **5. Conclusion – Evaluation :**

Teacher has to make children give an account of the experiment and its results one by one and then conclude the lesson

1. Draw the diagram showing the arrangement of apparatus for the experiment.
2. Do the experiment with threads made from twisting 2 or 3 lengths of thread, estimate and check results
3. Do the experiment with the same thread but of different lengths, estimate and check the results.
4. Do the experiment with cotton, silk, nylon and wool threads, estimate and check their tension.
5. What is tension?
6. What are the forces acting on a thread when a stone is suspended at its end?

During the training programme, after the model lesson is finished, teachers should discuss the nature of science, teaching method, academic standards, and curious items in the lesson. They should make a list of items which make children learn the lesson with enthusiasm. E.g. Historical background, surprising things, science wonders, puzzles, cartoons etc.

## Electrical Conductivity of Liquids

Good Conductors and Bad  
Conductors of Electricity

Activity 1

P<sub>1</sub>

Electric conductivity of

Liquids

Activity 2

P<sub>2</sub>

Chemical effect of

Electric current

Activity 4

P<sub>4</sub>

Electroplating

Lab activity

P<sub>6</sub>

Transforming a poor electric  
conductor into a good electric  
conductor.

Activity 3

Make your own cell

Activity (5)

P<sub>5</sub>

Electroplating

Uses

P<sub>1</sub>

## Unit 8 Electrical conductivity of Liquids

(8th Class Physics)

### Beginning:

1. Lesson started with changes that take place around us in nature.
2. Electrical conductivity of Liquids is responsible for many activities in daily life of student.

### Activities

1. Testing the material to know which allows electric current to pass through it. Fill in table -1 with the observations made (I)
2. Testing the electric conductivity of liquids - Filling table 2 (G)
3. Transforming a poor electric conductor into a good conductor - filling Table 3 (G)
4. Testing the effect of electric current on potato (I)
5. Making a cell (I)
6. Lab activity: Coating an iron key with copper by electroplating method.

### Think / Discuss

1. Some materials allow electric current to pass through them.
2. Some materials do not allow electric current to pass through them.
3. Identification of positive and negative electrodes of a cell.
4. Explanation of electrolysis.

### Figures / diagrams:

1. Figures about daily life situations
2. Figures showing the experiment procedures.
3. Figures showing the activity procedure.
4. Coating on metals using electroplating method.
5. Diagram showing the effect of electric current on potato.

### Tables:

Table-1 shows the materials which allows electric current in Activity 1.

Table-2 shows the electric conductivity of liquids in Activity 2.

Table 3 shows transforming a bad conductor into a good conductor in Activity 3.

### Key words



Important concepts from the lesson are given as a key words. Children can understand the lesson by discussing these words.

### **What we have learnt?**

1. Concepts are given briefly under the section ‘what we have learnt.’ Just like the key words, they too help children to have a deep understanding of the lesson.

### **Nature of Science**

1. Through the experiment of electroplating, children take precautions against rusting.
2. Select the material from his daily life and surroundings for electroplating and use the method.

### **Pedagogy:**

They understand the nature of a metal and take preventive measures to avoid rusting experimentally through scientific method following social constructivism.

### **Academic Standards**

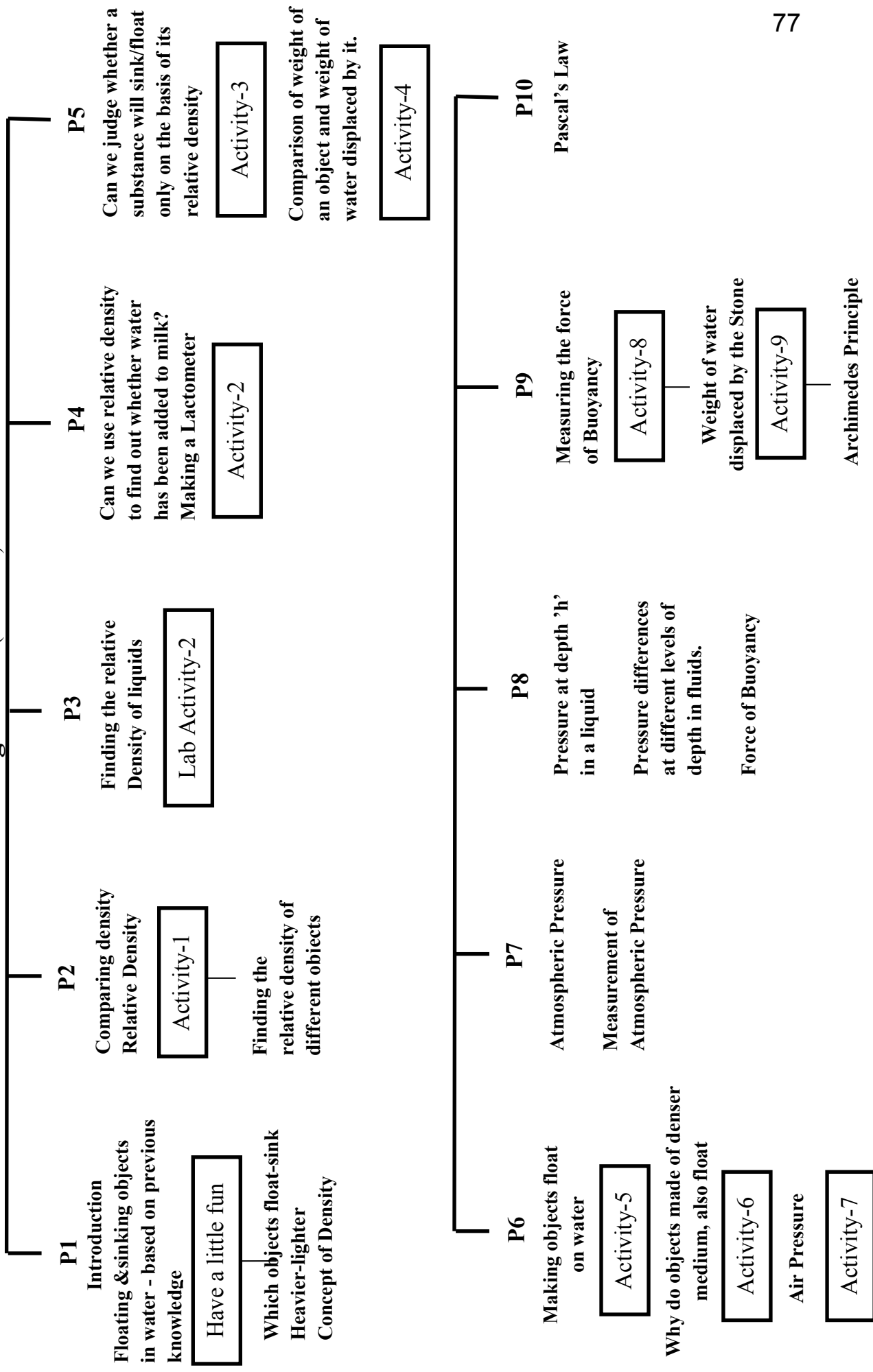
1. Understand, question and hypothesize the concept of electroplating.
2. Develop skills of experimentation through scientific process.
3. Collect and exhibit in the class different things from real life which are electroplated.

### **Curiosity:**

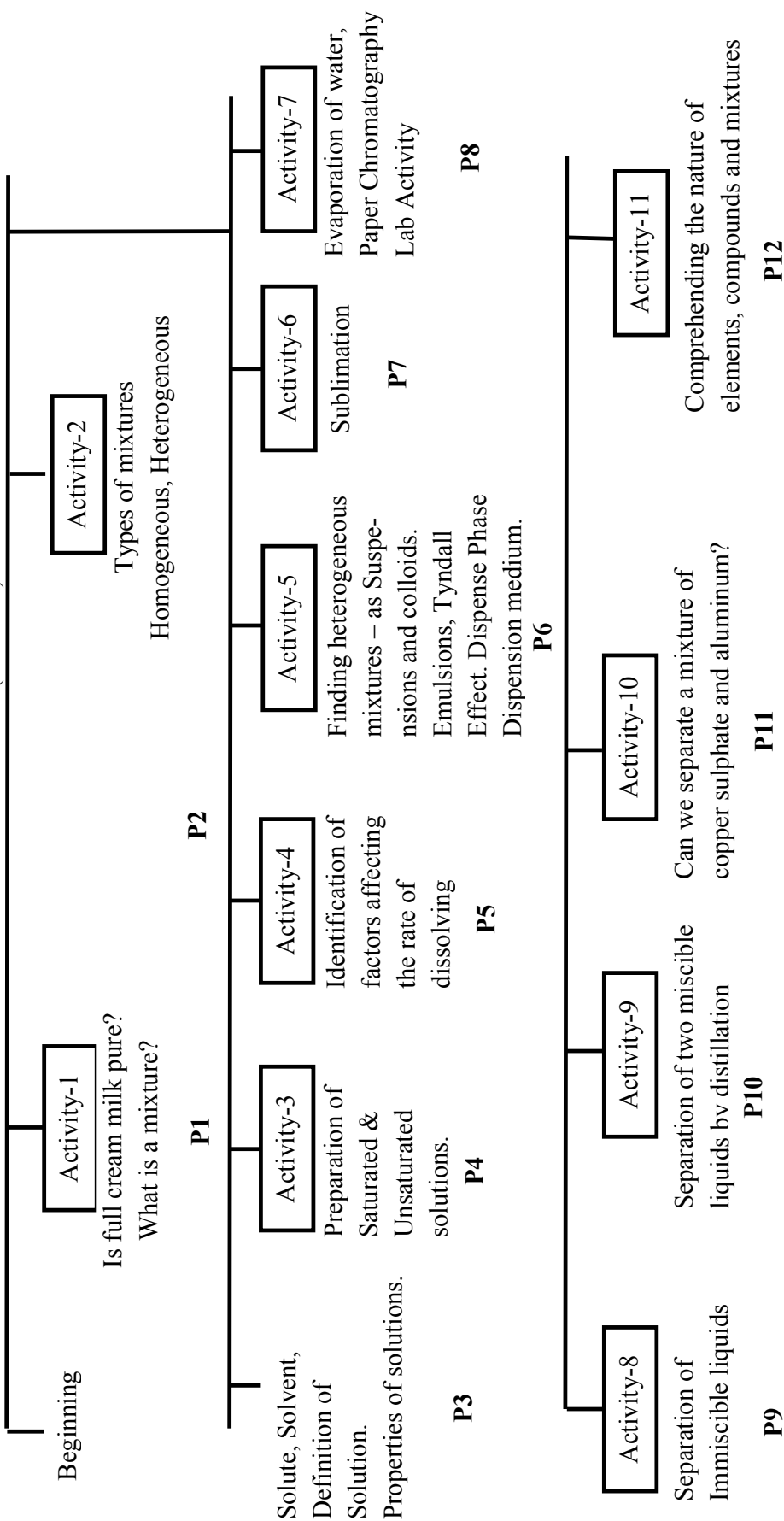
Students learn that electroplating not only protects rust-prone things from rust/corrosion but also makes them look nice. They use this process in daily life to protect rust-prone things from corrosion.

In the experiment we dissolve crystals of copper sulphate in pure water to prepare concentrated solution. Questions like ‘Why do we add dilute  $H_2SO_4$  to this?’ develop curiosity in children about the lesson.

## Floating Bodies (IX Class)



## Is Matter Around us Pure (IX Class)



## Is matter around us pure

(IX Class)

**Beginning:** Meaning of the term pure – How do we use the term pure in daily life situations. -- In what sense do we use this term in Chemistry.

### Activities:

1. Is milk with cream pure? (I/G)
2. Identification of homogeneous and heterogeneous mixtures. (G)
3. Preparation of saturated and unsaturated solutions.(G)
4. Identification of the factors affecting the rate of dissolving. (I/G)
5. Finding the heterogeneous mixtures as suspensions and colloids. (I/G/L)
6. Experiment showing sublimation.(G/L)
7. Evaporation of water.(G)
8. Paper Chromatography(G/L)
9. Separation of immiscible liquids.(L)
10. Separation of mixtures by distillation.(L)

### Questions:

- Previous knowledge has been tested, while explaining a concept or before performing an activity by asking questions from their daily life experiences.
- Some questions are given to imagine/ estimate the result of an experiment or an activity, before it is actually conducted.
- Some questions are given to discuss and analyze the concepts learnt.

### Think – Discuss:

Many questions are given on the activities conducted, on the concepts learnt and experiences gained to develop extended thinking.

### Diagrams:

- All are two dimensional pictures. Real photographs have been used to illustrate some concepts.
- Flow charts have been given to show the process of experiment and the key concepts of the lesson.

### Tables:

- Some tables are given with information for children
- Some are to be filled in by children with the observations/results of experiments.
- Some tables are given to facilitate analysis of the properties of matter.

### Keywords:

Key concepts like Evaporation, Sublimation, and Distillation are given as key words. By discussing these key words, children will understand the entire lesson. They are given in bold letters with English equivalents.

### What we have learnt:

The key concepts are given briefly in a sequence so that the children can sum up the lesson easily. One can understand the entire lesson by reading them.

### Improve your learning:

- Most components under this heading are such that they enable children give their own ideas based on the concepts they learnt in the lesson
- Some are given in such a manner that children can answer them only after performing the activity / experiment in the classroom.

## Model Lesson

**Concept** : Separation of heterogeneous mixtures: Chromatography.

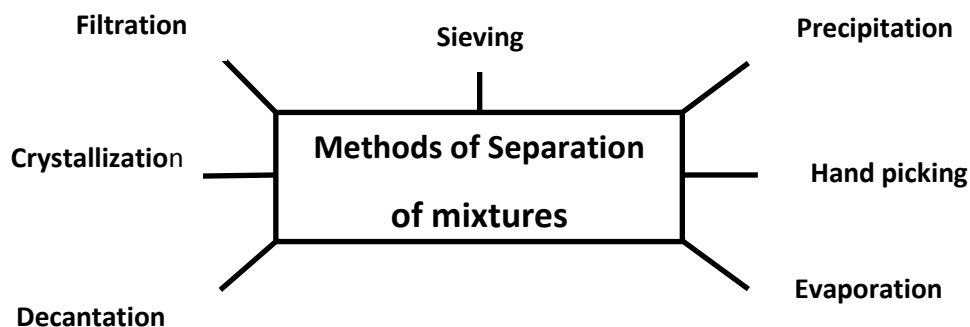
**Importance** : This is useful to choose the right technique in separating heterogeneous mixtures.

### Expected Learning Outcomes/ Academic Standards:

To develop conceptual understanding, questioning, hypothesizing, skills of experimentation and information skills.

#### 1. Mind mapping :

- Greeting:** Good Morning Children.
- Mind mapping:** Since you have studied the matter around us, tell me what you know about mixtures, and separation techniques.



#### c) Probing Questions :

- What is the difference between a mixture and a compound?

- How many types of mixtures are there? What are they?
- Give an example of a homogeneous mixture.
- Name some heterogeneous mixtures that you observed in daily life.
- What method is used to separate stones from rice?
- Give examples to mixtures that can be separated by ‘sieving’ method.
- Which method is used to separate dirt from rainy water?
- What type of heterogeneous mixtures can be separated by decantation?
- Is the ink we use daily a mixture or not?

## 2. Reading the Lesson

- Dear children read the lab activity “separating the components of ink with paper chromatography” on page no.61. Identify the new words and concepts. And discuss them in groups.
- Teacher has to write the words identified by children on the blackboard and explain them.
- You have read the lesson, haven’t you? Ask me some questions if you want to know more about the lesson. Teacher has to write the children’s questions on the blackboard.

## 3. Comprehension of Concepts – Discussion

List the apparatus required to perform the experiment. Arrange the apparatus and perform the activity as in text book. Students conduct the experiment in groups.

*Teacher writes the following questions on the blackboard and ask children to observe them while conducting the experiment.*

- How much time does the ink take to separate into components after the filter paper is dipped in water?
- Into how many colours does ink separate?
- Up to what height do the colours in ink creep

## 4. Demonstration - Discussion :

Teacher has to sum up the observations of the groups by writing them on the blackboard and discussing them.

Groups	Q-1	Q-2	Q-3
1			
2			
3			

1. In the above experiment, up to what height did the ink go and how much time did it take to reach that height?
2. How many colours did the ink separate into?
3. Does the ink separate into the same components irrespective of its colour?

4. What do we know from chromatography?
5. What way does chromatography help us?

While analyzing the tables, the teacher writes the above questions on the black board and explains them based on their answers. Children draw the diagram showing the arrangement of apparatus in the experiment.

### **5. Conclusions – Evaluation :**

- Each student has to express their ideas on chromatography and then the teacher concludes the topic
- The students have to think and write answers to the following questions.
  1. Imagine and write the results of the experiment when done with ordinary paper, charts, newspapers, etc., instead of filter paper.
  2. What changes may come if we draw a thin line instead of a thick one on the filter paper?
  3. Draw a diagram showing the experiment of chromatography.

In the training session, at the end of the model lesson, the teacher has to discuss the nature of science, teaching method, educational values, and curious items in the lesson. Make a list of interesting items of the lesson for the children. E.g.: Historical items charts, Science fiction, Puzzles, Cartoons etc.

### **Nature of Science:**

The scientific method of paper chromatography is helpful in separating coloured heterogeneous mixtures which is not possible with normal physical methods and this knowledge is helpful in separating coloured mixtures in real life situations into their components.

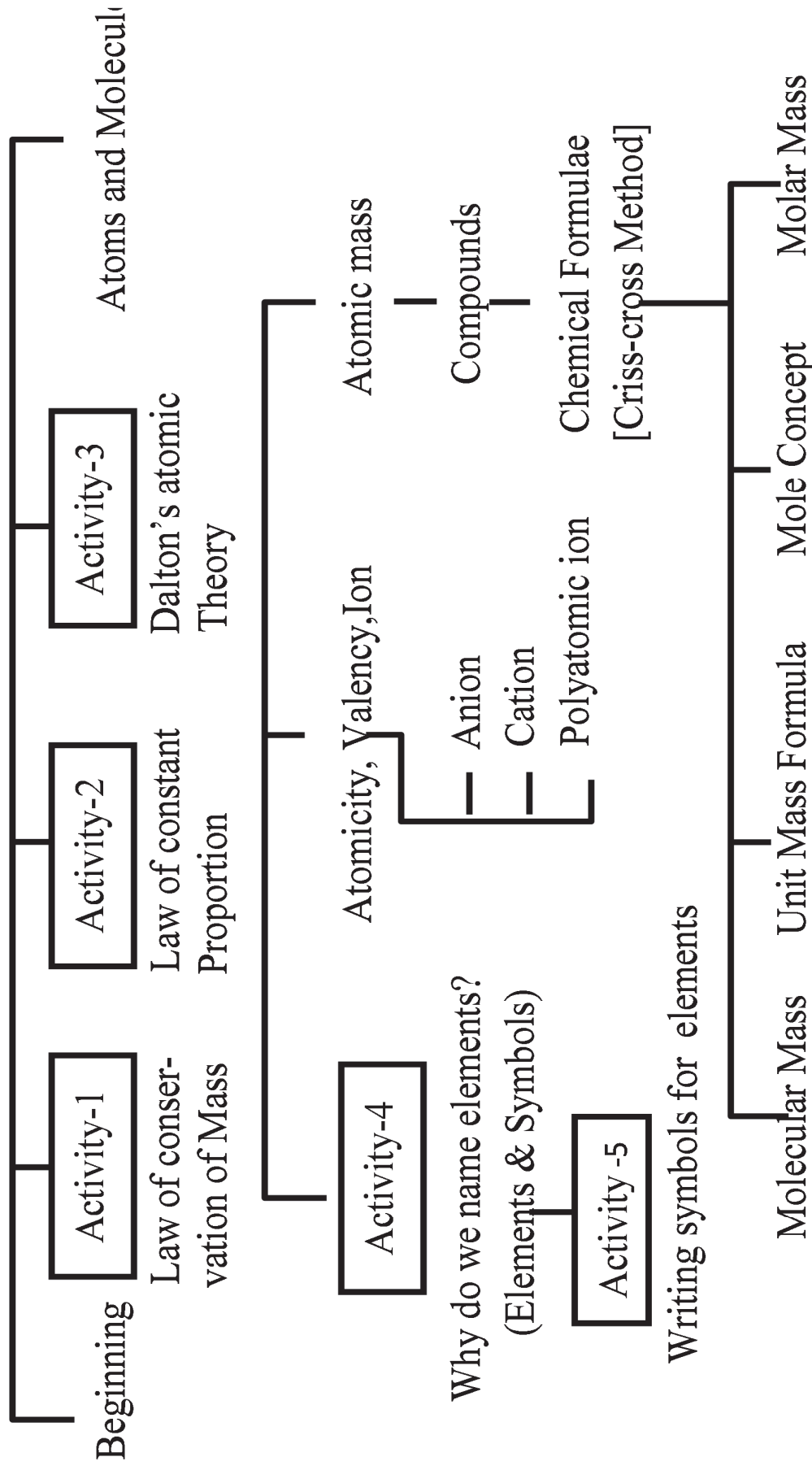
### **Pedagogy:**

They understand how to separate heterogeneous mixtures like ink into its constituents experimentally through scientific method following social constructivism.

### **Curiosity:**

Generally all the inks have only one colour. Children will be curious to know the number of colours into which the ink separates, and to know what will be the intensity of colours thus separated. They will also be curious to know whether any other coloured solution, other than ink, can be separated using chromatography

## Atoms and Molecules (IX CLASS) (Physics)





## ATOMS AND MOLECULES

### **Beginning:**

Lesson starts with examples of atoms and molecules from day to day life.

### **Activities:**

1. The Law of Conservation of Mass
2. The Law of constant proportion
3. Dalton's atomic Theory
4. Molecules of Compounds

### **Questions:**

Some questions from daily life experiences and previous knowledge are given before a concept or an activity. Guessing Questions, Analysis and discussion Questions are also given.

### **Think-Discuss:**

Many questions are given on the activities conducted, on the concepts learnt and experiences gained to develop extended thinking.

### **Diagrams:**

Two dimensional diagrams / portraits of scientists

### **Tables:**

- There are nine tables in all
- Some tables are given to complete / to fill in the blanks
- Some filled in tables are given with information

### **Key words:**

To understand the key concepts in the lesson, a list of key words are given.

### **What we have learnt:**

Key concepts in the lesson are given in sequential order under this heading. They are helpful in revising the lesson.

### **Improve your learning:**

1. Most components under this heading are such that they enable children give their own ideas based on the concepts they learnt in the lesson
2. Some questions are given to assess whether the student has achieved the Academic Standards specified for the lesson.
3. Some Questions given are based on real life experiences.

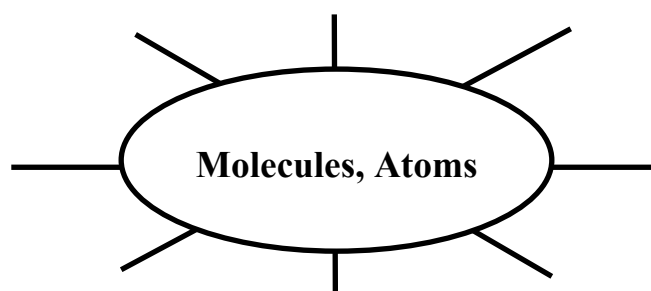
## MODEL LESSON

**Concept:** To define and verify 'the Law of constant Proportion'

### **1. Mind mapping:**

- a) **Greeting:** Good Morning Children
- b) **Mind mapping :**

- What do we finally get when we go on cutting some matter into smaller and smaller pieces? Tell me what you know about atoms and molecules?



**c) Probing Question :**

- What do you understand about Law of Conservation of mass?
- According to this law, does the mass change in a chemical reaction?
- In how many ways can we get Copper Carbonate?
- What are the constituents of Copper Carbonate?

**2. Reading :**

- Dear children, read the activity related to the Law of constant proportion, in your text book, from page No. 72 to 73.
- Teacher has to write the words identified by the students on the blackboard and explain them.
- You have read the lesson, haven't you? Ask me some questions if you want to know more about the lesson. Teacher has to write the children's questions on the blackboard.

**3. Comprehension of Concepts – Discussion**

**Activity 1:** Observe the table in the textbook showing the law of constant proportion and the information in it.

Teacher writes the following questions on the black board and discuss them with students.

- Joseph Proust calculated the weight percentages some elements. What are they?
- What results did he obtain?
- Did you observe any change in the weight percentages of copper, carbon and oxygen in the two samples?
- What do you infer from this?
- What did he learn from the water samples?
- State what is meant by constant proportion.

**Activity (2):**

100 g. of mercuric oxide decomposes to give 92.6 g. of mercury and 7.4 g. of oxygen. Let us assume that 10g. of oxygen reacts completely with 125g. of mercury to give mercuric oxide. Do these values agree with law of constant proportions?

#### 4. Demonstration – Discussion:

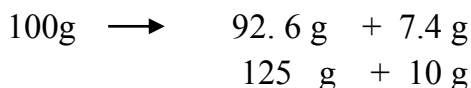
##### Observations:

- Amount of Mercuric Oxide – 100 g.
- Mercuric Oxide decomposes to give mercury and oxygen.
- Given that the amount of Oxygen is 7.4 g. and Mercury 92.6 g.

##### Discussion:

How many grams of mercuric oxide has to decompose to give 1g. of oxygen.

Mercury and oxygen are present in mercuric oxide.



How many grams of mercury is required to react with 10 g. of oxygen? Calculate.

#### 5. Conclusion – Evaluation:

Joseph Proust has observed different samples and put forward that “A given chemical substance always contains the same elements combined in a fixed proportion by weight.”

Dear Children Answer the following questions carefully.

1. Define the Law of Constant Proportions
2. Name the property that all the elements have to follow to satisfy the law of constant proportions.
3. Name the elements that are present in both tap water and well water. How will their weight percentages be?

After completing the model lesson, the teacher has to discuss, the nature of science, teaching methods, Academic Standards, curious topics, with teachers friends in the training class. A list of topics which the children are curious to learn have to be prepared. For instance, Historic Events, surprising things, wonders of science Puzzles, Cartoons, etc., related to the lesson have to be prepared.

The teacher has to observe the items that are helpful to observe, to explore, to experiment and to analyze. S/he has to think about various teaching methods that helps children develop scientific attitude and think scientifically. S/he should be very clear about the academic standards to be achieved in each lesson. The desired learning outcomes can be achieved when the teacher gets ready with things that make children curious like the historical background of the lesson, anecdotes from the lives of the scientists, etc., which will facilitate effective learning.

## 9. Science Resources

Science changes continuously and brings in development. This development helps human beings to better their life styles, to properly use nature and environment and protect them. Hence, teachers need to understand the advances/changes in science. For this s/he has to depend on a number of resources of which reference books are most important.

The works of Galileo and Kepler helped Newton in discovering ‘The law of gravitation’. In discovering ‘The theory of relativity’, Einstein was benefited from the books written by Riemann. The reference books should not only be used to get information but also to know the frontiers of science and to find solutions to unsolved questions and to search for explanations to inexplicable phenomena. Usually, reference books pose many questions. Good results can be achieved if they are understood and used appropriately in the teaching learning activities.

There are a number of institutions, schools, individuals and governments who are trying to bring science to the reach of everybody. For this, they have put in their websites a lot of information about the procedures to conduct various experiments and the techniques to prepare various tools and apparatus. Also, there are some good magazines that serve the same purpose.

These resources guide you, and help you in furthering your zeal to acquire knowledge, so the list of some resources is given below for your use.

### Publications / Magazines

1. Chekumuki, H.No. 3-78, B.C. Colony, Gudlasingaraam, Vidyanagar, Hanumkonda, Warangal – 501009
2. Resonance (English), Indian Academy of Sciences, C.V. Raman Avenue, P.B. No. 8005, Bangalore – 560080
3. Science Reporter (English), CSIR, Dr. K.S. Krishnan Marg, Near Pusa Gate, New Delhi - 110012.
4. Vipnet - News (English), Vigyan Prasar, BGVS, C-18, Saket, New Delhi-16
5. Jantar Mantar, Children Science Observatory, 130/3; Avvai Shanmugam Salai Gopalapuram, Chennai – 600086, Pub - Tamilanadu Science Forum
6. Down to Earth, Centre for Science and Environment, 41; Tughlakabad Institutional Area, New Delhi - 110062

**Reference Books:**

Telugu Academy Publications:

- |                                      |                                 |
|--------------------------------------|---------------------------------|
| - The Dictionary of Chemistry        | - రసాయనశాస్త్ర నిఘంటువు         |
| - The Dictionary of Physics          | - భౌతికశాస్త్ర నిఘంటువు         |
| - 101 Science Exhibits               | - 101 సైన్స్ ఎగ్జిబిట్స్        |
| - 71 Science Projects                | - 71 సైన్స్ ప్రాజెక్ట్స్        |
| - 99 Science Experiments             | - 99 సైన్స్ ప్రయోగాలు           |
| - Riddles in Science                 | - సైన్స్లో పొడుపు కథలు          |
| - Handbook of Physics                | - భౌతికశాస్త్ర దర్శిని          |
| - Problem solved in Physical Science |                                 |
| - How did Science Develop?           | - విజ్ఞానశాస్త్రం ఎలా ఎదిగింది? |
| - What is Science by K.Rohini Prasad |                                 |

**REFERENCES:**

## 1. Conceptual Physics - Paul G Hewitt

Even people without much grip on physics can read and understand this book. There are many real life situations in which science is reflected. This is a very good book

## 2. Thinking Physics – Epstein

This is an excellent book that can be used at all stages of science education.

## 3. Flying Circus of Physics - Jearl Walker

There is no match for this book. In a nutshell, it is full of applications and everyone should read it. This will certainly improve your curiosity in learning science.

## 4. Gravity - Gamow

Gamow is a great scientist. This book is written keeping a layman in view. However, it gives comprehensive knowledge about gravitation.

## 5. Physics for the inquiring mind : EM Rogers

Great book. There is not another book like this. Everything is discussed in the minutest detail.

## 6. The Evaluation of Physics - Einstein and Infeld.

Excellent book. Helps to understand the structure of Physics

## 7. The textbook of Elementary Physics - Landsberg MIR Publishers, 3 volume set.

There are many activities in this book. This can be used as a textbook at high school stage to learn physics

8. Problems in Physics - Zubov & Shalnov

This is an excellent problem book.

9. Chemical Elements, how they are discovered - D. N. Trifonov and V.D. Trifonov

As the title suggests, there are stories in the book about all the elements

10. Silhouettes of chemistry - D.N. Trifonov and L.G. Vlasov

In this book, the science of chemistry is presented in the form of stories. This helps children understand the nature of chemistry

11. Physics Foundations and Frontiers - Gamow

This is a good Physics text book at high school level with simple, easy to understand language

12. Understanding Physics - Cassiday, Holton, Rutherford

Every student must read this book

13. A Source Book in Physics - F. Magie

This gives an account of all developments in science up to 1900 with original papers of the scientists and their biographies

14. Physics, The human Adventure - Brush and Holton

This is a very good book for beginners and young learners of science.

15. Mad About Physics - Potter and Jargodski

This book contains many good applications of science

16. General Chemistry - L. Pauling

This is written by a Nobel Laureate. But it is easy to understand. This can be used as a foundation book for people learning chemistry

**Websites:**

1. A. Einstein: <http://www.aip.org/history/einstein>

2. A. Sakharov: <http://www.aip.org/history/sakharov>

3. M. Curie: <http://www.aip.org/history/curie/contents.html>

4. Virtual Physics Laboratories: <http://explorescience.com>

5. Nobel prize winner: <http://nobelprizes.com/nobel/nobel.html>

6. L. Kristick: "Physics: An Annotated list of key resources on the Internet"  
<http://www.ala.org/acrl/resmar00.html>

7. Physlink - information resource on all aspects of physics, <http://www.physlink.com>

8. Physics Ed: Physics Education Resources, A host of resource references on curricula, video, demonstration materials software and more.  
<http://www.hpcc.astro.washington.edu/scied/physics.html>
9. Physics-2000: Many interactive virtual experiments,  
<http://www.colorado.edu/physics/2000>
10. "How stuff works": <http://www.howstuffworks.com>
11. Physics web: <http://physicsweb.org/tiptop/lab>
12. Beyond discovery series, National Academy of Sciences  
<http://www.Beyond-Discovery.org>
13. Flash-Card Physics, <http://hyperphysics.phys-astr.gsu.edu/hphys.html>
14. Arvindgupta.com
15. [www.sciencebuddies.org](http://www.sciencebuddies.org) for Science Fair Projects
16. Bilogy.about.com
17. <http://www.bgvs.org>
18. [www.vascsc.org](http://www.vascsc.org)
19. [www.trueknowledge.com](http://www.trueknowledge.com)
20. [questionhub.com](http://questionhub.com)
21. [funwithscience.com](http://funwithscience.com)
22. [secreatsofphysics.com](http://secreatsofphysics.com)
23. [secreatsofchemistry.com](http://secreatsofchemistry.com)

## **SOURCES FOR PROCUREMENT OF MATERIALS**

1. S.D. Fine Chemicals Limited, 315-317; T.V. Ind. Estate, 248-Worli Road, Mumbai - 400030 India, Ph: 91-22-24937232, Fax: 91-22-24937232, E-mail: [sales@sdfine.com](mailto:sales@sdfine.com)
2. Therma Fisher Scientific India Pvt., Ltd., 403-404; Dephi 'B' wing, Hiranandani Business park, Powai, Mumbai – 400076, Ph: 91-22-66803000, Fax: 91-22-66803001,02
3. Final Limited, 184-185-186/P, Village - Chacharwadi-Vasna, Barla 8km milestone, Sarkhej Barla Highway Tq, Sanand Dist, Ahmedabad - 382110 Gujarat – India, Ph: 91-2717-656750, E-mail: [info@finarchemicals.com](mailto:info@finarchemicals.com)
4. Himedia Laboratories, A-516, Swastik Disha, Business Park, Via; Vadhani Indl. Est., Marg, Mumbai - 400086 India, Ph: 022-61471919, E-mail: [infor@himedialabs.com](mailto:infor@himedialabs.com),
5. Merck Limited, 7th Floor, Shivasagar Estate 'A', Dr. Annie Besant Road Worli, Mumbai – 400018, Ph: 91-22-66609000, Fax: 91-22-24950307 E-mail: [customer.services@merckgroup.com](mailto:customer.services@merckgroup.com)

**GLASS WARE**

1. Borosil Glass Works Limited, Khurana Construction House – 44, R.G. Thadani Marg., Worli, Mumbai – 400018, Tel: 91-(022) 24930362, E-mail: [borocil@borosil.com](mailto:borocil@borosil.com)
2. Merck Limited (Actira), 7th Floor, Shivasagar Estate ‘A’, Dr. Annie Besant Road, Worli, Mumbai - 400018 India, Ph: 91-22-66609000, Fax: 91-22-24950307  
E-mail: [customer.services@merckgroup.com](mailto:customer.services@merckgroup.com)

**PHYSICAL SCIENCE**

1. Edison Scientific Industries, 2473, Timber Market, Ambala Cantt - 133001  
Ph: 2643671, 4007619, 2. VISE N, 878, Arya Nagar, Jagadhri Road, Ambala Cantt – 133001, Ph: 2664 796; 266 3796

**SPECIMENS - SLIDES**

1. Micro Visual Slides Pvt., Ltd., 1-4-770; Musheerabad, Hyderabad - 500020
2. Bio - Craft Scientific System (P) Ltd., 37/277, Nagla Padi, New Agra  
Agra – 282005, Ph: 915622151021 / 2523886 Fax: 91-5622523886 / 2158731  
Mobile: 091-9837025396, E-mail: [info@biocraft-scientific.com](mailto:info@biocraft-scientific.com).  
[70in@yahoo.com](mailto:70in@yahoo.com)

**CHARTS**

1. Bio-Visual Products, 310, 3rd Floor, Oasis Plaza, Tilak Road, Abids, Hyderabad, Ph: 040-24760058 / 655 2496, Mobile: 91-9391231100, 9866368355, Fax: 040-24760077,  
E-mail: [info@bio-visual.com](mailto:info@bio-visual.com)
2. M/s Victory Graphics, 5-3-654/11A, 1st Floor, Old Topkhanna Road, Adj Lane to Begum Bazar Police Station, Hyderabad – 500012, Ph: 91-40-24613753; Cell: 9440058331

**Various Science Programmes in which children should participate**

1. Science Fairs at school, divisional and district level
2. National Children’s Science Congress
3. National Science Seminar
4. INSPIRE
5. Indian Science Congress
6. Andhra Pradesh Children’s Science Congress
7. National Science Day (28<sup>th</sup> February)
8. Science Club
9. Science Exhibition
10. Science Excursions – Field Trips



**NAMES OF INSTITUTIONS FOR SCIENCE**

1. Indian Institute of Chemical Technology - Hyderabad.
2. Centre for Cellular and Molecular Biology - Hyderabad.
3. National Institute for Nutrition - Hyderabad.
4. Centre for DNA, Finger Printing and Diagnostics
5. National Chemical Laboratory - Pune.
6. Central Drug Research Institute
7. Central Food Technology Research Institute - Mysore.
8. National Physical Laboratory - New Delhi.
9. Indian Institute of Science - Bangalore.
10. Indian Geographical Institute - Hyderabad.
11. Indian Institute of Petroleum – Dehradun
12. Institute of Microbial Technology - Chandigarh
13. Kerala shastra sahitya parishad - Kerala
14. Ekalavya Science Teaching Project - Madhya Pradesh
15. Jana Vignana Vedika - Andhra Pradesh
16. Konaseema Science Parishad - Andhra Pradesh

**SCIENCE CLUBS**

In science clubs, teaching science takes place quite informally in line with the interests of the students.

Science clubs play a major role in co-curricular activities since they give room and freedom to children to choose activities according to their interest and since they have opportunities to express themselves freely

**Objectives of Science Clubs**

- To inculcate scientific attitude in children
- To do challenging and complex experiments that cannot be done in the classroom
- To help children use their spare time properly
- To help children keep pace with the developments in science
- To form links with science clubs in other places, states and countries

- To produce future scientists
- To be a centre for science for children

### **Organization of Science Clubs:**

To make children participate in various curricular and co-curricular activities, they are divided into groups and each group is called with a specified name. The head teacher acts as the president of every science club. The science teacher and other teachers help form the rules and regulations of the club and conduct it effectively.

### **Important points in Science Club rules and regulations**

1. Name of the science club
2. Objectives of the science club
3. Membership ( enrollment, withdrawal, eligibility)
4. Organizing committee
5. Meetings
6. Financial matters
7. Programmes
8. Amendments

### **Organizing Committee:**

1. Patron: Arranges infrastructure facilities for effective functioning of the science club
2. Sponsor: Plays important role in establishing and giving shape to the science club (Science Teacher)
3. Chairman: Presides over various programmes conducted in science club
4. Secretary: Records the minutes of the meeting and looks after correspondence
5. Joint Secretary: Performs the role of secretary in her/his absence
6. Treasurer: Takes care of accounts: subscription, money received and spent etc.

7. Librarian: Takes responsibility for the books of the science lab and the science laboratory
8. Storekeeper: Takes care of tools and materials of the science club and maintains records related to them
9. Public Relations Officer: Takes responsibility for giving publicity to various programmes conducted by the science club

### **Activities of the Science Club:**

- Conducting seminars, discussions and workshops on science concepts/themes
- Arranging extension lectures by famous people on science matters
- Celebrating the birthdays of famous scientist and discussing their efforts / research for the cause of science and anecdotes from their life
- Conducting competitions in elocution, essay writing and quiz
- Designing / preparing models, pictures and posters
- Carrying out research in science, conducting science exhibitions
- Collecting and producing various things necessary for a museum
- Arranging for movie shows, slide shows and multimedia shows related to science
- Publishing a magazine on the activities of the science club

The ministry of Human Resources Development, Government of India, indicated that according to section 29(1), 29(2) and Section 35(1) of the Right to Education Act, the overall development of children should be assessed through continuous comprehensive evaluation. For this, it indicated that the children's individual performance should be recorded using the following components as tools. They are:

- The way children involve themselves in teaching learning activities
- Observing children's natural behavior in the school and outside the school
- Observing children when they are involved in individual and group activities
- Checking the written work given to children
- Anecdotal records of the children
-

## 10. Science Laboratory

### Experiments – Observations

1. What is an experiment?
2. What is the role and importance of experiments in science?
3. What should we do before, during and after an experiment?
4. What is the role of the teacher in the science laboratory?
5. What chemicals and materials are needed to conduct experiments for classes 8 &9?

Doing experiments is an important process skill in science. Experiments have an invaluable position in Science & Technology Revolution. A number of experiments done by scientists brought about revolutionary changes in human life and living. Scientists like Kepler, Jenner, Dalton, Bacon, Rutherford, and Mendeleev have made important inventions / discoveries only through their experiments. Hence, teachers should see that children do a lot of experiments on their own to construct scientific knowledge of various concepts and principles. Through this, we can develop in them scientific outlook.

In the process skills required to study science, experiments occupy a special place. To achieve the specified academic standards, children do some activities on their own with locally available materials or with the apparatus available in the laboratory. They make observations, analyze the data and draw conclusions. They do this either to test a hypothesis / assumption or demonstrate a known fact. This scientific procedure is called an experiment. Children have to do such experiments using pipettes, burettes, test tubes, simple balances, electric circuits, etc. in the process of learning many concepts in physics, chemistry, and other sciences. Therefore, the teachers should help children develop their ability in using tools/apparatus as said above and in reporting what has been done and found. Children should also be trained in identifying aims and objectives, drawing rough diagrams, observing in depth, etc.

### The Importance of Experiments:

Through experiments children:

- Comprehend science facts, principles, laws with proof
- Develop in them the capacity to find solutions to many problems in daily life
- Find answers to questions like ‘why’, ‘what’, and ‘how’.
- Develop their curiosity towards science – be it physics, chemistry or biology
- Resolve and get themselves ready to do new experiments
- Learn science naturally

### How to conduct experiments?

- Children should be encouraged to predict the results of the experiments

- As far as possible children should be given opportunities to do the experiments on their own
- Children should share and take responsibility of collecting materials required to do experiments
- Children should be asked probing questions before experiments
- Children should be told about the observations they have to make
- Children should be told about the procedure to record the observations
- Teachers/children should collect required apparatus/materials to conduct experiments on the chosen problem
- Teachers/children should prepare a plan to do the experiment
- The precautionary measures to be taken should be known to everybody
- Suitable place to conduct the experiment should be identified
- Children should be taught the tips and techniques in arranging apparatus and doing experiments
- Children should be taught the order in which things to be done
- Children should be asked to discuss the results of the experiments and draw conclusions
- After the children have recorded their observations, teacher should encourage them to do some supplementary activities to see what changes will come if some variables in the experiment are changed

### **What should the children / teachers do during an experiment?**

- Children should observe the procedure being followed in doing the experiment
- Children should observe the arrangement of apparatus and the way various apparatus / tools are used
- Children should note down their doubts that come up while observing/doing experiments
- Teachers should ask thought provoking questions all along
- Teachers should tell children how concepts are tested through experiments
- Teachers should make children identify cause and effect relations
- Children should use appropriate terminology and explain their understanding
- Children should be asked to identify the relations /differences between actual values and experimental results
- Teachers should encourage children to observe the experiment all along
- Children should be asked to draw a rough sketch of what they see through a microscope
- Children/teachers should record their observations

### **What should be done after the experiment?**

- Observations should be discussed



## **Physical Science Laboratory**

### **Science Laboratory – Planning**

Science means doing. Learning by doing is the guiding principle of science. Developing in children skills, competencies, scientific attitude and scientific outlook, thinking capacity and curiosity to explore are the main objectives of teaching science.

A laboratory creates conducive atmosphere to achieve the above objectives and to enable children acquire scientific knowledge. Through experiments, children can prove what they have learnt. Experiments help children in developing scientific concepts, application of science theories, observation of differences and the ability to evaluate.

Keeping in view the importance of laboratory, some committees and some people have prepared some models to construct and organize laboratories. While constructing a laboratory, the following key points should be kept in view.

1. The number of students who work at a time
2. Minimum area required to work freely
3. The number of science teachers
4. Store room
5. Area required for classroom teaching or area required to conduct lab activities

### **Model laboratories suggested for high school**

1. Doctor Whitehouse plan/design ('lecture room – laboratory' model)
2. Multipurpose laboratory ('lecture, display, laboratory' model)

### **Recommendations of All India Science Teachers Society**

1. There should be separate laboratories for physics, chemistry and biology in addition to the general laboratory
2. There should be 30 sq. feet floor space for each student
3. Store room should be partitioned and used as a preparation room
4. Working tables with suitable tools should be arranged properly at suitable place
5. Firefighting equipment should be accessible /handy

### **Science Kits:**

Now a days, the number of schools has increased in proportion with the increasing population. This has resulted in smaller classrooms and schools in lesser area thus leaving no scope for laboratory. To overcome these difficulties and teach science effectively, institutions like UNICEF, NCERT, and SCERT developed Science Kits.

Science Kits can be divided into two categories

1. Demonstration kits
2. Individual / students' kits

The kits are developed according to the level / subject. For example, Physical science demonstration kit, chemistry demonstration kit. Some companies developed separate kits for each unit. The advantages of science kits are:

- |                                     |                                       |
|-------------------------------------|---------------------------------------|
| 1. Cheap                            | 3. Easy to carry                      |
| 2. Give proper scientific knowledge | 4. Give practice in scientific method |
|                                     | 5. Develop scientific attitude        |

### **Laboratory on Wheels:**

This is useful where there are no laboratories or where the schools are not in a position to build and maintain laboratories and more importantly in remote villages where there are no laboratories. This has in it a trained teacher and materials like boxes containing science apparatus, slides, filmstrips, projectors, charts and models.

### **Organization of Laboratory:**

1. Grouping of students
2. Discipline
3. Instructions to students
 

A. Laboratory manuals	B. Laboratory Instructions	C. Instruction cards
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4. Students' Books
 

A. Observation Book	B. Instruction Record	C. Practical Record
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### **Procurement of laboratory materials:**

Procuring suitable material in sufficient number is a very important aspect of organizing a laboratory. While procuring materials for laboratory, the following points should be taken into consideration.

1. Science syllabus and science textbooks should be thoroughly examined
2. Prepare a list of planned teaching learning experiences, activities to be conducted and the required apparatus/tools/materials
3. Check stock periodically and order materials whose level have fallen below the minimum level
4. Materials required to for children to do experiments individually



Keeping in view the points mentioned above, a list should be sent to suppliers with a request to send quotations.

### Proforma to invite quotations for the supply of required materials

S.No	Material	Specification	Unit / Measurement	Quantity / No. Required

### Proforma for Comparative Statement

S.No	Material	Company&Rate	Company&Rate	Company&Rate	Selected Company

### Registers to be maintained in the Laboratory:

1. Register for unbreakable items – Permanent Stock Register (wood, metal)
2. Register for breakable items – Breakable Stock Register (Glass apparatus)
3. Register for consumables – Consumable Stock Register (chemicals, acids, wires, cells)

In addition to the above, the following registers should also be maintained:

1. Order Register
2. Issue Register
3. Requirement Register

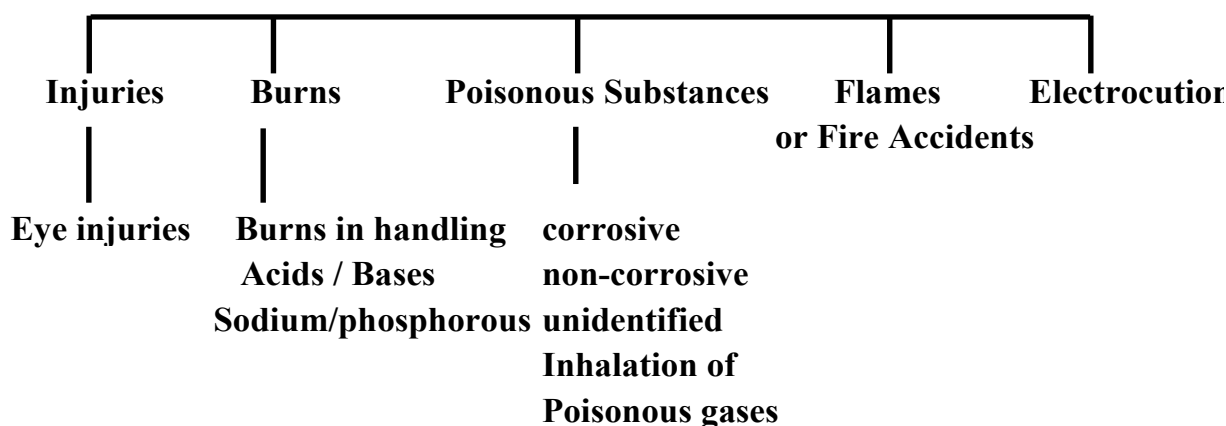
### Storage and Protection of Lab Materials:

Storage and Protection of Chemicals:

1. Chemicals should be arranged in alphabetical order and stored in special cupboards
2. Chemicals and reagents often used should be kept hand in the racks on the work tables of children
3. Chemicals which are either expensive or poisonous/dangerous should be kept under lock and key.
4. Liquid chemicals and dry chemicals should be stored separately
5. Highly reactive and potentially dangerous chemicals should be kept in a safe place

Storage and Protection of Glassware: Test tubes, beakers, measuring flasks, glass jars, pipettes, burettes, etc., should be placed on the racks /platforms category-wise. Ironware like retort stands should be painted so that they do not rust. Regarding experiments with electricity, 12 volts current should be made available

### Accidents in laboratory – First Aid:



- Burns due to Flames:**
- injured part should not touch ground/
  - Watch, ring should be removed from injured part
- Burns due to Acids:**
- pour copious amounts of water, wash with diluted sodium bi carbonate, use creams like Burnol
- Burns due to Alkalis:**
- wash with water, wash with lemon juice or acetic acid, use creams like Burnol
- Burns due to phosphorus:**
- Dip the injured part in water, remove phosphorus crumbs and wash with diluted silver nitrate
- Burns due to Sodium:**
- Remove sodium scraps with the help of cotton damped with kerosene. Apply Burnol
- Corrosive Poisonous Substances:**
- Do not make the patient vomit. Make him drink milk, egg white, and rice starch
- When Acid is drunk:**
- Do not make him vomit. Make him drink plenty of water followed by milk of magnesia
- When Alkali is drunk:**
- Do not make him vomit. Make him drink plenty of water followed by lemon juice
- When Unidentified substances are taken:**
- Mix activated carbon, Magnesium Oxide and
  - Tannic acid in the ration of 2:1 and give it to the patient. This is a universal antidote
- Electrocution:**
- Stop electric supply. Using a dry stick/dry towel and wearing rubber slippers put away electric wires
- Acid in eyes:**
- Wash eyes with plenty of water. Then wash again with 1 percent sodium bicarbonate solution
- Alkali in eyes:**
- Wash eyes with plenty of water. Then wash again with 1 percent boric acid solution

**First Aid Boxes:** These should be kept ready in every school. A separate first aid box with all necessary substances mentioned above should be kept in every laboratory

**Conducting the experiment:**

- The teacher should tell the students the aims of the experiment, the procedure to be followed, and the precautions to be taken before the experiment is actually conducted.
- The teacher should cultivate the habit of noting down readings accurately and recording results properly

**Grouping of Students:**

Experiments should be done either individually or in groups depending upon the apparatus/material available, the number of students, and the time at disposal

**Discipline:**

The instructions to be followed in the laboratory should be written on charts, displayed at prominent places in the lab and the teacher should ensure that they are followed without any deviation

**Instructions to Students:**

To facilitate children to do experiments, the teacher can give directions/instructions to students with the help of instructional cards. The most important of them are:

1. Experiment
2. Aim
3. Required apparatus/chemicals
4. Procedure
5. Drawing of the arrangement of apparatus
6. Precautionary measures
7. Recording Readings
8. Generalization based on readings/results

**Students – Books:**

For practical work every student should have the following books:

1. Observation Book: Readings should be noted down in this book while doing experiments
2. Instruction Record: Experiments should be done following the instructions in this
3. Practical Record: This record should be written after the experiment is over and the results are in hand

**Recording Progress:**

The teacher should monitor the children's competency in doing experiments and record his observations in the CCE register

**Importance of experiments in Science:**

Hitherto, it is quite usual for a student to get through 10<sup>th</sup> class examination even though s/he has never seen even a pipette or a burette, which means to say, without even entering into a science laboratory. Obviously they will never know even the basics of science, forget about scientific method and scientific thinking. The reasons for this state of affairs were many. Maybe the schools could not afford to have a science laboratory, but the scenario is different. The Government has put enough funds at the disposal of each school so as to enable them buy all the materials required to conduct all experiments given in the new textbooks.

Lab activities are the heart of science teaching. Since the guiding principle to learn science is 'learning by doing', all laboratory activities must be done to learn what is to be learnt in each class. Let us see some important aspects of experiments in science.

1. Science is proved: Science, learnt either through books or through the teacher, remains in the minds of children as a lump of knowledge unless and until they are given opportunities to verify what they have learnt through experiments
2. Remembered for a long time: Knowledge gained through doing experiments remains in the minds of children for a long time as they have direct experiences while doing experiments
3. Gives mental satisfaction: Every child is curious to learn. Since experiments give opportunities for children to see, touch and feel various things of interest, they satisfy their curiosity.
4. Training in scientific outlook and scientific method: Experiments promote scientific outlook in children and give them training in following scientific method. This in turn helps them understand other things and solve problems.
5. Develop many good habits: Experiments and other practical work inculcates in children many good habits like cooperation, coordination, resourcefulness, initiative, self-dependence, self-reliance and making conclusions based on proofs.
6. Improve many skills: Doing experiments and other practical work provides children with opportunities to develop skills to manipulate science apparatus and equipment and in drawing diagrams
7. Proper utilization of leisure: By involving themselves in experiments and other practical work, children will use their leisure fruitfully.
8. Monetary Benefit: Through some experiments and practical activities children may get monetary benefit. ( by selling what they have produced through their experiments)

**Apparatus / Materials required for  
Physics Lab to do experiments in 8th class textbook**

S. No	Chapter	Name of the Activity	Materials(used) required
1	Force	Types of forces	Magnet, Magnetic needle
		Lab Activity	Spring balance, weights
2	Friction	Lab Activity	Toy Trolley, Wooden block, inextensible string, weight, hanger, pulley and table.
		Friction produces heat	Match box
		How to reduce friction	Grease ( lubricant)
		Observing fluid friction	Glass, spoon
3	Synthetic fibres and Plastics	Identifying fibres Burning test	Cotton, Wool, Nylon, cooking apron cloth, silk cloth, stand rayon cloth, acrylic cloth, Polyester cloth.
		Identification of various articles with recycling codes	Bottles of soft drink, juice, fruit jam, ketchup, shampoo, boost, bournvita.
		Lab activity	Tong, Spirit lamp, samples of plastics (like, comb tooth brush handle, plastic bucket, handle of utensil and electric switch)
		Biodegradable - Non Biodegradable	Meals plate, Coffee mug peels of fruits and vegetables, leftover food stuff, waste Paper, cotton, cloth, plastic bag.
4	Metals and Non-metals	Observing appearance and colour of some materials	Fe, Zn, Cu, S, Al, C, Mg, I
		Identifying electric conductivity of a material	Battery, Bulb, Conducting wires.
		Observing heat conduction by metals	Iron rod, Wax, Stick ping spirit lamp.
		Relation with oxygen	Bunsen burner, litmus paper Mg, S, etc.,
		Relation with water	Two big troughs (500 ml) Na, two test tubes, dil. HCl, Con. HCl, H <sub>2</sub> SO <sub>4</sub>
		Reactivity of metals	Five beakers, Zn, Fe, Cu, CuSO <sub>4</sub>
		Some uses of non-metals	Crackers, gunpowder, Match Sticks, Antiseptic ointments.
5	Sound	Vibrating body producing sound	Bell, Match Box, rubber band, metal plate, spoon, Hack saw blade.
		Sound has energy	Plastic bottle, sugar crystals, small sound particles, Flute.
		Lab activity	Wooden table, 30 cm, metal scale, 30 cm

S. No	Chapter	Name of the Activity	Materials(used) required
6	Coal and Petroleum	Identification of articles and materials used for various purposes	Mud jar, plastic tiffin box, copper vessel, steel vessel, coal, metal box, plastic bucket, wood, iron, silver, gold, glass, mud, plastic
		Lab activity	Two boiling test tubes, rubber cork, two metal stands, gas tube, jet tube, Bunsen burner
7	Combustion Fuels and Flame	Do all materials burn?	Spirit lamp, metal dish, charcoal, magnesium ribbon, straw, cotton cloth, nylon cloth, dry stick, pebbles, wax, plastic piece
		Testing necessity of air for burning	Candle, glass tumbler, table
		Lab activity	Test-tube, holder, spirit lamp, match-box, agarbathi, potassium permanganate
		Burning a paper with sunrays	Convex lens, two small stones, 5ml petrol, alcohol, LPG
		Understanding ignition temperature	Two small paper cups, two tripods, wood, charcoal, petrol, kerosene
		Observing the behaviour of different solid fuels	Candle, coal, charcoal, magnesium ribbon, stick, camphor, dry dung, LPG
		Observing the structure of the flame	Wax candle, matchbox
		Observing what happens in different zones of candle flame	Candle, glass tube, copper wire
8	Electrical conductivity of liquids	Testing the material to know which allows electric current to pass through it	torch bulb / LED, battery cell, wooden sheet, two drawing pins, safety pin, electric wires, nail, paper, chalk piece, straw, plastic piece, paper clip, eraser
		Testing the electric conductivity of liquids	battery cell, LED, metal pins, plastic cap of injection bottle, copper wire, coconut oil, kerosene, lemon juice, sugar solution, distilled water, vinegar
		Transforming a poor electric conductor into a good conductor	Distilled water, salt, copper sulphate, lemon juice, a few varieties of vegetables, fruits
		Testing the effect of electric current on potato	Potato, knife, tester, LED, copper wires, battery, carrot, beetroot, brinjal, pumpkin
		Make your own cell	Two inj. bottles, LED, copper wire(5cm), sandpaper, 5cm X 2 mm zinc plate, lemon, tamarind, tomato juice, sulphuric acid
		Laboratory Activity	5 X 2 cm copper plate, copper sulphate crystals, iron key, glass beaker, water, sulphuric acid, burette, cell, copper wire

S. No	Chapter	Name of the Activity	Materials(used) required
9	Some Natural Phenomena	Charging by rubbing	Used ball pen refill, piece of polythene cloth, comb, balloon, straw, rice husk
		Laboratory Activity	Ball pen refill, balloon, comb, eraser, steel spoon, polythene sheet, white paper, woolen cloth
		Types of charges and their interaction	Two balloons, woolen cloth, polythene sheet, plastic tumbler, plastic straw, glass rod
		To find the presence of charge on a body	Small ball made of very light material, very thin silver wafer used to decorate sweets, thread, glass rod, silk cloth
		Demonstrating transfer of charge	Empty jam bottle, cardboard, metal paper clip, 4 X 1 cm thin aluminum foil, empty ball pen refill
		Collecting information about the damages caused by earth quakes	Collection of paper clippings showing damage caused by earthquakes and tsunami
		Locating the tsunami affected areas in the map	World map big enough to enable children to mark tsunami affected places around Indian Ocean like Andaman & Nicobar islands
10	Stars and the Solar system	Observing the movement of constellations (stars)	20 X 20 cm paper, umbrella, ripe yellow lemon, clay ball painted white

**Apparatus / Materials required for  
Physics Lab to do experiments in 9 th class textbook**

S. No	Chapter	Name of the Activity	Materials(used) required
1	Matter around us	Identifying the shape and volume of liquids	Vessels of different shape and size
		Observing the compressibility of different materials	100ml syringe
		Observing the diffusion of gases	Agarbathi, a box of matches
		Observing the diffusion of liquids	Two 250 ml beakers, dropper, blue and red coloured inks, potassium permanganate
		Observing the diffusion of particles of solids into liquids	Beaker, $KMnO_4$ , $CuSO_4$ graded tube, cotton damped with HCl, $NH_4Cl$
		How small are the particles of matter?	4 beakers, $KMnO_4$ Drops, Pipette
		There exists space between particles	1 beaker, salt, glass rod
		Effect of temperature on change of state	1 beaker, ice cubes, thermometer, spirit lamp, tongs, retort stand
		Effect of surface area, humidity and wind speed on evaporation	1 test tube, porcelain containers, thermometer
2	Motion	1) Drawing path and distinguishing between distance and displacement	1 ball, 1 scale, 1 pencil
		3) Observing the direction of motion of a body	rope, stone
		5) Observing the motion of a ball on an inclined plane	Ball, inclined plane
		6) Observing uniform circular motion	Rope, weight with a hook
3	Laws of Motion	1) Observing the motion of a pen cap kept on thick paper ring	Empty bottle, thick paper, pen cap
		2) Observing the motion of the coins hit by a striker	Carom coins, striker
		3) Pushing two wooden blocks with the same force	Two wooden blocks of different weight, scale
		6) Pulling two spring balances in opposite direction	Two spring balances
		7) Balloon rocket	Balloon, straw, thread, gum tape
		8) Dropping eggs	Two eggs, some cotton



S. No	Chapter	Name of the Activity	Materials(used) required
4	Is matter pure?	1)Is full cream pure?	A container, some milk, milk churner
		2)Finding out homogeneous and heterogeneous mixtures	Two test tubes, kerosene, salt
		3)Preparation of saturated and unsaturated solutions	One cup, sugar, spoon
		4)Factors affecting the rate of dissolving	3 glass beakers, salt, spirit lamp, tongs
		5)Finding of heterogeneous mixtures – suspensions and colloids	2 test tubes, chalk powder, milk, glass rod, laser light, filter paper, beaker
		6)Separation of mixtures by Sublimation	Stove, funnel, porcelain container, cotton, salt, ammonium chloride
		7)Process of evaporation of water	Stove, beaker, watch glass, ink
		8)Separation of immiscible liquids	Separating funnel, kerosene/caster oil, stop clock
		9)Separation of two miscible liquids by distillation	Retort stand, stove, thermometer, distillation flask, beaker, delivery tube, water condenser, acetone
		10)Separation of copper sulphate and aluminum	1 beaker, aluminum foil, concentrated sulphuric acid
		11)Understanding the nature of elements, compounds and mixtures	Two porcelain containers, iron filings, powdered sulphur
5	Atoms and Molecules	1)to understand change in mass before and after a chemical reaction (the law of conservation of mass)	Lead nitrate, potassium iodide, distilled water, conical flask, spring balance, test tube, stand, rubber crock, thread, etc.
7	Gravitation	1)Observing the motion of an object moving in a circular path	Electric motor, circular scale, wires, current supply
		3)Acceleration is independent of masses	Paper, book
		4)What is the direction of 'g'	Stone, stop clock
		5)Can we measure the weight of free-fall body?	Spring balance, weights
		6)Observing the changes during the free-fall of a body	Tray, rubber bands, stone
		7)Balancing of spoon and fork	Glass tumbler, fork, spoon
		10)Locating the centre of gravity	Meter scale, rope

S. No	Chapter	Name of the Activity	Materials(used) required
8	Floating Bodies	1) Finding the relative density	Overflow vessel, 50 ml measuring cylinder, spring balance, wooden piece, glass, etc.
		2) Making of lactometer	Ball pen refill, boiling test tube
		3) Identifying objects heavier or lighter than water	One beaker water, various other things
		4) Proving that the weight of an object and the weight of water displaced by it are equal	Overflow vessel, beaker, simple balance, weights, various things
		5) Making aluminum float	Aluminum foil, water tub
		6) Observing the upward force of liquids	Water tub, plastic bottle
		7) Observing air pressure and measuring atmospheric pressure	Water tub, tumbler, cotton, one metre glass tube, glass tub, mercury, retort stand
		8) Measuring the force of buoyancy	Spring balance, stone, overflow vessel
9	Work and Energy	1) Understanding the meaning of work as per science	Table, wooden blocks
		2) Increase and decrease in energy of an object	Table, spring
		4) Understanding the energy of moving objects	Table, metal ball, plastic tin
		5) Understanding potential energy	Bow and arrows, rubber bank
		7) Observing the energy in an object at different heights	Metal ball, scale to measure height and depth
		9) Conservation of mechanical energy	Pendulum made with a metal ball
10	Sound	1) Sound is a form of energy	Cylindrical tin, balloon, plane mirror, stand, laser light
		2) Observing the vibration of a tuning fork	Tuning fork, smoked glass, iron wire
		3) Demonstrating types of wave propagation	Spring, table
		4) Reflection of sound	Table, two tubes

## **Preparation of Improvised Apparatus / Alternative materials**

E.g. Preparation of working model of a Fire Extinguisher

Material required: Empty plastic bottle, stopper, L shaped glass tube

Chemicals: Sodium bicarbonate and vinegar

Procedure: Take an empty plastic bottle and half-fill with vinegar. Fix a single holed cork. Fix an L shaped tube through the hole. Take care that the end in the bottle is just below the neck. Whenever you want a fire extinguisher, you open the cork, put a spoon full of sodium bicarbonate, and shake the bottle well. Carbon dioxide comes out of the L shaped tube and extinguishes the fire.

We all know that to teach science effectively, we need a laboratory, chemicals and apparatus. But all schools may not have all the required lab material. It may be difficult for the government to supply them. Since the lab materials, equipment and chemicals cost a lot, not all schools can afford to buy them. Hence, the teacher has to prepare some apparatus/tools required to facilitate his/her teaching. Children can also be encouraged to collect / prepare materials. The apparatus/tools /materials prepared by the teacher/children using locally available / low-cost / no-cost materials are called improvised apparatus/tools/implements.

This is not just a cost reducing activity but an activity that improves the creativity and application skill of both the teacher and the children. They will find new uses to things which are considered useless by others. Bottles, tins, clips, needles, old bulbs, materials used in the kitchen like vinegar, baking soda, etc. they all find their way into the laboratory in the hands of an effective science teacher, helping children have a deep understanding of the science concepts.

## 11. Teacher Readiness

Readiness to do a job and believing in oneself are essential for a person to do a job successfully. No job will be successful when the people involved in doing it are not ready for it. That is why we often say that only those jobs / assignments will be successful which are done with commitment in word and deed. This can be called 'readiness'.

### Why Readiness?

When we want to go to another place or when we want to conduct a programme either in the school or in the house, we plan for it at least two or three days in advance. We look for answers to questions like How to conduct? What do we need? Who to meet? How to sequence various activities? Which place is suitable? etc. Then, we make a list of all that has come out of this planning and thinking. Shall we call it readiness?

In the same way, as a teacher of physical science, we too need such readiness. Let us have a look at the present state of affairs in our schools. On the pretext of heavy syllabus, and showing the urgency of covering the syllabus within the allocated time, the science teacher is attending the class without any plan or schedule. That is why the teaching learning activities are 'passive' and teaching is restricted to 'lecturing'.

Experiments in laboratory or classroom has become a rare sight in our schools, so the teaching learning process is not able to develop in children any scientific outlook. In the name of science, children's brains are filled in with information. No opportunities are given to them for knowledge construction. It is high time that the physical science teacher learnt how to get ready to face these challenges and be an effective teacher.

### Readiness in the teaching of Physical Science"

- Teaching Physical science without readiness is useless
- Since readiness is essential, the Physical science teacher should get ready in the following way. S/he should :
  - Read the lesson to be taught thoroughly
  - Prepare plans according to teaching strategies/methods (year plan, unit plan and lesson plan)
  - Have complete understanding of the nature of children in class and their strategies of learning
  - Design teaching learning activities to develop required process skills and to achieve targeted academic standards
  - Get ready to elaborate on key concepts, mind-mapping, activities and experiments in the lesson

- Get ready with all the materials and resources required to conduct activities, experiments, field visits, projects identified for the lesson
- Get ready to demonstrate the experiment and then guide children to do it either in groups or individually.
- See that children analyze the results of the experiments, make generalizations and thus construct knowledge
- Encourage and give suitable instructions / precautions to children when they are involved in doing activities and experiments
- Develop in children good comprehension of the key concepts through thought provoking questions. While preparing these questions the teacher should keep in view the previous knowledge of children and the phenomena they come across in day to day life.
- Encourage children to collect information / write answers on their own for questions given under the heading 'Think & Discuss'
- Make children read the contents of 'Do you know' and encourage them to collect and exhibit similar information in the classroom
- Do the experiments beforehand to make sure everything goes well
- Get ready with all the required materials to teach the lesson before going to the class
- Raise awareness in children about biodiversity and lead them to appreciate her/his surroundings and the beauty and diversity embedded in them
- Identify the possible project work / field visit in the lesson and get ready with worksheets / instruction sheets / information
- Check the observations sheets / worksheets and records of children regularly
- Get ready with assessment tools to check whether the targeted academic standards have been achieved in the classroom or not
- Inform children about their performance soon after marking the answer papers
- Develop /design remedial measures and additional teaching learning activities for slow learners
- Keep pace with the changes in the fields of science and technology and adapt his teaching accordingly
- Collect additional information through internet and reference books and pass it on to children

Let us hope that teachers will get ready to teach as shown above, and try to give children quality education, which brings out the creativity in children and make them future scientists

### **Additional activities to be taken up by the Physical science teacher**

The teacher should:

- Get the laboratory ready to conduct experiments
- Get the classroom ready to conduct experiments If there is no laboratory or if it is not in a good condition

- Exhibit the photographs of scientists in the laboratory and celebrate their birthdays
- Conduct school exhibition, science quiz and science day during every academic year without fail
- Visit the place selected for field visit at least a few days in advance, collect required information and obtain necessary permissions
- Work as a guide in conducting project works by dividing children into groups and giving them suitable instructions / worksheets/ material
- Collect the names, addresses and phone numbers of important people in the society around the school with a view to make them partners in school development. The teacher should also establish science club in the school and conduct interesting programmes to arise curiosity and the zeal to learn among children

Laboratory work is an indispensable part of chemistry instruction. In the hands of a good teacher, it is in itself an excellent vehicle for instruction. It gives an insight into authentic science. It is intellectually exacting. It requires careful attention to planning, execution and observation. It demands interpretation and abstraction. Most students enjoy it. It couples cognitive activities with 'hands on' action-oriented, concrete operational activities. It is a stimulating change from lectures and other forms of instruction.

It is interdisciplinary. It sharpens students' skills in reading and writing; applying mathematics to real problems, classifying, measuring, interpolating, extrapolating, drawing, inferences, framing hypotheses, and building mathematical, verbal and physical models.

It helps students to develop manual dexterity, patience, dependability and a spirit of cooperation. It helps to enhance and strengthen student-student and student-teacher interpersonal relations.

A learning laboratory is a busy laboratory. Although it is time consuming for students and mentally, emotionally and physically taxing for teachers, laboratory work is indispensable—if the spirit of science is to be conveyed to the younger generation and if they are to develop the capacity for independent learning.

This is the lesson of the laboratory method and the lesson which all education has to learn. The laboratory is a discovery of the conditions under which labour may become intellectually fruitful and not merely productive.

— John Dewey (1859-1952) Educator and Philosopher

*Source:* UNESCO—Teaching Chemistry in Secondary Schools.

## **Some Thought Provoking Questions, Historical Background, puzzles and cartoons**

To teach the lessons in 8<sup>th</sup> and 9<sup>th</sup> Physical Science textbook effectively, teachers need to collect some thought provoking questions, historical background, puzzles and cartoons related to the lessons and use them according to the teaching learning situation in the classroom. Some information is given below for ready reference.

### **CLASS – 8**

#### **Some Thought Provoking Questions**

##### **Motion:**

**1. It is raining. How to run getting wet as little as possible?**

Observe the direction of the rain. If it is raining vertically, or towards your front part, we have to run as fast as possible. If it is raining on the back, then we have to run with a speed equal to horizontal speed of the rain.

**2. How does a fielder catch the ball struck by a batsman?**

The person who catches the ball should move in such a way that the change in the rate of observed elevation angle is constant.

##### **Laws of Motion: Force, Friction:**

**1. You might have seen flying bean seeds. How can they fly?**

There are some small worms inside the beans. They exert pressure on the walls of the beans, so they fly.

**2. While making popcorn, they pop out. Why?**

Moisture is present in pop-corn. When we heat them, steam is formed. This steams expels out very fast and so popcorn also goes up. This can be stated as an example for law of conservation of mass.

**3. Can you move, sitting in a chair in a room, without keeping your legs down?**

Yes. When we try to move the chair sitting in it, the floor exerts frictional force on the chair. As a result of this, we can move along with the chair without keeping our legs down.

**4. Why do tyres have treads?**

In rainy season, water stagnates on road. When we travel with tyres with treads on such roads, water gets blocked in the gaps of treads, so tyres do not skid. If the

tyres are worn out (without any treads), a thin water layer forms between the tyre and the road making the tyre skid on the road.

**5. To stop a bike which is going very fast what would you apply? Normal brakes or locking brakes?**

When we apply normal brakes, rolling friction as well as static friction acts on between the road and the tyres. As a result, the wheel slows down and comes to rest. When we apply locking brakes, the wheel gets locked and hence skids on the road. In this case only the rolling friction, which is much lesser than the static friction, acts between the tyre and the road. Hence, it is dangerous to apply locking brakes. It is better to apply normal brakes followed by locking brakes.

**6. If the speed of the hurricane wind doubles, what would be the net force of wind on the house?**

When the speed of wind doubles, the mass that strikes the house also doubles. Since the mass of wind doubles, the momentum that strikes the house per second quadruples (becomes four times). Therefore, the net force will be 4 times the original wind.

**Work-Energy, Gravitation:**

**1. When will a Karate punch damage more?**

When a hand moves forward very fast on to a target and goes back, more force is applied on the target but the energy of the punch is not transferred to the target. On the other hand, when a hand moves forward very fast and lands on the target, the total kinetic energy of the punch will be transferred to the target, so it causes more damage.

**2. The path of the airship going to moon should be in the shape of 8. Why?**

When the path is in the shape of 8, it results in going nearer to the centre of gravity of moon & earth. As a result, there will be less work resulting in less energy utilization.

**Floating Bodies:**

**1. The difference in the water levels of edges of Panama Channel is almost 30 cm. How is it possible?**

On one side of Panama Channel is Pacific Ocean and on the other side is Atlantic Ocean. Since the water in Pacific Ocean is saltier than that of Atlantic Ocean, the density of the water in Pacific Ocean is more than that of Atlantic Ocean. Therefore, water level on one side is higher than the other by 30 cm. (Low at Pacific Ocean side)



**2. Why do doctors measure blood pressure at hands but not at legs?**

Actually doctors want to measure the blood pressure of the heart. Since heart and hands (when put on a table horizontally) are at the same height, they take it at hands. The principle is ‘The pressure exerted by a liquid is the same at all points on a horizontal line.’

**3. Will there be any difference in the level of the water in a pond when a stone in the boat is thrown into it?**

Yes. When a stone is in the boat, it displaces the water equal to its weight. This means the volume of the displaced water is more than the volume of the stone. But when it is thrown into the pond, it displaces water equal to its volume, which is much lesser than the previous one. Therefore, the water level of the pond decreases.

**Sound:**

**1. While writing on the blackboard, the piece of chalk screeches. Why?**

The piece of chalk screeches or does not screech depending on the angle at which it is held while writing on the blackboard. At a certain angle the molecules of the blackboard and the molecules of chalk repel each other. Because of this repulsion the molecules of chalk oscillate and strike the black board resulting in a screech. When we change the angle of writing, at a certain angle, the force of attraction comes into play as a result of which the piece of chalk attaches to the blackboard, which means there is some friction. As long as this friction is there, there will not be any screech.

**2. When we tear paper fast, the pitch of the noise increases. Why?**

When we tear paper, the bonds between the molecules of the fibre breakdown. Consequently, they vibrate resulting in a noise. If paper is torn very fast, the frequency of the vibrations of the molecules will be much higher. Therefore, the pitch of the sound produced then will be much higher.

**3. Drink bottle makes some sound when it is opened. Why?**

Usually, bottled drinks have some chemicals in them. When we open the cap of the bottle, some bubbles will form as they try to escape. These bubbles burst under the pressure of air outside making some sounds.

**4. When we bring a burning match stick near hydrogen gas, it extinguishes making a pop sound. Why?**

Hydrogen gas is lighter than air, so it goes up. Since it gets heated quickly, when we bring a lighted match, it takes heat and expands suddenly. Because of this sudden expansion, there will not be enough oxygen for the flame and it

extinguishes. This sudden expansion also causes collision between hydrogen molecules and air molecules resulting in pop sound.

**5. During night, sound is heard farther than daytime. Why?**

The velocity of sound is proportional to temperature. During night the temperature of the layers nearer to earth is lower than those farther. Therefore, the sound waves travels farther during night than daytime.

**Natural Phenomenon**

**1. Why do we feel happy and relaxed while taking a shower?**

Scientists have found out that negatively charged atmosphere is good for our body whereas positively charged atmosphere is bad for it. Under a shower, the air is mostly negatively charged, so our body is well cleaned and we feel happy and relaxed.

**2. What makes it possible for us to walk on ground?**

The forces of repulsion between our feet and the surface on which we walk make it possible for us to walk on it.

**3. How does a soap work?**

Dirt/dust has two types of oils: charged and uncharged. Soap molecules can attract both charged and uncharged particles. When we apply soap, the dirt/dust is attached to soap molecules. Finally, when we wash with water, both the soap and the dirt are removed.

**4. Tractor does not go down on a wet muddy ground, but a man does. Why?**

The total weight of the tractor is distributed on to the four wheels of the tractor, which reduces the pressure per square inch. Moreover, the back wheels are pretty big and the weight falls on bigger area reducing the pressure. In the case of man, the pressure will be more as his total weight exerts more pressure on a smaller area. Therefore, his legs go down on a wet muddy ground.

**5. Why does a flag flutter?**

The difference in pressure between the two sides of the flag makes it flutter.

**6. There is a beaker full of water and then a wooden block is placed inside the beaker. Will there be any change in the mass of the system (beaker of water + block)**

No. When a wooden block is put into the beaker, it displaces water equal to its weight.

## Historical Background

### **Motion:**

‘How does an object fall?’ Galileo (1564-1642) is the man who answered and gave / developed scientific reasoning.

One day, very early in the morning, while walking on the road, Galileo’s eyes fell on the streetlight which was swinging. He observed it carefully and found out that though the amplitude changes, there is no change in the time period of an oscillations.

Immediately, he returned home and started working on this phenomena with various things, hanging them with strings of different lengths. In each case, he calculated the time period. Finally, he concluded that the time period depends not on the weight of the thing suspended but on the length of the string used.

A pendulum takes (a part of a circular path) while making oscillations. When two objects of different weight are suspended using strings of the same length, there will not be any difference in their time period.

After that, he climbed up the tower of Pisa, and dropped two objects of different weight to demonstrate they fall on the ground at the same time irrespective of their weight.

After that, he wanted to find the relation between the distance travelled by an object and the time taken for it. Since our eyes are not capable of observing this in the case of a free falling body, he used an inclined plane to find the relation between distance and time. He tabulated his observations regarding the time taken for an object to travel distances of various length. From the table:

$$\text{Distance} \propto (\text{time})^2 \quad \text{or} \quad S \propto t^2$$

This happens only when velocity  $\propto$  time  $v \propto t$

$v = at$  ‘a’ is a constant. He called it ‘acceleration’

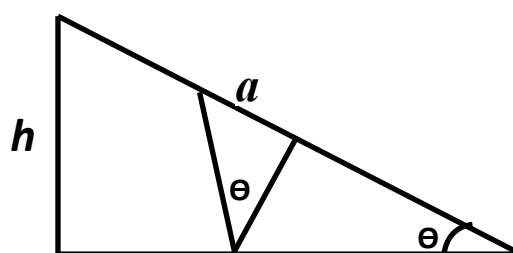
In time t, the distance travelled by the body is

$$\begin{aligned} S &= \frac{1}{2} v t \\ &= \frac{1}{2} at^2 \end{aligned}$$

If ‘a’ is the acceleration of a sphere on an inclined plane, from the diagram, we can say

$$\frac{a}{g} = \frac{h}{s}$$

$$\frac{s}{h} a = g$$



From this the acceleration due to gravity ‘g’ is measured as  $980/S^2$

### Puzzles (Think – Discuss)

#### Motion:

1. A man travelled for 70 hours in a car. The initial and final readings of odometer are 4849 and 5549 respectively. What is the average speed of his journey?

Average speed = Total Distance / Time taken

Distance travelled by Car = Final reading – Initial Reading

$$= 5549 - 4849$$

$$\therefore S = 700 \text{ km}$$

Average speed = 700 km / 7 hrs. = 10 km/hour

#### Laws of Motion:

2. What is the velocity of a small object that has separated from a rocket moving in free space with a velocity of 10 km / s

Since the net force that acts on the object in space is zero, the velocity of the small object is 10 km / s.

3. Observe fig. 9 on page 41. A strong man of 80 kg. mass is lifting a weight. What is the maximum limit of weight he can lift?

The man applies force to lift the weight. This force is stored as tension in the rope. This tension pulls the weight on the other side. (Note: Tension pulls the objects.)

When you apply 900 N force on rope, the same 900 N is presented as tension in rope. So 900N force pulls you up. Since you are 800 N weight. The net force is 100

N, so he moves up with an acceleration of  $\frac{5}{4} \text{ m/s}^2$  which is undesirable. Therefore,

he can lift a maximum weight of 80 kg.

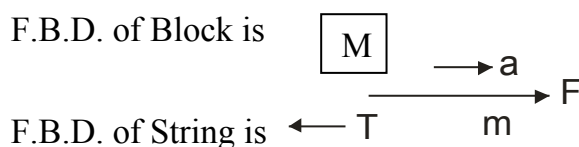
4. How can you prove that the tension throughout the string is uniform when the mass of the string is considered to be zero?(page 41)



Take a system as shown in the figure.

Let us assume that a force F is applied horizontally on a string at one end considering the force of friction is zero.

Let the masses of the block and the string are 'M' and 'm' respectively.



'T' is shown based on Newton's third Law.

Both of them have accelerations 'a'

Net force acting on string  $F - T = ma$

If the mass of the string  $m = 0$ ,  $F - t = 0 \Rightarrow F = T$

This proves that the other end of the string also has the same tension.

$\therefore$  Ignoring the mass of the string, the force applied at one end of string is uniform throughout the string.

### Gravitation:

**5. Out of two objects, if the mass of one object is doubled, what will be the gravitational force between them?**

If  $m_1$  &  $m_2$  are the masses of the two objects,

The gravitational force of attraction is  $F = \frac{G.m_1m_2}{r^2}$

If the mass of one object is doubled, then the gravitational force of attraction also doubles.

### Floating Bodies:

**6. What is the weight of total atmosphere around the Earth? (radius of the Earth is 6400 km)**

The mass of atmosphere of 1 cm<sup>2</sup> base is equal to 1 kg

$\therefore$  Total surface area of the Earth =  $4\pi r^2$

$$= 5.1 \times 10^{18} \text{ cm}^2$$

$\therefore$  Weight of total atmosphere =  $5.1 \times 10^{18} \text{ kg}$ .

### Work – Energy:

**7. A wooden chair is dragged on a level floor and brought to the same place. Let the distance covered be 's' and frictional force acted on the chair by the floor be 'f'. What is the work done by the frictional force? (page 143)**

$$\begin{aligned} \text{Work} &= \text{force} \times \text{distance travelled in the direction of force} \\ &= - fs \end{aligned}$$

- 8. A person starts from rest and begins to run. The runner puts a certain momentum into himself. What is the momentum of the ground? And the runner puts a certain amount of kinetic energy into himself. What is the kinetic energy of the ground?(page 150)**

In the given problem, the system is Person + the Earth.

The momentum is conserved when no force acts on it.

Since the initial momentum is zero, the final momentum is also zero.

Momentum of the person = - Momentum of the Earth

Person and the Earth moves with same momentum but in different directions.

Since Kinetic Energy =  $\frac{1}{2} m v^2$  & momentum =  $m v$

$$\begin{aligned} \text{K.E.} &= \frac{1}{2} \frac{m^2 v^2}{m} \\ &= \frac{(\text{momentum})^2}{2.m} \end{aligned}$$

Since person's momentum is equal to the Earth's momentum

$$\text{K. E.} \propto \frac{1}{\text{mass}}$$

Since the mass of the Earth is huge, its K.E. is negligible compared to the K.E. of the person.

- 9. A ball, initially at the top of the inclined hill, is allowed to roll down. At the bottom, its speed is 4m/s. Next the ball is again rolled down the hill, but this time it does not start from rest. It has an initial speed of 3m/s. How fast is it going when it gets to the bottom?**

In the both cases, the mass of the ball, initial point and the distance travelled are equal. Let the mass of the ball is 'm'. then its energy is equal to the kinetic energy.

$$\begin{aligned} \therefore \text{Object's Kinetic Energy} &= \frac{1}{2} m v^2 \\ &= \frac{m}{2} 4^2 = 16 \text{ units} \left[ \frac{m}{2} \text{ is constant} \right] \end{aligned}$$

In the second case, ball's initial energy is 9 units.

When the ball is rolling down the inclined plane, the nature of forces acting on it remains the same. No change. So the net energy is 16 units.

$\therefore$  Total energy = 9+16 = 25 units.

$\therefore$  Speed of ball = 5 m/s

**Sound:**

- 10. Do compressions and rarefactions in a sound wave travel in the same direction or in opposite directions? Explain.**

They travel in opposite directions. Otherwise, vacuum may be formed in some places.

## CLASS – 9

### Thought Provoking Questions

#### **Motion:**

1. Water flows out of a pipe in a continuous stream and then breaks down into drops. Why?
2. A man in a moving train said, “The train is moving”. Is it acceptable? Why?
3. A woman travelling in a car on a highway was stopped by a police man and asked her to pay fine.  
Police : Madam, you are going at a speed more than 60 kilometers an hour, so you have to pay the fine.  
She : No, Sir, I have started only 5 minutes ago from my home. You can ask me to pay fine only after an hour, so I will not pay the fine. If you are the policeman what do you say to her to collect fine.
4. How do you decide the direction of velocity?
5. Suppose you are travelling in a train from which you cannot see the outside world. Which one can you feel in such a train, acceleration or speed? Explain.
6. Give an example of a situation in which acceleration and velocity are in opposite directions.
7. What is ‘S’ in the equation  $S = ut + \frac{1}{2} at^2$
8. What factors influence motion?
9. Stand near a wall with a coloured piece of chalk in hand, jump into air and make a mark on the wall at the maximum possible height. From this, can you find out the period of time you were in air?

#### **Laws of Motion:**

1. Jumping out of a moving bus is dangerous. Why?
2. Usually, only the back wheels of vehicles are fixed with brakes. Why?
3. A ball hit the ground and bounced back. What forces act on it when it strikes the ground?
4. Two friends went to a pond. There were two small boats. They have a rope with them. They wanted to have a race but for that they needed to prove that both the boats have the same mass. Finally, they were able to do that. How do you think was it possible?
5. If a trolley travels with a constant speed in rain which is falling vertically, how does its momentum and kinetic energy change? Why?
6. Explain any situation where Newton’s 3<sup>rd</sup> law is applied.
7. If there is a change in the mass of a system, how do you explain it with Newton’s second law?

#### **Gravitation:**

1. Can a body have acceleration when there is no change in its speed? Give an example.
2. How are the planets able to revolve round the Sun?

3. How can we decide the density of the Earth?
4. How do you explain the stability of a body?
5. If a ball is placed in a big hollow sphere, what is the gravitational force between them?
6. What are tides? How do they form?
7. If a bomb falls out of a satellite, what course will it take?
8. Why walking, drinking etc. are difficult in a space ship?
9. State how the acceleration due to gravity of the Earth changes in the following situations:
  - a) When the radius of the Earth is halved (mass being constant)
  - b) When the mass of the Earth is doubled (radius being constant)

### Work-Energy

1. 'The work done by frictional force is always negative.' Discuss.
2. Can there be any work done when the displacement is zero. Give an example.
3. When a stone was thrown from a building of height 'H' with an initial velocity of 'u', it touched the ground with a velocity of 'v'. What is the work done by the air resistance?
4. A man took 5 minutes to climb up an escalator and reach a certain height when it was not working. He took 4 minutes to reach the same height when it was working. If he climbs up the steps when the escalator is working, how much time does he take to reach the same height?
5. State the equation  $W=FS$  and its limitations?
6. Potential energy is not absolute. But change in potential energy is absolute. Explain this with examples.

### Floating Materials

1. What is the pressure acting on the bottom of a free falling vessel filled with water?
2. Can you derive the force of buoyancy through the law of conservation of mass?
3. On which side of the petrol tanker is the pressure more? Why?
4. We know that ice blocks form on the surface of the ocean in places like Antarctica. Let us suppose that ice blocks of 10 metres thickness formed on water in such an area. What is the length of the rope required to dig water from a hole made in the ice block. (Density of ice = 0.9 gm./cc)
5. An ice block is floating on water. State how the water level changes in the following situations:
  - a) If the ice block is pure
  - b) If there is a small stone inside the ice block.
  - c) If there are some bubbles in the ice block.
6. What should be the shape of a vessel used as a boiler?



- Using a simple balance, measure the weight of a glass vessel with water. If we press the surface of water in the vessel, what will be the change in the weight? Explain?

### **Sound (8, 9 Classes)**

- What should be the maximum change in the pressure difference during sound propagation through air? Using this, if we move our hands, there will be vibrations in the air, but our ears cannot receive that sound. Why?
- Is wave length a vector or a scalar? Explain.
- Is velocity of sound the same as the velocity of the particles (which are responsible for the propagation of sound) in the medium?
- When heated in a vessel, water makes various sounds. Why?
- What energy is transferred from one place another through a sound wave?

### **Natural Phenomena:**

- Why lightning rod is fixed on the top of the house?
- While sieving sugar, the falling sugar particles fall a little bit away. Why?
- How many types of charge are there? How do you explain them?

### **Matter:**

- Why do people living in cold places wear caps?

### **Puzzles**

#### **Motion:**

- The ships floating on a river travel with different velocities though they travel in the same direction. This is because the capacity of engines they use are different. Similarly, bamboo pantus too travel down the river with varying speeds though they have no engines. It is observed that heavier pantus go faster. Why is this so?**

A. The velocity of water in a river is not the same across all its layers. The velocity is less at top layers because of the air pressure on it. Since heavier pantu travel on a deeper layer, its velocity will be more.

#### **Laws of Motion:**

- Hang a spring balance from the ceiling. Tie a rope to the bottom hook; pull and tie it to the ground such that it shows 100 gm. reading. Then, hang a 60 gm. weight from the same hook. Now what do you think is the reading of the spring balance. It is neither 40gm nor 160 gm. It is 100 gm.? How is it possible?**

A. The tension in the rope was 100 gm. When a 60 gm. weight was hanged, the tension became 40 gm., so there was no change in the reading. Even if a 100 gm. weight is hanged, there will not be any change in the reading, but the rope losses its tension.

- A man standing in a running train fall backwards when its speed is reduced slowly. Is this phenomenon in line with the Newton's first law?**

A. When the speed decreases slowly the man has to fall forward. But the man creates some torsion in the calf muscles of the legs. When the speed becomes zero, the person cannot bring them back into original state, so he falls backwards.

**4. Two masses  $M_1$ ,  $M_2$  placed on a friction free horizontal plane surface. If a force  $F$  is applied horizontally on  $M_1$  then the force on  $M_2$  is also  $F$ . Hence force acting on  $M_1$  due to  $M_2$  is  $-F$ . Hence the resultant force on  $M_1$  is zero. Though  $F$  increases,  $M_1$  remains stable but  $M_2$  moves as  $F/M_2$ . Do the experiment. Both  $M_1$  and  $M_2$  will move together. Can you explain?**

A. If we take the force acting on  $M_2$  as  $F$ , It means that we take it for granted that force  $F$  is transferred. This is a common misconception. If we take  $M_1$  and  $M_2$  as a system, the resultant external force acting on it becomes  $F$ .

$$\therefore \text{The acceleration of the System } a = \frac{F}{M_1 + M_2}$$

$\therefore$  If we take the resultant force on  $M_2$  as  $N$

$$N = M_2 a = \frac{M_2 F}{M_1 + M_2}$$

Hence we can conclude that the normal force  $N$  acts between  $M_1$  and  $M_2$ .

**5. Suppose you are in a moving train with acceleration 'a'. You observe a tree moving back. Its acceleration will be '-a'. We know that the resultant force on the tree is zero. Then how come the tree gained acceleration without resultant force? Is it against the Newton's second law of motion? What is your argument?**

A. The State of the observer is very important while applying Newton's laws of motion. These laws are applicable only when the observer is at rest or moving at a constant velocity. They need to be amended for an observer who is moving with acceleration.

### **Gravitation:**

6. Arrange 2 bangles of different radius on a table so that their centres coincide. We can take away the outer bangle without using much force. But according to Newton's law of Gravitation we need infinite force to do that as shown below:

The force between the two bangles  $F = \frac{GMm}{d^2}$  is equal to infinity since the

distance between two centres  $d = \text{zero}$ .

A. Newton's law of gravitation should be applied only to molecules. The forces of attraction work among the molecules in the bangles. If Newton's law of

gravitation is applied to the molecules in each bangle, we can prove, using integral calculus, that the force between the two bangles is zero.

### Work – Energy:

7. 100 N is the force that can be applied by a cyclist. The frictional force between the cycle and the road is 50 N. The total mass of the cycle and the man is 100 kg. Then, the acceleration of cycle and man is

$$a = \frac{100\text{N} - 50\text{N}}{100\text{kg}} = 0.5\text{m/s}^2$$

If he continues cycling for 20 minutes, his velocity after 20 minutes

$$v = at = 0.5 \times 20 \times 60 = 600 \text{ m/s}$$

This velocity is equal to the velocity of a bullet, so this is impossible. Then, how come we got this? Where have we gone wrong? Explain.

- A. To know what is wrong with this, first of all we should calculate the power used for cycling after 20 mints.

$$\begin{aligned} P &= \text{work/time} = \text{Force} \times (\text{distance} / \text{time}) = \text{Force} \times \text{Velocity} \\ &= 100 \text{ N} \times 600 \text{ m/ Sec} = 60,000 \text{ W} = 60 \text{ kW}. \end{aligned}$$

The velocity of 600m/s is possible only when the cyclist uses 60 KW power on the pedals. But this not possible. While cycling, the force exerted upon the pedal depends on its velocity. If is at rest, maximum force can be used. But as the cycle moves fast, the pedals also move fast resulting in less scope for the force to be exerted on them. At a certain pedal velocity, the force that can be exerted upon them becomes zero. Therefore, it is impossible to achieve the above said velocity.

8. Let us suppose a bullet was fired into a wooden block with Velocity V and it stayed inside the wooden block. If the masses of the bullet and the wooden block are the same, then

$$\text{The Velocity of wood and bullet} = \frac{mv}{2m} = \frac{v}{2}$$

$$\text{The initial kinetic energy of the bullet} = \frac{1}{2} m v^2$$

$$\text{The total kinetic energy of bullet and wood} = \frac{1}{2} (2m) \left(\frac{v}{2}\right)^2 = \left(\frac{1}{2} m v^2\right) \frac{1}{2}$$

$$= \frac{\text{Initial kinetic energy of bullet}}{2}$$

What happened to the remaining kinetic energy? Do you think ‘the law of conservation of energy’ does not apply here?

- A. The bullet travelled some distance inside the block. Frictional force acts between the bullet and the wooden block. Consequently, this force has to do work to

reduce the kinetic energy of the bullet. This comes out in the form of heat. This heat is equal to half of the bullet's initial kinetic energy.

**9. When 8 kg of coal is lifted to a height of 10 m, its potential energy becomes 800 J. What happens to this potential energy when the coal burns?**

A The gases that come out while the coal burns will have the same potential energy.

### **Floating Materials:**

**10. Some work should be done for taking a body to some height, which means we should spend some energy for it to happen. Contrary to this, some balloons, when filled with some gases (H<sub>2</sub>, He), fly up without spending any energy. How is this possible?**

A. When a gas balloon filled with hydrogen or helium goes up, it displaces a certain quantity of air whose mass is more than that of the gas inside the balloon.

V – Volume of the balloon

D – The density of gas inside the balloon

H – Height

g – Acceleration due to gravity.

The potential energy of balloon at height H is equal to  $V DgH$ .

Balloon occupied the place of air at a height H. This means, it displaced the air of same volume to a depth H.

The potential energy lost by air =  $V D^1gH$  (where  $D^1 =$  Density of air)

Reduction in the potential energy of air and balloon system

$$= VgH (D^1-D) > 0$$

This reduction makes the balloon fly upward. But actually, the density of air decreases with height and at some height the density of air and the density of the gas inside the balloon become the same. Then, it cannot go up.

### **Sound:**

**11. We can hear the sound produced by a vibrating tuning fork only when it is brought near our ears. But we can hear it from a distance when it is placed on a wooden bench. How is this possible?**

A. When a tuning fork vibrates in air, slowly, it loses energy slowly and steadily producing weak sound for a long time. But when it is placed on a table, it loses energy rapidly as it gives its energy to the table producing louder sound for a short time. Hence, we can hear that sound even from a distance.

## 12. Continuous Comprehensive Evaluation

RTE – 2009 directs that the learning experiences provided in school should help children develop in them the competencies appropriate for their class. Teaching lesson should enable children to construct knowledge on their own by participating in various learning situations/activities. To know to what extent children achieved the class specific academic standards, we need CCE. Therefore, there is a need to observe this continuous comprehensive evaluation very keenly. CCE is done in the form of ‘formative assessment’ and ‘summative assessment’.

### Continuous Comprehensive Evaluation – Formative Assessment

In the science classroom, the children participate in a multiplicity of activities, which are conducted to develop in them class-specific academic standards. As the process goes on, the teacher needs to know to what extent they have achieved them. For this, their progress should be monitored / measured with the help of formative and summative assessment. In this type of assessment, children do not need to memorize a lot of information; they do not feel the fear / stress of conventional examinations. Let us see how to do formative assessment in science in classes 8 and 9.

- Formative assessment has three parts: 1. Participation – presentation 2. Notebooks 3. Written assignments
- Unlike conventional examination, formative assessment should observe the children’s physical, cognitive, emotional and social development through classroom learning experiences / processes
- The children’s level of achievement of academic standards should be monitored in every lesson
- All academic standards in science viz., Conceptual Understanding; Asking questions and making hypothesis; Experimentation and field investigation; Information skills and Projects; Communication through drawing / model making; Appreciation and aesthetic sense / values; Application to daily life / concern to biodiversity should be monitored and observations should be recorded
- For this, the following assessment tools should be used: classroom discussions, notebooks of children, information tables, reports, reports on experiments, children’s diaries, portfolios, anecdotes, checklists, teacher’s diary, quiz, seminar, conference, wall magazine, school magazine
- Oral and written test can be used as tools for assessment
- During every lesson, the competencies of each child should be marked using the above said tools and appropriate grades (A<sup>+</sup>, A, B<sup>+</sup>, B, C) should be recorded

- Soon after the completion of the syllabus, the average of children's competencies should be calculated and recorded (Please refer to CCE Module)
- Since formative assessment is not an examination conducted at a specified time with a specified question paper, children should be given opportunities to learn again and improve their grade

### **How to do Summative Assessment?**

This is similar to an examination that assesses the achievement children in acquiring certain competencies specified for the class. But this should be stress free and should not encourage rote memorization and mechanical writing. Summative assessment should be done in the form of a written examination after the completion of syllabus or a part of the syllabus. Let us have a look at the important points in conducting summative assessment

- The teacher should prepare a question paper based on the specified syllabus
- Question papers prepared by external agencies/people should not be used
- Question papers should be firmly based on the academic standards of the class
- The teacher need not prepare a scoring key since most of the questions in the paper are open ended and since there is a scope to get a multiplicity of answers. We should not assume that all children come up with the same answer for a question.
- The question paper should give space for children to think creatively and write answers which are quite different from those given in the textbook. These answers may have come out of their experience or out their critical thinking/opinion. Such answers should be rewarded appropriately
- Since every section is a unit of 5 marks, the teacher should read the answer carefully and award marks
- If there are two 2 marks questions and one 1 mark question in a section, total marks out of 5 should be noted (however, s/he can give marks to the questions separately)
- Since all questions related to a certain academic standard appear in a single section, it is easy to know the weightage given to that standard and to know the children's performance in it

- The teacher can mark the answer papers in the manner used hitherto. However, s/he should be careful in doing that since the answers differ from student to student
- After marking the answer scripts, marks and grades should be tabulated according to the academic standards as shown below
- To give a grade, the teacher should consider the marks of the students and the range they fall into as shown in the table.

Look at the following example. Ravi is in class 8. Given below are his marks in various academic standards in the first summative assessment. Here, the teacher gave a question paper for 100 marks in 6 sections (In science we have 7 academic standards, but we have to club 6 and 7 and give it under one section). Marks are distributed among the sections according to the weightage given to each academic standard.

<b>Academic Standards</b>						<b>Marks</b>	<b>Grade</b>
1	2	3	4	5	6		
40	10	15	10	15	10	100	B+
20	8	10	6	11	7	62	

The answer scripts are marked and the scores are tabulated as shown. From the table, we know that Ravi secured 62 marks out of 100. Since his marks fall in the range 51 – 70, and the corresponding grade is B<sup>+</sup>, he is given that grade.

<b>Percent</b>	<b>Grade</b>
91 – 100	A+
71 – 90	A
51 – 70	B+
41 – 50	B
Below 40	C

## Summative Assessment

**Model Test Paper**
**Class – 8**
**Physical Science**
8<sup>th</sup> Class

Time:

Name of the Student..... Section .....No.....

I	II	III	IV	V	VI	Marks	Grade

### I. Conceptual Understanding

**a) Answer any two of the following questions.**
**2x10=20M**

1. We know that metals allow themselves to be drawn as wires. Explain, with suitable examples, the chemical properties of such metals.
2. What are the factors responsible for sound pollution in your area? What are the problems faced by people because of this pollution? Give your suggestions to prevent this?
3. When Rangayya was grazing his cattle in a field, suddenly, there were lightning and thunder. What precautions should Rangayya take in such circumstances? How do lightning and thunder happen?

**b) Answer the following questions**

4. Zavid said, “Friction is not only a friend, but also an enemy to humans.” How will you support him?
5. You have read about Solar System, haven't you? If you have to write an essay about it, what five important points do you choose? Write them and elaborate them?

**c) Give one-word answers to the following Questions?**

6. Example for combustible material?
7. Electrolysis means.....
8. In which direction does Polar star appear?
9. One difference between contact force and field force.....
10. Rapid combustion means.....

**d) Fill in the blanks with suitable words.**

11. Artificial fibres are made from ..... materials through synthesis.
12. To reduce friction in a machine, you use .....
13. When Sudheer put a lighted match at the mouth of a test-tube, it gave out a popping sound, so the gas in test tube can be .....



14. The instrument used to measure the intensity of sound .....
15. The meteors that fall on the Earth from the sky are called.....
16. Seismograph is used to measure .....

**e) Write what you understood about the following words.  $2 \times 1 = 2$**

17. Carbonization
18. Electrostatic Cell

**f) Choose the correct answer for each of the following questions.  $5 \times \frac{1}{2} = 2\frac{1}{2}$**

19. Choose the material which cannot be charged using friction  
 a) Plastic Scale b) Copper Rod c) Balloon filled with air  
 d) Wooden Piece
20. What is Rayan made from?  
 a) Coal b) Oxygen c) Coir d) Cellulose
21. What is the important constituent in coal?  
 a) Carbon b) Oxygen c) Air d) Water
22. Which of the following is an electric conductor?  
 a) Distilled water b) Drinking water c) Coconut Oil d) Kerosene
23. Which of the following is a non-metal?  
 a) Iron b) Zinc c) Copper d) Sodium

**II. Asking Questions and making Hypothesis  $2 \times 5 = 10$**

24. Imagine and write about our life in future when all the fuels in the Earth are used up?
25. Deepak had so many doubts about the various forces that act upon the roller used to roll the cricket pitch. What doubts do you have on this? List them.

**III. Experimentation and field investigation**

26. On the occasion of the celebration of Science day in your school, you got a chance to make and exhibit the electrolytic cell. Elaborate on the materials you gather and the procedure you follow to do it.

(Or)

Santhi gave a copper coating to her iron key. What do you think is the process she followed to do it. Write the stages sequentially.

**IV. Information skills and projects**

27. The following table gives details about the short fall of energy in India during the period 1991 – 1997. Study the table and analyze the data.  $1 \times 10 = 10$

S.No.	Year	% short fall of energy
1	1991	7.9
2	1992	7.8
3	1993	8.3
4	1994	7.4
5	1995	7.1
6	1996	9.2
7	1997	11.5

- Did the short fall of energy increase or decrease?
- How was the availability of energy in 1997 compared with 1991?
- In which year were the energy needs less?
- What does the increase in short fall of energy indicate?
- On what aspect of energy do we have to focus on as per the indications of this table?

28. What information do you have to gather to write a report on the use of petroleum products in your village / town? Prepare a table to record the information collected.

#### V. Communication through Drawing / Model making

- Draws a figure to explain the experiment you do to know the gases that come out when coal is heated. Also write the precautions to be taken to do the experiment.
- Draw a figure showing the procedure to make a tester using a magnetic compass, battery and wires. Write the uses of it.

#### VI. Appreciation, Values, Bio-diversity and real life applications

- If you have to speak on the effects of radiation from artificial satellites revolving round the Earth on Bio-diversity, what points do you focus on?
- Hari said to his father, "We can save a lot of fuel if we use a cycle instead of a motorbike to do errands." What suggestions do you give on this?
- Write answers in a sentence.
  - What is the use of recycling process?
  - Damage/ Harm when exposed to blasting sounds
  - A situation in which you use frictional force.
  - How do you appreciate the extensive use of plastic?
  - What is your advice to prevent sound pollution?

## Summative Assessment

**Model Test Paper**
**Class – 9**
**Physical Science**
9<sup>th</sup> Class

Time:

Name of the Student..... Section .....No.....

I	II	III	IV	V	VI	Marks	Grade

### 1. Conceptual Understanding

**a) Answer any two of the following questions** **2x10=20M**

1. Deduce the equations of uniform acceleration?
2. What are the features and limitations of Rutherford's atomic model?
3. Deduce a formula for pressure difference at different levels of depth in fluids.  
Explain Buoyancy from this.

**b) Answer the following questions** **2x5 = 10**

4. Distinguish between echo and reverberation?
5. Why does not the moon fall on the Earth due to gravitation?

**c) Write what you understood about the following words.** **5x1 = 5**

6. Compressibility
7. Fractional distillation
8. Formula unit mass
9. Inertia
10. Isotope

**d) Fill in the blanks with suitable words.**

11. The characteristic that shows the difference between shrill and growl voice is .....
12. The energy of a body which is at a certain height from the Earth is .....
13. The mass in unit volume is .....
14. The acceleration of a free falling body does not depend on .....
15. The Atom without neutrons is .....

**e) Choose the correct answer.** **5x1/2 = 2 1/2**

16. In  $\text{Na}_2\text{CO}_3$  the valency of sodium is
17. 1            b)2            c) 3            d) 4
18. Which of the following is a is pure  
Air            b) Soda            3) Distilled water            d) Steel
19. Which of the following can be used to explain the law of conservation of mass?  
Newton 2nd law of motion            b) Newton 3rd law of motion  
c) Newton 2nd and 3rd law of motion d) All of Newton's laws of motion
20. A man travelled from A to B with a velocity 40 km/h and returned from B to A with a velocity 50 km/h. What is his average velocity in km/h.....
21. Change in the state of a substance depends on.....