

Before Reading

- Read the Find Out statement to help you know what to look for as you read.
- **Think:** I need to find out what the parts of an ecosystem are and how they are organized.
- Look at the **Vocabulary** words.
- Be sure that you can pronounce each word.
- Look up each word in the Glossary.
- Say the definition to yourself. Use the word in a sentence to show its meaning.
- Read the title of the section.
- **Think:** I need to know what an ecosystem is. I need to read to find out what the parts of an ecosystem are. The heading Different Ecosystem gives me a clue that an ecosystem may have both living and nonliving parts.

During reading

Find the main idea in the first paragraph.

- Groups of living things and their environment make up an ecosystem.

Find **details** in the next paragraph that support the main idea.

- Some ecosystems have only a few living things.
- Environment that have more space, food, and shelter have many living things.

Let us observe the following table of different species

Flora and Fauna	Name of the species
Plants	Orchids species, sandalwood tree, cycas, medicinal plants, Rauwolfia serpentina etc.
Animals	Leopard, Indian Lion, Indian Wolf, Red Fox, Red Panda, Tiger, Desert Cat, Hyena etc. Gharial, Tortoise, python, Green sea turtle etc. Peacock, Great Indian bustard, Pelican, Great Indian horned bill etc. Golden monkey, Lion tailed macaque, Nilgiri Languor, Loris

Endemic Species

Observe the pictures and identify the animals. Also try to find out where these can be found?



You may find that these animals are specifically found in certain regions of the world.

You are also aware of the fact that many plants and animals are widely distributed throughout the world. But some species of plants and animals are found restricted to some areas only. Plants or animal species found restricted to a particular area of a country are called **Endemic Species**.

- Name an Endemic Species of our State?
- You may notice that kangaroo is endemic to Australia and Kiwi to New Zealand. Can you tell which among the above pictures represent an endemic species of India?

Name some other endemic species of India.

You can take help of books from your school library or internet.

- Plants and animals in an ecosystem can meet all their basic needs in their ecosystem.

Check your understanding of what you have read.

- Answer the question at the end of the section.
- If you are not sure of the answers, reread the section and look for the answer to the question.

After Reading:

Summarize what you have read.

- Think about what you have already learned about ecosystems and interactions.
- **Ask yourself:** What kind of system is an ecosystem? What interactions occur in an ecosystem?

Study the photographs and illustrations.

- Read the captions and any labels.
- Think: What kind of ecosystem is shown in the photographs?

What are the nonliving parts of the ecosystem?

What living parts of the ecosystem are shown?

Reading about science helps you understand the conclusions you have made based on your investigations.

Writing to communicate

Writing about what you are learning helps you connect the new ideas to what you already know. Scientists write about what they learn in their research and investigations to help others understand the work they have done. As you work like a scientist, you will use the following kinds of writing to describe what you are doing learning.

In informative writing: you may

- Describe your observations, inferences, and conclusions.
- Tell how to do an experiment.

In narrative writing: you may

- Describe something, give examples, or tell a story.

In expressive writing: you may

- Write letters, poems, or songs.

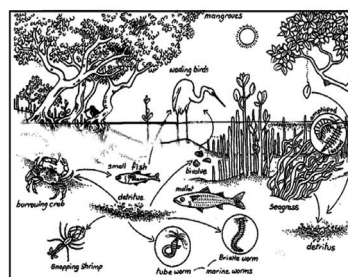
Biotic Components

Producers - maggrove, spirogyra, euglena, oscillatoria, blue green algae, ulothrix, etc.

Cosumers - shrimp, crab, hydra, protozoans, mussel, snails, turtle, daphnia, brittle Word, tube Worm, etc.

Decomposers - Detritus feeding bacteria, etc.

Abiotic components - Salt and fresh water, Air, sunlight, soil, etc.



Food web in Coringa Ecosystem

Do you know? There are over 1000 organisms living on our skin. In the chapter on microorganisms you have already seen the pictures of some of them. The biotic community consists of bacteria, fungi and small arthropods etc. The abiotic factors are dead skin cells, water, salts and oil of our sweat, air etc.

We have studied that

A living community cannot live in isolation. It lives in an environment which supplies its material and energy requirements and provides other living conditions. The living community, together with the physical environment forms an interacting system called the Ecosystem. An ecosystem can be natural or artificial, temporary or permanent.

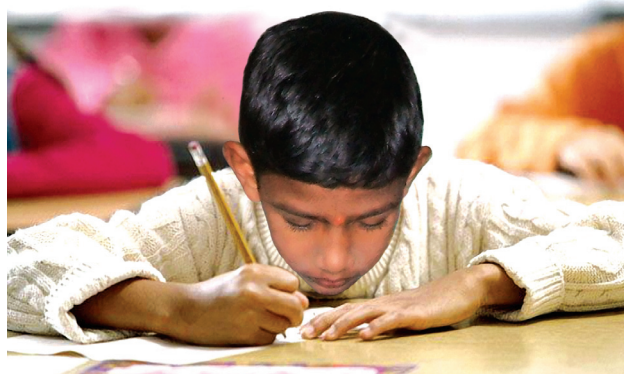
A large grassland or a forest, a small tract in a forest or a single log, an edge of a pond, a village, an aquarium or a manned spaceship can all be regarded as ecosystem. An ecosystem can thus be defined as a functional unit of nature, where living organisms interact among themselves and also with the surrounding physical environment.

(Brochure of CoP-11, Biodiversity Conference, Hyderabad, 1-19, Oct, 2012)

THE DESERT ECOSYSTEM

The desert occupy about 17% of the land and occur in the regions with an average rainfall of less than 23cms. Due to extremes of temperature, the species composition of desert ecosystem much varied and typical. The various components of a desert ecosystem.





In persuasive writing: you may

- Write letters about important issues in science.
- Writing about what you have learned in science helps others understand your thinking.

Measuring

Scientists make accurate measurements as they gather data. They use different measuring instruments, such as thermometer clocks, timers, rules, a spring scale, and balance, and they use beakers and other containers to measure liquids.



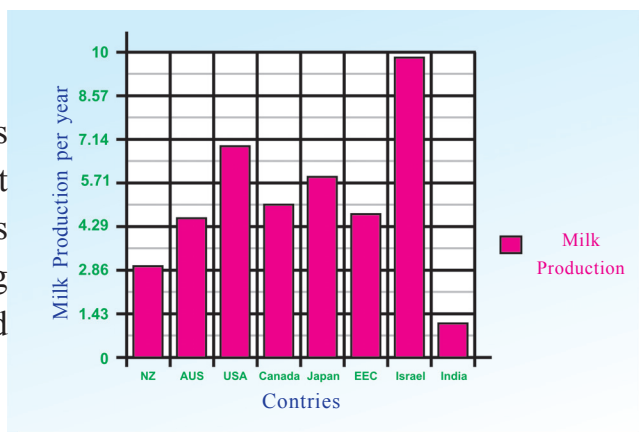
Using numbers

Scientists use numbers when they collect and display their data. Understanding numbers and using them to show the results of investigations are important skills that a scientist must have.

As you work like a scientist, you will use numbers in the following ways.

Interpreting Data

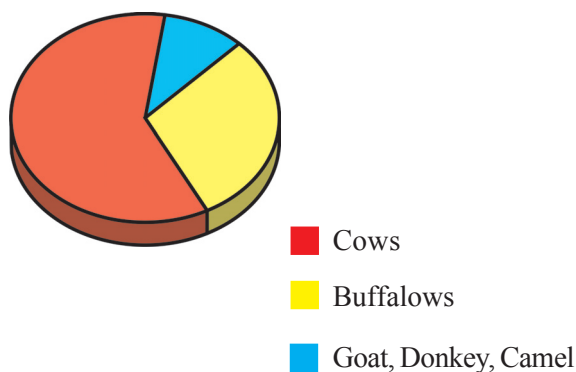
Scientists collect, organize, display, and interpret data as they do investigations. Scientists choose a way to display data that helps others understand what they have learned.



Tables, charts, and graphs are good ways to display data so that it can be interpreted by others.

Using Number Sense

Scientists must understand what the numbers they use represent. They compare and order numbers, compute with numbers shown on graphs, and read the scales on thermometers, measuring cups, beakers, and other tools.



Good scientists apply their math skills to help them display and interpret the data they collect.

In your school laboratory you will have many opportunities to work like a scientist.

An exciting year of discovery lies ahead!

Safety in science

Doing investigations in science can be fun, but you need to be sure you do them safely. Here are some rules to follow.

1. **Think ahead :** Study the steps of the investigation so you know what to expect. If you have any questions, ask your teacher. Be sure you understand any safety symbols that are shown.



2. **Be neat :** Keep your work area clean. If you have long hair, pull it back so it doesn't get in the way. Roll or push up long sleeves to keep them away from your experiment.
3. **Oops! :** If you should spill or break something or get cut, tell your teacher right away.
4. **Watch your eyes:** Wear safety goggles anytime you are directed to do so. If you get anything fall in your eyes, tell your teacher immediately.
5. **Yuck! :** Never eat or drink anything during a science activity unless you are told to so by your teacher.
6. **Protect yourself from shocks :** Be especially careful while using an electrical appliance. Be sure that electric cords are in a safe place where you can't trip over them. Don't ever pull a plug out an outlet by pulling on the cord.
7. **Keep it clean:** Always clean up when you have finished. Put everything away and wipe your work area. Wash your hands.

The secret of inventions and discoveries only lies in identifying the problem. The earth revolves around the sun even before the discovery of Heliocentric theory by Copernicus. In the same way the

things used to fall down on earth even before Newton's investigations. The meaning behind that were those people thought beyond the common man in identifying the problems. They thought and observe in unique way. We know that necessity is mother of invention, when people needed a mean to travel fast from place to another place discovered vehicles. In the same way to travel more fast we invented supersonic jet planes and even space craft's (to learn more about the development of science go through the book History of science written by F. Cojori).

There is a sequential order in discovering things. Let us observe how your mother cooks, you also can observe how a cycle mechanic repairs a cycle, try to observe how farmer ploughs his field. You will find a systematized pattern in all these things.

Write what you observe about these patterns and discuss in groups.

How do birds and ants find their way home? How trees shed leaves in a particular season? Likewise many more questions might have sprouting in your brain. Try to answer them in your own way. For this you need to follow a sequential order please go through the following...

- Identifying problem - Let us identify any problems from your surroundings

Ex: The bulb did not lit in the room.

- Making hypothesis - List out different solutions which you think for the identifying problem.

Ex: De filament, fuse failure, switch problem, wire problem.

- Collecting information- To solve the identifying problem collect material, apparatus, Information, persons.

Ex: Collect material like tester, screwdriver, wooden scale, wires, insulation tape, table and blade.

- Data analysis - Arrange the collected data or information to conduct experiment.

- Experimentation - To prove selecting hypothesis conduct experiment.

Ex: Observe filament of the bulb.

- Result analysis - Analyzing the results to find out the solution for the problem based on the results you need to select another hypothesis to prove.

Ex: Filament of the bulb is good in condition so we need to observe fuse.

- Generalisation - Based on the experiment and its results explain the solution for the problem.

Ex: Fuse is damaged so the bulb not glow, so we need to replace the fuse.

This is the way to find out solutions for the problems in a scientific way. You may also select such problems and find out your own solutions.

Branches of Science

Science studies various things in nature. While one branch studies plants, another branch studies animals. Let us see some of the branches of science and their field of study. You can also collect some information on this.

S.No	Branch of Science	Field of Study
1	Physics	Physical features of materials like motion, time, gravitation, etc.
2	Chemistry	Structure of materials, properties, reactions, etc.
3	Botany	Structure of plants, growth, diseases, etc.
4	Zoology	Structure of various animals, habits, habitat, classification, etc.
5	Astronomy	Sun, moon, stars, planets
6	Geology	Structure of the Earth, history, minerals, rocks, etc.
7	Agronomy	Cultivating crops, management of land and water resources, etc.
8	Anatomy	Structure / framework of various living organisms, functioning , etc.
9	Anthropology	Life styles/cultures of ancient and modern human beings, etc.
10	Microbiology	Bacteria, virus, etc.
11	Biotechnology	Matters related to genes, hybrid seeds, production of drugs, etc.
12	Entomology	Characteristics of insects, uses, etc.
13	Ornithology	Birds, their ways of living, migration, etc.
14	Psychology	Behaviour of living things, mental state, etc.
15	Seismology	About earthquakes
16	Taxonomy	Classifying living things in animal and plant kingdom in to groups, etc.
17	Paleontology	About plant animal fossils, etc.
18	Ecology	Environment system, etc.
19	Pathology	Various diseases, reasons for diseases, etc.
20	Meteorology	Physical and chemical dynamics of atmosphere, the Earth, oceans, their effects, etc.

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 8th and 9th 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 8th and 9th 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. Food
2. Living World
3. What is living beings made up of?
4. Natural resources

The lessons are selected based on the above themes. The lessons in 8th and 9th classes like ‘Agricultural Products’, ‘Food Production from Plants and Animals’, etc., are developed based on the lessons in 6th and 7th classes like ‘Our Food’, ‘Living Things’, etc. In the same way, lessons like ‘The Story of Microorganisms’, ‘Diversity in Living Organism’, ‘Different Eco Systems’, ‘Biodiversity’, ‘Animal Behaviour’, etc., are developed based on the theme ‘Living World’ and the lessons on Living and Non-living things, Parts of Plant and Animals. Under the theme, ‘What is living beings made up of?’, lessons like ‘Cell – The Basic Unit of Life’, ‘Cell – Its structure and Functions’, ‘Animal Tissue’, ‘Plant Tissue’, ‘Why do We Fall Ill?’ etc., are developed. Similarly, under the theme, ‘Natural Resources’, lesson like, ‘Not for Drink, Not for Breath’, ‘Soil Pollution’, ‘Bio Geo Chemical Cycles’, etc., are developed for classes 8 and 9 based on lesson on Water, Forests, etc., in classes 6 and 7.

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. Let us have a look at what lessons are developed under various themes:

S.No	Theme	8 th Class	9 th Class
1	Food	Food production from plants	Challenges in improving agricultural products
		Food production from animals	
2	Living World	Story of microorganisms	Diversity in living organisms
		Biodiversity and its conservation	Animal behaviour
		Different eco systems	Adaptations in different ecosystems
3	What is Living Beings Made up of	Cell-basic unit of life	Cell structure –it functions
		Reproduction in animals	Animal tissue, plant tissue
		adolescence	Movement of materials across the cell membrane
		Why do we fall ill	
4	Natural Resources	Not for drink, not for breath	Soil pollution
			Bio geo chemical cycles

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.

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:

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

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

The Story of Microorganisms

(Unit 3 - Class 8)

Unit-Analysis

The structure of a unit is designed embedding many components right from introduction to annexure. To understand this structure better, let us take a unit and look into the structure of it.

The lesson “Story of Microorganisms” in 8th class Biological science has two divisions. The first division gives the preliminary understanding of microorganisms, whereas the second division explains the advantages and disadvantages of microorganisms.

Structure of the unit “Story of Microorganisms”

The main components of the lesson appear under the following headings

- Introduction
- Activities
- Do You Know
- Think and discuss
- Key words
- Read and Enjoy
- Box items
- Pictures / diagrams
- Tables
- What we have learnt?
- Improve Your Learning
- Annexure (Additional Information)

Concepts in the unit

The Concepts mentioned below are discussed in the lesson “Story of Microorganisms”

- Microorganisms
- Useful (Friendly) Microorganisms
- Harmful Microorganisms
- Fermentation
- Vaccine
- Invention of vaccine for small pox
- Anti-bodies
- Nitrogen fixation
- Root nodules
- Diseases – microorganisms responsible
- Disease factors
- Disease carriers
- Food storage
- Pasteurization

Activities

Various activities are given in the unit to explain different concepts. Let us have a look at them.

Activity 1. Observing how milk turns to curd

Activity 2. Observing what happens when yeast is added to wheat flour.

Activity 3. Discussing the commercial uses of microorganisms.

Activity 4. Visiting the Primary Health Centre and collecting information about vaccination

Activity 5. Learning about the nitrogen fixing bacteria in roots of the plants.

Activity 6. Preparing Compost pit

Activity 7. Discussing the microorganisms that cause diseases in human beings, trees and animals, and analyzing the information tables.

Do you Know?

Under the title “Do you Know” information about the following topics, inventions/people are given - about usage of antibiotics, about Dr. Yallapagada Subbarao, inventor of Aureomycin, about Jonas Salk, who invented Polio Vaccine, about Rabies Vaccine, about disadvantages of B.T. seeds, about inventions of Ronald Ross and about the disease botulism.

Think-Discuss

Under this heading, there are questions on the uses of pasteurization and the changes that may occur in our environments in the absence of microorganisms.

Information Tables

Under this heading, information is given in tables about different diseases caused by microorganisms in human beings and plants, disease factors, disease carriers, disease spreading process and methods of preventing and containing those diseases.

Diagrams

There are 13 pictures/photos in the lesson including the Pictures of Alexander Fleming, Louis Pasteur, Jonas Salk, Edward Jenner, Ronald Ross, and Yallapragada Subbarao.

Key Words

Important concepts of the lesson are given as key words at the end of the lesson. E.g. Fermentation, Pasteurization.

What we have learnt?

Key concepts in the lesson, mainly about the advantages and disadvantages of microorganisms, are given in sequential order under this heading.

Let us improve our learning

There are 18 questions under this heading. These are framed based on the Academic Standards. Questions are asked on the topics like, experiments by children, conducting

project works, visiting libraries, etc. These questions give scope for children to work on their own and write about that individually.

Appendix

Under this heading there is a detailed explanatory note on how Ronald Ross discovered the Malaria parasite in mosquitoes.

Model Instruction of the Lesson

Let us select a concept from the lesson ‘Story of Microorganisms’, and see what learning activities should be given to pupils in the specified periods.

1. Mind Mapping

- a) **Greeting:** Good Morning Children! Sometimes we eat Bread. When do we eat bread?
- b) **Mind Mapping:** Say what do you know about bread? Writing the word ‘BREAD’, the teacher has to guide children to Mind map the word.

2. Motivating / probing questions:

- We make the children observe the bakery bread.
- How does it feel when you touch and press the bread?
- Why is the Bakery Bread like a Sponge?
- Do you know how the Bakery bread is prepared?

On the previous day I will ask children to mix yeast with Sugar Solution in a water bottle and fix a balloon to the neck. The next day I will ask them to take it into a watch glass and answer the following questions.

1. What kind of odor do you feel when you smell the solutions?
2. Guess, what the substance is? How did you identify? What is the odor of the substance?

Academic Standards:

- Comprehension of the concept of fermentation.
- Entering the results of the experiments in tables and representing them in the form of diagrams.
- Applying the Fermentation procedure learnt in their daily life.
- To make the children appreciate the role of Yeast in preparation of Bread and the role of the Yeast in the process of Fermentation.

3. Reading the Lesson:

Read up to activities 3 and 4 on pages 36, 37 in the lesson “Story of Microorganisms”. Identify the new words and concepts. Discuss in groups. Teacher

has to write the words identified by children on the blackboard and explain/discuss them. Children, 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.

4. Conduct of Activities – Comprehension of Concepts:

Activity 1:

- Form groups of five
- Collect materials like maida flour, Yeast, Water, Sugar, Cups etc., to do fermentation experiment
- Do the experiment as it is given in the textbook.
- Note your observations in your note books.
- Write the procedure followed in your experiment and draw diagrams.

To prove that the gas released during the experiment is carbon di oxide, the experiment in which the bottle containing sugar solution mixed with yeast fix and fitted with a balloon to its mouth, should be done.

5. Demonstration – Discussion:

Discussion should be done in the whole class on the topics of the experiments done by the students. The teacher should conduct the discussion by asking the following questions.

1. How much quantity of Yeast is mixed with the maida flour?
2. How much time did it take for maida to effervesce?
3. What the changes have come up when yeast is mixed with Maida?
4. What gas is released when yeast is mixed with maida?
5. Name the bacteria responsible for Fermentation?

6. Conclusion – Evaluation:

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

7. Home Work

Write answers to the following questions

1. Interpret and guess the results when yeast is mixed with other flour?
2. Write how, when and which way can we apply the results of this experiment in our daily life?

Biodiversity

(Unit 6 - Class 8)

1. Introduction

Reading the paper clipping regarding 'World Biodiversity Meet-2012' held in Hyderabad. Two animals in the list of world's most threatened (endangered) species belong to Andhra Pradesh itself.

2. Activities: Given activities make the pupils construct knowledge by learning on their own.

Activity 1: Identifying the living organisms in the surroundings (Field observation)

Activity 2: Identifying Biodiversity while visiting a Garden / Forest / farm visited (Field Observation)

Activity 3: Let us find out Biodiversity in plants and animals (Collection / Observation)

Activity 4: Expressing the differences among the individuals collecting the photographs of cricketers. (Collection / Observation)

Activity 5: How is biodiversity protected in the lesson 'Forest of life' (Discussing / Analysis)

Activity 6: Collecting information about Migration of Birds' (Discussion / Analysis)

3. Think and Discuss: Many open ended questions related to extended learning and requiring higher order thinking are given on the activities conducted, on the concepts learnt and experiences gained.

4. Case study: There are case studies on Ramagundam forest and Tiger Project. Information regarding how were they some time ago, how they are today and how they are going to be changed in future.

5. Tables: Information related to concepts such as wild life sanctuaries, Bird sanctuaries is given in the form of tables to develop curiosity, scientific thinking and sensitivity to biodiversity in children.

6. Concepts in Boxes: Information regarding, biodiversity meet, invasive alien species, protection of pandas, compressed card board is furnished as box items. They are interesting to pupils as well as teachers.

7. Project Work: Making of recycled paper from waste newspapers is given as a project work. Projects are useful in inculcating the science principle 'learning by doing' and in application of concepts learnt in their daily life.

8. Key Words: Main concepts of the lesson can be called as key words. The words that are introduced to the pupils for the first time are given as key words.

9. What we have learnt: The summary of the key concepts and sub concepts in the entire lesson are given.

10. Improve your learning: Assessment is taken care of by checking whether all the academic standards have been achieved or not. Questions related to all academic standards are given. These questions are for the pupils to answer on their own. There are 22 questions in all.

11. Figures / Pictures / Graphs / Maps: In this lesson there are many photographs. There are block diagrams, picture showing biodiversity, and a graph indicating biodiversity areas in the world.

12. Annexure: There is information regarding nature parks and sanctuaries in Andhra Pradesh.

Read and Learn: ‘The Animals law suit against Humanity’ is a mythological tale, given under ‘read-enjoy’. This explains the significance of biodiversity and says that all living beings have a right to live and a right to equality.

Biodiversity – concepts:

Period	Concept	Activities / Experiments / Discussion/Case study
IP	Biodiversity-introduction	Introduction through reading the paper Clipping of biodiversity meet-2002
2P	Biodiversity	Act-1: Drawing Model of living organisms in the surroundings (field observation)
	Diverse world of life under microscope	Act-2: Drawing the model of garden/forest/field and identifying living things in it (field observation)
3P	Biodiversity in Plants And Animals	Discussion: Discussion on the previous knowledge about Microorganisms.
		Act 3: Diversity in plants, animals and humans (observation)
4P	Biodiversity origin	Act 4: Observation of cricketers Case Study: Wild life in Ramagundam Forest

Period	Concept	Activities / Experiments / Discussion/Case study
5P	Endangered species Endemic species	Discussion: on the table in Red Data book.
6P	Origin of Biodiversity and Balance in nature.	Discussion: When is the biodiversity of an area completely wiped out? Discussion: Difficulties caused by Sudden invasion of species in an area.
7P	Value of Biodiversity and Its conservation	Working towards protection of biodiversity Case study: Tiger Project
8P	Importance of the role of tribal people in protecting Biodiversity	Act: discussion on 7 th class lesson Our Forest Discussion: National parks and Sanctuaries.
9P	Importance of Biodiversity Conservation	Project work: Migratory birds Studying Migration and its effect on Biodiversity of an area. Act: Collecting information about migratory birds.
10P	A small step towards	Discussion: Why would we recycle the paper?
11P	Saving forests	Project work: Making of recycled paper. Discussion: A plea of sparrow on the cover page
12P	Need for Biodiversity	Need for Biodiversity meet Read the animals lawsuit against Humanity in Annexure (Read and Learn)

Importance of Lesson:

All living organisms in the world, from bacteria to blue whale; from moss plant to conifer are a part of nature. Many species of Plants and Animals among them are becoming extinct due to various reasons and some are endangered. 'Biodiversity meet – 2012 was held in Hyderabad from 1st to 19th of September, 2012 to save this most valuable biodiversity. Delegates from 190 countries all over the world attended the meet. Efforts to conserve the biodiversity are planned and financial aspect is taken care of. 10,000 species a year or 27 species a day are becoming extinct. If this continues, the existence of humans will become quite difficult. Every being is valuable and unique in this nature. We cannot say one is valuable and the other is not.

Academic standards to be achieved:

1. What is Biodiversity? Pupil understands about biodiversity among different species and diversity among creatures of the same species. Pupil finds reason for the extinction of species.
2. Pupils recognize the variations among the organisms of different eco systems through field investigation.
3. Pupil Analyses the concepts better by taking up project works.

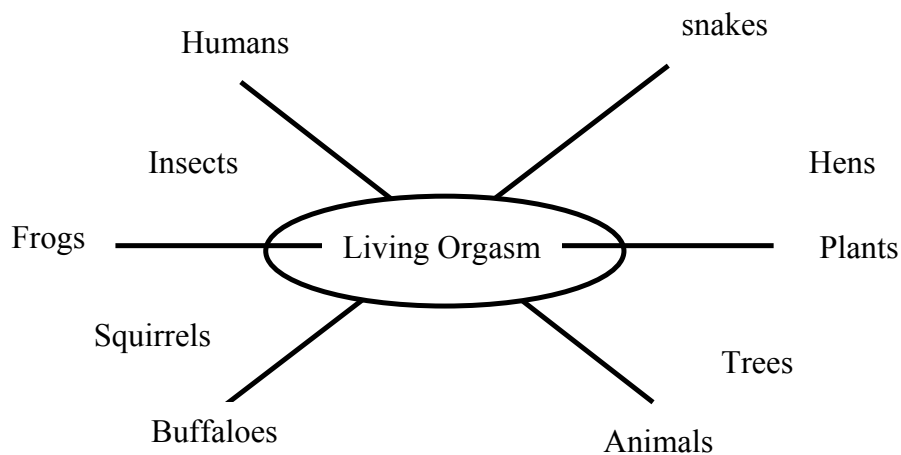
4. Pupils draw 'diversity in nature' in the form of pictures (diagram) Pupils analyse the information collected by them and exhibit it in the form of a graph.
5. Pupils appreciate the role plants and animals in biodiversity. Pupils recognize that every living being has a right to live.
6. Pupils start taking up actions to protect biodiversity. Pupils recognize that the existence of humans will become difficult as a result of the disappearance of different species.

Model lesson:

Let us have a look at the procedure adopted by the teacher to teach the concept 'Variations in plants' in Biodiversity"

1. Mindmapping:

- (a) **Greeting:** Good morning children. Let us discuss / think about various living organism in our surroundings.
- (b) **Mindmapping:** Which living organisms are found in a playground or a garden?



(c) Probing Questions :

- Children! Are all living organisms you said alike? Do you find any differences?
- How many kinds of living beings have you seen?
- Are all of them alike? What are these differences called?
- Are there any animals/birds which you have seen earlier but no longer exist now?
- What will happen if all living organisms in an eco-system are of same kind?
- Children, let us learn biodiversity through activities.

2. Academic standards to be achieved :

1. Pupils understand biodiversity and its components.
2. Pupils analyse the information collected through field observation.
3. Pupils draw a block diagram of the components in the field after observation.
4. Pupils appreciate the difference among the various organisms in the biodiversity.
5. Pupils understand biodiversity, so they have sympathy towards other living things.

3. Reading the lesson :

Read the information about activity 1, 'What is biodiversity?' on page 84 and 85 of the textbook. Find new words and concepts. Discuss in groups (Teacher should write the new words and concepts identified by pupil on the blackboard and explain). Ask the pupils, what else they wish to learn in this lesson. (Teacher should write the questions from pupils on the blackboard)

4. Conduct of Activities – Comprehension of Concepts:

Activity:

- Form into groups of 5
- Select any area in the premises of your school.
- Prepare a block diagram of the selected area as Rani did earlier.
- Record the number of organisms you have identified from the block diagram in the table.
- Write the information collected in the table.

Organisms	P	T	A	H	B	I	F	S
No.								

Plants **B**irds **T**rees **I**nsects **A**nimals **F**ishes **H**uman **S**nakes

5. Demonstration – Discussion :

Display the block diagrams prepared by pupils and discuss them. Teachers should make the pupils discuss what biodiversity is through the questions given below.

1. Which organisms are numerous? Which are scarce?
2. Why do you think some organisms are scarce?
3. Are all the plants you have identified alike? Are there any differences?
4. What are the differences among the animals you have shown? Are there any similarities?
5. What are the variations in the insects you have identified?
6. What is diversity?

6. Conclusion:

There are many kinds of species in a specified area or an eco-system. All of them are mutually interdependent. Further, the same relationship exists between biotic and abiotic components. This is referred to as biodiversity. Pupils should be made to speak about each aspect they have identified about diversity.

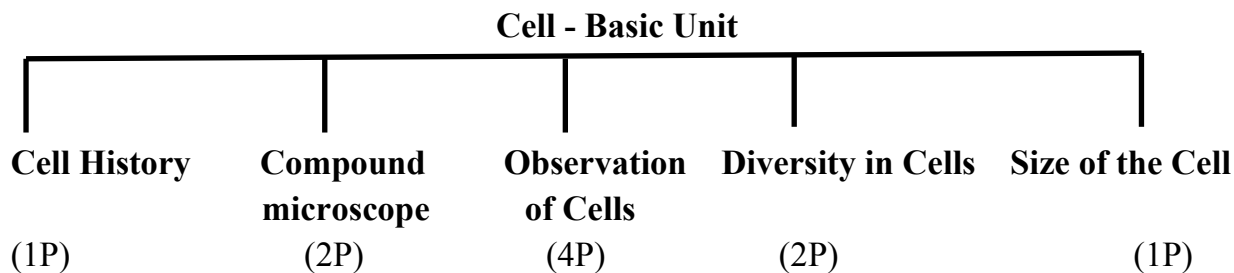
7. Home work:

Observe any two plants in the premises of your home. List out five differences and five similarities you have noticed between them.

Cell- Basic Unit of Life

(Unit 2 - Class 8)

Period Wise Distribution:



Analysis of the Unit

Introduction

The lesson started with the works of scientists explaining that all the trees and animals have come into existence out of cell.

Concepts

Activities

1. Cell History

a) Display of Photos of Scientists

b) Observation of Slide and Preparation of Slide

2. Compound microscope

a) usage and maintenance of Compound microscope

b) Observation of Slide and Preparation of Slide

3. observation of cells

a) Observation of Match Stick cells

b) Observation of Onion Peel

c) Observation of Cheek cells

4. Diversity in Cells

a) Observation of Plant cell, animal Cell, and different cells in human body through slides using compound microscope followed by Discussion

5. Size of the cell

Display of photos related to the size of cell - discussion

Activities

- 7 Activities are given in the lesson
- In Annexure of the lesson the structure of microscope and observing a slide under microscope are explained.

- In the annexure preparation of a temporary slide is explained.
- The activities 1, 2, 3,4,5,6 can be done using a microscope.
- In activity 7, cells of human body are observed with the help of Permanent slide and charts.
- Instructions are given to tabulate the information in activity 7.
- Analytical questions are given under each table

Diagrams and Graphs: In this lesson there are 13 diagrams, some are downloaded from Internet and the rest are drawn by artists. Cartoons on the number of cells and microscopic diagrams are also given.

Questions: Some thought provoking questions related to conducting activities are given. Questions that help to conduct debate /discussion on the Conceptual Understanding of the lesson are also given.

Do You Know: Information about Nanometer is given under this heading. The topic about cell size as a box item is explained interestingly.

Key words: Key words, to understand the main concepts are given. Ex. Cytoplasm.

What we have learnt: Key concepts in the lesson are given in sequential order under this heading.

Let us improve our learning: Questions related to Academic standards are given under the title” Let us improve our learning”. All the 17 questions give scope for children to write answers on their own.

Annexure: Information about the invention of microscope and its functions; Preparation of slides in order to observe them under microscope, the method of staining, etc., are given under this heading.

Model Lesson

1. Mind Mapping:

- Greeting:** Good Morning Children! You have learnt in earlier class that all the living beings are made up of cells. Let us recollect some important points.
- Mind Mapping:** Teacher has to write the word ‘cell’ on the blackboard and encourage children to mind map the concept.
- Academic standards to be achieved :**
 1. To explain the similarities and differences between cells by comprehending the concepts in the lesson.
 2. To ask questions about cells to clear doubts regarding different tissues.

3. Observing different tissues under microscope.
4. Drawing the diagrams of different tissues.

2. Reading the lesson

Reading information related to activity -8 on page 22, 23 and 24 in the textbook. Identifying new words and concepts. Teacher has to write the words identified by children on the blackboard and explain /discuss them.

3. Conduct of Activities – Comprehension of Concepts:

4. Essential equipment to observe the diversity in cells: microscope, Charts/ Permanent Slides of RBC, WBC, Nerve Cell, Bone cell.
5. Pupils should observe permanent slides of the above said cells under microscope.
6. Pupils should draw the diagrams of cells which are observed under microscope.
7. Diagrams drawn on chart should be compared with the diagrams observed under microscope.
8. The information about the topics observed should be tabulated.
9. Model cells of human body should be made and the diagrams showing them should be displayed.
10. Shapes of different cells should be compared with each other.

11. Demonstration – Discussion :

12. The observations made, Models/Diagrams drawn should be displayed.
13. The students may ask the teacher, why different cells have different shapes. The teacher should invite questions of this sort and see that good discussion goes on the questions/concepts.
14. The teacher should write questions related to differences, similarities of cells, Pseudo – Pods of Ameba, Size of the cells on the blackboard, discuss them and explain wherever necessary.

15. Conclusion:

The teacher should conclude by making the students discuss one component each from the lesson.

16. Home work:

1. Write about the method followed by you to observe Permanent slide of a cell under microscope.
2. Identify the cell which has no capacity of reproduction and draw its diagram.
3. Riaj told that the big onions have big cells when compared to small onions. Do you agree with him? Write your reasons?
4. How do you appreciate the fact that animals, human beings and trees are formed by small cells which are invisible?

Diversity in Living Organisms - Unit Analysis

(Unit 5 - Class 9)

Concepts	Periods – 12
1. Diversity in Plants	Period (1)
Activity 1: Observing leaf in a plant.	
Activity 2. Observing External Features of 5 plants	
Activity 3. Observing Seeds	Period (2)
Activity 4. Observing the features of dicots and monocots.	
2. Diversity in animals	Periods (3)
Activity 5. Observing the External features of insects.	
Activity 6. Observing Diversity in Human beings	
3. Classification	Periods (4)
Activity 7. Let us observe the diversity in different roots	
Let us discuss about the necessity of classification	
4. Classification of Animals	Period (5)
Classification and Evolution-History	
The hierarchy of classification	Period (6)
Moneta- Lab Activity	Period (7)
Protista- Lab Activity	Period (7)
Fungi –Lab activity +Specimens	
5. Plantae	Period (8)
Activity 8 Let us Observed different plants of Algae	period (9, 10, 11)
6. Classification of animals Lab activity	Period (12)
7. Nomenclature Method	Period (1)

The Importance of the lesson

The students learnt a few things about biodiversity in Class 8. Variations among the living beings of the same species or among different species is biodiversity. This is the beauty of nature. We have to understand this diversity if we want to know about all the living beings in the world. The lesson is developed with so many activities, diagrams, tables that interest children and help them learn how scientists classified the living beings with the help of similarities and variations among them.

Introduction

The lesson “Diversity in living beings” is introduced with interesting questions related to lessons “The Story of Microorganisms” and “Cell- the basic unit of Living beings.”

Concepts

1. Diversity in Plants
2. Diversity in animals
3. Classification.
4. Classification – Evolution and Classification – History
5. Class, Species, Domain in the method of classification
6. Moneta: Eubacteria, Cyanobacteria, anabaena, Orca bacteria.

7. Protista: Splitting, Fusion.
8. Fungi: Spores, Rhizopus, Mucus, Agaricus.
9. Plantae: Cryptogams, Phanerogams, Bryophyte, Pteridophyta, Gymnosperms, Angiosperms, Monocots, Dicots.
10. Classification of Animals: Porifera, Coelenterata, Platyhelminthes, Nematoda, Annelida, Arthropoda, Mollusca, Echinodermata, Protochordata, Vertebrata-Pisces, Amphibians, Reptiles, Aves, Mammals.
11. Nomenclature Method: Genus, Species. Binomenclature.

Activities

- Collecting Information, Analyzing Tables.
- Observing Specimens.
- Analyzing Flow Charts.
- Lab Activities – All put together there are 9 activities.

Questions

There are questions:

- To motivate children at the beginning of the lesson.
- To do analysis after the Activities
- To understand the importance of concepts and analyze the concepts.
- To provoke thoughts before concepts and after the concepts as well.
- Based on the academic standards, at the end of the lesson under the heading 'Improve your learning' to encourage children write answers on their own.

Do you Know?

Interesting information is given under the heading 'Do You Know?'

Ex. 1. In classification, first about Cell and then about the three domains related to evolution.

Ex. 2. Interesting facts/information related to Arthropods.

Ex. 3. Information about fishes and hippopotamus

Photos/Figures Diagrams/Tables

Photos of Scientists; Diagrams, Tables, Flow charts related to Classification are given.

Key Words

A list of key words like Diversity, Classification, Genus, Species etc. is given at the end of the lesson.

What we have learnt?

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

Let Us Improve Our Learning.

There are questions on topics and concepts discussed in the lesson. Questions are asked using charts, anecdotes/incidents, dialogues/monologues and tables. They give scope for children to think and write on their own.

Annexure

Three annexures are given in the lesson to help children understand biodiversity and the importance of classification. They are: charts of Plants, Classification of Plants and Classification of Animals.

Model lesson

Concept: Observation of leaves in Plants

1. Mind Mapping:

- a. Greeting:** Good Morning Children! There are a wide variety of plants and animals around us, aren't there? Let us talk about some of them.
- b. Mind mapping:** What variations/differences did you observe among the plants around you? (Teacher should write the title "variations /differences among Plants" and ask the students to mindmap the concept.
- c. Probing Questions:** The teacher should make the students think by asking the following questions.
 1. What sort of Plants do you see at your home and school?
 2. Do they all look alike?
 3. What variations/differences did you find among them?
 4. What are the different parts of a plant?
 5. Do the parts of a plant you have said are the same in all plants around you? What are differences? Let us observe and discuss the diversity by observing different leaves.

2. Academic Standards to be achieved.

The students will be able to:

1. Hypothesize that the external feature of leaves can be different or similar.(AS-2)
2. Observe different leaves in different Plants? (AS-3)
3. Explain the diversity in leaves? (AS-1)
4. Appreciate the diversity in leaves? (AS-6)
5. Draw shapes of different leaves? (AS-5)

3. Reading the lesson :

Read the contents related to the concept on pages 50 and 51 of the textbook. Find the new words and concepts. Discuss in groups. The teacher should write and explain the words and concepts chosen by the students. The teacher should ask the students what more do they wish to learn. The questions from the students should be written on the blackboard.

3. Conduct of Activities – Comprehension of Concepts:

Activity 1

Understanding the existence of diversity by observing different leaves

Divide the students into 5 groups. They should:

- collect different leaves by visiting and observing various plants and trees
- observe the collected leaves
- see whether all the leaves are the same; In what features / characteristics do they differ
- Observe the colour, shape, length, width, edges, and venation of the leaf.
- Record their observations in a table as shown below
- Draw diagrams showing edges of different leaves observed by them.
- draw venation in leaves
- draw a graph showing the relation between the diversity in a specific feature(Leaf-External feature) and the number of different plants with that feature (The number of leaves)

S.No.	Name of the Plant	Length of the leaf	Width of the leaf	Colour	Shape	Edge	Venation

4. Demonstration – Discussion :

The children should exhibit the tables with their observations. The teacher should conduct the whole class discussion by asking the following questions.

1. Do all the leaves look the same or different?
2. Generally, in which features do they differ from one another?
3. In what two features do they differ more?
4. How are the edges of leaves? Draw the edges of the leaves observed by you?
5. Draw and show the shapes of the leaves you have observed?
6. How do the length and width of the leaves vary? How much is the difference?
7. What colours did you find in leaves?
8. How many venations did you observe?

5. Conclusion:

The children should be asked to review the lesson with the help of important points in the lesson. The, the teacher should conclude the lesson with some closing remarks.

6. Homework:

The students should write answers to the following questions in their notebooks.

1. Think and write “Why there is diversity in Leaves?”
2. Are there any Plants without leaves? Observe your surroundings and write?

3. Have you observed any changes in leaves depending on the region in which they live?

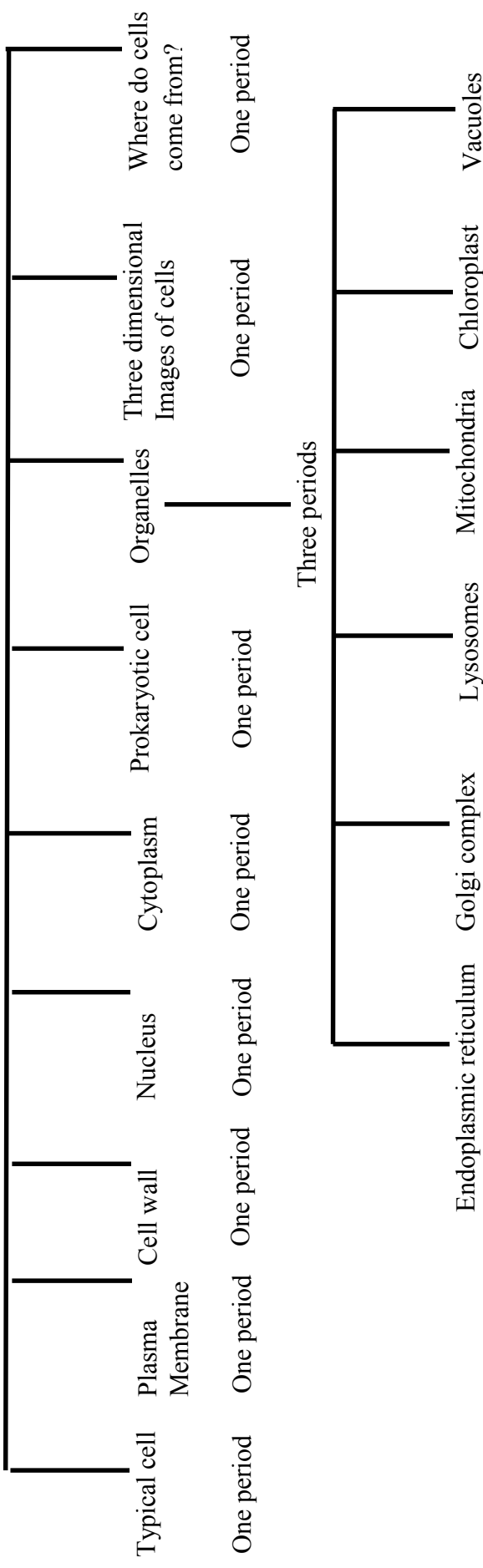
Science is Process. A product, a search for truth, the facts and principles of science may not be eternal truths, but they show us the nature of science. The experiments, activities, observations, questions, discussions, proofs in this unit demonstrate us the nature of the science. The main aim of Science is to believe in a concept only after it is proved. This unit has that characteristic.

The teaching of science makes sure that knowledge construction and self-learning are improved. All the activities in the lesson follow the same principle. Here, the students conduct activities based on the suggestions given, tabulate the results, and then make inferences/conclusions. Activities are so developed that no concept is taught directly and that every concept is driven home through activities, discussions, Experiments and observations.

Comprehending the importance of the lesson, participating directly in the conduct of activities, predicting the results of the experiments, checking them for validity and exploring the concepts give children great enthusiasm. Many academic standards are taken care of in this lesson. To explain a concept on their own, giving examples, giving reasons, identifying similarities and differences (Similarities and differences between tissues, similarities and differences between xylem and Phloem) come under the first academic standard “Conceptual Understanding”. Similarly, Questioning: while conducting Experiments and activities (What will happen when Phloem is absent in plants); interpreting: hypothesizing that water flows through red coloured cells when they observed it under microscope – these come under the second academic standard. The experiments (Why there are red coloured cells in transverse section of the plant stem?) come under the third academic standard. Diagrams of tissues, Transverse sections, Charts of cell structure come under the fifth academic standard. Appreciating the transport of nutrients and water in very tall trees like Eucalyptus and red wood, and the similarities in the structure of human beings and trees come under sixth academic standard. Taking responsibility to protect trees and biodiversity by learning the unique and complex structures in plants and their importance/role in biodiversity come under the seventh academic standard. Hence, it is important for the teacher to plan activities and teach the lesson keeping in view these academic standards.

Cell – Its Functions Analysis of the Unit (9th Class)

Period-wise Division



Cell its structure and Functions

(Unit 1 - Class 9)

Introduction

Lesson started with a discussion on what children have learnt in 8th class about ‘Cell’

- Lesson started with a discussion on the previous knowledge of children (from lessons in 6th, 7th and 8th classes) about cell, its discovery and its shape.
- Thorough knowledge is given on “Typical Cell”. To understand the typical cell, differences between the cell seen under microscope and the diagrams of Plant cell and animal cell are explained.

Concepts

1. The organelles present in a common cell are present in a typical cell.
2. Plasma membrane is present in animal cell whereas cell wall is present in Plant cell.
3. Cells which have no nucleus are called Prokaryotes.
4. The parts in a cell are called Organelles
5. The Organelles in the cell are Endoplasmic Reticulum, Golgi complex, Ribosomes, Lysosomes, Mitochondria, Chloroplast, and Vacuoles.
6. Cell theory is proposed by Schneider and Schwann.

Concepts

Activities

- | | |
|--------------------------------------|--|
| 1. Typical cell | observing the typical plant cell and animal cell |
| 2. Plasma Membrane | Observing Plasma Membrane using Rheo leaf (Lab Activity) |
| 3. Nucleus | Observing the Nucleus in Cheek cell (Lab Activity) |
| 4. Cell Wall | Observation through chart- Discussion-Analysis |
| 5. Prokaryotic Cell | Observation through chart, Observing Bacteria Slide. |
| 6. Cytoplasm: | Observation through chart, slides and discussion.
Observations of Chloroplasts in Rheo Leaf and Algae
Observation of Mitochondria in Onion peel. |
| 7. Organelles: | Observing Vacuoles in Stem of the Succulent Plant.
Observing the Cart of Organelles and Permanent slides. (Individual Activity). |
| 8. Three dimensional Shapes of Cell: | Observing the three dimensional shapes of cell – Discussion |
| 9. Where do the cells Comes from: | Discussion through thought provoking questions |

Do you know:

The number of chloroplasts in a cell which participate in Photosynthesis is shown under this heading.

Diagrams/Charts/Graphs:

Thought provoking Questions are asked on the functions of cells. There are cartoon diagrams and linear diagrams on organelles. Diagrams of some organelles that can be seen only under Electron microscope are given. There are other diagrams of parts that are visible directly under laboratory microscope.

Key words:

Important components/ concepts like Protoplasm and Cytoplasm are given as key words at the end of the lesson.

What we have learnt:

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

Improve Your Learning:

Under this heading questions are given in order to evaluate the 7 Academic Standards related to Biological Science. The questions have scope for children to think on their own and write their answers.

Model Lesson**Concept: Nucleus**

Activity: to observe the nucleus of cheek cell.

1. Mind Mapping

- a. **Greeting:** Good morning children. You have learnt the lesson ‘Cell-basic unit of life’ in the previous class. Let us try to recollect some important concepts regarding cells.
- b. **Mind Mapping:** Say what you know about Cell from what you have learnt. Teacher should write the word ‘cell’ on the blackboard and ask the students to mind map the word.
- c. **Probing Questions :**
 - Which cell can be seen easily under microscope?
 - Name the organelles that you know in a typical cell?
 - What are the organelles that can be seen in both Plants and Animals?
 - What do you think is the necessity of various organelles present in the cell?

2. Academic standards to be achieved :

1. To understand nucleus and parts of the nucleus?
2. To question to understand the structure of the nucleus?
3. To acquire the experimental skills to observe the nucleus in Cell?
4. To draw diagrams of nucleus and labeling it?
5. To appreciate the functions of nucleus in the cell?

3. Reading the Lesson

Read the lesson on pages 3 and 4 of the textbook. Find out the new words and Concepts. Discuss in groups. The teacher should write and explain the words, concepts found by students. Children, ask me some questions if you want to know more about the lesson. Teacher has to write the children's questions on blackboard.

4. Conduct of Activities – Comprehension of Concepts:

- Form groups of 5 students and they have to conduct activities in the laboratory.
- Students should collect the suitable material to conduct the activity.
- Teacher should give instructions to students and tell them the dos and don'ts.
- The teacher should observe the performance of each and every student while they conduct the experiment.
- Ask the students to observe the slide of cheek cell prepared by them and to draw its diagram.
- Make the students identify the parts of nucleus looking at the diagram in textbook or a chart.
- Students should write briefly about the nucleus in cheek cell with the help of textbook.

5. Demonstration – Discussion :

The teacher should see that students exhibit their diagrams of nucleus in cheek cell and discuss.

Teacher should conduct a discussion by writing on the blackboard the following questions on nucleus

- 1) What will happen if there is no nucleus in a cell?
- 2) What did Brown said about cell?
- 3) Why did Schneider called nucleus, a cytoplasm?
- 4) What are the functions of nucleus?
- 5) What do we call eukaryotic cells? Why?
- 6) What are prokaryotic cells?
- 7) Do you think there is a relationship between the shape of the cells and the shape of the nucleus?
- 7) What will happen if we separate nucleus from the cell?

8) What precautions have you taken while observing nucleus in cheek cell in your laboratory?

6. Conclusion

The teacher should conclude the lesson by making the students participate in the discussion by talking on one component each like nucleus in cheek cell, functions of nucleus, scientists and their research, etc.

7. Home work

Answer the following questions in your note book

1. What is the important organelle in a cell?
2. What is the shape of a nucleus?
3. Does the nucleus have the same shape in all cells
4. What are the parts of a nucleus?
5. What are the differences between Prokaryotic and eukaryotic cell?

Plant Tissue Analysis of the Unit (9th Class)

Unit Mapping

Plant Tissue		Allotted periods : 10					
Introduction	Introduction	Types of tissue	Meristematic tissue	Dermal tissue	Ground tissue	Vascular tissue	Conclusion Unit revision Assessment Additional information
Cells in various parts of plants	Introduction to types of tissue	Act: observation of cells in onion peel	Act: Observing the tip of the stem	Act: Observation of Rheo leaf	Act: Observation of permanent slide	Act: Observation of TS of the stem	
Act: observation of cells in onion peel	Act: conversation	Act: comparing meristematic tissue at the tips of stem	Act: observation of TS of a dicot stem	Act: Observation of pores			
Act: Cells in a leaf peel		Preparation of table		Do you know?			
Act: cells in root tip		Act: observation of TS of a dicot stem					
Act: Growing roots							
2.5 periods	One period	One period	One period	One period	One period	One period	One period
half period							

Plant Tissue

(Unit 2 - Class 9)

The importance of the lesson

Students have already learnt that cell is a basic unit. They also learnt about cell history, diversity in cells, organelles and cell theory. The present unit discusses thoroughly the tissues of plants, which are the prime resources for living beings to survive. It is natural for a student who has the primary knowledge about respiration, transport of blood, excretion, finding food source, etc., in human beings, to think of and be curious about how those functions are performed in plants. The main objective of the unit is to show the student, how great is the design and performance of various tissues, for example, xylem for transport of water and phloem for nutrients. The student compares the absorption of water by a tall tree with the working of a motor that brings up water from a bore well and wonder at the nature's ingenious ways. Moreover, s/he recognizes the speciality of plants and trees and work towards protecting them and thereby the biodiversity in nature.

In this unit, a very special opportunity is given to the student to conduct an activity to know the procedure followed to decide the age of a tree. Slide preparation procedure given in the annexure helps children to develop their process skills.

The teacher could decide his journey of teaching by having a bird's eye view on the unit - how many concepts?; What are the activities; Diversity in activities; Key words; Content under the title "Do you know?"; Are there any other things added?; How to recollect the content under the title "What we have learnt?" How the topics under title "Let us improve our learning" are connected with academic standards; etc.

Let us see how a concept can be conducted in the classroom?

Lesson: plant tissue

Concept: Vascular Tissue

1. Mind Mapping:

- a) **Greeting:** Good Morning Children. We have learnt about different organelles in the previous lesson.
- b) **Mind mapping.** Say what you know about organelles. Teacher should write the word "Organelles" on the blackboard and guide children to mind map the concept.

C) Probing Questions:

- 1) What part do you think is important in Cell?
- 2) What is the difference between cytoplasm and protoplasm?
- 3) Where from the cell gets Energy?

2. Academic Standards

The students:

1. Elaborate on Vascular tissue in Plants
2. Prepare a slide of TS of stem and observe Vessel tubes under Microscope
3. Draw Diagrams observing permanent slides of xylem and phloem.
4. Appreciate the structure and design of the transport system in very tall plants to supply water and nutrient substances

3. Reading the Lesson

Read the content related to Vascular tissue on page 19. Identify new words and concepts. The teacher should write the words identified by students on blackboard and explain. Children! Ask me what you wish to know more about this. (The Questions should be written on the blackboard.)

4. Conduct of Activities – Comprehension of Concepts:

Activity 1. Vascular Tissue-Observation

1. Form into groups of four. You are given four glass jars with red coloured water and four plants. Using this material, conduct the experiment related to the lesson 'Plants Nutrition' in 7th class.
2. Now observe the colour absorbed by plants. Note the changes in stem. Prepare the slide for T.S of this stem in the same way as you have done with the T.S of stem and root earlier. Observe the prepared slide under microscope.
3. Draw the diagram and label the parts of TS of stem as it is seen through microscope.

5. Demonstration and Discussion:

The diagrams and slides prepared by students should be exhibited and a discussion should be conducted by asking the following questions.

1. Did you see the colour seen in inner cells in outer cells too?
2. What did you understand when you saw red coloured cells?
3. How did you conduct the dissection of the stem?
4. Were you able to identify the red cells and apical meristem?
5. Give reasons for redness in cells?

Activity 2. Observing Xylem and Phloem

1. Observe the Permanent slide of Phloem under microscope?
2. Compare the diagram with the diagram given in your textbook?
3. Draw the diagram and label it?
4. Observe the Permanent slide of Phloem?
5. Compare the diagram with the diagram given in your textbook?

6. Draw the diagram and label it?

6. Demonstration and Discussion:

The teacher should discuss the observations of the children by asking the following questions.

1. What parts supply water to the plant?
2. What parts prepare food in plants?
3. How does water from the roots reach leaves of the plants?
4. How does the food, synthesized in leaves, reach other parts of the plant?
5. What cells have you observed in vessels?
6. How do you feel when you think about the transportation of nutrients in very tall trees like Red Wood and Eucalyptus?

7. Conclusion

The teacher should conclude by making each student elaborate on a certain concept in the lesson.

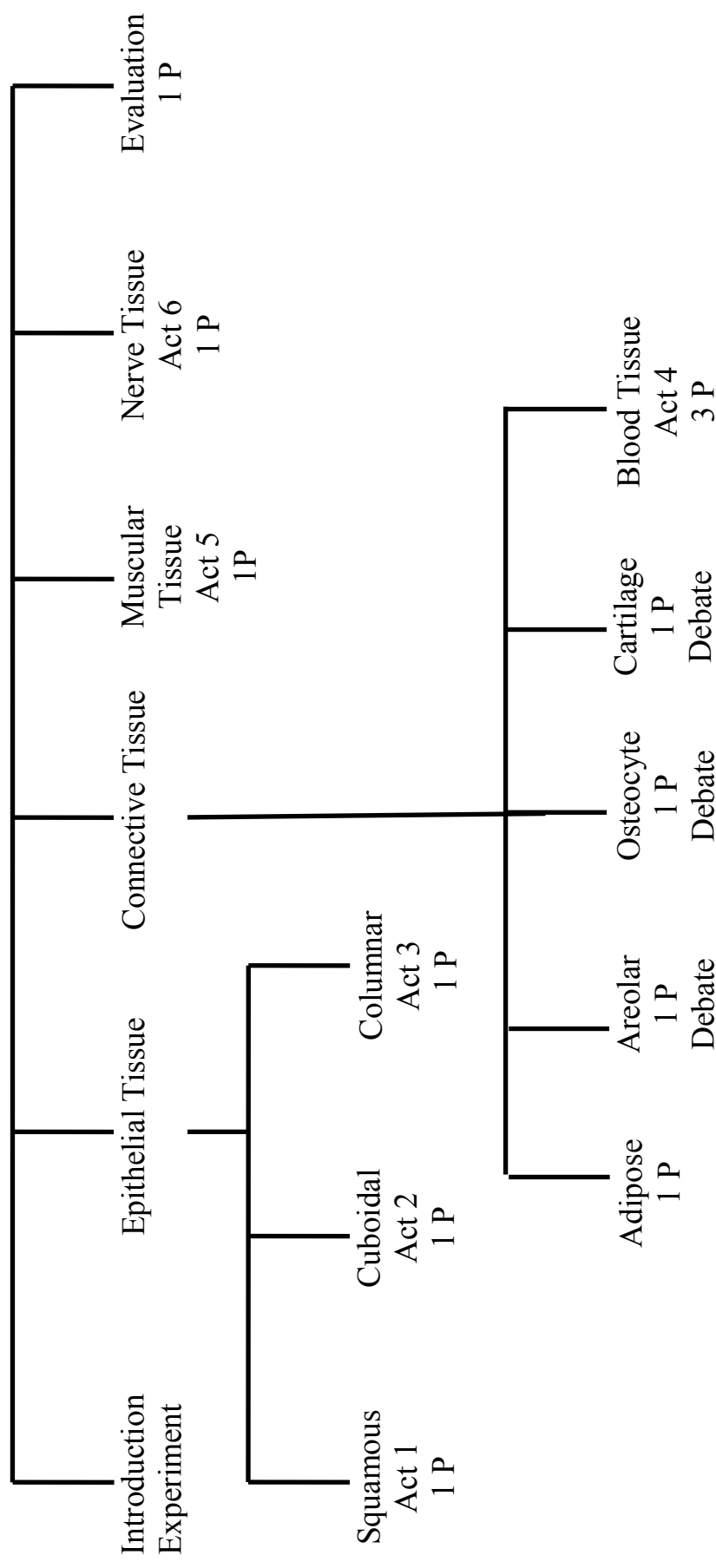
8. Home work

1. List the similarities in the digestive system of human beings and transport system in plants?
2. Write the Keywords and their meanings related to this concept?
3. What will happen if the Phloem and xylem are absent in Plants?
4. What are the benefits with the formation of Vessel tubes in plants?
5. Red wood and Eucalyptus trees grow very tall, don't they? How do the minerals reach the top and the nutrients reach the bottom?

Animal Tissue – Unit Analysis (Class 9)

Period-wise Distribution

Animal Tissue



Animal Tissue

(Unit 3 - Class 9)

Introduction: The Lesson Is introduced as given below

1. Recalling what the children have learnt in the previous lesson about plant tissue
2. Enlisting what different organ systems do
3. Identifying tissues using a slide and a microscope

Concepts:

1. Closely arranged layer like group of cells is epithelial tissue.
2. Blood tissue acts as connective tissue.
3. In Epithelial tissue, there are Squamous, Cuboidal, and Columnar tissues.
4. Adipose, Areola, Osteocyte, Bone tissue work as connective tissues.
5. Muscle tissues are of three types- they are Striated, Non striated, Cardiac muscles.
6. Nerve tissue can transmit and receive information but cannot reproduce.

Activities

1. Identifying Tissues in collected Samples – Lab
2. Observing the Permanent slide of epithelial tissue. – Lab/Class
3. Observing the Permanent slide of Cuboidal tissue. – Lab/ Class
4. To know about Blood. –Debate
5. To know about one’s own blood group -- Lab
6. To observe different Muscle cells -- Lab
7. To observe the Nerve cell -- Lab/Class

Questions

1. In introduction there are probing questions.
2. Some activities started with thought provoking questions.
3. Many questions are open ended.
4. Analytical questions are given at the end of Activities

Think and Discuss

Higher Order thinking questions are given to understand the topics deeply.

Ex: Blood is a connective tissue? How?

Do You Know?

Additional information is given about Bone marrow and Epithelial tissues. Some other additional information is also given on the concepts of the lesson.

Diagrams /Charts

1. There are 16 diagrams in all.
2. Among them, 8 are downloaded from the internet and the rest are drawn by artists.

3. There are some diagrams of collected specimens. Eg. Bone tissue, Blood tissue, Cheek tissue.

Tables

There are 4 tables. They are useful to self-learning as they call for the skills of identifying differences and similarities and to analysis of the topics. Some tables are to give children interesting and useful information whereas some are meant for the children to collect and record data.

Key Words

Ten Key Words are given at the end of the lesson. Eg. 1. Nissal Granules 2. Ranvier Nodes

What we have learnt?

Key concepts in the lesson are given in sequential order under this heading. They are useful for recapitulation.

Improve Your Learning

1. Under this heading question on only five academic standards are given.
2. Most questions are related to Conceptual Understanding.
3. All the questions are related to day to day life.
4. Most of the questions improve self-learning ability. They have scope for children to give a multiplicity of answers.
5. Some questions develop the drawing skills and experimental skills of the students.

Model Lesson

Concept: Nerve Cell

1. Mind Mapping:

- a) **Greeting:** Good Morning Children! We have learnt many things about tissues in the lesson “Animal Tissue”. Let us recall some of them.
- b) **Mind Mapping:** The teacher should make the students talk about the concept of animal cell and conduct mind mapping. Their experiences should be analyzed by asking the following questions about Nerve cell.

1. How do you feel when you put your hands in Hot water or Cold water?
2. How do you feel when you see a beautiful Flower?
3. How do you feel when a thorn pricked your foot?
4. How do you know that a hot thing burns you?

- c) **Academic Standards:**

The students can:

1. Elaborate on Nerve Cell.
2. Draw the diagram of nerve cell by observing Permanent slide of Nerve Cell through microscope.
3. Appreciate the function of nerve cell, which is to transmit or receive information.

2. Reading the lesson

Children! Read 35 and 36 pages in text book. Identify the new words and concepts. Discuss in groups. The teacher should write and explain the new words and concepts identified by students. The teacher should encourage the students to ask questions on what more they wish to know. The questions should be written on the blackboard.

3. Conduct of activities – Comprehension of Concepts.

1. Form into groups of four.
2. Pick out the permanent slide of nerve cell from the slide box and observe it under microscope.
3. Draw diagram observed under microscope in your note book.
4. Compare the diagram with the diagram in text book.
5. Label the diagram with the help of text book.
6. Read the textbook and write briefly about nerve cell.

4. Demonstration – Discussion

Children should display their observations and diagrams. The teachers should conduct whole class discussion using the following questions

1. Which is the biggest part of Nerve Cell?
2. What are the root-like structures raised from cell body?
3. What are the granule-like structures in cell body? What are their functions?
4. What is the longest part of the Nerve cell?
5. What is myelin sheath and does it do?
6. What do you know about Ranvier Nodes?
7. What is Axon?
8. In case nerve cells die, do new ones regenerate in their place?

5. Conclusion

The teacher should conclude the lesson based on the results of debates. The nerve cells spread all over the body and transmit/receive information, but they cannot regenerate like the other cells.

6. Home Work

List all the differences and similarities between nerve cell and the muscle cell.

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 - Tamilnadu 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 Infield.

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 textbook at high school level with simple, easy to understand language

12. Understanding Physics - Cassidy, 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 for Science Fair Projects
16. Bilogy.about.com
17. <http://www.bgvs.org>
18. www.vascsc.org
19. www.trueknowledge.com
20. questionhub.com
21. funwithscience.com
22. secreatsofphysics.com
23. 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
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 HighwayTq, Sanand Dist, Ahmedabad - 382110 Gujarat – India, Ph: 91-2717-656750, E-mail: info@finarchemicals.com
4. Himedia Laboratories, A-516, Swastick Disha, Business Park, Via; Vadhani Indl. Est., Marg, Mumbai - 400086 India, Ph: 022-61471919, E-mail: 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

GLASS WARE

1. Borosil Glass Works Limited, Khanna Construction House – 44, R.G. Thadani Marg., Worli, Mumbai – 400018, Tel: 91-(022) 24930362, E-mail: 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

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.manu-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
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 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 (28th 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. 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. Biology - Experiments

Experiments – Observations

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

Doing experiments is an important process skill in Biology. 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. For example, Sir Ronald Ross discovered the parasite responsible for malaria in mosquito and helped the human kind prevent the spread of that disease. 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 Biology, 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. In biology, children need to use microscope to observe very small organisms or cells, so teachers should give them training in preparing slides and in using microscope. In biology laboratory, in addition to experiments, children have to do direct observations (Eg. Parts of plants, products, models of living organisms) very keenly, identify objectives, drawing rough diagrams, etc., so teachers should give them practice in developing these skills too.

The Importance of Experiments:

Through experiments children:

- Comprehend facts, principles, laws with proof in biology
- 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 Biology
- Resolve and get themselves ready to do new experiments
- Learn Biology 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
- Conclusions should be drawn about the truth/falsity of the assumptions / hypotheses
- It should be checked and discussed whether the results of the experiments correlate/ corroborate with real life experiences
- The results of the experiments should be discussed
- Teachers should tell children how to correlate/ apply the results of the experiments with real life situations/happenings
- ‘How far the results of the experiments are useful to solve the problem’ should be discussed

How to make children think?

- Children should be made to think by asking thought provoking questions before and after the experiments
- Children should be asked to predict the results of the experiments
- Children should be asked to give reasons for ‘why the results are like this?’
- Children should be asked to indicate / show the arrangement of apparatus
- Children should be asked to predict the results of the experiment done in changed experimental conditions

Things to remember

1. For classes 6to 10, at least one ‘lab period’ for each lesson is a must
Physical Science – 14 periods Biological Science – 14 periods
2. In the textbook wherever an activity is given under ‘Lab’, it must be done in Biology laboratory in the allocated lab period
3. Wherever there is no Biology laboratory, the classroom itself should be used as the science lab.
4. Children should be given instructions about what they should do in the lab:
 - a) Before the experiments
 - b) During the experiments
 - c) After the experiments

They should also be given clear instructions about: what to do? How to do? What things need keen observation? And what to be recorded? The teacher should see that all children follow the above instructions and involve themselves in the lab activities.

The precautions / things to be borne in mind while conducting experiments in Teaching Biology

Collection: We should take care of the animals and plants when we separate them from their own surroundings and bring them to labs.

Preservation: Preserving the collected specimens in dry or moist forms.

Collection of Plants: Method of preparation of Herbarium.

Specimens: Preservation.

Section Cuttings: Preparing slides by dissecting specimens to observe cells, Organelles and tissues.

Staining: Staining by using different colouring agents to observe the parts in prepared slides clearly.

Making Slides Making permanent slides and Temporary Slides.

Making Specimens: Preparing alternative tools and Specimens.

Drawing and labelling of parts:

Suggestions to draw and label diagrams in the Record book.

The Diagram/Chart should be drawn in suitable ratio.

Should be drawn neatly.

All the labels should be written one below the other at a certain distance from the diagram

The labels should be shown by arrow marks.

While colouring pictures, natural colours should be used.

The observed topic should be written in the form of a Report.

Lab Period

Why should we have a separate lab period?

In the New Science text books space is given to conduct experiments specially. Among them some are meant for conducting in class room and some are meant for labs only. 14 lab Periods are provided for biology in school time table. Two lab periods should be conducted in addition to the 24 periods allocated for biology (per a week).

Experiments to be done in the laboratory

VIII Class

Month	Lesson	Lab Activity
Jun	What is science	Using Micro scope properly, Preparing Slides, Staining.
Jul	World of Micro-organisms	Teacher should Select.
Aug	Reproduction in Animals	Teacher should Select.
Sep	Adolescence	Teacher should Select.
Oct	Bio Diversity and its Conservation	Teacher should Select.
Nov	Different Eco systems	Structure of Ecosystem
Dec	Production of Food from	Teacher should Select.

	Plants	
Jan	Production of food from Animals	Teacher should Select.
Feb	Not for drink Not for breathe	Observing factors for water pollution
Mar	Why do we fall ill?	Teacher should Select.

Experiments to be done in the laboratory

IX Class

Month	Lesson	Lab Activity
Jun	Cell its structure and Functions	Observing the nucleus in cheek cell
Jul	Plane Tissues, Animal tissues	Identifying blood groups in collected animal tissue.
Aug	Movement of materials across the cell membrane	Observing densities of different solutions, Osmosis. Let us prepare semi permeable membrane.
Sep	Diversity in living organism	Observing Specimens
Oct	Sense Organs	Teacher should select
Nov	Animal behavior	Choice box – Cockroach Experiment
Dec	Challenging in improving Agricultural Products	Developing Hybrid Flowers.
Jan	Adaptations in Different Ecosystem	Teacher should select.
Feb	Soil Pollution	Teacher should select.
Mar	Bio Geo Chemical Cycles	Teacher should select.

Apparatus, Materials, skinning materials/chemicals, charts, specimens, permanent slides and liquids required to conduct experiments in classes 8 and 9

Apparatus /Material Required	
1. Compound microscope	36. Cotton Cloth
2. Watch Glass	37. Plastic Bottles
3. Slides	38. Eggs
4. Brush	39. Scent Bottle
5. Needle	40. Coffee
6. Blade	41. Ink
7. Coverslip	42. Balloons
8. Beaker	43. Rice
9. Plastic Bottle	44. Iron Funnel
10. Tooth Pick	45. Square Box
11. Blotting Paper	46. Card Board
12. Funnel	47. Hybrid Plants
13. Rheo Leaf	48. Local Variety Plants
14. Onion Peel	49. Polythene Bucket
15. Betel Leaf	50. Thermometer

16. Potato	51. Beans Seeds
17. Simple microscope	52. Pots
18. Petridish	53. Scale
19. Glass bottles/Jars to Preserve Specimens	54. Sea Shells
20. Marker Pen	55. Electric Cell
21. Forceps	56. Wire, Switch Bulb
22. Chicken Piece	57. Match Sticks, Dropper
23. Syringe	58. Green thin Grass
24. Blood Test kit	59. Butter Milk
25. Wax Pencil	60. Spirogyra, Maida
26. Disposable Needles	61. Root Nodules of ground nut.
27. White China Glass	62. Pebbles, Magnifying lens
28. Sugar	63. Wooden Spoon, News Papers
29. Salt	64. Roller, Spade, Sticks
30. Fresh Kismiss	65. Green thin Grass
31. Pins	66. Butter Milk
32. Boiled Potato	67. Spirogyra, Maida
33. Knife	68. Root Nodules of ground nut.
34. Retort Stand	69. Pebbles, Magnifying lens
35. Wheat Flour	70. Wooden Spoon, News Papers
Permanent Slides	Charts
1. Plant Cell	1. Eye-External
2. Animal Cell	2. Structure
3. Different Cell Organelles :	3. Eye-Internal Structure
4. Mitochondria	4. Roads, Cones
5. Nucleus	5. Ear-Structure
6. Chloroplast	6. Internal Structure of nose
7. Golgi bodies	7. Tongue
8. Endoplasmic reticulum	8. Internal Structure of the skin
9. Plant Tissues	9. Plant diseases
a. Parenchyma	10. Pond Eco System
b. Collenchyma	11. Fresh Water Eco System
c. Sclerenchyma	12. Biotic Fixation
d. Meristematic Tissue	13. Bio-Geographical Circles
10. TS of stem, root, leaf of Monocot and dicot plants.	14. Male & Female Reproductive Systems
11. Chlorenchyma	15. Sperm Cell
12. Arenchyma	16. Ovum
13. Xylem, Phloem	17. Life History of Frog
14. Budding in Hydra & Binary fission in Amoeba	18. Life History of House-fly
15. Epithelial Tissue	19. Endocrine Glands.
16. Epithelial Tissues slide	20. Adams Apple
17. Muscular Tissue	21. Endangered Species
18. Columnar Tissue/Squamous Tissue	22. Endemic Species

19. Cuboidal Epithelial Tissue	23. Migration Birds
20. Adipose Tissue	24. Food Web
21. Areolar Tissue	25. India Map Showing Food Production
22. Cartilage	26. Latest Agricultural Tools
23. Striated Muscle	
24. Non-Striated Muscle	
25. Cardiac Muscle	
26. Nerve Tissue	
27. Amoeba, Euglena, Paramolim	
28. Rhizopus, Agaricus, Yeast, Clamydomonas	
29. Algae	
30. Spores	
31. Blood Tissues	
Skinning Materials	Specimens
1. Methylene Blue	1. Hydra
2. Saffranin	2. Teneosolaum
3. Glycerin	3. Ascaris
4. Formaldehyde	4. Megascadex
5. Formalin	5. Cockroach
6. Ethyl Alcohol	6. Prawn
7. Canada Balsam (permanent slide)	7. Scorpion
8. Clove Oil (permanent slide)	8. Snails
9. Diluted Hcl	9. Starfish
10. Vinegar	10. Cycas Male cone
11. Iodine	11. Cycas microphores
12. Potassium	12. Balanoglossus
13. Permanganate	13. Amphioxus
14. Copper Sulphate	14. Fish
15. Potassium Chromate	Liquids:
16. Calcium Chloride	1. Diluted Salt Solution
17. Crystal Violet	2. Sugar Solution

Note: In teaching Biology for classes 8 and 9, Laboratory is very essential. The above mentioned equipment, chemicals specimens, and charts should be in schools. They should be purchased from the school funds. In addition to them, local resources and natural resources should also be utilized as teaching material. Along with them, the information from farmers, Health agents, educationists, different vocational artists should be in the school. The information and the human resources can be utilized in teaching. For that clear planning is essential. Through this, we can provide quality education to the students.

The 2nd, 3rd and 4th chapters in 8th class Biology textbook contain many activities. They are meant to be conducted in laboratory. According to the facility of the teacher, activities should be taught in laboratory.

How to conduct the lab activity?

To make an activity in the laboratory, tools, material and chemicals should be made ready/available. It is essential for the students to have knowledge and understanding about the activity. For example, let us watch see how an experiment from 9th class 1st chapter “observation of Nucleus in cheek cells” can be done.

1. What should be done before conducting laboratory activity?

➤ *Students should be asked probing/ thought provoking questions :*

- Do all the cells in human body contains nucleus?
- Is nucleus present in our cheek cell?
- Can we observe nucleus as we observe the cell?

(According to the no of students and no of apparatus children should be divided into groups.)

- To each and every group, activities should be assigned.
- Available material should be collected by students.

2. What to do when a laboratory activity is conducted:

- Teacher should explain the objective of experiment, procedure and precautions in handling the apparatus/materials.
- Teacher should observe how the students are collecting cheek cells, how they are staining, how they are preparing a slide and how they are observing the slide.
- If the students feel any difficulty in doing activity, teacher should help them. After observing the slide, they should draw the diagram and compare the diagram with the diagram given in the textbook.
- They should note their observations in the notebook.

Conclusion / Confirmation:

- Dark stained dots in the cell are known as Nucleus.
- Ask children to observe the nucleus in other cells following the same procedure.
Ex: Onion peel, Rheo leaf, any plant or animal cell.

3. What to do after the experiment:

- Results of the experiment should be analyzed. Based on the results and analysis, conclusion should be made.

4. How to prepare the Record?

Object: Observation of Nucleus in cheek cells.

Required apparatus:

Procedure :

Conclusion :

Precautions :

With the above aspects, record should be prepared. The related diagrams, tables results and analyses should be recorded/noted in the record.

5. Assessment:

According to the performance of the students in experimentation, noting results, analysis, preparation of record, they should be allotted appropriate grade in Formative Assessment (F.A.)

8th Class Period-wise Lab Equipment

SNo	Unit Name	Required Material/Lab Equipment
1	What is Science	Beans, Different types of soils, Flower Pots, Scale, Shells, Bulb, Wire, Switch, Battery.
2	Cell basic unit of life	Match Sticks, Onion, Blade, Slide, Cover slip, Dropper, Compound Microscope, Needle, Glycerin, Methyl Blue, Safranin, Filter Paper, Wooden Spoon, Red Ink, Permanent slide: Chlamydomonas, Ameba, E-Coli, T.S of Dicot stem or Tridax, Red Blood Cells, Bone cell, Nerve cell, White Blood cells, Striped Muscle cell, Smooth Muscle cell
3	World of Micro Organisms	Butter Milk, Crystal violet, Spirogyra collected from water pits, Maida, Yeast, Groundnut root nodules vaccine chart.
4	Reproduction in Animals	Slide which show different stages of Budding in Hydra. Slide which show Binary fission in Amoeba Monocot, Dicot flowers Charts: 1. Male reproductive system and Female Reproductive system of Human Beings 2. Sperm cell, Ovum, 3. Life history of Frog Wide mouthed bottle, Glass, Petro dish, Marble stone Magnifying glass, Beaker.
5	Adolescence	1. Tape 2. Charts: Adams Apple, Endocrine glands in Human body.
6	Biodiversity and its	Charts:

	conservation	<ol style="list-style-type: none"> 1. Endangered Species 2. Endemic Species. 3. Migratory Birds Project Work: Plastic Trays, ladle, measuring jar, cotton clothes, Old newspapers, Wire screen, Blender, Heavy Books which are heavy in its weight, Roller.
7	Different Ecosystems	Measuring tape, Thread, Small wooden sticks, Magnifying glass, Pickaxe,
8	Food Production from Plants, Methods of Management.	<ol style="list-style-type: none"> 1. India Map(Showing important food crops) 2. Food grains from Rabi and Kharif (Belongs to same crop. 3. Chart showing modern agri tools and machines. 4. Cart showing irrigation methods in olden days. 5. Chart showing modern methods of irrigation methods.
9	Food Production from Animals, Methods of Management	Charts: <ol style="list-style-type: none"> 1. Jersey, Holstein cows, Chilling centre. 2. Diagrams of Poultry. 3. Emu culture, Apiculture, aquaculture.
10	Not for drink Not for breathe	Pollution control certificate Charts: Articles, Essays on pollution factors, debate on air pollution, Controlling pollution
11	Why do we fall ill?	Chart: ascaris, Leishmania, Trypanosoma

Essential things to be borne in mind while conducting activities: In biology laboratory, mainly, observations related to the main concepts should be done using lab equipment. Regarding things that cannot be seen through naked eyes, skills in preparation of slides and observing them under microscope etc., are very important.

In 7th and 8th classes we learnt about microscope. Eyepiece lenses and objective lenses for the microscope should be selected properly. According to the magnification power required, the lenses should be selected.

1. Eyepiece lenses have 10 x 15 x Magnification power.
2. Objective lenses have 10 x 40 x 100 magnification power.
3. In general the compound microscopes used in schools have the following magnification power. Eye piece lens 10 x, objective lens 10 x and 40x.
4. If we arrange eyepiece 10 x and objective lens 10 x, it makes the object 100 times larger. (10x10). we call this low power magnification.
5. If we arrange eyepiece lens 10 x and objective lens 40 x it makes the object (10x 40) 400 times larger.

6. Some types of slides should be viewed with high power magnification, E.g. Nucleus, Mitochondria etc.
7. Some type of slides, section cuttings should be seen in low power. E.g. Rheo leaf cells, root tip cells, Stem tip cells etc.
8. Teacher should explain which types of lenses are used for different slides.
9. Generally all the section cuttings should be seen in low power. In some special cases, High power is needed. Hence, according to the need, students should change the eyepiece lens or objective lens. These instructions should be given by the teacher.
10. In permanent slides low power can be used, but it should be changed to high power to observe at cellular levels.
11. If the reflector is not arranged properly to focus light, we cannot see the slide properly, so it should be adjusted to focus the light evenly.
12. Sometimes, though the eyepiece lens and objective lenses are working properly, we can't see the object clearly. To view clearly, children need to learn how to use fine adjustment and coarse adjustment.

Precautions to be taken while making a slide:

To observe the plant and animals cells along with permanent slides. We should prepare some temporary slides. Some precautions in preparing them are

1. To observe the plant or animal cell and tissues, fresh materials should be used.
2. Tender stems and roots should be taken to observe the cells.
3. Hard and stale stems, roots are difficult for section cutting.
4. Sharp blades should be used to take section so that we can get thin sections.
5. After taking the section, it should be kept in watch glass containing water.
6. With the help of a soft fine brush, section should be kept on the slide.
7. Section should be covered with a coverslip using a needle so that no air bubbles form under the cover slip.

Precautions / Techniques in Staining:

To see the cells and cell organelles clearly, cutting should be stained. Staining makes the slide clear. Different strains are used for different cells and tissues. Generally Methylene blue, Crystal Violet, Safranin or red ink is used. Different stains are used to see different parts of a cell clearly.

1. To observe cells, Methylene blue is used.
2. To observe the nucleus of a cell, Safranin is used.
3. To observe Mitochondria, Methylene blue should be used.
4. Some cell organelles become clear when they accept some stains. By learning this, specific stains should be used.
5. During staining, one or two drops of stain should be dropped in watch glass water.

6. Bring the cutting on to the slide; add one or two drops of stain and put the coverslip.
7. Hold the slide at one side and keep it slantly and pour the water drop by drop. Be careful and see that the section cutting does not come out. Extra stain comes out through water.
8. Use blotting or filter paper to remove the excess water.
9. In a single section cutting, two different stains should not be used.
10. Staining should not be done directly. Stains are poured as drops into the watch glass water and section cutting is dipped into that water. Now they are ready to be observed under microscope.

Techniques in preparing a slide:

Skill is very essential in preparing plant and animal cell slides in the laboratory. Let us see some examples.

Observing Bacteria:

Generally we cannot see Bacteria through classroom microscope. In 8th class Biology lesson “Microorganisms”, to make a slide, some precautions should be taken.

1. Take the water part of the buttermilk with the help of a filler and put a single drop on the slide.
2. Take another slide and spread the liquid.
3. Heat the slide for 3-4 seconds swinging the slide from side to side on candle flame.
4. Take care that soot does not form on the slide.
5. Do not heat it for a long time.
6. Do not swing the slide on the flame making sudden jerks. It should be heated gently.
7. Now put a drop of crystal violet stain.
8. Keep the slide aside for some time.
9. Don't heat the slide by keeping another slide on it. It is not possible to stain then. Just for spreading up of liquid only we need another slide.
10. By holding at an end pour the water drop by drop and wash the stain.
11. Don't pour more water. Take care because the material may come off.
12. Now put the slide under the microscope and observe it.

Muscle and Bone tissue observation:

To prepare a slide to observe muscle and bone tissue for 9th class Lesson “Animal tissues”, it takes some time as the slide should be prepared carefully. In taking a small piece of muscle or bone, preparing a slide and observing it under microscope, the following precautions should be taken.

Muscle cell

1. Put a small piece of muscle or bone in concentrated Hydrochloric acid. (4-6 grams). Soak it for some time.
2. Take out the material with the help of forceps.
3. Take a thin piece from muscle and put it on the slide.
4. Put another slide on it and press both slides gently. Take care that the glass slide does not break.
5. Now the muscle material spreads on the glass slide.

Bone cell

6. By soaking the bone in concentrated sulphuric acid, it becomes smooth. Now take a small piece from it with the help of forceps.
7. Keep the material on the slide and put another slide on it to spread the material.
8. Now stain the slide with one or two drops of Methylene Blue or Saffranin.
9. Even though the bone is soaked in the concentrated Hydrochloric acid, to take out a small piece from bone, we can use a hammer, when it is not possible to take a small piece with forceps.
10. In the staining process, the stain mixed in the water can be taken with a smooth brush and applied to the material, to spread evenly.

Preparation of Permeable layer using Egg membrane

Let us observe the permeability in the lesson “Transport of substances through plasma membrane.” This known as Selectively Permeable membrane. While conducting the experiment with egg membrane, we can observe the differences between Osmosis and permeability. Keep the egg in toilet cleaning liquid for some time until the shell is dissolved. Clean it in tap water and remove the substance inside. Then we can use this as a permeable membrane.

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 have 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 Biology”

- Teaching Biology without readiness is useless
- Since readiness is essential, the Biology 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 Biology 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

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⁺, A, B⁺, 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 in biology. 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.

Academic Standards						Marks	Grade
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⁺, he is given that grade.

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

Summative Assessment

Model Test Paper

Class – 8

Biology

8th Class

Time:

Name of the Student..... SectionNo.....

I	II	III	IV	V	VI	Marks	Grade

I. Conceptual Understanding

a) Answer any two of the following $2 \times 10 = 20$

1. What are the steps followed by farmers in paddy cultivation? What do they do at each stage of cultivation?
2. In general, how many types of reproduction take place in living organisms? What are they? Explain the reproduction that takes place without reproductive cells with examples?
3. What is Biodiversity? How do you recognize its importance? Which activities do you think you need to take up for the conservation of Biodiversity?

b) Answer the following

$2 \times 5 = 10$

4. Somu told that some diseases could be prevented forever. Explain how it is possible.
5. Which water resources are polluted in your area? Give reasons for their pollution.

c) Write the appropriate answer in one word.

6. What transmits disease causing organisms from one living being to another?
7. What is the gas responsible for Bhopal tragedy?
8. What is apiculture?
9. What is the use of decomposers in an ecosystem?
10. In which district is the Kinnerasani sanctuary located?
11. In which part of the body is Adam's apple located?
12. Which Cell in the human body can move with the help of a tail?
13. Which scientist proved that microbes can be killed by boiling?
14. What is the jelly like substance between cell membrane and nucleus called?

d) Find out the suitable answers for the following.

$5 \times 1/2 = 2 \frac{1}{2}$

15. Which of the following is not a reagent ()
A) Crystal violet b) Safranin c) Methylene blue d) Tetracycline
16. The disease on which Ronald Ross did research is ()

- a) Cholera b) Malaria c) AIDS d) Encephalitis
17. Which of the following gives information about the endangered species.
 a) Eco book b) Endemic book c) Red data book d) Orchid Book
18. Which crop is called global grain ()
 a) Rice b) Wheat c) Jowar d) Raagi
19. The reason for declaring the vicinity of Tajmahal as “No drive zone” is
 a) minimize traffic b) Saving fuel c) Pollution d) save river bank
20. In general, Mangroves spread over region.
21. Farmers use Diethane M-45 for
22. Rhode Island Red is a species of

II. Asking questions and Making hypothesis

25. If you happen to go for a blood test, which questions will you ask him about diseases and microorganisms?
26. Imagine and write what will happen if there are no decomposers in ecosystem?

III. Experimentation and field investigation

27. Write about the method you have adopted to observe cork cell in the match stick in laboratory

(Or)

Which method do you adopt to observe biodiversity in the premises of your school?

IV. Information skills and projects.

28. Raziya observed frog’s tadpole and prepared the following table. Observe it and analyze

S.No.	Day of observation	Observed aspects
1	1 st	Eggs are spherical and in clusters.
2	7 nd	I have identified tadpole
3	11 rd	Gills are seen in tadpole
4	21 st	Tadpole swims like a fish
5	32 nd	Limbs are observed
6	48 th	Young frog is jumping

- Which changes have the eggs of the frog undergone?
- What is the evidence for the metamorphosis in frog?
- What are the reasons for the resemblance between tadpole and fish?
- In which stage of the life history of frog have you identified noticeable change?

- Which aspects do you think need to be added to the table to understand the life history of frog better?

29. Read the following information and answer the questions.

Rama planned to collect information about Dairy Industry, Milk Production and sales and prepare a report. State what she has got to do for this.

- What information does Rama have to collect?
- Whom does she have to meet?
- Which aspects need to be added to the information table?
- How else can Rama display the information other than the table?
- What should be taken as a unit to record milk production?

V. Communication through drawing and model making.

30. Draw a neat sketch of Human sperm cell and label it. What is the use of mitochondria in its neck?
31. Prepare a flow chart showing food web in Pond ecosystem.

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

32. In your village, in which preventive measures against contagious diseases do you wish to participate? Why?
33. Naveen said Agriculture and Animal husbandry are connected with each other. How do you support him?
34. Answer the following in one sentence.
 - a) Write a slogan on Air pollution-control.
 - b) How do you appreciate work distribution among honey bees?
 - c) Rangayya used pesticides in his farm indiscriminately. What is your opinion on the crop he is cultivating?
 - d) The cranes on the tree by the side of a pond built nests. How will you feel when you see them?
 - e) If you have to write an essay on metamorphosis in frog, to which aspect will you give more importance

Summative Assessment

Model Test Paper

Class – 9

Biology

9th Class

Time:

Name of the Student..... SectionNo.....

I	II	III	IV	V	VI	Marks	Grade

I. Conceptual Understanding

a) Give elaborate answers to any two of the following 2x10 = 20

1. Indicate some methods to increase food production? Explain any two of them?
2. Explain how differences among living organisms cause variations?
3. Take Nitrogen cycle as an example and explain how biotic and abiotic components depend on each other.

b) Answer the following questions 2x5=10

4. What are adaptations in living organisms? What is its need?
5. Write the differences between striated and non-striated muscles?

c) Give one-word answers to the following questions.

6. Based on what did the scientists start classifications for the first time?
7. What is used to prepare Vermen form compost?
8. What is the production of ammonia from nitrogenous wastes called?
9. What protects us from the powerful ultra violet rays from the sun?
10. What happens to cell if plasma membrane breaks?
11. are called the power houses of cell.
12. Water enters potato osmometer through Method.
13. Scientific study of animal behavior is called
14.% of water absorbed by plants is used for photosynthesis.
15. are used in communication.

d) Choose the correct answer 5x1/2 = 2 ½

16. Movement of Rat in the trap against the electric shock prone area is ()
a) Instinctive tendency b) Conditioning c) reflex d) imprinting ()
17. The structure that controls the moment of substances from and to the cell is ()
a) Cell wall b) Nucleus c) Cell membrane d) None ()
18. Water absorbed by roots is supplied to all parts of the body through
a) Phlegm b) Xylem c) Connective tissue d) Cambium ()
19. What in blood are called microscopic policemen?
a) monocytes b) lymphocytes c) platelets d) red blood corpuscles ()

20. Pigment present in rods of eyes
 a) Chlorophyll b) Melanin c) Rhodopsin d) Chloroplast

e) **Write a sentence about each of the following words.**

21. Protista, Blue green algae, Fungi, Mollusca, Rhizopus

II. Asking questions and Making hypothesis

22. Which questions do you ask to know about the functioning of tissues in plants?
 (Or)

Ravi is studying in 9th class. His eyes are not properly working these days.
 What do you think are the reasons for this?

III. Experimentation and field investigation

23. Which substances did you use for the experiment to prove Osmosis in laboratory? What precautions did you take during the experiment?
 (Or)

Madhavi wants to observe cheek cells under microscope. Elaborate on what she has to do and what precautions she has to take.

IV. Collecting information – Project work.

24. Hari observed various crop plants in the field and listed out their characters.

Analyze this table.

Name of the Plant	Venation	No. of seed leaves	Roost system (Tap/Fibrous)
Maize	Parallel	1	Fibrous root system
Rice	Parallel	1	Fibrous root system
Beans	Reticulate	2	Tap root system
Green Gram	Reticulate	2	Tap root system
Bengal gram	Reticulate	2	Tap root system

Write the characters of Mono cotyledons and Di cotyledons based on the above table.

Characters	Di cotyledons	Mono cotyledons
Venation		
Root system		
No of cotyledons		

25. What information table do you prepare to observe the behavior of Birds and animals in our surroundings in the following situations? What precautions do you take?

Collecting food, when happy, when angry, when frightened, caring for their young ones,

V. Communication through drawing and model making.

26. Draw a neat sketch of the internal structure of eye and label it. What are the uses of tears?

Draw a neat sketch of Plant cell and label it. What is the reason for the existence of cell wall in a plant cell?

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

27. To conduct a rally in your village on greenhouse effect, prepare five slogans.

28. Water pollution has been identified as a problem in Ramapuram. What suggestion will you give to solve it?

29. Answer the following questions in a sentence each.

- a. What is your opinion on the classification of living organisms into phyla by scientists?
- b. Rafi told that blood donation is good for health. How do you support it?
- c. If you do not want to cause any sound pollution, what will you do for it?
- d. What did you surprise in the structure of an eye?
- e. David said that crops grown using chemical fertilizers are not good. Why did he say so?