

State Council of Educational Research and Training
Telangana State, Hyderabad





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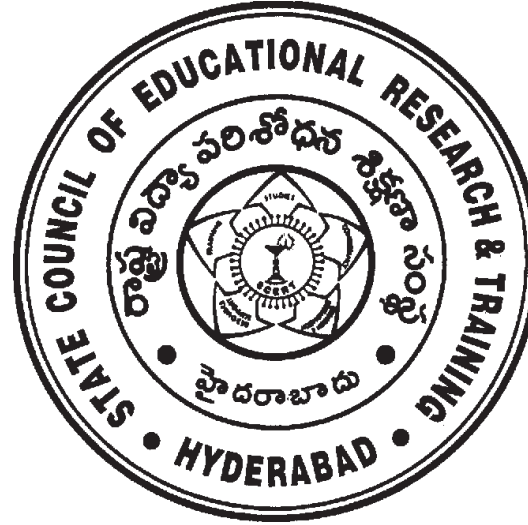


State Council of Educational Research and Training
Telangana State, Hyderabad

SCIENCE - BIOLOGY

8-10 Classes

Syllabus - Educational Standards



State Council of Educational Research & Training
Telangana, Hyderabad

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ముందుమాట

ఉపాధ్యాయ మిత్రులారా!

మానవ జీవితం సుఖవంతంగా సాగడానికి విజ్ఞానశాస్త్రం ఆవిష్కరణ చేయాలని మనకందరికీ తెలుసు. పాఠశాల స్థాయిలో విజ్ఞానశాస్త్రం అంటే ప్రకృతిలోని సూత్ర సిద్ధాంతాలను, నియమాలను అర్థం చేసుకోవడం ద్వారా ప్రకృతిని పరిరక్షించడానికి విద్యార్థులను సంసిద్ధులను చేయడమే. కాబట్టి పాఠ్యప్రణాళిక దీనికి అత్యధిక ప్రాధాన్యతనిస్తుంది. జాతీయ విద్యా ప్రణాళికా చట్టం - 2005 విజ్ఞానశాస్త్రం తరగతి గది నాలుగు గోడలకు పరిమితమైనది కాదనీ చుట్టూ ఉన్న పరిసరాలతో సజీవ, నిర్జీవ అంశాలతో సన్నిహిత సబంధం కలిగివీటిని అర్థం చేసుకునేదిగా ఉండాలనీ చేసిన సూచనల మేరకు పాఠ్యప్రణాళిక రూపకల్పన జరిగింది. విద్యాహక్కుచట్టం 2009 సూచించినట్లు పాఠశాల విద్య పూర్తయ్యే సరికి ప్రతి విద్యార్థి తప్పనిసరిగా నిర్ధారిత విద్యా ప్రమాణాలను సాధించాలి. లేకపోతే ఇన్ని సంవత్సరాల విద్యార్థి పాఠశాల జీవితం నిరుపయోగమవుతుందని పేర్కొన్నది. కాబట్టి పాఠశాలలో కల్పించే అభ్యసన అనుభవాలు పిల్లల్లో నిర్ధారిత విద్యా ప్రమాణాలు సాధించేందుకు వీలు కలిగించేవిగా ఉండాలి. ఆంధ్రప్రదేశ్ రాష్ట్ర విద్యా ప్రణాళికా పరిధి పత్రం - 2010 కూడా విజ్ఞానశాస్త్ర అధ్యయనంపట్ల స్పష్టమైన వైఖరిని వ్యక్తంచేసింది. అదేమిటంటే నేర్చుకున్న జ్ఞానం పిల్లల భావిజీవితానికి సహకరించేదిగా ఉండాలి. శాస్త్రీయ వైఖరులు కలిగిన వ్యక్తులుగా రూపుదిద్దేందుకు బోధనాభ్యసన ప్రక్రియలు దోహదపడాలని నిర్దేశించింది. వీటన్నింటిని దృష్టిలో ఉంచుకున్నప్పుడు పాఠశాలలో పిల్లలకు అందించే ప్రతి కార్యక్రమం ప్రకృతిని అర్థంచేసుకోవడం, వినియోగించుకోవడంతోపాటు దానిని సంరక్షించుకోవడం కూడా అవసరమనే భావనను అందించేదిగా ఉండాలని మనకు అర్థమవుతుంది.

తరగతి గదిలో ఉపాధ్యాయుని పాత్ర అత్యంత కీలకమైనది. ఉపాధ్యాయుడు తాను బోధించే అంశాల వెనుక ఉన్న తాత్వికతను, వాటివల్ల సాధించవలసిన లక్ష్యాలను, పిల్లల శక్తి సామర్థ్యాలను గురించి స్పష్టమైన ఎరుకతో ఉండడం అత్యవసరం. అలా అయినప్పుడు మాత్రమే పాఠ్యపుస్తకంలోని పాఠాన్ని కేవలం సమాచారం రూపంలో కాకుండా పిల్లల్లో జ్ఞాన నిర్మాణం కలిగే రీతిలో బోధనాభ్యసన అనుభవాలను కల్పించగలుగుతారు. విజ్ఞానశాస్త్రమంటే కేవలం ఏవో కొన్ని ప్రయోగాలుగా, ప్రదర్శనలకు పరిమితమైనది కాదని, విభిన్న భావనలను నిశితంగా పరిశీలించి అధ్యయనం చేయడం ద్వారా నూతన ఆవిష్కరణలకు దారి తీసేదిగా ప్రకృతిని, పర్యావరణాన్ని పరిరక్షించుకునే బాధ్యతకలిగిన వ్యక్తులుగా పిల్లలను తీర్చిదిద్దడమని అర్థంచేసుకోవాలి.

ఉపాధ్యాయునికి పాఠ్యాంశాల అమరిక ఆరోతరగతి నుండి పదో తరగతి వరకు ఏ విధంగా ఉంది? ఏయే లక్ష్యాలను సాధించాలని నిర్దేశించబడింది అనే అంశాలపై స్పష్టమైన అవగాహన కలిగి ఉన్నప్పుడు అతడి బోధనా విధానంలో స్పష్టమైన మార్పు చోటుచేసుకుంటుంది. అందుచేత ఉపాధ్యాయుడు పాఠ్యప్రణాళిక, బోధనాభ్యసన ప్రక్రియలు, బోధనా వ్యూహాలు, విజ్ఞానశాస్త్రం-విద్యాప్రమాణాలు, బోధనాభ్యసన సామగ్రి, ఉపాధ్యాయుని సంసిద్ధత, మదింపు, నమోదు విశ్లేషణ మొదలైన అంశాలన్నింటిపట్ల సంపూర్ణ అవగాహన కలిగి ఉండాలంటే ఉపాధ్యాయుడు తప్పనిసరిగా విజ్ఞానశాస్త్ర తాత్విక నేపథ్యాన్ని తప్పనిసరిగా అర్థంచేసుకోవలసిన అవసరం ఉంది.

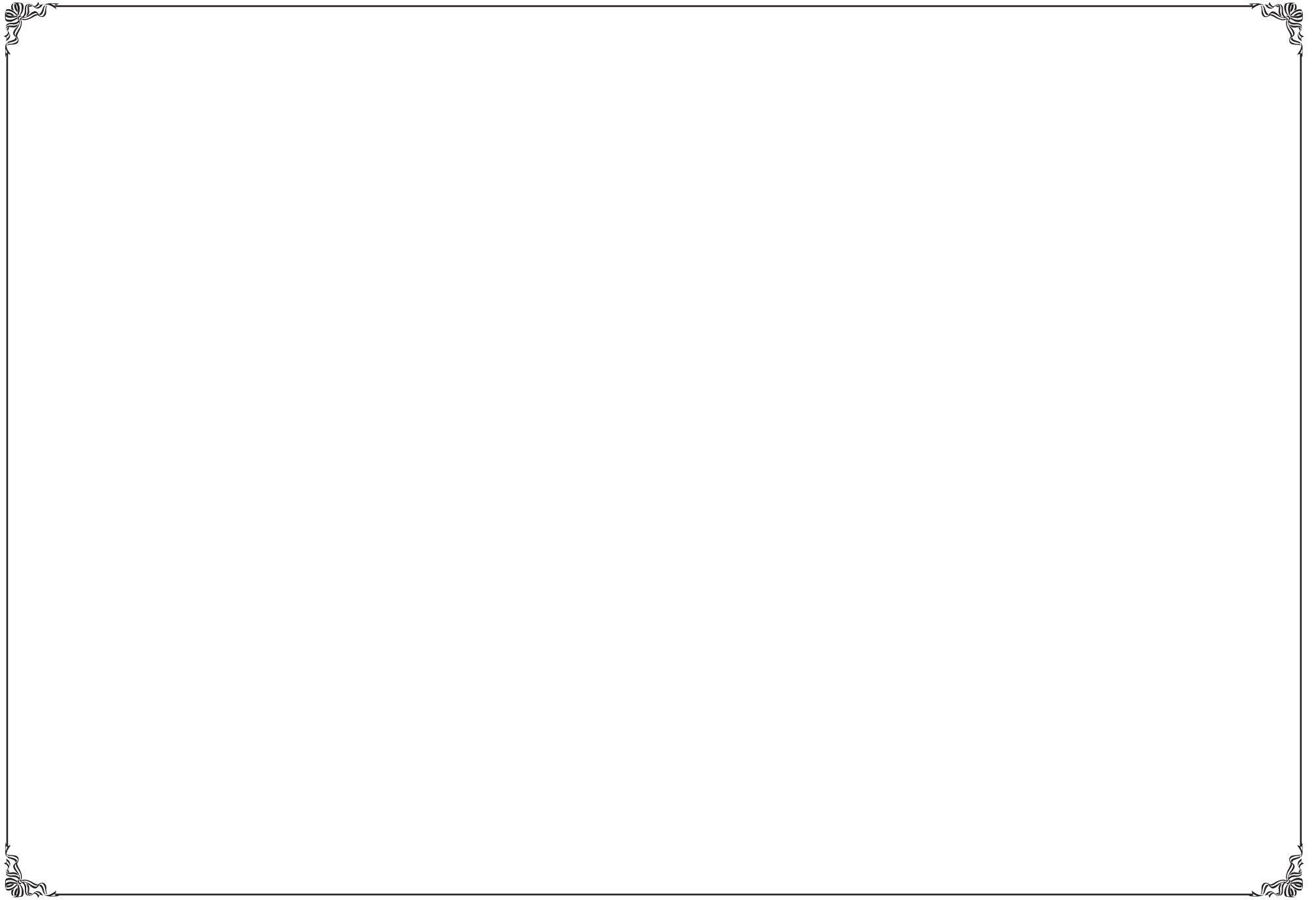
విజ్ఞానశాస్త్రం విద్యాప్రమాణాలు, బోధనా వ్యూహాలు, పాఠ్యప్రణాళిక పేరిట రూపొందిన ఈ పుస్తకం ఎంతో ఉపయోగకరమైనది. విద్యార్థులు, తల్లిదండ్రులు, ఉపాధ్యాయులు, పాఠశాల యాజమాన్యం, మానిటరింగ్ అధికారులు, మండల, జిల్లా విద్యాధికారులు, ఉపాధ్యాయ విద్యాబోధకులు, విద్యావేత్తలు మొదలైన వారందరూ తప్పనిసరిగా పరిశీలించవలసిన పుస్తకం ఇది. పిల్లలు నిర్ధారిత సామర్థ్యాలు సాధించాలంటే ఉపాధ్యాయులు, విద్యాధికారులు, తల్లిదండ్రుల సమిష్టి కృషి అవసరం. ఈ సందర్భంలో విద్యారంగంతో సంబంధం కలిగిన వారందరికీ ఈ పుస్తకం ఒక కరదీపికలా ఉపయోగపడుతుంది. విజ్ఞానవంతమైన రేపటి సమాజాన్ని నిర్మించడానికి శాస్త్రీయ ఆలోచనలు కలిగిన విద్యార్థులు అవసరం. దేశాభివృద్ధికి విద్యార్థులకు అత్యంత ప్రధానమైన ఉత్సాహక వనరు. సమర్థవంతమైన పాఠశాలల నుండే సమర్థవంతమైన విద్యార్థులు రూపు దిద్దుకుంటారు కాబట్టి ఉపాధ్యాయులు సంపూర్ణ అవగాహనతో కృషిచేయవలసిన అవసరం ఉంది.

తేది :

స్థలం : హైదరాబాదు

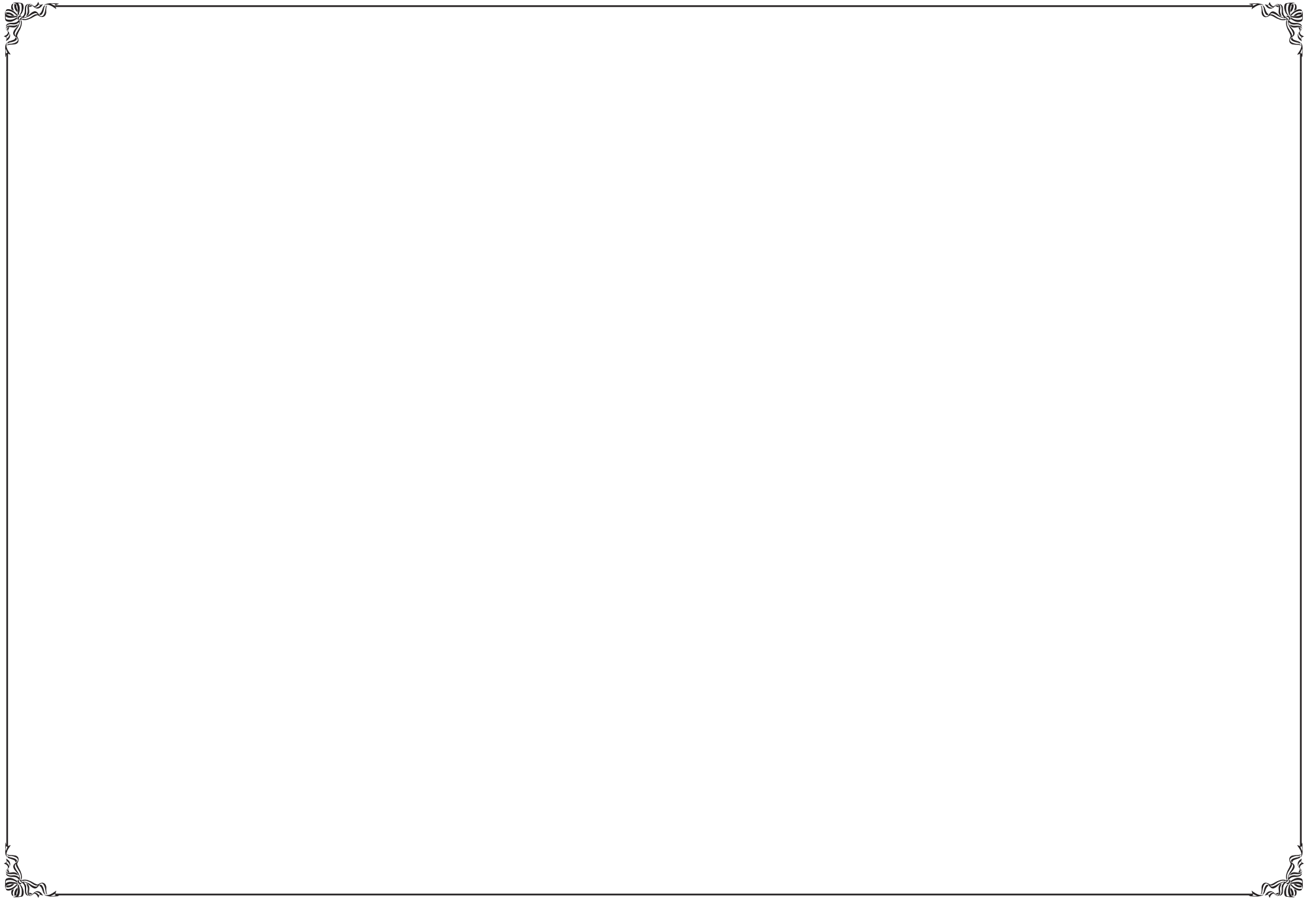
రాష్ట్రవిద్య, పరిశోధన, శిక్షణ సంస్థ,

తెలంగాణ.



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1

Need of change - New Text Books

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 awake 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 selfassessment 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.



State Curriculum Framework - 2011

(Executive Summary)

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 cocurricular 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 ;V 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 cocurricular 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 ;V 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 selfassessment, 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.

3

Nature of Science

Science as a Process of Constructing Knowledge and Nature of Scientific Knowledge

Over the course of human history, people have developed many interconnected and validated ideas about the physical, biological, psychological, and social worlds. Those ideas have enabled successive generations to achieve an increasingly comprehensive and reliable understanding of the human species and its environment. The means used to develop these ideas are particular ways of observing, thinking, discovering meaningful patterns and relationships, building conceptual models, theorizing, experimenting, and validating. These ways represent a fundamental aspect of the nature of science and reflect how science tends to differ from other modes of knowing. Understanding nature of science itself has been a challenging task as it emerges from a complex interjection of philosophy, history, sociology and psychology of science and its practice.

Some important aspects of nature of science are:

- Science presumes that the things and events in the universe occur in consistent patterns that are comprehensible through careful, systematic study. However, nature is not simply revealed to us as we see it. There is much more to it to be discovered in fine structures or simplifying complexities of phenomenon through constructing concepts which are totally abstract in nature expressed as mathematical entities. More often, our intuitive concepts based on direct experience get overthrown giving rise to very counter-intuitive concepts that defy simplistic metaphorical understanding. Learning science calls upon teachers and students to come to grips with and understand such concepts very early. Concepts like force, inertia, cells, atoms and molecules, mass, energy, electric current, etc. all fall in this category.
- Science also assumes that the universe is, a vast single system in which the basic rules are everywhere the same. Knowledge gained from studying one part of the universe is applicable to other parts. For instance, the same principles of motion and gravitation that explain the motion of falling objects on the surface of the earth also explain the motion of the moon and the planets.

- Science is a process of constructing knowledge. The process depends both on making careful observations of phenomena and on inventing theories for making sense out of those observations. Consequences of theories are deduced through devising qualitative or mathematical models based on rational arguments leading to their verification or falsification through observations and controlled experiments giving rise to principles, theories and laws governing the physical world. Interestingly enough, what we choose to observe is in turn dictated by the tentative conceptualization or theorization prevailing at that time. Philosophers of science describe this as ‘observations are theory-laden.
- Speculation and conjecture also have a place in science, subject to subsequent verification by relevant observations and/or experiments. There is an important creative element in practice of science.
- Scientific ideas are subject to change making science a dynamic, expanding body of knowledge. Change in knowledge is inevitable because new observations may challenge prevailing theories, as the domain of human experience expands. The laws of science are never viewed as fixed eternal truths. Even the most established and universal laws of science are always regarded as provisional, subject to modification in the light of new observations, experiments and analysis.
- Feynman, a famous scientist said “Scientific knowledge is a body of statements of varying degrees of certainty — some most unsure, some nearly sure, none *absolutely* certain.” He further goes on to say, “Of all its (science) many values, the greatest must be the freedom to doubt.” Indeed scepticism has been an important characteristic of scientific thinking and has played an historic role in progress of science.
- Most scientific knowledge is durable. For example, in formulating the theory of relativity, Albert Einstein did not discard the Newtonian laws of motion but rather showed them to be only an approximation of limited application within a more general concept. Continuity and stability are as characteristic of science as change is, and certainty as prevalent as tentativeness.
- Science cannot provide complete answers to all questions. There are many matters that cannot be usefully examined in a scientific way. There are, for instance, beliefs that, by their very nature, cannot be proved or disproved (such as the existence of supernatural powers and beings, or the true purposes of life). For scientific investigation to be possible it must be possible to ascribe to the phenomenon a consistent conceptual framework that lends itself to logical analysis leading to systematic observation and/or experimentation.
- Systematic inquiry is fundamental to the process of generating scientific knowledge. Science asks three basic questions-
What is there?
How does it work?
How did it come to be this way?

- Scientific inquiry is not easily described apart from the context of particular investigations. There simply is no fixed set of steps that scientists always follow, no one path that leads them unerringly to scientific knowledge. There are, however, certain features of science that give it a distinctive character as a mode of inquiry. Although those features are especially characteristic of the work of professional scientists, everyone can exercise them in thinking scientifically about many matters of interest in everyday life.
- Science demands evidence. Fundamentally, the various scientific disciplines are alike in their reliance on evidence, the use of hypothesis and theories, the kinds of logic used, and much more. The validity of scientific claims is settled by referring to observations of phenomena. Hence, science concentrates on getting accurate data.
- Science is a blend of logic and imagination. Scientific concepts do not emerge automatically from data or from any amount of analysis alone. The assumption has to be connected with conclusions through scientific arguments that conform to the principles of logical reasoning. Sometimes discoveries in science are made unexpectedly even by accident and often by leaps of imagination.
- Science explains and predicts. The predictions may be about evidence from the past that has not yet been found or studied. A theory about the origins of human beings, for example, can be tested by new discoveries of human-like fossil remains. This approach is clearly necessary for reconstructing the events in the history of the earth or of the life forms on it. It is also necessary for the study of processes that usually occur very slowly, such as the building of mountains or the aging of stars.
- Science requires accurate record keeping, peer review and replicability. New knowledge must be reported clearly and openly.
- Science is not authoritarian. Theories are judged by their results: When someone comes up with a new or improved version that explains more phenomena or answers more important questions than the previous version, the new one eventually takes its place. The history of science reveals both an evolutionary and revolutionary character.
- Science is a complex social activity. Scientific work involves many individuals doing many different kinds of work and goes on to some degree in all nations of the world. Men and women of all ethnic and national backgrounds participate in science and its applications. These people—scientists and engineers, mathematicians, physicians, technicians, computer programmers, librarians, and others—may focus on scientific knowledge either for its own sake or for a particular practical purpose, and they may be concerned with data gathering, theory building, instrument building, or communicating.
- While not everything from different cultures would qualify as scientific knowledge, people from all cultures have contributed to science in some way or the other. This can be attributed to human endeavor to arrive at reliable validated knowledge in different cultures.

- Science has been part of social and cultural traditions and in turn scientific ideas have been rooted in the social and cultural milieu. An important contribution of science has been the way it has been reshaping our worldview. For example, till hardly four hundred years ago everybody believed the earth to be the centre of the universe with the sun and the moon going round it. Today, even if it might apparently not seem so, every child grows up with the knowledge that the earth is orbiting round the sun and is definitely not the centre of the universe.
- While technology definitely predates science, there has been a close relationship between technology and science, particularly over last four centuries. In fact, it would not be wrong to describe modern technology as applied science as much of technology around us is based on basic principles of science. Technological solutions are guided by design, aesthetics, economics and other practical considerations as also by scientific principles.
- The very definition of progress has come to be linked with advances in science and technology. New fields of work and production have emerged while traditional fields have been transformed beyond recognition like agriculture, manufacturing, construction, transport, communication and entertainment. People are faced with a fast-changing world demanding flexibility to adapt to new demands and creativity to take advantage of new opportunities. Science education has to rise to meet these expectations.



Objectives of Teaching Science

As per the general aims objectives content pedagogy and assessment would differ across different stages. While deciding gradation of science curriculum it must be borne in mind that a majority of the students study science as a compulsory subject up to class – X in Andhra Pradesh. Although most of these children are not going to train as professional scientists or technologists in their latter career, they need to become scientifically literate. The science curriculum up to class – X should be oriented more towards developing awareness among the learners about interface of science, technology and society besides being able to look at the world in a rational manner and apply principles of science to daily life. It should stress not only the content of the science but also the process skills and their linkage with the experiences and daily life.

Primary Stage

The main objectives of science teaching at this stage are to maintain the curiosity about the world and have the child engage in exploratory and hands on activities that would lead to the development of basic cognitive and psychomotor skills. All this would be through language, observations, recording, differentiation, classification, inference drawing, reading and making illustrations, design and fabrication of simple things, estimation and measurement. The curriculum should also help the child internalize values of cleanliness, honesty, co-operation, concern for life and environment at the primary stage.

During this stage,

- 1) Children should be encouraged to explore their immediate environment without too much focus. For example, in the first two years this exploration can be without the aid of a specific science textbook. The book on language can contain topics that induce the child to look around and develop a familiarity with their surroundings.
- 2) Science education can be a part of environmental studies from class III to V so that children can examine and relate to their world holistically.

The assessment of Science at this stage should aim at checking the knowledge acquired as well as the skills developed. Some not obvious skills only language comprehension and reading ability, ability to work in groups, etc.

The criteria for identifying the content at the primary stage are relevance, meaningfulness and interest to the child. The content should provide opportunities to deal with the real and concrete world of the children, rather than a formal abstract world. The present practice of introducing ideas and concepts pertaining to science and social science as environment studies should be continued and further strengthened, with opportunities for children to observe, explore and relate to environment closely. It is, therefore, essential for the curriculum, syllabus and textbook developers of both the 'sciences' and 'social studies' groups to work together.

Scientific concepts to be taught at this stage should be chosen so as to make sense of everyday experiences. Apart from simple experiments and hands on experiences, an important pedagogical practice at this stage is to engage the students (in groups) in meaningful investigations – including particularly the problems they perceive to be significant and important. This may be done through discussions in the class with the teacher, peer interactions, gathering information from newspapers, talking to knowledgeable persons in the neighbourhood, collecting data from easily available sources, doing simple experiments and carrying out simple investigations in the design of which the students have a major role to play.

Upper Primary Stage

Science education at this stage should provide a gradual transition from an exposé to ideas of science through environmental studies of the primary stage to elements of science including its concepts, processes and methods.

Scientific concepts to be taught at this stage should be chosen so as to be related to the child's life and to help the child acquire a better sense of her everyday experiences.

The emphasis on the process skills of science should continue through the upper primary stage to enable children learn how to learn for themselves so that they could carry on learning to even beyond school.

The examination should assess the child's practice and problem solving skills, ability to analyze data, application of learnt knowledge, development of concepts, understanding, reading and making graphical representations and solving simple numerical exercises.

The Technology component of Science Curriculum could include design and fabrication as well as practical knowledge about common mechanical and electrical devices and about local specific technologies.

1. Science education should remain as general science for class VI to VII.
2. At this stage group activity, peer group interaction allowing the child to articulate her formulations, questions, etc.
3. Children should be engaged in learning the principles of science through familiar experiences and to start recognizing the relationship of science and technology with society.
4. For example, students should be encouraged to make very simple working models using locally available materials.

Secondary Primary Stage

At the Secondary Stage concepts principles and skills of science would now appear appropriately but stress should be on use of concepts, on the ability to investigate and on comprehension and not on mere formal definitions. The organization of science content must be around what is close to children and the curricular load needs to be substantially reduced from the present to make room for aiding concept development and for the elements of design.

Relation with Other Subjects

When we want to relate learning of concepts to the experiences it becomes difficult to separate them into small pieces. Analysis of even experiments would cut across many concepts and thoughts sometimes across topics and even disciplines. Therefore, it is important to keep this in mind. The linkage of different aspects of the idea located in different disciplines makes it richer and nuanced. So in the sense of choosing themes and in the sense of deepening the relationship with the concept it is essential that the disciplines within science be visualised as linked and science be looked in terms of its relationships with other disciplines as well.

Application of Science in Daily Life

While organizing curriculum for teaching of science we should include all the essential aspects of the science subject needed by a child in meeting the general requirements of his day-to-day life. For this purpose attempts are to be made to take all essential and useful topics related with the day-to-day life activities and needs from all the different branches and areas of science. And then integrate them in a cohesive way for being used in a generalized way in ones day-to-day life. From early morning when we wake up, there are so many phenomena that excite our curiosity initiating us to think about how those things occur. We also see that science is with us every day. Children in washing face, brushing our teeth, noting time, reading in light and countless other things recognize the use of technology. Modern science and technology have changed our lives in many dramatic ways. Airplanes, automobiles, communication satellites, computer, plastics and T.V. are only a few of the scientific and technological inventions that have transformed human life.

Development of nuclear energy as source of power, development of better varieties of plants and highly effective fertilizer, development of antibiotics and new drugs which help to control many infections, diseases and also studies on anatomy and physiology have led to emerging new surgical operations and to invention of life caring machines that can do the work of organs as lungs, kidneys etc. Their impact on our life is a double edged sword and students must recognize the need to balance the use of technology in their lives.

We must point out science education today does not have enough examples from practical life. As a result, we are not able to use concepts in our daily life. The practical implications for life are totally distinct from the textbooks. It is not surprising that the students who are good at using ideas with the help of the textbook get puzzled by similar issues in daily life.

Science education does not develop the ability to analyze or discuss the possibilities to solve the problems that the individual and the society faces, and fails in creating an attitude that is required for solving a problem. There is also no scope for developing scientific awareness. Nothing is learnt of science if the child does not pass through stages of observation, data collection, data analysis, arriving at a conclusion, calculation and inference. Study of science should further pass through phases like locating an issue, its analysis, experimentation and observation. By taking up projects that are research-oriented, and undergoing the process of arriving at an inference, identifying mistakes and gaps child learns science and about life. The learner should pass through all the stages that the scientists pass through including temporary hypothesis formulation. Science education at present does not create such a favourable circumstance for any of this.



Academic Standards

“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 Sagars 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.

8th CLASS SCIENCE BIOLOGY - REVISED SYLLABUS

1. What is Science ?

- 1.1 Science - The individual perspective
- 1.2 Science - The Societal perspective
- 1.3 Science and Change
- 1.4 How do scientists work ? - Scientific Method
- 1.5 Process Skills
- 1.6 Reading to learn - Writing to Communicate
- 1.7 Safety in the Laboratory - Safety in Science
- 1.8 Some of the divisions in Science (Science - Some Divisions)

2. Cell - The Basic Unit of Life

- 2.1 Discovery of the cell
 - Observing cells in a match stick
 - Observing cells in an onion peel
 - Observing human cheek cells
- 2.2 Cell - Nucleus - Robert Brown Experiment
 - Observing cells in a leaf
 - Different cells in Human body

3. Microbial World

- 3.1 Invention of Microscope - Discovery of Microorganisms
- 3.2 Groups of Microorganisms - Observation
 - Observing microorganisms in water
 - Observing fungi

- Observing Bacteria
- Observing Algae
- Observing Protozoans and Micro-arthropods
- Observing Soil Microorganisms

3.3 Viruses - Introduction

3. Microbial World - 2

3.1 Useful Microorganisms

- 3.1.1 Observing microorganisms in Maida - Yeast Mixture

3.2 Commercial use of Microorganisms

- Medicinal use of Microorganisms

- 3.2.1 Antibiotic - Invention of Penicillin

3.3 Vaccines

- 3.3.1 Invention of Vaccine against Smallpox

3.4 Soil Microorganisms and Soil Fertility

- 3.4.1 Nitrogen Fixation

3.5 Harmful Microorganisms

- 3.5.1 Microorganisms causing disease in Man
- 3.5.2 Microorganisms causing diseases in Animals
- 3.5.3 Microorganisms causing diseases in Plants

3.6 Food Preservation

- 3.6.1 Preserving food in heat and cold method, packing
- 3.6.2 Pasteurisation

4. Reproduction in Animals

- 4.1 Oviparous and Viviparous Animals
- 4.2 Identifying the method of reproduction based on ears, hair on the skin and feathers
- 4.3 Kinds of / types of Reproduction in Animals - Sexual and Asexual Reproduction
- 4.4 Asexual Reproduction
 - 4.4.1 Budding in Hydra
 - 4.4.2 Binary fission in Amoeba
- 4.5 Sexual Reproduction
 - 4.5.1 Male Reproductive System
 - 4.5.2 Female Reproductive System
 - 4.5.3 Fertilization - Development of an Embryo
 - External and Internal Fertilization
- 4.6 Life cycle of Frog
- 4.7 Cloning

5. Adolescence

- 5.1 Changes at Adolescence
 - 5.1.1 Measuring increase in Height and observing growth rate
 - 5.1.2 Observing the changes in the body - Secondary sexual characters
 - 5.1.3 Adam's apple - Voice change
- 5.2 Reproduction in Human Beings

5.2.1 Menstrual cycle

- 5.3 Child Marriages - Demerits
- 5.4 Adolescence - Behavioural changes
- 5.5 Adolescence - Effect of Endocrine glands
- 5.6 Adolescence and Health
 - Sweat and Pimples
 - Balanced Diet
 - Hygiene / Cleanliness
 - Physical Exercise

6. Biodiversity and its Conservation

- 6.1 Conference on Biodiversity - Information
- 6.2 Biodiversity
 - Identifying biodiversity in the surroundings
 - 6.2.1 Diversity / variations in plants
 - 6.2.2 Observing variations in plants
 - 6.2.3 Observing variations in animals
 - 6.2.4 Observing variations in human beings
- 6.3 Degradation of forests - concept of Biodiversity
 - 6.3.1 Endangered species, Endemic species
 - 6.3.2 Information on Endangered species - Red Data Book
- 6.4 Biodiversity - Balance in Nature
- 6.5 Biodiversity and its Conservation
 - 6.5.1 National Parks and Sanctuaries
- 6.6 Conservation of forests - preparation / making of recycled paper

7. Different Ecosystems

- 7.1 Concept of Ecosystem
 - 7.1.1 Structure of an Ecosystem
- 7.2 Ecosystem - Relationship between biotic components
- 7.3 Changes in the Ecosystem
- 7.4 Types of Ecosystem :
 - Grassland Ecosystem
 - Forest Ecosystem
 - Desert Ecosystem
 - Fresh water Ecosystem
 - Marine Ecosystem
- 7.5 Ecosystem - Biotic and Abiotic components
 - Producers
 - Consumers
 - Decomposers
 - Abiotic Components
- 7.6 Energy Flow in an Ecosystem

8. Food Production from plants - Methods of management

- 8.1 Crops in India
 - 8.1.1 Crops in our Village, District and State
- 8.2 Duration of crops
 - Long-term crops and short-term crops
 - Kharif crops and rabi crops
 - Duration of night and its effect on crop production

- 8.3 Cultivation of Paddy
 - Preparing the soil (ploughing, manuring)
 - Leveling the soil
 - Selection of seeds, cleaning the seeds
 - Watering
 - Different types of sowing the seeds
 - Transplanting
- 8.4 Manures, Pesticides.
 - 8.4.1 Crop protection, methods of management
 - 8.4.2 Identification of pests, controlling the pests
 - 8.4.3 Pest controlling practices
- 8.5 Obtaining high yield
 - 8.5.1 Manures / fertilizers - Natural and Artificial manures
 - 8.5.2 Irrigation, modern methods of irrigation - Drip irrigation
 - 8.5.3 Weeding
- 8.6 Rotation of crops - methods
- 8.7 Methods of storing grains - godowns and cold storage units

9. Food Production from animals - Methods of Management

- 9.1 Animal Husbandry
 - 9.1.1 Rearing animals - Rearing animals in villages - challenges
- 9.2 Milk Production
 - 9.2.1 Milk collection - Pasteurization and Chilling

- 9.2.2 Selection of live stock
- 9.2.3 Livestock - Methods of Management
- 9.3 Poultry
 - Types / varieties of hen - Broilers, Layers
 - Poultry Farms, Incubator
- 9.4 Apiculture
 - 9.4.1 Types of Honey bees and their life
- 9.5 Fisheries
 - Marine fishes
 - Fresh water fishes (Aqua culture)

10. Not to Drink - Not to Breath

- 10.1 Vehicles - Pollution check - Pollution under control certificate
- 10.2 Atmospheric pollution
 - 10.2.1 Air pollution - Pollutants
 - 10.2.2 Primary pollutants, Secondary pollutants
 - 10.2.3 Pollution - The Reasons
 - Natural Calamities
 - Human Activities
 - Power Generation Plants
 - Chemical fertilizers, Insecticides
 - Deforestation
 - Industrial Effluents - Chloro - fluoro carbons
 - Mining
 - 10.2.4 Air Pollution - The Effects
 - Aerosols, Hydrogen, Sulphide, Carbon monoxide
 - 10.2.5 Air Pollution - Controlling Measures

- 10.3 Water Pollution
 - 10.3.1 Testing the pollutants in water samples
 - 10.3.2 Pollution of River Musi
 - 10.3.3 Definite, Indefinite Pollutants
 - 10.3.4 Plants - Nutrients
 - 10.3.5 Biodegradable wastes
 - 10.3.6 Heat - Water pollution
 - 10.3.7 Solid wastes, toxic chemicals
 - 10.3.8 Controlling water pollution

11. Why do we fall ill ?

- 11.1 Health - its significance - What do we mean by 'Being healthy'?
 - 11.1.1 Individual, social problems
 - Community Health, Personal Health
- 11.2 Distinction between 'Being healthy and Disease free'
- 11.3 Disease - and its causes
 - 11.3.1 Infections and non-infections diseases
 - 11.3.2 Short-term, Long-term diseases - Illhealth
 - 11.3.3 Diseases - Carriers of diseases
 - Bacteria, Viruses, protozans etc.
 - 11.3.4 How does a disease spread ? (or how do diseases spread?)
 - 11.3.5 Disease causing organisms (Pathogens) - the changes in organ systems in the body
- 11.4 Prevention of diseases - Principles, Actions

9th CLASS SCIENCE BIOLOGY - REVISED SYLLABUS

1. Cell structure and functions

1.1 Typical cell

1.1.1 Comparing Plant and Animal cell

- 1.1.2 Cell organells - Cell membrane (Plasma membrane)
- Cell wall
 - Nucleus
 - Eukaryotic cell
 - Prokaryotic cell
 - Cytoplasm

1.1.3 Protoplasm - Cytoplasm

- 1.1.4 Cell organells - Endoplasmic Reticulum
- Ribosomes
 - Lysosomes
 - Golgi bodies
 - Mitochondria
 - Vacuoles

1.2 Plastids - Chloroplasts

1.3 Are cells flat ?

1.4 Where do cells form from ?

2. Plant tissues

2.1 Parts of the plants - their functions

2.1.1 Observing the cells in leaf and onion peels

2.1.2 Observing the cells in root tip

2.1.3 Observing growing roots in onion

2.2 Plants - Tissues ● Meristematic tissues

- Dermal tissue
- Ground tissue
- Vascular tissue

2.2.1 Meristematic tissues

- Apical meristem
- Lateral meristem
- Intercalary meristem

2.3 Observing the tissues in transverse section of a dicot stem

2.4 Dermal tissue - observing epidermal cells in Rhea leaf

2.5 Ground tissue - Parenchyma, Sclerenchyma, Collenchyma

2.5.1 Parenchyma - Chlorenchyma, Aerenchyma, Storage tissue

2.6 Vascular Tissue - Xylem, Phloem (Vascular Bundles)

3. Animal Tissues

3.1 Organ systems - functions

3.1.1 Observing tissues

3.1.2 Observing the cells in the blood sample

3.2 Different types of Animal tissues

- Epithelial Tissues
- Connection tissue
- Muscular Tissues
- Nervous tissue

3.3 Epithelial tissue - Columnar, Cuboidal, Squamous Epithelial tissue - characteristics.

3.4 Connection tissue - Acreolar, Adipose, Skeletal tissue

- Bone, Cartilage, Ligament, Tendon

3.5 Blood Tissue - Story of blood

3.5.1 Blood tissue - Red Blood Cells, White Blood Cells,
Blood - Platelets

White Blood Cells - Granulocytes (Neutrophile,
Basophile, Eosinophile
- Agranulocytes
(Lymphocytes,
monocytes)

3.5.2 Blood Flow, Blood clotting (muscular tissue)

3.6 Blood Groups - Universal Acceptors, universal donors, Blood
grouping - Testing.

3.7 Nervous tissue

4. Movement of materials across the cell membrane

4.1 The Substances that get into and go out of the cell

4.1.1 Solutions and their concentration (Sugar solution)

4.1.2 Observing the changes of kishmish when placed in
sugar solution and tap water.

4.2 Osmosis - the flow of liquids through selectively membrane

4.2.1 Filtration

4.2.2 Functions of Plasma membrane

4.2.3 Flow of substances through Plasma membrane

4.2.4 Importance of Osmosis in living organisms

4.3 Diffusion

5. Diversity in living organisms

5.1 Observing diversity in plants

5.1.1 Identifying the plants based on selected characters /
features

5.1.2 Observing the seeds

5.1.3 Observing the characters of monot and dicot plants

5.2 Diversity in animals

5.2.1 Observing external characters in Insects

5.2.2 Variations / Diversity in Human beings, Diversity in
plants (based on selected characters)

5.3 Classification - the concept, its need - evolution

5.3.1 History of classification

or

Classification - its Historic elements

5.3.2 Method of classification - the five kingdom
classification proposed by Whittaker (1969)

● Monera ● Protista ● Plantae ● Fungi ● Animalia

5.4 Classification of Plant Kingdom

5.5 Classification of Animal Kingdom

6. Sense Organs

6.1 Sense organs - Opinions of our ancestors

6.2 What do our sense do ? / How do sense organs help us ?

6.2.1 Stimulus - Response

6.3 Eye-its structure, cells and tissues / structure of the eye-cells
- and tissues in the eye

6.3.1 Functioning of the eye

6.3.2 Eye and Illusions

6.3.3 Taking care of our eyes, diseases and defects of the
Eye - An understanding

6.4 Ear - its external and internal structure

6.4.1 Ear - the hearing / auditory sensation

6.4.2 Functions of the ear, caring for the ears

6.5 Structure of the Nose

- 6.5.1 The smell or olfactory sense - How do we know the sense of smell ?
- 6.5.2 Taking care of nose
- 6.6 Structure of the Tongue
 - 6.6.1 How do we know the taste ?
 - 6.6.2 Taking care of the Tongue
- 6.7 Structure of the skin
 - 6.7.1 How does the skin convey the sense of touch ?
 - 6.7.2 Skin diseases, taking care of skin

7. Animal behaviour

- 7.1 Animals behave in different ways / or Animals exhibit different behaviour
- 7.2 Different types of Animal behaviour
 - Instinct
 - Imprinting
 - Conditioning
 - Imitation
- 7.3 Pavlov Experiments on conditioning
- 7.4 Human behaviour : Instinct, imitation, conditioning
 - 7.4.1 Investigating behaviour in the field, laboratory
 - 7.4.2 Investigation in the field - tagging
- 7.5 Animals - and their intelligence

8. Challenges in improving agricultural products

- 8.1 Relationship between growth of population and the need for food
 - 8.2.1 Need of improving agricultural produce
- 8.2 How to increase the food production ?

- High yielding varieties
- Irrigation facilities
- 8.2.1 Relationship between water and crop yield.
- 8.2.2 Plant nutrients / or nutrients needed by the plants
- 8.2.3 Crop Rotation
- 8.2.4 Cultivating mixed crops
- 8.2.5 Organic manure
- 8.2.6 Chemical Fertilizers

8.3 Soil testing

8.4 Conventional manures

- Vermi compost
- Panchagavya

8.5 Organic farming

8.5.1 The long-term effect of chemical fertilizers on the yield of the crop

8.6 Crop protection

8.6.1 Weeds

8.6.2 Plant - Diseases - Prevention (Pesticides)

9. Adaptations in different Ecosystems

9.1 Ecosystems

9.1.1 Ecosystems - Adaptations in Plants

9.2 Desert Ecosystem - Adaptations in plants and animals

9.3 Aquatic Ecosystem - Adaptations in plants and animals

9.3.1 Marine Ecosystem - Adaptations in plants and animals

9.3.2 Aquatic organisms - The secrets of swimming

9.3.3 The zones in the marine ecosystem on the basis of availability of light at different depths.

- Euphotic zone
- Bathyal zone
- Abyssal zone

9.3.4 Zones in the fresh water Ecosystem

- Littoral zone
- Limnetic zone
- Profundal zone

9.4 Water salinity - Adaptations

9.5 Adaptations to temperature in plants, animals

- Hibernation and Aestivation
- Symbiosis (Lichens)

9.6 Adaptations - Evolution (story of Darion's Finches)

10. Soil Pollution

10.1 What is soil ?

10.1.1 What is soil ?

10.1.2 Soil properties - Physical, Chemical and Biological properties of the soil

10.2 Soil fertility

10.3 Soil pollution

10.3.1 Fertility of soil due to decomposition of wastes

10.3.2 Soil pollution - Wastes

- Biogradable wastes
- Non-biogradable wastes

10.4 Causes of land pollution

10.4.1 Manures and Chemicals

10.4.2 Biomagnification

10.4.3 Solid wastes

10.4.4 Deforestation

10.4.5 Urbanization

10.4.6 Pollution of undreground soil

10.5 Effects of soil pollution on Environment

10.6 Control measures of soil pollution

10.6.1 Bioremediation, soil conservation

11. Biogeochemical cycles

11.1 Pollution, concept of biogeochemical cycles in relation to the ecosystems - an understanding

11.2 Waste cycle

11.3 Nitrogen cycle

11.3.1 Nitrogen fixation

11.3.2 Nitrification

11.3.3 Assimilation

11.3.4 Ammonification

11.3.5 Denitrification

11.3.6 Nitrogen cycle and human intervention

11.4 Carbon cycle

11.4.1 Photosynthesis - Carbon - fixation

11.4.2 Carbon cycling and storage

11.4.3 Carbon cycle - Human intervention

- Global warming
- The green house effect

11.5 Oxygen cycle

11.5.1 Oxygen cycle storage

11.5.2 Ozone layer and its effect

10th CLASS SCIENCE BIOLOGY - REVISED SYLLABUS

1. Nutrition

- 1.1 Life process- Introduction, Basis of theme making
 - 1.1.1 Recalling the related issues from previous work
- 1.2 Nutrition in plants
 - 1.2.1 Understand the concept of photosynthesis in general terms
 - 1.2.2 Raw materials required
 - 1.2.3 Process involved in photosynthesis- light reaction, dark reaction
 - 1.2.4 Products- With reference to carbohydrates, energy
 - 1.2.5 A brief account of fate of carbohydrates which is the end products (accumulation and conversion)
 - 1.2.6 Suggested Activities- T.S of leaf to observe chloroplast, Hydrilla experiment, KOH.
 - 1.2.7 Variegated leaf.
 - 1.2.8 Do you know? - Insectivorous plants are autotrophic.
- 1.3 Nutrition in human beings
 - 1.3.1 Parts of the alimentary canal,
 - 1.3.2 Digestive glands
 - 1.3.3 Enzymatic reactions and assimilation (Brief account)
 - 1.3.4 Do you know?-(Vitamins & minerals), deficiency diseases

2. Respiration

- 2.1 Introduction- Recall- Respiration as a characteristics of living beings, how the process takes place, organs or organs systems involved in the product
- 2.2 Respiratory system in human being- Respiratory organs, mechanism of gaseous exchanges (Flow chart/diagram etc)
 - 2.2.1 Pathways of respiration – Substrate breakdown, release of energy, product
- 2.3 Types of respiration- aerobic, anaerobic
- 2.4 Respiration in plants

3. Transportation

- 3.1 Introduction- Need of the transport system in all living being, material that are transported, medium of the transport (blood- human being, water- plants)
- 3.2 Transportation system in human being- Heart (the pumping organ) Structure and function, circulation of blood, channels for blood circulation- artery, vein, capillaries, double circulation, and lymphatic system.
- 3.3 Transportation in plants- (a) Mechanism of water transportation in plants (Brief account), transpiration, ascent of sap, cohesive and adhesive forces, root pressure. Detailing of ascent of sap with activity / experiment. (b) Translocation of food.

4. Excretion

- 4.1 Introduction- Need of excretion by posing question/by summarizing the earlier chapter.
- 4.2 **Excretion in human being-** excretory system, parts and function, Kidney as a excretory/ osmoregulatory organ (L.S. of kidney to show location of nephron, its structure and function as a unit of excretion)
- 4.3 Artificial kidney, hemolysis.
 - 4.3.1 Other pathways of excretion in human being.
- 4.4 **Excretion in plants-** Process, important secretory/excretory products useful for human being.

5. Control & coordination

- 5.1 Introduction- Need for control and coordination.
- 5.2(a) Nervous system in humans being- Recall of the structure of nerve (Response to stimuli), reflex arch (Types of nerves, Different nervous system)
- 5.3 Human brain and its functions
- 5.4 Role of hormone- general account of hormone in human being and their function
- 5.5 Control and coordination in plants- response to stimuli, movement & growth, plants hormones and their function.
- 5.6 Tropic movements in plants - Photo, geo, hydro, chemo tropism.

6. Reproduction

- 6.1 Introduction- Recall of reproduction work which has done so far, importance of reproduction (continuation of genetic

material from generation to generation, as a basis of variation)

- 6.2 Observable phenomena related to process
 - 6.2.1 Growth and development of human embryo
- 6.3 Sexual reproduction in plants
- 6.4 Cell division (Brief account of the basis of the above observable phenomena)
 - 6.4.1 Mitosis, Meiosis
- 6.5 Reproductive health- Family planning, safe sex, HIV/ Aids

7. Coordination of Life Process

- 7.1 Introduction- Recall life processes, how they work together
- 7.2 Sensation of hunger and system involved- Nervous, muscular
 - 7.2.1 Outcome of sensation- watering of mouth, looking for food, panic of stomach
- 7.3 Consumption of food- process involved in breakdown of substances in mouth
 - 7.3.1 Travel food through food pipe-Role of nervous system, muscular system
 - 7.3.2 Reaching the stomach- stimulus, response, enzyme reaction, acidic, action of sphincter
 - 7.3.3 Intestinal process involved- Intestine to blood and all parts of body, blood to expulsion of waste, intestine to expulsion of waste

7.3.4 Relationship between different life processes related to digestion-source of energy for all these processes.

8. Heredity and Evolution

8.1 Heredity; Introduction- Recalling (Variation in organisms, selection of characters based on variation, based on variation forming classification)

8.2 Variation- accumulation of variation, inheritance- heredity, similarity and difference, Mendel's contribution of heredity, rules of inheritance, sex determination in human being.

8.3 Evolution

8.3.1 Variation in population with an illustration- Natural, Artificial selection

8.3.2 Acquired characters (traits) vs inherited traits, Darwin and Lamarck,

8.4 Evidence of evolution- fossils, homologous and analogous organs

8.4.1 Evolution by stages

8.4.2 Speciation

8.4.3 Human Evolution

9. Our Environment

9.1 Introduction- recall the work done- food chain, food web, Interdependence between living things

9.2 Detail of interdependence between biotic and abiotic components taking case study as an example

9.3 Concept of quantification of biotic and abiotic factors in the forms of pyramids.

9.4 Brief account about type of pyramids- biomass, number

9.4.1 Taking one ecosystem as a base detailing both the pyramids.

9.4.2 Some case studies (Kolleru, Edulabad water reservoir)

10. Natural resources

10.1 Introduction- By probing questions related to natural resources from specific situation from daily life

10.1.1 Resource used by human beings

10.1.2 Types of resources, classification

10.2 Consumption of natural resources- statistical data for eliciting the abuses (Comparison within two areas, Based on case studies)

10.3 Elements of abuse- Nature's fundamental principle, a letter of Mother Nature to people, greediness of human being, deforestation and desertification

10.4 Management and conservation- why conservation, How- World conservation strategies, Localized strategies, Case study of loss of agricultural resources in a particular district and its conservation.

ACADEMIC STANDARDS - VIII CLASS BIOLOGY

Chapter - I

What is Science

I. Key Concepts

1. Science - Perspectives
2. Scientific method - steps
3. Processing skills
4. Branches of Science

(i) Conceptual understanding

- Explains about science, steps in scientific method. Processing skills and branches of Science.
- Gives examples for processing skills.
- Gives reasons for why one should take precautions while doing.
- Explains what a good science learner does.

(ii) Questions - Making hypothesis

- Questions about the work of scientists, development mode of Science, steps in scientific method.
- Ties to understand the development of science & Scientific principles behind every instance.

(iii) Experiments & Field investigations (observations)

- Identifies the steps involved in scientific method of germinations seeds.
- Observes Processing skills in their day to day activities

(iv) Information skills & Projects

- Collects information about the branches of Science.

(v) **Drawing / model making**

- Draws different stages of germinating seeds.

(vi) **Appreciation & Aesthetic sense / Values**

- Appreciates the work of Scientists.
- Identifies and following the values of Biology.

(vii) **Application to daily life / concern to biodiversity.**

- Maintains personal & environmental Hygiene.
- Follows Scientific method
- Improves processing skills.
- Develops awareness to Vaccines.
- Takes precautions to preserve food materials.

Chapter - 2

Cell - Basic Unit of life

(i) **Conceptual understanding**

- Understands the circumstances that led to discovery of cell.
- Explains about the Scientists and their effort in discovery of cell.
- Understands that the cells are different sizes and shapes.
- Give examples of unicellular originations

(ii) **Questioning - Making Hypothesis**

- Make hypothesis of difficulties in for motion of tissues if the cells are of same shape

(iii) **Experiments - Field Observations.**

- Observe cells of onion peel under the micro scope.
- Prepares and observe the slide of cheek cells.

(iv) Information Skill- Projects.

- Collects the pictures of scientists who explained the cell structures.
- Collects information and pictures of structure of the cell and its organelle from internal and other sources.

(v) Drawing- Model Making.

- Draw diagram of different cells of human body.

(vi) Appreciation-Aesthetic Sense-Value.

- Appreciation the scientists for their works to explain the cell structure.

(vii) Application to Life- Concern to Biodiversity.

- Uses micro scope for different observations

Chapter - 3a

Story of Micro Organisms -1

Key concepts

1. Micro scope - Inventions of micro organisms.
2. Observations of micro organisms.
3. Observation of micro organisms in water and soil.
4. Identifying the virus as connecting link between living non-living things.

I. Conceptual Understanding

- Explains about microscope, Discovery of micro organisms, Micro organisms in environment, Staining of bacteria uses and harmful effects of micro organisms.
- Classifies the micro organisms into bacteria, Algae, Fungi, Protozoa and micro orthopods.
- Gives examples for micro organisms in soil and water
- Gives reasons why virus is a connecting link between Living and Non living things.

(ii) Questioning–Making Hypothesis

- Questions about the life of micro Organisms and disease causing micro organisms.
- Imagines about the micro organisms of soil, air, water and in the bodies of animals and human bodies.

(iii) Experiments - Field observation

- Prepares slides of bacteria from curd, micro orthropods, Protozoans, Algae, fungi and micro organisms of soil and water and observes under a microscope.

(iv) Information skills, Projects

- Collects the information to prepare a table regarding micro organisms - Diseases.
- Works for a project on micro organisms in a neighbourhood Pond with the help of a micro scope.

(v) Drawing - Model making.

- Draw the diagrams of micro organisms
- Makes models of micro organisms with clay or thermocol.

(vi) Appreciation - Aesthetic Sense - Values.

- Appreciates the inventors of micro scope and micro organisms and their efforts.
- Shows interest in uses of micro organisms in preparation of curd, cheese, antibiotics and bio fertlizers, and the investigations of Scientists in recognising harmful micro organisms.

(vii) Application to daily life - concern to biodiversity

- Uses of the useful microorganisms and careful about harmful micro organisms.
- Maintains personal and environmental hygiene.

Story of Micro Organisms -2

Key concepts

1. Useful micro organisms
2. Antibiotics, Invention of Vaccine.
3. Nitrogen fixation - Increasing the fertility of soil.
4. Harmful micro organisms.
5. Diseases caused micro organisms in plants Animals and Human beings and their spreading.
6. Preservation of food. Pasteurization.

I. Conceptual understanding

- Explains about useful, harmful microorganisms Pasteurization, nitrogen fixation and diseases caused by micro organisms in plants and human beings.
- Give examples for useful and harmful micro organisms.
- Give reasons for spoiling of food.
- Differentiates between antibiotics and vaccines.

II. Questioning - Making Hypothesis.

- Question the role of micro organisms in preparation of Bread, Cake, Curd, Idli, Dosa etc. and spread of diseases.
- Imagines what happens to unpasteurized milk and effect of diseases in plants if they are not controlled.

III. Experiments - Field Observation

- Prepare and observe the slides of micro organisms.
- Observe the details on milk packet, diseased plants and root nodules.

IV. Information skills - Project

- Understands the process of Pasteurization through a project.
- Gathers information about Vaccination antibiotics, spread of diseases in plants and human beings and their control

V. Drawing - Model Making.

- Draws diagrams of Pencillium, Nostac and anabena.

VI. Appreciation-Aesthetic sense - Values.

- Appreciates the work of scientists in the preparation of Vaccines, antibiotics, Pasteurization, Control of Diseass.
- Have gratitude towars micro organisms

VII. Application to daily life - concern to bio diversity.

- Understands the value personal & environmental hygiene in the Control of many diseases
- Encourages the people to take vaccinations and inoculations.
- Decides not use over dose of antibiotics.
- Takes Precautions in preservation of food.

Chapter - 4

Reproduction In Animals

Key concepts

1. Types of reproduction in animals.
2. Type of asexual reproduction - Budding Binaryfission.
3. Sexual reproduction - Female, male reproductive systems - fertilization - growth of embryo.
4. Life history of frog.
5. Cloning.

I. Conceptual understanding.

- Explains about oviparus, Viviparas organisms sexual - Asexual reproduction, cloning and life history of frog.
- Differentiotes between sexcal - asexual reproduction

- Compares the reproduction in hydra & Amoeba
- Differentiates internal and external fertilization.

II. Questioning - making hypothesis.

- Questions about reproductive methods in plants and animals, stages of metamorphosis make hypothesis the consequences if large number of eggs are not released in fishes and frogs and inherited characters.

III. Experiments - Field Observation

- Observes the male, female reproductive parts of plants and make a note of them.

IV. Information skills - Projects.

- Executes project on Different Stages of life of frog record the result and prepare the report.
- Gathers information about the animals which are cloned.

V. Drawing - Model making

- Draw diagrams of asexual reproduction in amoeba, hydra, Male & female reproduction system in human beings. Ovum and sperm. Stages of life cycle of frog.

VI. Appreciation - Aesthetic sense - Value.

- Appreciates the wonderful creation of male and female reproductive systems in plants and animals.
- Appreciates the intelligence of Scientist for effort in creation of clones and test tube babies.

VII. Application to daily life - concern to biodiversity.

- Applies the knowledge of reproduction in rearing fishes in the aquarium and growing school & kitchen garden.

The age of Adolescence

Key concepts

1. Changes in adolescence
2. Reproductive stage in Human beings.
3. Child marriage
4. Effect of hormones in adolescence.
5. Adolescence health

I. Conceptual understanding

- Explains the changes occurred in adolescence, reproductive stage, effect of hormones and health of adolescence.
- Gives reasons for the physical changes in adolescence.
- Differentiates between male and female reproductive stages.

II. Questioning - Making Hypothesis

- Questions about the physical changes and effect of hormones on adolescence stage.
- Make hypothesis the ill effects of child marriages and effect of bad companionship and bad habits.

III. Experiments - Field observations.

- Observations physical changes, effect of hormones, youth with good and bad behaviour.
- Read quotes of Vivekananda and observe and follow good behaviour.

IV. Information skills - Projects.

- To understand adolescence does self observation.
- Collects information of friends through check list before befriending.
- Prepare charts regarding healthy habits hygiene, exercise for adolescents and exhibits in the class.

V. Drawing- Model making

- Drawing diagram of placement of endocrine glands in the body.

VI. Appreciation- Aesthetic sense -Values.

- Prepare slogans against bad behaviour and to inculcate right path and behaviour.
- Finds indicator ways to use the leisure time for proper utilisation.

VII. Application to daily life - Concern to Bio - diversity.

- Uses the knowledge of adolescence to self.
- Knowledge of changes in adolescence removes the worries, myths and mis conceptions.
- Attains materials Physically mentally and emotionally.

Chapter - 6

Bio Diversity and its Conservation

Key concepts

1. Bio diversity in plants, animals, human beings and on earth.
2. Romagundam - Forest case study
3. Endangered animals.
4. Endemic species
5. Bio-diversity - Its importance.

I. Conceptual understanding

- Explains about biodiversity, endemic species, endangered species, importance of biodiversity need of national parks and sanctuaries.
- Differentiates among endangered species endemic species and invasive alien species.
- Gives example for the animals on the verge of extinction.
- Gives reasons for importance of biodiversity.

II. Questioning-Making hypothesis

- Questions about biodiversity, endangered species role of man in protection of biodiversity and establishing national parks & sanctuaries.
- Makes hypothesis of after effects of biological imbalance.

III. Experiments - Field observation

- Observes the bio diversity in the locality
- Observes the biodiversity in plants, animals humanbeings and on earth (activity 3,4)
- Prepares recycled paper.

IV. Information Skills - Projects.

- Collects information and pictures of animals from nearby sanctuary or wild life sanctuary or forest office.
- Collects information about the bird sanctuaries from internet
- Collects information about the meetings conducted on biodiversity.

V Drawing - Model Making

- Draw diagrams of endangered and endemic organisms

VI. Appreciation - Aesthetic sence - Values

- Appreciate the work of wild life sanctuaries in maintaining the biodiversity.
- Prepares slogans on importance of biodiversity.

VII. Application to daily life - Concern to biodiversity

- Raises Voice against human actions which destroy biodiversity. Suggests ways for protection of biodiversity.
- Be kind towards animals and plants and never harms them.

Different Ecosystems

Key concepts

1. Habitat, Ecosystem, foodweb, Producers
2. Consumer, decomposers, Food Chain

I. Conceptual understanding

- Explains the concepts like habitat, ecosystem food chain, food web, Producers, Consumers, decomposers.
- Narrates the relation between habitat and ecosystem
- Differentiates between producers and consumers.

II. Questions - Making hypothesis

- Prepares questions to find out the organisms found in one ecosystem are not found in the other ecosystem.
- Hypothesizes the consequences when consumer number increase than the producers.

III. Experiments - Field Observations

- Observes the food habits of different animals in different ecosystems.
- Observes the consequences when an organism from one ecosystem is introduced in another ecosystem.

IV. Information skills - Projects

- Collects the data of different organisms and their food habits in different ecosystems presents in a table.

V. Drawing - Model making

- Draw diagrams like food chain, food web

VI. Application - Aesthetic sense Value

- Appreciates the producers in ecosystem as they are the food in ecosystem.
- Understanding the fact that every organism is important in maintaining ecological balance hence it is the right of each organism to live hence appreciates the right of every organism.

VII. Application to life - Concern to biodiversity

- Understanding the interaction of organisms in ecosystem and habit at protects the biodiversity without doing once harm to habitats and organisms

Chapter - 8

Production of food from Plants

Key concepts

1. Crops Agricultural Practices
2. Crops that grown indifferent seasons
3. Crop preparing the soil
4. Selection of good seeds
5. Different types of sowing seeds
6. Harvesting - Storage of grains

I. Conceptual understanding

- Able to explain different agricultural practices.
- Differentiates between Kharif and Rabi Craps.
- Describes different methods of preparing land for different crops
- Give reasons for using good quality seeds.
- Explains different management methods for different crops.

II. Questioning - Making hypothesis

- Prepares questionnaire to find reasons for sowing some seeds in specific times.

III. Experiments - Field observation

- Observes why paddy crops need more water
- Visits fields to know different crop management methods.

IV. Information skills - Projects

- Collects information from agricultural officer low cost weeding process
- Collects information about high yielding crop varieties and prepares a table with collected data.

V. Drawing - Model making.

- Draw the diagrams of wooden plough, iron plough, seed drill etc.

VI. Appreciation - Aesthetic sense - Values

- Appreciates the efforts of farmers who cultivates food for the nation.
- Appreciates the efforts of scientists for developing high yielding crop varieties.
- Enjoys the beauty of fields and gardens.

VII. Application to life - Concern to biodiversity.

- Raises the crops using good quality varieties.
- Yet high yield through modern agricultural management processes
- Uses less chemical manures & pesticides, protects environment and biodiversity.

Chapter - 9

Production of food from Animals

Key concepts

1. Animal husbandry
2. High yield in milk production
3. Animal husbandry - Economic resources
4. Poultry - Profits
5. Apiculture
6. Fisheries - Fresh water, marinefishes aqua culture

I. Conceptual understanding

- Understands the concept of animal husbandry
- Explains the management methods in animal husbandry.
- Compares profits and lose in poultry
- Explains the pre cautions to be taken in apiculture
- Differentiates the practices in rearing fresh water and marine fish.

II. Questioning - Making hypothesis.

- Questions about the problems baced in animal husbandry
- Make Hypothesises the problems is hybridization would not taken place in food production

III. Experiments - Field observations

- Observeds the requirements in cattle rearing, poultry and aqwa culture etc.

IV. Information skills - Projects

- Visits and prepares a table showing investment and expenditure incurred in the fields of cattle rearing, poultry aqwal culture apiculture and sericulture etc.

V. Drawing - Model making.

- Identifies local and hybried cattle among the pictures given.

VI. Appreciation - Aesthetic sense - Value

- Be kind to cattle, fish, poultry, honeybus as they are providing to human needs.
- Appreciates the eforts of scientists for the high yeild from animals due to hybridization.

VII. Application to life. Concern to biodiversity

- Selects the hybrid or local breed animal according to the need and uses them.

Not for drinking Not for Breathing

Key concepts

1. Pollution - Concept
2. Pollution - Types
3. Causes / factors of pollution

Effects of Pollution

- Preventive measures of pollution

I. Conceptual understanding

- Understands the concept of pollution
- Explains types of pollution
- Analyses causes of pollution
- Explains ill effects of pollution
- Suggests preventive measures to reduce pollution

II. Questioning - Making hypothesis

- Prepares questions for additional information about pollution
- Makes Hypothesizes, the effects of increasing air, water soil pollution

III. Experiments - Field observations

- Prepares report on problems and diseases in animals and plants due to increasing pollution.

IV. Information skills - Projects

- Observes the pollution effected areas its effect on organisms due to air, water and soil pollution and prepares a report.
- Collects information to control pollution from pollution control board members, educators internet etc.
- Conducts a project on plants and crops around the factories, prepare a report.

V. Drawing - Model making

- Draw graph showing the percentage of gases in atmosphere

VI. Appriciation - Aesthetic sense - Values

- Appreciates the managements of factories / establishment those who treat the effluents before they are released into soil water and air.

VII. Application to life - Concern to biodiversity

- Uses bio pesticiedes instead of chemical pesticides and prevents pollution.
- Prepares organic manure with degradable waste instead of burying it
- Contributes in building pollution free country.

CHAPTER - 10

Why do we fall ill

Key Concepts

1. Health - Concept
2. Causes for ill ness
3. Diseases - kind of diseases
4. Spread of disease - Control

I. Conceptual understanding

- Explains the causes of disease
- Understands the treatment for the diseases
- Explains the mode of infection and its control measures.
- Explains the relation between un hygienic conditions and diseases.

II. Questioning - Making Hypothesis

- Prepares questionnaire to find reasons for spreading of diseases.
- Makes hypothesis to give reasons why some people die even after medication

III. Experiments - Field observations

- Observe and Prepares report showing relation between the habit at of the village and spread of diseases.
- Observes the people suffering with disease and record the charecteristics of the disease.

IV. Information skills - Projects.

- Able to record the diseases that occur in different seasons.
- Identifies and gives reasons for the frequently occuring diseases in the village.

V. Drawing - Model making

- . Able to draw different types of disease causeing organisms (staphylococci bacteria, Trypanasoma, Leishmania, Ascaris)

VI. Appreciation - Aestheticsense - Value

- Appreciates the efforts of scientists for their work in treatment and control of diseases.
- Appriciates the service of doctors.

VII. Application to life - Concern to biodiversity.

- Fallows and make others to follow personal hygiene and environmental hygiene.

ACADEMIC STANDARDS - IX CLASS - BIOLOGICAL SCIENCE

CHAPTER- 1

Cell structure and functions

Key concepts

1. Typical Cell
2. Cell - organelles - Functions
3. Types of cells
4. Cell theory

I. Conceptual understanding

- Explains cell structure, plant, animal cell, types of cells and cell theory.
- Differentiates plant and animal cell
- Give reasons for the existence of plastids in there
- Give examples for cell organelles

II. Questioning - making hypothesis

- Questions to understand the structure and functions of cell organelles.
- Make hypothesis the function of cell wall and what happens when it breaks.
- Make hypothesis about the size and function of vacuoles and consequences in absence of them.

III. Experiments - Field observation

- Prepares slide of cells and plasma membrane in Rio leaf.
- Observes cell membrane and nucleus in cheek cell slide.

IV. Information skills - Projects

- Gets information about lysosomes the suicidal bags and their function

- Tabulates cell organelles and their function.
- Collects information structure and function of cell wall, cell membrane.

V. Drawing - Model making

- Draw diagram of typical cell
- Make models of plant and animal cells
- Make model of mitochondria

VI. Appreciation - Aesthetic sense value

- Appreciations the role of cell in formation of body and metabolic activities
- Appreciates and respect scientists who described the cell and its organelles.
- Enjoys making slides

VII. Application to life - Concern to bio diversity

- Knowing the cell is basic unit of life and try to protect organisms and bio diversity
- Applies the knowledge of mitochondria in understanding respiration.

CHAPTER- 2

Plant tissues

Key concepts

1. Parts of plants - Functions
2. Meristematic tissues
3. Dermal tissues
4. Grand tissue
5. Vascular tissue

I. Conceptual understand

- Explains parts of plant, functions, dermal tissues, Ground tissue and vascular tissue
- Explains different plant tissues and functions.
- Describes different types of meristematic tissues and their location.
- Give examples where meristem locates.

II. Questioning - Making Hypothesis.

- Make hypothesis is what circumstances onions grow roots.
- Questions the relationship between growth and meristematic tissue.

III. Experiments - Field Observations

- Observes growth areas in plants.
- Prepares sections, slides of dermal tissues and stomata from Rheo leaf.

IV. Information skills - Projects

- Collects information regarding water transport in tall trees.
- Prepares a table showing different plant tissues and their function.

V. Drawing - Model making

- Draw diagrams of different ground tissues
- Draw diagrams of stomata and guard cells.
- Draw diagrams of T.S of stem

VI. Appreciation- Aesthetic sense-value.

- Appreciates role of meristem in growth
- Appreciates the functions of vacuole and stomata in water management
- Enjoys growing roots in onion, taking sections of it
- Develops patience while observing cells under microscope.

VII. Application to life - Concern to bio diversity

- Observes the hair on stem, leaf which grow from dermal tissues.
- Grows fast growing plants, encourage and protect bio diversity.

CHAPTER - 3

Animal tissues

Key Concepts

1. Functions of organ system
2. Types of epithelial tissues
3. Types of connective tissues
4. Types of muscle tissue
5. Nerve Cells

I. Conceptual under standing

- Explains functions of organ systems, epithelial tissues, connective tissue.
- Compares and differentiate epithelial, connective and muscle tissues.
- Give examples for muscle tissues
- Give reasons for the placement of different organs, bones and muscle in their give positions.

II. Questioning - Making hypothesis

- Identifies blood groups with help of kit
- Observes the blood reports in path lab
- Prepares slide of Blood smear and report it.

III. Information skills - projects

- Collects information on blood donation from internet
- Prepares a chart of different types of muscles, their characters and placement

IV. Drawing - Model making

- Draw diagram of Nerve cell
- Make model of nerve cell
- Draw diagram of epithelial tissue

V. Appreciation - Aesthetic sense - Values.

- Appreciates the work of WBC as scavengers, guard cells.
- Observes and analyze cartilage, nerve connective tissues, muscle tissues from butcher shop.

CHAPTER - 4

Movement of materials across the cell membrane

Key concepts

1. Materials entering and going out of cell.
2. Preparing sugar solution of different concentrations.
3. Osmosis
4. Filtration
5. Functions of cell membrane, importance of material transport.

I. Conceptual under standing.

- Explains about material transport through plasma membrane, preparing different concentration sugar solution, method of osmosis, filtration, function of cell membrane and its importance
- Give examples of material transport through plasma membrane.
- Differentiates between osmosis and diffusion.
- Give reasons how water enter the plants through roots.

II. Questioning - making hypothesis

- Make hypothesis of consequences when cell don't have permeability.
- Able to say what happens if osmosis does not take place in our body.

III. Experiments - Field observation

- Performs experiments to show transport of materials through plasma membrane
- Exhibits diffusion of using coffee powder, K.MnO₄ crystals and scent bottle
- Skill fully remove permeable membrane from egg.

IV. Information skills - Projects

- Collects information from internet and prepare report interesting facts about osmosis and diffusion
- Prepares table of material transport through cell membrane
- Recognizes saturated and solutions of different concentrations.

V. Drawing - Model making

- Draw picture of potato Osmometer
- Draw flow chart showing different stages of egg experiment

VI. Appreciation - Aesthetic sense - Values.

- Appreciates the permeability of plasma membrane
- Knows and understands the value of discrimination through plasma membrane and permeability

VII. Application to life - Concern to Biodiversity.

- Observes and use diffusion in day to day life.
- Applies the knowledge of filtration when he filters water or using water filters.

Diversity in Living organisms

Key concepts

1. Diversity in plants
2. Diversity in animals
3. Diversity in Human beings
4. Classification - Necessities evolution - history
5. Monera, Protista, Fungi, Plantae
6. Classification of animals.

I. Conceptual understanding

- Explains diversity in plants, animals and human beings.
- Explains the importance of classification, its organisation and history of evolution.
- Give examples of monera, Protista, fungi and plantae.
- Differentiates monocots and Dicot ?
- Differentiates amphibians and aves.

II. Questioning - making hypothesis

- Questions to know interesting facts about different flora and fauna
- Makes hypothesis of consequences if plants and algae do not possess chloroplasts.
- Questions about classification

III. Experiments - Field observation

- Identifies the specimen in lab.
- Observes different plants and animals and prepare report on their characteristics.
- Prepares slides of amoeba, Euglena etc.

IV. Information skills - Projects

- Collects information and pictures from internet about coral reefs, sponges and porifers.
- Collects and preserves plants like moss, fern prepares report on them.
- Prepares a table and report on diversity in plants and animals.
- Collects information about echidna, Platypus.

V. Drawing Model making.

- Draw a flow chart classifying the chordates into class and sub class.
- Prepares a flow chart of groups of animalia kingdom.
- Prepare models of bacteria, englena, Paramecium.

VI. Appreciation = Aesthetic sense - Values

- Appreciates the scientists for their contribution for classification.
- Appreciates the biodiversity
- Understanding the fact life is base of all diversified living things, inculcates the value for unity in diversity.

VII. Application to life - Concern to biodiversity.

- Observing the characters of organism and place in supporting groups.
- Under stands that diversity is necessary for existance of organisms and be kind to them.

Sense Organs

Key concepts

1. Sense organ - Introduction
2. Stimulus - response
3. Eye - structure, Function - Protection
4. Ear - Structure - Function Protection
5. Nose - Structure - Function Protection
6. Tongue - Structure - Function Protection
7. Skin - Structure - Function - Protection
8. Skin - Diseases

I. Conceptual under standing

- Explains about different sense organs
- Says differences among different sense organs in human beings
- Identifies the relation between sense organs.

II. Questioning - Making Hypothesis

- Questions about sense organs functioning
- Make hypothesis of absence of sense organs in man.

III. Experiments - Field observations.

- Observes sense organs with appropriate medical instruments.
- Prepares a repore on importance of sense organs.

IV. Information skills - Projects.

- Collects information and pictures related to different sense organs.
- Collects information about the diseases of different sense organs

V. Drawing - Model Making

- Draw diagrams of different sense organs and label them.
- Explains about sense organ with help of diagrams.

VI. Appreciation - Aesthetic sense - Value.

- Appreciates the function of sense organ which help in enjoying the beauty of nature.
- Appreciates the coordination (harmony) between the sense organs in process of their functioning.

VII. Application to life - Concern to bio diversity.

- Know how to take care of sense organs and follow the precautions to protect them.
- Takes care of sense organs.

CHAPTER - 7

Animal Behaviour

Key concepts

1. Animal behavior - Introduction
2. Animal behavior - types.
3. Differences between animal and human behaviour
4. Animals - Investigative behavior.

I. Conceptual understanding.

- Explains different kinds of behaviour in animals.
- Gives Examples for animal behaviour.
- Identifies the difference between human and animal behaviour.

II. Questioning Making hypothesis

- Questions the different behaviour of animals.
- Makes hypothesis based on instinct and their relations.

III. Experiments - Field observations

- Observes conditional behaviour of animals in lab.
- Observes the behavior of animals in natural and created environments studies the investigative behavior of animals.

IV. Information skills - Projects.

- Collects information about different behaviors of animals from different media.
- Prepares a report on animal behaviour in the surroundings.

V. Drawing - Model making

- Draws different animals pictures.
- Explains the behaviour of animals depicted in the pictures.

VI. Appreciation - Aesthetic sense - Value.

- Understands the behaviour of animals and be kind to them.
- Appreciates the behavior of animals in give situations.

VII. Application to life - concern to biodiversity.

- According to behavior of animals develops positive attitude towards them.
- Be kind to animals and takes action to protect them.

CHAPTER- 8

Challenges in improving Agricultural Products

Key concepts

1. Agriculture - Introduction
2. Methods to increase food production.
3. Relation between agriculture and irrigation.
4. Nutrients required by plants.

5. Need of crop rotation.
6. Cultivating Mixed crops.
7. Chemical and Bio fertilizers
8. Soil testing - Fermi Compost
9. Organic farming
10. Natural pest controlling methods.

I. Conceptual understanding.

- Explains different agricultural product.
- Relates the relation between irrigation and yield.
- Differentiates between chemical and natural manures.

II. Questioning - Making hypothesis.

- Questions to know the benefits of crop rotation.
- Make hypothesis benefits of organic farming.

III. Experiments - Field observation.

- Examines the soil sample in lab.
- Prepares vermi Compost.

IV. Information skills - Projects.

- Collects information about the methods used for different crops by farmers.
- Prepares report about the yearly yield of the farmers in the village.

V. Drawing - Model making.

- Draws pictures of different crop plants.
- Prepares graph of yield from different crops.

VI. Appreciation -Aesthetic sense - Values

- Appreciates the role of organic manures in protecting bio diversity.
- Appreciates the role of symbiotic rhizobium bacteria in root nodules of legume plants.

VII. Application to life - concern to bio diversity.

- Understands pest control measures used in agriculture.
- Encourages usage of organic manures.
- Learns about role of Bio Technology in agriculture.

CHAPTER - 9

Adaptations in different Eco systems

Key concepts

1. Eco system -Introduction
2. Adaptions in desert animals.
3. Adaptions in aquatic ecosystem.
4. Marine eco system
5. Freshwater eco system
6. Adaptions to temperature in animals.
7. Adaptions to temperature in plants

I. Conceptual understanding

- Explains different ecosystems.
- Differentiates between fresh water and marine eco systems.
- Compares the adaptions in animals with plants.

II. Questioning - Making Hypothesis

- Questions why adaptations for organisms.
- Makes hypothesis of co relation between eco systems

III. Experiments - Field observations

- Prepares slide of aquatic plant stem and leaves
- Identifies the organisms in different zones of marine eco system.

IV. Information skills -Projects

- Prepares list of adaptations in organisms in near by pond/lake (Under teacher's supervision)
- Prepares a report based on adaptations of organisms according to their ecosystem.

V. Drawing - Model making

- Draws pictures of flora and fauna of pond eco system.

VI. Appreciation - Aesthetic sense - Values

- Appreciates amphibians as they are wonderful organisms in adaptations
- Appreciates the adaptations in organisms as they struggle to live in adverse conditions.

VII. Applications to life - Concern to bio diversity

- Protects the habitats of some organisms which live in special circumstances destroyed by human actions
- Understands the diversity in eco system and tries to protect it with sympathy.

Adaptations in different Eco systems

Key Concepts

1. Pollution - Introduction
2. Soil Pollution - Physical properties of soil fertility - Organic matter in soil.
3. Factors of soil pollution
4. Bio magnification
5. Loses of deforestation
6. Urbanization
7. Effects of Soil pollution - Preventive measures.
8. Bio Remediation

I. Conceptual understanding.

- Explains pollutions, factors of pollution kinds of soil pollution, effects of pollution and preventive measures.
- Differentiates Bio magnification and Bio remediation.
- Gives reasons for urbanization.

II. Questioning - Making hypothesis

- Questions the effects of soil pollution on agriculture.
- Makes hypothesis the future consequences of if the soil pollution continues.

III. Experiments - Field observation

- Observes soil pollution and its factors
- Observes the pollution caused by plastic and hospital wastes.

IV. Information skills - Projects

- Prepares a table of factors of soil pollutants

- Prepares a report on managing the soil pollutants.
- Analyses the methods to prevent soil pollution

V. Drawing - Model making

- Prepares flow chart to prevent soil pollution
- Draw a picture depicting causes of soil pollution

VI. Appreciation - Aesthetic sense - Values

- Appreciates the role of micro organisms in increasing soil fertility.
- Appreciates soil as it is an important for all the organisms to live on it.

VII. Application to life - Concern to Bio diversity

- Stop using plastics bags to prevent soil pollution
- Prepares slogans to protect soil
- Grows plants as a part reforestation

CHAPTER - 11

Bio Geo Chemical cycles

Key Concepts

1. Bio Geo Chemical cycles - Introduction
2. Water cycles - Importance
3. Nitrogen cycle
4. Stages of Nitrogen fixation
5. Nitrogen cycle - Human actions
6. Photo synthesis
7. Carbon cycle Human actions

8. Green house effect
9. Oxygen cycle
10. Zone - Zone depletion

I. Conceptual Understanding

- Explains bio geo chemical cycles, nitrogen, oxygen, Carbon cycles
- Explains ozone layer and causes for its depletion.
- Give examples for bio geo chemical cycles in nature

II. Questioning - Making Hypothesis

- Questions why water is called universal solvent.
- Makes hypothesis the consequence in absence of Photo synthesis
- Makes hypothesis the importance of water cycle.

III. Experiments - Field observations.

- Does experiment artificial rain in school campus.
- Explains the depletion of ozone layer through experiment.

IV. Information skills - Projects.

- Prepares and analyses the effect of green house gases.
- Prepares report on effect of human activities in ozone layer depletion.
- Prepares a report on effect of water pollutants in water bodies.

V. Drawing - Model making.

- Draw diagram depicting bio geo chemical cycles.
- Explains exchange of water between earth and atmosphere with help of water cycle chart.

VI. Appreciation - Aesthetic sense - Values.

- Appreciates importance of photo synthesis in nature.
- Appreciates the co relation between biotic and abiotic components of nitrogen cycle.
- Appreciates the role of plants in balancing gas components in air.

VII. Application to life - concern to bio diversity.

- Aware of air pollution due to burning fuels, encourage wastage of fuels.
- Participates in debates and essay writing on importance of ozone.
- Prepare slogans on green house effect

10th Class - Advance Standards to be achieved

CHAPTER - 1

Nutrition

I. Understanding the content

- Explain the Difference between autotrophy and heterotrophy
- Explain the reasons for photosynthesis happening in plants and for not happening in animals.
- Explain differences between light dependent and light independent reactions.
- Tell the contrasts and comparisons between photosynthesis and respiration.
- Recognise the commonalities of food collecting methods in human and different animals.
- Explain the nutrition in parasites and plants with examples.
- Explain actirlies happens in different parts of human elementary canal.
- Explang the igesting system of dfferent food materials.
- Tell the difficulties and reasons related to indigestion.
- Explain the deseases due to mal nutrition with examples.
- Explain the reasons and difference between kwashorkar and marasmus deseases.
- Explain vitamin deficiency deseases and the resources of vitamins with examples.

II. Questioning - Making hypotheses :

- Questions the method of collecting the required materials for photosynthesis.
- Questions the food preperatory methods in plant parts which are not green.
- Hypathesise the expermental results of green plant light obsorption.
- Questions the need of reutlising the food materials prepared in plants.
- Try to know the reasons for some materials not digested in the stomach.
- Guess the consequences of mal nutritions food.

III. Experiments - Field trips

- Conduct the experiment that determines the presence of carbohydrates.
- Observe Prestlay's experiment and comment on the results.
- Conduct the experiment that determines the necessity of sun light for photosynthesis. Test to determine oxygen.
- Conduct the experiment that oxygen is produced during photosynthesis.
- Know the acidic and basic reactions in the alimentary canal through litmus test.

IV. Collecting the information

- Visit the health centre and collect the information on the diseases due to mal nutrition.
- Visit the families in the habitat and collect the information of the people suffering from the diseases due to vitamin deficiency and digestion related ailments and reasons for them.
- Collect the information on low cost nutritious food materials, the children of different ages through internet.

V. Drawing the diagrams - Making Models

- Draw the diagrams of the structure of the chloroplast and internal structure of leaf. Explain the importance.
- Draw and label the diagram of human digestive system. Explain its functioning.
- Draw the diagram of food collecting method of Ameatra. Tell the relation of excretion and collection.
- Make the flow chart of food movement in alimentary canal. Explain about peristaltic.
- Make the model of human digestive system. Explain the role of enzymes in digestion.

VI. Appreciating, having aesthetic sense

- Appreciate the process of making food by the green plants for the survival of the whole living organisms.
- Appreciate the efforts of these tests in photosynthesis.
- Observe in their locality the dependence of some plants on other plants.
- Appreciate the food collecting methods of the organisms.
- Appreciate the structure of the alimentary canal and the role of enzymes.

VII. Sympathy towards biodiversity

- Campaign on the importance of nutritious food. Put efforts that everyone should take nutritious food.
- Follow good, habits in order to healthy and makes others to follow it.
- Recognizes that different types of plants and animals depend one on another for their servival and identifies their maintainance in balancing the diversity. Prepares cartoons and essays reflecting that.

CHAPTER - 2

Respirtion

I. Understanding the content

- Explain the properties of the gases that release and absorb in respiration.
- Compare respiration with photosynthesis.
- Explain the contrasts between respiration and photosynthesis.
- Explain the differences between respiration and combustion.
- Explain the differences between aerobic and anarobic respirations.
- Explain the differences between the respiration in plants and animals.
- Explain the differences ebtween exhale and inhale.
- Explain the passage of air in respiration in different parts of the human body.
- Explain the functioning of epiglottlis while breathing and swallowing.
- Explain the relation between respiration and energy release.
- Explain the process of respiration.

II. Questioning and making hypatheses

- Question the release of energy in anaroebic respiration.
- Questions the release of energy in plants.
- Hypothesise what happens in the organisms at non-availability of respiratory materials.
- Hypothesise how the heat released from the body affects life processes.

III. Experiments - Field Trips

- Conducts the experiment of release and absorption of gases in respiration.
- Conducts the experiment the release of heat and carbondioxide in anaerobic respiration.
- Conducts the experment of CO₂ by product in energy release.
- Conducts the experiment of the release of heat energy and CO₂ in respiration.

IV. Collecting the information :

- Collect the information on the processes and composition percentages of releases in respiration through internet.
- Collects the information and pictures on the evaluation of respiratory organs in different animals.

V. Drawing the diagrams - Making Models :

- Draw and lable the diagram of metochondria. Explain how they are functioning as energy storages.
- Draw the diagram that shows the air spaces in leaf. Explains the gases exchanging system.
- Draw the diagram that shows the structure of alveoli of lungs and tells their functioning.
- Make the flow chart of the path of the air passage in respiration and explains it.

VI. Appreciating, having aesthetic sense :

- Appreciate the process of respiration in human.
- Appreciate the speciality of respiration and photosynthesis in plants are being opposite to each other mutually.
- Appreciate the energy releasing system in respiration. Follows correct respiratory methods and pranayama.
- Appreciate the role of fermentation in materials buomening.

VII. Sympathy towards Biodiversity :

- Observe in real life processes the method of respiration in different organisms.
- Recognise the importance of inhale, exhale in respiration.
- Knows how respiration helps for the survival of the organisms.

Blood Circulatory System - Academic standards

I. Content Understanding

- Explain the relations between the pulse rate and heart beat.
- Explain different parts and their functioning of heart.
- Explain the differences between arteries and veins.
- Recognizes the differences between single circulation, double circulation. And explain the reasons for it.
- Tells the differences between circulation and transportation of materials in plant.
- Explain the differences between xylem and phloem.
- Explain the method of root hairs absorbing water.
- Explain with examples how root pressure, transpiration for the transportation of materials.

II. Questioning - making hypothesis

- Questions the place of heart valves in circulation.
- Questions the relation between heart beat and circulation.
- Hypothesise the physical actions that happens in plant when transportation of materials.
- Hypothesise the consequences in plants in xylem is removed.

III. Experiments - Field Trips

- Observes the internal structure of goat's heart by doing dissection.
- Observe the blood pressure by using stethoscope and sphygmomanometer.
- Observe root pressure through rubber tube experiment.
- Conducts the experiment of transpiration by using polythene sac.

IV. Collecting the Information

- Collect the information on relation among body weight, heart weight and heart beat of different animals.
- Collect the pictures, information on evolutionary order of the heart of different animals and make reports.

V. Drawing the diagrams - making models

- Draw and label the internal structure of the heart, make model.
- Draw the chart of single, double circulation.
- Make the flow chart of the cardiac cycle.
- Draw the diagrams of different cells of xylem and pheaom.
- Make the model of stethoscope. And hear the heart beat with this.

VI. Appreciating, having aesthetic sense

- Appreciates the function of circulatory system and heart in humans.
- Appreciates the mechanism of food and mineral salts transportation in tall trees.
- Praises the system of circulation affecting heart beat.

VII. Sympathy towares biodiversity

- Knows the importance of circulatory system in humans.
- Knows the adverseties of high blood pressure. Follows good health habits.
- Observes the diversities of circulatory systems in different animals.

CHAPTER - 4

Excretion - Academic Standards

I. Content Understanding :

- Explains with examples different excretory materials in human.
- Explain the differences between the exretory material of animals and that of humans.
- Explain the functioning and structure of different exretory organs in human.
- Explains with examples the excretory materials that formed in plants and explain their economic importance.
- Recognizes the differences between excretion and secretion.
- Copares the method of blood purification with the method of filtration.

II. Questioning - making hypotheses

- Questions the system of urine formation in human.
- Questions the system of blood purification done by kidney.
- Hypothesise what happens if the kidney do not purefy the blood. Hypothesise the situation when excretion is needed in plants.

III. Experiments - Field Trips

- Observes the kidney of goat / sheep or its model by dissecting it.
- Observes the internal structure of the kidney and explains it.
- Knows the method testing of urine sample / blood sample.

IV. Collecting the Information

- Collects the information of endocrine glands in human, the harmones they secrete and their effect on the body through internet.
- Collects the details of phytoharmones that resctricts the growth of different plants.

V. Drawing the diagram - making models :

- Draw and lable the diagrams of human brain, newron and spinal cord.
- Draw and label the diagram of reflex arc.

VI. Appreciating and having aesthetic sense :

- Appreciates the coordination of diffrent parts of the body are under the control of nervous system.
- Appreciates the impact of harmones on plant's growth.

VII. Sympathy towards Biodiversity :

- Knows the importance of growth hormone.
- Apply the coordination of different plants of the body with real life situations.

Reproduction - Generating System

I. Understanding the content :

- Explains the method of sexual reproduction.
- Explains different types of asexual reproductive systems of human.
- Explain the male and female reproductive systems of human.
- Explains the relation between child birth and child marriages.
- Explains the method of sexual reproduction in plants.
- Tells the types of cell division and the differences between them.
- Suggests different methods of population control.

II. Questioning - Making Hypotheses :

- Questions about the diseases in human that comes through sexual reproduction.
- Hypothesise the products that formed by cell division.
- Imagines the consequences that occur if the sex chromosomes are not formed in organisms and if there are deficiencies in reproductive system.

III. Experiments - Field Trips :

- Explains the structure of Rhizopus, Fungi by observing them through microscope.
- Explain the functioning of the sexual parts of the flower by directly observing it.
- Observes the permanent slide of pollen grain and knows its developmental stages.

IV. Collecting Information :

- Collects the information through internet about the methods of asexual reproduction that are given in the text book.
- Collects the information and make a report about HIV/AIDS, its treatment and prevention through school library, internet.

V. Drawing the diagrams - making models :

- Draw and label the diagrams that show the methods of asexual reproduction in different plants.
- Draw the LS of the flower. Explain the method of reproduction.
- Draw and label the diagrams that explain sexual reproduction in plants.

VI. Appreciating, having aesthetic sense :

- Appreciates the formation of adult organism in plants and animals from very tiny cells through fertilization.
- Knows sexual health and follows the values.

VII. Sympathy towards biodiversity :

- Recognizes the diversity in the method of vegetative propagation in different plants.
- Discuss on sexual health, participates in awareness programmes.

CHAPTER - 7

Coordination in life processes

I. Understanding the content :

- Knows what's hungry ?
- Knows the changes in our body that occurs due to hunger.
- Knows the relation between hunger and smell.
- Recognizes that the mouth is the food chewing machine.
- Knows the differences among the different teeth in our mouth.
- Knows that the food passes in the elementary canal through peristaltic movements.
- Knows that the stomach is mixing and digesting machine.

II. Questioning - making hypotheses :

- Knows how the food digest in the stomach through questions.

III. Experiments - Field Trips :

- Knows the taste of jeera, sunf, apple, tomato just by chewing without seeing them.
- Knows the smell of asafoetida, garlic by smelling them with closed eyes.
- Knows how the food breaks down by using the model of chalkpieces kept in vinegar.
- Knows what happens if the flour is kept in the mouth for sometime.
- Knows the pH of mouth at intervals of one hour.
- Knows how bolus moves in the elementary canal by keeping potato in a cycle tube.

IV. Collecting Information :

- Collects the information on the types of teeth in the mouth, their structure and the method of cleaning them through library books.

V. Drawing the Books - making models :

- Draw and label the diagram of taste buds on the tongue.
- Draw and label the teeth in the mouth

VI. Appreciating, having aesthetic sense :

- Knows, how different types of teeth are useful in real life.
- Appreciates different life processes being related to one another.

VII. Sympathy towards Biodiversity :

- Comments on the diversity and coordination among different life processes in the human body.
- Prepares cartoons and poems about the diversities in life processes.
- Recognizes that every life process is an important one and behaves carefully at them.

Heridity

I. Understanding the content :

- Understands the diversity and its importance.
- Explains with examples the researches of Mendal and his Biography.
- Explain the law of dominance, Law of segregation.
- Explains the importance of diversity in the population.
- Explains acquired, inherited characters.
- Understands and comments on the experiments of Lamark, Darwin and their biographies.

II. Questioning - making hypotheses :

- Questions the trails of heridity, formation of new species and evolution of organisms.
- Hypothesise the later stages of evolution in beetle.
- Hypothesise on the future issues in the evolution order of human.

III. Experiments - Field Trips :

- Proves Mendal's principles expermentally.
- Explains the diversity in population, through beetle experiment.

IV. Collecting the information :

- Fill the table with the information of five friends. Analyses semlarites and their characters.
- By seeing the physical features like nose, forehead in the mirror, fill the table whether they resemble their mother/father/father-in-la2/mother-in-law.
- Prepares the scrap book with the picutres and information related to fossils.

V. Drawing the diagrams - making models :

- Make the flow chart showing the ratios of monohybrid cross and disybrid cross.
- Make the flow chart showing sex determination in humans.

VI. Appreciating, having aesthetic sense :

- Appreciate the efforts of Mendal, Lamark, Darwin.
- Appreciates determining the age of fossil by using carbon dating method.
- Recognizes the relations among organisms in the evolution.

VII. Sympathy towards biodiversity :

- Recognizes diversity in evidences from embryology.
- Comments on Darwin's theory by applying it ot organisms.
- Makes cartoons, characters on human evolution.

CHAPTER - 9

Our Environment

I. Understanding the content :

- Describes food relations, different types of pyramids in ecosystem.
- Explains the impact of human activities on environment.

II. Questioning - making assumptions :

- Questions the food relations among the organisms in ecosystems.
- Questions the disasters related to ecosystem.
- Make hypothesis on the situations due to the change in the number of organisms in ecosystem.
- Make hypotheses on human activites and their impact on environment.

III. Experiments - Field Trips :

- Observes different food chains and the food relations among them in his/her environment.
- Observes the number of organisms and their relations in different ecosystems.
- Observes and make reports on human activities and their impact on ecosystems.

IV. Collecting the information :

- Collects the information on the pollutants that join in the ecosystems of their environments.
- Collects the information of environmental disasters that happened in different countries of the world.
- Makes the reports on human activities and their impacts on environment.

V. Drawing the diagrams - Making Models :

- Make different food chains through pictures.
- Makes the model of ecosystem's number pyramid and comments on that.

VI. Appreciating, having aesthetic sense :

- Appreciates the food relationships among the organisms in the ecosystem.
- Shows respect towards nature/environment for having living and non-living organisms and helps the human survival.
- Shows individual responsibility and social consciousness towards environment.
- Feels happy by observing different ecosystems.

VII. Sympathy towards biodiversity :

- Takes the decision to save the organisms and resources as he/she feels that for the survival of the organisms the food relations among them are necessary.
- Encourages and creates the human activities that helps the ecosystems.
- Student, prevents joining of toxins / pollutants in the ecosystem.

CHAPTER - 10

Natural Resources

I. Understanding the content :

- Explains the conservative methods of natural resources.
- Gives examples for water conservative methods.
- Tells reasons for the reduction of natural resources.
- Explains about persons and organizations that follow different methods in utilising different types of natural resources.

II. Questioning - making assumptions :

- Questions on conservation and misuse of natural resources.
- Makes hypotheses on the impact of human activities on natural resources.
- Questions about renewable resources.

III. Experiments - Field Trips :

- Observes keenly the issues like water resources, insects in his/her environment.
- Observes the biodiversity in villages and other places.
- Observes the methods of garbage throwing in their houses.

IV. Collecting the information :

- Collects the information on the preventing methods of water misuse which is the main aspect of natural resources and its implementing methods.
- Acquires the information analysing skill from the given graph.
- Can take the project work in survey form.
- Make the tables with the names of persons, organisations that work for the conservation of natural resources.

V. Drawing the diagrams, making models :

- Prepares flow chart on the methods natural resources conservation.
- Draw the graph on the collected information.

VI. Appreciating, having aesthetic sense :

- Appreciates the role of natural resources in human survival.
- Have the conscious to conserve the natural resources. Prepares essays, pamphlets explaining it.
- Appreciates the persons, organizations that participate in conservation of natural resources.

VII. Sympathy towards biodiversity :

- Follows, encourages the methods of natural resources conservation.
- Recognizes biodiversity and save them with honour.
- Recognizes the importance of 3R's and follow it in daily life.

6

Teaching Learning Strategies

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

Let us observe some of the important teaching learning strategies :

- Discussions - Responses
- Reading the lesson
- Asking questions
- Conducting experiment
- Enquiry and problem solving
- Project work
- Field investigations
- Information skills - Data collection, Analysis - Tabulation
- Report writing
- Quiz
- Seminar
- Symposium
- Puzzles

- Drawings, making models, plotting graph
- Collection of scientific stories, Rhymes
- Preparation of cartoons
- Conducting lecture the eminent personalities
- Interviews
- Preparation of substitute apparatus, conducting substitute experiments
- Utilization of library and internet.

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 mindmapping. 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 fixe 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

VIII CLASS - BIOLOGY - SYLLUBUS

Theme : How organisms formed

Lesson Name : What is science

No.	Key Concepts	Teaching / learning stratagies	Teaching learning process / sources
1.	<p>What is science</p> <ul style="list-style-type: none"> ● Science personal perspective ● Science social perspectier ● Science change ● Science change 	<ul style="list-style-type: none"> ● Discussion on science, nature secrets of nature, truth of nature reasons and understanding ● Water, measuring jar ● Give examples of different organisms, stars galaxies ● Learns some by doing experiments ● Discuss why scientist do experiments again and again ● Discussion on relation between science and society, solutions for the problem faced in the society, resources and effeort of scientisty ● discussion on how knowledge of science is changing day by day. ● Discuss the changes occuring in the results, theories and experiments of science ● Discussion on how knowledge of science is changing day by day ● Discuss the changes occuring in the results, therories and experiments of science ● Discuss how scientist invent new theories, real secrets of science and method of science 	<ul style="list-style-type: none"> ● Discussion on different soils, seeds ● Scale, note book, graph, water, soil ● Discussion giving exampels, observation, spring balance weighing scale, bulb, holder, battery, paper, clips, towel ● Analysis of data, graph, chart Tester, screw driver, insutation lape, current wires, woodenscale, blade, bulb, fuse ● Understanding through discussion ● Chart showing the different branches of science

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● How scientists work - scientific method - process of investigation ● Continue experimenting ● Using scientific process skills ● What is needed for investigation and invention ● Reading for learning ● Reporting the information ● Science safety ● There is proper method in making hypothesis and inventing new theories ● Branches of science 	<ul style="list-style-type: none"> ● Discuss scientific method, and how it helps in solving problems ● Discuss process skills, steps to followed in scientific method ● Do some experiments ● Examines the correctners of hypothesis ● Understands to use process skills, to plan an experiment and classify the works. ● Use of processing skills ● Proceing the hypothesis ● Planning & perform experiment ● Controlling factors ● Discuss how to read, how to understand ● Presenting the information and ideas using numbers analysing data, measuring using statistycal data. ● Uses measuring experiments, present in tables, charts and graphs ● It is importanat to plan, keeping clean, questioning, safety of eyes, keeping away shock are essential ● Discuss about identifying problem, making hypothesis, collecting data, proving the hypothesis in an order ● Understand different branches of science 	<ul style="list-style-type: none"> ● Observation, questioning ● Making hypthesis ● Planing experiments ● Procing and presenting results ● Observing the experimental skills. comparing ● Discussion ● Making hypothesis of use of sample, ● Thinking, Discussing identifying. ● Observing, proving, describing, collecting ideas analysing skills graphs. ● Measuring equipments. ● Discussion ● Discussion ● Chart showing different branches of science.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Discovery of cell ● Observing the cells in matchstick ● Diversity in cells ● Observing leaf cells ● Observing different cells of human body 	<ul style="list-style-type: none"> ● Learns about history of cell. ● Observe thin layer of cells of matchstick under microscope ● Slip, water, microscope. ● Learns about the diversity of cell in their shapes, size and number ● Observes unicellular organisms learns metabolic activities carried in single cell ● Observes thin layers of glass blade and compare with other glass blade ● Observes different section of leaves stems and identify cells ● Observes slides and charts of different cells in human body and identify them 	<ul style="list-style-type: none"> ● Discussion - Pictures of scientists, cork microscope, chart. ● Observation, Experimental skills, Drawing diagrams, matchstick, blade, brush, slide, cover ● Observing identifying cells, chart showing different cells. ● Slides and charts of unicellular organism ● Observation, compare, identify ● Experimental skills ● Tender glass blade, slide, water coverslip, brush, microscope ● Observation, explanation, compare ● Charts and permanent slides of different cells of human microscope

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Reading for learning ● Reporting the information ● Science safety ● There is proper method in making hypothesis and inventing new theories ● Branches of science 	<ul style="list-style-type: none"> ● Discuss how to read, how to understand ● Presenting the information and ideas using numbers analysing data, measuring using statistical data. ● Uses measuring experiments, present in tables, charts and graphs ● It is important to plan, keeping clean, questioning, safety of eyes, keeping away shock are essential ● Discuss about identifying problem, making hypothesis, collecting data, proving the hypothesis in an order ● Understand different branches of science 	<ul style="list-style-type: none"> ● Thinking, Discussing identifying. ● Observing, proving, describing, collecting ideas analysing skills graphs. ● Measuring equipments. ● Discussion ● Discussion ● Chart showing different branches of science.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
3.	<ul style="list-style-type: none"> ● Discovery of micro scope and micro organisms ● Micro organisms ● Micro organisms in water ● Observing fungi ● Observing other micro organisms 	<ul style="list-style-type: none"> ● Learns the discovery and history of microscope and micro organisms ● learn about different micro organisms ● Observes pond water rich in micro organisms and pelgic algae under a micro scope and understand the structure and kinds of micro organisms. ● Learns about different kinds of algae decaying vegetables breadmould, slide, coverslip, microscope. ● Observes bread mould, other fungces under microscope. ● Observes bacteria, algae protozoa, micro orthropods and soil micro 	<ul style="list-style-type: none"> ● Discussion, chart showing single lence microscope, photo of antony van leunhawk. ● Observation of different micro organisms/ slides draw diagrams ● Experimental skills, observation drawing skill, microscope, pond water scope, pond water rich in algae slide. ● Discussion, decaying wood, mushrooms, ● Experimental skill, observation, drawing diagrams. ● Observation, experimental skill, discushion, bettermilk, card, slide, coverslip, crystal violet solution, dry grass, water beater, glass soil from fields, bacterial, algae protozoa, slides & charts

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
4.	<p>Micro organisms</p> <ul style="list-style-type: none"> ● Useful micro organisms ● Observing the change of milk into curd ● Effect of yeast on flour give reasons. ● Give reasons for fermentation of idly, dosa bread butter ● Economic uses micro organisms 	<ul style="list-style-type: none"> ● Are micro organisms friends ? or enemies ● Learns some microorganisms are used preparing foods like idly, bread, dosa, cake etc. some are used in preparing medicine and increasing soil fertility ● learns lactobasillus bacteria turns milk into curd when add curd to warm milk. ● Raising (puffing) of yeast mixed dough ● 2 cups maid a flour dry yeast fermented and unfermented idly dosa batter. ● Learn reasons for the sweet smell of sugar solution mixed with yeast ● Alcohol / wine / bear, acitic acid ethyl alcohol from molases are prepared industrially by the process of fermentation 	<ul style="list-style-type: none"> ● Discussion ● Discussion ● Observation, experimental skills, warm milk, milk, two bowls, butter milk/curd. ● Observation, explanation. ● Observation, explanation, beakers, 2 bowls, water, yeast sugar ● Discussion, samples of alcohol, wine, bear, acetic acid

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Role of micro organism in field of medicine ● Antibiotic penicillin discovery ● Vaccine ● Visit Health ● Micro organisms in soil, soil fertility 	<ul style="list-style-type: none"> ● Antibiotics to treat cholera, typhoid, T.B. Gonorrhoea diarrhoea are prepared from micro organisms. ● Learn story of penicillin ● Learns that vaccines are used to prevent disease like polio etc. ● Learns vaccines can prevent diseases in animals also ● Collects data from doctor or volunteer about the vaccinations done at different ages of baby ● Learns the role of micro organisms in nitrogen fixation in soil. Nutrients for plants 	<ul style="list-style-type: none"> ● Discussions ● Samples of antibiotics ● Names of antibiotics chart ● Discussion, sample of Penicillin ● Pictures of Dr. Y.V. Subbarao, Alexander Fleming ● Picture of polio vaccination ● Discussion ● Jonas salk picture ● Collect information, exhibit, explanation ● Chart showing data of vaccination ● Picture of Edward Jenner and child affected by smallpox ● Discussion

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Nitrogen fixation ● Observing root nodules ● Preparing compost pit ● Harmful micro organisms ● Micro organism casuee diseases in Human beings ● Communicable diseases ● Micro organisms cause diseases in animals ● Disease causing microorganisms in plants 	<ul style="list-style-type: none"> ● Learns that Rhizobium in root nodules of legumancae plants fixes atmospheric nitrogen into nitrotes ● Collects root nodules of legumes ● Observes powder of root nodules under micro scope ● Prepare a compost pit and prepare compost from decomposing material ● Learns about micro organisms that causes diseases in plants and animal ● Learns that food materials clothes etc are spoiled by micro organisms. ● Visit doctor and collect information of disease causing micro organisms and diseases caused by them ● Learns communicable diseases like cold, conjunctivitis, smallpox, swineflu, TIB, Chickengunia caused by micro organisms ● learns some insects acts as carriers for micro organisms. Ex-plasmodium the malarial parasite is carried by mosquito ● discuss other disease caused by micro organism ● learns from tables ● Anthrax in Goat & Sheep, galikunta in cattle, rabis in dogs, Birdfly in poultry are caused by micro organisms. ● Discuss about bacteria, Fungi Virus that cause diseases in plants 	<ul style="list-style-type: none"> ● Discussion ● Root nodules of pea plant ● Collecting, observation, indentification ● Experimental skills ● Discussion, Chart of anaphelous mosquito, slide of plasmodium in RBC, picture of Rorald Ross food, flies picture ● Chart of diseases caused by micro organisms ● Questioning, collecting information ● Discussion ● discussion ● Disease causing microorganisms in animals - chart ● Discussion ● Plants - micro organisms - diseases chart

Theme : How organisms formed**Lesson Name : Story of micro organisms**

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Food poisoning ● Storage of food hot and cold methods ● Pasteurization 	<ul style="list-style-type: none"> ● Learns Micro organisms like clostridium and botexlinam causes food poisoning ● Learns protecting food from micro organisms in the form of jams and pickles ● Learns heating / Freezing the food are some methods of preserving food ● Learns milk can be stgored by pasteurization method ● Learns method pasteurization 	<ul style="list-style-type: none"> ● Discussion on food poisoning, collect ● Discussion ● Methods of preserving food - chart ● Samples of preserved food ● Discussion ● Picture of lowis pasteur

Theme : How organisms formed**Lesson Name : Reproduction in animals**

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
5.	Oviparus and viviparus animals <ul style="list-style-type: none"> ● Types of reproduction, Asexual reproduction ● Sexual reproduction ● Life cycle of frog ● Story of dolly 	<ul style="list-style-type: none"> ● Learns about oviparus and viviparus animals ● Observes slides of budding inhydro, yeast under micro scope ● Learns male and female reproductive parts and their function ● Learns male and female reproductive organs structure and function in human beings. Eg - Ovum, sperm. ● Discuss about internal and external fertilization ● Learns the reason for resemblences of parents in their progeny. ● Learns about life cycle of frog, method of metamorphosis ● Does project life cycle of frog, and discuss Eg - observation of tadpole larva ● Discuss and learns about closing and creation of Dolly 	<ul style="list-style-type: none"> ● Observation, discussion, pictures - chart ● Experimenal skills, observation, ● Chart of budding in hydra & Yeast ● Observation, discussion ● Collect flower reproductive parts chart ● Female & male reproductive organs in human beings Fertilization, Duum - sperm, charts ● Collecting material, observation experimental skills ● Doing projects following steps ● Life cycle of frog - chart wide mouthed transparent bottle tub, glass, dropper, petridish, pebbess, magnifying glass, beaker, eggs of frog / larvae ● Discussion, pictures of Dolly & Ionwilmatt.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
6.	<ul style="list-style-type: none"> ● Changes in adole adole scence ● Growth of reproductive organs ● Reproductive age in human beings ● Child marriage a social evil ● Fast and frigid last and frigid ● Hormones and adole ● Adolescence 	<ul style="list-style-type: none"> ● Observes growth and its rate ● Discuss the changes in bodies of girls & boys. ● Observes voice breaking, adams apple in boys ● get to know about sweating and pimples in adolescence ● Learns about growth of reproductive organs, mesutrial cycle in women, ovulation in women release of sperms in boys, process of fertilization ● Learns that child marriage is a social evil, marriage age, consequences of child bearing at young age ● Discuss on behaviorial changes like ● Learns about Female and male reproductive hormones and their function ● Learns about balanced diet, clearliness, physical exercise needed for the fast growing age 	<ul style="list-style-type: none"> ● Discussion, observation, preparing tables ● Assessing, drawing ● Changes in adolescence chart, graph of heights ● Chart of adams apple ● Discussion, menstrual cycle, reproductive reproductive system flowchart ● Explanation, drawing diagrams ● Discussion ● Discussion ● Discussion, drawing - observation ● human endrocrive glands chart ● Prepare tales ● Chart - Balanced diet

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
7.	<ul style="list-style-type: none"> ● What is bio diversity? <p>Finding variations in plants and animals</p> <p>Bio diversity a case study</p> <ul style="list-style-type: none"> ● Endangered species ● Engenic species ● Species Concept ● Origin of biodiversity and balance in nature ● Importance of biodiversity and its. Conservation 	<ul style="list-style-type: none"> ● Learns about different kinds of flora and fauna through activity ● Learns living organisms vary in different aspects like colour, size, shape etc., ● Observes variations in plants, animals and students in class ● Learns need of Biodiversity through a case study ● Collects information about endangered species. ● Learns about Red Data book ● Come to know what are endemic species and area of endemic species. ● Learns about species concept and it, is neet found in plants and animals that reproduce asecually ● Learns the ways to keep up balance in nature and bio diversity ● Learns that balance in nature in maintained even after natural calamities wipes away eco systems. ● Learns importance of small insects in nature ● Conservation of bio diversity is essential of human beings 	<ul style="list-style-type: none"> ● Observation, recording ● Pictures of Gooty Tarantula spider, Indian bustard. ● Discussion ● Sketch of nouse and surroundings ● Activity skills, observation ● Biodiversity on earth, Discussion ● Discussion ● Discussion, collection of picturers endangered species chart ● Pictures of endenic species, chart ● Discussion ● Discussion ● Discussion ● Pictures of Alien Invasive species ● Discussion, observation ● Honey bee, butterfly pictures.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
8.	<p>What is eco system? structure of eco system</p> <ul style="list-style-type: none"> ● Interdependence ● Changes in the eco system ● Types of eco-systems ● Energy flow in eco system 	<ul style="list-style-type: none"> ● Know about eco systgem through an activity of observation of organisms ● Learns enterdependence of biotic component by study of food chain and eco systems, food chain and food web. ● Discuss and below the changes in eco systems. ● Know that eco systems develop due to abiotic factors. ● Know the relation and inter dependence of biotic and abiotic comporentes in eco system ● Under stands types of ecosystems like dessert, water, forest eco systems ● Know about energy flow in the ecosystem and energy transfer in different traphic levels 	<ul style="list-style-type: none"> ● Discussion ● Experimentation skills observation ● Measuring tape, thread, small sticks, magnifying glass, crownar ● Observation, activity, dawning, chart showing iner dependece of biotic compornet in ● Discussion, chart showing different eco system ● Discussion, picture of koringa mangrooves, desert ecosystem, forest eco system, ● Picterres of flora and fauna of different ecosystems <p>Chart showing energy flow in ecosystem</p>

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Crops in India ● Production of Paddy ● Germination ● Different types of sowing seeds transplantation ● Applying manure and pesticides ● Pest control 	<ul style="list-style-type: none"> ● Know the different crops grown in India ● Knows when crops are grown ● Collects information of crops ● Discuss the process of agricultural practices involved in production of paddy in different countries ● Preparing soil, levelling, sowing seeds ● Selection of good seeds, and seed crisis ● Know the methods of protecting seeds from pests and micro organisms ● Know different seed drills for sowing and transplantation ● Methods of transplantation and machines used for transplantation ● Know the need of manure and pesticides in crop protection. ● Know to identify pests ● Know the pest controlling process followed by farmers and preventive measures taken up. 	<ul style="list-style-type: none"> ● Discussion graph ● Map of crops in India. ● Duration of crops ● Discussion, observation ● Chart showing the production of paddy in Pictures of different ploughing appliances, leveling appliances. ● Glass of water, ● Chart showing methods of sowing ● Discussion, observation ● Discussion, observation ● Chart showing sowing methods, sowing machines ● Charts showing paddy plants. ● Discussion, collecting sample of infected paddy leaves ● Chart showing characters of infected plants ● Collection of infected parts of plants. ● Discussion ● Charts - Methods of pest controlling ● Charts of diseases like aphids, viruses, tikka.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● How do farmers get high yeilds. ● Irrigation ● Modern methods of irrigation ● Weeding ● Harvesting ● Storage of grains 	<ul style="list-style-type: none"> ● Know the use of natural and artifical manures ● Discuss profit and loss in the yeild. ● Know to identify good manures ● Discuss the consequences of over dosage of manure to soil. ● Knows about furrow and basin irrigation ● Discuss why water is essential for plants ● Collects information when farmers irrigate their fields ● Know the methods of drip irrigation and sprinklers ● Knows about weeds, process of weeding machines used for weeding ● Know harvesting methods of paddy ● Different harvesters used for harvesting threshing, winnowing ● Know the methods of storing grains, storages, cold storages 	<ul style="list-style-type: none"> ● Discussion ● Chart showing the differences between natural and artificial manures. ● Samples of natural and artificial manures. ● Discussion - Manures, Nutrients - chart. ● Chart of different irrigation methods. ● Picture of sprinklers and drip irrigaiton. ● Discussion, collection of information. ● Picture of sprinklers and drip irrigation ● Discussion, observation pictures of different kinds weeds, weeding machines ● Pictures of harvesting ● Discussion ● Pictures of threshing , winnowing ● Pictures of storage, cold storage ● Discussion

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
10.	<ul style="list-style-type: none"> ● Animal husbandry ● Poultry ● Epiculture ● Fisheries 	<ul style="list-style-type: none"> ● Knows about animal husbandry cattle rearing, high milk yielding breeds, selection of good breeds and management of animal husbandry ● Graph showing milk production ● Pictures of local hybrid cows ● Pictures of milk chilling centres. ● Pictures of Prof J.K.Kurian ● Picture of Bio Gas plant. ● Collects information of local variety of poultry. ● Differentiate between broilers and layers. ● Discussing methods of hatching eggs in poultry. ● Learns about apiculture production of honey sources of nectar ● Know about fish and prawn culture ● Know different species of fresh water 	<ul style="list-style-type: none"> ● Discussion, observation, fieldstrips. ● Pictures of animal husbandry animals which give us food, table of animals which give us food. ● Discussion, Observation ● Pictures of different fowls ● Pictures of Emu ● Chart of differences in Broilers and layers. ● Picture of poultry farm ● Chart showing management methods in poultry ● Discussion, Picture of specimens of Honey ● Pictures of prawn, fish, crab list marine fish with economic importance and their pictures

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● What is air pollution ? ● Factors of pollution ● Effects of air pollution ● Water pollution 	<ul style="list-style-type: none"> ● Know about air pollution, factors of air pollution due natural calamities do experiment of oil paper to estimate the pollution level of the area. ● Know causes for pollution are natural, human activities, nuclear power plants ● Know the disaster of Tchernoby / ● Know the water and soil pollution due to pesticides and power plants ● Know the pollution due CFC from bridges, A/C s and deforestation. Coal mines, limestone mines ● Discuss about suspended particulated matter pollutants in air. ● Discuss about preventive measures to prevent air pollution ● Know how water is polluted ● Where from the pollutants are generated 	<ul style="list-style-type: none"> ● Discussion ● Pollution under control certificate ● Air - its components - graph / chart ● 5x5 cm white papers, oil - picture of volcano ● Discussion ● Pollutants of air - chart ● Roots of pollution - chart ● Discussion ● Chart showing control measures of air pollution ● Paper cutting related to air pollution ● Discussion pure water, polluted water, beakers, tap, well, pond, river water samples, soap, litmus papers.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Control measures to prevent water pollution 	<ul style="list-style-type: none"> ● Know the degradable and non degradable, know about nutrients for plants, know about nutrients for plants, entrophication in water bodies. ● Discuss how the pollutants like heat, precipitate, toxic cheni cals are released from pharma centical industries into water bodies ● Discuss different methods ● To prevent water pullution and arias to be taken care of pollution 	<ul style="list-style-type: none"> ● Chart showing degradable - non degradable wastes. ● Chart showing the different pollutants pollute water bodies. ● Discussion ● Observation ● Chart showing prevention measures to water ● Chart on flourasis

IX CLASS SYLLABUS - BIOLOGY

Theme : How organisms formed

Lesson Name : Cell Structure

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
1.	<p>Typical cell</p> <p>Cell membrane or plasma membrane</p> <ul style="list-style-type: none"> ● Cell Wall ● Nucleus ● Cytoplasm ● Cell Organelle ● Golgi apparatus 	<ul style="list-style-type: none"> ● Observing typical plant cell, animal cell Drawing, knowing differences between them ● Observing the experiment cells of Rheo leaf with microscope and drawing diagram of it ● Place section of Rheo leaf in dilute salt water for some time and observe under microscope differentiate and give reasons for the differences from the normal section ● Discuss the functions of cell wall in the class ● Preparing slide of cheek cells and observe nucleus in it ● Observe the permanent slide of nucleus and draw diagram ● Observation, drawing diagram ● Nucleus chart, Bacterial cell chart. ● Discussion on cytoplasm in class room ● Observing Endoplasmic reticulum under micro scope, Discussion ● Discussion about Glogi apparatus in calss 	<ul style="list-style-type: none"> ● Drawing diagrams ● Observing , differentiating ● Charts, slides, models of animal and plant cells. ● Rheo leaf, microscope watch glass, slide brush, needle, blade, cover slip, salt solution ● Observing, Differentiating ● Give reasons ● Discussion ● Slide preparing skill observation ● Toothpic, slide, cover slip, needle watch glass, blotting paper, microscope 1% methelene blue salt solution, glyserin. ● Discussion ● Observation, Discussion ● Chart showing cell organelle model, permanent slide. ● Discussion

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Lysomes ● Mitochondria ● Plastids ● Vacuoles ● Are cell flat? ● Where do cells come from? 	<ul style="list-style-type: none"> ● Explains the suicidal activity of lysosomes ● Conductivity experiment to observing mitochondria in onion peel ● Discussion on the structure of mitochondria, explanation in classroom ● Observe chloroplasts in Rheo leaf or alg ● ae with help of microscope draw diagram ● Explain the structure. ● Take section of succulent plant like alovera stem or leaf and observe stem or leaf and observe under microscope ● Observing three dimensional images of cells and determing the shape of cell ● Discussion on cell theory of scheiden and schwann in the class 	<ul style="list-style-type: none"> ● Explanation ● Experimental skill, explanation discussion ● Onionpeel, Janus green solution, microscope brush, watchglass, slide, needle, model, chart ● Experimental skill, observation ● Explanation ● Microscope, Rheo leaf or algae needle, cover slip, slide, brush, watch glass, chart, model chart of chloroplast. ● Experiment skills, Discussion. ● Aloevera or succulent plant leaf or stem, slide, watchglass brush, safranin, microscope ● Observation, Determination. ● Cell slide, microscope, chart. ● Discussion

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
2.	<ul style="list-style-type: none"> ● Parts of plants and their functions ● Cells in onion peel ● Cells in a leaf peel Cells in the root tip ● Meristematic tissue ● Dicot stem tissues ● Dermal Tissues ● Connective tissue 	<ul style="list-style-type: none"> ● Prepare a table showing the different functions of parts of plants. ● Observing cells in onion peel under microscope drawing diagram. ● Onion peel, slide, brush, needle, slide, watch ● Observing the thin edge of torn leaf (betel leaf or trade seantia) under micro ● Scope and drawing diagrams watch glass, water, brush, needle, micro scope ● Observing cells in onion root tip and ● Identifiying the tissue ● Observing apical, laterak inter calary meri ● Stematic tissues in L.S of shoot tip slide ● Compare the tissues in tips of stema and root and tabulate the observations ● Prepare slide T.S of dicot stem and obs ● Serve under microscope and draw diagram ● Observing the torn edge of betel leaf for arrangement of cells and identifying (epiderm, mesoderm and endoderm) ● Observing the permanent slides of chloren 	<ul style="list-style-type: none"> ● Preparing table ● Plant with all parts ● Experimental skill observation, drawing diagram glass, cover slip. ● Experimental skill. ● Observation, drawing diagram. ● Betel or trade scantia leaf, slide, cover slip, ● Experiment skill, observation ● Glass tumbler, water, onion, balde, glycerin, slide, cover slip, fillter paper, brush, microscope ● Identifying ● Compare, preparing tables ● T.S Dicot stem permanent slide. ● Chart of T.S Dicot stem ● Experimental skills, observation, identifying ● Rheo or betel leaf, microscope, watch glass, water, slide, brush, needle. ● Chart showing stomata. ● Observation

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Vascular tissue ● Lab activity ● Epithelial tissue ● Cuboidal epithelium ● Columnar epithelium ● Connective tissue 	<ul style="list-style-type: none"> ● Chyma, Aerenchyma, storage tissues under microscope, noting down the observation ● Observing the T.S of stem of plant which kept in red water for 2 hours. ● Identifying the cells turned red are xylum and phloem tissues ● Observing different tissues of epithelial blood muscle under microscope from sample collected from chicken shop. ● Scrape the outer layer of buccal cavity and observe under microscope. ● Slides, microscope, cover slip, 1% methelene blue brush, needle, watch glass blotting paper. ● Observing the permanent slide of cuboidal epithelium from school lab and draw and note the details. ● Observes the permanent slide and draw the diagram ● Explaining different types of connective tissues with help of charts and discuss 	<ul style="list-style-type: none"> ● Explanation ● Permanent slide ● Experiment skills, observation. ● Determination of xylum and phloem ● Red ink, water, beaker, tender plant, ● Microscope, blade slide, coverslip, xylum, phloem permanent slide, chart showing xylum and phloem ● Experiment skills, observation ● Noticing differences. ● Microscope, permanent slide. ● Dil Hcl solution, chicken piece with bone, brush, cover slip. ● Experimental skill, observation. ● Drawing diagram. ● Experimental skills, observation. ● Drawing diagrams ● Permanent slide, microscope chart. ● Experimental skills - observation ● Permanent slide - chart. ● Explanation, discussion ● Permanent slide, charts.

Theme : How organisms formed

Lesson Name : Cell Structure

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Blood tissue ● Muscle Tissue ● Nerve tissue 	<ul style="list-style-type: none"> ● Discussion on RBC, WBC platelets ● Finding blood groups using kit ● Observing permanent slides of striated, non striated and cardiac muscles under microscope and differentiate. ● Observing nerve cells permanent slide under microscope and explain the characters 	<ul style="list-style-type: none"> ● Discussion ● Experimental skills ● Disposable needle, slides, blood testing kit, cotton, 70% alcohol wax pencil. ● Experiment skills. ● Differentiating ● Drawing permanent slides. ● Specimen of bone joint, joint of bone and muscle ● Observation, explanation. ● Nerve cell permanent slide.

Theme : How organisms formed

Lesson Name : Movement of materials across the cell membranes

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
4.	<ul style="list-style-type: none"> ● Get in - Go out ● Preparing sugar solution ● Which one is more concentrated solution ● Observing different concentrated solutions ● Osmosis 	<ul style="list-style-type: none"> ● Discuss the permeability of the substances given in table ● Explain making saturated sugar solution and discuss ● Preparing three different concentration solution and discuss ● Perform the experiment of kismis in 100ml of saturated solution ● Perform the osmosis with potato bowl and determine osmosis. 	<ul style="list-style-type: none"> ● Preparing table ● Discussion ● Explanation, discussion ● Salt/sugar, water, beaker spoon. ● Comparing, Explaining ● Three beakers, Sugar, spoon, water. ● Experiment skills, observation, two beakers water, sugar, kismis. ● Experimental skill.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Filtration ● Functions of plasma membrane ● Material transport through plasma membrane ● Semi permeable membrane ● Importance of osmosis in organisms ● Diffusion 	<ul style="list-style-type: none"> ● Perform the experiment of filtration to determine permeability ● Discuss the functions of plasma membrane ● Conduct osmosis experiment using egg membrane to prove osmosis. ● Discuss the functions of plasma membrane ● Discuss the importance of osmosis ● Conduct experiment on diffusion using scent, Coffee powder, KMnO_4 determine the diffusion and explain. ● Copper sulphate crystals, Potassium chromate 	<ul style="list-style-type: none"> ● Fresh potato, peeler, boiled potato, 2 petri dishes, two pins, water, knife sugar solution ● Experimental skills. ● Beaker, funnel, stands, filter paper, sugar, iodine wheat/rice flour, cotton cloth 500ml transparent bottles. ● Discussion. ● Experiment skills determining osmosis ● Three beakers, two petri dishes, salt, dil Hcl two equal sized eggs, cloth, paper strip spoon. ● Two eggs three beakers, sugar, water thread measuring jar syringe. ● Discussion ● Determining diffusion ● Insense stick, coffee powder Potassium Permanganate crystals, Petridishes

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
5.	<ul style="list-style-type: none"> ● Diversity in Plants ● Observe the characters of monocot & dicot plants ● Observing the charecters ● Variations in animals ● Variation in two different plants ● Classification evolution ● History of evolution 	<ul style="list-style-type: none"> ● Prepares table of length, width, Colour, Shape, edge, Venation, of different leaves, compare and contrast ● Compars five different plants with flowers and observes diversity in them ● Compare the characters of different kinds of seeds prepare table of the diversity observed. ● Prepares table with characters of mono cot and dicot plants, Compare and differentiate to obseve diversity in them ● Monocot & di cot plants with roots. ● Seeds ● Collects different insects observe the charecters prapare table, discuss the similarities and differences ● Prepares a table of external charecter of students in class, discuss similarities and differences ● Compare and contrast the characters of two different same sieal neem plants and discuss ● Discussion on classification and evolution ● Discussion on history of evolution 	<ul style="list-style-type: none"> ● Preparing tables ● Listing differences and semilarities ● Defferent kinds of leaves ● Discribing the similarities ● 5 tpes of plants ● Different kinds of seeds ● Preparing table ● Compare, ● Observes diversity ● Collecting insects ● Preparing table ● Discuss similarities and differences ● Charts adn pictures of different insects. ● Collectgion, preparing table ● Discuss similarities and differences ● Weighing machine ● Measuring scale to measure height ● Ink pad ● Preparing table ● Discuss similarities and differences ● Two neem plants ● Discussion ● Discussion

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● The heirarchy of classification ● Monera ● Protista ● Fung ● Plantae ● Classification of animals Porifera to echinodermater ● Proto chordata, chordate ● Nomenclature 	<ul style="list-style-type: none"> ● Discussion onheirarchy of classification and species ● Observe the permanent slide of moneraorganisms under microscope and under stand the characters ● Observe the permanent ● Slide of protista organisms under micro scope and understand the characters amoeba, englena, Paramxium slides charts ● Observe and discuss the characters of slide or speciman of bungi, give examples ● Observes characters of different plants fern, moss discuss and give examples ● Observe the slides, specimans or models of organism from porigero to echino dermatata, discuss characters give examples ● Observing the charecters of specimans or models of prodo chordates and chordates, give examples. ● Sepcimeus, micro scope, charts slides, water ● Discuss the need of nomenclature, and give examples 	<ul style="list-style-type: none"> ● Discussion and explanation with chart ● Experimental skills ● Anabina slide ● Experimental skills ● Giving expamples ● Pond water, microscope, slide coverslip, ● Experimental skills ● Give examples, explain ● Yeast, agaricus, Phizopus slides, yeast model ● Experimental skills ● Give examples ● Speximans of moss, fern, ● Charts of moss, fern ● Angio sperns, gymasperms cycas, cone ● Experimental skill ● Give examples ● Chart showing classifical with examples Slides, models. ● Observation, discussion ● Explanation ● Drawing ● Discussion, explanation ● Char showing scientific ● Name of some organisms

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
6.	<p>History of sense organs</p> <ul style="list-style-type: none"> ● What do our senses do? ● Stimulus to response ● Sensorgans eye, structure and function ● Eye - illusions ● Ear structure and function of ear, taking care of ear. ● Auditory sensation ● Nose structure and function sense of smell ● Skin, touch, caring of skin diseases 	<ul style="list-style-type: none"> ● Discussion to understand the history of sense organs explanation ● Discussion on our senses ● Explanation about stimulus to response with help of circuit diagrams ● Conduct the sugar in water experiment to show that our body is designed to identify and relate the changes in the stimulus ● Discussion and explanation the structure and function of eye ● Observation of pictures ● Discussion on structure & function of ear and taking care of ear explanation ● Observation to understand the working method of ear ● Discussion of structure and functions of nose, sense of smell ● Identifying smells blind folded ● Skin - sense of touch 	<ul style="list-style-type: none"> ● Discussion, explanation ● Chart showing sense organs ● Discussion, explanation ● Explanation ● Chart showing nerve impulse ● Experimental skill ● Determination, explanation ● Glass, sugar, water, teaspoon ● Discussion, Explanation ● Chart showing eye or ● Chart showing rods and cones ● Observation, magnifying glass, parrot, cage pictures stick, chart with lines ● Discussion, explanation ● Model or chart showing structure of ear ● Observation, iron or plastic funnel, rubber balloon, rubber band, rice grains ● Discussion, drawing ● Chart or model showing structure of nose ● Smelling piece of ginger, garlic Tamarind, banana, Jaggery ● Chart of skin specimen, types of skin, three tooth picks

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
7.	Animal behaviour factors influence the behaviour <ul style="list-style-type: none"> ● Types of animals behaviour ● Human behaviour ● Lab activities 	<ul style="list-style-type: none"> ● Discuss what is animal behaviour ● Give examples of different animals behaviours ● Discuss the factors that influence animal behaviour ● Discuss and explain different types of animal behaviour ● Discuss behaviours like instinct, imprinting conditioning and imitation ● Discussion on human behaviours like imitation instinct, conditioning and investigating an field ● Conduct experiment of choice box ● Observe different behaviours of animals calcium chloride, wet cotton ● Discussion on experiments towards animals intelligence 	<ul style="list-style-type: none"> ● Discussion - Explanation ● Pictures depicting the animal behaviour ● Discuss & observation ● Picture of Ivon Paulov ● Pavlou's dog experiment ● Discussion and explanation ● Discussion - Explanation ● Hypothesis, Inference ● Discussion, explanation ● Choice box, cockroaches

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
8.	<p>Relation between population growth and food production</p> <ul style="list-style-type: none"> ● Factors promote plant growth ● Methods to increase the food production ● Water - What does a plant do with water ● Growing crops according to availability of water ● Plant nutrients ● Nutrients in soil ● Crop rotation 	<ul style="list-style-type: none"> ● Analyse and discuss the relation between population growth and food production ● Discussion the measure to be taken to increase food production ● Analyse and discuss on the data given on factors and plant growth ● Discussion a methods to increase the food production ● Discussion, on rule by bred varieties in increasing food production ● Analysis of data showing relation between irrigation and plant growth ● Discuss about crops grown according to availability of water ● Discuss the agricultural methods to follow in less availability of water ● Draw route map of Magarjun Sagar right and left canals ● Discussion based on table of plant nutrient requirement explanation ● Identifying micro macro nutrients ● Discussion on crop rotation - benefits explanation 	<ul style="list-style-type: none"> ● Data analysis, discussion group activity, Plotting the data in the table as graph. ● Data analysis, discussion ● Chart, graph ● Discuss - Explanation ● Regular and hybrid seeds and fruits ● Analysis of data ● Observation through experiment ● Determine, explanation, drawing ● Potted plant, polythene bag discussion. ● Discussion, explanation drawing ● Chart showing water bodies in village ● Picture showing dam nearby ● Data analysis, explanation ● Chart showing micro macro nutrients ● Discussion, determining nutrients based on table ● Collecting samples of N.P.K. Manures. ● Discussion - Explanation

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Uses of soil nutrients ● Mixed Crops ● Organic manures ● Soil testing (1) Vermicompose (2) Pancha gavya (3) Organic manure (4) Chemical fertilizers ● Crop protection 	<ul style="list-style-type: none"> ● Based on data discuss what nutrients helps plant in what way ● Discuss on benefits of mixed crops make understand which crops can be grown as mixed crops can be grown as mixed crops ● Discuss why one legumenacar crop is present in mixed crops ● Discussion on organic manures & ● Discussion on benefits of soil tassing ● Collect data from farmer about craps growing according to soil ● Discuss about vermicompost, ● Pancha gavya ● Organic manures and chemical fertiligers ● Chemical fertilizers ● Discussion on controlling pests, weeds and deseases on crops & Explanation 	<ul style="list-style-type: none"> ● Discussion - Explanation ● Discussion - Explanation ● Charts ● Root nodules of legume / pea plant ● Collection, observation determination ● Discussion - Expanation ● Collecting orgnic manure ● Green manure ● Data collection, discussion ● Soil test report ● Leaves of coconu, sugarcane, banana coconum fiber, dry black gram, fresh dung, Jute bags, earth worms ● Cow milk, curd, ghee, dung, wrine, taddy cocomnut water, sugar canejuice ● Samples of organic and chemical manures ● Chart showing differences bwtween organic and chemical fertilizers ● Discussion - Explanation ● Chart showing infectial crops ● Chart of insecticides ● Chart of insects their enenies

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
9.	<ul style="list-style-type: none"> ● Adaptations in plants <p>Adaptations in aquatic ecosystem</p> <ul style="list-style-type: none"> ● Adaptations on basis of light Penetration ● Fresh water ecosystem ● Other adaptations 	<ul style="list-style-type: none"> ● Discussion and explanation on adaptations in different plants in in Ecosystem ● Discussion and explanation about adaptations of plants and animals in freshwater and marine ecosystems ● Discussion and explanation on adaptations of plants and animals in enphotic, Bathyl and abyssal zones ● Discussion and explanation on adaptation of plants and animals in littoral and limetic zones ● Discussion and explanation on adaptations of plants and animals for temperature and adverse conditions 	<ul style="list-style-type: none"> ● Discussion - explanation ● Charts / models of adaptations in ecosystem ● Discussion Explanation ● Discussion Explanation ● Chart showing zones of Oceans ● Discussion, Explanation ● Chart zones of lake / pond ● Discussion explanation ● Chgart of adaptations ● Chart showing diversity in beks of sparrows ● Picture of darwin

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
10.	Soil componets <ul style="list-style-type: none"> ● Soil properties ● Fertility of soil ● Soil pollution ● Bio magnification ● Waste management ● Bio Remediation 	<ul style="list-style-type: none"> ● How is soilformed ● Discussion & Explanation ● Physical chemical and biological properties of soil ● Discussion on soil fertility ● Discuss reasons for soil pollution ● Dump and decompose degradable wastes ● Seperates degradable non degradable waste ● Explanation ● Waste management ● Explanation 	<ul style="list-style-type: none"> ● Discussion , explanation on componets of soil graph ● Observation - Explanation ● Different types of soil samples ● Litmus paper, water ● Chart showing properties of soil samples ● Discussion, charts of soil fertility, Nitrogen fixing bacteria, roots ● Discussion - Explanation ● Vegitable peels, Kitchen waste plastic, Paper, rubber ● Chart of degradable non degradable waste ● Graph of waste material in soil ● Discussion-chart of Bio magnification ● Discussion, graph of waste management ● Discussion, chart of Bio Remediation

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
11.	Bio Geo chemical cycles <ul style="list-style-type: none"> ● Labactivity ● Ozonelayer 	<ul style="list-style-type: none"> ● Discussion and explanation on water cyle, Nitrogen cuycle, ● Conduct experiment to find effect of green house effect on temperature ● Discussion & Explanation on ozone layer and its depletion 	<ul style="list-style-type: none"> ● Discussion - explanation ● Charts of water, Oxygen Nitrogen , carbon cycles ● Experimental skills ● Factors of green house gases ● Plastic bottle, thumometer note book pencil ● Discussion - explanation ● Ozonelayer, chart on depletion of ozone layer.

X CLASS SYLLABUS - BIOLOGY

Theme : Food

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
1.	<ul style="list-style-type: none"> ● Phaosynthesis ● Water and photosynthesis ● Air and photosynthesis ● Carbon di-oxide is necessary for photosynthesis. ● Light and photosynthesis. ● Sun light is essential for the preparation of starch. ● Chforphill and photosynthesis. 	<ul style="list-style-type: none"> ● Testing the pressure of starches ● Rereading the experiment of Von Helmont ● Priestly experiment, display of experiment ● Mohl's half leaf experiment ● Hydrila experiment ● Black paper experiment. ● Observation of Chtorophsts 	<ul style="list-style-type: none"> ● Questioning and discussion - mind mapping ● Beaker, Boiling water, plant in a pot, leaf of a plant which is planted in pot, test tube, bunsen burner, tripod stand. ● Asbesto net, Ethenol, Petri dish, Iodine souldution, ink filler. ● Questioning and Discussion. ● Bell jar, candle, rat mint plant in a pot, glass jar with wide mouth, half slided rubber cork, potassium hydroxide, ink filler, Iodine solution, petri dish. ● Beaker, water, test tube, glass funnel, Hydrilla plant, glowing match stick/ incuse stick, Ingenhous, Englemau, Priestly - pictures. ● De starced leaf dark paper, clippicks ● Discussion

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<p>Where does photo synthesis take place ?</p> <ul style="list-style-type: none"> ● Photosynthesis, Mechanical light and dark reaction ● How heterotrophs procure food? Cuscuta - parasite ● Nutrition in human beings ● Various enzymes ● Human alimentary canal health aspects. 	<p>Exhibiting various steps in light reaction and dark reaction</p> <p>Observing the way of collection of food in amoeba Haustoria in cuscuta.</p> <ul style="list-style-type: none"> ● Various parts in alimentary canal, litmus testing, Observation, discussion Observation of enzymes chart ● Collection of information about the diseases occur due to malnutrition 	<ul style="list-style-type: none"> ● Leaf T.S. (Transverse section) slide, chart chloroplast slide and chart, compound microscope ● Presentation reaction, chart of light and dark reactions. ● Presentation reaction chart of light reaction and dark reactions <p>Observation, slide, chart, compound microscope.</p> <p>Observation, discussion, chart of human alimentary canal model, flowchart, litmus paper</p> <p>Presentation, Discussion, Children suffering from malnutrition, Kwashiorkor, marasuras diseases, pictures, chart of diseses due to vitamin deficiency. Children suffering from presentation, discussion malnutrition, kwashiorkor, Marasras. Chart of the diseases occur due to the vitamin dificiency</p>

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Respiratory substrates ● Steps in respiration ● Breathing & Pathways of air ● Epiglottis and passage of air ● Mechanism of respiration in human beings <p>Inspiration & expiration diffusion pathway Respiration in plants diffusion in plants, diffusion in roots Photosynthesis respiration</p>	<p>Observation group activity Discussion, questioning brain storming, discussion presentation Experiment, presentation discussion</p> <ul style="list-style-type: none"> ● Charts - of - ribcage chest cavity, air diffusion in lungs, ● Components in inhaling and exhaling air-graphical representation, Transportation of air-flowchart. ● Observation, experiment discussion, presentation 	<p>Mind mapping, Lavoisier, Priestly experiment, display of charts Text tube, Glass pipe, Rubber cork, Rubber tube, water, lime water, air path, picture flowchart.</p> <ul style="list-style-type: none"> ● Leaf internal structure - slide of stomata chart of tissues, thermometer, germinating seeds, dry seeds, glass bottle, flask lime water, beaker

Theme : Food

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Pulse and Internal structure of heart ● Arteries, Veius, blood circulation, heart beat evolutionary process of blood circulation ● Lymphatic system single/ double circulation system / blood pressure, coagulation of blood ● Transportation of materials in the plant. Absorption of root hairs root pressure, Traanspiration Transportation of materials. 	<ul style="list-style-type: none"> ● Observation of heart of the goat ● Discussion through activities <p>Observation, discussion and presentation</p> <ul style="list-style-type: none"> ● Arteries, veius, observation discussion, presentation <p>(Measuring the blood pressure) Identifying blood pressure observation single Circulation and double circulation.</p> <ul style="list-style-type: none"> ● Experiment, observation conducting an experiment discussion, presentation 	<ul style="list-style-type: none"> ● Observing students pulserate, charts showing heart place, model of the heart, internal structure of the heart, chart, model, goat's heart, blade, sharpkuife, water, scissors ● Arms of a man, arteries, veius, chart, Williams Harwe's picture, Heart beat, chart of blood circulation cycle, stethoscope. Evolutionary blood circulation charts in various organisers. ● Chart of Lymphatic system, single circulation, double circulation, double circulation charts. ● Sphygmomanometer to measure blood pressure, Stethoscope, slide of blood co-agulation, microscope. ● A Plant in the pot, glass pipe, rubber tube, stem T.S., Polytheme bag, xylum, phloeun chart slide.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<p>Responding stimuli, (Co-ordination in nervous system) Integrating Pathways -Nervous Co-ordination afferent and efferent motor nerves, reflex arc central nervous system, brain, spinal, cord, cardiac nerve, nerve coordination-Revision, autonomous nervous system (ductless) Endocrine glands Insulin How plants respond to the stimuli ? How plants respond to the stimuli ? Control of phytohormones - coordination.</p> <ol style="list-style-type: none"> 1. Auxins, 2. cytokinins 3. Ethylene 4. Gibberellins 5. Abscisic acids 6. Tropic and nastic movements 	<ul style="list-style-type: none"> ● Holding a stick, structure of a nerve cell observing a slide, mind mapping, brain storming experiment, observation discussion, presentation. <p>Experiment with a plant growing towards light and response (to the sunlight) Went experiment, Experiment and observation, questioning discussion, presentation</p>	<ul style="list-style-type: none"> ● Slide of a nerve cell, Chart, scale, stick, chart of nerve impulse. Model / chart of a brain, model chart of spinal cord, chart of various parts in brain and their duties. ● Chart of myelinated axons leave the spinal cord from both sides of the vertebral column, Endocrine glands, and their secretions chart. (hormones chart) <p>Observation of the leaves of Mimosa pudica Display of various phytohormones on chart, glass bottle, soil, bean seeds coleoptile Agar black tendrils.</p>

No.	Key Concepts	Teaching / learning stratagies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Introduction ● Sexual reproduction in plants ● Cell division cell division ● Sexual & Health education ● Population control 	<p>Testing previous knowledge Discussion, Presentation</p> <p>Rhyzoples-mould is observed under the microscope, experiment, discussion, presentation, sexual reproduction in human beings.</p> <p>Observation of a poller grain under a micro scope</p> <p>Observation of permanent slides of various stages of celldivision</p> <p>Discussion of Aids health education</p> <p>Discussion - how to control population.</p>	<p>Charts of various ways of asexual reproduction, slide of Rhyzopus, mould, coverslip watger, disposable gloves, chart of male and feenal reproductive system chart of human development.</p> <ul style="list-style-type: none"> ● Observation of a pollen grain under the microsope ● permanent slides with various of microscope ● A chart of the life history of HIV. ● Various methods of controlling population display of charts.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Introduction ● Feeling hunger ● Consequences of hunger Outcome of sensation of hunger) ● Relation between smell and taste ● mouth is a masticating machine ● Travel of food through oesophagus, stomach, the mixer and digester. Travel of food from the stomach to the intestine. 	<ul style="list-style-type: none"> ● Observation - previous knowledge ● Discussion ● The table which shows hunger in various situations. ● Jeera, Sounf, apple, tomato etc recognizing the ● Identifying the smell of Hing and ginger by closing eyes. ● Activity. Taste is something connecting with the tongue and the plate - Sugar Crystals over the tongue ● To show breakdown of food by using the model of chalk piece kept in vinegar. ● Observe the teeth in mouth and identifying teeth ● Various teeth in the mouth and their duties in a tabular form ● Action of saliva on flour ● testing PH of mouth at intervals of one hour ● model preparation cycle tube / tomato ● making a model of oesophagus to observe how bolus moves forward. 	<ul style="list-style-type: none"> ● Charts ● Filling tables and charts ● Skills of experiment, jeera, tomato, apple, saunf ● Skills of experiment - Hing, ginger, sugar tastes Experimental skills. Piece of chalk, Vinegar, discussion, presentation, Observation, charts containing the picture of teeth in a mouth chart with the pictures of various teeth Filling up the table Experimental skills :- starch, Experimental skills; PH (papers) (lit nus papers) Stomach - Chart Human digestive system

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<p>Variations Phenotype Genotype Mendel theories Law of Dominance</p> <p>Law of segregation</p> <ul style="list-style-type: none"> ● Sex determination in human beings ● Acquired and Inherited characters and Evolution 	<ul style="list-style-type: none"> ● Observing friends with the sample no of t5 and making a table with information ● Discussion with the help of examples ● Discussion with the help of examples ● Experiment which proves mendal theory, Experimental skill. ● Disussion with the examples ● Compare the features of nose ● Compare the features of nose, ear, forehead, mouth hair which are similar to father, mother, grand father etc., ● Organising beetle activity discussion and presentation ● Discussion Jean Baptist Lamarck Charles Darwin Orign of species. Evidences of evolution homologous, analogous organs. Endences of embryology Fossils Human evolution. 	<ul style="list-style-type: none"> ● Observation, filling up the table discussion, chart ● Chart ● Chart ● 3 cm chart pieces - 16 ● 2 m chart peices - 16 ● Red buttons 16 - white buttons - 16 ● Chart with table ● Chart ● Chart ● Lawrk, charles darwin chart ● Evidence of Evolution - chart Homdogous and analogous organs ● Evidences from embryology ● Chart with fossils - ● Chart of human evolution.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
9.	<p>Macro ecosystem in the world</p> <ul style="list-style-type: none"> ● Food relations ● Food - web= nitch ● Ecological pyraminds ● Number pyramid ● Biomass pyramid ● Energy pyramid ● Rule of 10% ● Human activities impact on ecosystem bio magnification 	<p>Observation of charts and pictures</p> <ul style="list-style-type: none"> ● Identifying food chain ● Discuss awearus for the given questions / writing ● Observing the chart, discussion, charts, pictures ● Pyramids in ecosystem - reading ● Types of phramids flow chart ● Comparing the number of organisms is various tropic levels, drawing number phramids. ● Estimating explanations ● Counting explanations ● Counting explanations ● Discussing answers for the given questions ● Stydying casestydy, discussion , writing for the given quesitons. 	<ul style="list-style-type: none"> ● Earth- various climates charts ● Charts which shows macro ecosystem in the world ● Map ● Plants, animal pictures in macro eco system. ● Tundra, pine forests, deciduous forests, savannah, tropical forests, deserts ● Food chairs, pictures / charts, models ● Food web - chart ● Egypt pyramid - explanation, map ● Explanation, boservation, number pyra mid, chart, model, estimatiuous, comparisons, drawing maps. ● Biomass pyramid, drawing a chart ● Energy pyramid - chart ● Human activities - effecton environment chart, pictures Bio magnification - ● Collection of vegetables fruits, nuts covered by pesticides.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
10.	<p>Introduction of National Resouces</p> <ul style="list-style-type: none"> ● Table - I ● Table - II The situation in the Village of Vanaparathi, Vaddicherla after five years ● Table III Income from Crops ● Table IV Expenditure bore by the small and large farmers on the irrigation and wells. ● Water for all <p>Case II Study about , Kothapalli One trial with water management.</p>	<ul style="list-style-type: none"> ● Recording the natural resources available in our environment thinking about the reasources ● Reading ‘case’ and discuss the table - I and discuss questions and answers ● Table - II, Reading, Discussion Questions and their answers ● Tale III Observation, reading the discussion, Observation, Questious and auswers. ● Table IV Observation, reading and discussion Table, Reading and discussion ● Discussing answers for the given questions <p>Case study describing chart</p>	<ul style="list-style-type: none"> ● Map of vanaparathi, Vaddicherla Villages situated in Warangal District ● Table - I Area of irrigation lands chart and graph. ● Table - III Income from crops - Chart / Graph ● Table - IV small and large farmers their investment and expenditure on water irrigation and wells - Chart-graph. ● Explanation - Answering confirmation, water, statistics - graph. ● Explanation - Answering confirmation - Statistics of water - graphical representation Kothapalli District in Warangal District.

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Improving methods of Production and income ● Community based interventions ● Farmer based interventions ● 2004 survey - Andhra Pradesh Availability of water ● The Water resources available 200 in Andhrapradesh ● Water consumptions conservation and wastage ● Available Natural resources aroundes ● Forest : A very important and replenishable resource ● Soil ● Bio - diversity 	<ul style="list-style-type: none"> ● Explanation ● Explanation A map which shows the Lakshmi Canal from Sri Ram Sagar Project. ● Explanation ● Observation of water statistics - Discussing Question and Answers ● Graph / Observation / Discussing questions and answers / Gussing ● Studying 5 houses with the help of questionnaire about water consumption - conservation and wastage - Discussion - confirmation. ● Writing an essay about any other resource except water . Questions and Answers discussion. ● Explanation, appreciation Presentation of observation list chart ● Observing Lawn ● Plants which are destroyed in the lown 	<ul style="list-style-type: none"> ● ICRISAT-Picture ● Sri Ram project - Photo ● Distribution of water for various purposes in Andhra Pradesh - graph / Table / Chart ● Statistical reports for the year 2005 water distribution for various fields - Table - graph. ● Available water resources in the year 2000 in Andhra Pradesh ● Chart on the collected information ● Important resource in our loality - Chart Essay ● Pictures of Froests and cutting down forests (deforestation) ● Picture of Soil erosion

No.	Key Concepts	Teaching / learning strategies	Teaching learning process / sources
	<ul style="list-style-type: none"> ● Fossil fuels... ● Protection - A vital concern ● Conservation teams 	<ul style="list-style-type: none"> ● Study : Study of various insects living in our house and surroundings ● Discussing answers for the questions, Explanation Excavation of minerals, collecting news peoples protest -arranging seminars ● Discussiong answers for the questions, Explanation Discussion Taking the example of Kothapalli village and discussing the role of villagers and other institution / organisation ● Explanation & discussion 	<p>Name of different plants in lown</p> <ul style="list-style-type: none"> ● Observation, study, list of insects on chart, making a list of insects <ol style="list-style-type: none"> 1) Names of different insects 2) Seasons - seasonally appeared 3) Insects disappeared in period time of a year <p>Percentage of Resources consumption in India, graphical representation Display of charts with the collected information</p> <p>Three - R's chart and their importance, Pictures of division of garbage at home</p> <ul style="list-style-type: none"> ● List of Concervative teams and organisations - Chart



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

TEACHERS' RESOURCE BAG

Some Resource Books that Help make Science Fun

1. The Third Book of Experiments, Leonard De Vries, Carousel Books
2. Science Works, Ontario Science Centre, Ontario
3. Toying Around with Science, Bob Friedhoffer, Franklin Watts, New York
4. The Science Explorer, P. Murphy, E. Klages, L. Shore, An Owl Book
5. 700 Science Experiments for Everyone, Compiled by UNESCO, Doubleday
6. 100 Amazing Science Fair Projects, Glen Vecchione, Goodwill Publishing House, New Delhi
7. 365 Simple Science Experiments with Everyday Materials, Richard Churchill, Sterling Publishers
8. The Book of Experiments, Leonard De Vries, Carousel
9. Joy of Learning, (Standards 3 to 5), Center for Environmental Education, Ahmedabad, India
10. Experiments for You, John Tollyfield, Evans Brothers, London
11. How to Turn Water Upside-Down, Ralph Levinson, Beaver Books, London
12. Experiments with Everyday Objects, Kevin Goldstein-Jachson, Granada Publishing, New York
13. Simple Science Experiments, Batstord, Hans Jurgen Prees
14. Let's Discover Science, David Horsburgh, Oxford University Press
15. Chai Ki Pyali Mein Paheli, Partho Ghosh & Dipandar Home (Hindi) National Book Trust, New Delhi 110016

16. UNESCO Source book for Science in the Primary School, Harlen & Elstgeest, National Book Trust, New Delhi 110016
17. Soap Bubbles, C.V. Boys, (Eng/Hin), Vigyan Prasar, C-24 Qutub Institutional Area, New Delhi 110016
18. The Chemical History of a Candle, Michael Faraday (Eng/Hin), Vigyan Prasar, New Delhi, info@Vigyanprasar.gov.in
19. Science in Everyday Life, J.B.S. Haldane, Vigyan Prasar, New Delhi, info@Vigyanprasar.gov.in
20. VSO Science Teacher's Handbook, Andy Byers, Ann Childs, Chris Lane (Hindi) Eklavya, Bhopal, pitara@eklavya.in
21. Environment & Self-Reliance, Yona Friedman, Eda Schaur (Eng/Hin), Vigyan Prasar, New Delhi
22. Energy & Self-Reliance, Yona Friedman, (Eng/Hin) Vigyan Prasar, New Delhi, info@vigyanprasar.gov.in
23. The Story of Physics, T. Pammanabhan (Eng/Hin) Vigyan Prasar, New Delhi, info@vigyanprasar.gov.in
24. On the Various Forces of Nature, Michael Faraday, Vigyan Prasar, New Delhi, info@vigyanprasar.gov.in
25. The Insect World of J. Henri Fabre, Vigyan Prasar, New Delhi, info@vigyanprasar.gov.in
26. The Autobiography of Charles Darwin, Vigyan Prasar, New Delhi, info@vigyanprasar.gov.in
27. The Bicycle Story, Vijay Gupta, Vigyan Prasar, New Delhi, info@vigyanprasar.gov.in
28. Aakash Darshan Atlas, Gopal Ramchandra Paranjpe, NCERT, Sri Aurobindo Marg, New Delhi 110016
29. Preparation for Understanding, Keith Warren, illus. by Julia Warren, UNESCO
30. Resonance Journal of Science Education, Indian Academy of Sciences
31. Balvignanic, Eklavya, Bhopal

Courtesy : Aha! Activities, Eklavya, Bhopal

Websites & E-Resources for Middle and Primary School Science

1. LET'S DISCOVER SCIENCE PART I By David Horsburgh (out of print but downloadable as a pdf file from the link:
<http://vidyaonline.org/arvindgupta/david1.pdf>)

2. LET'S DISCOVER SCIENCE PART II By David Horsburgh (out of print but downloadable as a pdf file from the link:
<http://vidyaonline.org/arvindgupta/david2.pdf>)
3. LET'S DISCOVER SCIENCE PART III By David Horsburgh (out of print but downloadable as a pdf file from the link:
<http://vidyaonline.org/arvindgupta/david3.pdf>)
4. LET'S DISCOVER SCIENCE PART IV By David Horsburgh (out of print but downloadable as a pdf file from the link:
<http://vidyaonline.org/arvindgupta/david4.pdf>)
5. LET'S DISCOVER SCIENCE PART V By David Horsburgh (out of print but downloadable as a pdf file from the link:
<http://vidyaonline.org/arvindgupta/david5.pdf>)
6. LEARNING ABOUT LIVING PART ONE By David Horsburgh (out of print but downloadable as a pdf file from the link:
<http://vidyaonline.org/arvindgupta/D6.pdf>)
7. LEARNING ABOUT LIVING PART THREE By David Horsburgh (out of print but downloadable as a pdf file from the link:
<http://vidyaonline.org/arvindgupta/D7.pdf>)
8. THINKING AND DOING By David Horsburgh (out of print but downloadable as a pdf file from the link:
<http://vidyaonline.org/arvindgupta/thinkanddo.pdf>)
9. SMALL SCIENCE for Classes I to V (with the accompanying Workbooks and Teachers' Books) Homi Bhabha Centre for Science Education, TIFR, Mumbai. <http://www.hbcse.tifr.res.in/smallscience>.
10. <http://www.arvindguptatoys.com/> contains an enormous list of books on enlivening science learning, rated by Arvind Gupta. Many of them can be downloaded for free.
11. LOW COST EQUIPMENT FOR SCIENCE AND TECHNOLOGY EDUCATION - Vol. 1 - Compiled by UNESCO
<http://unesdoc.unesco.org/images/0010/001023/102321eb.pdf> Provides ideas on how to make school science equipment using inexpensive materials.
12. LOW COST EQUIPMENT FOR SCIENCE AND TECHNOLOGY EDUCATION - Vol. 2 - Compiled by UNESCO -
<http://unesdoc.unesco.org/images/0007/000728/072808eb.pdf> Provides ideas on how to make school science equipment using inexpensive materials.
13. <http://www.exploratorium.edu/> is a fascinating website with tons of resources, activities and continuous updating to reflect the latest developments in the field.

14. <http://www.johnkyrk.com/> has links to animations of cell structure, cell biology, DNA, etc.
15. http://www.bbc.co.uk/schools/scienceclips/ages/8_9/circuits_conductors_fs.shtml has an interactive tutorial on conductors.
16. [http://www.primaryschool.com.au/science results.php?kla=Science%20and%20Technology& unit=Switched%20On](http://www.primaryschool.com.au/science%20results.php?kla=Science%20and%20Technology&unit=Switched%20On) has links to several interactive lessons like the one above.
17. <http://www.juliantrubin.com/bigten/pathdiscovery.html> allows the user to simulate online repetitions of famous experiments or inventions.
18. <http://www.freeindia.org/biographies/greatscientists/> has biographies of Indian scientists.
19. <http://www-gap.dcs.st and.ac.uk/~history/Indexes/Indians.html> has info on ancient Indian mathematicians.
20. <http://www.calcuttaweb.com/people/snbose.shtml> has some more biographies of Indian scientists.
21. <http://www.shodor.org/succeed/curriculum/FOR/observation.html> contains an interactive module to test one's observation powers.
22. http://www.scienceclass.net/PowerPoints/NOS_Test_Review.ppt contains a PPT that talks of the nature of science.
23. http://www.scienceclass.net/PowerPoints/NOS_Test_ReviewGT.ppt contains a second such PPT.
24. http://www.scienceclass.net/Teachers_Lessons.htm contains many valuable links to lessons on science topics for middle school level.
25. <http://www.science-class.net/TAKS/taks.htm> has many links to PPTs that elaborate specific concepts for middle school.
26. <http://teachers.net/lessons/posts/1228.html> (a website leading from [http://www.curriki.org/xwiki/bin/view/Coll_rmlucas/LabClassificationofShoes?bc=; Coll_rmlucas.10](http://www.curriki.org/xwiki/bin/view/Coll_rmlucas/LabClassificationofShoes?bc=;Coll_rmlucas.10) Classification) describes an activity wherein children have to classify shoes, so as to understand the importance of classification. (Useful in all branches of science, particularly chemistry and biology.)
27. http://www.encyclomedia.com/videoarctic_food_chain.html has a video on the arctic food chain.
28. <http://www.kbears.com/ocean/octopus/index.html> has a presentation and info on the octopus.
29. <http://magma.nationalgeographic.com/ngexplorer/0309/articles/mainarticle.html> contains rich info on underwater life.
30. <http://www.seaworld.org/animal-info> has a plethora of links and info on animals.
31. <http://www.seaworld.org/fun-zone/coloringbooks/pdf/emp-penguin.pdf> has a colouring page for kids to have fun, when learning about animals.

32. <http://kids.nationalgeographic.com/Animals/CreatureFeature/> is a superb site where you can click on an animal to find out more about it. The 'more' includes facts, a video with sound, a map of places where it can be found, etc.
33. Resources for Teaching Middle School Science (1998) - http://books.nap.edu/catalog.php?record_id=5774 (ISBN 0309057817) National Science Resources Center of the National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and the Smithsonian Institution
34. Resources for Teaching Elementary School Science (1996) - http://books.nap.edu/catalog.php?record_id=4966 (ISBN 0309052939) National Science Resources Center of the National Academy of Sciences and the Smithsonian Institution
35. <http://www.exploratorium.edu/explore/handson.html> contains many online as well as hands on activities for children of this age group and younger.
36. <http://fi.edu/tfi/activity/act-summ.html> contains many online as well as hands on activities for children of this age group and younger.
37. http://www.bbc.co.uk/schools/scienceclips/ages/10_11/science_10_11.shtml contains activities listed alphabetically, topic wise.
38. http://www.bbc.co.uk/schools/scienceclips/ages/9_10/changing_sounds.shtml contains simple sorting and tabulation exercises for Class V and below.
39. http://www.bbc.co.uk/schools/scienceclips/ages/10_11/forces_action.shtml contains more complicated tabulation and interpretation exercises for Class VI/VII.
40. http://www.bbc.co.uk/schools/teachers/ks4/bitesize_chemistry.shtml contains chemistry assessment worksheets for Classes VIII and IX.
41. <http://www.bbc.co.uk/schools/gcsebitesize/chemistry/classifyingmaterials/> contains exercises for assessing classification of matter, atomic structure, bonding and formulae/equations for Class VIII and above.
42. <http://www.bbc.co.uk/schools/gcsebitesize/physics/electricity/> has some thinking-type questions for Class VIII and above.
43. <http://www.bbc.co.uk/schools/gcsebitesize/physics/forces/> has excellent questions for Classes VII, VIII and above.
44. <http://cse.edc.org/products/onlinecurr/catalog.asp> has an online catalogue of web-based resources for middle and elementary school science.
45. <http://www.explorelarning.com/index.cfm?method=cResource.dspView&ResourceID=491> has a beautiful animation of the photoelectric effect, can be shown to Class VIII.
46. <http://www.explorelarning.com> has a number of interactive simulations to learn science, appropriate for this age group.
47. <http://cse.edc.org/products/onlinecurr/WBMISearchResults.asp> has a complete list of topics and the modules available therein, for students of this age group and a little older as well.

48. <http://www.blupete.com/Literature/Biographies/Science/Scientists.htm> has links to biographies of scientists.
49. <http://www.juliantrubin.com/bigten/pathdiscovery.html> is a website with a collection of links for discovery and invention.
50. <http://www.fordham.edu/Halsall/science/sciencesbook.html> is an Internet Sourcebook for the History of Science.
51. <http://www.middleschoolscience.com/tunefork.htm> has a good activity for learning about the tuning fork and sound vibrations, suitable for Classes VII and VIII.
52. http://www.pbs.org/benfranklin/exp_shocking.html has a lovely interactive simulation of the kite experiment performed by Benjamin Franklin.
53. <http://www.pbs.org/teachers/sciencetech/> has grade-wise, topic-wise lesson plans for middle and primary school science teaching.
54. <http://www.learner.org/resources/series90.html> has a set of videos on the science of teaching science.
55. <http://www.outlookindia.com/scriptur11w2.asp?act=sign&url=/full.asp?fodname=20050328&fname=Science&sid=1> has Nobel Prize-Winning Science Discoveries made palatable for children.
56. http://www.teachernet.gov.uk/teachingandlearning/subjects/science/science_teaching_resources/ provides links to a number of e-teaching learning resources for primary science.
57. <http://www.firstscience.com/home/> is a leading online popular science magazine featuring articles on important breakthroughs, the latest science news, video clips, blogs, poems, facts, games and a whole lot more science-related content.
58. Chakmak: Science magazine for children http://www.eklavya.in/go/index.php?option=com_content&task=category§ionid=13&id=57&Itemid=84
59. Sandarbh: A resource bank for teachers http://www.eklavya.in/go/index.php?option=com_content&task=category§ionid=13&id=51&Itemid=72
60. Srote: Science and Technology features -http://www.eklavya.in/go/index.php?option=com_content&task=category§ionid=13&id=56&Itemid=81
61. <http://www.gobartimes.org/20090315/20090315.asp> is a bi-monthly children's magazine highlighting news and views on environment and development through comic strips, cartoons, quizzes, essay competitions and interactive pages. It also serves as a useful teaching aid in classrooms for teachers.
62. <http://edugreen.teri.res.in/index.asp> is a website for children that makes environmental learning fun
63. <http://www.nuffieldcurriculumcentre.org/go/Default.html> provides links to websites of various science projects that undertake to enliven science teaching
64. <http://www.exploratorium.edu/ifi/resources/workshops/teachingforconcept.html> provides a link to the paper "Teaching for Conceptual Change: Confronting Children's Experience; Watson, Bruce and Richard Kopnicke; Phi Delta Kappan, May 1990".

Some Important Organisations in Science Education

S.No.	Name of the Organisation	Contact Details
1.	Agastya International Foundation	Address : Kataria House, 219 Kamaraj Road, Bangalore - 560042. Phone : 080-25548913-16 Website : www.agastya.org E-Mail : Maagastya@vsnl.com
2	Avehi-Abacus Project	Address : Third floor, K.K. Marg Municipal School, Saat Rasta, Mahalaxmi, Mumbai- 400 011 Phone : (022)2307 5231, (022) 2305 2790 Website : http://avehiabacus.org E-mail : avcab@vsnl.com
3	Bangalore Association for Science Education (BASE)	Address : Jawaharlal Nehru Planetarium, Sri. T. Chowdaiah Road, High Grounds, Bangalore-560001 Phone : 080-22266084, 22203234 Website : http://www.taralaya.org E-Mail : taralaya@vsnl.com
4	Bharat Gyan Vigyan Samiti/ Indian Organisation for Learning and Science	Address : Basement of Y.W.A. Hostel No. II, Avenue - 21, G-Block, Saket, New Delhi-110 017. Phone : 011-2656 9943, Website : http://www.bgvs.org E-Mail : bgvs_delhi@yahoo.co.in , bgvsdelhi@gmail.com
5	Center for Environment Education	Address : Nehru Foundation for Development, Thaltej Tekra, Ahmedabad - 380 054, Gujarat Phone : 079-26858002 Website : http://www.cceindia.org E-Mail : cee@ceeindia.org
6	Center for Science and Environment	Address : 41, Tughlakabad Institutional Area, New Delhi-110062, INDIA Phone : 011-29955124/25, 29956394, 29956401, 29956399 Website : http://www.cseindia.org E-Mail : cse@cseindia.org
7	C.P.R. Environmental Education Centre (CPREEC)	Address : The C. P. Ramaswami Aiyar Foundation No.1, Eldams Road, Alwarpet, Chennai Tamilnadu, India-600 018 Phone : 044-24337023, 24346526, 24349366 Website : www.cpreec.org E-Mail : cpreec@vsnl.com , ecoheritage_cpreec@vsnl.net
8	Eklavya	Address : E-10, BDA Colony, Shankar Nagar, Shivaji Nagar, Bhopal - 462 016 Madhya Pradesh Phone : 0755-267 1017, 255 1109 Website : http://eklavya.in

S.No.	Name of the Organisation	Contact Details
9	Eklavya Institute of Teacher Education (EI)	Address : Eklavya Education Foundation, Core House, Off. C.G.Road, Ellisbridge, Ahmedabad-6 Phone : 079-26461629, Website : www.eklavya.org E-mail : eklavya@ekalavya.org
10	Homi Bhabha Centre for Science Education Research,	Address : Mr. H C Pradhan, Tata Institute of Fundamental, V.N. Purav Marg, Mankhurd, Mumbai, 400088 Phone : 022-25554712, 25580036 Website : www.hbcse.tifr.res.in E-Mail : postmaster@hbcse.tifr.res.in
11	Indian Science Congress Association	Address : 14, Dr. Biresw Guha Street, Kolkata - 17 Phone : 033-2287 4530 Website : http://sciencecongress.nic.in E-mail : iscacal@vsnl.net
12	Kalpavriksh Environment Action Group	Address : 134, Tower 10, Supreme Enclave, Mayur Vihar, Phase 1, Delhi 110 09 Phone : 011-22753714 Website : http://www.kalpavriksh.org
13	Kerala Sastra Sahitya Parishad	Address : Parishad Bhavan, Chalappuram PO, Kozhikkode - 673 002, Kerala, India Phone : 0495-2701919, 9447038195 Website : http://www.kssp.org.in E-Mail : gskssp@gmail.com
14	National Council for Science & Technology Communication (NCSTC)	Address : Department of Science & Technology Technology Bhavan, New Mehrauli Road, New Delhi-11001. Phone : 011-26567373, 26962819 Website : www.dst.gov.in E-Mail : dstinfo@nic.in
15	Navanirmithi	Address : Navnirmithi, 301,302,303, 3rd floor, A wing, Priyadarshani Apartment, Padmavati Road, IIT Market Gate, Powai, Mumbai- 400 076. Phone ; 022-25773215, 25786520 Website : www.navnirmithi.org E-mail : contact@navnirmithi.org

S.No.	Name of the Organisation	Contact Details
16	Nuffield Foundation	Address : 28 Bedford Square London WC1B 3JS Phone : 020 7631 0566, 020 7580 7434 Website : www.nuffieldfoundation.org E-mail : info@nuffieldfoundation.org
17	Rajiv Gandhi Foundation	Address : Jawahar Bhawan, Dr. Rajendra, Prasad Road, New Delhi - 110 001, INDIA Phone : 011-23755117, 23312456 Website : www.rgfindia.org E-mail : info@rgfindia.org
18	State Institute of Science Education	Address : S.I.S.E (Rajya Vigyan Sansthan), P.S.M Campus, Jabalpur, M.P. 482001 Phone : 0761-2625776 Website : http://sisejbp.nic.in
19	Sutradhar	Address : 59/1, 3rd Cross, 10th A Main, Indiranagar 2 Stage, Bangalore 560038. Phone : 080-25288545 Website : www.sutradhar.com E-Mail : sutra@vsnl.com
20	Tamil Nadu Science Forum	Address : Balaji Sampath, C2 Ratna Apts. AH 250, Shanti Colony, Annanagar, Chennai-600040, TAMIL NADU Phone : 044-26213638 Website : bsampath@eng.umd.edu
21	Tamil Nadu State Council for Science and Technology,	Address : Directorate of Technical Education Campus, Chennai 25. Phone : 022-22301428 Website : www.tanscst.org E-mail : enquiry@tanscst.org
22	Vidya Bhawan Society	Address : Fatehpura, Udaipur, Rajasthan 313001 Phone : 0294 2450911 Website : http://www.vidyabhawan.org E-Mail : info@vidyabhawan.org, vbsudr@yahoo.com
23	Vikram A Sarabhai Community Science Center	Address : Opp. Gujarat University, Navrangpura, Ahmedabad - 380 009 Phone : 079-26302085,26302914 Website : www.vascsc.org, E-Mail : info@vascsc.org

8

Teacher Preparation

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

Why Readiness?

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

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

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

Readiness in the teaching of Physical Science"

- Teaching Physical science without readiness is useless
- Since readiness is essential, the Physical science teacher should get ready in the following way. S/he should :

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

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

Additional activities to be taken up by the Physical science teacher

The teacher should:

- Get the laboratory ready to conduct experiments
- Get the classroom ready to conduct experiments If there is no laboratory or if it is not in a good condition
- Exhibit the photographs of scientists in the laboratory and celebrate their birthdays
- Conduct school exhibition, science quiz and science day during every academic year without fail
- Visit the place selected for field visit at least a few days in advance, collect required information and obtain necessary permissions
- Work as a guide in conducting project works by dividing children into groups and giving them suitable instructions / worksheets/ material
- Collect the names, addresses and phone numbers of important people in the society around the school with a view to make them partners in school development. The teacher should also establish science club in the school and conduct interesting programmes to arise curiosity and the zeal to learn among children



Continuous Comprehensive Evaluation

From RTE Act - 2009, we know that children should achieve all-round development, and that schools should take responsibility for this. Children should develop physically, mentally, morally and emotionally. For this, children's interests, attitudes and values should be developed along with school subjects.

The curriculum gives equal importance to teaching learning experiences and the evaluation of the achievement of children. If the evaluation conducted in schools evaluate not only the children's ability to construct knowledge, but also their personality development, and is done on a continuous basis throughout the year, it can be called Continuous Comprehensive Evaluation.

Here,

CONTINUOUS means: not limited to any particular teaching learning process or any event or any situation, but to observe all components of learning on continuous basis. This is to say that observing/evaluating children's physical and cognitive development in an orderly manner on a continuous basis in the school and outside the school without letting them know that they are being evaluated. By identifying the gaps in learning and by taking up remedial measures, the teacher as well as the student should be able to do self-assessment.

COMPREHENSIVE means:

'All-round development'- development in the children's physical, mental, ethical and cognitive domains. For this, equal importance should be given to scholastic and co-scholastic areas in the curriculum without looking at them as two separate areas. This means treating arts, work, values, health and life skills on par with language, mathematics, science and social studies. This way, it looks at the children's development not just from the standpoint of scholastic achievement but also from the view point of their interests, competencies and attitudes too. This is to say that comprehensive evaluation gives equal importance to creativity, analytical skills and rational thinking in addition to knowledge, understanding and application.

The Need for Evaluation

For us evaluation means conducting examinations. Teachers, parents and the society as a whole used to look at evaluation from the examination point of view. Forcing the children to memorize the information given in the textbooks, making them write it in the examinations and finally awarding marks for that has become the main aim of education. These examinations, conducted in the name of evaluation, instead of forming positive attitude towards learning and school, subject children to fear, anxiety and stress.

The marks and ranks that are used to measure the progress of children are putting children continuously under pressure, so their physical and cognitive development is hampered. The teaching learning processes have changed targeting the achievement of marks. Evaluation has become a big examination programme that is conducted ignoring the children's interests, attitudes and competencies. In this mad race for marks, undesirable happenings are taking place giving way to meaningless competition leaving no scope for the children's emotional development and the achievement of life skills. The unit and terminal examinations conducted in the name of evaluation are only good for stamping children 'pass' or 'fail' but not to identify the learning gaps and to remediate them.

The present evaluation system is teacher centered. The information given in the name of 'progress cards' contain evaluation done on scholastic areas only. On many occasions, though we claim to conduct Continuous Comprehensive Evaluation, in fact, only scholastic areas are given importance.

The co scholastic areas like art education, work experience, value education, life skills, etc., are not given due importance. Moreover, we misunderstand that Continuous Comprehensive Evaluation means conducting more examinations. Therefore, there is an urgent need for the policy makers, experts in the field of education and teachers to have a closer look at Continuous Comprehensive Evaluation and try to understand its true meaning.

Aims of Continuous Comprehensive Evaluation

Evaluation is not meant for memorizing information and reproducing it in examinations. It should assess the behavioural changes in children's cognitive, psycho-motor and affective domains which have been brought out by the learning experiences provided in the classroom, and help children to improve. The information given to children in the form of various lessons is not enough for them. NCF - 2005 indicated that it is the responsibility of the school to develop in children the skills and competencies necessary for their future life, like analytical skills, creative thinking, logical reasoning; and life skills, like self-discipline, patience, tolerance, social adjustment and facing and solving problems with tact. So far these have been treated as extra-curricular activities or co-curricular activities, and little or no importance has been given to them. This is detrimental to the all-round development of children. Hence, the state curriculum framework - 2011 has indicated that all these components should be treated as curricular activities, erasing the divide between them. Therefore, it is decided to evaluate the children's physical, cognitive, emotional and social development giving equal importance to each of them. Let us have a look at the objectives of Continuous Comprehensive Evaluation from this angle.

- To help develop cognitive, psychomotor and affective domains
- To lay emphasis on thought processes and de-emphasize memorization
- To make evaluation an integral part of teaching-learning process
- To use evaluation for improvement of students' achievement and teaching-learning strategies, on the basis of regular diagnosis followed by remedial instructions
- To use evaluation as a quality control device to maintain desired standards of performance
- To determine social utility, desirability or effectiveness of a programme and take appropriate decisions about the learner, the process of learning and the learning environment
- To make the process of teaching and learning a learner-centered activity

Continuous Comprehensive Evaluation should be organized as a part of teaching learning processes. This helps us to know how efficient are the learning experiences provided in the school in developing the children. In Continuous Comprehensive Evaluation, all components are evaluated equally without maintaining the distinction between curricular and co-curricular areas.

The evaluation procedures followed in school as a part of Continuous Comprehensive Evaluation should be such that they observe children completely in all aspects and record them. It is also necessary to assess children through examinations conducted periodically along with the evaluation done through observation of children inside and outside the classroom in tandem with the teaching learning processes. However, whatever may be the evaluation procedure, its results should not be used to compare two children.

Evaluation should not only observe how children learnt, and what was learnt but should also help them retain what was learnt. Interests, attitudes, emotions, special interests, physical growth and health related components should also be assessed along with knowledge, understanding, application, analysis and adjustment to new situations. This evaluation is of two types:

1. Formative Evaluation
2. Summative Evaluation

1. Formative Evaluation

Working towards improving the children's learning through observing and recording their performance while they are participating in teaching learning processes is called Formative Evaluation (assessment). It is used by the teacher to continuously monitor children's progress in a non-threatening, supportive

environment. It involves regular descriptive feedback, rather than marks and grades, which gives a chance for the students to reflect on their performance, take advice and improve upon it.

The teacher can estimate what the children have learnt; and how they are learning based on the discussions in the classroom, their answers to questions in the middle and at the end of the lessons, their notebooks, class work and homework, group activities and project work, etc. This is called formative evaluation.

Formative evaluation gives continuous feedback to the teacher as well as the children all along the teaching learning processes, so it helps them make necessary changes in their teaching/learning strategies. If used effectively, it can improve children's performance tremendously while raising their self-esteem and reducing the work load of the teacher. Let us have a look at the features of this formative evaluation.

Formative Evaluation

- Is a process to observe the progress of the child and how s/he is learning
- Is diagnostic and remedial
- Makes the provision for effective feedback on how children are learning
- Provides the platform for the active involvement of children in their own learning.
- Enables teachers to adjust teaching by taking into account the results of evaluation
- Recognizes the profound influence evaluation has on the motivation and self-esteem of students, both of which are crucial influences on learning
- Recognizes the need for students to be able to assess themselves and understand how to improve
- Builds on children's prior knowledge and experience in designing what is taught.
- Incorporates varied learning styles based on how and what to teach.
- Encourages children to understand the criteria that will be used to judge their work
- Offers an opportunity to children to improve their work after feedback,
- Helps children to support their peers, and expect to be supported by them.
- This is conducted in a natural environment free from stress and fear and without making the children aware of being tested
- The teacher can have an understanding of the children's progress while they participate in teaching learning processes

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

విజ్ఞాన శాస్త్రం - ప్రశ్నల వారీగా భారత్వం

విద్యా ప్రమాణాలు	వ్యాసరూప ప్రశ్నలు	స్వల్ప సమాధాన ప్రశ్నలు	సంక్షిప్త ప్రశ్నలు	లక్ష్యాత్మక ప్రశ్నలు	మార్కులు	శాతం
విషయావగాహన	2 (10)	2 (5)	-	20 (1/2)	40	40%
ప్రశ్నించడం, పరికల్పనలు	-	2 (5)	-	-	10	10%
ప్రయోగాలు - క్షేత్రపరిశీలనలు	1 (10)	-	-	-	10	10%
సమాచార నైపుణ్యాలు ప్రాజెక్టు పనులు	1 (10)	-	5 (1)	-	15	15%
పటనైపుణ్యాలు, బొమ్మలు గీయడం నమూనాలుచేయడం ద్వారా భావప్రసారం	-	2 (5)	-	-	10	10%
ప్రశంస, విలువలు జీవవైవిధ్యం పట్ల స్పృహ కలిగి ఉండడం	-	2 (5)	5 (1)	-	15	15%

సూచన: బ్రాకెట్లోని సంఖ్యలు మార్కులను, బ్రాకెట్ బయటి సంఖ్యలు ప్రశ్నల సంఖ్యలను సూచిస్తాయి.

సామాన్య శాస్త్రం - 6-9 తరగతులు

అంశం	ఫార్మేటివ్					సమ్మేటివ్						
	పిల్లల భాగస్వామ్యం, ప్రతిస్పందనలు	రాత అంశాలు	ప్రాజెక్టు పనులు	లఘు పరీక్ష	మొత్తం	విషయావగాహన	ప్రశ్నించడం	ప్రయోగాలు	సమాచార నైపుణ్యాలు	బొమ్మలు/పటాలు	ప్రశంస, నిత్యజీవిత విలువలు, వినయంగా, జీవవైవిధ్యం	మొత్తం
భారత్వం	20%	20%	20%	40%	100%	40%	10%	10%	15%	10%	15%	100%
మార్కులు	10	10	10	20	50M	40	10	10	15	10	15	100M

- 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 Section No.....

I	II	III	IV	V	VI	Marks	Grade

I. Conceptual Understanding

a) Answer any two of the following

2x10 = 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 2x5=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 Section No.....

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 Vermin 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 1/2

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

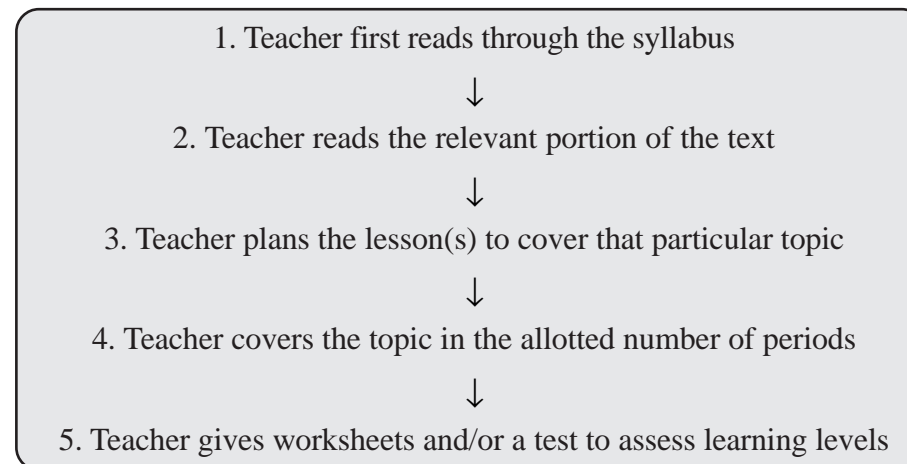
27. To conduct a rally in your village on greenhouse effect, prepare five slogans.
28. Water pollution has been identified as a problem in Ramapuram. What suggestion will you give to solve it?
29. Answer the following questions in a sentence each.
- What is your opinion on the classification of living organisms into phyla by scientists?
 - Rafi told that blood donation is good for health. How do you support it?
 - If you do not want to cause any sound pollution, what will you do for it?
 - What did you surprise in the structure of an eye?
 - David said that crops grown using chemical fertilizers are not good. Why did he say so?

Bringing the Laboratory into the Classroom: Bringing Inventive Thinking into the Mind

Neeraja Raghavan

There is no doubt that a good laboratory will enrich the learning and teaching of science. While this is undisputable, it is possible to transform the teaching and learning of science even without a full-fledged laboratory, provided one can draw upon everyday experiences, commonly asked questions, easily available materials and just a few tools that may need to be purchased.

If we map the journey of a typical science class, we will probably see something like what is shown below:



In the above work flow, the role of the teacher is that of a lecturer, and (s)he will doubtless cover the topic efficiently, if (s)he moves as planned. The role of the child is largely that of a passive recipient, who is called upon to listen to and absorb whatever was taught, only to repeat it (preferably verbatim) during the assessment. Conspicuous by their absence are the following: experiential learning, the triggering of curiosity, the articulation of questions, the performing of experiments, the noting down of observations, the 'seeing' of a pattern in data collected, the drawing of logically consistent conclusions and finally, the shift in thinking that results from a transformative experience.

In order to show that none of these processes is too far - fetched - even in Class IV - in a school without a laboratory, I shall first draw upon a research paper which describes a very simple experiment. A fourth grade teacher had to teach 'heat' to her students, and she chose not to adopt a route such as the one delineated above. Instead, she began by asking the nine-year-old children (in cold Massachusetts) about their experience of warmth and heat, in the nine winters that they had faced so far. (See text box below)

"Sweaters are hot," said Katie.

"If you put a thermometer inside a hat, would it ever get hot! Ninety degrees, maybe," said Neil.

"Leave it there a long time, and it might get to a hundred. Or 200," Christian added.

Confronted with the children's preconceptions in so direct a manner, this talented teacher decided to have the class test out each one of them. She did this by having the class place thermometers in hats, sweaters and even a rolled up rug. When children found that the first few readings on the temperatures did not show any difference, they were convinced that they needed to leave the thermometers in longer. (Here, the resistance that we normally encounter in giving up a pet premise is palpable!) So they left the thermometers overnight and came back the next day, sure that the temperatures would be soaring! Instead they found no demonstrable change. Still, they were not yet ready to abandon their ideas. A less talented (or more harried) teacher would probably have stopped at this point, corrected them and explained the reason why the temperature did not rise. Instead, this teacher empowered her students to 'own the problem' and continue pondering, testing and discussing their ideas until they were themselves ready to give up their erroneous belief and incorporate new knowledge.

What is remarkable about this class? First, the teacher was less focused on covering the syllabus than on uncovering students' preconceptions. Next, she was wise enough to allow the learning to unfold at its own pace, by testing the premise of each child, and waiting for them to give up their incorrect preconceptions only when they were convinced of their incorrectness. I can almost hear the teacher's lament: "But we can't possibly do this for each and every topic! We will never finish the syllabus in this way!" Yes, you probably won't. But to your surprise, you may find that you won't need to. Because in the process of nudging the children to think through their own preconceptions, the immense learning that has been effected will stand the class in good stead when the next topic has to be DIScovered! (not covered.) [Besides, by covering the entire syllabus under the thick hood of efficient transaction, one is not effecting a change in thinking at all: and how, then, can one claim to be teaching science?] Thirdly, the link between scientific thinking and one's everyday life are so obvious in this class, that there is no need to teach that chapter on 'Scientific Temper' (which usually forms a mandatory part of the syllabus) and now, doesn't that reduce the 'portion' to be 'covered'?!

Science Communicator's Forum (SCF) has innovated cost-effective ways to convey scientific concepts. For instance, since prisms are expensive, members of SCF use a glass of water and an inexpensive laser light to demonstrate the internal reflection of light. Similarly, in order to explain the concept of land and sea breeze, students are asked to take a tumbler and put some water on one side and sand on the other side. The tumbler is then left outside in the sun. An incense stick is lit and placed in between the sand and water. Once the sand and the water are warm, the movement of the smoke indicates which way the breeze is blowing. This way, students get to learn the basics of how sea and land breeze occur. [from http://timesofindia.indiatimes.com/Education/Beyond_the_chalk_talk_method_of_teaching/articleshow/3935253.cms Times of India 5 January 2009, Beyond the chalk-talk method of teaching) Times of India 5 January 2009, Beyond the chalk-talk method of teaching)

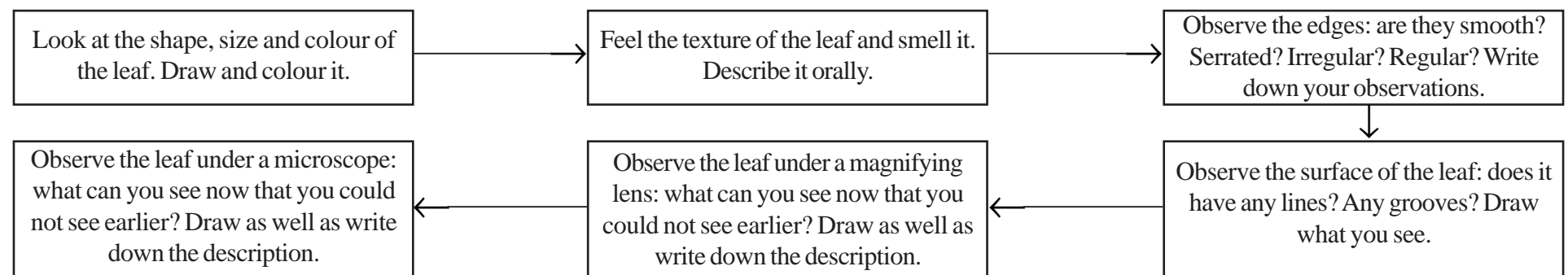
It is important to see how the shift in thinking can only occur when the teacher begins to view science more and more as a 'Verb', and less and less, as a 'Noun'. In getting children to 'own' their premises, one is empowering them to hold certain beliefs, something we never do when we are only focused on 'covering' the syllabus. Then, as we lead the children into enquiring into these strongly held beliefs, we are moving from a secure ground where the child is not threatened: instead, the child is confident enough to test his/her premise. Would it now be unreasonable to expect such a child to carry on with this practice of testing out dearly held beliefs, even outside the classroom? Surely not! It is, therefore, desirable to bring in this process of thinking into the science class, and much of this does not require a hi-fi laboratory, at least for Class IV and V.

Some suggested ways of developing Observation, Enquiry and Thinking Skills in Class IV and V are described in the following section, through the example of a Leaf.

In addition, it is important that the teacher goes to class prepared with at least a few names and biographies of scientists who have worked on the topic to be taught (in this example, leaves and plants) so as to be able to connect at least some of the questions asked (by the children) to those asked by scientists down the ages. Beginning with a set of stories about scientists, (to be culled from references, some of which are suggested elsewhere in this issue), the teacher must show how those scientists looked at certain things and then asked certain questions, just like the children are now doing in class. [For example, in connection to some of the questions posed for a leaf, here are some related scientists and discoveries, which took this writer less than ten minutes to cull from the Internet:

- ◆ While studying an orchid, botanist Robert Brown (1831) identified a structure within the cells that he termed the "nucleus."
- ◆ In the 1770s, Jan Ingenhousz discovered that plants react to sunlight differently than shade and from the underpinnings of this, the understanding of photosynthesis was born.
- ◆ From the fifteenth century onwards, early European explorers who went on sailing expeditions around the world, noticed that the tropics host a much greater variety of species. Answering why this is the case allows today's scientists to help protect life on Earth.]

Guidelines for gradually honing observation skills: (increasing intensity of colour of textbox shows increased intensity of observation) We are taking the example of a leaf:



Guidelines for gradually honing enquiry skills : In the example of a leaf, the nature of questions that can be drawn out/discussed could be of the type:

- ◆ Why is this leaf shaped thus?
- ◆ What are the uses of this leaf?
- ◆ When does it grow?
- ◆ Where does it grow?
- ◆ When does it die?
- ◆ What does it need to grow?
- ◆ Why does/doesn't it smell?
- ◆ Does it have brothers and sisters like I do?
- ◆ Does it belong to a family like I do?
- ◆ What is this leaf made up of?
- ◆ Can I eat it?
- ◆ Who can eat this leaf?
- ◆ Does its shape, size or colour change over time?
- ◆ Can its shape, size or colour be changed by planting it in different soils? By giving it different food?
- ◆ Do insects like to sleep on it? Eat it?
- ◆ How can we protect the leaf from insects? Animals? And so on.

A word of caution: In the commonly-experienced hurry to arrive at the 'right answer', too often the brilliant question is missed, the sustained enquirer is ignored, and the exercise turns into one of ticking right versus wrong answers. It is strongly recommended therefore that the flood of enquiry be sustained through active encouragement of those who kept asking, right until the end of term/year.

Thinking: Following the flood of enquiry, it may be opportune (depending upon the level of understanding and interest of the class) to stoke the fire further through discussion. This is an important part of the process of drawing the child into the fold of timeless scientific enquiry, by connecting the questions asked by the child to prior questions/discoveries or presentday unknowns. Again, it is important to bear in mind that without unduly hurrying the child to think of answers to the questions asked in the Ask stage, this Think step should be used well to roll the questions over with the tongue, as one would a piece of candy. Suck it, taste it, feel its juice pouring down your throat! The important thing here is not to worry about answers, but to allow for bold and free thinking around each question, perhaps again in the form of further questions.

Questions spring up in the mind from our own level of understanding and knowledge. Therefore, the teacher would do well to pause and take some time in looking at questions asked through the screen of the following filters, continuing with the example of the leaf:

1. A question like “Why is this leaf green?” could be connected by the teacher to why anything appears coloured, do we all see the same colour, what causes the perception of colour in each person, etc. Thus, the child can be asked to draw a chain of questions, each inside a bubble, as it were, and see how one question in the first bubble is leading to the spurting of so many more questions.
2. Questions on the shape and size of the leaf can be connected by the teacher to our own shapes and sizes, that of animals and other parts of creation, and the class can together muse on possible links between function and shape/size of any creature. Would an elephant be an elephant if it were not so huge? Would a jackfruit be as tasty if it were not so big? etc.
3. Questions like 'How does the leaf grow?' could be connected to the story of the discovery of photosynthesis (see Box 1 below), which the teacher needs to go prepared with, to class.

Box 1: Photosynthesis

Too often, this topic is taught as if the entire mystery was just revealed to scientists by the flick of a wand. This writer visited a very interesting website: <http://www.juliantrubin.com/bigten/pathdiscovery.html> and culled the following information in less than twenty minutes of surfing. The teacher would do well to collect four or five such stories before taking up a new topic, so as to awaken the scientist within the child.

Is Water the Source of Energy in Plants?

Experiment I

Jan Baptista van Helmont, Flemish physician, chemist, and physicist, in the 1600s carried out a famous experiment by growing a willow tree in a pot for five years. At the end of this period the tree had increased in mass by 74 kg but the mass of the soil had changed little. Van Helmont believed that water was the source of the extra mass and the plant's source of life. What could the other possibilities be? How would you test out each of those possibilities? (Sequence of experiments as they were performed historically, follows.)

Experiment II

John Woodward, a professor and physician at Cambridge University in the late 1600s, tried to design an experiment to test Van Helmont's hypothesis that water was the source of the extra mass. In a series of experiments over as many as 77 days, Woodward measured the water consumed by plants. For example, one plant showed a mass gain of about 1 gram, while Woodward had added a total of almost 76,000 grams of water during the 77 days of plant growth - this was a typical result. Woodward correctly suggested that most of this water was “drawn off and conveyed through the pores of the leaves and exhaled into the atmosphere”. So the hypothesis that water is the nutrient used by plants was rejected. (Teacher can describe the experiment and ask students to draw the inference.)

The Interaction of Plants With Air

In August of 1771, Joseph Priestley, an English Chemist, put a sprig of mint into a transparent closed space with a candle that burned out the air (oxygen was not discovered yet) until it soon went out. After 27 days, he relit the extinguished candle again and it burned perfectly well in the air that previously would not support it. And how did Priestley light the candle if it was placed in a closed space? He focused sun light beams with a mirror onto the candle wick (Priestley had no bright source of light and had to rely on the sun). Today, of course, we can use more sophisticated methods to light the candle like focusing light from a flood light through a converging lens or by an electrical spark. So Priestly proved that plants somehow change the composition of the air.

In another celebrated experiment from 1772, Priestley kept a mouse in a jar of air until it collapsed. He found that a mouse kept with a plant would survive. However, we do not recommend to repeat this experiment and hurt innocent animals. (Teacher can describe the experiment and ask students to draw the inference.)

Plants and Light

Jan Ingenhousz took Priestley's work further and demonstrated that it was light that plants needed to make oxygen (oxygen was discovered a few years earlier in 1772 by Carl Wilhelm Scheele). Ingenhousz was mistaken in believing that the oxygen made by plants came from carbon dioxide.

However, Jan Ingenhousz was the first person to show that light is essential to the plant process that “somehow purifies air fouled by candles or animals”.

In 1779, Ingenhousz put a plant and a candle into a transparent closed space. He allowed the system to stand in sunlight for two or three days. This ensured that the air inside was pure enough to support a candle flame. But he did not light the candle. Then, he covered the closed space with a black cloth and let it remain covered for several days. When he tried to light the candle it would not light.

Ingenhousz concluded that somehow the plant must have acted in darkness like an animal. It must have breathed, fouling the air. And in order to purify the air, plants need light. (The teacher can describe the experiment and ask students to draw the inference.)

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Developing Scientific Temper

Dileep Ranjekar

Among the several goals of education, the one that appeals to me the most is “Developing Scientific Temper”. There could be several reasons for this - upbringing, the education that I received, the atmosphere at home and the fact that both my brother and sister are scientists of some repute, or could be the work environment in the organisation I worked in.

Watching my ten-month old grandson, Anurag, grow, and my recently spending a day at the “Science Mela” in Shorapur block in Karnataka, are two experiences that have made me think of this subject more seriously.

For Anurag, it is a whole new world. He has just learnt to walk independently, stand up, reach out, touch, put pressure on things, and before him lies a whole new world to be explored. It is absolutely amazing how he keeps repeating things tirelessly, saves his fingers from getting crushed, does not waste time in crying even if he falls quite badly, learns how to move knobs, understands what will start music and what will stop it, interestingly keeps shifting his attention to something new, and shows immense joy on his face when he causes the light to switch on or off, or the moment he encounters any new attraction. There are no pre-conceived notions, no one way of doing things, no resistance to absorb fresh facts that emerge out of a new experience.

The “Science Mela” in Shorapur was a different experience. It had the ingenuity of primary school children and their teachers in organizing several kinds of experiences for the 1500 children and their parents who participated in the “mela”. It broke several commonplace myths and created fresh awareness about one's own existing knowledge and understanding. I, for one, had a notion that I had a very good sense of accurately judging weights. In one of the stalls, I was required to lift three different stones and guess the weight of the stones. I was crestfallen to know that all my guesses were nowhere near the actual weight of the stones. The science mela was a powerful example of how, by simple methods, awareness, interest and knowledge could be created at a mass scale through an event that is organized by the children and the teachers themselves. What appealed to me, was the difference the mela would create to the life of those children and teachers who organized it.

Scientific temper has been defined by several educationists, philosophers and scientists. Our Indian Constitution upholds the cultivation of scientific temper as one of the fundamental duties of citizens. Scientific temper is an attitude or a way of being that involves application of the mind, application of logical analysis, willingness to meet with new facts and evidence without pre-conceived notions, and willingness to question conclusions based on newer evidence. What does this entail or lead to? Necessarily an open mind, the ability to consider facts as they exist, discuss, debate, develop rationale, argue, analyse before concluding, and the willingness to live with the co-existence of several truths.

Even to an untrained mind, science automatically means knowledge, experiment, questioning, gathering of data, reason, something that is not mystical but can be proven, touched, felt, smelt, experienced, etc. Scientific temper would mean comfort with all the above and more. Very rightly, the distinction has often been made between “science” and “scientific temper”. While science gives us knowledge, tells us the logic, provides an experience, explains why

things exist the way they do, “scientific temper” would guide us on the constructive use of the knowledge, abilities and experiences that science equips us with. There is both wisdom and morality involved in the usage of knowledge. Thus, for instance, scientific temper would lead to an attitude of “secularism” where you respect others' religious practices, rather than developing blind faith in a single religious practice and propagating that it is the only “right” way to practice religion.

There is no place for “superstition” and “blind faith in mythology” in the world of scientific temper. While mythological stories could be powerfully used to lead to virtual learning for young minds, forcing people to believe in stories that have no evidence is counterproductive to the process of forming a logical society. This can also be extended to learning history where one has to seek evidence, examine the same, connect to several other frames and conclude reliably as to what would have happened during a certain period rather than resorting to ambiguous interpretations based on one's own belief of what must have happened.

I would go the extent of saying that scientific temper has greater implications for the broader way in which society and human beings think, respond, and conduct themselves, than its implications for science itself. A doctor, for instance, may be a great scientist but cannot be considered as having scientific temper if he/she does not meet patients on time and extorts disproportionate money for the treatment offered.

It beats me when I hear reputed science education institutions having politics based on caste, gender and several other illogical issues. One may recollect the two suicides not too long ago, at one of the leading institutes in the country - one for harassment, based on social backwardness and the other arising out of stress due to the unmarried status of the lecturer, where the parents were forcing marriage. These are reflective of the need for the development of a “scientific temper” in society at large. How do we, in the twenty-first century still discriminate based on caste, creed, religion, gender, marital status and economic status of a person? Why don't we accept that marriage is a personal choice and that standard norms for a 'marriageable age’ should not have any place in current modern society? Scientific temper plays a major role in questioning status quo, breaking stereotypes and establishing practices that meet the current needs of society.

To me, scientific temper is accepting newer methods of thinking, continuous questioning, being open to accepting that your own experiences, views, and conclusions need continuous re-calibration, and breaking stereotypes. It is about our ability to say “I don't know”. A truly scientific attitude should make us tolerant, break artificial barriers of caste, religion, political and geographical boundaries, and enable us to be self-reliant to the extent that we have the courage to change ourselves at any phase in life. Dileep Ranjekar is Chief Executive Officer, Azim Premji Foundation.