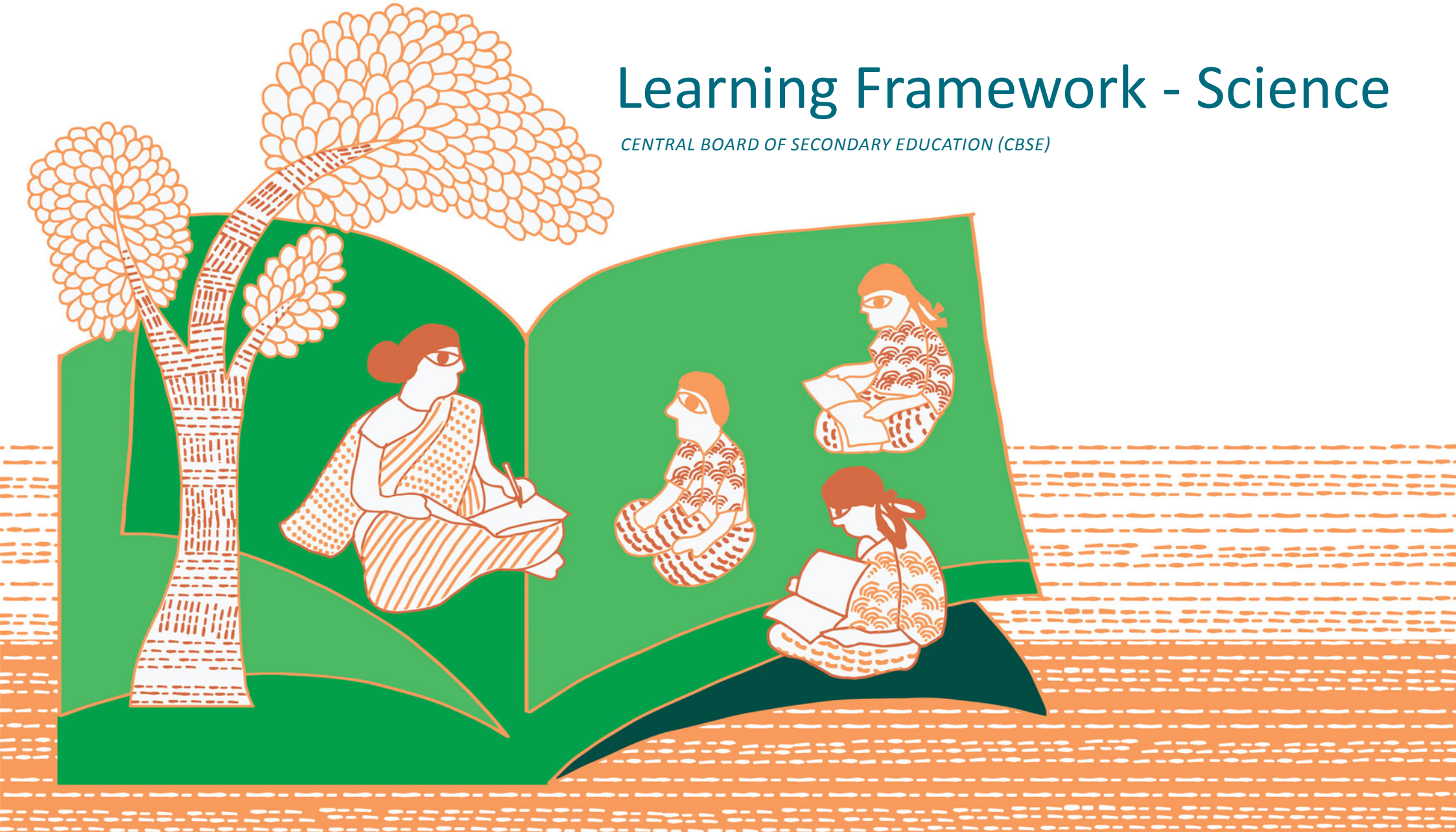
Learning Framework - Science

CENTRAL BOARD OF SECONDARY EDUCATION (CBSE)



Foreword

The National Education Policy (NEP) 2020 released by the Government of India, has given a clear mandate for competency-based education (CBE) to enhance acquisition of critical 21st century skills by the learners. The first determinant for implementing CBE is a curriculum which is aligned to defined learning outcomes and that clearly states the indicators to be achieved.

The Central Board of Secondary Education (CBSE) has collaborated with Azim Premji University, Bengaluru, to develop the **Learning Framework for Science, Mathematics, Social Science, English and Hindi for classes 9 and 10.** The Learning Frameworks comprise explicitly stated knowledge, skills and dispositions that an education system should try to achieve. These frameworks would help develop a common shared understanding among teachers, students and other stakeholders and would serve as a common benchmark for teaching, learning and assessment across the country. These frameworks present indicators that are aligned to the CBSE curriculum and the NCERT Learning Outcomes. They further outline samples of pedagogical processes and assessment strategies to encourage curiosity, objectivity, creativity with a view to nurture scientific temper. This framework would be a key resource for the teacher as he/ she transacts the curriculum. They have been developed to ensure that the teacher aligns the teaching learning to meet the set quality standards and also use it to track learning levels of students. The effort has been to synchronize focus on quality education with uniformity in quality of standards across CBSE schools.

We hope, these frameworks would not only become a reference point for competency-based education across the country but also facilitate planning and design of teaching-learning processes and assessment strategies by teachers and other stakeholders

Team CBSE

Preface

The shift towards competency-based teaching and learning in the National Education Policy 2020 will be an important basis for curricular and pedagogical transformation in schools. The learning goals defined by the Policy, namely holistic and integrated development of students, and the acquisition of higher order cognitive capacities such as analysis, critical thinking and problem solving will be enabled by this shift. Such indicators will also enable equitable educational experiences through ensuring equivalence of pedagogical approaches and learning outcomes across schools and Boards of Examination.

In keeping with the thrust on indicator based teaching-learning proposed in the National Education Policy, 2020, Azim Premji University has supported the Central Board of Secondary Education to develop a 'Learning Framework'. The learning framework is a comprehensive package which provides learning outcomes, indicators, assessment frameworks, samples of pedagogical processes, tools and techniques for formative assessment, blueprint, assessment items and rubrics. Five such frameworks have been developed for English, Hindi, Science, Social Science and Mathematics at the secondary stage.

This document details the Learning Framework for Science. Learning Science involves various interconnected steps: observation, looking for regularities and patterns, making hypotheses, devising qualitative or mathematical models, deducing their consequences, verification of theories through observations and controlled experiments and thus arriving at the principles, theories and laws governing the physical world.

The National Education Policy 2020 emphasizes "Evidence-based reasoning and the scientific method will be incorporated throughout the school curriculum …. in order to encourage rational, analytical, logical, and quantitative thinking in all aspects of the curriculum." As per the Position Paper of the National Focus Group on Teaching of Science (2005), at the secondary stage, the students should be engaged in learning Science as a composite discipline, in working with hands and tools to design advanced technological modules, analysis on issues of surrounding environment and health and systematic experimentation to verify theoretical principles.

Science education at this stage should enable students to develop a historical and developmental perspective and to enable students to view Science as a social enterprise. This document presents outcomes and indicators that focus on these Science specific skills that students need to attain through different concepts addressed in the syllabus. In addition to this, sample pedagogical processes, formative assessment strategies and summative assessment items are also provided to enable teachers to derive principles for making the alignment between learning outcomes-pedagogy and assessment in their classrooms.

Team Azim Premji University

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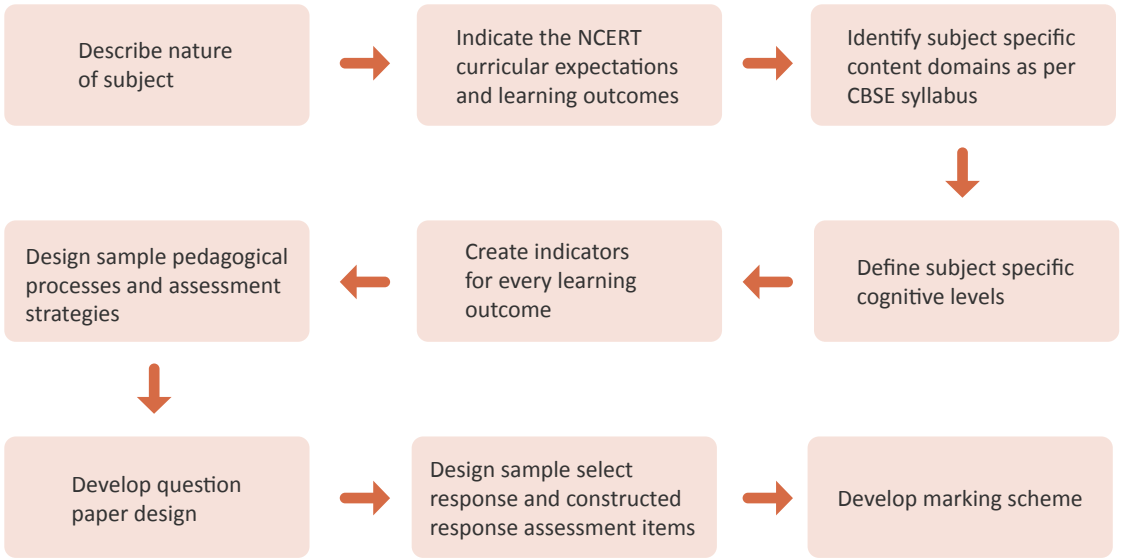
1. Introduction

Development of quality standards is paramount for any education board, to understand and track the learning level of students in the country. These standards comprise explicitly stated knowledge, skills, and dispositions that the education system should strive to achieve. The quality standards are expected to serve as common benchmarks for teaching, learning and assessment. It is hoped that this framework would enable teachers, schools, and other boards to design teaching-learning processes and develop assessment tools. The Learning Framework is a comprehensive package which delineates indicators, assessment frameworks, samples of pedagogical processes, tools & techniques for formative assessment purpose, blueprint, and assessment items and rubrics.

2. Process of Developing the Learning Framework Document

An academically rigorous process has been undertaken to develop this document for various subjects, namely, English, Hindi, Social Sciences, Science and Mathematics. The flow diagram below depicts the steps in the process of developing the Learning Framework.



2.1 Describe Nature of Subject

The school curriculum as per National Curriculum Framework 2005, is a broad plan for facilitating certain capabilities in learners which are guided by the larger aims of school education. These aims of school education are an inter-play of various variables – philosophical, psychological, existing socio-cultural context and the needs of the society, the nature of learning and many more informed by research. etc. Various school subjects enable in pursuing these aims through their distinct disciplinary focus and methods. This section clearly states the processes followed for constructing knowledge in a subject, and the tools and methods of enquiry used in each subject. Further, the relevance of engaging with the given subject in school education is highlighted. The research affirms that an in-depth understanding of the nature of subject would enable a teacher to design quality pedagogy and assessment in alignment to the subject specific skills.

2.2 Indicate the NCERT Curricular Expectations and Learning Outcomes

The broad aims of school education stated in NEP 2020 are to-

- Develop good human beings capable of rational thought and action, possessing compassion and empathy, courage and resilience, a scientific temper and creative imagination, with sound ethical moorings and values
- Build character, and enable learners to be ethical, rational, compassionate and caring
- Achieve full human potential – through developing all aspects and capabilities of learners
- Develop the creative potential of each individual
- Enable learners to learn to think critically and solve problems, and use a multidisciplinary perspective
- Enable learners to innovate, adapt and absorb new material in novel and changing fields
- Enable children to not only learn, but more importantly learn how to learn
- Develop engaged, productive and contributing citizens for building an equitable, inclusive and plural society as envisaged by our Constitution
- Achieve economic and social mobility, inclusion and equality by ensuring all students can access quality education, with particular focus on historically marginalised, disadvantaged, and underrepresented groups
- Prepare a workforce with multidisciplinary abilities across the sciences, social sciences, arts and humanities through experiential, holistic, integrated, inquiry-driven, discovery-oriented, learner-centred, discussion-based, flexible and enjoyable education

The curricular expectations related to different age-groups are spelt out stage-wise for various levels- primary, upper primary, secondary and senior secondary. These are stated at a broader level and pitched at an appropriate level of students understanding. In this document, curricular expectations as defined in

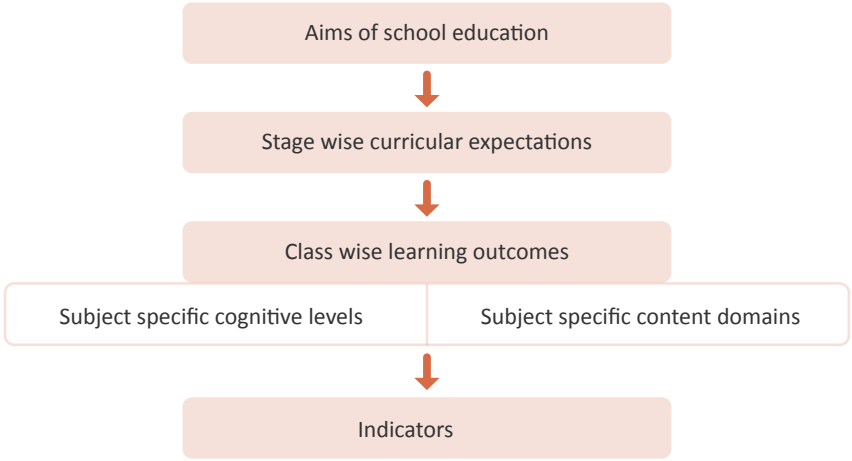
NCERT secondary stages learning outcomes document are referred. These curricular expectations form the basis for organising the age-appropriate content based on learners' prior knowledge. Curricular expectations for a subject are ascertained through a range and variety of specific learning outcomes defined for each class. The NCERT learning outcomes at the secondary stage are the primary point of reference for this document. Learning outcomes provide a benchmark on which learning progress can be tracked in both quantitative and qualitative manner. The NCERT learning outcomes linked with curricular expectations are indicator based and help to determine the pedagogical processes for their development. The indicator based learning encourages students to not only acquire knowledge but also apply knowledge and skills to successfully perform tasks in real life situations.

2.3 Identify Subject Specific Content Domains as per CBSE Syllabus

The learning outcomes for each subject are expressed in terms of cognitive skill to be demonstrated and the content to be acquired by the learners. In accordance with the nature of the subject, the CBSE curricula aligns content domains to various textbook chapters for every subject. To help teachers see the connection between syllabus, textbook and learning outcomes, relevant NCERT learning outcomes are mapped to each of these content domains/ themes.

2.4 Define Subject Specific Cognitive Levels

Cognitive levels describe the thinking processes that students are expected to engage in when encountering the indicators. Revised Bloom's taxonomy provides a useful frame of reference to classify the learning outcomes. It also helps in aligning the classroom pedagogy and assessment practices with the learning outcomes. In this document, an attempt is made to define the subject specific cognitive levels that essentially draw from Revised Bloom's Taxonomy. Such subject specific cognitive levels are able to capture the disciplinary knowledge and skills in a concrete manner. Assessment frameworks developed by Trends in International Mathematics and Science Study (TIMSS) and Programme for International Student Assessment (PISA) are referred to while conceptualising these subject specific cognitive levels.



2.5 Devise Indicators for Every Learning Outcome

The overarching learning outcomes are further broken down into specific indicators aligned to the subject specific skills and the content in related chapters in the textbook. They are focused on subject specific skills that students need to attain through different concepts addressed in the CBSE curriculum. A clear understanding of the scope of these learning outcomes for each concept dealt within a textbook chapter will be immensely helpful for both teachers and students to plan their teaching and learning in a better way. Therefore, indicators aligned to subject specific skills are defined for every learning outcome. These indicators:

- Are aligned to the goals of teaching the subject at the secondary stage
- Are defined as specific, measurable, and demonstrable indicators
- Are distributed across all content domains/ themes as per the prescribed CBSE syllabus
- Address 21st century skills including collaboration, communication, creativity, and critical thinking across school subjects
- Range from simple to complex cognitive processes for all subjects
- Are supplemented with sample assessment strategies and provide suggestions to concretise these in the classrooms

2.6 Design Sample Pedagogical Processes and Assessment Strategies

NCERT secondary stage learning outcomes document provides a common set of pedagogical processes for each subject. The specific indicators are further supported with sample pedagogical and assessment strategies. This has been done to enable teachers to derive principles for making the alignment between learning outcomes, pedagogical practices, and assessment in their classrooms. The key principles considered while designing the pedagogical processes and assessment strategies are:

- Student-centred
  - Since new knowledge is built over existing knowledge, both pedagogy and assessment shall focus on learners' pre-requisite knowledge, skills, attitudes, and beliefs that they bring into a classroom setting.
  - Constructivist approaches to learning, with the learners being at the center of the learning process as an active constructor of knowledge shall be emphasised.
  - Since learners effectively learn by doing, classroom processes shall involve activities and analysis on issues surrounding the environment.
  - Cooperative and peer-supported teaching learning activities shall be used to empower learners to take charge of their own learning.

- Indicators centred
  - The focus shifts to measurable and observable behavior of what learners do at the end of an instruction.
  - Learners comprehend better when the method of teaching, learning activities and assessment strategies are all aligned well to the indicators. Pedagogical processes and assessment strategies shall be aligned to both content domains and cognitive skills as indicated in indicator statements.

- Assessment centred
  - Assessments should be viewed as an integral part of pedagogy and focus on giving timely individualised feedback to learners. Quality formative assessments shall be designed as it helps to modulate learners understanding of their own learning and helps teachers adapt their pedagogy based on learner performances.
  - Multiple modes of assessment, including portfolios, project work, presentations, written and oral assignments, shall be used to provide a scope to reflect individual capacities of a learner.
  - Peer assessment involving learners assessing the work of their peers against set assessment criteria shall be used.

2.7 Develop Question Paper Design

Question paper design also called as blueprint is a map and a detailed specification that ensures that all aspects of the curriculum are covered by the question paper. It translates the design in operational terms and all the dimensions of an item (content domain and cognitive level) become clear to the question paper developer. The information in the question paper design pertains to the content domains and; cognitive levels that will be tested; number of assessment items; aggregation of the percentages of content domains and cognitive levels. A balanced design adequately represents all the content domains and uniformly addresses a range of cognitive skills. This is a planning document where all the relevant information of a question paper is listed in the form of a table.

2.8 Design Sample Select Response and Constructed Response Assessment Items

A test developer may decide on the item format/item type that will be used in the test. Broadly item formats are of two kinds- Selected response questions like multiple choice questions, true/false where learner has to select the correct response from the options provided and Constructed response questions- where the learner has to produce the correct response. These could be as short as one-word responses to long essay type questions. A sample set of assessment items of both select response type and constructed response type is included in this document.

2.9 Develop Marking Scheme

The marking scheme is as important as the assessment item. For assessment item, particularly those assessing understanding and other cognitive levels, it is necessary to include variations in learner responses. There should be scope for fully correct, partially correct, levels of partially correct responses. Also, the marking scheme should be aligned to the cognitive level of the item. If an item is testing application of a concept, the marking scheme should illustrate the possible responses that could be representing application. At any given point of time the marking scheme would only be indicative – it may not include an exhaustive summary of all possible responses.

3. Potential Users/ Uses of the Document

- **Classroom teaching, learning and assessment:** This document will be helpful for teachers and learners to see the connection between syllabus, textbook and learning outcomes. The indicators can be used to effectively plan classroom pedagogy and design formative assessment. The indicators can also be used by students to self-assess and plan their learning effectively.
- **Pre-service and In-service Teacher Professional Development:** This document can be utilised for developing content for professional development programs for teachers both at the pre-service and in-service level. The sample pedagogical processes and assessment strategies will provide student teachers as well as in-service teachers an insight on how to concretise the learning outcomes in the classroom.
- **Textbook development:** Clearly stated indicators could also facilitate the review and revision of the text books used for secondary stage, and in the designing of new textbooks.
- **Developing Assessment Frameworks and tools for large scale assessments/surveys:** This document may be used at the developing assessment frameworks and question papers for board examinations of different states leading to uniformity in quality standards across states. It could be used as a framework for drawing key indicators for National Achievement Survey (NAS). Reporting the assessment data against these outcomes will provide a comprehensive overview of the education system in the country.

4. The Nature of Science

Among many ways in which the inquiring and imaginative human mind engages, expresses, and explains nature's wonder is through science. It is a human endeavour that observes the physical and biological environment carefully, looks for any meaningful patterns, processes, and relations, making and using new tools to interact with nature, and building conceptual models to understand the world. Also, the knowledge developed helps understand the evolutionary past, current state and predict the future of humanity and nature. It provides us with a way to present ideas that can be tested, repeated, and verified. Scientists gather evidence (as opposed to "proof") to support or falsify hypotheses. Theories, laws, and principles are supported, modified, or replaced as new evidence appears and are central to scientific thinking.

Despite many attempts to shrug it off in textbook chapters and a note to the teacher section, the prevailing perception on the nature of doing science is through *the* scientific method and not *a* scientific method. And that method is linear. This perception of the nature of doing science needs countering, for the art of doing science is a creative, iterative, and interconnected process built on curiosity, healthy scepticism, and questioning.

While science is at its best in understanding simple linear systems of nature, its predictive or explanatory power is limited when it comes to dealing with non-linear complex systems of nature. Yet, with all its limitations and failings, science is unquestionably the most reliable and powerful knowledge system about

the physical world known to humans, augmenting the spirit of enquiry, creativity, objectivity, and aesthetic sensibility leading towards the development of scientific temper. The school science curriculum across classes could gradually nurture scientific temper through appropriate learning opportunities.

NCF 2005 position paper on teaching of science at secondary stage emphasises the learning of science as a composite discipline, in doing so, it encourages the designing of advanced technological modules, analysing issues of health and the surrounding environment, and experimenting systematically to discover and verify theoretical principles.

In a progressive forward-looking society, science can play a truly liberating role, helping people out of the vicious circle of poverty, ignorance, and superstition. In a democratic political framework, the possible aberrations and misuse of science can be checked by the people themselves. Science, tempered with wisdom, is the surest and the only way to human welfare. This conviction provides the basic rationale for science education.

5. Secondary Stage Curricular Expectations

The Constitution's Fundamental Duty 'to develop the scientific temper, humanism, and the spirit of inquiry and reforms begins at the primary stage and manifests beautifully at the secondary stage across subjects as scientific literacy is *not* the sole look out of science learners. The NCERT curricular expectations articulate that aspect of science education at the content and cognitive dimensions. A thematically built content spread across classes IX and X adheres to the validities of teaching science.

SNo.	***NCERT Secondary Level Curricular Expectations***
CE1	Develop understanding of concepts, principles, theories and laws governing the physical world, consistent with the stage of cognitive development.
CE2	Develop ability to acquire and use the methods and processes of science, such as observing, questioning, planning investigations, hypothesising, collecting, analysing and interpreting data, communicating explanations with evidence, justifying explanations, thinking critically to consider and evaluate alternative explanations, etc.
CE3	Conduct experiments, also involving quantitative measurements.
CE4	Appreciate how concepts of science evolve with time giving importance to its historical perspectives.
CE5	Develop scientific temper (objectivity, critical thinking, freedom from fear and prejudice, etc.).
CE6	Nurture natural curiosity, aesthetic sense, and creativity.
CE7	Imbibe the values of honesty, integrity, cooperation, concern for life and preservation of environment.
CE8	Develop respect for human dignity and rights, equity, and equality.

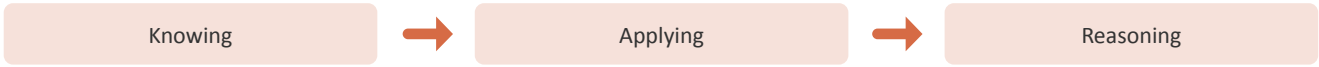
6. Content Domains

The science content up to Class X is not framed along disciplinary lines, but rather organised around themes that are potentially cross-disciplinary in nature. The same set of themes are used, from Class VI to X. The themes included are: Food; Materials; The world of the living; How things work; Moving things; People and ideas; Natural phenomena and Natural resources. While these run all through, in the higher classes, there is a consolidation of content which leads to some themes being absent, e.g., Food from Class X.

Content Domain	***Class IX- Textbook Chapter***	***Class X- Textbook Chapter***
1. Materials	1. Matter and its surroundings 2. Is Matter around us pure? 3. Atoms and Molecules 4. Structure of Atoms	1. Chemical reactions and equations 2. Acids, bases and salts 3. Metals and Non-metals 4. Carbon and its compounds 5. Periodic classification of elements
2. The World of the Living	5. The Fundamental Unit of Life 6. Tissues 7. Diversity in Living Organisms 8. Why do we fall ill?	6. Life processes 7. Control and Coordination 8. How do organisms reproduce? 9. Heredity and Evolution
3. Natural Phenomena		10. Light – Reflection and refraction 11. Human eye and colourful world
4. How things work		12. Electricity 13. Magnetic effects of electric current
5. Moving things, People and Ideas	9. Motion 10. Forces and Laws of Motion 11. Gravitation 12. Work and Energy 13. Sound	
6. Natural Resources	14. 14. Natural Resources	14. Sources of energy 15. Our environment 16. Management of natural resources
7. Food	15. Improvement in Food Resources	

7. Subject Specific Cognitive Levels

At the secondary stage, the curriculum emphasis is on comprehension of concepts, principles, and laws of science and not on mere formal definitions. Science at this stage also relies on inference and interpretation. Experimentation, often involving quantitative measurement, as a tool to discover/verify theoretical principles is an important part of the curriculum at this stage. Considering the nature of learning outcomes defined for science, the cognitive levels can be divided into three domains that describe the thinking processes students shall engage in and consequently demonstrate the expected outcomes.



1. **Knowing** - This domain addresses the student's ability to recall, recognise, describe, and provide examples of facts, concepts, and procedures that are necessary for a sound foundation in science. Accurate and broad-based factual knowledge enables students to successfully engage in more complex cognitive activities essential to the scientific enterprise.

Recall/ Recognise	• Identifies or states facts, relationships, and concepts. • Identifies the characteristics or properties of specific organisms, materials, and processes. • Identifies the appropriate uses for scientific equipment and procedures. • Recognises and uses scientific vocabulary, symbols, abbreviations, units, and scales.
Describe	• Describes or identifies descriptions of properties, structures, and functions of organisms and materials. • Identifies relationships among organisms, materials, processes, and phenomena.
Provide Examples	• Provides or identifies examples of organisms, materials, and processes that possess certain specified characteristics. • Clarifies statements of facts or concepts with appropriate examples.

2. **Applying** – This domain focuses on using this knowledge to compare, contrast, and classify groups of objects or materials; relating knowledge of a science concept to a specific context; generating explanations; and solving practical problems. Learners here are required to engage in applying knowledge of facts, relationships, processes, concepts, equipment, and methods in real-life contexts and expanding dimensions of this acquired knowledge.

Compare/Contrast/Classify	• Identifies or describes similarities and differences between groups of organisms, materials, or processes. • Distinguishes, classifies, or sorts individual objects, materials, organisms, and processes based on characteristics and properties.
Relate	• Relates knowledge of an underlying science concept to an observed or inferred property, behavior, or use of objects, organisms, or materials.
Use Models	• Uses diagrams or models to demonstrate knowledge of science concepts, to illustrate a process, cycle, relationship, or system, or to find solutions to science problems.
Interpret Information	• Uses knowledge of science concepts to interpret or calculate relevant textual, tabular, pictorial, and graphical information/data.
Explain	• Provides or identifies an explanation for an observation or a natural phenomenon using a science concept or principle.

3. **Reasoning** – In this domain, learners are engaged in reasoning to analyse data and other information, draw conclusions, and extend their understandings to new situations. In contrast to the more direct applications of scientific facts and concepts exemplified in the applying domain, learning outcomes in the reasoning domain involve unfamiliar or more complicated contexts. Scientific reasoning also encompasses developing hypotheses and designing scientific investigations within and beyond classrooms.

Analyse	• Identifies the elements of a scientific problem and use relevant information, concepts, relationships, and data patterns to answer questions and solve problems.
Synthesise	• Answers questions that require consideration of several different factors or related concepts.
Formulate Questions/ Hypothesise/ Predict	• Formulates questions that can be answered by investigation and predicts the results of an investigation, given information about the design. • Formulates testable assumptions based on conceptual understanding and knowledge from experience, observation, and/or analysis of scientific information. • Uses evidence and conceptual understanding to make predictions about the effects of changes in biological or physical conditions.
Design Investigations	• Plans investigations or procedures appropriate for answering scientific questions or testing hypotheses. • Describes or recognises the characteristics of well-designed investigations in terms of variables to be measured and controlled, and cause and effect relationships.
Evaluate	• Evaluates alternative explanations. • Weighs advantages and disadvantages to make decisions about alternative processes and materials. • Evaluates results of investigations with respect to the sufficiency of data to support conclusions.
Draw Conclusions	• Makes valid inferences based on observations, evidences, and/or understanding of science concepts. • Draws appropriate conclusions that address questions or hypotheses. • Demonstrates understanding of cause and effect.
Generalise	• Makes general conclusions that go beyond the experimental or given conditions; applies conclusions to new situations.
Justify	• Uses evidence and science understanding to support the reasonableness of explanations, solutions to problems, and conclusions from investigations.

The following tables showcase how the three domains of the cognitive dimension can take root for a chapter. A given concept may or may not tick all the thinking processes that fall under three domains of Knowing, Applying and Reasoning.

Example 1: Chemical reactions and chemical equations

Knowing		***Applying***		***Reasoning***	
Recall	• Recalls the method of writing the formula of a chemical compound. • Identifies the reactants and products in a chemical reaction.	Compare/ Contrast/ Classify	• Compares chemical reactions based on them either releasing or absorbing energy. • Classifies the chemical reactions as a combination, decomposition, displacement, double displacement and oxidation/reduction reactions. • Differentiates corrosion from rancidity.	Analyse	
Describe	• Describes the different types of chemical reactions.	Relate	• Identifies the kind of chemical reaction based on observations of experiments performed.	Synthesise	• Integrates the understanding of types of chemical reactions to unknown chemical equations to classify them as combination, decomposition etc.
Provide Examples	• Provides examples for the types of chemical reactions.	Use Models		Formulate question/ Hypothesise/ Predict	• Verifies the balancing of chemical equations. • Predicts the type of chemical reaction based on the chemical equations.
		Interpret Information	• Interprets the type of chemical reaction based on narratives/ case studies.		
		Explain	• Explains the process of corrosion. • Explains the various steps involved in balancing chemical equations.		

Example 2: Force and laws of motion

Knowing		*Applying*		*Reasoning*	
Recall	• Recalls that pushing, pulling or hitting objects change their state of motion. • Recognises correct usage of units related to force and laws of motion.	Compare/ Contrast/ Classify	• Compares balanced and unbalanced forces. • Differentiates earth-centric world view and sun-centric world view.	Analyse	• Identifies the role of friction to minimise, maximise or stabilise motion in different scenarios.
Describe	• Describes what is action and reaction. • Describes the contributions of Newton and Galileo to Laws of Motion.	Relate	• Relates the concept of action-reaction to daily instances.	Synthesise	• Integrates the understanding of laws of motion on various indoor and outdoor games and situations.
Provide Examples	• Provides examples of inertia from daily experiences.	Use Models	• Uses models to explain the law of conservation of momentum.	Formulate question/ Hypothesise/ Predict	• Verifies the concept of inertia. • Verifies the conservation of momentum by peer-constructed Newton's cradle. • Predicts the conservation of momentum by peer-constructed modified versions of the Newton's cradles.
		Interpret Information	• Interprets velocity-time graph.	Design Investigations	• Plans investigations/ experiments on the laws of motion and friction on various surfaces by controlling variables. • Plans investigations on simple moving toys, dismantles it and attempts to explain their working principle in terms of motion.

Knowing		*Applying*		*Reasoning*	
		Explain	• Explains the role of friction in motion. • Explains the various factors affecting the linear motion.	Evaluate	• Evaluates the possibilities of 'eliminating' friction in examples from daily instances.
				Draw conclusions	• Draws conclusions from mass-velocity relation on the conservation of momentum.

Example 3: A living cell

Knowing		*Applying*		*Reasoning*	
Recall	• Identifies the major cell structures such as nucleus, mitochondria, ER etc.	Compare/ Contrast/ Classify	• Compares plant and animal cells.	Analyse	• Analyses the structure and function correlation between intestinal villi and the rate of absorption.
Describe	• Describes the differences between prokaryotic and Eukaryotic cells.	Relate	• Relates how guard cells help gas exchange in leaves.	Synthesise	• Responds why calling cells as 'bricks' of our body doesn't justify what they actually are.
Provide Examples	• Provides examples of cell types that have chloroplasts.	Use Models	• Uses a model to demonstrate how cell is a dynamic entity.	Formulate question/ Hypothesise/ Predict	• Investigates, predicts and verifies 'what if' scenarios for living cells under certain conditions.
		Interpret Information	• Interprets tabular, pictorial and graphical information related to cells.	Justify	• Justifies the complexity of animal and plant cell in contrast to bacterial cells.
		Explain	• Explains the 'how' of cellular respiration.		
				Design investigations	• Designs an experiment on determining the cell size. • Investigates a sample of pond water to observe, draw and record variety of life forms in it.

8. Learning Outcomes

Following learning outcomes for secondary stage developed by (NCERT) states important knowledge, skills and dispositions students need to attain at the end of an academic year for Class IX and X science subjects.

SNo.	***Class IX – Ncert Secondary Level Learning Outcomes***
LO1	**The learner differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.
LO2	**Classifies materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics**, such as classification of plants, animals under various hierarchical sub-groups, natural resources, classification of matter based on their states (solid/ liquid/ gas) and composition (element/ compound/ mixture), etc.
LO3	**Plans and conducts investigations/ experiments to arrive at and verify the facts/ principles/ phenomena or to seek answers to queries on their own**, such as how does speed of an object change? How objects float/ sink when placed on surface of liquid? Is there any change in mass when chemical reaction takes place? What is the effect of heat on state of substances? What is the effect of compression on different states of matter? Where are stomata present in different types of leaves? Where are growing tissues present in plants?
LO4	**Relates processes and phenomena with causes/ effects**, such as symptoms with diseases/ causal agents, tissues with their functions, production with use of fertilisers, process of evaporation with cooling effect, various processes of separation with the physical and chemical properties of the substances, production of sound with vibrations of source, etc.
LO5	**Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.
LO6	**Calculates using the data given**, such as distance, velocity, speed, frequency, work done, number of moles in a given mass of substance, concentration of solution in terms of mass by mass percentage of substances, conversion of Celsius scale to kelvin scale and vice versa, number of neutrons in an atom from atomic number and mass number, speed of sound, kinetic and potential energies of an object, boiling points of liquids to predict the order of their separation from the mixture, etc.
LO7	**Draws labelled diagrams/ flow charts/ concept map/graphs**, such as biogeochemical cycles, cell organelles and tissues, human ear, distance-time and speed-time graphs, distribution of electrons in different orbits, process of distillation/ sublimation, etc.
LO8	**Analyses and interprets graphs/ figures etc.**, such as distance-time and velocity-time graphs, computing distance/ speed/ acceleration of objects in motion, properties of components of a mixture to identify the appropriate method of separation, crop yield after application of fertilisers, etc.
LO9	**Uses scientific conventions/ symbols/ equations to represent various quantities/ elements/ units**, such as SI units, symbols of elements, formulae of simple compounds, chemical equations, etc.
LO10	**Measures physical quantities using appropriate apparatus/instruments/ devices,** such as weight and mass of an object using spring balance, mass using a physical balance, time period of a simple pendulum, volume of liquid using measuring cylinder, temperature using thermometer, etc.
LO11	**Applies learning to hypothetical situations**, such as weight of an object at moon, weight of an object at equator and poles, life on other planets, etc.

SNo.	***Class IX – Ncert Secondary Level Learning Outcomes***
LO12	**Applies scientific concepts in daily life and solving problems**, such as separation of mixtures, uses safety belts in automobiles, covers walls of large rooms with sound absorbent materials, follows intercropping and crop rotation, takes preventive measures to control disease causing agents, etc.
LO13	**Derives formulae/ equations/ laws**, such as mathematical expression for second law of motion, law of conservation of momentum, expression for force of gravity, equations of motion from velocity-time graphs, etc.
LO14	**Draws conclusion**, such as classification of life forms is related to evolution, deficiency of nutrients affects physiological processes in plants, matter is made up of particles, elements combine chemically in a fixed ratio to form compounds, action and reaction act on two different bodies, etc.
LO15	**Describes scientific discoveries/ inventions**, such as discovery of various atomic models, discovery of cell with invention of microscope, experiments of Lavoisier and Priestley, beliefs regarding motion, discovery of real cause for peptic ulcers, Archimedes principle, classification of living things, etc.
LO16	**Designs models using eco-friendly resources**, such as 3-d model of a cell, water purification system, stethoscope, etc.
LO17	**Records & reports experimental data objectively and honestly. Exhibits values of honesty/ objectivity/ rational thinking/ freedom from myths/superstitious beliefs while taking decisions, respect for life, etc.**, such as records and reports experimental data exactly, sexually transmitted diseases are not spread by casual physical contact, vaccination is important for prevention of diseases, etc.
LO18	**Communicates the findings and conclusions effectively**, such as those of experiment/ activity/ project orally and in written form using appropriate figures/ tables/ graphs/ digital form, etc.
LO19	**Applies the interdependency and interrelationship in the biotic and abiotic factors of environment to promote conservation of environment**, such as organic farming, waste management, etc.

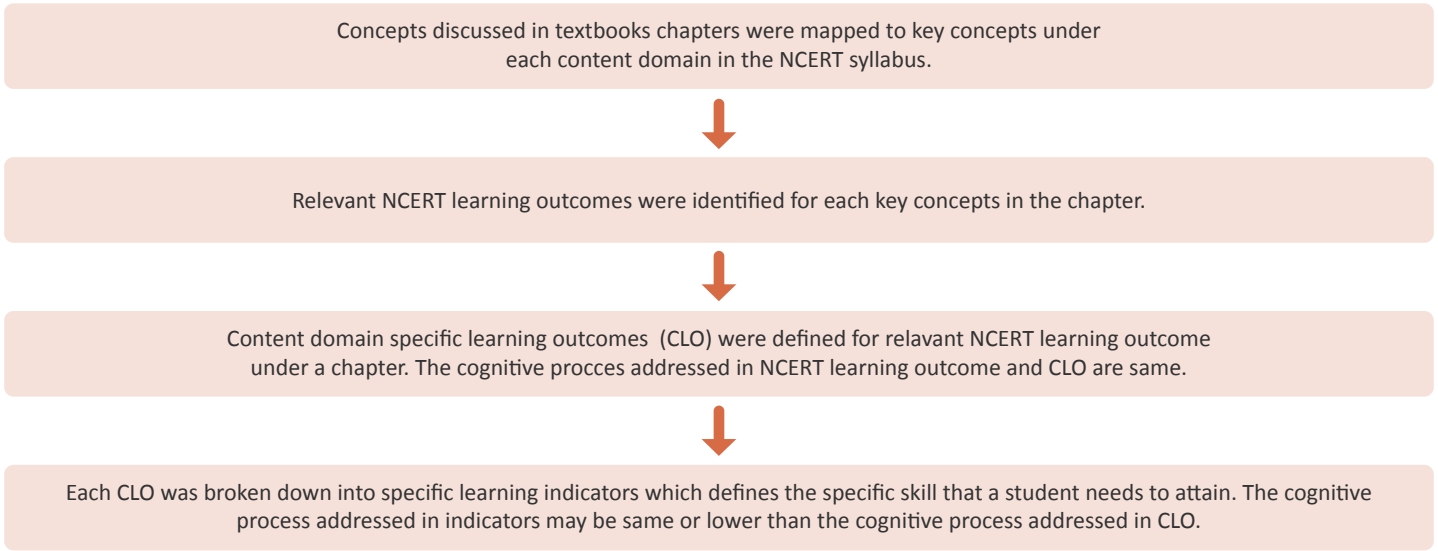
SNo	***Class X – Ncert Secondary Level Learning Outcomes***
LO1	**Differentiates materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as autotrophic and heterotrophic nutrition, biodegradable and non- biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.
LO2	**Classifies materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics**, such as metals and non-metals based on their physical and chemical properties, acids and bases based on their chemical properties, etc.
LO3	**Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own**, such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why a plant shoot moves towards light?
LO4	**Relates processes and phenomena with causes/ effects**, such as hormones with their functions, tooth decay with Ph of saliva, growth of plants with pH of the soil, survival of aquatic life with pH of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc.
LO5	**Explains processes and phenomena**, such as nutrition in human beings and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions based on reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.

SNo	*Class X – Ncert Secondary Level Learning Outcomes*
LO6	**Draws labelled diagrams/ flow charts/ concept map/graphs**, such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.
LO7	**Analyses and interprets data/ graph/ figure**, such as melting and boiling points of substances to differentiate between covalent and ionic compounds, pH of solutions to predict the nature of substances, V-I graphs, ray diagrams, etc.
LO8	**Calculates using the data given**, such as number of atoms in reactants and products to balance a chemical equation, resistance of a system of resistors, power of a lens, electric power, etc.
LO9	**Uses scientific conventions to represent units of various quantities/ symbols/ formulae/ equations**, such as balanced chemical equation by using symbols and physical states of substances, sign convention in optics, SI units, etc.
LO10	**Measures physical quantities using appropriate apparatus/ instruments /devices**, such as pH of substances using different indicators, electric current and potential difference using ammeter and voltmeter, etc.
LO11	**Applies learning to hypothetical situations**, such as what happens if all herbivores are removed from an ecosystem? What will happen if all non-renewable sources of energy are exhausted?
LO12	**Applies scientific concepts in daily life and solving problems**, such as takes precautions to prevent sexually transmitted infections, uses appropriate electrical plugs (5/15a) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health, avoids using appliances responsible for ozone layer depletion, applies concept of decomposition reaction of baking soda to make spongy cakes, etc.
LO13	**Derives formulae/ equations/ laws**, such as equivalent resistance of resistors in series and parallel, etc.
LO14	**Draws conclusion**, such as traits/ features are inherited through genes present on chromosomes, a new species originates through evolutionary processes, water is made up of hydrogen and oxygen, properties of elements vary periodically along the groups and periods in periodic table, potential difference across a metal conductor is proportional to the electric current through it, etc.
LO15	**Takes initiative to know about scientific discoveries/ inventions**, such as Mendel's contribution in understanding the concept of inheritance, Dobereiner for discovering triads of elements, Mendeleev for the development of the periodic table of elements, oersted discovery that electricity and magnetism are related, discovery of relation between potential difference across a metal conductor and the electric current through it by ohm, etc.
LO16	**Exhibits creativity in designing models using eco-friendly resources**, such as working model of respiratory, digestive and excretory systems, soda acid fire extinguisher, periodic table, micelles formation, diamond/ graphite/ Buckminsterfullerene, human eye, electric motor and generator, etc.
LO17	**Exhibits values of honesty/ objectivity/ rational thinking/ freedom from myth/ superstitious beliefs while taking decisions, respect for life, etc.** such as reports and records experimental data accurately, says no to consumption of alcohol and sensitises others about its effect on physical and mental health, motivates for organ donation, prevents pre-natal sex determination, etc.
LO18	**Communicates the findings and conclusions effectively**, such as those of experiment/ activity/ project orally and in written form using appropriate figures/ tables/ graphs/ digital form, etc.

SNo	*Class X – Ncert Secondary Level Learning Outcomes*
LO19	**Makes efforts to conserve environment realising the inter- dependency and interrelationship in the biotic and abiotic factors of environment,** such as appreciates and promotes segregation of biodegradable and non - biodegradable wastes, takes steps to promote sustainable management of resources in day-to-day life, advocates use of fuels which produces less pollutants, uses energy efficient electric devices, uses fossil fuels judiciously, etc.

9. Content Domain Specific Learning Outcomes and Indicators

The learning outcomes defined by NCERT are generic and broadly defined. They are focused on science specific skills that students need to attain through different concepts addressed in the syllabus. A clear understanding of the scope of these learning outcomes for each concept dealt with in a textbook chapter will be immensely helpful for both teachers and learners to plan their teaching and learning better. To enable this, the following process is followed:



9.1 Class IX

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Materials **Chapter 1 – Matter in our surroundings** Key concepts Physical nature of matter; characteristics of particles of matter; states of matter – solid, liquid and gaseous; changes in states of matter; sublimation; boiling; evaporation – factors influencing the process	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO1: Differentiates the **three states of matter - solid, liquid and gas.**	C1: Defines matter as solid, liquid and gas using their characteristics. C2: Differentiates between latent heat of vaporisation and the latent heat of fusion. C3: Differentiates between sublimation and evaporation. C4: Differentiates between the three states of matter based on shape, intermolecular spaces, continuous movement of particles. C5: Emphasises the contrast between the three states of matter using specific examples. C6: Differentiates between plasma and Bose-Einstein Condensate.
	LO5: **Explains processes and phenomena,** such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO2: Describes the various processes bringing change in the state of matter like evaporation, boiling, melting, sublimation, condensation. CLO3: Explains the effect of change of temperature and pressure on states of matter.	C7: Explains the difference between evaporation and boiling C8: Describes the process of sublimation and evaporation. C9: Explains the effect of temperature change on melting, freezing, evaporation, condensation and sublimation.
	LO12: **Applies scientific concepts in daily life** and solving problems, such as separation of mixtures, uses safety belts in automobiles, covers walls of large rooms with sound absorbent materials, follows intercropping and crop rotation, takes preventive measures to control disease causing agents, etc.	CLO4: Applies the **concept of evaporation seen in day-to- day life.**	C10: Relates to processes like drying of clothes, cooling of surfaces to the process of evaporation.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
	LO10: **Measures physical quantities** using appropriate apparatus, instruments, and devices, such as, weight and mass of an object using spring balance, mass using a physical balance, time- period of a simple pendulum, volume of liquid using measuring cylinder, temperature using thermometer, etc.	CLO5: Measures **the melting point and boiling point of a substance using a thermometer.**	C11: Explains the meaning of melting and boiling point. C12: Explains the use of apparatus like a thermometer for measuring the melting and boiling points of substances. C13: Measures melting and boiling point using thermometer.
Materials **Chapter 2 – Is matter around us pure?** Key concepts Mixtures – types of mixtures, homogeneous/ heterogeneous; solution – properties of a solution, concentration of a solution; suspension and its properties; colloidal solution and its properties; separation of a mixture – using evaporation, centrifugation, a separating funnel (for immiscible liquids), sublimation, chromatography, distillation (for miscible liquids), fractional distillation, crystallisation; purification of water; physical and chemical changes; pure substances – elements and compounds	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO6: Differentiates between **mixtures and pure substances; homogenous and heterogeneous mixtures; true solutions, colloids and suspensions; mixtures and compounds.**	C14: Distinguishes between mixtures and compounds based on appearance, behaviour towards magnets and effect of heat. C15: Differentiates mixtures as homogeneous and heterogeneous based on their properties. C16: Identifies various examples of true solutions, colloids and suspensions from day-to-day life and differentiates between them. C17: Describes substances as elements, compounds, and mixtures. C18: Differentiates mixtures as homogenous, heterogenous, colloids or suspensions.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Materials **Chapter 2 – Is matter around us pure?** Key concepts Mixtures – types of mixtures, homogeneous/ heterogeneous; solution – properties of a solution, concentration of a solution; suspension and its properties; colloidal solution and its properties; separation of a mixture – using evaporation, centrifugation, a separating funnel (for immiscible liquids), sublimation, chromatography, distillation (for miscible liquids), fractional distillation, crystallisation; purification of water; physical and chemical changes; pure substances – elements and compounds	LO3: **Plans and conducts investigations or experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own**.	CLO7: Investigates **the nature and properties of various types of chemical substances through experiments.**	C19: Investigates the types and properties of mixtures, solutions, colloids, and suspensions using simple experiments. C20: Plans tasks on how to prepare suspensions of soil, chalk powder and fine sand in water. C21: Plans tasks on how to prepare colloidal solutions of starch in water and egg albumin or milk in water.
	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc	CLO8: Describes **different methods of separation to get individual components from a mixture.** CLO9: Explains **saturated and unsaturated solutions and finds concentration of the given solutions.**	C22: Explains the separation of sand and water using filtration. C23: Explains the process of centrifugation and use of separating funnel to separate immiscible liquids. C24: Describes the method of distillation and fractional distillation for separation of miscible liquids and components of air. C25: Explains the separation of the mixture of ammonium chloride and sand using sublimation. C26: Describes the process of chromatography for separating components of ink. C27: Explains the method of separating the components of a mixture of sand, common salt and ammonium chloride (or camphor).
	LO16: **Applies scientific concepts in daily life and solving problems**, such as, separation of mixtures, uses safety belts in automobiles, covers walls of large rooms with sound absorbent material, follows intercropping and crop rotation, takes preventive measures to control disease causing agents, etc.	CLO10: Relates the importance of **methods of separation in day- to-day life applications**.	C28: Draws connect with the use of distillation and fractional distillation to the desalination of water for drinking and irrigation. C29: Explains the fractional distillation of crude oil. C30: Relates to the relevance of fractional distillation to everyday life. C31: Supports and agrees to the importance of choosing the right separation technique for obtaining the pure substance from a mixture in day-to-day life.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Materials **Chapter 3 – Atoms and Molecules** Key concepts Laws of chemical combination – law of conservation of mass, law of constant proportion; atom – atomic mass; molecule – of elements and compounds; ion – writing a chemical formula; molecular formula and mole concept.	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO11:Describes **the laws of chemical combination.**	C32: Outlines the law of conservation of mass with the help of specific examples. C33: Outlines the law of constant proportion with the help of specific examples.
		CLO12:Explains atoms, molecules and represents compounds **using chemical formulae; the concept of the mole and relates it with molecular mass.** CLO13:Explains the terms **relative mass and atomic mass unit.**	C34: Identifies the difference between atoms and molecules. C35: Identifies relative atomic masses of different atoms of elements. C36: Uses symbols to write formulae of compounds like magnesium chloride, aluminium oxide, calcium sulphate etc. C37: Explains the concept of the mole and relates it with molecular mass.
	LO6: **Calculates using the data given**, such as distance, velocity, speed, frequency, work done, number of moles in a given mass of substance, concentration of solution in terms of mass by mass percentage of substances, conversion of Celsius scale to kelvin scale and vice versa, number of neutrons in an atom from atomic number and mass number, speed of sound, kinetic and potential energies of an object, boiling points of liquids to predict the order of their separation from the mixture, etc.	CLO14:Calculates number of **moles in a given mass of substance and number of neutrons in an atom from atomic number and mass number using the given data.**	C38: Describes how to measure the mass of a substance to calculate the number of moles. C39: Calculates molecular mass of molecules using atomic mass values. (element/ compound)
	LO9: **Uses scientific conventions/ symbols/ equations to represent various quantities/ elements/ units**, such as SI units, symbols of elements, formulae of simple compounds, chemical equations, etc.	CLO15:Uses **symbols of elements and valencies to write formulae of compounds.**	C40: Recalls the symbol of elements. C41: Uses correct formula for monoatomic, diatomic molecules. C42: Recalls that the formula of ionic compounds is made of a cation and an anion

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Materials **Chapter 4 – Structure of atoms** Key concepts Charged particles in matter; structure of an atom - Thomson model, Rutherford model, Bohr model; discovery of the neutron; electron and proton; valency; atomic mass; mass number; isotopes; isobars.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO16: Differentiates elements **based on neutron number/ proton number/ electron number.**	C43: Differentiates between isotopes and isobars C44: Differentiates between three subatomic particles of an atom (with respect to charge and mass)
	LO5: **Explains processes and phenomena**, such as, functions of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, rotation and revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting, boiling, freezing, how bats use ultrasonic waves to catch prey, etc.	CLO17: Explains **valency and reactivity of elements using atomic structure and periodic table position and constructs simple chemical formulae of compounds using valency information.** CLO18: Describes **isotopes and isobars and states their uses.**	C45: Explains the valency of elements based on the atomic structure. C46: Identifies the atomic structure from atomic mass and atomic number (up to number 20 in the periodic table) C47: Describes isotopes and isobars and states their uses.
	LO9: **Uses scientific conventions, symbols, and equations to represent various quantities, elements, and units**, such as, SI units, symbols of elements, formulae of simple compounds, chemical equations, etc.	CLO19: Uses **symbols of elements and valencies to write formulae of compounds**. CLO20: Uses the **number of neutrons, protons and electrons to write symbol of an element.**	C48: Recalls the symbol of elements. C49: Writes atomic mass, atomic number and symbol to represent an element.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Materials **Chapter 4 – Structure of atoms** Key concepts Charged particles in matter; structure of an atom – Thomson model, Rutherford model, Bohr model; discovery of the neutron; electron and proton; valency; atomic mass; mass number; isotopes; isobars.	LO7: **Draws labelled diagrams, flow charts, concept maps, graphs**, such as, biogeochemical cycles, cell organelles and tissues, human ear, distance-time and speed-time graphs, distribution of electrons in different orbits in an atom, process of distillation and sublimation, etc.	CLO21:Draws labelled diagrams of the **distribution of electrons in different orbits of an atom.**	C50: Draws/illustrates the atomic shells for different elements up to atomic number 20 in the periodic table. C51: Draws sketches of the Bohr's model of atom.
	LO15: **Describes scientific discoveries and inventions**, such as, discovery of various atomic models, discovery of cell with invention of microscope, experiments of Lavoisier and Priestley, beliefs regarding motion, discovery of real cause for peptic ulcers, Archimedes principle, classification of living things, etc.	CLO22:Traces the journey of the **structure of an atom from the Thomson to the Bohr model of atom.** CLO23:Recounts the **discovery of the various atomic models.**	C52: Describes Thomson's model of an atom. C53: Describes the structure of an atom as per Rutherford's atomic model. C54: Describes the observations and conclusions of Rutherford's atomic model. C55: Describes the Rutherford model of an atom C56: States the drawbacks of Rutherford's model of an atom. C57: Explains the structure of an atom as per Bohr's model and how this model overcomes the drawbacks of Rutherford's model. C58: Describes the structure of atoms and identifies the subatomic particles – electrons, protons, neutrons and their arrangement in the atoms. C59: Outlines the atomic model of Dalton. C60: Traces the path from Thomson's plum pudding model to Rutherford's nuclear atom. C61: Describes Chadwick's discovery of the neutron.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
World of living **Chapter 5 -** **The fundamental unit of life** Key concepts: Cell as a basic unit of life; Prokaryotic and eukaryotic cells, multicellular organisms; cell membrane and cell wall, cell organelles: chloroplast, mitochondria, vacuoles, ER, Golgi Apparatus; nucleus, chromosomes – basic structure, number. Cell division, Handling of Microscope.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO24:Differentiates organisms/ processes/phenomenon based on their properties/ characteristics **such as unicellular and multicellular, prokaryote and eukaryote, plant and animal cells, osmosis and diffusion.**	C62: Describes the differences and similarities between single-cell and multicellular organisms. C63: Recognises that cell walls and chloroplasts differentiate plant cells from animal cells. C64: Distinguishes cell membrane from cell wall based on structure and functions. C65: Differentiates between the processes of osmosis and diffusion with relevant examples and situations. C66: Describes the differences between prokaryotic and eukaryotic cells and organisms. C67: Identifies major cell organelles such as a nucleus, mitochondria, endoplasmic reticulum, vacuoles, chloroplast cell membrane, and cell wall etc. from temporary mounts/permanent slides/pictures .
	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts/ principles/ phenomena or to seek answers to queries on their own**, such as how does speed of an object change? How objects float/ sink when placed on surface of liquid? Is there any change in mass when chemical reaction takes place? What is the effect of heat on state of substances? What is the effect of compression on different states of matter? Where are stomata present in different types of leaves? Where are growing tissues present in plants?	CLO25:Plans and conducts investigations to verify the phenomenon of diffusion and osmosis based on queries/confusions and daily experiences.	C68: Plans and conducts investigations to verify the phenomenon of diffusion and osmosis based on queries/confusions and daily experiences.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
World of living **Chapter 5 –** **The fundamental unit of life** Key concepts: Cell as a basic unit of life; Prokaryotic and eukaryotic cells, multicellular organisms; cell membrane and cell wall, cell organelles: chloroplast, mitochondria, vacuoles, ER, Golgi Apparatus; nucleus, chromosomes – basic structure, number. Cell division, Handling of Microscope.	LO4: **Relates processes and phenomena with causes/ effects**, such as symptoms with diseases/ causal agents, tissues with their functions, production with use of fertilisers, process of evaporation with cooling effect, various processes of separation with the physical and chemical properties of the substances, production of sound with vibrations of source, etc.	CLO26:Relates **processes and phenomenon with causes/effects in terms of osmosis and nutrition in amoeba.**	C69: Relates the changes in egg and raisins when placed in a hypotonic and hypertonic solution to endo/exo-osmosis. C70: Relates the processes of osmosis and diffusion in daily lives and situations. (e.g. appearance of wrinkles on fingers after longer exposure to soap solution etc.) C71: Relates the nature and flexibility of cell membrane to the process of endocytosis in amoeba.
	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO27:Explains the features of **cell (plasma membrane, nucleus, cytoplasm and cell organelles), activities inside the cell and the interactions of the cell with its environment.**	C72: Explains that living things are made of cells that both carry out life functions and reproduce by division. C73: Explains the cell as a dynamic entity and building unit of life. C74: Explains cell structures and their functions: cell membrane and cell wall, cell organelles and cell inclusions; chloroplast, mitochondria, vacuoles, endoplasmic reticulum, golgi apparatus; nucleus, chromosomes. C75: Explains the complexity of animal and plant cells in contrast with bacterial cells.
	LO7: **Draws labelled diagrams/ flow charts/ concept map/graphs**, such as biogeochemical cycles, cell organelles and tissues, human ear, distance-time and speed-time graphs, distribution of electrons in different orbits, process of distillation/ sublimation, etc.	CLO28:Draws labelled diagrams illustrating types **of cells, organelles and behaviour of cells.**	C76: Prepares stained temporary mounts of onion peel and human cheek cells, records observations, and draws labelled diagrams. C77: Draws labelled diagrams to depict behaviour of cells in different osmotic solutions. C78: Draws comparative diagrams of cells and organelles.
	LO15: **Describes scientific discoveries/ inventions**, such as discovery of various atomic models, discovery of cell with invention of microscope, experiments of Lavoisier and Priestley, beliefs regarding motion, discovery of real cause for peptic ulcers, Archimedes principle, classification of living things, etc.	CLO29:Describes **events and individuals related with discovery of cell and invention of microscope.**	C79: Describes events and individuals related with discovery of cell, its components and invention of the microscope.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
World of living **Chapter 5 –** **The fundamental unit of life** Key concepts: Cell as a basic unit of life; Prokaryotic and eukaryotic cells, multicellular organisms; cell membrane and cell wall, cell organelles: chloroplast, mitochondria, vacuoles, ER, Golgi Apparatus; nucleus, chromosomes – basic structure, number. Cell division, Handling of Microscope.	LO16: **Designs models using eco-friendly resources**, such as 3-d model of a cell, water purification system, stethoscope etc.	CLO30:Creates 3D models on **types of animal and plant cells using eco-friendly resources.**	C80: Designs/creates 3D models on types of animal and plant cells using eco-friendly resources.
World of living **Chapter 6 – Tissues** Key concepts Tissues, organs, organ systems, organism. Structure and functions of animal and plant tissues (four types in animals; meristematic and permanent tissues in plants).	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO31:Differentiates **plant tissues (parenchyma, sclerenchyma, collenchyma) and animal tissues (striated muscles and nerve fibres) based on diagrams, properties, functions and observing slides.**	C81: Identifies parenchyma, collenchyma and sclerenchyma tissues in plants using prepared/permanent slides. C82: Distinguishes between meristematic and permanent plant tissues. C83: Distinguishes between epithelial, connective, muscular and nervous animal tissues. C84: Identifies striped, smooth and cardiac muscle fibres and nerve cells in animals using prepared/permanent slides. C85: Locates regions of growth (apical, intercalary and lateral meristem) on the plant body. C86: Differentiates between xylem and phloem tissues underlining the structural and functional aspects.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
World of living **Chapter 6 – Tissues** Key concepts Tissues, organs, organ systems, organism. Structure and functions of animal and plant tissues (four types in animals; meristematic and permanent tissues in plants).	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts/ principles/ phenomena or to seek answers to queries on their own**, such as how does speed of an object change? How objects float/ sink when placed on surface of liquid? Is there any change in mass when chemical reaction takes place? What is the effect of heat on state of substances? What is the effect of compression on different states of matter? Where are stomata present in different types of leaves? Where are growing tissues present in plants?	CLO32: Plans and conducts investigations about the **localisation of stomata on plant leaves.** CLO33: Plans experiments to **locate the presence of meristematic tissues in plants.**	C87: Investigates the density of stomata in terms of their position on leaves (upper and lower surface) across a variety of suitable plants. C88: Observes and records the growth of onion root tips, relates with type of tissues present there and studies the effect of root tip removal.
	LO4: **Relates processes and phenomena with causes/ effects**, such as symptoms with diseases/ causal agents, tissues with their functions, production with use of fertilisers, process of evaporation with cooling effect, various processes of separation with the physical and chemical properties of the substances, production of sound with vibrations of source, etc.	CLO34: Relates type of **tissues with functions and habitat of plant and animals.**	C89: Relates features and characteristics of connective tissues to their functions in animals by observing prepared slides. C90: Relates features and characteristics of simple permanent tissues to their functions in plants by observing prepared slides. C91: Relates the presence of husk in coconut and hard shells of nuts to the lignified and dead sclerenchyma tissue. C92: Relates characteristics and function of tissues to habitat of plants and animals.
	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO35: Explains the **types of plant tissues (Meristematic and Permanent) and animal tissues (Epithelial, Connective, Muscular and Nervous).**	C93: Explains the structure and functions of animal tissues: striped/striated, smooth and cardiac muscle fibres, connective tissues (bone, cartilage and tendon), epithelial tissue and nerve cells (sensory neuron). C94: Explains the structure and functions of plant tissues: meristematic and permanent tissues (Parenchyma, collenchyma and sclerenchyma). C95: Elaborates the role of meristematic tissue in non-uniform growth of plants. (Growth at specific regions)

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
World of living **Chapter 6 – Tissues** Key concepts Tissues, organs, organ systems, organism. Structure and functions of animal and plant tissues (four types in animals; meristematic and permanent tissues in plants).	LO7: **Draws labelled diagrams/ flow charts/ concept map/graphs**, such as biogeochemical cycles, cell organelles and tissues, human ear, distance-time and speed-time graphs, distribution of electrons in different orbits, process of distillation/ sublimation, etc.	CLO36:Draws labelled diagram of **types of tissues in plants and animals. (Meristematic, permanent, epithelial, connective, muscular and nervous)**	C96: Prepares stained temporary mounts of suitable leaf peels (like Rhoeo etc.) to record observations for stomata and make labelled diagrams. C97: Draws labelled diagrams of complex permanent tissues (xylem, phloem) and their associated elements. C98: Draws labelled diagram of simple permanent tissues in plants (T.S and L.S)
	LO11: **Applies learning to hypothetical situations**, such as weight of an object at moon, weight of an object at equator and poles, life on other planets, etc.	CLO37:Applies learning of **types of tissues, structures and function to hypothetical situations.** (e.g absence of a type of tissue/structure in plants and animals, consequences if stomatal opening is closed/clogged etc.)	C99: Applies learning of types of tissues, structures and function to hypothetical situations. (e.g absence of a type of tissues in plants and animals, consequences if stomatal opening is closed etc.)
	LO16: **Designs models using eco-friendly resources**, such as 3-d model of a cell, water purification system, stethoscope, etc.	CLO38:Creates 3-d models on **different types of animal and plant tissues using eco-friendly resources.**	C100: Creates 3-d models on different types of animal and plant tissues using eco-friendly resources.
	LO18: **Communicates the findings and conclusions effectively**, such as those of experiment/ activity/ project orally and in written form using appropriate figures/ tables/ graphs/ digital form, etc.	CLO39:Communicates the findings **of an activity/ experiment/ investigation around types of tissues/ structures found in plants and animals.**	C101: Shares the findings related to an activity/experiment/ investigation on stomatal density or growth regions in plants to their peer group using graphs, tables, slides etc.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
World of living **Chapter 7 – Diversity in living organisms** Key concepts Diversity of plants and animals – basic issues in scientific naming, Basis of classification, Hierarchy of categories/ groups, Major groups of plants (salient features) (Bacteria, Thallophyta, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms. Major groups of animals (salient features) (non-chordates up to phyla and Chordates up to classes).	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO40:Differentiates between **major groups/subgroups of plants and animals (e.g., angiosperm, gymnosperm, pteridophyte, Arthropoda, Nematoda etc.) based on their salient features/body design.**	C102:Compares and contrasts between the salient features of pteridophytes and gymnosperms using representative examples/specimens. C103:Distinguishes the external features of root, stem, leaf and flower of monocot and dicot plants. (Both textually and through observations) C104:Differentiates organisms based on symmetry and layers of cells in body. (asymmetric, bilaterally symmetric, radially symmetric, diploblast and triploblast)
	LO2: **Classifies materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics**, such as classification of plants, animals under various hierarchical sub-groups, natural resources, classification of matter based on their states (solid/ liquid/ gas) and composition (element/ compound/ mixture), etc.	CLO41:Classifies **plants and animals under various hierarchical subgroups based on major characteristics.**	C105:Assigns respective hierarchical subgroups to representative specimens (plants and animals) based on key characteristics.
	LO4: **Relates processes and phenomena with causes/ effects**, such as symptoms with diseases/ causal agents, tissues with their functions, production with use of fertilisers, process of evaporation with cooling effect, various processes of separation with the physical and chemical properties of the substances, production of sound with vibrations of source, etc.	CLO42:Relates **processes/ phenomenon of evolution to system of classification.** CLO43:Relates to **evolutionary linkages between phyla/ divisions/class among plants and animals in terms of body design/ characteristics etc.**	C106:Relates processes/phenomenon of evolution to system of classification. C107:Relates to evolutionary linkages between phyla/ divisions/classes among plants and animals in terms of body design/characteristics etc.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
World of living **Chapter 7 – Diversity in living organisms** Key concepts Diversity of plants and animals – basic issues in scientific naming, Basis of classification, Hierarchy of categories/ groups, Major groups of plants (salient features) (Bacteria, Thallophyta, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms. Major groups of animals (salient features) (non-chordates up to phyla and Chordates up to classes).	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO44: Explains **diversity in organisms and basis of hierarchical classification in reference to evolution, body organisation and other characteristics.**	C108: Describes the basis of kingdom-based classification and elaborates upon key characteristics/features of each kingdom. (Monera, Protista, Fungi, Plantae and Animalia,) C109: Explains major groups of animals with salient features for invertebrates up to phyla (Porifera, Cnidaria, Platyhelminthes, Echinodermata, Mollusca, Nematoda, Arthropoda, Annelida and Chordata) and chordates up to class (Amphibia, Reptilia, Aves, Mammalia). C110: Explains the characteristics of Spirogyra, Agaricus, Moss, Fern, Pinus (either with male or female cone) and an Angiospermic plant. C111: Elaborates on significance of biodiversity in reference to evolution.
	LO7: **Draws labelled diagrams/ flow charts/ concept map/graphs**, such as biogeochemical cycles, cell organelles and tissues, human ear, distance-time and speed-time graphs, distribution of electrons in different orbits, process of distillation/ sublimation, etc.	CLO45: Draws labelled diagrams of representative organisms and their identifying **features/ characteristics from various sub-groups.** CLO46: Draws flow charts to classify plants and animals into **various groups and subgroups based on their characteristics.**	C112: Draws labelled diagrams of representative organisms and their identifying features/characteristics from various sub-groups. C113: Draws flow charts to classify plants and animals into various groups and subgroups based on their characteristics.
	LO9: **Uses scientific conventions/ symbols/ equations to represent various quantities/ elements/ units**, such as SI units, symbols of elements, formulae of simple compounds, chemical equations, etc.	CLO47: Uses scientific conventions to write scientific names of some common plants and animals following **binomial nomenclature.**	C114: Uses scientific conventions to write scientific names of some common plants and animals following binomial nomenclature.

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World of living **Chapter 7 – Diversity in living organisms** Key concepts Diversity of plants and animals – basic issues in scientific naming, Basis of classification, Hierarchy of categories/ groups, Major groups of plants (salient features) (Bacteria, Thallophyta, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms. Major groups of animals (salient features) (non-chordates up to phyla and Chordates up to classes).	LO11: **Applies learning to hypothetical situations**, such as weight of an object at moon, weight of an object at equator and poles, life on other planets, etc.	CLO48:Applies learning of **characteristic/salient features and classification parameters of organisms** in hypothetical situation predicting consequences/ implications and changes required. (e.g consequences and changes required, if reptilians have to become amphibians)	C115: Applies learning of **characteristic/salient features and classification parameters of organisms** in hypothetical situation predicting consequences/implications and changes required (e.g consequences and changes required, if reptilians have to become amphibians)
	LO14: **Draws conclusions**, such as classification of life forms is related to evolution, deficiency of nutrients affects physiological processes in plants, matter is made up of particles, elements combine chemically in a fixed ratio to form compounds, action and reaction act on two different bodies, etc.	CLO49:Draws conclusion by drawing connections between larger principles of **classification and the process of evolution across life forms.**	C116: Concludes the place of a representative organism in a subgroup based on classification principles and its development (morphological and physiological) over time.
	LO15: **Describes scientific discoveries/ inventions**, such as discovery of various atomic models, discovery of cell with invention of microscope, experiments of Lavoisier and Priestley, beliefs regarding motion, discovery of real cause for peptic ulcers, Archimedes principle, classification of living things, etc.	CLO50:Describes the **role and work of early biologists in classification and nomenclature of life forms.**	C117: Describes the role and work of early biologists in classification and nomenclature of life forms.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Moving things, People and Idea **Chapter 8 – Motion** Key concepts Motion –displacement, velocity; uniform and non-uniform motion along a straight line, acceleration, distance-time and velocity time graphs for uniform and uniformly accelerated motion, equations of motion by graphical method; elementary idea of uniform circular motion.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO51:Differentiates between **kinds of motion.**	C118:Differentiates between displacement and distance, both mathematically and practically. C119:Differentiates between speed and velocity, acceleration and deceleration, both mathematically and practically. C120:Differentiates between uniform and non-uniform motion, velocity/acceleration using examples and graphs. C121:Differentiates between uniform motion and uniform accelerated motion. C122:Differentiates between uniform linear motion and uniform circular motion
	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts/ principles/ phenomena or to seek answers to queries on their own**, such as how does speed of an object change? How objects float/ sink when placed on surface of liquid? Is there any change in mass when chemical reaction takes place? What is the effect of heat on state of substances? What is the effect of compression on different states of matter? Where are stomata present in different types of leaves? Where are growing tissues present in plants?	CLO52:Plans and conducts investigations and experiments to arrive at and verify **the facts, principles of uniform motion, non-uniform motion and uniform circular motion.**	C123:Plans and conducts experiments and verifies the speed–time correlation. C124:Plans and conducts experiments and verifies velocity-time correlation. C125:Plans and conducts experiments and verifies distance-time correlation.
	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO53:Explains processes such as **circular motion**	C126:Explains how uniform circular motion is an example of accelerated motion

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Moving things, People and Idea **Chapter 8 – Motion** Key concepts Motion –displacement, velocity; uniform and non-uniform motion along a straight line, acceleration, distance-time and velocity time graphs for uniform and uniformly accelerated motion, equations of motion by graphical method; elementary idea of uniform circular motion.	LO6: **Calculates using the data given**, such as distance, velocity, speed, frequency, work done, number of moles in a given mass of substance, concentration of solution in terms of mass by mass percentage of substances, conversion of Celsius scale to kelvin scale and vice versa, number of neutrons in an atom from atomic number and mass number, speed of sound, kinetic and potential energies of an object, boiling points of liquids to predict the order of their separation from the mixture, etc.	CLO54:Calculates the **unknown variable using the data given.**	C127:Calculates the physical quantities related to motion (displacement, speed, velocity, acceleration) in a word problem and from a graph.
	LO7: **Draws labelled diagrams/ flow charts/ concept map/graphs**, such as biogeochemical cycles, cell organelles and tissues, human ear, distance-time and speed-time graphs, distribution of electrons in different orbits, process of distillation/ sublimation, etc.	CLO55:Draws graphs that represent various **aspects of motion.**	C128:Plots graphs from a given data or from personal experience (distance-time, speed-time, acceleration-time graphs).
	LO8: **Analyses and interprets graphs/ figures etc.**, such as distance-time and velocity-time graphs, computing distance/ speed/ acceleration of objects in motion, properties of components of a mixture to identify the appropriate method of separation, crop yield after application of fertilisers, etc.	CLO56:Analyses and **interprets data, graphs related to motion.**	C129:Interprets graphs from a given data or from personal experience (distance-time, speed-time, acceleration-time graphs).
	LO9: **Uses scientific conventions/ symbols/ equations to represent various quantities/ elements/ units**, such as SI units, symbols of elements, formulae of simple compounds, chemical equations, etc.	CLO57:Uses scientific conventions/symbols/ equations to represent various **quantities such as SI units.**	C130:Uses the SI units for distance, velocity and acceleration while solving word problems.
	LO13: **Derives formulae/ equations/ laws**, such as mathematical expression for the second law of motion, the law of conservation of momentum, expression for force of gravity, equations of motion from velocity-time graphs, etc.	CLO58:Derives formulae/ equations from **velocity-time graphs**.	C131:Derives formulae/equations from velocity-time graphs.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Moving things, People and Ideas **Chapter 9 – Force & Laws of Motion** Key concepts Force and motion, Newton's laws of motion: inertia of a body, inertia and mass, momentum, force and acceleration. Elementary idea of conservation of momentum, action and reaction forces.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	**CLO59:Differentiates materials/ objects/ organisms/ phenomena/ processes**	C132: Differentiates between balanced and unbalanced forces. C133: Differentiates between types of inertia. C134: Differentiates between action and reaction forces, inertia and mass.
	LO2: **Classifies materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics, such** as classification of plants, animals under various hierarchical sub-groups, natural resources, classification of matter based on their states (solid/ liquid/ gas) and composition (element/ compound/ mixture), etc.	CLO60:Classifies materials/ objects/ processes based on inertia	C135: Classifies various motion on the basis of types of inertia. C136: Classifies objects on the basis of their mass and inertia (greater the mass, greater the inertia)
	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts/ principles/ phenomena or to seek answers to queries on their own**, such as how does speed of an object change? How objects float/ sink when placed on surface of liquid? Is there any change in mass when chemical reaction takes place? What is the effect of heat on state of substances? What is the effect of compression on different states of matter? Where are stomata present in different types of leaves? Where are growing tissues present in plants?	CLO61:Plans and conducts investigations/ experiments to **verify laws of motion.**	C137: Verifies inertia qualitatively through activities drawn from daily experiences. C138: Verifies conservation of momentum qualitatively through activities drawn from daily experiences.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Moving things, People and Ideas **Chapter 9 – Force & Laws of Motion** Key concepts Force and motion, Newton's laws of motion: inertia of a body, inertia and mass, momentum, force and acceleration. Elementary idea of conservation of momentum, action and reaction forces.	LO4: **Relates processes and phenomena with causes/ effects**, such as symptoms with diseases/ causal agents, tissues with their functions, production with use of fertilisers, process of evaporation with cooling effect, various processes of separation with the physical and chemical properties of the substances, production of sound with vibrations of source, etc.	**CLO62:Relates processes and phenomena with causes/ effects**, such as Newton's three laws of motion and conservation of momentum	C139:Explains why passengers fall in forward direction when the brakes are applied to a moving vehicle. C140:Explains why a karate player is able to break a pile of tiles in one blow. C141:Explains the propulsion of a rocket.
	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO63:Explains **the laws of motion.**	C142:Explains the concept of inertia, in plain text and in equations. C143:Explains the concept of mass. C144:Explains the conservation of total momentum. C145:Explains how uniform circular motion is an example of accelerated motion.
	LO6: **Calculates using the data given**, such as distance, velocity, speed, frequency, work done, number of moles in a given mass of substance, concentration of solution in terms of mass by mass percentage of substances, conversion of Celsius scale to kelvin scale and vice versa, number of neutrons in an atom from atomic number and mass number, speed of sound, kinetic and potential energies of an object, boiling points of liquids to predict the order of their separation from the mixture, etc.	CLO64:Calculates the unknown from the given data relevant **to force and laws of motion.**	C146:Calculates force, acceleration, momentum and assigns proper SI units to them.
	LO9: **Uses scientific conventions/ symbols/ equations to represent various quantities/ elements/ units**, such as SI units, symbols of elements, formulae of simple compounds, chemical equations, etc.	CLO65:Uses SI units for **force and laws of motion concepts.**	C147:Engages in hands-on conversion and numerical tasks between various related units (Kmph to m/s etc.).

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Moving things, People and Ideas **Chapter 9 – Force & Laws of Motion** Key concepts Force and motion, Newton's laws of motion: inertia of a body, inertia and mass, momentum, force and acceleration. Elementary idea of conservation of momentum, action and reaction forces.	LO11: **Applies learning to hypothetical situations**, such as weight of an object at moon, weight of an object at equator and poles, life on other planets, etc.	CLO66:Applies learning **to moving bodies.**	C148:Applies the concepts of inertia, force, and mass qualitatively on daily experiences.
	LO13: **Derives formulae/ equations/ laws**, such as mathematical expression for second law of motion, law of conservation of momentum, expression for force of gravity, equations of motion from velocity-time graphs, etc.	**CLO67:Derives formulae/ equations/ laws**, such as mathematical expression for second law of motion, law of conservation of momentum	C149:Derives Newton's Laws of motion.
	LO15: **Describes scientific discoveries/ inventions**, such as discovery of various atomic models, discovery of cell with invention of microscope, experiments of Lavoisier and Priestley, beliefs regarding motion, discovery of real cause for peptic ulcers, Archimedes principle, classification of living things, etc.	CLO68:Describes the **contributions of Galileo and Newton in this field.**	C150:Describes the ways in which Galileo and Newton saw motion as a concept. C151:Enacts Newton or Galileo based on their contributions to motion.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Moving things, People and Idea **Chapter 10 – Gravitation** Key concepts Gravitation; universal law of gravitation, force of gravitation of the earth (gravity), acceleration due to gravity; mass and weight; free fall Thrust and pressure. Archimedes' principle, buoyancy, elementary idea of relative density.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO69:Differentiates **phenomena/processes related to gravitation.**	C152:Differentiates between weight and mass, qualitatively and mathematically. C153:Differentiates between density and relative density through experiments/activities. C154:Differentiates between thrust and pressure.
	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts/ principles/ phenomena or to seek answers to queries on their own**, such as how does speed of an object change? How objects float/ sink when placed on surface of liquid? Is there any change in mass when chemical reaction takes place? What is the effect of heat on state of substances? What is the effect of compression on different states of matter? Where are stomata present in different types of leaves? Where are growing tissues present in plants?	CLO70:Plans and conducts experiments to **arrive at and verify the laws of flotation, freefall.**	C155:Verifies Archimedes' principle through experiments from daily objects. C156:Verifies the concept of freefall through experiments.
	LO4: **Relates processes and phenomena with causes/ effects**, such as symptoms with diseases/ causal agents, tissues with their functions, production with use of fertilisers, process of evaporation with cooling effect, various processes of separation with the physical and chemical properties of the substances, production of sound with vibrations of source, etc.	CLO71:Relates **processes and phenomena to cause and effect, such as buoyancy, force of gravity.**	C157:Relates force to mass, qualitatively and mathematically. C158:Relates mass and distance to freefall, qualitatively and mathematically. C159:Relates 'g' with the radius of a planet. C160:Relates floatation with relative density.

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Moving things, People and Idea **Chapter 10 – Gravitation** Key concepts Gravitation; universal law of gravitation, force of gravitation of the earth (gravity), acceleration due to gravity; mass and weight; free fall Thrust and pressure. Archimedes' principle, buoyancy, elementary idea of relative density.	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO72:Explains the **laws of gravitation, buoyancy, force of gravity, relative density.**	C161:Explains laws of gravitation mathematically. C162:Explains how laws of gravitation are universal. C163:Explains how objects sink or float in water. C164:Explains the process of freefall. C165:Explains the concept of relative density mathematically.
	LO6: **Calculates using the data given**, such as distance, velocity, speed, frequency, work done, number of moles in a given mass of substance, concentration of solution in terms of mass by mass percentage of substances, conversion of Celsius scale to kelvin scale and vice versa, number of neutrons in an atom from atomic number and mass number, speed of sound, kinetic and potential energies of an object, boiling points of liquids to predict the order of their separation from the mixture, etc	CLO73:Calculates **weight, pressure, acceleration due to gravity, relative density.**	C166:Calculates the unknown variable (weight, pressure, acceleration due to gravity, relative density) from a given data and assigns a proper SI unit to it.
	LO13: **Derives formulae/ equations/ laws,**such as mathematical expression for second law of motion, law of conservation of momentum, expression for force of gravity, equations of motion from velocity-time graphs, etc.	CLO74:Derives **equations/laws of gravitation.**	C167:Derives equations/laws of gravitation.
	LO15: **Describes scientific discoveries/ inventions**, such as discovery of various atomic models, discovery of cell with invention of microscope, experiments of Lavoisier and Priestley, beliefs regarding motion, discovery of real cause for peptic ulcers, Archimedes principle, classification of living things, etc.	CLO75:Describes **scientific discoveries/ inventions, such as discovery of various concepts under gravitation.**	C168:Enacts the Eureka moment of Archimedes with respect to the laws on floatation. C169:Presents the role of Kepler and Newton in refining our understanding of the motion of heavenly bodies. C170:Describes using poster, the story of Newton arriving at the inverse square law.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Moving things, People and Idea **Chapter 11 – Work and Energy** Key concepts Work done by a force, energy, power; kinetic and potential energy; law of conservation of energy.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO76:Differentiates various forms of **energy, power & average power.**	C171:Differentiates between kinetic and potential energy both qualitatively and mathematically through examples. C172:Differentiates the scientific definition of work in contrast with popular notion of work. C173:Differentiates between work, energy and power.
	LO2: **Classifies materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics**, such as classification of plants, animals under various hierarchical sub-groups, natural resources, classification of matter based on their states (solid/ liquid/ gas) and composition (element/ compound/ mixture), etc	CLO77:Classifies processes, based on, properties/ characteristics related to work and energy.	C174:Classifies the types of work done positive, zero and negative C175:Classifies the types of energy conversions
	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO78:Explains **processes and phenomena, such as the law of conservation of energy.**	C176:Explains the law of conservation of energy. C177:Explains interconversion of energy. C178:Explains the concept of energy in the context of plants and vehicles. C179:Explains the concept of potential energy through various examples from daily life.

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Moving things, People and Idea **Chapter 11 – Work and Energy** Key concepts Work done by a force, energy, power; kinetic and potential energy; law of conservation of energy.	LO6: **Calculates using the data given**, such as distance, velocity, speed, frequency, work done, number of moles in a given mass of substance, concentration of solution in terms of mass by mass percentage of substances, conversion of Celsius scale to kelvin scale and vice versa, number of neutrons in an atom from atomic number and mass number, speed of sound, kinetic and potential energies of an object, boiling points of liquids to predict the order of their separation from the mixture, etc	CLO79: Calculates **kinetic energy, potential energy, power and average power and commercial unit of energy.**	C180: Calculates the unknown variable (kinetic energy, potential energy, power and average power) from a given data and assigns proper SI unit to it.
	LO9: **Uses scientific conventions/ symbols/ equations to represent various quantities/ elements/ units**, such as SI units, symbols of elements, formulae of simple compounds, chemical equations, etc.	CLO80: Uses SI units for **energy, work and power.**	C181: Uses SI units for energy, work and power. C182: Defines 1 watt of power/average power. C183: Relates commercial unit of energy to the related SI unit of energy. C184: Relates to work done as positive/negative and zero.
	LO13: **Derives formulae/ equations/ laws**, such as mathematical expression for second law of motion, law of conservation of momentum, expression for force of gravity, equations of motion from velocity-time graphs, etc.	CLO81: Derives **kinetic energy and potential energy from the laws of motion.**	C185: Derives kinetic energy and potential energy from the laws of motion.
Moving things, People and Idea **Chapter 12 – Sound** Key concepts: Nature of sound and its propagation in various media, speed of sound, range of hearing in humans; ultrasound; reflection of sound; echo and sonar. Structure of the human ear (auditory aspect only).	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO82: Differentiates between **pitch, loudness and intensity, ultrasonics and infrasonics, reflection of sound vs reflection of light.**	C186: Differentiates between pitch, loudness and intensity through practical demonstration and wave graphs. C187: Differentiates between sound and light reflection conceptually, qualitatively and diagrammatically.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Moving things, People and Idea **Chapter 12 – Sound** Key concepts: Nature of sound and its propagation in various media, speed of sound, range of hearing in humans; ultrasound; reflection of sound; echo and sonar. Structure of the human ear (auditory aspect only).	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts/ principles/ phenomena or to seek answers to queries on their own**, such as how does speed of an object change? How objects float/ sink when placed on surface of liquid? Is there any change in mass when chemical reaction takes place? What is the effect of heat on state of substances? What is the effect of compression on different states of matter? Where are stomata present in different types of leaves? Where are growing tissues present in plants?	CLO83: Plans and conducts investigations/ experiments to arrive at and verify the **process of sound production and propagation, echo production, reflection of sound.**	C188: Verifies the need for a medium for sound propagation through experiment. C189: Verifies the difference in sound propagation across different mediums (air, water, solid) through experiment. C190: Verifies that sound is a longitudinal wave through experiment. C191: Verifies conditions needed to create an echo through the experiment. C192: Investigates how sound is produced in wind, string and percussion instruments. C193: Verifies why a cone shaped megaphone is more suitable for public announcements.
	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO84: Explains the process of **sound propagation, reflection of sound, echo, reverberation.**	C194: Explains the process of sound propagation in various mediums, both textually, diagrammatically (models can be used). C195: Explains the process of sound propagation in human ear. C196: Explains the process of sound propagation in an auditorium. C197: Explains the role of density on sound propagation. C198: Explains the working and application of a sonar. C199: Explains how bats use ultrasound to catch a prey. C200: Explains how ultrasound is used for cleaning. C201: Explains the concept of multiple reflection of sound. C202: Explains the process of resonance in sound.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Moving things, People and Idea **Chapter 12 – Sound** Key concepts: Nature of sound and its propagation in various media, speed of sound, range of hearing in humans; ultrasound; reflection of sound; echo and sonar. Structure of the human ear (auditory aspect only).	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs**, such as biogeochemical cycles, cell organelles and tissues, human ear, distance-time and speed-time graphs, distribution of electrons in different orbits, process of distillation/ sublimation, etc.	CLO85: Draws labelled diagrams/ graphs such as **sound production diagram, structure of human ear, sound waves in an auditorium, reflection and echo of sound.**	C203: Draws labelled diagram of human ear. C204: Draws wave graphs showing pitch, loudness and intensity. C205: Draws a diagram showing reflection of sound waves in an auditorium. C206: Draws a diagram of sound waves showing frequency, amplitude and velocity. C207: Draws wave graphs with respect to medium density. C208: Draws wave graphs with respect to the range of hearing.
	LO9: **Uses scientific conventions/ symbols/ equations to represent various quantities/ elements/ units**, such as SI units, symbols of elements, formulae of simple compounds, chemical equations, etc.	CLO86: Uses SI units for **the concepts under sound.**	C209: Uses SI units for the concepts under sound.
World of living **Chapter 13 – Why do we fall ill?** Key concepts Health and its failure. Disease and its causes. Diseases caused by microbes and their prevention – Typhoid, diarrhoea, malaria, hepatitis, rabies, AIDS, TB, polio; pulse polio programme.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO87: Differentiates between **acute, chronic, infectious, non-infectious diseases, their causes, types, treatment, mode of transmission and means of prevention.**	C210: Distinguishes between infectious and non-infectious diseases with suitable examples. C211: Differentiates between acute and chronic diseases. C212: Identifies the medium/ agents/carriers of disease based on symptoms.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
World of living **Chapter 13 – Why do we fall ill?** Key concepts Health and its failure. Disease and its causes. Diseases caused by microbes and their prevention – Typhoid, diarrhoea, malaria, hepatitis, rabies, AIDS, TB, polio; pulse polio programme.	LO2: **Classifies materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as classification of plants, animals under various hierarchical sub-groups, natural resources, classification of matter based on their states (solid/ liquid/ gas) and composition (element/ compound/ mixture), etc.	CLO88:Classifies and **categorises diseases based on the causal organism.**	C213:Classifies and categorises the diseases based on their causal organism as bacterial/fungal/viral/protozoan diseases.
	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts/ principles/ phenomena or to seek answers to queries on their own**, such as how does speed of an object change? How objects float/ sink when placed on surface of liquid? Is there any change in mass when chemical reaction takes place? What is the effect of heat on state of substances? What is the effect of compression on different states of matter? Where are stomata present in different types of leaves? Where are growing tissues present in plants?	CLO89:Plans and conducts investigations around **revalance, means, source, prevention and treatment of a disease in a community.**	C214:Investigates the common health problems, their causes, treatment and prevention by the health department in a community.
	LO4: **Relates processes and phenomena with causes/ effects**, such as symptoms with diseases/ causal agents, tissues with their functions, production with use of fertilisers, process of evaporation with cooling effect, various processes of separation with the physical and chemical properties of the substances, production of sound with vibrations of source, etc.	CLO90:Relates **symptoms with the type of diseases.** CLO91:Relates kind of **treatment to the type of pathogen.** CLO92:Relates with role of **factors associated to healthy lifestyle.** CLO93:Relates the **role of preventive measures with transmission of diseases**.	C215:Relates symptoms with the type of diseases. C216:Relates the kind of treatment to the type of pathogen. C217:Relates the role of personal and public hygiene, balanced diet and exercise in maintaining a healthy lifestyle. C218:Relates the role of social distancing, wearing mask and sanitiser usage in preventing transmission of infectious diseases.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
World of living **Chapter 13 – Why do we fall ill?** Key concepts Health and its failure. Disease and its causes. Diseases caused by microbes and their prevention – Typhoid, diarrhoea, malaria, hepatitis, rabies, AIDS, TB, polio; pulse polio programme.	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO94:Describes the **spread, causes, prevention and treatment of diseases.**	C219:Describes infectious and non-infectious diseases, their causes and manifestation – coronary heart disease, asthma, cancer, malaria, polio, measles, Cholera, AIDS, gonorrhoea, the common cold. C220:Describes diseases caused by microbes (virus, bacteria and protozoans) and their prevention. C221:Describes the organ and tissue specific manifestations of disease-causing microbes. C222:Explains principles of treatment and prevention of disease. C223:Debates the delivery and impact of Pulse Polio programmes. C224:Discusses the benefits and risks of vaccination and the misinformation which exists about vaccination.
	LO7: **Draws labelled diagrams/ flow charts/ concept map/graphs**, such as biogeochemical cycles, cell organelles and tissues, human ear, distance-time and speed-time graphs, distribution of electrons in different orbits, process of distillation/ sublimation, etc.	CLO95:Draws flow chart to **depict common methods leading to transmission of diseases.**	C225:Draws flow charts to depict common methods leading to transmission of diseases.
	LO8: **Analyses and interprets graphs/ figures etc.,** such as distance-time and velocity-time graphs, computing distance/ speed/ acceleration of objects in motion, properties of components of a mixture to identify the appropriate method of separation, crop yield after application of fertilisers, etc.	CLO96:Analyses and interprets graphs/data **related with prevalence/containment and immunisation for several diseases** (e.g Comparative graphs/ data sets on prevalence of a viral disease and its containment through vaccination programs)	C226: Analyses and interprets graphs/data related with prevalence/containment and immunisation drives for several diseases (e.g comparative graphs / data sets on prevalence of a viral disease and its containment through vaccination programs)

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
World of living **Chapter 13 – Why do we fall ill?** Key concepts Health and its failure. Disease and its causes. Diseases caused by microbes and their prevention – Typhoid, diarrhoea, malaria, hepatitis, rabies, AIDS, TB, polio; pulse polio programme.	LO12: **Applies scientific concepts in daily life and solving problems,** such as separation of mixtures, uses safety belts in automobiles, covers walls of large rooms with sound absorbent materials, follows intercropping and crop rotation, takes preventive measures to control disease causing agents, etc.	CLO97:Applies knowledge of **infectious agents, transmission, symptoms and treatment** to design appropriate preventive strategies for containment of disease in neighbourhood/ community.	C227:Applies knowledge of infectious agents, transmission, symptoms and treatment to design appropriate preventive strategies for containment of disease in neighbourhood/ community.
	LO15: **Describes scientific discoveries/ inventions**, such as discovery of various atomic models, discovery of cell with invention of microscope, experiments of Lavoisier and Priestley, beliefs regarding motion, discovery of real cause for peptic ulcers, Archimedes principle, classification of living things, etc.	CLO98:Describes people and events related to **discovery of diseases, causative organisms and related vaccines.**	C228:Presents/ enacts the events, people and processes involved in discovery of a disease, its cause and cure (Discovery of vaccines – Jenner, Lister and Salk , discovery of penicillin, causative organism for Peptic ulcers).
	LO17: **Records & reports experimental data objectively and honestly. Exhibits values of honesty/ objectivity/ rational thinking/ freedom from myths/superstitious beliefs while taking decisions, respect for life, etc.**, such as records and reports experimental data exactly, sexually transmitted diseases are not spread by casual physical contact, vaccination is important for prevention of diseases, etc.	CLO99:Exhibits objectivity/ rational thinking while dealing with issues of **myths/superstitious and beliefs pertaining to spread and prevention of diseases**.	C229:Exhibits objectivity/rational thinking while dealing with issues of myths/superstitious beliefs pertaining to spread and prevention of diseases.
	LO18: **Communicates the findings and conclusions effectively**, such as those of experiment/ activity/ project orally and in written form using appropriate figures/ tables/ graphs/ digital form, etc.	CLO100:Propagates awareness around **communicable diseases and prevention strategies.**	C230:Propagates awareness around local communicable diseases and their prevention through visual aids, newspaper cuttings, posters, role play etc.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Resources **Chapter 14 – Natural Resources** Key concepts Physical resources – air, water, soil; Air for respiration, for combustion, for moderating temperatures, movements of air and its role in bringing rains across India; air, water and soil pollution (brief introduction); holes in ozone layer and the probable damages; bio-geo chemical cycles in nature – water, oxygen, carbon, nitrogen.	LO2: **Classifies materials, objects, organisms, phenomena, and processes, based on properties or characteristics**, such as, classification of plants and animals under various hierarchical sub-groups, natural resources, classification of matter based on their states (solid/liquid/gas) and composition (element/ compound/ mixture), etc.	CLO101:Categorises **natural resources based on properties.**	C231:Sorts out natural resources into air, water and soil resources. C232:Recognises the constituent parts of air being nitrogen, oxygen and water vapour. C233:Recognises that soil includes mineral matter, air, water and organisms. C234:Comprehends that air, water and land are important for supporting life.
	LO5: **Explains processes and phenomena**, such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO102:Explains the processes/ phenomenon/ interdependence involved across **biogeochemical cycles in nature: water, oxygen, carbon and nitrogen.**	C235:Explains the processes/phenomenon/interdependence involved across biogeochemical cycles in nature: water, oxygen, carbon and nitrogen
	LO19: **Applies the interdependency and interrelationship in the biotic and abiotic factors of environment to promote conservation of environment**, such as, organic farming, waste management, etc.	CLO103:Constructs an understanding of the **interdependency of the natural resources.**	C236:Explains how air is necessary for respiration, combustion, and moderating temperatures. C237:Explains movements of air and its role in bringing rains across India.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Resources **Chapter 14 – Natural Resources** Key concepts Physical resources – air, water, soil; Air for respiration, for combustion, for moderating temperatures, movements of air and its role in bringing rains across India; air, water and soil pollution (brief introduction); holes in ozone layer and the probable damages; bio-geo chemical cycles in nature – water, oxygen, carbon, nitrogen.	LO12: **Applies scientific concepts in daily life and solving problems**, such as separation of mixtures, uses safety belts in automobiles, covers walls of large rooms with sound absorbent materials, follows intercropping and crop rotation, takes preventive measures to control disease causing agents, etc.	CLO104:Applies scientific concepts in daily life to **solve issues regarding the use of the natural resources.**	C238:Explains the use of water for drinking, agriculture and industry. C239:Relates to the variation in supply and demand of water and challenges involved. C240:Elucidates the processes involved in water treatment for drinking supply and sewage treatment. C241:Explains the importance of soil for agriculture – nutrient supply for crops, and how soil degradation and improvement can occur. C242:Explains air, water and soil pollution and its impact on life. C243:Explains the 'holes' in ozone layer – causes and effects. C244:Describes the causes and impact of water pollution from sewage, mining, and industrial processes and fertiliser runoff from farming. C245:Elucidates the causes and impact of soil pollution from farming, mining and industrial processes.
	LO7: **Draws labelled diagrams, flow charts, concept maps, graphs**, such as, biogeochemical cycles, cell organelles and tissues, human ear, distance-time and speed-time graphs, distribution of electrons in different orbits in an atom, process of distillation and sublimation, etc.	CLO105:Draws labelled flow charts of **various natural cycles**.	C246:Illustrates the processes of the biogeochemical cycles in nature: water, oxygen, carbon and nitrogen.
	LO15: **Describes scientific discoveries and inventions**, such as, discovery of various atomic models, discovery of cell with invention of microscope, experiments of Lavoisier and Priestley, beliefs regarding motion, discovery of real cause for peptic ulcers, Archimedes principle, classification of living things, etc.	CLO106:Recounts the **discoveries that influence the environment.**	C247:Describes the discovery of the holes in the ozone layer at the poles.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Food **Chapter 15 – Improvement in food resources** Key concepts Plant and animal breeding and selection for quality improvement, use of fertilisers, manures; protection from pests and diseases; organic farming.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics**, such as prokaryote and eukaryote, plant cell and animal cell, diffusion and osmosis, simple and complex tissues, distance and displacement, speed and velocity, balanced and unbalanced forces, element, compound and mixture, solution, suspension and colloid, isobars and isotopes, etc.	CLO107:Differentiates between **types of cropping patterns and nutrient management processes.**	C248:Distinguishes between mixed and intercropping. C249:Differentiates between types of biological manures (compost, vermicompost, green manure) C250:Distinguishes between micro and macro nutrients.
	LO3 : **Plans and conducts investigations/ experiments to arrive at and verify the facts/ principles/ phenomena or to seek answers to queries on their own**, such as how does speed of an object change? How objects float/ sink when placed on surface of liquid? Is there any change in mass when chemical reaction takes place? What is the effect of heat on state of substances? What is the effect of compression on different states of matter? Where are stomata present in different types of leaves? Where are growing tissues present in plants?	CLO108:Plans and conducts investigations on **side effects of fertilisers/ pesticides.**	C251:Surveys the use of fertilisers/manure and their impact on crop growth and soil fertility. C252:Investigates traditional and modern methods of weed/ pest control. C253:Investigates types of diseases in plants/animals, their causes and impact on yield/productivity. C254:Investigates effects and implications of using pesticides on humans and animals.
	LO4 : **Relates processes and phenomena with causes/ effects**, such as symptoms with diseases/ causal agents, tissues with their functions, production with use of fertilisers, process of evaporation with cooling effect, various processes of separation with the physical and chemical properties of the substances, production of sound with vibrations of source, etc.	CLO109:Relates **crop productivity with usage of fertilisers.** CLO110:Relates **preventive control measures for safe storage of grains with factors responsible for loss during storage of grains.** CLO111:Relates **modern crop and animal hunbandary practices with greater yield/production and increased income of farmers.**	C255:Relates crop productivity with usage of fertilisers. C256:Relates preventive control measures for safe storage of grains with factors responsible for loss during storage. C257:Relates modern crop and animal husbandary practices with greater yield/production and increased income of farmers.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Food **Chapter 15 – Improvement in food resources** Key concepts Plant and animal breeding and selection for quality improvement, use of fertilisers, manures; protection from pests and diseases; organic farming.	LO5: **Explains processes and phenomena,** such as function of different organelles, spread of diseases and their prevention, effect of force on the state of motion of objects, action and reaction, revolution of planets and satellites, conservation laws, principle of separation of different gases from air, melting/ boiling/ freezing, how bats use ultrasound to catch prey, etc.	CLO112: Explains the **best practices of crop improvement and animal husbandry with factors affecting the environment.**	C258: Explains selective breeding in plants and animals to improve quality, yield and manage diseases. C259: Explains methods of protection from pests and diseases, both biological and chemical. C260: Explains how nutrient deficiency impacts plants and animals. C261: Explains how the addition of fertilisers (natural manure and manmade ammonium nitrate) change crop productivity but can have negative effects. C262: Debates on impact of using hormones/ drugs/ pesticides etc on crops/animals and environment. C263: Elaborates upon the principles of composite culture fishing. C264: Explains desirable traits which can be achieved through cross breeding in poultry farming. C265: Describes factors influencing the yield of honey production. C266:Discusses different kinds of irrigation systems adopted to supply water in fields. C267: Discusses the positions adopted by people around benefits and risks of intensive and organic farming. C268: Generates dialogue around the impact of animal production on climate and resource usage.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Food **Chapter 15 – Improvement in food resources** Key concepts Plant and animal breeding and selection for quality improvement, use of fertilisers, manures; protection from pests and diseases; organic farming.	LO8: **Analyses and interprets graphs/ figures etc.**, such as distance-time and velocity-time graphs, computing distance/ speed/ acceleration of objects in motion, properties of components of a mixture to identify the appropriate method of separation, crop yield after application of fertilisers, etc.	CLO113:Analyses and interprets graphical/tabular data on **crop yields in relation to nutrient levels after application of fertiliser.** CLO114:Analyses and interprets graphical/tabular data on **crop production in comparison with projected population growth across countries.**	C269: Analyses and interprets graphical data on crop yields in relation to nutrient levels after application of fertiliser. C270: Analyses and interprets graphical data on crop production in comparison to projected population growth across countries.
	LO19: **Applies the interdependency and interrelationship in the biotic and abiotic factors of environment to promote conservation of environment**, such as organic farming, waste management, etc.	CLO115:Links biotic and abiotic factors with the process of making **vermicompost and principles of biological control w.r.t environment conservation.**	C271: Links biotic and abiotic factors with the process of making vermicompost and principles of biological control with respect to environment conservation.

9.2 Class X

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Materials **Chapter 1 – Chemical reactions and equations** Key concepts Chemical equations – writing a chemical equation, balancing chemical equations; types of chemical reactions – combination, decomposition, displacement, double displacement (precipitation), oxidation and reduction, endothermic/ exothermic; effects of oxidation-reduction reactions – corrosion, rancidity.	LO1 : **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as autotrophic and heterotrophic nutrition, biodegradable and non- biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.	CLO1: Differentiates the **types of chemical reactions**.	C1: Distinguishes between combination, decomposition, displacement, double displacement, precipitation, neutralisation, oxidation and reduction reactions. C2: Separates oxidation from reduction in terms of loss and gain of oxygen. C3: Recognises the difference between exothermic and endothermic reactions.
	LO3 : **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own**, such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light?	CLO2: Performs experiments to classify the **types of reactions**.	C4: Conducts the following experiments and states the type of reaction: - action of water on quicklime, action of heat on ferrous sulphate crystals, iron nails in copper sulphate solution and reaction between sodium sulphate and barium chloride solutions. C5: Writes balanced word and symbol skeletal and complete equations for the reactions.
	LO14: **Draws conclusion**, such as traits/ features are inherited through genes present on chromosomes, a new species originates through evolutionary processes, water is made up of hydrogen and oxygen, properties of elements vary periodically along the groups and periods in periodic table, potential difference across a metal conductor is proportional to the electric current through it, etc	CLO3:Deduces the kind of **chemical reactions seen in nature, based on observations.**	C6: Infers that corrosion/rusting is an oxidation reduction reaction. C7: Deduces that rancidity in oils, fats and chips is due to the process of oxidation.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Materials **Chapter 2 – Acids, Bases and Salts** Key concepts Chemical properties of acids and bases – reaction with metals, metal carbonates, metal hydrogen carbonates, bases, metal oxides; non-metallic oxides; common properties of acids and bases – with water; strong acid/base solutions, pH scale and its importance; salts – common salts (bleaching powder, baking soda, washing soda); crystals – copper sulphate, plaster of Paris; water of crystallisation; acid-base indicators. .	LO2: **Classifies materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as metals and non-metals based on their physical and chemical properties, acids and bases on the basis of their chemical properties, etc.	CLO4:Categorises **compounds as acids and bases based on their chemical reactions.**	C8: Classifies compounds as bases or acids based on their reactions with – litmus solution, zinc metal and solid sodium carbonate. C9: Categorises indicators as natural and synthetic type.
	LO5: **Explains processes and phenomena,** such as nutrition in human beings and plants, transportation in plants and plants, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO5:Explains the **methods of preparing salts that contain water of crystallisation.**	C10: Explains the preparation of bleaching powder, baking soda and washing soda. C11: Explains the preparation of salts like copper sulphate. C12: Observes that some salts like copper sulphate have water of crystallisation.
	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own**, such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light?	CLO6: Plans investigation to **find pH value of given solution; to verify the acidic/basic nature of solutions using the pH scal**	C13: Conducts experiments using pH paper/ universal indicator to find the pH of solutions like dilute hydrochloric acid, dilute sodium hydroxide solution, dilute ethanoic acid solution, Lemon juice, water, and dilute hydrogen carbonate solution. C14: Verifies the acidic/basic nature of solutions using the pH scale. C15: Recognises the importance of pH in biosphere by citing examples of pH of the human body, blood, acid rain, plant growth etc.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Materials **Chapter 3 – Metals and Non-metals** Key concepts Physical properties of metals, non-metals; chemical properties of metals – burning in air, reacting with acids, salt solutions of other metals, with non-metals; metal reactivity series; occurrence of metals – extraction of metals, enrichment of ores, refining of metals.	LO2: **Classifies materials/objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as metals and non-metals based on their physical and chemical properties, acids and bases based on their chemical properties, etc.	CLO7: Classifies **metals and non-metals based on their chemical properties; ionic, covalent and metallic bond and relate this to physical and chemical properties.**	C16: Defines elements as metals and non-metals based on physical properties like physical state, lustre, sonority, ductility and chemical properties like burning in air, reacting with acids. C17: Identifies metals that can be used to store acids based on reactivity series. C18: Classifies ionic and covalent compounds based on their physical properties. C19: Classifies various metallurgical processes used based on reactivity of metals. C20: Relates reactivity of metals to their position in the Periodic Table and their properties. C21: Defines bonding as ionic, covalent and metallic and relates this to physical and chemical properties.
Materials **Chapter 3 – Metals and Non-metals** Key concepts Physical properties of metals, non-metals; chemical properties of metals – burning in air, reacting with acids, salt solutions of other metals, with non-metals; metal reactivity series; occurrence of metals – extraction of metals, enrichment of ores, refining of metals.	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own**, such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why a plant shoot moves towards light?	CLO8: Observes corrosion in metal articles and its process in order to develop ways to prevent corrosion by forming alloys, painting and galvanising	C22: Conducts experiments to show ionic compounds are good conductors of electricity in solutions. C23: Investigates the rust resistance process used in iron pillar at the Qutub Minar through secondary data. C24: Conducts an activity to show action of steam on metals (Refer activity 3.10 in textbook). C25: Conducts an activity to show that both water and air are necessary for rust formation (Refer activity 3.14 in textbook) C26: Investigates the factors causing corrosion in metals- Fe, Cu, Ag. C27: Analyses how alloys are used in daily life in the form of stainless steel, 22 carat gold.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Materials **Chapter 3 – Metals and Non-metals** Key concepts Physical properties of metals, non-metals; chemical properties of metals – burning in air, reacting with acids, salt solutions of other metals, with non-metals; metal reactivity series; occurrence of metals – extraction of metals, enrichment of ores, refining of metals.	LO5: **Explains processes and phenomena**, such as nutrition in human beings and plants, transportation in plants and plants, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO9: Explains the **properties of metals and non-metals; reaction of metals with salt solutions; reactivity of metals; extraction of metals from their ores.**	C28: Explains the properties of metals and non-metals and relates this to their atomic structure and bonding. C29: Describes the reactions of metals Zn, Fe, Cu and Al on the following salt solutions – $ZnSO_4$, $FeSO_4$, $CuSO_4$, $Al_2(SO_4)_3$. C30: Infers the reactivity of the metals and arranges them in the decreasing order of reactivity based on the above results. C31: Explains extraction of metals, enrichment of ores, extracting metals according to their position in activity series and refining of metals. (with suitable examples and equations) C32: Describes the conditions needed for extraction and the reactions taking place during extraction.
	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs,** such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.	CLO10:Draws **labelled diagrams for the metallurgical processes.**	C33: Draws a flow chart of the various steps involved in the extraction of a metal. C34: Draws labelled diagram for the electrolytic refining of copper. C35: Draws the diagram to show action of steam on a metal (Refer activity 3.10 in NCERT).
	LO7: **Analyses and interprets data/ graph/ figure**, such as melting and boiling points of substances to differentiate between covalent and ionic compounds, pH of solutions to predict the nature of substances, V-I graphs, ray diagrams, etc.	CLO11:Analyses data to differentiate between covalent and ionic compounds on the basis of melting point and boiling point, metals and non-metals based on melting point and boiling point, the colour change in metal salt solution during a reaction and relates it to the reactivity of metals or to a specific metal ion.	C36: Compares melting point and boiling point of common compounds used in daily life like common salt, calcium carbonate etc (Refer table 3.5 in the textbook). C37: Interprets the metal reactivity series to decide the course of displacement reactions. C38: Analyses the colour change in a metal salt solution during a reaction.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Materials **Chapter 4 – Carbon and its compounds** Key concepts Bonding in carbon – the covalent bond; versatile nature of carbon – saturated/unsaturated compounds, chains/branches/rings; homologous series; nomenclature of organic compounds; chemical properties of organic compounds – combustion, oxidation, addition, substitution; carbon compounds – ethanol, ethanoic acid; soaps and detergents.	LO2: **Classifies materials/objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as metals and non-metals based on their physical and chemical properties, acids and bases on the basis of their chemical properties, etc.	CLO12:Classifies **carbon compounds based on certain properties.**	C39: Classifies carbon compounds/hydrocarbons as saturated and unsaturated. C40: Classifies saturated/unsaturated carbon compounds as alkanes, alkenes, alkynes, alcohols, carboxylic acids, ketones and aldehydes. C41: Defines homologous series prefixes of carbon compounds up to 10 carbon atoms and provides examples. C42: Classifies reactions as esterification and saponification
	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,** such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light?	CLO13:Describes the **processes for investigating the properties of carbon compounds; the comparative cleaning capacity of a sample of soap in soft and hard water**.	C43: Investigates the properties of acetic acid like odour, solubility in water, effect on litmus and reaction with sodium bicarbonate. C44: Compares cleaning capacity of different soap samples in soft and hard water. C45: Conducts an activity to show the action of soap and detergent in soft and hard water. C46: Conducts an experiment to make esters using alcohol and carboxylic acid C47: Conducts an experiment to distinguish experimentally between alcohol and carboxylic acid using oxidising agent C48: Conducts an experiment to identify between saturated and unsaturated compound using bromine water.
	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs,** such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc	CLO14:Draws labelled diagrams of **compounds with covalent bonding.**	C49: Draws structures of simple alkanes, alkenes, alkynes, chloroethane, ethanol, ethanoic acid, ethanal (acetaldehyde) and propanone (acetone). C50: Draws the diagram of micelles. C51: Draws the structure of different allotropic forms of carbon.

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Materials **Chapter 5 – Periodic classification of elements** Key concepts Classification of elements – Dobereiner's triads, Newlands' law of octaves, Mendeleev's Periodic table, Modern Periodic table; Position of elements in the modern periodic table, trends in the modern periodic table – atomic size, valency, metallic/non-metallic character.	LO2: **Classifies materials/objects/ organisms/ phenomena/ processes, based on properties/ characteristics,** such as metals and non-metals based on their physical and chemical properties, acids and bases on the basis of their chemical properties, etc	CLO15:Classifies **elements based on specific properties.**	C52: Classifies elements based on Dobereiner's Triads, Newlands Law of Octaves and Mendeleev.
	LO5: **Explains processes and phenomena,** such as nutrition in human beings and plants, transportation in plants and plants, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO16:Explains **the features of modern periodic table and reactivity of elements based on their position in periodic table.**	C53: Explains the arrangement of elements in Modern Periodic Table based on increasing order of atomic number. C54: Explains periodic properties of elements like atomic size, valency, metallic character across periods and down groups in the Modern Periodic Table. C55: Explains how the reactivity series of metals is linked to their atomic structure and position in the Modern Periodic Table.
The World of the Living **Chapter 6 – Life Processes** Key Concepts Define 'living' things, Basic concept of nutrition, respiration, transportation and excretion in plants and animals.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as autotrophic and heterotrophic nutrition, biodegradable and non- biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.	CLO17:Differentiates processes/ phenomenon/ characteristics **relating to life in plants and animals.**	C56: Defines a "Living Being" and the characteristics living organisms share. C57: Differentiates between photosynthesis and respiration. C58: Distinguishes between autotrophic and heterotrophic nutrition.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
The World of the Living **Chapter 6 – Life Processes** Key Concepts Define 'living' things, Basic concept of nutrition, respiration, transportation and excretion in plants and animals.	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own**, such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light?	CLO18:Plans and conducts investigations/experiments **to verify the facts and delve deeper into life processes**.	C59: Plans and conducts investigations to validate - gaseous exchange taking place in plants/animals during photosynthesis/ respiration; production of starch during photosynthesis. C60: Plans and conducts investigations to validate release of carbon dioxide in germinating seeds during respiration. C61: Investigates movement of water in plants in relation to rate of transpiration. C62: Investigates the haemoglobin/blood pressure levels in humans and animals. C63: Plans and prepares temporary mount of leaf epidermis to observe stomatal apparatus. C64: Plans and conducts investigations to observe shoot/root movements in terms of stimulus.
	LO4: **Relates processes and phenomena with causes/ effects,** such as hormones with their functions, tooth decay with pH of saliva, growth of plants with pH of the soil, survival of aquatic life with pH of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc.	CLO19:Relates **features of structures/ organs present in living beings with their functions.** CLO20:Relates effect on **physiological processes of organisms in terms of factors present in their environment.**	C65: Relates to the features of digestive organs based on type of food intake by organisms. (herbivores, carnivore and omnivores) C66: Relates the breathing rate of an organism with amount of oxygen available in its ambient atmosphere.
	LO5: **Explains processes and phenomena**, such as nutrition in human beings and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO21:Explains processes and role of associated **structures/organs in plants (photosynthesis & respiration, transpiration & translocation) and animals (respiration, digestion, transportation and excretion).**	C67: Explains the process of nutrition and respiration in unicellular and multicellular organisms. C68: Explains the utilisation of energy liberated through cellular respiration. C69: Describes the transport and exchange of oxygen in mammals and amphibians. C70: Elaborates on the role and significance of different organs/structures involved in various life processes across organisms.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
The World of the Living **Chapter 6 – Life Processes** Key Concepts Define 'living' things, Basic concept of nutrition, respiration, transportation and excretion in plants and animals.	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs,** such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.	CLO22: Draws labelled diagrams/ flowcharts to **indicate pathways and organs involved in life processes (digestion, respiration, circulation and excretion etc.)**	C71: Draws a comparative diagram/flowchart contrasting artificial and natural processes of kidney functioning (i.e., Dialysis v/s natural process). C72: Draws labelled sectional diagram of heart depicting directional blood flow. C73: Draws labelled diagram of human respiratory system depicting directional gaseous exchange.
	LO7: **Analyses and interprets data/ graph/ figure**, such as melting and boiling points of substances to differentiate between covalent and ionic compounds, pH of solutions to predict the nature of substances, V-I graphs, ray diagrams, etc.	CLO23: Analyses and interprets data **related to rate of respiration and transpiration, haemoglobin and blood pressure levels etc.**	C74: Analyses and interprets data related to rate of respiration and transpiration, haemoglobin and blood pressure levels etc.
	LO11: **Applies learning to hypothetical situations,** such as what happens if all herbivores removed from an ecosystem? What will happen if all non-renewable sources of energy are exhausted?	CLO24: Applies learning of **life processes in hypothetical situations predicting consequences/ implications.**	C75: Applies learning of life processes in hypothetical situations predicting consequences/ implications (if bile juice doesn't get secreted by liver, if the stomata clog etc.).
	LO14: **Draws conclusion,** such as classification of life forms is related to evolution, deficiency of nutrients affects physiological processes in plants, matter is made up of particles, elements combine chemically in a fixed ratio to form compounds, action and reaction act on two different bodies, etc.	CLO25: Draws conclusions **after performing experiments related to photosynthesis and respiration.**	C76: Draws conclusions through experiments/ activities that CO_2 and chlorophyll are necessary for photosynthesis. C77: Draws conclusions through experiments/ activities that anaerobic respiration results in release of CO_2 and alcohol. C78: Draws conclusions through experiments/ activities that aerobic respiration results in CO_2 and water.

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The World of the Living **Chapter 6 – Life Processes** Key Concepts Define 'living' things, Basic concept of nutrition, respiration, transportation and excretion in plants and animals.	LO16: **Exhibits creativity in designing models using eco-friendly resources,** such as working model of respiratory, digestive and excretory systems, soda acid fire extinguisher, periodic table, micelles formation, diamond/ graphite/ Buckminster fullerene, human eye, electric motor and generator, etc.	CLO26:Exhibits creativity in designing models **of digestive/ circulatory/ excretory system using eco-friendly resources/ waste materials.**	C79: Exhibits creativity in designing models of digestive/ circulatory/ respiratory/ excretory system using eco-friendly resources/ waste materials.
	LO18:**Communicates the findings and conclusions effectively**, such as those of experiment/ activity/ project orally and in written form using appropriate figures/ tables/ graphs/ digital form, etc.	CLO27:Communicates the **effects of diseases related to impairment of life process (respiration, circulation, transportation etc,) and their prevention in humans.**	C80: Presents the effects of commonly found diseases in neighbourhood and their prevention using slides, videos, data, graphs, posters, newspaper/magazine cuttings, role play etc.
The World of the Living **Chapter 7 – Control and Coordination** Key concepts Tropic movements in plants; Introduction to plant hormones; Control and coordination in animals: voluntary, involuntary and reflex action, nervous system; chemical coordination: animal hormones	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as autotrophic and heterotrophic nutrition, biodegradable and non- biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.	CLO28:Differentiates between **type of actions/hormones in plants and animals relating to control and coordination.**	C81: Differentiates reflex actions in animals (voluntary, involuntary and reflex). C82: Distinguishes between tropic movements in plants. C83: Identifies the differences between hormonal and nervous controls in animals.
	LO2: **Classifies materials/objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as metals and non-metals based on their physical and chemical properties, acids and bases on the basis of their chemical properties, etc	CLO29:Classifies phenomenon/ processes/ characteristics/ **actions relating to control and coordination of animals/ plants.**	C84: Categorises the functions/actions performed based on parts of brain. (forebrain, mid brain, hind brain) C85: Classifies the hormonal glands in terms of their position and functions in the body. C86: Classifies the movements in plants based on growth or non-growth movements.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
The World of the Living **Chapter 7 – Control and Coordination** Key concepts Tropic movements in plants; Introduction to plant hormones; Control and coordination in animals: voluntary, involuntary and reflex action, nervous system; chemical coordination: animal hormones	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,** such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light?	CLO30: Plans and conducts investigations/ experiments to **delve closely into hormonal regulation and response to stimuli in plants/animals.**	C87: Investigates the prevalence, complications and prevention of diseases arising due to hormones. C88: Investigates the type of stimulus and resulting movements across variety of plants. C89: Investigates and verifies the pathways of reflex arcs through activities/experiments.
	LO4: **Relates processes and phenomena with causes/ effects,** such as hormones with their functions, tooth decay with Ph of saliva, growth of plants with Ph of the soil, survival of aquatic life with Ph of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc.	CLO31: Relates **hormones with their functions in plants and animals.** CLO32: Relates **movement in plants and reflex actions in animals to its causes/pathways.**	C90: Relates hormones with their functions in plants and animals. C91: Relates tropic movements in plants with the stimulus. C92: Relates symptoms of hormonal disorders with the hormonal deficiency in animals. C93: Relates stimulus with sequence of events leading to reflex actions. C94: Relates bending in plants to differential growth.
	LO5: **Explains processes and phenomena**, such as nutrition in human beings and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions based on reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO33: Explains the processes/ phenomenon/mechanisms **relating to control and coordination in animals/plants.**	C95: Explains tropic movements in plants in reference to hormonal regulation. C96: Explains control and coordination in animals with reference to nervous system. C97: Describes hormone regulation systems in humans. (insulin, growth hormones, adrenaline, testosterone and oestrogen) C98: Discusses the causes of hormonal imbalances and its impact on human health. C99: Explains the role of plant growth hormones.

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The World of the Living **Chapter 7 – Control and Coordination** Key concepts Tropic movements in plants; Introduction to plant hormones; Control and coordination in animals: voluntary, involuntary and reflex action, nervous system; chemical coordination: animal hormones	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs,** such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.	CLO34:Draws labelled diagrams/ flowcharts/concepts maps **to depict important aspects of control and coordination in humans. (nervous system, brain and hormonal glands etc.)**	C100: Draws labelled diagrams of reflex arc/parts of human brain/ location of endocrine glands and hormones secreted by them (Male and Female).
	LO7: **Analyses and interprets data/ graph/ figure,** such as melting and boiling points of substances to differentiate between covalent and ionic compounds, pH of solutions to predict the nature of substances, V-I graphs, ray diagrams, etc.	CLO35:Analyses and interprets data/ graphs/ figures **relating to prevalence of diseases resulting from failure of control and coordination mechanisms.**	C101: Analyses and interprets data/ graphs (district/state/national) relating to prevalence of diseases due to hormonal imbalances and failure of similar mechanisms (Diabetes, Goitre, Gigantism, dwarfism etc.).
	LO 11:**Applies learning to hypothetical situations,** such as what happens if all herbivores removed from an ecosystem? What will happen if all non-renewable sources of energy are exhausted?	CLO36:Applies learning **relating to brain and hormonal functioning to hypothetical situations predicting consequences/ implications.** CLO37:Applies learning of **hormonal regulation in plants to hypothetical situations predicting consequences/ implications.**	C102:Applies learning of brain and hormonal functioning to hypothetical situations predicting consequences/ implications. (e.g What if specific part of brain damages? What if a hormonal gland or respective feedback pathway malfunctions etc.?) C103:Applies learning of **hormonal regulation in plants to hypothetical situations predicting consequences/ implications.** (e.g Consequences of increase or decrease in the production of cytokinin/auxin/ gibberellin/Abscisic acid etc.)

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The World of the Living **Chapter 7 – Control and Coordination** Key concepts Tropic movements in plants; Introduction to plant hormones; Control and coordination in animals: voluntary, involuntary and reflex action, nervous system; chemical coordination: animal hormones	LO12: **Applies scientific concepts in daily life and solving problems,** such as takes precautions to prevent sexually transmitted infections, uses appropriate electrical plugs (5/15a) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health, avoids using appliances responsible for ozone layer depletion, applies concept of decomposition reaction of baking soda to make spongy cakes, etc.	CLO38:Applies knowledge of **hormonal regulation in plants to stimulate their growth.** CLO39:Applies knowledge of **hormonal deficiency and its causes in humans to lead a healthy lifestyle** (e.g Making iodised salt a part of regular diet).	C104: Applies learning of hormonal regulation in plants to stimulate their growth. C105: Applies learning of hormonal deficiency and its causes in humans to lead a healthy lifestyle (e.g Making iodised salt a part of regular diet).
	LO15: **Takes initiative to know about scientific discoveries/ inventions**, such as Mendel's contribution in understanding the concept of inheritance, Dobereiner for discovering triads of elements, Mendeleev for the development of the periodic table of elements, oersted discovery that electricity and magnetism are related, discovery of relation between potential difference across a metal conductor and the electric current through it by ohm, etc.	CLO40:Takes initiative to know about scientific discoveries/ inventions **relating to hormonal mechanisms, hormonal diseases and their prevention and cure in plants/animals. (e.g Discovery of insulin and plant growth hormones etc.)**	C106: Takes initiative to know about scientific discoveries/inventions relating to hormonal mechanisms, hormonal diseases, their prevention and cure in plants/animals (e.g discovery of insulin, plant growth hormones etc.).
	LO16: **Exhibits creativity in designing models using eco-friendly resources**, such as working model of respiratory, digestive and excretory systems, soda acid fire extinguisher, periodic table, micelles formation, diamond/ graphite/ Buckminsterfullerene, human eye, electric motor and generator, etc.	CLO41:Exhibits creativity in designing working/ static models **of brain parts / functioning of reflex arc /endocrine system/nervous system/ neuron etc.** using eco-friendly resources	C107: Exhibits creativity in designing working/ static models of brain parts / functioning of reflex arc /endocrine system/nervous system/ neuron etc. using eco-friendly resources.

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The World of the Living **Chapter 7 – Control and Coordination** Key concepts Tropic movements in plants; Introduction to plant hormones; Control and coordination in animals: voluntary, involuntary and reflex action, nervous system; chemical coordination: animal hormones	LO17:**Exhibits values of honesty/ objectivity/ rational thinking/ freedom from myth/ superstitious beliefs while taking decisions, respect for life, etc.** such as reports and records experimental data accurately, says no to consumption of alcohol and sensitises others about its effect on physical and mental health, motivates for organ donation, prevents pre-natal sex determination, etc.	CLO42:Exhibits values of objectivity/ rational thinking/ freedom from myth/superstitious beliefs while debating **matters of hormonal and nervous system disorders** (e.g Dwarfism and Gigantism are not hereditary, Females with late onset of menstrual cycle will not be fertile etc.).	C108: Exhibits values of objectivity/rational thinking/ freedom from myth/superstitious beliefs while debating **matters of hormonal and nervous system disorders** (e.g Dwarfism and Gigantism are not hereditary, females with late onset of menstrual cycle will not be fertile etc.).
	LO18:**Communicates the findings and conclusions effectively**, such as those of experiment/ activity/ project orally and in written form using appropriate figures/ tables/ graphs/ digital form, etc.	CLO43:Communicates findings and conclusions **around prevalence, occurrence and prevention of major hormonal diseases** using slides, posters, data tables, graphs, pamphlets and videos, pursued/assigned as a project/ assignment.	C109: Communicates findings and conclusions around prevalence, occurrence and prevention of major hormonal diseases using slides, posters, data tables, graphs, pamphlets and videos, assigned or pursued as a project/assignment.
The World of the Living **Chapter 8 – How Do Organisms Reproduce** Key concepts Reproduction in plants and animals. Need for and methods of family planning. Safe sex vs. HIV/ AIDS. Childbearing and women's health.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as autotrophic and heterotrophic nutrition, biodegradable and non-biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.	CLO44:Differentiates various **modes/ processes of sexual and asexual reproduction in plants and animals.**	C110: Differentiates between asexual and sexual reproduction. C111: Distinguishes between the type of fissions. C112: Compares the concepts of pollination and fertilisation. C113: Differentiates between types of pollination. C114: Differentiates between types of asexual reproduction. C115: Identifies between types of flowers based on reproductive organs. C116: Distinguishes reproductive organs in humans based on their functions.

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The World of the Living **Chapter 8 – How Do Organisms Reproduce** Key concepts Reproduction in plants and animals. Need for and methods of family planning. Safe sex vs. HIV/ AIDS. Childbearing and women's health.	LO2: **Classifies materials/objects/ organisms/ phenomena/ processes, based on properties/ characteristics,** such as metals and non-metals based on their physical and chemical properties, acids and bases on the basis of their chemical properties, etc	CLO45:Classifies various **contraceptive devices/measures into categories based on their principle of action.**	C117: Classifies various contraceptive devices/ measures into categories based on their principle of action.
	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,** such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light?	CLO46:Plans and conducts investigations/experiments **around modes of reproduction in plants/animals, contraception and STDs in humans.**	C118: Investigates cross and self-pollination in plants. C119: Investigates changes in structure of different flowers after fertilisation C120: Plans dissections to study the variations in features of reproductive organs across flowering plants. C121: Surveys commonly used birth control measures/prevalent STDs in nearest health centres. C122: Plans investigations/experiment to observe unicellular organisms and their reproductive modes (yeast, amoeba spirogyra etc.). C123: Plans investigations/experiment to observe vegetative structures in plant parts (bryophyllum, potato etc.).
	LO4: **Relates processes and phenomena with causes/ effects,** such as hormones with their functions, tooth decay with Ph of saliva, growth of plants with Ph of the soil, survival of aquatic life with Ph of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc.	CLO47:Relates **physical and behavioural changes during puberty to hormonal changes.** CLO48:Relates **female-male sex ratio** to determinants of healthy society. CLO49:Relates **rate of birth and death to population size along with living standards of society.**	C124: Relates physical and behavioural changes during puberty to hormonal changes. C125: Relates female-male sex ratio to determinants of healthy society. C126: Relates rate of birth and death to population size along with living standards of society.

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The World of the Living **Chapter 8 – How Do Organisms Reproduce** Key concepts Reproduction in plants and animals. Need for and methods of family planning. Safe sex vs. HIV/ AIDS. Childbearing and women's health.	LO5: **Explains processes and phenomena, such as** nutrition in human beings and plants, transportation in plants and plants, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO50:Explains processes and phenomenon **related to reproduction in plants and animals.**	C127: Explains the advantages of sexual reproduction. C128: Explains methods of vegetative propagation with examples. C129: Describes the significance of menstruation. C130: Elaborates on process of fertilisation, pregnancy and birth in humans. C131: Describes contraception in humans and safe sexual practices. C132: Explains puberty and bodily changes associated to the same.
	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs,** such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.	CLO51:Draws labelled diagrams/flow chart illustrating **modes and process of reproduction and reproductive organs in animals/ humans/plants.**	C133: Draws labelled diagrams/flow charts illustrating modes and process of reproduction and reproductive organs in animals/humans/plants.
	LO7: **Analyses and interprets data/ graph/ figure,** such as melting and boiling points of substances to differentiate between covalent and ionic compounds, pH of solutions to predict the nature of substances, V-I graphs, ray diagrams, etc.	CLO52:Analyses and interprets data/graphs **relating to contraception, STDs and sex determination.**	C134: Interprets data relating to usage and availability of contraception. C135: Interprets graphs showing incidence of STDs in terms of states/country. C136: Interprets graphs/data showing numbers for illegal pre- natal sex determination tests.
	LO11: **Applies learning to hypothetical situations,** such as what happens if all herbivores removed from an ecosystem? What will happen if all non-renewable sources of energy are exhausted?	CLO53:Applies learning of **reproductive processes to hypothetical situations predicting consequences/ implications.**	C137: Applies learning of reproductive processes to hypothetical situations predicting consequences/ implications(what happens if -egg is not fertilised in human female? / Some key pollinators become extinct etc.?).

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The World of the Living **Chapter 8 – How Do Organisms Reproduce** Key concepts Reproduction in plants and animals. Need for and methods of family planning. Safe sex vs. HIV/ AIDS. Childbearing and women's health.	LO12: **Applies scientific concepts in daily life and solving problems,** such as takes precautions to prevent sexually transmitted infections, uses appropriate electrical plugs (5/15a) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health, avoids using appliances responsible for ozone layer depletion, applies concept of decomposition reaction of baking soda to make spongy cakes, etc.	CLO54:Applies knowledge of **vegetative propagation and associated plant structures** to curate and grow suitable plants in school premises/ kitchen garden/ community parks etc.	C138: Applies learning of vegetative propagation and associated plant structures to curate and grow suitable plants in school premises/ kitchen garden/community parks etc.
	LO17: **Exhibits values of honesty/ objectivity/ rational thinking/ freedom from myth/ superstitious beliefs while taking decisions, respect for life, etc**. Such as reports and records experimental data accurately, says no to consumption of alcohol and sensitises others about its effect on physical and mental health, motivates for organ donation, prevents pre-natal sex determination, etc.	CLO55:Exhibits objectivity and rational thinking **while approaching discussions on puberty and sex in peer groups.**	C139: Exhibits objectivity and rational thinking while approaching discussions on puberty and sex in peer groups.
	LO18:**Communicates the findings and conclusions effectively,** such as those of experiment/ activity/ project orally and in written form using appropriate figures/ tables/ graphs/ digital form, etc	CLO56:Propagates awareness **around contraception measures and STDs using posters, data tables, graphs, pamphlets and videos.**	C140: Propagates awareness around contraception measures and STDs using posters, data tables, graphs, pamphlets and videos.
The World of the Living **Chapter 9 –** **Heredity and Evolution** Key concepts: Heredity; Origin of life: brief introduction; Basic concepts of evolution.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as autotrophic and heterotrophic nutrition, biodegradable and non- biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.	CLO57:Differentiates processes/ phenomenon/ **principles of heredity and evolution and their influence on human life.**	C141: Distinguishes between acquired and inherited traits. C142: Differentiates between homologous and analogous organs with examples. C143: Distinguishes between monohybrid and dihybrid cross.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
The World of the Living **Chapter 9 -** **Heredity and Evolution** Key concepts: Heredity; Origin of life: brief introduction; Basic concepts of evolution.	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,** such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light?	CLO58:Plans and conducts investigation/experiment **around inherited traits, evolution and sex- determination.**	C144: Investigates prevalence of selected inherited traits in a small population. C145: Investigates understanding of variation and evolution across different sections of community. C146: Investigates social perception of community on sex determination.
	LO5: **Explains processes and phenomena**, such as nutrition in human beings and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO59:Explains process/phenomenon/ principles **related to heredity and evolution.**	C147: Explains laws of inheritance linked to features of offspring. C148: Describes fossilisation with examples. C149: Explains process of speciation. C150: Discusses nature of evolution in terms of variation. C151: Explains sex determination in human beings. C152: Explain genetic control over traits.
	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs,** such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.	CLO60:Draws labelled **genetic diagrams/flow charts/ punnet squares etc to illustrate inheritance of traits over generations and sex determination etc.**	C153: Draws labelled genetic diagrams/flow charts/ punnet squares etc to illustrate inheritance of traits over generations and sex determination etc.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
The World of the Living **Chapter 9 -** **Heredity and Evolution** Key concepts: Heredity; Origin of life: brief introduction; Basic concepts of evolution.	LO7: **Analyses and interprets data/ graph/ figure**, such as melting and boiling points of substances to differentiate between covalent and ionic compounds, Ph of solutions to predict the nature of substances, V-I graphs, ray diagrams, etc.	CLO61:Analyses data to interpret **the pattern of inheritance in pea and other similar plants.**	C154: Analyses data to interpret the pattern of inheritance in pea and other similar plants.
	LO11:**Applies learning to hypothetical situations,** such as what happens if all herbivores removed from an ecosystem? What will happen if all non-renewable sources of energy are exhausted?	CLO62:Applies learning of **heredity and inheritance to predict trait expressions in a situation.**	C155: Predicts proportion of features in offspring from furnished genetic data on parents.
	LO12: **Applies scientific concepts in daily life and solving problems,** such as takes precautions to prevent sexually transmitted infections, uses appropriate electrical plugs (5/15a) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health, avoids using appliances responsible for ozone layer depletion, applies concept of decomposition reaction of baking soda to make spongy cakes, etc.	CLO63:Applies understanding of **acquired and inherited characters to examine related beliefs in society/community/ peer groups in daily life.**	C156: Applies understanding of acquired and inherited characters to examine related beliefs in society/community/peer groups in daily life (e.g., Inheritance of ear piercings in female, Children of athletes may or may not be good athletes?).
	LO14:**Draws conclusion,** such as traits/ features are inherited through genes present on chromosomes, a new species originates through evolutionary processes, water is made up of hydrogen and oxygen, properties of elements vary periodically along the groups and periods in periodic table, potential difference across a metal conductor is proportional to the electric current through it, etc.	CLO64:Draws conclusions, such as **traits/ features are inherited through genes present on chromosomes, a new species originates through evolutionary processes, etc.**	C157: Draws conclusions that traits/ features are inherited through genes present on chromosomes, a new species originates through evolutionary processes, etc.

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The World of the Living **Chapter 9 -** **Heredity and Evolution** Key concepts: Heredity; Origin of life: brief introduction; Basic concepts of evolution.	LO15: **Takes initiative to know about scientific discoveries/ inventions,** such as Mendel's contribution in understanding the concept of inheritance, Dobereiner for discovering triads of elements, Mendeleev for the development of the periodic table of elements, oersted discovery that electricity and magnetism are related, discovery of relation between potential difference across a metal conductor and the electric current through it by ohm, etc	CLO65:Takes initiative to know about **Mendel's contribution in understanding the concept of inheritance**. CLO66:Takes initiative to know about **Darwin's contributions in concept of Evolution**. CLO67:Takes initiative to know about **JBS Haldane contribution in understanding on origin of life.**	C158: Presents life events and Mendel's detailed work on peas leading to laws of inheritance. C159: Presents life events, disputes and detailed work of Darwin leading to concept of evolution. C160: Presents life events and detailed work of Haldane leading to understanding of the origin of life.
	LO17: **Exhibits values of honesty/ objectivity/ rational thinking/ freedom from myth/ superstitious beliefs while taking decisions, respect for life, etc.** Such as reports and records experimental data accurately, says no to consumption of alcohol and sensitises others about its effect on physical and mental health, motivates for organ donation, prevents pre-natal sex determination, etc.	CLO68:Exhibits objectivity and rational thinking **while dealing with myths/superstitions related to hereditary and inheritance.**	C161: Exhibits rational thinking/objectivity towards perceptions associated with sex determination. C162: Exhibits rational thinking/objectivity towards perceptions linking caste system to heredity and inheritance.
	LO18: **Communicates the findings and conclusions effectively,** such as those of experiment/ activity/ project orally and in written form using appropriate figures/ tables/ graphs/ digital form, etc.	CLO69:Communicates awareness **around perception of linking caste system to heredity and inheritance using videos, pictures, articles and poster etc.**	C163: Communicates awareness around perceptions of linking caste system to heredity and inheritance using validated videos, pictures, articles and posters etc.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Phenomena **Chapter 10: Light – Reflection and Refraction** Key Concepts: Convergence and divergence of light. Images formed by a concave mirror; related concepts centre of curvature, principal axis. Optical centre, focus, focal length. Refraction; laws of refraction. Images formed by a convex lens; functioning of lens inhuman eye; problems of vision and remedies.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as autotrophic and heterotrophic nutrition, biodegradable and nonbiodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual image.	CLO70:Differentiates between **reflection and refraction.**	C164:Differentiates between reflection and refraction textually and diagrammatically.
	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,** such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light?	CLO71:Plans and conducts investigations/ experiments to arrive at and verify the facts/ principles/ **phenomenon that light seems to be travelling in a straight line.**	C165:Verifies the claim that light seems to travel in a straight line. C166:Performs experiments to verify the laws of reflection and refraction.
	LO5: **Explains processes and phenomena**, such as nutrition in human beings and plants, transportation in plants and plants, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO72:Explains processes and phenomena, such as the **type of images formed for different mirrors and lenses, the role of medium/density in refraction**.	C167:Explains the types of images formed by different mirrors and lenses both textually and diagrammatically. C168:Explains the role of medium/density in refraction both textually and diagrammatically.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Phenomena **Chapter 10: Light – Reflection and Refraction** Key Concepts: Convergence and divergence of light. Images formed by a concave mirror; related concepts centre of curvature, principal axis. Optical centre, focus, focal length. Refraction; laws of refraction. Images formed by a convex lens; functioning of lens inhuman eye; problems of vision and remedies.	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs,** such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.	CLO73:Draws **ray diagrams of different kinds of lenses.**	C169:Draws ray diagrams for different kinds of lenses. C170:Interprets the drawn ray diagrams.
	LO8: **Calculates using the data given,** such as number of atoms in reactants and products to balance a chemical equation, resistance of a system of resistors, power of a lens, electric power, etc.	CLO74:Calculates the **focal length, centre of curvature, magnification or refractive index etc., from the given data**.	C171:Calculates/finds the unknown variable and assigns proper units wherever applicable.
	LO9: **Uses scientific conventions/ symbols/ equations to represent various quantities/ elements/ units,** such as SI units, symbols of elements, formulae of simple compounds, chemical equations, etc	CLO75:Uses **Cartesian sign convention for spherical mirrors.**	C172:Uses Cartesian sign convention for spherical mirrors.
	LO12: **Applies scientific concepts in daily life and solving problems,** such as takes precautions to prevent sexually transmitted infections, uses appropriate electrical plugs (5/15a) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health, avoids using appliances responsible for ozone layer depletion, applies concept of decomposition reaction of baking soda to make spongy cakes, etc.	CLO76:Applies the **concept of refraction on fishing and eye correction.**	C173:Applies the concepts of refraction to eye correction and fishing. C174:Applies the concept of magnification while using a compound microscope in the lab.

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Natural Phenomena **Chapter 11 – Human eye and colourful world** Key Concepts: The human eye – power of accommodation; defects of vision – myopia, hypermetropia, presbyopia; refraction of light through a prism; dispersion of white light through a prism; atmospheric refraction; Tyndall effect; scattering of light.	LO2: **Classifies materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as metals and non-metals based on their physical and chemical properties, acids and bases on the basis of their chemical properties, etc.	CLO77:Classifies the **defects of human eye vision.**	C175: Classifies myopia, hypermetropia and presbyopia as defects of human eye vision.
	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs,** such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.	CLO78:Draws labelled diagrams for **various concepts of light.**	C176: Draws labelled diagram of refraction across a media interface. C177: Draws labelled diagram of dispersion of light through a prism. C178: Draws and labels the structure of the human eye. C179: Draws and labels the ray diagram of a) white light passing through a prism, b) its recombination on passing through an identical, inverted prism, and c) the formation of a rainbow.
	LO8: **calculates using the data given**, such as number of atoms in reactants and products to balance a chemical equation, resistance of a system of resistors, power of a lens, electric power, etc.	CLO79:Uses l**aw of refraction for various calculations.**	C180: Uses the law of refraction to calculate the angle of incidence and angle of refraction and refractive index. (Using glass, slab and prism etc.)
How things work **Chapter 12 – Electricity** Key Concepts: Potential difference, potential.: Ohm's law, Series combination of resistances. Parallel combination of resistances. Power dissipated due to current. Interrelation between P, V, I and R.	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,** such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, Ohm's law etc.	CLO80:Plans and conducts experiments to verify **Ohm's law, effect on resistance when the resistors are connected in series and in parallel., heating effect of current.**	C181: Verifies experimentally the relationship between current, potential difference and resistance (Theoretically and experimentally). C182: Verifies the effect on resistance when resistors are connected in series and in parallel (Theoretically and experimentally). C183: Verifies the heating effect of current. (Theoretically and experimentally) C184: Verifies the relationship between resistance, wire length and wire cross section area (Theoretically and experimentally).

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
How things work **Chapter 12 – Electricity** Key Concepts: Potential difference, potential.: Ohm's law, Series combination of resistances. Parallel combination of resistances. Power dissipated due to current. Interrelation between P, V, I and R.	LO5: **Explains processes and phenomena**, such as nutrition in human beings and plants, transportation in plants and plants, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO81:Explains the process of **electric conduction., electric circuit, Ohm's law.**	C185: Explains the relationship between charge, current and time. C186: Explains the need for a stream of electrons and a conductor. C187: Explains Ohm's law in text, through a formula and through a graph. C188: Explains how an electric circuit functions, both in text and through a diagram.
	LO7**: Analyses and interprets data/ graph/ figure,** such as melting and boiling points of substances to differentiate between covalent and ionic compounds, Ph of solutions to predict the nature of substances, V-I graphs, ray diagrams, etc.	CLO82:Analyses and interprets **V-I graphs**	C189: Analyses and interprets V-I graphs pertaining to household electric appliances/ supply.
	LO8: **Calculates using the data given**, such as number of atoms in reactants and products to balance a chemical equation, resistance of a system of resistors, power of a lens, electric power, etc.	CLO83:Calculates the **unknown variable by using appropriate formula and assigning a relevant unit.**	C190: Calculates the resistance/potential difference/current/heating of a circuit. C191: Calculates the power of a motor. C192: Determines effective resistance of a given circuit, finds the current in each branch and potential difference across each element of a simple circuit.
	LO9: **Uses scientific conventions to represent units of various quantities/ symbols/ formulae/ equations,** such as balanced chemical equation by using symbols and physical states of substances, sign convention in optics, SI units, etc.	CLO84:Uses the **convention that the direction of electric current is opposite to the direction of flow of electrons**. CLO85:Uses the SI units and symbols for **current, charge, potential difference, resistance, resistivity etc.**	C193: Uses symbols of components of a circuit diagram.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
How things work **Chapter 12 – Electricity** Key Concepts: Potential difference, potential.: Ohm's law, Series combination of resistances. Parallel combination of resistances. Power dissipated due to current. Interrelation between P, V, I and R.	LO10: **Measures physical quantities using appropriate apparatus/ instruments / devices**, such as pH of substances using different indicators, electric current and potential difference using ammeter and voltmeter, etc.	CLO86:Measures physical quantities using appropriate apparatus/ instruments /devices, **such as electric current and potential difference using ammeter and voltmeter, etc.**	C194: Measures the physical quantities and records them with proper units (using voltmeter and ammeter etc.).
	LO12: **Applies scientific concepts in daily life and solving problems,** such as takes precautions to prevent Sexually Transmitted Infections, uses appropriate electrical plugs (5/15A) for different electrical devices, uses vegetative propagation to develop saplings in gardening, performs exercise to keep in good health etc.	CLO87:Applies scientific concepts in daily life and solving problems, such as **uses appropriate electrical plugs (5/15A) for different electrical devices.**	C195: Applies concepts from electricity to decrease/increase resistance. C196: Applies concepts from electricity to ironing clothes.
	LO13**: Derives formulae/ equations/ laws** such as equivalent resistance of resistors in series and parallel etc.,	CLO88:Derives equation for **resistivity, for series and parallel connection of resistors, for Joule's law of heating.**	C197: Derives equation for resistivity. C198: Derives equation for series and parallel connection of resistor. C199: Derives equation for Joule's law of heating.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
How things work **Chapter 13 – Magnetic Effect of Electric Current** Key Concepts: Magnetic field Field lines, Field due to a current carrying wire. Field due to current carrying coil or solenoid. Force on current carrying conductor Fleming's left-hand rule. Electric motor., Electromagnetic induction., Induced potential differences, induced current. Electric generator. Principle and working. Direct current. Alternating current; frequency of AC. Advantage of AC over DC. Domestic electric circuits. Explains how an electric circuit functions, both in text and through a diagram	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as autotrophic and heterotrophic nutrition, biodegradable and non-biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.	CLO89:Differentiates between the **process of direct and alternating current conduction.**	C200: Differentiates between the process of direct and alternating current conduction.
	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,** such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, Ohm's law etc.	CLO90:Plans and conducts experiments to verify **the path of magnetic field lines**.	C201: Verifies the claim that magnetic field lines are not planar. C202: Verifies the claim that no two field lines found to cross each other. C203: Verifies the claim that field lines are more crowded when the magnetic field is stronger. C204: Verifies the claim that magnetic field lines are closed curves.
	LO4: **Relates processes and phenomena with causes/ effects,** such as hormones with their functions, tooth decay with pH of saliva, growth of plants with pH of the soil, survival of aquatic life with pH of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc.	CLO91:Relates processes and phenomena with causes/effects such as **deflection of compass needle due to magnetic effect of electric current.**	C205: Relates the effect of electric current on a compass needle. C206: Relates the effect on magnetic field due to a current through a straight conductor, a circular loop and through a solenoid. C207: Relates processes and phenomena with causes/effects of how polarity changes when a magnet is broken midway.

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How things work **Chapter 13 – Magnetic Effect of Electric Current** Key Concepts: Magnetic field Field lines, Field due to a current carrying wire. Field due to current carrying coil or solenoid. Force on current carrying conductor Fleming's left-hand rule. Electric motor., Electromagnetic induction., Induced potential differences, induced current. Electric generator. Principle and working. Direct current. Alternating current; frequency of AC. Advantage of AC over DC. Domestic electric circuits. Explains how an electric circuit functions, both in text and through a diagram	LO5: **Explains processes and phenomena**, such as nutrition in human beings and plants, transportation in plants and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc	CLO92: Explains the working principle of **electric motor, electric generator, household electric supply, role of various parts of motor and generator, different ways to induce current.**	C208: Explains different ways to induce current. C209: Explains how an electric circuit functions, both in text and through a diagram. C210: Explains the precautions that are to be taken to avoid overloading of electric circuits. C211: Explains the role of various components involved in an electric motor/generator.
	LO9: **Uses scientific conventions to represent units of various quantities/ symbols/ formulae/ equations,** such as balanced chemical equation by using symbols and physical states of substances, sign convention in optics, SI units, etc.	CLO93: Uses scientific conventions to represent **the direction of magnetic field lines both inside and outside a magnet.**	C212: Uses scientific conventions to represent the direction of magnetic field lines both inside and outside a magnet. C213: Discusses the three-coloured wire convention used in domestic circuits.
	LO15: **Takes initiative to know about scientific discoveries/ inventions**, such as Mendel's contribution in understanding the concept of inheritance, Dobereiner for discovering triads of elements, Mendeleev for the development of the periodic table of elements, oersted discovery that electricity and magnetism are related, discovery of relation between potential difference across a metal conductor and the electric current through it by Ohm, etc.	CLO94: Describes the **contributions of Fleming, Faraday, Oersted in the field of electricity and magnetism.**	C214: Describes the contributions of Fleming, Faraday, Oersted in the field of electricity and magnetism. C215: Discusses the safety measures used in electric circuits.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Resources **Chapter 14 – Sources of Energy** **Key concepts:** Different forms of energy, leading to different sources for human use: fossil fuels, solar energy; biogas; wind, water and tidal energy; nuclear energy. Renewable versus non-renewable sources	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on properties/ characteristics,** such as autotrophic and heterotrophic nutrition, biodegradable and non-biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.	CLO95:Differentiates processes/ phenomenon/ factors associated with **forms of energy available to us.**	C216: Differentiates between renewable and non-renewable sources of energy. C217: Compares and contrasts between conventional and non-conventional sources of energy. C218: Distinguishes sources of energy weighing associated factors (usability, economics, technology and environment)
	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own**, such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light?	CLO96:Plans and conduct/ investigations around **conservation, availability, alternatives, feasibility and usage of energy sources.**	C219: Investigates ways in which energy consumption can be reduced in households/schools/ institutions. C220: Investigates the energy profile of a city/ state/country in terms of combination of sources from where electricity is drawn (thermal powers, hydel power, nuclear power and other alternatives) C221: Investigates and explores further on the potential of extracting energy from the sea and its plausibility (Tidal, wave, thermal)

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Natural Resources **Chapter 14 – Sources of Energy** **Key concepts:** Different forms of energy, leading to different sources for human use: fossil fuels, solar energy; biogas; wind, water and tidal energy; nuclear energy. Renewable versus non-renewable sources	LO5: **Explains processes and phenomena,** such as nutrition in human beings and plants, transportation in plants and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO97: Explains processes/phenomena and factors relating to **various form of energy at world's disposal.**	C222: Explains different forms of energy and their extraction with pros and cons (fossil fuels, nuclear, solar energy, biogas, ethanol wood/ biomass, wind, water and tidal etc.). C223: Discusses consequences of increasing energy demand and ways to curb the same. C224: Describes characteristics of an ideal energy source. C225: Discusses role of sun in reference to various energy sources (especially nuclear and geothermal) C226: Describes dissipation of energy with changes in form and usability. C227: Explains principles of nuclear fission and working of nuclear reactor. C228: Discusses principles and feasibility of deriving ocean thermal energy. C229: Explains the causes of acid rain and its effects on environment.
	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs,** such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.	CLO98: Draws labelled diagrams/ flow charts/ concept maps/ graph **depicting and illustrating energy consumption, major sources for energy requirements, designs of energy generation pathways, dams, biogas plants etc.**	C230: Draws labelled diagrams/ flow charts/ concept maps/ graph depicting and illustrating energy consumption, major sources for energy requirements, designs of energy generation pathways, dams, biogas plants etc.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Resources **Chapter 14 – Sources of Energy** **Key concepts:** Different forms of energy, leading to different sources for human use: fossil fuels, solar energy; biogas; wind, water and tidal energy; nuclear energy. Renewable versus non-renewable sources	LO7: **Analyses and interprets data/ graph/ figure,** such as melting and boiling points of substances to differentiate between covalent and ionic compounds, Ph of solutions to predict the nature of substances, V-I graphs, ray diagrams, etc.	CLO99:Analyses and interprets data and graphs on **available sources of energy/ reserves of fossil fuels/emission of gases/ energy efficiency of a system etc**.	C231: Analyses and interprets graphs on changing energy use over time. C232: Analyses data on emission of gases from power plants and its potential impact on global temperature. C233: Calculates overall energy efficiency of a system from the furnished data sets.
	LO11: **Applies learning to hypothetical situations,** such as what happens if all herbivores removed from an ecosystem? What will happen if all non-renewable sources of energy are exhausted?	CLO100:Applies learning of **energy sources and their major types to predict consequences if all non – renewable sources of energy are exhausted etc.**	C234: Applies learning of energy sources and their major types to predict consequences if all non – renewable sources of energy are exhausted etc.
	LO15: **Takes initiative to know about scientific discoveries/ inventions,** such as Mendel's contribution in understanding the concept of inheritance, Dobereiner for discovering triads of elements, Mendeleev for the development of the periodic table of elements, oersted discovery that electricity and magnetism are related, discovery of relation between potential difference across a metal conductor and the electric current through it by ohm, etc.	CLO101:Takes initiative to know about **work of Einstein relating to the concept of "nuclear fusion".**	C235: Presents life and key works of Einstein, emphasising upon his equation which relates to the nuclear fusion process in a nuclear reactor.
	LO16: **Exhibits creativity in designing models using eco-friendly resources**, such as working model of respiratory, digestive and excretory systems, soda acid fire extinguisher, periodic table, micelles formation, diamond/ graphite/ Buckminsterfullerene, human eye, electric motor and generator, etc.	CLO102:Exhibits creativity in designing models using eco-friendly resources such as a **working solar heater/cooker, working model of dam, static model of a nuclear reactor, working windmills etc.**	C236: Designs models using eco-friendly resources such as a working solar heater/ cooker, working model of dam, static model of a nuclear reactor, working windmills etc.

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Natural Resources **Chapter 14 – Sources of Energy** **Key concepts:** Different forms of energy, leading to different sources for human use: fossil fuels, solar energy; biogas; wind, water and tidal energy; nuclear energy. Renewable versus non-renewable sources	LO19:**Makes efforts to conserve environment realising the inter- dependency and interrelationship in the biotic and abiotic factors of environment**, such as appreciates and promotes segregation of biodegradable and non - biodegradable wastes, takes steps to promote sustainable management of resources in day-to-day life, advocates use of fuels which produces less pollutants, uses energy efficient electric devices, uses fossil fuels judiciously, etc.	CLO103:Makes effort to conserve environment by **advocating fuels with less emissions, using energy efficient appliances and devices, using fossil fuels judiciously etc.**	C237: Makes effort to conserve environment by advocating fuels with less emissions, using energy efficient appliances and devices, using fossil fuels judiciously etc.
Natural Resources **Chapter 15 – Our Environment** Key Concepts: Environmental problems, what can we do? Biodegradable, nonbiodegradable. Ozone depletion.	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as autotrophic and heterotrophic nutrition, biodegradable and non- biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.	CLO104:Differentiates objects/ organisms/ phenomenon related to **conservation of larger environment**.	C238: Distinguishes between biodegradable and non-biodegradable wastes. C239: Differentiates biotic and abiotic factors. C240: Categorises organisms in terms of trophic levels. C241:Distinguishes between food chain and web.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Resources **Chapter 15 – Our Environment** Key Concepts: Environmental problems, what can we do? Biodegradable, nonbiodegradable. Ozone depletion.	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,** such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light?	CLO105:Plans and conducts investigations to **be aware of factors impacting the immediate and larger ecosystem.**	C242: Investigates the presence of pesticides in food items. C243: Surveys and classifies the types of waste generated in community. C244: Investigates the waste segregation practices in households and municipal levels. C245: Investigates the sewage treatment protocols and practices in community and local industries. C246: Investigates the way in which medical wastes are disposed at a health centre. C247: Investigates the ways of recycling waste products and its impact on environment.
	LO4: **Relates processes and phenomena with causes/ effects,** such as hormones with their functions, tooth decay with pH of saliva, growth of plants with pH of the soil, survival of aquatic life with pH of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc.	CLO106:Relates **biomagnification with increase in the concentration of non – biodegradable substances in the food chain.**	C248: Relates biomagnification with increase in the concentration of non-biodegradable substances in the food chain.
	LO5: **Explains processes and phenomena**, such as nutrition in human beings and plants, transportation in plants and plants, transportation in plants and animals, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO107:Explains processes and phenomenon **related to conservation of larger environment.**	C249: Explains food chains and web in terms of interdependence and trophic levels. C250: Describes formation, role and depletion of ozone. C251: Discusses biological magnification and its effects. C252: Describes the role of decomposers. C253: Explains steps to conserve the environment. C254: Explains the flow of energy across trophic levels.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Resources **Chapter 15 – Our Environment** Key Concepts: Environmental problems, what can we do? Biodegradable, nonbiodegradable. Ozone depletion.	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs,** such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.	CLO108:Draws labelled diagrams/ flow charts/ concepts maps to **depict and illustrate food chains, recycling processes, interdependence among biotic and abiotic factors etc.**	C255: Draws labelled diagrams/ flow charts/ concepts maps to depict and illustrate food chains, recycling processes, interdependence among biotic and abiotic factors etc.
	LO7: **Analyses and interprets data/ graph/ figure,** such as melting and boiling points of substances to differentiate between covalent and ionic compounds, pH of solutions to predict the nature of substances, V-I graphs, ray diagrams, etc.	CLO109:Analyses and interprets data/ graphs/figures **related to changes on the environment.**	C256: Analyses and interprets data on impacts of temperature changes on the environment. C257: Analyses and interprets data on plastic consumption and its recycling.
	LO8: **Calculates using the data given**, such as number of atoms in reactants and products to balance a chemical equation, resistance of a system of resistors, power of a lens, electric power, etc.	CLO110:Calculates the **amount of energy available in various trophic levels in a food chain with given data.**	C258: Calculates the amount of energy available in various trophic levels in a food chain from given data.
	LO11: **Applies learning to hypothetical situations**, such as what happens if all herbivores removed from an ecosystem? What will happen if all non-renewable sources of energy are exhausted?	CLO111:Applies learning of **interdependence of organism and environmental factors to predict consequences in a situation.**	C259: Applies learning of interdependence of organisms and environmental factors to predict consequences in a situation (e.g., Effect of removal and addition of trophic level in an ecosystem etc.).

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Resources **Chapter 15 – Our Environment** Key Concepts: Environmental problems, what can we do? Biodegradable, nonbiodegradable. Ozone depletion.	LO 19:**Makes efforts to conserve environment realising the inter- dependency and interrelationship in the biotic and abiotic factors of environment,** such as appreciates and promotes segregation of biodegradable and non-biodegradable wastes, takes steps to promote sustainable management of resources in day-to-day life, advocates use of fuels which produces less pollutants, uses energy efficient electric devices, uses fossil fuels judiciously, etc.	CLO112:Makes efforts and takes steps to conserve environment **realising the inter- dependency and interrelationship in the biotic and abiotic factors of environment, promoting segregation of biodegradable and non - biodegradable wastes with appropriate recycling and reusage etc.**	C260: Takes steps to conserve environment realising the inter- dependency and interrelationship in the biotic and abiotic factors of environment, promoting segregation of biodegradable and non-biodegradable wastes with appropriate recycling and reusage etc.
Natural Resources **Chapter 16 – Sustainable Management of Natural Resources** Key Concepts: Management of natural resources. Conservation and judicious use of natural resources. Forest and wildlife, coal and petroleum conservation. People's participation. Chipko movement. Legal perspectives in conservation and international scenario. Big dams: advantages and limitations; alternatives if any. Water harvesting. Sustainability of natural resources	LO1: **Differentiates materials/ objects/ organisms/ phenomena/ processes, based on, properties/ characteristics,** such as autotrophic and heterotrophic nutrition, biodegradable and non- biodegradable substances, various types of reactions, strong and weak acids and bases, acidic, basic and neutral salts, real and virtual images, etc.	CLO113:Differentiates processes/ structures/ways related to **management and conservation of natural resources.**	C261: Distinguish between three R's (reuse, reduce, recycle). C262: Compares and contrasts traditional and modern water harvesting.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Resources **Chapter 16 – Sustainable Management of Natural Resources** Key Concepts: Management of natural resources. Conservation and judicious use of natural resources. Forest and wildlife, coal and petroleum conservation. People's participation. Chipko movement. Legal perspectives in conservation and international scenario. Big dams: advantages and limitations; alternatives if any. Water harvesting. Sustainability of natural resources	LO3: **Plans and conducts investigations/ experiments to arrive at and verify the facts, principles, phenomena or to seek answers to queries on their own,** such as investigates conditions necessary for rusting, tests the conductivity of various solutions, compares the foaming capacity of different types of soap samples, verifies laws of reflection and refraction of light, ohm's law, do variegated leaves perform photosynthesis? Which gas is evolved during fermentation? Why plants shoot moves towards light?	CLO114: Plans and conducts investigations to **gain insights into water quality, water shortage, rainfall, emission standards, forest cover and distribution of resources, etc.**	C263: Plans and investigates the pH levels of water sources in community against permissible limits" (tap water, handpump etc.). C264: Plans and investigates the rainfall patterns across geographies (using atlas, data from meteorological dept.). C265: Plans and investigates traditional water harvesting structures (history, usage, ownership etc.). C266: Surveys the emission standards across the countries.
	LO4: **Relates processes and phenomena with causes/ effects,** such as hormones with their functions, tooth decay with pH of saliva, growth of plants with pH of the soil, survival of aquatic life with pH of water, blue colour of sky with scattering of light, deflection of compass needle due to magnetic effect of electric current, etc.	CLO115: Relates **coliform count to contamination of water.** CLO116: Relates **responsibility of stakeholders to conservation of resources**	C267: Relates coliform count to contamination of water. C268: Relates responsibility of stakeholders to conservation of resources.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Resources **Chapter 16 – Sustainable Management of Natural Resources** Key Concepts: Management of natural resources. Conservation and judicious use of natural resources. Forest and wildlife, coal and petroleum conservation. People's participation. Chipko movement. Legal perspectives in conservation and international scenario. Big dams: advantages and limitations; alternatives if any. Water harvesting. Sustainability of natural resources	LO5: **Explains processes and phenomena,** such as nutrition in human beings and plants, transportation in plants and plants, extraction of metals from ores, placement of elements in modern periodic table, displacement of metals from their salt solutions on the basis of reactivity series, working of electric motor and generator, twinkling of stars, advance sunrise and delayed sunset, formation of rainbow, etc.	CLO117:Explains **natural resource management to achieve sustainability by creating equilibrium between social factors, economic factors and environmental factors.**	C269: Explains importance of resource conservation and ways to achieve same (fossil fuels, water, forest and wildlife, minerals etc.). C270: Describes significance of peoples stake in environment conservation. C271: Explains pros and cons of dam construction. C272: Discusses causes and implications of monoculture on Biodiversity. C273: Describes stakeholders and dynamics involved in resource conservation. C274: Explains people movements and learning derived from them. C275: Discusses impact of environmental factors on socio- economic aspects of people. C276: Summarises major principles of natural resources management. C277: Discusses resource management by community and its implications to livelihood.
	LO6: **Draws labelled diagrams/ flow charts/ concept map/graphs**, such as digestive, respiratory, circulatory, excretory and reproductive systems, electrolysis of water, electron dot structure of atoms and molecules, flow chart for extraction of metals from ores, ray diagrams, magnetic field lines, etc.	CLO118:Draws labelled diagrams/ flow charts/maps and graphs **depicting traditional and modern water harvesting schemes, impact of dam construction in a geography, pH range of water, rain fall pattern etc.**	C278: Draws labelled diagrams/flow charts/ maps and graphs depicting traditional and modern water harvesting schemes, impact of dam construction in a geography, pH range of water, rain fall pattern etc.

Content Domain, Chapter, Key Concepts	*Learning Outcomes – NCERT*	*Content Domain Specific Learning Outcomes*	*Indicators*
Natural Resources **Chapter 16 – Sustainable Management of Natural Resources** Key Concepts: Management of natural resources. Conservation and judicious use of natural resources. Forest and wildlife, coal and petroleum conservation. People's participation. Chipko movement. Legal perspectives in conservation and international scenario. Big dams: advantages and limitations; alternatives if any. Water harvesting. Sustainability of natural resources	LO7: **Analyses and interprets data/ graph/ figure**, such as melting and boiling points of substances to differentiate between covalent and ionic compounds, pH of solutions to predict the nature of substances, V-I graphs, ray diagrams, etc.	CLO119:Analyses and interprets data/ graphs/ figures on **status of natural resources like forest coverage, water, wildlife, mining output, rainfall, coal and petroleum etc.**	C279: Analyses and interprets graphs on changing forest cover over time. C280: Analyses data on pattern of rainfall across geographies over the years. C281: Analyses and interprets data on production of coal/ minerals/ petroleum against the reserves. C282: Analyses and interprets graphs of underground water table across geographies over the years (urban/ rural/ forest/ desert).
	LO19:**Makes efforts to conserve environment realising the inter- dependency and interrelationship in the biotic and abiotic factors of environment,** such as appreciates and promotes segregation of biodegradable and non - biodegradable wastes, takes steps to promote sustainable management of resources in day-to-day life, advocates use of fuels which produces less pollutants, uses energy efficient electric devices, uses fossil fuels judiciously, etc.	CLO120:Makes an effort to conserve environment by **taking steps to promote sustainable management of resources in day-to-day life.**	C283: Takes steps to conserve the environment by taking steps to promote sustainable management of resources in day-to-day life.

10. Sample Pedagogical Processes and Assessment Strategies for Classroom Purposes

10.1 Class 9

Content Domain: Materials

Chapter 1: Matter in our Surroundings

Learning outcomes and indicators	*Pedagogical Processes*	*Assessment Strategies*
Differentiates the three states of matter – solid, liquid and gas. **Indicators:** Some indicators under the CLO are taken here. • Defines matter as solid, liquid and gas using their characteristics. • Differentiates between the three states of matter based on shape, intermolecular spaces, continuous movement of particles. • Emphasise the contrast between the three states of matter using specific examples. • Differentiates between plasma and Bose-Einstein Condensate.	• Explore ideas relating to States of Matter based on the daily experiences of students. **Questions for discussion and suggested activities:** *In what ways are materials different from each other?* *Is there a similarity in different materials?* *In how many ways can you group the different materials you see around?* *How do solids, liquids and gases differ from each other?* *Can materials exist in all the three states?* • Engage students to undertake activities to understand different characteristics of matter and ask them to note their observations followed by discussion. (e.g., feeling the texture of a piece of wood as opposed to water) • Demonstrate the properties of states of matter through activities with examples from daily life. (e.g., dissolving salt in water, lighting incense sticks, burning of camphor) • Emphasise the contrast between the solid and liquid state of matter. (e.g., demonstrate the dispersion of potassium permanganate crystals into water, their dissolution and formation of the pink coloured solution.)	• Prepare a comparison table of different states based on (shape, density volume, intermolecular force, compressibility, etc.). • Give reasons for certain observations, e. g. Naphthalene balls/ Iodine disappear with time without leaving any solid; We can get the smell of perfume sitting several meters away; Water at room temperature is a liquid, etc.

Learning outcomes and indicators	*Pedagogical Processes*	*Assessment Strategies*
	• Ask students to feel the texture, observe the colour and lustre, effect of air, water and heat, etc., on each of the materials (wood, salt, paper, ice, steel, water, etc.). Alternatively, related videos could be shown. **Projects to consider: -** • Ask the students to research more on the two new states of matter, namely plasma and Bose-Einstein Condensate and conduct a discussion in the class on the same.	
Describes the various processes bringing change in state of matter like evaporation, boiling, melting, sublimation, condensation. **Indicators:** • Distinguishes evaporation from boiling. • Describes the process of sublimation. • Explains the effect of temperature change on melting, freezing, evaporation, condensation and sublimation.	• Initiate a dialogue wherein the students share their experiences of evaporation, condensation, boiling and melting. **Questions for discussion and suggested activities:** *What are the examples of evaporation that you can think of? Can you see how liquids evaporate?* • Demonstrate activities that explain evaporation (e.g., a few drops of petrol/kerosene on a dish; two dishes, one with petrol and the other with water) • Discuss how evaporation happens only on the surface and that it's a natural phenomenon. *Are evaporation and boiling the same?* *Can you think of some examples?* • Demonstrate activities that explain boiling (e.g., experimental setup to show boiling point of water) • Discuss how boiling is a bulk phenomenon and every liquid has a specific boiling point. *Are these substances boiling?* *Have they reached the boiling point?* *Do substances reach their boiling point without being heated?* • Conduct activity to show that evaporation is a surface phenomenon, followed by questions. • Show video/activity and questions on sublimation. • Engage students (individually /in groups) to observe change of state; and record what is observed.	• Provide the image of an experimental setup of sublimation with camphor and explain the process taking place.

<table>
<tr><th>Learning outcomes and indicators</th><th>Pedagogical Processes</th><th>Assessment Strategies</th></tr>
<tr><td></td><td>• Observe the effect of heat on each of the resources. (Teacher to perform the experiment for camphor, ammonium chloride and naphthalene.)</td><td></td></tr>
<tr><td>Explains the effect of change of temperature and pressure on states of matter.</td><td>Questions for discussion and suggested activities:
What happens to a solid/liquid when heated?
Do the particles undergo any change?
Are the particles in motion?
• Demonstrate the effect of heat on ice/water taken in a beaker.
• Explain that particles change their kinetic energy and also overcome the forces of attraction between them.
How does the change in pressure effect the particles of a gaseous substance?
• Demonstrate the effect of pressure on a gas taken in a piston and cylinder.
How do change in pressure and temperature effect the state of a gaseous substance?
• Explain that increase in pressure and decrease of temperature leads to liquefaction of gases.</td><td>• Populate the following table to describe the changes that occur when pressure and temperature is varied.
<table><tr><td>On increasing pressure</td><td>On decreasing pressure</td></tr><tr><td></td><td></td></tr><tr><td>On increasing temperature</td><td>On decreasing temperature</td></tr><tr><td></td><td></td></tr></table></td></tr>
<tr><td>Applies the concept of evaporation seen in day-to- day life.
Indicators:
• Identifies the process of evaporation in day-to-day activities.
• Relates to processes like drying of clothes, cooling of surfaces to the process of evaporation.</td><td>Questions for discussion and suggested activities:
What kinds of clothes help us keep cool?
Why do wet clothes make us feel cool?
• Provide examples of evaporation as seen in everyday life. (water in an earthen pot gets cool due to evaporation; water cycle – here, the water bodies undergo evaporation which leads to cloud formation and subsequently, rain.)
• Demonstrate the process of evaporation by taking one/two drops of petrol on the palm of the hand. The palm feels cool.
• Discuss surface area and its influence on the rate of evaporation (Spreading of clothes; porosity of earthen pots)</td><td>• Identify the process of evaporation in the table/grid with different processes along with brief descriptions.
• Perform a group activity wherein students list out examples of evaporation and its application in daily life.</td></tr>
</table>

Learning outcomes and indicators	*Pedagogical Processes*	*Assessment Strategies*
CLO5: Measures the melting point and boiling point of a substance using a thermometer. **Indicators:** • Explains the meaning of melting and boiling point. • Explains the use of apparatus like a thermometer for measuring the boiling points of substances. • Measures the boiling point using a thermometer.	**Questions for discussion and suggested activities:** What do you understand by the boiling point of a liquid? What kind of apparatus is needed to find the boiling point of a liquid? How do you know that a liquid has attained its boiling point? • Explain the term atmospheric pressure. • Demonstrate the setup for the measuring the boiling point of water. • Explain the use of the thermometer and the appropriate way to use it. • Demonstrate the correct way to read a thermometer minimising parallax error. • Students to work in groups to find the boiling point of a liquid.	• Record and present data on boiling points and its variation in the boiling points (samples of water, salt solution, sugar solution could be given). • Share analysis and inference of the variation in boiling points under similar conditions (Teacher to moderate and provide inputs – collates the data from the groups and discusses the variation in boiling points in terms of error, composition of solution, source of water and STP/environmental conditions.). • Explain common errors and ways to rectify the same in the groups.

10.2 Class X

Content Domain: Materials

Chapter 2 – Acids, Bases and Salts

Learning outcomes and indicators	*Pedagogical Processes*	*Assessment Strategies*
Categorises compounds as acids and bases based on their chemical reactions. **Indicators:** • Classifies compounds as bases or acids based on their reactions with – litmus solution, zinc metal and solid sodium carbonate. • Categorises indicators as natural and synthetic type.	• Begin the class by asking the students to mention a few acids, bases and salts, which they come across in their day-to-day life. • Conduct a quiz by asking questions regarding: Acids and their properties, acids found in natural substances, bases and their properties, litmus neutralisation, examples of neutralisation in everyday life. **Questions for discussion and suggested activities:** *Why are some substances sour in taste (lemon) and some bitter in taste (bitter gourd)?* *Why does soap solution feel slippery?* *Why does seawater taste salty?* • Help students in conducting experiments to identify properties of acids, bases and salts. Facilitate students to identify the common properties of acids and bases.	• State reasons for a given phenomenon (e. g. Tap water conducts electricity whereas distilled water does not, dry HCl gas does not turn blue litmus red whereas dilute HCl does, etc.). • Explain the colour change seen in indicators when they react with solutions of varied acidic and basic nature.

Learning outcomes and indicators	*Pedagogical Processes*	*Assessment Strategies*
	• Explain how a universal indicator can be used to measure the strength of given acid or base. • Teacher to emphasise the reason behind the colour change in indicators. • Help students to conduct experiments for testing different substances (orange juice, lemon juice, soap solution, litmus solution, zinc, copper, aluminium, hydrochloric acid, sulphuric acid, nitric acid, sodium hydroxide, common salt) with indicators. • Group activity prepare natural indicators with turmeric paper, red cabbage, hibiscus and compare the result with commercially available indicators like universal indicator, litmus paper • Explain the reactions of acids with metals, metal carbonates, metal hydrogen carbonates and metal oxides and reactions of bases with metals and non-metallic oxides. • Conduct experiments using various reactions of bases with metals and non-metallic oxides. • Conduct experiments using various acid-base indicators to check if the given sample is an acid or a base.	
Explains the methods of preparing salts that contain water of crystallisation. **Indicators:** • Describes the preparation of bleaching powder, baking soda and washing soda. • Explains the preparation of salts like copper sulphate. • Outlines that some salts like copper sulphate have water of crystallisation.	• Recall the formation of salts in daily life (e.g., salt coating in vessels used for boiling water, geyser coils). • Formation of salts in the lab through reactions like neutralisation and precipitation. **Questions for discussion and suggested activities:** *How can salts be prepared?* *What is the condition needed for the formation of insoluble salts?* • Demonstrate the formation of salts followed by the explanation of their formation (e.g., baking soda, washing soda, copper sulphate) • Explain the meaning of 'water of crystallisation'. • Demonstrate the effect of heat on a salt-like copper sulphate. The colour changes from blue to grey/white. The water of crystallisation is lost, giving rise to anhydrous copper sulphate.	• State chemical properties for a particular use of salts (e. g. antacid, fire extinguisher, bread, etc.).

Learning outcomes and indicators	*Pedagogical Processes*	*Assessment Strategies*
Plans investigation to find pH value of given solution; to verify the acidic/ basic nature of solutions using the pH scale. **Indicators:** • Conducts experiments using pH paper/universal indicator to find the pH of solutions like dilute hydrochloric acid, dilute sodium hydroxide solution, dilute ethanoic acid solution, Lemon juice, water and dilute hydrogen carbonate solution. • Verifies the acidic/basic nature of solutions using the pH scale. • Recognises the importance of pH in biosphere by citing examples of pH of human body, blood, acid rain, plant growth etc.	**Questions for discussion and suggested activities:** *What is meant by the pH of a solution?* *What is its significance in our daily life?* • Explain that pH has an important role to play in choosing potable water, the kind of food, fruits and vegetables that are eaten. *How does the change in intensity of the colour is related to the pH scale?* *What is meant by pH paper/indicator?* *How does pH paper change colour with acids and bases?* *Do you think different acids like dilute hydrochloric acid and ethanoic acid would show the same pH? If no, think of a reason for this.* *What could be the pH of salts? What does the pH of a salt indicate about its nature?* • Demonstrate the pH of different solutions to categorise them as acids or bases. (dilute hydrochloric acid, dilute sodium hydroxide solution, dilute ethanoic acid solution) • Discuss the influence of pH in choosing the type of soil for plant growth. Also, the kind of fertiliser that can be used once the type of soil is identified.	• Provide for various solutions, including fruit and vegetable juices, and measure the pH of each. Predict the items which are suitable for human consumption with appropriate reasons.

11. Question Paper Design

Class X

Content domain	*Marks distribution*
Materials	25
World of living	23
Natural Phenomena	12
How things work	13
Natural Resources	7
Total	**80**

Item types	*Item category*	*Number of questions*	*Marks distribution*
Select response question	MCQ (Single correct answer)	5	5
	MCQ (Multiple correct answers)	5	5
	Assertion/ Reasoning	5	5
Constructed response question	Short answer	10	20
	Long answer	7	35
		34	**80**

Cognitive process	*Assessment objective*	*Thinking process*	*Marks distribution*
Knowing	Demonstrate knowledge and understanding of scientific ideas, techniques, and procedures.	• Recall/ recognise • Describe • Provide examples	20
Applying	Apply knowledge and understanding of scientific ideas, techniques and procedures to classroom and real-world situations.	• Compare/ Contrast/ Classify • Relate • Use Models • Interpret Information • Explain	30
Reasoning	Analyse and evaluate scientific information and ideas to interpret patterns and relationships and make judgements to draw conclusions.	• Analyse • Synthesise • Formulate Questions/ Hypothesise/ Predict • Design investigations • Draw conclusions • Generalise	30
Total			80

12. Sample Assessment Items and Marking Scheme

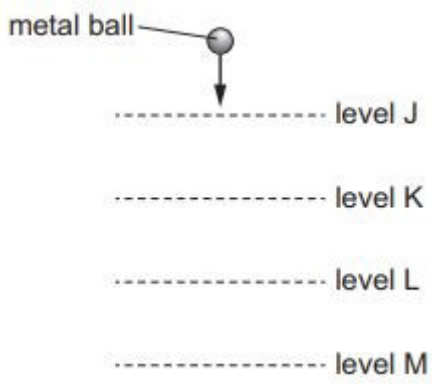
12.1 Class IX

1. Multiple Choice Question (MCQ) - with single correct answer

Content Domain (Chapter name)	Materials (Is Matter Pure?)	
Content Domain Learning outcome	Describes different methods of separation to get individual components from a mixture.	
Indicator	Explains the separation of sand and water using filtration.	
Cognitive level	Applying	
Thinking Process	Relate	
Difficulty level	Low	
Marks	1	
Time	1 min	
Item Stem	A sea salt is a mixture of sand and sodium chloride. Sand is insoluble in water and hexane. Sodium chloride is soluble in water but not in hexane. What is needed to separate sand from sodium chloride? 1. Filter paper 2. Fractionating Column 3. Hexane 4. Water	
Correct answer	1 and 4	As water is the only solvent that will dissolve sodium chloride.
Distractor 1	2 and 3	Fractionating column is not needed to separate this kind of mixture. This apparatus is used to separating miscible liquid mixtures.
Distractor 2	1 and 3	Hexane is not a solvent for either sand or sodium chloride. The student does not understand the importance of the solvent for separating the mixture.
Distractor 3	2 and 4	Fractionating column is not needed to separate this kind of mixture. This apparatus is used to separating miscible liquid mixtures.

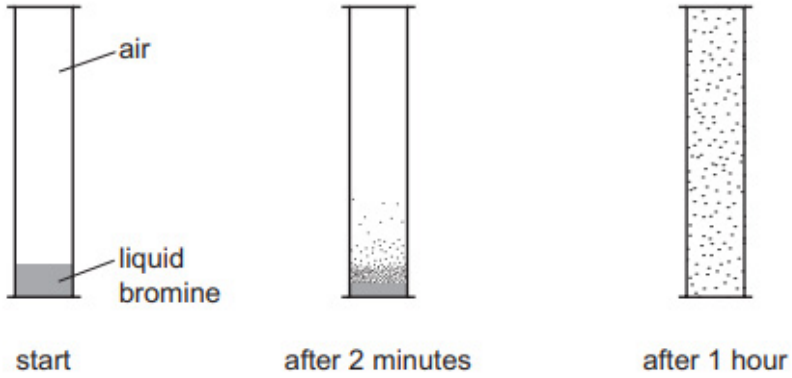
<table>
<tr><td>Content Domain (Chapter name)</td><td colspan="4">The World of Living (Why do we fall ill?)</td></tr>
<tr><td>Content Domain Learning outcome</td><td colspan="4">Classifies and categorises diseases based on the causal organism.</td></tr>
<tr><td>Indicator</td><td colspan="4">Classifies and categorises the diseases based on their causal organism as bacterial/fungal/viral/protozoan diseases.</td></tr>
<tr><td>Cognitive level</td><td colspan="4">Applying</td></tr>
<tr><td>Thinking Process</td><td colspan="4">Classify</td></tr>
<tr><td>Difficulty level</td><td colspan="4">Low</td></tr>
<tr><td>Marks</td><td colspan="4">1</td></tr>
<tr><td>Time</td><td colspan="4">1min</td></tr>
<tr><td>Item Stem</td><td colspan="4">Which row correctly matches the diseases to categories of causative organisms?
<table><tr><td></td><td>Influenza</td><td>Anthrax</td><td>Kala – azar</td></tr><tr><td>A</td><td>Protozoa</td><td>Virus</td><td>Bacteria</td></tr><tr><td>B</td><td>Virus</td><td>Bacteria</td><td>Protozoa</td></tr><tr><td>C</td><td>Virus</td><td>Protozoa</td><td>Bacteria</td></tr><tr><td>D</td><td>Bacteria</td><td>Protozoa</td><td>Virus</td></tr></table></td></tr>
<tr><td>Correct answer</td><td>B</td><td colspan="3">Correctly matches the diseases to their causative organism. Student can relate with disease and category of causative organism.</td></tr>
<tr><td>Distractor 1</td><td>A</td><td colspan="3">Assumes this as a right row. Not able to relate with disease and category of causative organism</td></tr>
<tr><td>Distractor 2</td><td>C</td><td colspan="3">Assumes this as a right row. Not able to relate with disease and category of causative organism</td></tr>
<tr><td>Distractor 3</td><td>D</td><td colspan="3">Assumes this as a right row. Not able to relate with disease and category of causative organism.</td></tr>
</table>

Content Domain (Chapter name)	**Gravitation**
Content Domain Learning outcome	Explains the laws of gravitation, buoyancy, force of gravity, relative density.
Indicator	Explains the process of freefall.
Cognitive level	Apply
Thinking Process	Explain
Difficulty level	Low

Marks	1		
Time	1min		
Item Stem	A heavy metal ball falls vertically downwards through air past four equally spaced levels J, K, L and M.  The times taken to fall from one level to the next are measured. Where is the speed of the ball greatest and which time is shortest? (© UCLES)		
	Speed is greatest between	Time is shortest between	
Correct answer	L and M	L and M	Demonstrates that objects accelerate as they fall and hence need less time.
Distractor 1	J and K	J and K	Assumes uniform motion for falling objects throughout.
Distractor 2	J and K	L and M	Assumes uniform motion and later an accelerated fall.
Distractor 3	L and M	J and K	Assumes free fall but more time at higher levels.

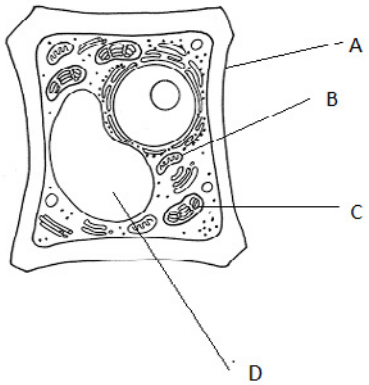
2. Constructed Response Questions

<table>
<tr><td>Content domain (Chapter name)</td><td colspan="3">Materials (Structure of the Atom)</td></tr>
<tr><td>Content Domain Learning outcome</td><td colspan="3">Uses the number of neutrons, protons and electrons to write symbol of an element.</td></tr>
<tr><td>Indicator</td><td colspan="3">Uses the understanding of atomic mass and atomic number to write the symbol of an element.</td></tr>
<tr><td>Cognitive level</td><td colspan="3">Applying</td></tr>
<tr><td>Thinking Process</td><td colspan="3">Interpret information</td></tr>
<tr><td>Difficulty level</td><td colspan="3">Medium</td></tr>
<tr><td>Marks</td><td colspan="3">3</td></tr>
<tr><td>Time</td><td colspan="3">3 mins</td></tr>
<tr><td>Item stem</td><td colspan="3">Complete the table to identify the atoms or ions which have the following number of protons, neutrons and electrons. You could use any alphabet to represent the element.
<table>
<tr><th></th><th>Number of protons</th><th>Number of neutrons</th><th>Number of electrons</th></tr>
<tr><td>$^{23}Na_{11}+$</td><td>11</td><td>12</td><td>10</td></tr>
<tr><td></td><td>5</td><td>6</td><td>5</td></tr>
<tr><td></td><td>17</td><td>20</td><td>18</td></tr>
</table></td></tr>
<tr><td colspan="4">Marking Scheme</td></tr>
<tr><td>Part</td><td>Mark</td><td>Answer</td><td>Further Information</td></tr>
<tr><td></td><td>½</td><td>For calculating mass number as 11</td><td></td></tr>
<tr><td></td><td>½</td><td>$^{11}\mathbf{X}_{5}$</td><td>For writing numbers 11 and 5 at the appropriate places. The student could use any other alphabet to represent the element.</td></tr>
<tr><td></td><td>½</td><td>For calculating mass number as 37</td><td></td></tr>
<tr><td></td><td>½</td><td>$^{37}\mathbf{Y}_{17}^{-}$</td><td>For writing 37 and 17 at the appropriate places. The student could use any other alphabet to represent the element.</td></tr>
<tr><td></td><td>1</td><td>For including the negative sign in the symbol of the ion, $^{37}\mathbf{Y}_{17}^{-}$</td><td></td></tr>
</table>

Content domain (Chapter name)	Materials (Matter in our surroundings)
Content Domain Learning outcome	Describes the various processes bringing change in state of matter like evaporation, boiling, melting, sublimation, condensation.
Indicator	Describes the process of sublimation and evaporation.
Cognitive level	Applying
Thinking Process	Interpret information
Difficulty level	Low
Marks	2
Time	2 mins
Item stem	A small amount of liquid bromine is placed at the bottom of a sealed gas jar of air. After two minutes red-brown fumes were seen just above the liquid surface. After one hour the red-brown colour had spread completely throughout the gas jar.  1. What is the process that liquid bromine is undergoing? 2. How can you explain the state of bromine in the third jar (after 1 hour)

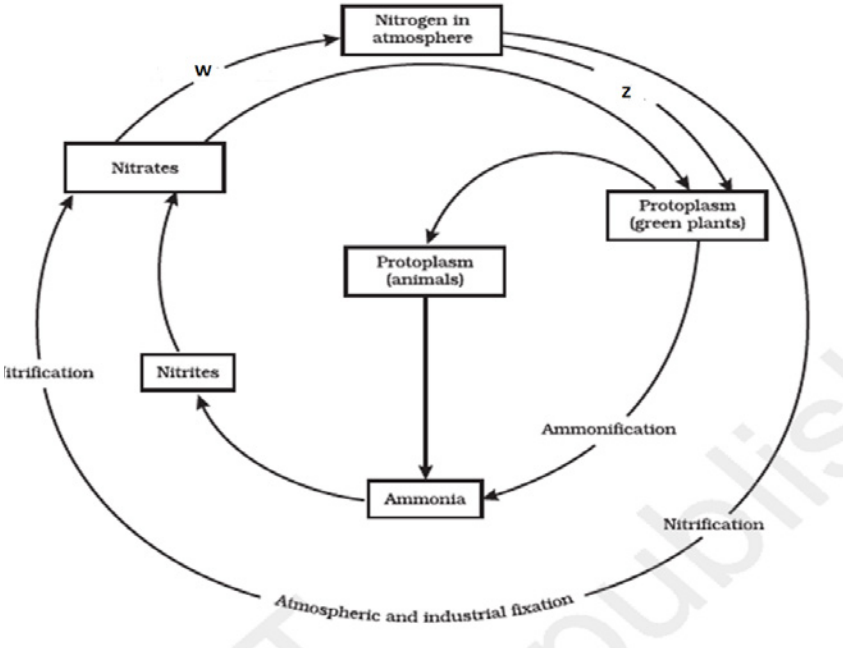
Marking Scheme

Part	***Mark***	***Answer***	***Further Information***
1	1	Evaporation	Liquid bromine is moving into the gaseous/vapour state – ½ mark.
2	1	Gaseous State	The particles are in a state of constant movement – ½ mark

Content domain (Chapter name)	World of Living (The Fundamental unit of Life)
Content Domain Learning outcome	Differentiates organisms based on their characteristics such as unicellular and multicellular, prokaryote and eukaryote, plant and animal cells.
Indicator	Differentiates between the processes of osmosis and diffusion with relevant examples and situations. Describes the differences between prokaryotic and eukaryotic cells and organisms. Identifies major cell organelles such as nucleus, mitochondria, vacuoles, chloroplast cell membrane and cell wall etc. from *diagrams* and temporary mounts/permanent slides.
Cognitive level	Applying
Thinking Process	Interpret information, Explain
Difficulty level	Medium
Marks	5
Time	6 min
Item stem	Below is a diagram of a plant cell:  *Image Source -* ***https://cpb-us-e1.wpmucdn.com/cobblearning.net/dist/2/1402/files/2016/11/PlantCellColorPageWorksheetandQuizCe-1c88ibr.pdf*** a. Identify and name the parts labelled A, B, C and D. b. Explain cell behaviour when placed in hyper-hypotonic solutions. c. State the name of one structure that is present in bacterial and plant cells but not in animal cell.

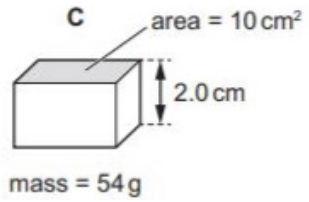
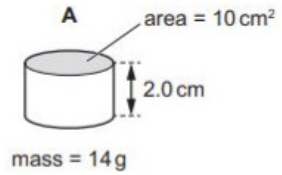
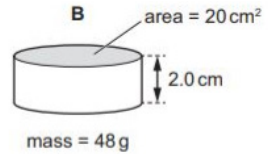
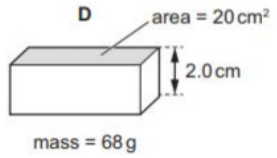
Marking Scheme			
Part	***Mark***	***Answer***	***Further Information***
a.	½+½+½+½	A – Cell Wall B – Mitochondria C – Chloroplast D – Vacuole	
b.	1+1	Cell when placed in: Hypotonic Solution – If the medium surrounding the cell has a higher water concentration than the cell, meaning that the outside solution is very dilute, the cell will gain water by osmosis. It will swell based on net movement on both sides. Hypertonic solution – If the medium surrounding the cell has a lower water concentration than the cell, meaning that the outside solution is very concentrated, the cell will lose water by osmosis. It will shrink based on net movement on both sides.	Similar explanations shall be accepted in written form. Sequential labelled diagrams explaining same shall be accepted.
c.	1	Cell Wall	

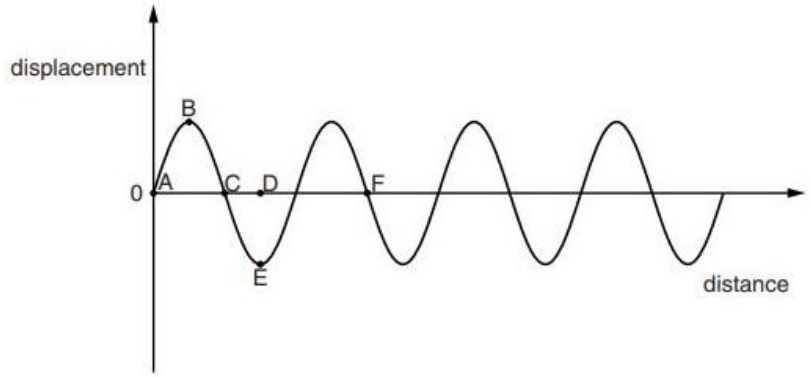
Content domain (Chapter name)	Natural Resources (Natural resources)
Content Domain Learning outcome	Explain the processes/phenomenon/interdependence involved across biogeochemical cycles in nature: Water, Oxygen, Carbon and Nitrogen
Indicator	Explain the processes/phenomenon/interdependence involved in biogeochemical cycles of nature: Water, Oxygen, Carbon and Nitrogen.
Cognitive level	Applying
Thinking Process	Interpret information, Explain
Difficulty level	Medium
Marks	3
Time	4 min

Item stem	The following diagram shows nitrogen cycle in nature: *Image source: NCERT Textbook (Class IX)*  a. Identify and name the processes taking place at positions 'W' and 'Z' in above diagram. b. Explain the physical process related to conversion of elemental nitrogen into usable forms in nature.

Marking Scheme

Part	***Mark***	***Answer***	***Further Information***
a.	½+½	W – Denitrification Z – Nitrogen Fixation	
b.	1 +1	Physical process: Part 1: During lightning, the high temperatures and pressures created in the air convert nitrogen into oxides of nitrogen. Part II: These oxides dissolve in water to give nitric and nitrous acids and fall on land along with rain. Where these are then utilised by various life forms.	Accept similar kind of explanations. 1 Mark for each part Mention of nitric and nitrous acids should be there. Deduct ½ each if these are not mentioned.

Content Domain (Chapter name)	**Gravitation**	
Content Domain Learning outcome	Calculates weight, pressure, acceleration due to gravity, relative density.	
Indicator	Calculates the unknown variable (weight, pressure, acceleration due to gravity, relative density) from a given data and assign proper SI unit to it.	
Cognitive level	Apply	
Thinking Process	Calculate	
Difficulty level	Medium	
Marks	1	
Time	3min	
Item Stem	The diagrams show four solid blocks with their dimensions and masses. Which block has the greatest density? (© UCLES)	
Correct answer		Verifies the options, first by calculating the volume from the given data and then uses the formula 'density = mass/volume' to calculate the density.
Distractor 1		Without calculating, assumes 'Less is the mass; more is the density.'
Distractor 2		Without calculating, assumes 'More is the area; more is the density'
Distractor 3		Without calculating, assumes 'More is the mass; more is the density always.'

Content domain (Chapter name)	Sound
Content Domain Learning outcome	Differentiates between pitch, loudness and intensity, ultrasonics and infrasonics, reflection of sound vs reflection of light.
Indicator	Differentiates between pitch, loudness and intensity through practical demonstration and wave graphs.
Cognitive level	Apply
Thinking Process	Explain
Difficulty level	Medium
Marks	3
Time	3min
Item stem	A folk singer has begun a musical concert. A segment of the sound wave from the concert is represented in the following graph.  (i) when she sings at a lower pitch, what will happen to the distance between points A and C? (ii) when she sang at a higher volume, how will the points B and E change? What happens to the new wavelength?

Marking Scheme			
Part	***Mark***	***Answer***	***Further Information***
(i)	1	A and C are closer.	Accept, 1. A and C are closer as the frequency increases. OR 2. A and C are closer as the time period decreases. Do not accept, A and C are farther
(ii)	1 1	B goes higher and E goes lower. Wavelength doesn't change.	Accept, amplitude increases. Do not accept 'B goes lower, and E goes higher' or 'B and E go lower' or 'B and E go higher' Do not accept if the learner writes wavelength is increases or decreases.

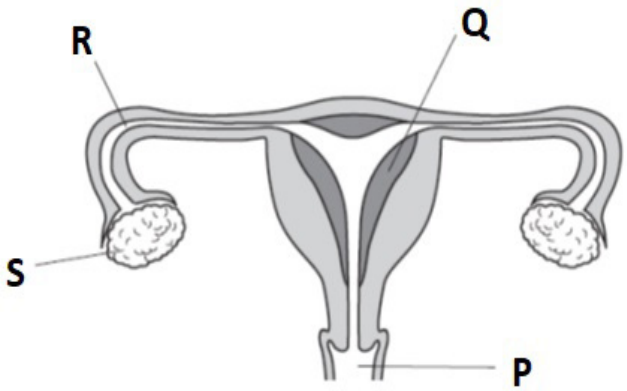
Content domain (Chapter name)	Sound		
Content Domain Learning outcome	Plans and conducts investigations/ experiments to arrive at and verify the process of sound production and propagation, echo production, reflection of sound.		
Indicator	Verifies the difference in sound propagation across different mediums (air, water, solid) through experiment.		
Cognitive level	Reasoning		
Thinking Process	Design investigations		
Difficulty level	Medium		
Marks	4		
Time	5min		
Item stem	There are hardly any public places where we are not surrounded by sound waves. Can you devise a method to determine the speed of sound in air?		
Marking Scheme			
Part	***Mark***	***Answer***	***Further Information***
	4	- Means of producing sharp sound - Use of suitable reflecting surface - Measure total distance travelled by sound - Time taken for sound to travel the measure distance - Use speed = distance/time	Award 4 for any four from the list, award 3 for any three, award 2 for any two, award 1 for speed = distance/time.

12.2 Class X

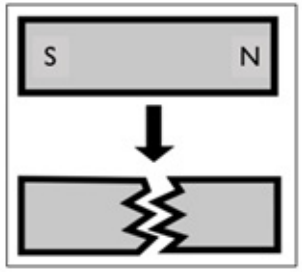
1. **Multiple Choice Questions (MCQ)**

Content Domain (Chapter name)	Materials (Chemical Reactions and Chemical Equations)	
Content Domain Learning outcome	Differentiates the types of chemical reactions.	
Indicator	Separates oxidation from reduction in terms of loss and gain of oxygen.	
Cognitive level	Applying	
Thinking Process	Classify	
Difficulty level	Low	
Marks	1	
Time	1min	
Item Stem	Which of the following equations shows an oxidation reaction?	
Correct answer	A. $C + O_2 \rightarrow CO_2$	Carbon is being oxidised to carbon dioxide.
Distractor 1	B. $CaCO_3 \rightarrow CaO + CO_2$	This is a decomposition reaction.
Distractor 2	C. $CaO + 2HCl \rightarrow CaCl_2 + H_2O$	This is a reaction between a basic oxide and an acid.
Distractor 3	D. $N_2O_4 \rightarrow 2NO_2$	The student may take it as oxidation-reduction reaction.

Content Domain (Chapter name)	World of Living (How do Organisms Reproduce)
Content Domain Learning outcome	Explains processes and phenomena related to reproduction in plants and animals.
Indicator	Elaborates on process of fertilisation, pregnancy and birth in humans.
Cognitive level	Applying
Thinking Process	Interpret information
Difficulty level	Medium
Marks	1

<table>
<tr><td>Time</td><td colspan="2">1 min</td></tr>
<tr><td>Item Stem</td><td colspan="2">The diagram shows the female reproductive system.
 

Which row depicts the correct sites of egg fertilisation and zygote implantation in normal conditions?
<table>
<tr><td></td><td>Egg Fertilisation</td><td>Zygote Implantation</td></tr>
<tr><td>A</td><td>P</td><td>S</td></tr>
<tr><td>B</td><td>Q</td><td>R</td></tr>
<tr><td>C</td><td>S</td><td>Q</td></tr>
<tr><td>D</td><td>R</td><td>Q</td></tr>
</table></td></tr>
<tr><td>Correct answer</td><td>D</td><td>Sperm fertilises the egg in oviduct/ fallopian tube (R). Zygote gets down and implants on to uterine wall (Q). Student understands the process of fertilisation in conjunction with female reproductive system.</td></tr>
<tr><td>Distractor 1</td><td>A</td><td>Assumes this as correct row. As “P” is the entry point for sperm, students may treat it as a site of egg fertilisation, neglecting upward movement of sperm – “S” can be deduced seeing there is no other distractor with “P” as the site of fertilisation.</td></tr>
<tr><td>Distractor 2</td><td>B</td><td>Assumes this as correct row. As “Q” is not far from entry point of sperm - So this can be taken as the site of fertilisation. They can go ahead with “R” as implantation site.</td></tr>
<tr><td>Distractor 3</td><td>C</td><td>Assumes this as correct row. As “S” is where the eggs are stored, neglecting its release in the fallopian tube - so it can be taken as a site of fertilisation. They can go ahead with “Q” as implantation site or some might be aware of this.</td></tr>
</table>

Content Domain (Chapter name)	Magnetic Effect of Electric Current	
Content Domain Learning outcome	Relates processes and phenomena with causes/effects such as deflection of compass needle due to magnetic effect of electric current.	
Indicator	Relates processes and phenomena with causes/effects of how polarity changes when a magnet is broken midway.	
Cognitive level	Knowing	
Thinking Process	Recall	
Difficulty level	Low	
Marks	1	
Time	1min	
Item Stem	A bar magnet is broken into two parts as shown in the given figure -  Which of the following option shows the right polarity of two ends of the broken pieces of the magnet?	
Correct answer	 	Original edges will retain their polarity and the new broken edges will have opposite polarities.
Distractor 1	 	Learner assumes that original edges will have their polarity reversed and the new broken edges will have opposite polarities.
Distractor 2	 	Wrong polarity
Distractor 3	 	Wrong polarity

2. Constructed Response Questions

<table>
<tr><td>Content domain (Chapter name)</td><td colspan="4">Materials (Metals and Non-Metals)</td></tr>
<tr><td>Content Domain Learning outcome</td><td colspan="4">Explains the properties of metals and non-metals; reaction of metals with salt solutions; reactivity of metals; extraction of metals from their ores.</td></tr>
<tr><td>Indicator</td><td colspan="4">Explains the properties of metals and non-metals and relates this to their atomic structure and bonding.</td></tr>
<tr><td>Cognitive level</td><td colspan="4">Apply</td></tr>
<tr><td>Thinking Process</td><td colspan="4">Interpret</td></tr>
<tr><td>Difficulty level</td><td colspan="4">Medium</td></tr>
<tr><td>Marks</td><td colspan="4">2</td></tr>
<tr><td>Time</td><td colspan="4">3 mins</td></tr>
<tr><td>Item stem</td><td colspan="4">Read the information given in the table carefully and answer the questions: -

<table>
<tr><th>substance</th><th>boiling point</th><th>electrical conductivity of solid</th><th>electrical conductivity when molten</th><th>density in g / cm^3</th></tr>
<tr><td>aluminium</td><td>high</td><td>conducts</td><td>conducts</td><td>2.70</td></tr>
<tr><td>diamond</td><td></td><td></td><td></td><td>3.51</td></tr>
<tr><td>potassium bromide</td><td>high</td><td>does not conduct</td><td>conducts</td><td>2.75</td></tr>
<tr><td>sulfur</td><td>low</td><td>does not conduct</td><td></td><td>2.07</td></tr>
</table>

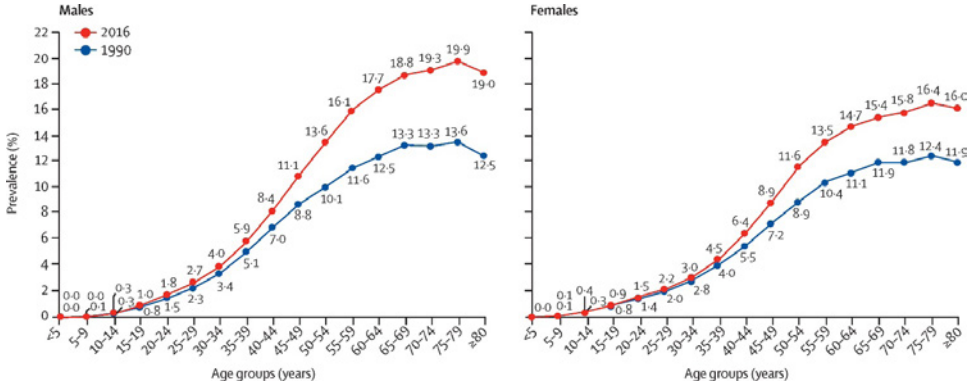
1. Fill in the table to show the electrical conductivity of diamond and molten sulphur.
2. Which information in the table shows that potassium bromide is an ionic compound?
3. State one piece of evidence from the table for the molecular nature of sulphur.</td></tr>
<tr><td colspan="5">Marking Scheme</td></tr>
<tr><td>Part</td><td>Mark</td><td colspan="2">Answer</td><td>Further Information</td></tr>
<tr><td>1</td><td>½ + ½</td><td colspan="2">Diamond does not conduct electricity.
Sulphur does not conduct electricity</td><td></td></tr>
<tr><td>2</td><td>½</td><td colspan="2">High boiling point</td><td></td></tr>
<tr><td>3</td><td>½</td><td colspan="2">Low boiling point</td><td></td></tr>
</table>

Content domain (Chapter name)	Materials (Carbon and its compounds)
Content Domain Learning outcome	Classifies carbon compounds based on certain properties.
Indicator	Classifies saturated/unsaturated carbon compounds as alkanes, alkenes, alkynes, alcohols, carboxylic acids, ketones and aldehydes.
Cognitive level	Apply
Thinking Process	Classify
Difficulty level	Low
Marks	2
Time	2 mins
Item stem	The following two hydrocarbons form a part of a homologous series and are isomers of each other: - CH_3 — CH_2 — CH_2 — CH_2 — OH and $(CH_3)_2CH$ — CH_2 — OH 1. Name the homologous series that they belong to. 2. Give one reason for classifying them as isomers.

Marking Scheme

Part	***Mark***	***Answer***	***Further Information***
1.	1	Alcohols	
2.	1	Same molecular formula	

Content domain (Chapter name)	World of Living (Control and coordination in Animals)
Content Domain Learning outcome	Analyses and interprets data/graphs/ figures relating to prevalence of diseases resulting from failure of control and coordination mechanisms.
Indicator	Analyses and interprets data/ graphs (district/state/national) relating to prevalence of diseases due to hormonal imbalances and failure of similar mechanisms. (Diabetes, Goitre, Gigantism, dwarfism etc.)
Cognitive level	Applying
Thinking Process	Interpret information, Explain
Difficulty level	Medium

Marks	3
Time	5 min
Item stem	The below graphs shows age specific prevalence of diabetes in males for year 1990 and 2016 :  *Image Source: https://www.thelancet.com/journals/langlo/article/PIIS2214-109X(18)30387-5/fulltext#seccestitle10* a. Which age range shows highest prevalence percentage of diabetes for year 2016? b. What is the increase in prevalence percentage for age group 25-29 from year 1990 to 2016? c. Explain the requirement of artificial insulin by diabetic patients?

Marking Scheme

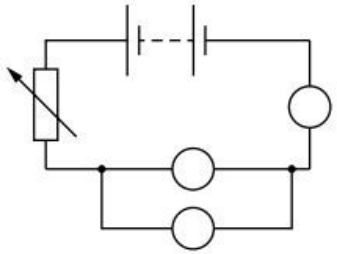
Part	***Mark***	***Answer***	***Further Information***
a.	1	For 2016 Age group: **75-79**	
b.	1	Increase in prevalence percentage from 1990 to 2016 for age range 25-29: **0.4%**	
c.	1	Insulin hormone is produced in pancreas and helps in regulating blood sugar levels in the body. If it is not secreted in proper amount the sugar level in blood rises causing harmful effects. Therefore, in case of malfunctioning of hormone release mechanism artificial insulin is injected to control the sugar levels.	Similar explanations shall be accepted.

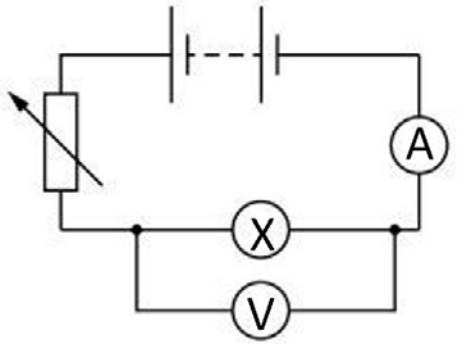
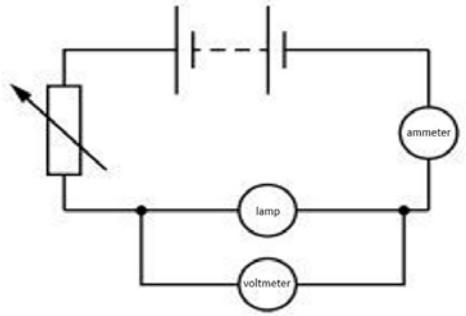
3. Constructed Response Questions - Biology

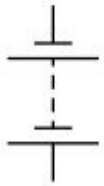
<table>
<tr><td>Content domain (Chapter name)</td><td>Natural resources (Our Environment)</td></tr>
<tr><td>Content Domain Learning outcome</td><td>Explains processes and phenomena related to conservation of larger environment.
Calculates the amount of energy available in various trophic levels in a food chain with given data.
Applies learning of interdependence of organism and environmental factors to predict consequences in a situation.</td></tr>
<tr><td>Indicator</td><td>Explain food chains and web in terms of interdependence and trophic levels.
Calculates the amount of energy available in various trophic levels in a food chain with given data.
Applies learning of interdependence of organisms and environmental factors to predict consequences in a situation. (e.g., Effect of removal and addition of trophic level in an ecosystem etc.)</td></tr>
<tr><td>Cognitive level</td><td>Apply, Reasoning</td></tr>
<tr><td>Thinking Process</td><td>Interpret information, Draw Conclusions, Perform calculations</td></tr>
<tr><td>Difficulty level</td><td>Medium</td></tr>
<tr><td>Marks</td><td>5</td></tr>
<tr><td>Time</td><td>6 min</td></tr>
<tr><td>Item stem</td><td>Given below is a food chain:
 

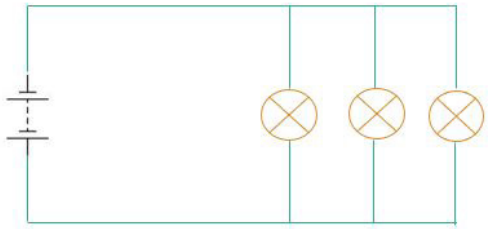
a. Please draw the below table and tick () the appropriate boxes to show the terms that can be used to describe listed organisms in table.
<table>
<tr><td>Organism</td><td>Producer</td><td>Herbivore</td><td>Secondary Consumer</td><td>Tertiary consumer</td></tr>
<tr><td>Frog</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Grasshopper</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Maize plant</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Snake</td><td></td><td></td><td></td><td></td></tr>
</table>
b. If the amount of energy available to snake is 8kJ, what would be the energy available to the producer?
c. What will be two major consequences of dramatic decline in population of frogs?</td></tr>
</table>

<table>
<tr><td colspan="4">Marking Scheme</td></tr>
<tr><td>Part</td><td>Mark</td><td>Answer</td><td>Further Information</td></tr>
<tr><td>a.</td><td>½ + ½ +½ + ½</td><td>
<table>
<tr><td>Organism</td><td>Producer</td><td>Herbivore</td><td>Secondary Consumer</td><td>Tertiary consumer</td></tr>
<tr><td>Frog</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Grasshopper</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Maize plant</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Snake</td><td></td><td></td><td></td><td></td></tr>
</table>
</td><td>½ for each correct column</td></tr>
<tr><td>b.</td><td>½ +½ +½ +½</td><td>Part1: Energy available to snake is 8 KJ = 10% of 80 KJ
Part 2: Energy available to frog is 80 KJ = 10% of 800 KJ
Part3: Energy available to grasshopper is 800KJ= 10% of 8000 KJ
Part 4: Hence, Energy available at producer (Maize plant) = 8000KJ</td><td>½ for each part</td></tr>
<tr><td>c.</td><td>½ +½</td><td>Part 1. Decreasing frog population will trigger rise in population of grasshoppers. Grasshoppers will damage and bring down maize (producer) population affecting variety of food chains and webs.
Part 2. Snake population will also go down having implications on eagle population. Feeding patterns across trophic levels may also change dramatically.</td><td>If part 1 & 2 are majorly covered with similar kind of explanation, it should be accepted.
½ mark for each part.</td></tr>
</table>

Content domain (Chapter name)	Electricity
Content Domain Learning outcome	Explains the process of electric conduction, working of electric motor, electric circuit, Ohm's law.
Indicator	Explains how an electric circuit functions, both in text and through a diagram.
Cognitive level	Apply
Thinking Process	Interpret
Difficulty level	Medium
Marks	4
Time	3min
Item stem	A student changes the current in a filament lamp. She measures the current and the potential difference (p.d.) across the lamp. Her circuit diagram given below is unlabeled.  i. Label it with proper circuit symbols. ii. After many hours of use, the filament wire in a lamp becomes thinner. State the effect, if any, on the resistance of the lamp.(© UCLES)

Marking Scheme			
Part	***Mark***	***Answer***	***Further Information***
(i)	1	ammeter with correct symbol in series with lamp	-(A)-
	1	voltmeter with correct symbol in parallel with lamp	-(V)-
	1	lamp correct symbol	 also accept, 
(ii)	1	(resistance) increases	

Content domain (Chapter name)	Electricity
Content Domain Learning outcome	Explains the process of electric conduction., working of electric motor, electric circuit, Ohm's law.
Indicator	Explains how an electric circuit functions, both in text and through a diagram.
Cognitive level	Apply
Thinking Process	Explain
Difficulty level	Low
Marks	3
Time	3min
Item stem	Here is an incomplete electric circuit drawn.  i. Complete the above circuit to show a battery connected to three lamps arranged in parallel. ii. Describe two advantages of connecting these lamps in parallel with the battery. (© UCLES)

Marking Scheme			
Part	***Mark***	***Answer***	***Further Information***
(i)	1	3 lamp symbols drawn (lamps connected) in parallel with battery. 	
(ii)	2 full	• lamps all have full voltage (across them) • if one (lamp) breaks, others continue to operate/ little/ no effect on others • lamps can be switched on and off independently	Any two from the list will fetch 2 marks. Any one from the list will fetch 1 mark.

13. Reference Documents

1. *NCERT (2005). National Curriculum Framework, New Delhi.*
2. *NCERT (2006). National Focus Group, Position Paper on Teaching of Science, New Delhi*
3. *NCERT (2006). National Focus Group, Position Paper on Aims of Education, New Delhi*
4. *NCERT Science Textbook. http://ncert.nic.in/textbook/textbook.htm*
5. *PISA 2018 Science Framework.*
6. *TIMSS 2019 Science Framework.*
7. *CBSE assessment framework for Science, Math and English of classes VI-X (pp.11-64). (2021). British Council.*
8. *Azim Premji University (2018). Learning outcomes-Secondary stage.*
9. *National Academies Press (2000). How people learn: Brain, mind, experience, and school.*

Learning Framework - Science

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