Draft

विद्ययाऽमृतमश्नुते

एन सी ई आर टी
NCERT

Syllabus

Secondary Stage (Phase I)
Grade 9
Part 2–Science, Mathematics, and Social Science

Based on National Curriculum Framework for School Education–2023

NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

DISCLAIMER

The Draft Syllabus of Grade 9 has been uploaded to support school teachers in their academic planning and preparatory activities before the commencement of the 2026–27 academic session.

The syllabus has been released for all subjects in Grade 9 in three parts as detailed below:

- Part 1: Languages
- Part 2: Science, Mathematics, and Social Science
- Part 3: Individuals in Society, Vocational Education, Arts Education, and Physical Education and Well-being

The syllabi include the core elements aligned with the National Curriculum Framework for School Education (NCF-SE 2023) as given below, and subject-specific aspects aligned with the nature of the subject:

- curricular goals,
- competencies,
- learning activities and/or learning outcomes,
- pedagogical approaches,
- indicative time allocation, and
- assessment orientation.

Languages cut across subject areas, therefore, while NCF–SE 2023 allocates annual hours for languages, specific time allocation in terms of hours for individual themes or chapters has not been specified in the language syllabus, as is done in the syllabi of other subject areas.

In alignment with this competency-based syllabus, the presentation of content in the new NCERT textbooks focuses on experiential learning, cross-curricular linkages, cultural rootedness, values, Indian Knowledge Systems (IKS), holistic assessment, inclusion, and the use of educational technology.

With a view to achieving the goals of multidisciplinary education and the holistic development of students, it is essential to accord equal importance to all subject areas, including Individuals in Society, Vocational Education, Arts Education, and Physical Education and Well-being, and to implement them in both letter and spirit. The subject Individuals in Society will be replaced by Environmental Education in Grade 10. Therefore, the development of competencies in this subject area must be ensured in Grade 9, which will support the progressive building of competencies in Environmental Education at the Grade 10 level.

The new Grade 9 textbooks for all subject areas, as recommended by the NCF-SE 2023 are currently under development and will be made available by March 2026. These textbooks are being developed in alignment with the NEP 2020, NCF-SE 2023, and the draft syllabus prepared by the NCERT.

Syllabus

Secondary Stage (Phase I)

Grade 9

Part 2 – Science, Mathematics, and Social Science

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राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

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Syllabus

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Part 2–Science, Mathematics, and Social Science

Overview

The National Education Policy (NEP) 2020 in its para 4.1 states, "The curricular and pedagogical structure of school education will be reconfigured to make it responsive and relevant to the developmental needs and interests of learners at different stages of their development, corresponding to the age ranges of 3–8, 8–11, 11–14, and 14–18 years, respectively. The curricular and pedagogical structure, and the curricular framework for school education will therefore be guided by a 5+3+3+4 design, consisting of the Foundational Stage (in two parts, i.e., 3 years of Anganwadi/pre-school + 2 years in primary school in Grades 1–2; both together covering ages 3–8), Preparatory Stage (Grades 3–5, covering ages 8–11), Middle Stage (Grades 6–8, covering ages 11–14), and Secondary Stage (Grades 9–12 in two phases, i.e., 9 and 10 in the first, and 11 and 12 in the second, covering ages 14–18)".

The secondary stage marks a crucial phase in schooling for learners aged 14–18, and Grades 9–10 constitute its first phase. As per the National Curriculum Framework for School Education 2023, in Grades 9 and 10, students continue to engage with all curricular areas studied in the middle stage, while also deepening disciplinary understanding, and strengthening reasoning and argumentation across domains. In addition, Individuals in Society and Environmental Education are introduced as interdisciplinary areas in Grades 9 and 10, respectively, enabling students to apply ethical and moral reasoning to public issues and environmental concerns.

Content at this stage is expected to build conceptual depth along with familiarity with the methods of inquiry specific to each curricular area. Pedagogy encourages greater independence, self-study, exploration, and meaningful classroom discussions while maintaining a judicious balance between direct instruction and opportunities for seminars, projects, and discovery-based engagements.

The NCF-SE 2023 recommends the assessment design that plays an important role in shifting the focus from mere content retention to conceptual understanding, analysis, synthesis, and fluency in the inquiry-based learning. It also recommends board examinations in Grade 10 to assess competencies defined in the learning standards included in NCF-SE 2023 for each curricular area, with multiple examination cycles and certification. These 'Learning Standards' and the processes associated with them, for example, the 'flow-down' from the 'Aims of Education' to 'Learning Outcomes', are central to NCF-SE 2023—to ensure alignment and integration of the different components of the curriculum design and practice, such that our school education achieves what we have envisioned for our children.

The NCF-SE 2023 proposes the following ten curricular areas for Grades 9 and 10:

1. Language 1 (R1)
2. Language 2 (R2)
3. Language 3 (R3)
4. Mathematics
5. Science
6. Social Science
7. Individuals in Society
8. Vocational Education
9. Arts Education
10. Physical Education and Well-being

In Grade 10, all the above curricular areas will remain the same, except for 'Individuals in Society', which will be replaced by Environmental Education.

Curricular Areas (Grades 9–10)

Below is a concise outline of each area in terms of content, pedagogy, and assessment, based strictly on the NEP 2020 and NCF-SE 2023.

Languages (Language 1, Language 2, and Language 3)

At the secondary stage, language learning strengthens learners' abilities to use language meaningfully for comprehension, expression, interpretation, and critical engagement with texts. The content includes a balanced selection of literary and non-literary texts drawn from diverse Indian languages and contexts, enabling learners to appreciate linguistic diversity, cultural rootedness, and social relevance. Pedagogical processes emphasise dialogic reading, reflective writing, listening and speaking activities, and contextual use of language through discussion, interpretation and creative expression. Students engage with texts not only as readers but also as meaning-makers who connect textual ideas with their experiences. Assessment focuses on understanding, interpretation, articulation of ideas, communicative clarity, and the ability to analyse and respond to texts in multiple modes, rather than solely relaying on rote memorisation.

Mathematics

The mathematics curriculum at the secondary stage deepens the conceptual understanding and strengthens connections between mathematical ideas, real-life applications, and reasoning. The content includes number systems, algebraic thinking, geometry, measurement, data handling, and emerging domains appropriate to learners' developmental level. Pedagogy encourages exploration, problem-posing, logical reasoning, representation, and verification through activities, such as real-world contexts and collaborative work rather than mechanical procedures. Learners are guided to explain their strategies, compare solution paths, and reflect on underlying concepts. Assessment places emphasis on conceptual clarity, reasoning, representation, application and mathematical communication, while also recognising multiple solution approaches and thought processes.

Science

Science learning at the secondary stage strengthens the scientific understanding by linking observation, experimentation, explanation, and everyday experience. The content spans the key themes in physical, chemical, biological and environmental sciences, enabling learners to recognise patterns, processes and interrelationships in the natural world. Pedagogy emphasises inquiry, investigation, practical work, demonstrations, field-based observations, and opportunities to ask questions and construct explanations. Learners are encouraged

to connect science with local contexts, technology, the environment, and responsible use of resources. Assessment focuses on conceptual understanding, inquiry processes, interpretation of evidence, reasoning, and the ability to communicate explanations, rather than on the memorisation of facts.

Social Science

The Social Science curriculum develops historical, geographical, economic, civic, and social perspectives that help learners interpret society and public life with sensitivity and critical awareness. The content introduces key themes in history, polity, economy, society, and environment with reference to the Indian and global contexts. Pedagogy foregrounds discussion, interpretation of sources and narratives, case-based learning, mapping activities, and reflective engagement with contemporary issues. Learners are encouraged to relate social processes to their experiences, diversity, and Constitutional values. Assessment focuses on reasoning, interpretation of evidence, articulation of viewpoints, and the ability to connect ideas across themes, rather than the reproduction of information.

Individuals in Society

Individuals in Society enables learners to reflect on personal identity, relationships, emotions, responsibility, and ethical participation in family, community and public spaces. The content draws upon everyday social experiences, concerns of growing-up, interpersonal interactions, dignity, empathy and cooperation, while nurturing respect for diversity and social harmony. Pedagogy is dialogic and reflective, using discussions, real-life situations, collaborative tasks, and experiential activities that allow learners to examine perspectives, express views, and relate personal understanding to wider social concerns. Assessment is primarily formative and reflective, focusing on sensitivity, ethical reasoning, collaborative conduct, and responsible behaviour in authentic contexts rather than factual recall.

Arts Education

Arts Education fosters aesthetic appreciation, imagination, cultural awareness, and creative expression through engagement with visual, performing and literary arts. The content includes exposure to regional and national artistic traditions, local cultural practices, and contemporary creative forms. Pedagogy emphasises participation,

observation, making and performing, reflection, and appreciation of artistic processes in culturally grounded contexts. Students learn to interpret meaning, recognise forms of expression, and relate artistic practice to personal and community experience. Assessment values process creativity, engagement, reflection, and the ability to appreciate and communicate artistic meaning, rather than product-centered evaluation alone.

Physical Education and Well-being

Physical Education and Well-being promotes holistic development through physical fitness, movement, health awareness, emotional balance, team spirit, and responsible lifestyle choices. The content includes physical activities, games and sports, movement skills, health and safety awareness, and perspectives on well-being. Pedagogy prioritises participation, cooperative play, self-discipline, goal-setting, and reflective awareness of one's physical and emotional state. Learners engage in individual and group activities that nurture resilience, self-confidence, and positive social interaction. Assessment focuses on participation, effort, collaboration, responsible behaviour, and personal progress rather than competitive ranking alone.

Vocational Education

Vocational Education at the secondary stage introduces learners to work-centered knowledge, skills, and values linked to local contexts, livelihoods, and emerging economic opportunities. The content includes awareness of vocational domains, foundational technical skills, safe work practices, and appreciation of the dignity of labour. Pedagogy is experiential and activity-oriented, involving hands-on tasks, community linkages, observation of work processes, and reflective engagement with real-world situations. Assessment is based on performance in tasks, application of skills, problem-solving, collaboration, and responsible work behaviour, with emphasis on authenticity and relevance.

Cross-cutting Themes

Across all Curricular Areas at the secondary stage, the NCF-SE 2023 emphasises learning rooted in India's cultural and civilisational contexts while remaining open to contemporary knowledge and

global perspectives. Cultural rootedness is expressed through meaningful engagement with India's social, artistic, linguistic, environmental, scientific and historical heritage, encouraging students to understand their experiences, and recognise continuity between local experience and broader national traditions. This orientation also strengthens the values of ethical citizenship, social responsibility, and sensitivity to community life. Inclusion remains a foundational principle across curriculum, pedagogy and assessment, ensuring that learning experiences are accessible, respectful of diversity, and responsive to the varied backgrounds, languages, abilities, and circumstances of learners, thereby supporting equal participation and opportunities. The NCF-SE 2023 further highlights the importance of drawing on Indian Knowledge Systems (IKS) as rich sources of concepts, practices, and worldviews across domains, enabling students to appreciate indigenous intellectual traditions alongside modern disciplinary knowledge and to engage with them through inquiry, reflection, and critical understanding as part of their holistic development in Grades 9 and 10. Besides educational technology, legal literacy, electoral literacy, and financial literacy have also been integrated across the curricular areas.

The syllabus of Grade 9 is divided into three parts. Part 1 contains the syllabus of four languages — Hindi, Urdu, English, and Sanskrit. Part 2 contains the syllabus of three subjects, such as Mathematics, Science and Social Science. Part 3 contains the syllabus of four curricular areas — Individuals in Society, Vocational Education, Arts Education, and Physical Education and Well-being.

Part 2 of the Syllabus, includes a detailed syllabus of Science, Mathematics and Social Science.

Science

Introduction

Nature of Science

Science is the study of the natural and physical world around us through a systematic process of observing, questioning, forming hypotheses, testing hypotheses through experiment, analysing evidence, and continuously revising our knowledge. It develops essential skills like curiosity, creativity, evidence-based thinking, and sound decision-making that help us lead rational and fulfilling lives. Learning Science provides valid knowledge about the world, and builds scientific values and capacities. It draws from Biology, Chemistry, Physics, Earth Science, Mathematics, Computational Sciences, and sometimes Social Science and Vocational Education to offer an interdisciplinary understanding of the role of science. Quality science education, fostering inquiry and research is vital for addressing global challenges, such as climate change, healthcare, sustainable development, and social equity. Thus, integrating Science with other subjects is a key focus of the curriculum framework. Science is introduced as a separate curricular area at the first two years of the secondary stage (Grades 9 and 10). At this stage, the approach integrates the disciplines of Biology, Chemistry, Physics, and Earth Science. A disciplinary approach is taken in the final two years of the secondary stage (Grades 11 and 12), with Physics, Chemistry, and Biology being offered separately.

Nature of Knowledge

Science is an organised body of knowledge that evolves through curiosity, inquiry, logical reasoning and experimentation. It helps in understanding the physical and natural world, identifying patterns and relationships, and discovering causes and effects. Science also supports the creation of models, theories, laws and principles. Science involves creativity to explore and understand the world, with concepts like natural selection, planetary models, and atomic theory. Asking questions, forming hypotheses, designing experiments and creating models are all part of this creative process. Scientific knowledge includes evidence-based explanations that can be tested in real-life situations using processes like observation, reasoning, inference and replicability. Scientific knowledge is very reliable but keeps evolving as reflected in its history. New evidence or a reconceptualisation of prior evidence and knowledge lead to changes in existing knowledge in science on a continuous basis. Learning science at the secondary stage should encourage learners to extend their understanding towards abstraction and engage with complex ideas. It should help learners analyse the role of science and technology in society, and develop an interdisciplinary understanding of science. Science learning should enable learners to establish linkages of science with other curricular areas. It should help them understand the contribution of India to the world's scientific knowledge, including the role of indigenous practices.

Aims of the Subject

Science Education helps students to develop an understanding of the natural and physical world through systematic inquiry. Learning Science also develops important capacities, such as observation, questioning, analysis, inference, etc. This helps individuals to meaningfully participate in society and the world of work with a scientific temper, critical and evidence-based thinking, asking relevant questions, analysing practices and norms, and acting for necessary change.

Science Education aims to achieve:

(a) **Scientific understanding of the natural and physical world:** Scientific understanding develops through specific observations, questions, experiments, theories, laws, principles, and concepts. Science Education aims to provide adequate knowledge to build a systematic and verifiable understanding of the natural and physical world.

(b) **Capacities for scientific inquiry:** The abilities to put forth hypotheses, arguments, predictions, and analyses, test hypotheses, evaluate situations, and draw logical conclusions are fundamental to learning Science.

(c) **Understanding the evolution of scientific knowledge:** Scientific knowledge evolves with the efforts of various individuals and organisations over thousands of years. Exploring the key moments and discoveries reveals how science has evolved over time and continues to do so.

(d) **Interdisciplinary understanding between Science and other curricular areas:** Learning in Science involves understanding interlinkages across disciplines. Subjects cannot be viewed in isolation; instead, they contribute to a holistic understanding of the world.

(e) **Understanding of the relationship between Science, Technology, and Society:** Natural curiosities, along with different societal needs and issues, lead to the generation of scientific knowledge and technologies to satisfy the curiosities and tackle the world's ongoing challenges.

(f) **Scientific temper:** Developing the capacities for critical and evidence-based thinking, and freedom from fear and prejudice is central to learning Science. Students will imbibe scientific values and dispositions, such as honesty, integrity, scepticism, objectivity, tenacity, perseverance, collaboration and cooperation, concern for life, and preservation of the environment.

(g) **Creativity:** Science Education should nurture creativity and a sense of aesthetics as observing patterns in the world around us, asking good questions, formulating plausible hypotheses and designing good experiments to test those hypotheses that often requires artistry and creativity.

Vision of the NEP 2020 and Key Paradigm Shift in the NCF-SE 2023 for Science Education

The NEP 2020 brings a transformative vision to Science Education by promoting conceptual understanding, inquiry-based learning, and scientific temper over rote memorisation. It encourages hands-on experiments, interdisciplinary connections, and the use of technology to make learning engaging and relevant. In alignment with the

NEP 2020, the NCF-SE 2023 emphasises a stage-wise, competency-based approach, focusing on real-life applications and local contexts for better comprehension. The focus areas also aim to be rooted in India and in the knowledge of India, including the Indian Knowledge Systems (IKS) and environmental education.

Together, the NEP 2020 and NCF-SE 2023 aim to create Science Education that fosters curiosity, critical thinking, and a deeper connection between science and society. Overall, the integration of Science Education with the NEP 2020 and the NCF-SE 2023 represents a shift towards meaningful, engaging, learner-centric pedagogy and competency-based assessment. It envisions science classrooms that encourage curiosity, creativity, collaboration and connection with the real world, ultimately nurturing not just future scientists, but responsible, informed and critically thinking citizens.

Approach

Learning Science requires students to actively engage with the world around them to understand it, while also communicating and sharing ideas and observations. It involves a gradual increase in their ability to handle complex and abstract concepts, aligned with their cognitive and procedural capacities. At this stage, students must begin to engage with what they cannot 'see' to provide explanations for what they can observe and be able to represent the world in scientific terms, draw inferences and make predictions. They must be able to see scientific patterns and relationships, and formalise their observations and understanding in the form of generalisation and mathematisation. They must be able to identify and manipulate variables to develop causal relationships. Students must develop an interdisciplinary understanding of Science, and its linkages with other curricular areas, as well as the connection between Science, Technology and Society. They must also understand the contribution of India to the world's scientific knowledge. They must also be enabled to conduct scientific inquiry independently and connect their findings to their understanding of scientific concepts, laws, and principles, as well as communicate their findings in different modes with accuracy and creativity.

Learning Standards

Learning standards (Curricular Goals and Competencies) describe what students should know, understand, and be able to do in Science. In Grades 9–10, Science is taught using an integrated approach that combines Biology, Chemistry, Physics, and Earth Science. This helps students understand the connections between disciplines and relate Science to their observations and experiences. At this stage, scientific inquiry skills are developed alongside conceptual understanding, with content selected both for disciplinary relevance and real-life usefulness. Students must deepen their understanding of the world, explore scientific questions through discussion and experimentation, and communicate their learning in various ways. It is important to note that the Curricular Goals are interdependent and not separate.

Development of the Competencies

Learning standards are organised into four levels: broad curricular aims define the overall objectives for Science Learning by the end of each schooling stage; more specific Curricular Goals guide the design of the science curriculum for each stage and topic; Competencies represent measurable scientific skills and knowledge-based on these goals, assessed at the end of each stage; and detailed Learning Outcomes (LOs) are granular milestones of learning and usually progress in a sequence leading to the attainment of a competency. These LOs enable teachers to plan their content, pedagogy, and assessments towards achieving specific competencies.

Curricular Goals (CGs) and Competencies (Cs)

CG-1 Explores the world of matter, its interactions, and properties at the atomic level

C-1.1 Describes classification of elements in the Periodic Table, and explains how compounds (including carbon compounds) are formed based on the atomic structure (Bohr's model) and properties (valency)

C-1.2 Investigates the nature and properties of chemical substances (distillation, crystallisation, chromatography, centrifugation, types and properties of mixtures, solutions, colloids, and suspensions)

C-1.3 Describes and represents chemical interactions and changes using symbols and chemical equations (acid and base, metal and non-metal, reversible and irreversible)

CG-2 Explores the physical world around them, and understands scientific principles and laws based on observations and analysis

C-2.1 Applies Newton's laws to explain the effect of forces (change in state of motion — displacement and direction, velocity and acceleration, uniform circular motion, acceleration due to gravity) and analyses graphical and mathematical representations of motion in one dimension

C-2.2 Explains the relationship between mass and weight using universal law of gravitation, and connect it to the laws of motion

C-2.3 Manipulates the position of object and properties of lenses (focus, centre of curvature) to observe image characteristics and correspondence with a ray diagram, and extends this understanding to a combination of lenses (telescope, microscope)

C-2.4 Manipulates and analyses different characteristics of the circuit (current, voltage, resistance) and mathematises their relationship (Ohm's law), and applies it to everyday usage (electricity bill, short circuit, safety measures)

C-2.5 Defines work in scientific terms, and represents the relationship between potential and kinetic energy (conservation of energy) in mathematical expressions

C-2.6 Demonstrates the principle of mechanical advantage by constructing simple machines (system of levers and pulleys)

C-2.7 Describes the origin and properties of sound (wavelength, frequency, amplitude) and differences in what we hear as it propagates through different instruments

C-2.8 *Explores interconnected systems and phenomena that support and affect life on Earth (hydrosphere, biosphere, atmosphere, geosphere, cryosphere and their interrelationships, earth processes, hazards, etc.)

**Additional Competency for Earth Science*

CG-3 Explores the structure and function of the living world at the cellular level

C-3.1 Explains the role of cellular components (nucleus, mitochondria, endoplasmic reticulum, vacuoles, chloroplast, cell wall), including the semi-permeability of cell membrane in making cell the structural basis of living organisms and functional basis of life processes

C-3.2 Analyses similarities and differences in the life processes involved in nutrition (photosynthesis in plants; absorption of nutrients in fungi; digestion in animals), transport (transport of water in plants; circulation in animals), exchange of materials (respiration and excretion), and reproduction

C-3.3 Describes the mechanisms of heredity (in terms of DNA, genes, chromosomes) and variation (as changes in the sequence of DNA)

CG-4 Explores interconnectedness between organisms and their environment

C-4.1 Applies the knowledge of cellular diversity in organisms along with the ecological role organisms play (autotrophic or heterotrophic nutrition) to classify them into five kingdoms

C-4.2 Illustrates different levels of organisations of living organisms (from molecules to organisms)

C-4.3 Analyses different levels of biological organisation from organisms to ecosystems and biomes along with interactions that take place at each level

C-4.4 Analyses patterns of inheritance of traits in terms of Mendel's laws and its consequences at a population level (using models and/or simulations)

C-4.5 Analyses evidences of biological evolution demonstrating the consequences of the process of natural selection in terms of changes — in allele frequency in population, structure, and function of organisms

CG-5 Draws linkages between scientific knowledge and knowledge across other curricular areas

C-5.1 Explores how literature and arts have influenced Science

C-5.2 Examines a case study related to the use of Science in human life from the perspective of Social Sciences and Ethics (for example, Marie Curie, Jenner, treatment of patients with mental illnesses, the story of the atomic bomb, green revolution and GMOs, conservation of biodiversity)

C-5.3 Applies scientific principles to explain phenomena in other subjects (sound pitch, octave, and amplitude in music; use of muscles in dance form and sports)

CG-6 Understands and appreciates the contribution of India through history, and the present time to the overall field of Science, including the disciplines that constitute it

C-6.1 Knows and explains the significant contributions of India to all matters (concepts, explanations, methods) that are studied within the curriculum in an integrated manner

CG-7 Develops awareness of the most current discoveries, ideas, and frontiers in all areas of scientific knowledge in order to appreciate that Science is ever evolving, and that there are still many unanswered questions

C-7.1 States concepts that represent the most current understanding of the matter being studied, ranging from mere familiarity to conceptual understanding of the matter as appropriate to the developmental stage of the students

C-7.2 States questions related to matters in the curriculum for which current scientific understanding is well-recognised

CG-8 Explores the nature of Science by doing Science

C-8.1 Develops accurate and appropriate models (including geometric, mathematical, graphical) to represent real-life events and phenomena using scientific principles, and use these models to manipulate variables and predict results

C-8.2 Designs and implements a plan for scientific inquiry (formulates hypotheses, makes predictions, identifies variables, accurately uses scientific instruments, represents data—primary and secondary—in multiple modes, draws inferences based on data, and understanding of scientific concepts, theories, laws and principles, and communicates findings using scientific terminology)

Key Concepts and Learning Outcomes

The Science syllabus of Grades 9 and 10 is presented in tabulated form with three columns. The name of the theme and the number of allocated periods are given in the first column. The second column highlights the key concepts. The third column presents learning outcomes. The learning outcomes are meant to guide the classroom

processes to achieve specific competencies. They may facilitate teachers to consistently observe and track learning to respond to all kinds of needs of diverse learners.

Grade 9		
Tentative Name of the Theme	**Key Concepts**	**Learning Outcomes**
(Number of Hours)		**Learner will be able to:**
Introductory Theme Number of periods (10)		
Cell Number of periods (12)	• Discovery of cell • Plant and animal cells • Prokaryotic and eukaryotic cells • Cell as a structural and functional unit of life; structure and function of key organelles (nucleus, mitochondria, chloroplast, endoplasmic reticulum, vacuoles, plasma membrane, cell wall) • Permeability of cell membranes • Cellular division and cancer • Recent advancement in cell biology	C-3.1 • Differentiate between plant and animal cell, prokaryote and eukaryote • Describe the structural and functional features of cells • Explain the role of cells in the structure and functions of organisms • Explain activities inside the cell and its interactions with the environment • Demonstrate osmosis in cells • Prepare slides to observe cell structure
		C-3.2 • Differentiate between diffusion and osmosis
		C-3.3 • Explain the role of cell division mitosis and meiosis in creating similarities and variations
		C-4.2 • Identify and describe the role of biomolecules in the structure and function of cell
		C-5.2 • Cite case study related to the use of science in human life, for example, Leigh Syndrome and mitochondrial dysfunction
		C-5.3 • Apply learning of a structure and function of muscles cells or joints in dance form and/or sports
		C-6.1 • Discuss significant contributions of India, for example, Professor Arun Kumar Sharma for his work on chromosomes and methods for its studies
		C-7.1 • Recognise that the cell is a structural unit of life and functional unit of life processes

		C-7.2 • Pose questions, such as — Can we create artificial cell which behaves exactly like a natural living cell?
		C-8.1 • Exhibit creativity and design models using low cost or no-cost eco-friendly material to study structure and functions of cell and cell organelles
		C-8.2 • Carry out an experiment to understand the osmosis • Analyse results and present findings using scientific terms
Tissues Number of periods (13)	• Tissues: Introduction and importance • Level of organisation in the living organisms • Plant and animal tissues • Types of plant tissues • Meristematic tissues (types and function of each) • Permanent tissues (types, structure and function of each) • Animal tissues • Overview (epithelial, connective, muscular and nervous tissues — types, structure and function of each) • Elementary idea of musculoskeletal system • Care of musculoskeletal system: injuries, postural care, nutrition and exercise	C-4.2 • Differentiate between plant and animal tissues; meristematic and permanent tissues; simple and complex tissues; parenchyma, collenchyma and sclerenchyma; xylem and phloem; striated smooth and cardiac muscles; • Different types of joints • Relate the structure of the different types of tissues with their functions • Explain the role of various types of tissues in plants and animals • Describe the level of organisation in a multicellular organism
		C-5.3 • Establish the correlation between different tissues for fitness, for example, role of muscles, cartilage and bones in facilitating movement
		C-6.1 • Explain the importance of yoga exercises for physical agility and in maintaining the correct posture
		C-6.1 • Discuss significant contributions of India, for example, Professor Sipra Guha Mukherjee and Professor S.C. Maheshwari for their significant contribution in the plant cell and tissue culture research in India
		C-7.1 • Discuss the techniques and medical recommendations in recovery from muscular injuries

		C-8.2 • Carry out an experiment to understand the growth in plant due to apical meristem • Represent data in multiple modes, including appropriate figures, tables, graphs, or digital formats, interpret and draw inferences from the data • Analyse results and present findings using scientific terms • Communicate findings and conclusions effectively, such as those from experiments, activities, or projects, both orally and in written form
Reproduction Number of periods (13)	• Introduction to different forms of reproduction — sexual and asexual • Types of asexual reproduction with examples • Sexual reproduction in flowering plants (flower and its parts, pollination, fertilisation, seed dispersal) • Sexual reproduction in humans: male and female reproductive systems (structure and function, formation of gametes, sperm and egg, fertilisation, pregnancy and development of embryo, menstrual cycle) • Reproductive health and hygiene • Introduction to birth control methods and importance	C-2.8 • Analyse the interactions between members of different groups of organisms, such as plants and pollinators
		C-3.2 • Compare asexual and sexual reproduction • Describe male and female reproductive organs in plants and animals • Differentiate between ovule and seed; ovary and fruit • Explain pollination and fertilisation
		C-3.3 • Explain how variations are introduced by sexual reproduction
		C-4.3 • Identify and explain the role of biotic and abiotic agents in seed dispersal and pollination
		C-5.1 • Illustrate the structure of male and female reproductive units or systems in plants and animals
		C-5.2 • Recognise the significance of contraceptive devices for population control and health including reproductive health
		C-6.1 • Describe the contribution of India to the understanding of human anatomy
		C-6.1 • Discuss significant contributions of India, for example, Professor Panchanan Maheshwari for laying the foundation of plant cell and tissue culture research in India
		C-7.1 • Recognise the importance of improvements in medical field for assisted reproductive technologies

		C-7.2 • Pose questions, such as — How do heavy metals harm reproductive organs? Can extreme heat affect fertility?
Diversity Number of periods (12)	• Importance of classification • Five kingdoms and their key features with examples • Major division of animals and plants • Binomial nomenclature • Acellular entities: viruses	C-4.1 • Distinguish organisms based on certain characteristics, such as number of cells present, cellular organisation and mode of nutrition • Classify various organisms in groups, such as five kingdoms, on the basis of their cellular organisation and ecological role • Describe the significance and rules of binomial nomenclature • Apply binomial nomenclature on some common organisms in their surroundings
		C-2.8 • Analyse the interactions between members of different groups of organisms, such as lichens • Discuss ecological role of diverse organisms
		C-7.1 • Recognise three domains of classification of organisms on molecular basis
Exploring Mixtures and Their Separation Number of periods (12)	• Homogeneous and heterogeneous mixtures; • Solutions, suspensions, colloids and their properties • Various ways to express concentration of solutions (mass by mass percentage of a solution, mass by volume percentage of a solution, volume by volume percentage of a solution) • Separation techniques based on the physical properties of components, including crystallisation, distillation, paper chromatography, sublimation, centrifugation and coagulation	• C-1.2 • Differentiate between homogeneous and heterogeneous mixtures on the basis of their properties • Demonstrate separation techniques, such as crystallisation, distillation, paper chromatography, sublimation, centrifugation and coagulation • Classify mixtures as solutions, suspensions, or colloids based on their properties • Explain the scientific principles behind different separation techniques • Apply the knowledge of homogeneous and heterogeneous mixtures in daily life • Define and calculate the concentration of solutions using mass by mass percentage, mass by volume percentage, volume by volume percentage • Analyse graphs of solubility and explain how the solubility of substances changes with temperature • Use scientific conventions and standard units to express concentrations • Handle common laboratory chemicals and apparatus safely • Relate separation techniques with practices observed in the local environment

		C-5.1 • Draw labelled diagrams or flow charts of separation techniques
		C-5.2 • Display awareness about the societal impact of chemistry in making life healthier, cleaner and sustainable
		C-5.3 • Correlate the phenomenon used in centrifugation to the spinning dance
		C-6.1 • Describe the cultural practices, like traditional methods of distillation • Display awareness about the contributions of Indian scientists, such as Dilip Mahalanabis
		C-7.1 • Demonstrate the use of small-scale or micro-scale experiments, such as crystallisation of copper sulfate, as an alternative to traditional methods
		C-7.2 • Poses question, such as — Can we create artificial blood that works just as real blood for all patients?
		C-8.1 • Exhibit creativity and work collaboratively in groups to create models of apparatus used for separating mixtures, such as a paperfuge and a distillation unit, using eco-friendly materials
		C-8.2 • Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of scientific concepts, and predict the results of an experiment or investigation based on their hypotheses • Accurately use scientific instruments, apparatus and chemicals to collect data • Analyse results and findings using scientific terms • Represent findings in multiple modes, including appropriate figures, tables, graphs, or digital formats, and interpret and draw inferences from the findings • Communicate findings and conclusions effectively, such as those from experiments, activities or projects, both orally and in written form

Structure of an Atom Number of periods (14)	• Atoms are the basic units of elements • Atoms consist of subatomic particles • Atomic Models (Thomson's Model, Rutherford's Model, and Bohr's Model) • Distributions of electrons in elements (up to 18 elements) • Symbols • Valency as the combining capacity • Atomic number • Mass number • Isotopes • Isobars	C-1.1 • Differentiate between subatomic particles (electrons, protons, and neutrons) based on their charge, and position in the atom • Illustrate how electrons are distributed in different energy levels, such as K, L, M, N ... or by numbers n = 1, 2, 3, 4 ... • Explain valence electrons, valency, atomic number, atomic mass, isotopes, and isobars • Calculate the number of electrons, protons, and neutrons of an element using its atomic and mass numbers • Interpret data, such as atomic mass, maximum number of electrons in a shell, and valency to classify elements accurately • Use scientific conventions as per international standards, such as notations for electron, proton, neutron, unified atomic mass unit (u), and distribution of electrons in various shells, such as K, L, M, N ...
		C-1.3 • Recognise and accurately apply the chemical symbols for the first eighteen elements according to IUPAC
		C-5.1 • Draw labelled diagrams of various atomic models, such as Thomson's model, Rutherford's model and Bohr's model • Create and present a role play, stage play, or story of 'Journey Inside the Atom' to display awareness about the contributions of key scientists in the discovery and development of atomic structure
		C-5.2 • Display awareness about the role of Indian scientists and their contributions to atomic science for peaceful purposes and explore how their works influenced India's scientific development
		C-5.3 • Display awareness about the societal impact of science in making life healthier, like the use of various isotopes in medicines to treat different diseases, and atomic energy in power generation • Design and develop games that utilise atomic number, mass number, and subatomic particle clues to accurately predict and identify elements

		C-6.1 • Display awareness about the contributions of the ancient Indian philosopher, Acharya Kanad's idea of indivisible particles *(Parmanu)*
		C-7.1 • Describe the use of the atomic mass unit (u) to measure the mass of atoms as per IUPAC recommendations • Describe scientific discoveries that explain how the structure of the atom has evolved over time through various atomic models proposed by different scientists
		C-7.2 • Pose question, such as — Is it possible to completely understand everything that happens inside an atom?
		C-8.1 • Exhibit creativity and work collaboratively in groups to design different models of atoms
		C-8.2 • Formulate hypotheses about scientific phenomena by applying prior knowledge and understanding of scientific concepts, and predict the results of data based on the hypotheses • Analyse results and present findings using scientific terms • Correlate the results and conclusions of different models of atomic structure • Represent data in multiple modes, including appropriate figures, tables, graphs or digital formats, and interpret and draw inferences from the data • Communicate findings and conclusions effectively, such as those from experiments, activities or projects, both orally and in written form
Atoms and Molecules Number of periods (14)	• Law of conservation of mass • Law of constant proportion • Dalton's Atomic theory • Molecules of elements, Molecules of covalent compounds and their properties • Ions, Ionic compounds and their properties • Writing chemical formulae • Molecular mass • Formula unit mass	C-1.1 • Differentiate between chemical species based on their properties or characteristics, such as atoms and molecules, elements and compounds, ionic and covalent compounds, cations and anions, formula unit mass and molecular mass • Plan and demonstrate activities to observe and verify the law of conservation of mass • Explain the Dalton's atomic theory, the law of conservation of mass, the law of constant proportions, and formation of ionic and covalent compounds

		• Calculate the charge on an ion, valency from the atomic number, the molecular and formula unit mass • Use scientific conventions, symbols, and valency to write the chemical formulae of simple compounds • Display awareness about the scientific discoveries, such as the contributions of Antoine Lavoisier, Joseph Proust, and John Dalton • Handle common laboratory chemicals and apparatus safely
		C-5.1 • Draw diagrams of electron dot structures of atoms and molecules
		C-5.2 • Describe how atoms and molecules can lead to beneficial applications, such as medicine, energy and peaceful use of atomic science • Relate atomic bonding to social bonding
		C-5.3 • Design educational games to write chemical formulae using symbols
		C-6.1 • Display awareness about the contributions of Indian scientists in promoting the peaceful use of atomic energy and the traditional use of the red pigment 'cinnabar' obtained from rocks
		C-7.1 • Describe the basic concepts that matter are made of particles; elements combine in fixed ratios to form compounds; the law of conservation of mass; and different types of bonding (ionic and covalent)
		C-7.2 • Pose question, such as — Are there any chemical changes that do not obey the law of conservation of mass?
		C-8.1 • Exhibit creativity and work collaboratively in groups to construct simple models of compounds
		C-8.2 • Formulate hypotheses about scientific phenomena by applying prior knowledge and understanding of scientific concepts and laws, and predict the results of data based on the hypotheses

		• Accurately use scientific instruments, apparatus and chemicals to collect data • Analyse results and findings using scientific terms • Represent data in multiple modes, including appropriate figures, tables, graphs or digital formats • Communicate findings and conclusions effectively, such as those from experiments, activities or projects, both orally and in written form
Earth as a System: Energy, Matter and Life Number of periods (12)	• Earth as interconnected system • Nature of solar energy: solar radiation, electromagnetic spectrum, and speed of light • Solar energy interaction with the Earth's Surface and differential heating of the Earth (the role of the atmosphere and the Earth's surface) • Differential warming of the Earth causes winds • Biogeochemical cycles (water cycle, carbon cycle, nitrogen cycle, oxygen cycle) • Human impact on Earth's system	C-2.8 • Explain the interconnectedness between different spheres of the Earth (biosphere, geosphere, hydrosphere, cryosphere and atmosphere) • Explain the nature of solar radiation • Explain that solar radiation is an electromagnetic waves having different frequencies • Explain how heat from the Sun warms the Earth's surface differently based on the shape, latitude and tilt of the Earth • Explain the interaction of solar radiation with the Earth's surface and relate the differential heating of the Earth's surface with the atmospheric phenomena, such as air movement, evaporation, etc., and describe phenomena like mountain, valley, sea and land breezes • Describe how the latitude and tilt of the Earth, and absorption and reflection of solar radiation by different surfaces cause differential heating of the Earth's surface • Identify various components of the Earth that interact with solar energy • Explain the role of the atmosphere in influencing weather and climate on the Earth • Identify the reflectivity of different materials through reliable scientific sources, such as the internet and books • Describe how elements like carbon, nitrogen, oxygen and water are recycled between biotic and abiotic environments • Explain biogeochemical cycles, and the roles of biogeochemical cycles in circulating matter and energy continuously between the non-living environment (abiotic) and living (biotic) organisms, making nutrients available, and maintaining environmental balance

		C-6.1 • Reflect the changing nature of Earth's environment through our traditional knowledge
		C-7.2 • Pose questions, such as — What will happen if there is no differential heating of the Earth?
		C-8.1 • Draw flow charts, concept maps for biogeochemical cycles, differential heating of the Earth's surface and Electromagnetic spectrum
		C-8.2 • Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of differential heating of the Earth and biogeochemical cycle • Predict the results of an experiment or investigation based on their hypotheses • Communicate findings and conclusions effectively, such as those from experiments, activities or projects, both orally and in written form
Motion Number of periods (13)	• Motion — displacement, velocity, acceleration • Graphical representation of motion for an object moving in a straight line in one direction (with constant velocity, and constant acceleration) • Kinematic equations for motion in a straight line with constant acceleration (by graphical method) • Elementary idea of uniform circular motion	C-2.1 • Differentiate between distance travelled and displacement, and speed and velocity for objects moving in a straight line • Define displacement, velocity, acceleration, and uniform circular motion • Express displacement, velocity, acceleration in appropriate SI units • Plot and interpret position-time graphs and velocity-time graphs to describe the motion of an object moving in a straight line in one direction (with constant velocity and constant acceleration) • Calculate average velocity from position-time graph, displacement and average acceleration from velocity-time graph • Derive kinematic equations for motion in a straight line with constant acceleration by graphical method • Calculate values of unknown physical quantities from the given physical quantities, using kinematic equations • Derive the expression of speed for uniform circular motion
		C-8.1 • Analyse real-life events and phenomena, and identify the key factors that influence their behaviour

		C-8.2 • Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of scientific concepts, theories, laws, and principles • Predict about the outcome of an experiment or investigation based on their hypotheses • Identify the variables that are relevant to a scientific investigation and determine how to control or manipulate them • Accurately use scientific instruments and equipment to collect data • Represent data in multiple modes, including tables, graphs and visual representations, and interpret and draw inferences from the data • Communicate their findings using scientific terminology and effectively communicate their conclusions to others
Force and Laws of Motion Number of periods (13)	• Force; balanced and unbalanced forces • Force of friction • Newton's first law of motion • Newton's second law of motion • Newton's third law of motion	C-2.1 • Explain that force has magnitude as well as direction • Identify situations in which balanced and unbalanced forces are acting on an object • Explain the role of friction on the motion of objects • Recognise that for an object moving with constant velocity, the net force is zero, whereas a change in velocity (acceleration) is caused by a force • State and explain Newton's first law of motion • State and explain Newton's second law in terms of mass and acceleration • Calculate force using mathematical expression of Newton's second law of motion • Define SI unit of force • State and explain Newton's third law of motion • Apply Newton's laws of motion to explain everyday life events
		C-8.1 • Analyse real-life events and phenomena, and identify the key factors that influence their behaviour • Develop a model to represent real-life event • Use models to manipulate variables and predict results

		C-8.2 • Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of scientific concepts, theories, laws, and principles • Predict about the outcome of an experiment or investigation based on their hypotheses • Identify the variables that are relevant to a scientific investigation and determine how to control or manipulate them • Accurately use scientific instruments and equipment to collect data • Represent data in multiple modes, including tables, graphs and visual representations, and interpret and draw inferences from the data • Communicate their findings using scientific terminology and effectively communicate their conclusions to others
Work, Energy and Simple Machines Number of periods (13)	• Concept of work; work done by a constant force • Work-Energy theorem • Mechanical energy, kinetic and potential energy, and conversion between potential energy and kinetic energy • Conservation of energy • Power • Simple machines and their mechanical advantage (pulley, inclined plane, lever)	C-2.5 • Define work done by a constant force and its SI unit • Calculate work done by a force using mathematical expression • State work-energy theorem • Explain the concept of energy and state its SI unit • Name forms of energy and identify their interconversion in surroundings (elementary idea) • Define kinetic energy of a moving object and derive its mathematical expression • Define potential energy for an object raised to a height and derive its mathematical expression • Calculate kinetic and potential energy using mathematical expressions • Explain conversion between potential energy and kinetic energy (for the case of an object under free fall) • State the law of conservation of energy • Define power and its unit • Calculate power using its mathematical expression
		C-2.6 • Identify different simple machines (pulley, inclined plane and lever) • Define mechanical advantage and calculate its value for simple machine • Demonstrate and explain mechanical advantage of simple machines

		C-8.1 • Analyse real-life events and phenomena, and identify the key factors that influence their behaviour • Develop model to represent real-life event • Use models to manipulate variables and predict results
		C-8.2 • Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of scientific concepts, theories, laws, and principles • Predict about the outcome of an experiment or investigation based on their hypotheses • Identify the variables that are relevant to a scientific investigation and determine how to control or manipulate them • Accurately use scientific instruments and equipment to collect data • Represent data in multiple modes, including tables, graphs and visual representations, and interpret and draw inferences from the data • Communicate their findings using scientific terminology and effectively communicate their conclusions to others
Sound Number of periods (11)	• Production of sound • Propagation of sound (as a longitudinal wave through a medium) • Graphical representation of sound wave • Characteristics of sound wave (wavelength, frequency, time period, amplitude, intensity, speed) • Human perception of sound (pitch, loudness) • Propagation of sound in different media (solid, liquid) • Reflection of sound (echo, reverberation), echolocation	C-2.7 • Demonstrate the production of sound in multiple ways (through vibration of strings, membranes, air columns) using materials in surroundings • Explain that sound is produced by vibrations • Demonstrate that sound can travel through different mediums (air, solid and liquid) • Describe that sound needs a medium for propagation • Explain that sound travels as a longitudinal wave • Describe the characteristics of sound waves the (wavelength, frequency, time period, amplitude, intensity and speed) • Analyse graphs representing sound • Write relationship between time period and frequency of sound wave • Derive mathematical expression for speed of sound • Calculate speed of sound using its mathematical expression • Explain human perception of sound in terms of audible range, loudness and pitch of sound • Describe reflection of sound, and apply it to echo and reverberations in surroundings

		• Explain the use of sound waves for echolocation
		C-5.3 • Describe music in terms of characteristics of sound waves, such as loudness and pitch
		C-6.1 • Name historical buildings designed for echoes, such as whispering gallery of Gol Gumbaz • Display awareness about Sir C.V. Raman
		C-8.1 • Analyse real-life events and phenomena, and identify the key factors that influence their behaviour • Develop model to represent real-life event • Use models to manipulate variables and predict results
		C-8.2 • Formulate hypotheses about scientific phenomena based on prior knowledge and understanding of scientific concepts, theories, laws, and principles • Predict about the outcome of an experiment or investigation based on their hypotheses • Identify the variables that are relevant to a scientific investigation and determine how to control or manipulate them • Accurately use scientific instruments and equipment to collect data • Represent data in multiple modes, including tables, graphs and visual representations, and interpret and draw inferences from the data • Communicate their findings using scientific terminology and effectively communicate their conclusions to others

Time Allocation

The NCF-SE 2023 tentatively allocates 130 annual hours and 162 annual periods (every 50 minutes) for the Science subject at the Secondary Stage (Grades 9 and 10). It also provides a tentative weekly breakdown of these periods. Additionally, the NCF-SE 2023 specifies that some subjects require block periods of 100 minutes (1 hour 40 minutes) for hands-on work, activities, lab work, and other pedagogical requirements.

Pedagogy

Learning Science involves not just learning theories and facts of Science, but also making connections between conceptual learning and real life, acquiring the capacities of scientific inquiry, and most importantly, applying these to understand the world. It involves making classroom processes flexible, inclusive, and reflective of diverse needs. Use of technology can bridge gaps and enable independent learning to support the diverse needs of students with disabilities. Effective pedagogy is based on a good understanding of how children grow and learn, and a clear focus on Curricular Goals, Competencies, and Learning Outcomes that must be achieved by students.

Pedagogical Principles for Science Education

- Simulating the processes of science, such as asking questions, hypothesising, observing, testing, finding evidence, collecting data, analysing, modifying conclusions, communicating, and re-questioning.
- Exposing students to a variety of aspects of learning Science in varied settings—the laboratory, classroom, and field—through approaches, such as inquiry, discovery, didactic, and hands-on Science.
- Encouraging and sustaining curiosity by providing varied experiences that may challenge students' existing notions and ideas.
- Using scientific vocabulary during instruction, and creating a variety of contexts and situations for students to communicate their understanding, ideas, and observations.
- Peer and collaborative learning.
- Building on students' existing knowledge and using multiple representations (mathematical, graphical, diagrammatic, and models).
- Connecting scientific knowledge inside and outside the classroom.
- Horizontal connections with other curricular areas.

Various Pedagogical Approaches for Science Education

- **Hands-on Science:** The most important part of learning Science is actually 'doing Science' through hands-on experiential learning.

'Doing Science' can range from trial and error, using materials around them, or using basic scientific instruments (measuring instruments), and laboratory apparatus. In this process, students gain conceptual understanding and develop capacities through manipulating, designing, and building experiments and demonstrations.

- **Discovery approach:** Students explore the natural world by following their own interests and discover patterns of how the world works during their explorations. Teachers may also create opportunities or draw attention to natural phenomena that students can explore further. Often, this discovery is followed by other, more structured approaches to ensure learning.
- **Inquiry approach:** The inquiry approach allows students to navigate through unknown questions and explore solutions on their own. It allows students to work as scientists. The inquiry approach engages students with systematic observation, such as visualising, experimenting, inferring, communicating, and discovering relations. This approach allows teachers to choose the appropriate type of inquiry with respect to the concept and to scaffold (support as per need) students' learning.
- **Project-centered approach:** This approach allows learning within the classroom to continue outside the classroom and extend over a period of time. In this process, connections to daily life are also made. The project-centered approach allows students to develop artefacts or products (charts, presentations and speeches) that reflect and communicate their emerging understanding. It also allows the integration of concepts across different curricular areas. For example, visits to the sites of local professional communities and interactions with the people engaged there, such as potters, weavers, craftspersons, farmers, blacksmiths, carpenters and electricians would enable integrating concepts from Vocational Education and Arts with Science.
- **Didactic approach:** Often, teaching Science involves communicating certain important information in the form of scientific terms, phenomena, and the historical development of concepts and ideas. In this approach, the teacher largely regulates the direction and flow of the lesson.
- **Demonstration:** The teacher demonstrates the working of certain instruments or outcomes of experimental set-ups to draw the

attention of the students to relevant concepts. These demonstrations enrich students' learning experiences of the concepts.

These approaches can be implemented in a variety of settings. A combination of the recommended pedagogical approaches and settings is also often used for teaching a concept.

Practical—Experiential Learning in Science

Experiments and activities connect scientific concepts with real-life situations, and help students develop a deep understanding of Science. By performing experiments, students learn through observation and practice rather than memorisation. Such experiences foster curiosity, strengthen conceptual understanding, and encourage critical thinking through questioning, analysis and interpretation of results. Practical experiments also help students develop problem-solving skills and gain confidence in applying scientific knowledge. Thus, experiments and activities play a key role in making learning Science effective, engaging, and meaningful.

With this understanding, practical work holds an essential place in Science textbooks of the secondary stage, Phase II, because Science is not only about learning facts, but also about understanding how these facts are discovered, tested, and applied. Through practical activities, students observe phenomena, perform experiments, and verify laws and principles, which helps them develop scientific thinking and problem-solving skills. The Grade 9 Science textbook thoughtfully integrates experiments and activities with conceptual content, and the same approach will be followed for Grade 10. These can be carried out by teachers and students, both in the classroom and the laboratory, and in many cases even at home. A separate laboratory manual for the secondary stage, Phase I will be published by the NCERT in due course.

Assessment

Assessment is a critical component of the teaching-learning process. In Grades 9 and 10, where students engage with complex

scientific concepts and competencies, assessment must go beyond comprehension to encourage conceptual clarity, process skills, and holistic development.

Purpose of Assessment

Assessment in Science serves two primary purposes:

- To measure students' achievement of competencies and learning outcomes.
- To evaluate and improve teaching-learning strategies and materials.

Assessment helps teachers gain insights into students' progress, provide timely feedback, and make informed pedagogical decisions. It also allows students to reflect on their learning and identify areas for improvement.

Types of Assessment

There are three approaches to assessments — Assessment of Learning, Assessment for Learning, and Assessment as Learning.

Assessment for Learning (Formative Assessment) is continuous and ongoing. It is used to track students' learning and provide ongoing feedback that can be used by teachers to improve their teaching and by students to improve their learning.

Assessment of Learning (Summative Assessment) evaluates students' learning at the end of a lesson or a logical period of teaching. Some examples of summative assessments include a term-end test or the Board examinations. Summative assessment results can also be used for formative purposes, i.e., for informing teaching and learning.

Assessment as Learning (Self-assessment) encourages students to actively reflect on their learning process actively, helping them develop self-awareness and critical thinking. It involves students monitoring their progress, and using feedback to set goals and improve. This approach fosters lifelong learning skills by making assessment an integral part of learning.

Traditional assessments often emphasise recall-based questions, contributing to stress and failing to reflect deep understanding. The current shift focuses on:

- Designing competency-based assessments aligned with learning outcomes.
- Prioritising conceptual understanding, critical thinking, and application of scientific knowledge.
- Integrating formative assessments as part of daily classroom interactions to support continuous learning.

In Grades 9 and 10, Science assessment must capture both content knowledge and scientific processes, such as observation, experimentation, reasoning and communication.

- Given the demand for greater subject depth, regular formative assessments should be effectively practised for facilitating meaningful learning and constructive feedback.
- Classroom assessments, as in the middle stage, will continue to play an important role, considering the nature and complexity of the competencies at this stage. Self-assessment will also play a key role in the students' learning. Students should be facilitated to monitor what they are learning and use the feedback from this monitoring to adjust, adapt and decide their own strategies for learning.
- Assessments can be designed using case-based questions, simulations, and essay-type questions to assess competencies and to continually replan and revise the teaching-learning process. Questions that require creativity are especially encouraged at this stage.
- In the secondary stage, a variety of written tests, practical tests, projects, etc., should be used. At the end of each year or term of the secondary stage, there will be a comprehensive summative assessment of each subject—the Board examinations in relevant cases.

A variety of assessment methods, such as paper and pencil tests, oral assessments, project work, group assignments, etc., should be used. Assessment tools and processes must accommodate students performing at different levels within a classroom. Students with and without disabilities learn together, and the teaching-learning system is suitably adapted to meet the learning needs of students with different disabilities. Well-designed, graded assessments can be used to better understand individual student needs, so that these needs can be adequately addressed.

Textbook: NCF-SE 2023 aligned with new textbook of Science for Grade 9 developed by the NCERT.

Mathematics

Introduction

Nature of Mathematics as a Subject: Mathematics is often called the universal language because it uses logic and reasoning that everyone can understand, regardless of their culture or language. It is the study of patterns, numbers, shapes, and relationships that help us understand the world we live in. From the symmetry we see in nature to the technology we use every day, mathematics helps explain how things work. While mathematics can seem abstract and theoretical, it is very useful in real life, such as helping us solve problems, think critically, and create new ideas.

At its heart, mathematics is always changing and growing. It is built on basic rules and proven ideas, but it also helps us model real-world situations, predict what might happen, and find the best solutions to problems. It offers both, a way to discover truths about the universe, and a creative activity that requires imagination and hard work. This combination of being both creative and logical makes Mathematics a special and important subject.

Mathematics also helps us understand order and accuracy. It is based on logic, but solving problems often requires creative thinking to find new methods and solutions. Its universal value comes from its ability to describe things using numbers, symbols, and equations. Mathematics is essential for progress in many fields, such as Engineering, Medicine, Economics, and Social Sciences. By learning mathematics, students develop the skills to face challenges in a clear and confident way.

Nature of Knowledge in Mathematics: Mathematical knowledge is built step-by-step, with ideas connected to each other like a ladder. It has grown over many centuries, thanks to the contributions from mathematicians all over the world. Mathematics is based on basic rules

and logical ideas, which are used to create more complex theories and models. Unlike Sciences that rely on experiments and observations, Mathematics uses reasoning and proof. This makes it unique because its truths are universal and don't depend on the outside world.

One special feature of mathematics is that it deals with abstract ideas. Concepts like numbers, shapes, and equations are not physical things but representations that help us understand the real world. For example, algebra can describe how a rocket moves and geometry is key to designing buildings. This ability to work with abstract ideas allows Mathematics to connect theory with real-life applications, making it useful in many areas.

Mathematics also raises interesting questions about whether its truths are discovered (already existing) or invented (created by humans). This makes it even more fascinating as it involves both, finding universal truths and creating new systems to solve problems. By learning about the nature of Mathematics, students not only gain problem-solving skills, but also come to appreciate its deep intellectual history and development over time.

Through learning strategies, regular practice, and connecting Mathematics to other subjects, students can develop critical thinking, solve real-world problems, and understand how mathematics affects their lives and the world around them.

Aims of Mathematics Teaching-learning

- **Develop logical and analytical thinking:** It nurtures the ability to think critically, reason logically, and solve problems systematically. It equips students with the tools to approach challenges in structured and innovative ways, enabling them to grasp abstract concepts and apply them to real-life contexts.
- **Promote problem-solving skills:** It cultivates the ability to recognise, analyse, and solve diverse problems, thereby fostering resilience and adaptability in various situations.
- **Encourage mathematical communication:** It enables students to articulate mathematical ideas effectively, using appropriate terminology, symbols, and visual representations.

- **Foster appreciation for mathematics:** It instils an understanding of the beauty and relevance of Mathematics as a discipline. It encourages curiosity and a lifelong interest in the subject as well as its historical roots.
- **Integrate mathematics with real world applications:** It demonstrates the practical uses of mathematics in everyday life inspiring students to see its relevance in diverse fields, such as Science, Technology, Engineering, and Economics.
- **Encourage collaborative and independent learning:** It promotes both teamwork and individual exploration in mathematical problem-solving, fostering a balanced approach to learning.
- **Inculcate precision and rigor:** It emphasises accuracy, attention to detail, and logical consistency, helping students develop disciplined habits of mind.
- **Build confidence in mathematical abilities:** It creates a learning environment where students feel encouraged to explore, make mistakes, and grow in their mathematical understanding without fear of failure.

Approach: Practice, Theory, and Interdisciplinarity

Recommended Ways of Learning Mathematics

The process of learning Mathematics is as much about understanding concepts as it is about applying them effectively. Mathematics requires a balance between conceptual clarity, procedural fluency, and problem-solving skills. Recommended ways of learning Mathematics revolve around fostering curiosity, engagement, and a structured approach to knowledge acquisition.

- **Focus on conceptual understanding:** Mathematical learning should prioritise understanding the 'why' behind a concept, rather than just the 'how'. When students grasp the reasoning behind mathematical principles, they develop the ability to apply their knowledge to other fields and novel situations.
- **Active participation and discovery-based learning:** Mathematics is best learned through active engagement. Inquiry-based approaches, such as exploring patterns, solving puzzles, or conducting mathematical experiments help students discover

principles by themselves, make learning enjoyable, and deepen their understanding.

- **Use of visuals and representations:** Visual aids like graphs, diagrams, and models play a crucial role in Mathematics education. Representing abstract concepts visually helps students make connections between ideas, and enhances their ability to think spatially and logically.
- **Collaborative learning:** Working in groups encourages students to share perspectives, explain their reasoning, and learn from one another. Group discussions and collaborative problem-solving foster critical thinking and communication skills, which are essential in mathematics.
- **Scaffolded learning:** Mathematics is cumulative, with each concept building on previous knowledge. Teachers and learners must ensure that the foundational concepts are well understood before progressing to more complex topics. Scaffolding or gradually increasing the difficulty of problems, helps students build confidence and competence.
- **Integration of technology:** Tools like graphing calculators, dynamic geometry software, and educational apps can make learning mathematics interactive and engaging. These tools also allow students to explore complex problems that would be difficult to solve manually, broadening their understanding of mathematical applications.
- **Real-world applications:** Connecting mathematical concepts to real-life contexts makes the subject more relevant and interesting.
- **Encouraging a growth mindset:** Students often perceive mathematics as a fixed ability rather than a skill that can be developed. Encouraging a growth mindset helps learners see challenges as opportunities to improve, reduce math-related anxiety and building resilience.

Interdisciplinarity in Mathematics Learning

Interdisciplinarity in mathematics learning involves connecting mathematical concepts and methods with other disciplines, such as Science, Technology, Engineering, the Arts, and Social Sciences. This approach not only enriches students' understanding of Mathematics but also highlights its relevance in solving complex, real-world problems. Interdisciplinary learning fosters a holistic view of

mathematics, emphasising its role as a tool for understanding the world. It encourages students to think beyond disciplinary boundaries, preparing them for the challenges of a rapidly changing and interconnected world.

The Place of Practice in Mathematics Learning

Practice occupies a central role in mathematics education. While understanding concepts is essential, it is through practice that students develop the fluency and precision necessary to apply their knowledge effectively. Regular, targeted practice helps reinforce learning, build confidence, and improve problem-solving skills.

- **Reinforcement of concepts:** Repeated practice allows students to internalise mathematical principles and procedures, recognise patterns, and develop efficient problem-solving techniques.
- **Development of procedural fluency:** Mathematics often involves performing calculations or following algorithms. Practicing these procedures helps students perform them accurately and efficiently, freeing up cognitive resources for higher-order thinking.
- **Building problem-solving skills:** Practice exposes students to a variety of problem types, encouraging them to think critically and adapt their strategies to new situations. Regular exposure to challenging problems also fosters perseverance and creativity.
- **Error analysis and learning:** Practice provides opportunities for students to make mistakes and learn from them. By analysing errors, learners develop a deep understanding of concepts and avoid repeating the same mistakes.
- **Retention of knowledge:** Regular practice ensures that mathematical knowledge is retained over time. Spaced repetition, where concepts are revisited at intervals, is particularly effective in strengthening long-term memory.

However, it is important to emphasise quality over quantity in mathematical practice. Mindless repetition of problems without understanding can lead to frustration and disengagement. Practice should be purposeful, diverse, and aligned with the learner's needs and goals.

Learning Standards

Curricular Goals (CGs) and Competencies (Cs) from the NCF-SE 2023

CG-1: Understands numbers (natural, whole, integer, rational, irrational, and real), ways of representing numbers, relationships amongst numbers, and number sets.

C-1.1 Develops understanding of numbers, including the set of real numbers and its properties.

CG-2: Builds deductive and inductive logic to prove theorems related to numbers and their relationships (such as '$\sqrt{2}$ is an irrational number', a recursion relation for *Virahanka* numbers, a formula for the sum of the first *n* square numbers).

C-2.1 Understanding of powers (radical powers) and exponents.

CG-3: Discovers and proves algebraic identities and models real-life situations in the form of equations to solve them.

C-3.1 States and proves remainder theorem, factor theorem, and division algorithm.

C-3.2 Models and solves contextualised problems using equations (for example, simultaneous linear equations in two variables or single polynomial equations), and draws conclusions about a situation being modelled.

C-3.3 Learns Brahmagupta's quadratic formula (in both symbolic and poetic form) and its derivation, and uses it to solve some of the poetic puzzles of Bhaskara as well as modern-day problems.

CG-4: Analyses characteristics and properties of two-dimensional geometric shapes, and develops mathematical arguments to explain geometric relationships.

C-4.1 Describes relationships including congruence of two-dimensional geometric shapes (such as lines, angles, triangles) to make and test conjectures and solve problems.

C-4.2 Proves theorems using Euclid's axioms and postulates for triangles and quadrilaterals, and applies them to solve geometric problems.

C-4.3 Proves theorems about the geometry of a circle, including its chords, subtended angles, inscribed polygons, and area in terms of pi.

C-4.4 Understands the irrationality of pi, the best approximations to be discovered over human history, and the first exact formula (infinite series) for pi given by Madhava.

C-4.5 Specifies locations and describes spatial relationships using coordinate geometry, for example, plotting a pair of linear equations and graphically finding the solution, or finding the area of triangle with given coordinates as vertices.

C-4.6 Understands the definitions of the basic trigonometric functions, their history and motivation (including the introduction of the sin and cos functions by Aryabhata using chords), and their utility across the sciences.

CG-5: Derives and uses formulae to calculate areas of plane figures, surface area, and volumes of solid objects.

C-5.1 Visualises, represents, and calculates the area of a triangle using Heron's formula and its generalisation to cyclic quadrilaterals given by Brahmagupta's formula.

C-5.2 Visualises and uses mathematical thinking to discover formulae to calculate surface areas and volumes of solid objects (cubes, cuboids, spheres, hemispheres, right circular cylinders or cones, and their combinations).

CG-6: Analyses and interprets data using statistical concepts (such as measures of central tendency, standard deviations) and probability.

C-6.1 Applies measures of central tendencies, such as mean, median, and mode.

C-6.2 Applies concepts from probability to solve problems on the likelihood of everyday events.

CG-7: Begins to perceive and appreciate the axiomatic and deductive structure of Mathematics.

C-7.1 Proves mathematical statements and carries out geometric constructions using stated assumptions, axioms, postulates, definitions, and mathematics vocabulary.

C-7.2 Visualises and appreciates geometric proofs for algebraic identities and other 'proofs without words'.

C-7.3 Proves theorems using Euclid's axioms and postulates for angles, triangles, quadrilaterals, circles, area-related theorems for triangles, and parallelograms.

C-7.4 Constructs different geometrical shapes like bisectors of line segments, angles and their bisectors, triangles, and other polygons, satisfying given constraints.

CG-8: Builds skills, such as visualisation, optimisation, representation, and mathematical modelling along with their application in daily life.

C-8.1 Models daily-life phenomena and uses representations, such as graphs, tables, and equations to draw conclusions.

C-8.2 Uses two-dimensional representations of three-dimensional objects to visualise and solve problems, such as those involving surface area and volume.

C-8.3 Employs optimisation strategies to maximise desired quantities (such as area, volume, or other output) under given constraints.

CG-9: Develops computational thinking, i.e., deals with complex problems and is able to break them down into a series of simple problems that can then be solved by suitable procedures/algorithms.

C-9.1 Decomposes a problem into sub-problems.

C-9.2 Describes and analyses a sequence of instructions being followed.

C-9.3 Analyses similarities and differences among problems to make one solution or procedure work for multiple problems.

C-9.4 Engages in algorithmic problem-solving to design such solutions.

CG-10: Knows and appreciates important contributions of mathematicians from India and around the world.

C-10.1 Recognises the important contributions made by mathematicians (Indian and others) in the field of Mathematics (such as the evolution of numbers, geometry, and algebra).

C-10.2 Recognises modern contributions to Mathematics made in both India and abroad, and understands the next frontiers and next major open questions in the field of Mathematics.

CG-11: Explores connections of Mathematics with other subjects.

C-11.1 Applies mathematical knowledge and tools to analyse problems or situations in multiple subjects across Science, Social Science, Visual Arts, Music, Vocational Education, and Sports.

Development of the Competencies

Grade 9

Themes (Instructional Hours)	Themes Outlines/Key Concepts	Learning Outcomes (Pertinent) Cgs, Cs
1. Coordinate Geometry (4 hours)	• Brief history of coordinate geometry • The 2-D Cartesian coordinate system • Distance between two points in the 2-D plane • Midpoint of the distance between two points in the 2-D plane	The student will be able to: • Specify locations and the position of one point relative to another point using coordinates. • Represent a floor plan on a grid using coordinates. • Compute the distance between two points using coordinates. • Determine whether three points lie in a straight line using coordinates. • Compute the position of the midpoint of a line segment using coordinates. • Check whether a triangle is right-angled using coordinates. • Apply computational thinking to model situations on the coordinate plane and verify geometric properties through systematic reasoning. **Relevant CGs: CG-4, C-4.5, CG-9**
2. Introduction to Polynomials (8 hours)	• Algebraic expressions • Definition of a polynomial. Degree of a polynomial • Introduction to linear polynomials and applications • Exploring linear patterns • Modelling linear growth and linear decay • Linear relationships • Visualising linear relationships • Slope and y-intercept of a line y = ax + b	The student will be able to: • Understand the meaning of an algebraic expression. • Define a polynomial. • Identify the degree, terms and coefficients of terms in a polynomial. • Model linear growth and decay using linear polynomials. • Explain and identify patterns in linear relationships. • Identify the slope and y-intercept of a linear equation in two variables. • Graph a linear equation in two variables. • Use computational thinking to identify patterns, construct linear expressions, and systematically represent and analyse linear relationships using equations and graphs. **Relevant CGs: CG-3, C-3.2 , CG-9**

3. Number Systems (8 hours)	• Introduction to rational numbers • Representation of rational numbers on the number line • Density of rational numbers and its proof • Finding rational numbers between any two rational numbers • Decimal representation of rational numbers • Introduction to irrational numbers • Proof of irrationality of $\sqrt{2}$ and $\sqrt{3}$ • The square root spiral	The student will be able to: • Understand the concept of a rational number. • Represent rational numbers on the number line. • Understand the properties of rational numbers. • Explain the concept of density of rational numbers. • Compute decimal representation of rational numbers. • Understand the concept of irrational numbers. • Prove the irrationality. • Construct the square root spiral. • Apply computational thinking to represent rational and irrational numbers through algorithms and visual models, generate decimal expansions systematically, and reason about numbers using step-by-step logical procedures. **Relevant CGs: CG-1, C-1.1, CG-9**
4. Introduction to Euclid's Geometry: Axioms and Postulates (4 hours)	• History of geometry • Constructing a square with a given side as described in the Baudhayana's *Sulbasutras* • Discovering Euclid's definitions • Axioms: Axioms of measurement and rules for geometric objects	The student will be able to: • Describe how geometry grew from the practical needs ancient civilisations. • Describe contributions of India, Egypt and Greece to the development of geometric ideas. • Understand the role of definitions, axioms, and postulates. • Explain that there are elements of plane geometry (point, line, surface) for which we have an intuitive sense. • State the 5 postulates of Euclidean geometry. • Define parallelism of straight lines. • Explain the construction of a square as given in the *Sulbasutras*. • Justify simple constructions using the axioms. **Relevant CGs: CG-7, C-7.1, C-7.3**
5. Lines and Angles (6 hours)	• Rays and angles • Measures of angles • Intersecting lines and angles • Pairs of angles • Theorems and examples on intersecting lines • Theorems and examples on parallel lines	The student will be able to: • Explain the notion of an angle. • Explain the notion of a ray. • Explain that angles are formed between two rays with a common starting point. • State that a straight angle equals two right angles and measures 180° while a right angle measures 90°. • Classify angles as acute, right, obtuse, or reflex. • Define parallelism. • State and apply the linear pair theorem and its converse.

		• Follow proof by contradiction in geometry. • Prove that vertically opposite angles are equal. • Identify corresponding, alternate, and interior angles. • Explain transitivity of parallelism. • Explain why a triangle must have at least two acute angles; why it cannot have two obtuse angles, or all three angles less than 60° • Apply computational thinking to analyse geometric ideas by breaking constructions into ordered steps, using axioms and postulates as rules, and justifying geometric results through logical step-by-step reasoning. **Relevant CGs: CG-7, C-7.1, C-7.3, CG-9**
6. Sequences and Progressions (10 hours)	• Introduction to sequences • Explicit or general rule of a sequence • Recursive rule of a sequence • Arithmetic Progressions (AP): nth term, visualising an AP, and practical contexts leading to APs • Sum of the first n natural numbers • Geometric Progressions (GP): nth term, visualising a GP, and practical contexts leading to GPs • Applications of GP in fractals • Tower of Hanoi puzzle	The student will be able to: • Understand the concept of a sequence of numbers. • Identify the pattern in a sequence and predict the next few terms. • Determine the recursive and explicit rules for different sequences. • Obtain the terms of a sequence given its recursive and explicit rule. • Identify Arithmetic Progressions (AP). • Determine the nth term of an AP. • Visualise an AP graphically. • Identify Geometric Progressions (GP). • Determine the nth term of a GP. • Visualise a GP graphically. • Analyse attributes of fractals using GP. • Solve the Tower of Hanoi puzzle. • Use computational thinking to identify patterns, write step-by-step rules, and model patterns in sequences and progressions. **Relevant CGs: CG-11, C-8.1, CG-9**
7. Triangles: Congruence Theorems (12 hours)	• Practical applications and uses of triangles • Conditions of congruence of triangles and their proofs • Theorems on triangles • Propositions and converse of a proposition • Problems based on applications of theorems on triangles	The student will be able to: • Explain that a triangle is rigid, unlike a quadrilateral. • Identify uses of triangle rigidity. • Explain why triangles give strength and stability to structures. • Describe what it means for two triangles to be congruent. • Identify correspondence between the vertices, sides, and angles of two congruent triangles. • Use the SAS congruence axiom. • Use the SSS congruence condition.

		• Use the ASA congruence condition. • Use the RHS congruence condition. • Use the AAS congruence condition. • Prove the basic properties of isosceles triangles. • Explain the notion of a proposition. • Explain the notion of converse of a proposition. • Identify the converse of a given proposition. • Explain that not all converses are true; use counter examples to show that some converses are false. • Explain why SSA is not, in general, a valid congruence condition. • Identify the situations where SSA is a valid congruence condition. • Justify the role of diagram accuracy. **Relevant CGs: CG-4, C 4.1, C-7.3**
8. Mensuration: Area and Perimeter (10 hours)	• Perimeter of shapes • Perimeter of a circle: Introduction to Pi and its irrationality • Length of an arc • Area of shapes: rectangles, parallelograms, and triangles • Heron's formula • Squaring a rectangle: Proof from Baudhayana's *Sulbasutras* • Area of a circle: derivation • Area of the sector of a circle • Brahmagupta's formula for area of a cyclic 4-gon • Heron's formula as a special case of Brahmagupta's formula	The student will be able to: • Define perimeter as the length around the boundary of any shape. • Explain that the circumference-to-diameter ratio is constant for all circles. • List historical approximations to π (from Archimedes, Aryabhata, and Zu Chongzhi). • Compute the circumference of a circle and the length of an arc. • Apply ideas of circle perimeter and arc-length to real-world contexts. • Explain why a median of a triangle divides it into two triangles of equal area. • Use Heron's formula to compute the area of a triangle from its sides. • Explain the classical problem of 'squaring' a given shape. • Explain how ancient civilisations approximated the area of a circle. • Compute the area of a circle using the formula. • Explain and use the formula for area of a sector of a circle. • Solve problems on areas of sectors and segments of circles. • State Brahmagupta's formula for the area of a cyclic quadrilateral in terms of its sides. • Explain why Heron's formula is a 'special case' of Brahmagupta's formula. • Explain the notion of 'special case' and 'generalisation' in mathematics.

		• Use computational thinking to break down shapes, apply step-by-step methods to calculate perimeter and area, recognise patterns across formulae, and understand generalisation and special cases in geometry. **Relevant CGs: CG-5, C-5.1, CG-9**
9. Exploring Algebraic Identities (12 hours)	• Revisiting algebraic identities • Visualising identities using geometrical models • Factorisation of algebraic expressions using identities • More identities and their applications • Visualising factorisation of quadratic expressions through algebra tiles • Factorisation without using algebra tiles • Finding new identities • Simplifying rational expressions	The student will be able to: • Visualise algebraic identities using geometric models. • Determine the factors of algebraic expressions using identities. • Interpret factors of quadratic expressions through geometric models. • Find simplified versions of rational expressions. • Use computational thinking strategies, such as decomposition and step-by-step procedures to visualise algebraic identities, factor expressions, and simplify rational expressions. **Relevant CGs: CG-7, C-7.2, CG-9**
10. 4-gons (Quadrilaterals) (12 hours)	• Properties of parallelograms • Important theorems related to parallelograms and their proof • The midpoint theorem and its applications • Understanding the notion of central symmetry in the context of parallelograms	The student will be able to: • Frame a precise definition of a 4-gon. • Prove various characterisations of a parallelogram. • Prove the midpoint theorem. • Prove a converse of the midpoint theorem. • Prove that the medians of a triangle are concurrent and each median is divided in the ratio 2:1 at the point of concurrence. • Prove that the 4-gon formed by joining the midpoints of a given 4-gon is a parallelogram. • Find the coordinates of the midpoint of a line segment given its end points and find the coordinates of the fourth vertex of a parallelogram given the other three. • Understand reflection and rotation symmetries of 4-gons. • Understand how any 4-gon can tile a plane. • Practice forming logical converses of statements and asking questions guided by converses of theorems. • Engage in drawing, measurement and paper manipulation activities to discover geometric patterns involving triangles and 4-gons. **Relevant CGs: CG-4, C-4.2, C-7.3**

11. Circles (12 hours)	• Practical applications and uses of circles • Definitions related to a circle — centre, diameter, and radius • Chords and the angles they subtend • Midpoints and perpendicular bisectors of chords • Distance of chords from the centre • Subtended angles by an arc • Cyclicity of points	The student will be able to: • State the definition of a circle. • Explain the meanings of the terms 'chord', 'diameter', 'radius', 'arc', 'segment', and 'sector'. • Explain why there exists a unique circle through three non-collinear points. • Construct the circumcircle and circumcentre of a triangle. • Describe the location of the circumcentre for acute, obtuse, and right-angled triangles. • Explain what 'angle subtended by an arc at the centre' means. • Explain why 'equal chords subtend equal angles at the centre'. • Explain why 'chords that subtend equal angles at the centre are equal'. • Explain why 'the line from the centre of a circle to the midpoint of a chord is perpendicular to the chord'. • Explain why 'a perpendicular from the centre to a chord bisects the chord'. • State the relationship between length of a chord and its distance from the centre of the circle. • Explain why 'equal chords are equidistant from the centre (and conversely)'. • Explain why 'among unequal chords, the longer chord is closer to the centre'. • Explain why 'the diameter is the longest chord'. • Explain why 'the angle subtended by an arc at the centre is double the angle subtended by the arc at any point on the remaining part of the circle'. • Explain why 'angles in the same segment of a circle are equal'. • Explain why 'the angle in a semicircle is a right angle'. • Determine when four given points are concyclic. • Explain why 'a quadrilateral with supplementary opposite angles is cyclic, and conversely'. • Explain how circular wheels have influenced transport, farming, building, and technology. • Identify cultural motifs involving circles, for example, the Dharmachakra, Ashoka Chakra, Sudarshan Chakra.

		• Use computational thinking to break down circle-related problems, apply geometric rules step-by-step, and verify properties of figures, such as chords, angles, and cyclic quadrilaterals through systematic reasoning. **Relevant CGs: CG-4, C-7.3, CG-9**
12. Linear Equations in Two Variables (14 hours)	• Introduction to linear equations in two variables through practical examples • Solution of linear equation in two variables: graphical representation • Slope-intercept form of linear equation in two variables • Drawing graphs of linear equations when x and y assume only certain values • Pair of linear equations in two variables • Graphical method for solving a pair of linear equations in two variables • Nature of solutions: consistency and inconsistency • Algebraic methods of solving a pair of linear equations: method of substitution and method of elimination	The student will be able to: • Understand the concept of a linear equation in two variables. • Graph a pair of linear equations. • Solve a pair of linear equations graphically. • Solve a pair of linear equations through the methods of substitution and elimination. • Determine the nature of solutions of a pair of linear equations. • Model and solve contextualised problems using a pair of linear equations and draw conclusions. • Model daily-life phenomena using representations, such as graphs, tables, and equations. • Use computational thinking to systematically represent, solve, and interpret pairs of linear equations through graphs, tables, and step-by-step procedures. **Relevant CGs: CG-3, C-3.2, C-8.1, CG-9**
13. Mensuration: Surface Area and Volume (6 hours)	• Surface areas and volumes of spheres (including hemispheres) and right circular cones	The student will be able to: • Recognise cuboids and cubes in real-life situations. • Compute the surface area and volume of a cuboid. • Explain how a cube is a 'special case' of a cuboid. • Describe a right circular cylinder using its radius and height. • Compute the surface area and volume of a cylinder. • Recognise cones in daily life, and describe them using radius and height. • Compute the surface area and volume of a cone.

		• Recognise a pyramid, and identify its base and apex. • Compute the surface area and volume of a pyramid. • Recognise spheres in real-life situations. • Compute the surface area and volume of a sphere. • Use computational thinking to systematically calculate, and compare surface areas and volumes of 3-D shapes by varying dimensions and analysing patterns. **Relevant CGs: CG-5, C-5.1, CG-9**
14. Statistics (8 hours)	• Graphical representation of data • Measures of central tendency	The student will be able to: • Collect, organise, visualise and interpret data to answer a statistical investigative question. • Compute and apply weighted average in different settings. • Read and interpret stacked bar graphs and 100% stacked bar graphs. • Apply computational thinking strategies to analyse real-life data, create appropriate graphical representations, and interpret mean, median and mode for decision-making. **Relevant CGs: CG-6, C-6.1, CG - 9**
15. Introduction to Probability (8 hours)	• Concept of probability and randomness • The probability scale • Empirical probability: analysing statistical data and performing experiments • Theoretical probability: sample space and events • Representing probability through tree diagrams and tables	The student will be able to: • Understand the concept of randomness. • Describe the likelihood of an event using the probability scale. • Estimate the empirical probability of the occurrence of an event by analysing statistical data. • Define theoretical probability of an event. • Apply the definition of theoretical probability to compute the probability of an event. • Compute probability of events with the help of tree diagrams and tables. • Use computational thinking strategies, such as pattern recognition and simulation, to model random experiments and estimate probabilities. **Relevant CGs: CG-6, C-6.2, CG - 9**
Total Number of Hours = 134	• Themes 1 to 8 may be covered in 74 hours • Themes 9 to 15 may be covered in 60 hours	

Pedagogy / Instructional Methods

Mathematics education at the secondary stage aims to transition learners from routine computation and applying procedures towards abstraction, reasoning, modelling and meaningful applications. According to the NCF-SE 2023 (Chapter 3), students at this stage should develop capacities for logical thinking, identifying patterns, formal argumentation leading to proof, problem solving, and computational thinking. Achieving these aims requires thoughtful instructional design and pedagogy that supports conceptual understanding and illustrates real-life relevance of Mathematics as a discipline.

Assessment

Elements of Assessment in Mathematics

Assessment in mathematics serves multiple purposes: monitoring student progress, identifying learning gaps, providing feedback, and evaluating overall achievement. Effective assessment practices involve a variety of methods to capture the full range of students' mathematical understanding and skills. Assessment is not just a tool for evaluation but a critical component of the teaching-learning process. By adopting effective pedagogical approaches and diverse assessment methods, mathematics education can foster deep understanding, critical thinking, and a love for lifelong learning in students.

Formative Assessment

Formative assessment is an ongoing process used during the learning journey to monitor student progress and provide immediate feedback. It helps teachers identify areas where students struggle and adjust instruction accordingly. Key features and methods of formative assessment include:

- **Observations and questioning:** Teachers can observe students during problem-solving activities or ask open-ended questions to gauge understanding. For instance, "Why do you think this method works?" encourages deeper thinking.

- **End of lesson tasks:** At the end of a lesson, students can complete a quick task or answer a question to demonstrate their understanding of the day's topic.
- **Mini quizzes:** Short, low-stakes quizzes help teachers check for understanding without the pressure of formal tests.
- **Peer and self-assessment:** Encouraging students to evaluate their own or their peers' work fosters reflection and critical thinking.
- **Mathematical discussions:** Classroom discussions allow students to share their thought processes and reasoning, providing insights into their understanding.

Formative assessment is not about assigning grades but about improving learning. Feedback should be specific, constructive and actionable, guiding students on how to improve.

Summative Assessment

Summative assessment evaluates student learning at the end of a unit, term, or course. It provides a snapshot of what students have achieved and is often used for grading or certification. Common forms of summative assessment include:

- **Written tests and exams:** These assess a range of skills, from procedural fluency to problem-solving and mathematical reasoning. For example, a test on algebra might include solving equations, graphing functions, and applying algebraic concepts to word problems.
- **Standardised assessments:** National or regional standardised tests evaluate students' proficiency according to prescribed benchmarks.
- **Project reports:** Long-term projects, such as statistical surveys or mathematical modelling, can be evaluated as part of summative assessment.

Summative assessments should cover a balance among content knowledge, procedural skills, and higher order thinking to provide a comprehensive evaluation of students' abilities.

Assessment Through Open-Ended Exploratory Work and Projects

Open-ended tasks and projects assess students' ability to think critically, explore multiple solutions, and apply mathematics creatively. These assessments go beyond routine problems and encourage higher-order thinking. Some examples include:

- **Open-ended problems:** Tasks that have no single correct answer or require multiple steps to solve. For instance, 'design a floor plan for a house using geometric principles' allows students to explore shapes, measurements, and area calculations.
- **Mathematical investigations:** Students explore a problem or concept in depth, such as investigating patterns in number sequences or studying the properties of geometric figures.
- **Data analysis projects:** Assigning students to collect, analyse, and interpret real-world data fosters statistical thinking. For example, students might conduct a survey on a school-related issue and present their findings using charts and graphs.
- **Interdisciplinary projects:** Projects that connect Mathematics to other fields, such as Science or Economics, show the practical utility of Mathematics. For instance, students might analyse the cost-effectiveness of renewable energy sources using mathematical models.

These assessments provide insights into students' creativity, critical thinking, and ability to apply mathematics in non-routine contexts.

In accordance with the National Education Policy (NEP) 2020 and the National Curriculum Framework for School Education (NCF-SE) 2023, assessment at the secondary stage (Grades 9 and 10) shall be competency-based, learner-centric and flexible with provision for two levels of assessment to address learner diversity, interests and aspirations.

As per the NEP 2020 perspective, assessment in Mathematics at this stage shall be conducted at two levels:

Two-level Assessment

(a) Proficiency Level (Mandatory for all Students)

The Proficiency Level assesses essential competencies expected of all learners, including:

- Conceptual understanding.
- Application of knowledge in familiar and real-life contexts.
- Procedural fluency and foundational reasoning.

All students shall appear in the Proficiency Level assessment. Performance at this level shall be reflected in the marks obtained and recorded in the marksheet.

(b) Advanced Level (Optional)

The Advanced Level is intended for learners who demonstrate deeper interest, aptitude or readiness in a subject. It assesses:

- Multi-concept integration.
- Application in unfamiliar and complex contexts.
- Strategic competence, adaptive reasoning and productive disposition

Performance at the Advanced Level shall be recognised separately as per the assessment policy of the concerned examining body.

Examination Structure for Two-level Assessment

(a) Proficient Level Examination

- A question paper with 100 marks standard examination to assess conceptual understanding, application of concepts in real life, procedural fluency, etc.
- All students will attempt a 100 marks standard examination.
- Marks obtained in this exam will appear in the marks sheet.
- The difficulty of the questions in this exam would be distributed as: easy (25%), medium (50%), and difficult (25%).

(b) Advanced Level Examination

- Interested students will take an optional Advanced Level examination.
- Assessment of multi-concept integration, application of concept in unknown scenarios, strategic competence, adaptive reason, and productive disposition, etc.
- Students who clear Advanced Level will have the mention along with the percentile obtained in the advanced exam.
- If a student attempts an Advanced Level examination and does not clear it, it is not to be mentioned in the certificate.
- The difficulty of the questions in this exam would be distributed as: easy (15%), medium (25%), and difficult (60%).

Role of Textbooks in Two-level Assessment

Textbooks developed as per NCF-SE 2023 are designed to support both levels of assessment.

- All core content, examples, and exercises in each theme address the Proficiency and Advanced Level competencies.

- Ensure learning opportunities for all students.
- Avoids academic labelling.
- Encourages learners to progress at their own pace.
- Provides recognition to students with advanced aptitude without imposing additional burden on others.
- Holistic Progress Cards to be integrated for formative assessment, and incorporate self-assessment and peer assessments. Questions can be at different levels, starting with a basic understanding of concepts, development of various capacities, values, interdisciplinary linkages, application of concepts in real life in known and unknown situations, critical evaluation, exploration and research, etc.
- This framework supports holistic development while maintaining academic rigour and alignment with national curricular goals.

Guidance for Teachers and Schools

- Teachers shall transact the textbook, ensuring that at least grade level competencies are achieved by the learner.
- Enrichment tasks to be introduced after students have attained conceptual clarity at the Proficiency Level. For this, the Advanced Level questions have been asterisked (*) in the textbook itself.
- Students opting for the Advanced Level assessment should be provided with additional academic support through:
    - Guided discussions
    - Independent projects
    - Analytical writing or problem-solving tasks
    - Use of supplementary resources, digital content, and reference materials

Importantly, no separate syllabus is prescribed for the advanced level. Both levels draw from the same syllabus and learning outcomes.

Best Practices for Assessment in Mathematics

To make assessment effective and meaningful, the following principles should be followed:

- **Diverse assessment methods:** Use a mix of formative, summative, and exploratory assessments to capture the full range of students' skills and understanding.

- **Alignment with learning goals:** Assessment tasks should align with the objectives of the curriculum, focusing on both conceptual understanding and procedural fluency.
- **Timely and constructive feedback:** Feedback should highlight strengths, identify areas for improvement, and provide actionable steps for growth.
- **Encouraging reflection:** Assessment should encourage students to reflect on their learning, helping them identify their strengths and weaknesses.
- **Inclusion of real-world contexts:** Real-life problems and interdisciplinary tasks make assessment more engaging and relevant.

Textbook: NCF-SE 2023 aligned new textbook of Mathematics for Grade 9 developed by the NCERT.

Social Science

Introduction

The teaching and learning of Social Science at the secondary stage is aligned with the transformational vision of the National Curriculum Framework for School Education (NCF-SE) 2023 and the National Education Policy (NEP) 2020. The NCF-SE 2023 emphasises learning, i.e., competency-based, inquiry-oriented, and rooted in Indian Knowledge Systems (IKS) and lived realities. The deliberate reduction of content load with a focus on core concepts rather than memorisation, creates space for discussion, exploration, and deep understanding. The framework's call for interdisciplinarity encourages students to draw meaningful connections across disciplines and relate classroom learning to real-life contexts and experiences.

Furthermore, the NCF-SE 2023 envisions rootedness in India, in which learning is grounded in India's diverse heritage and intellectual traditions, while also being combined with a global outlook. Within this perspective, Social Science education engages students with India's historical experiences, democratic values, and patterns of economic and social development, geographical understanding alongside global processes and contemporary challenges. By integrating the aims of the NEP 2020, Social Science education seeks to transform learning into a process that builds knowledge, capacities, and values essential for personal growth, social harmony and national progress.

Social Science at the secondary stage is an integrated study of human society like its evolution, structures, and dynamics through the disciplines of History, Geography, Political Science, and Economics. It explores how societies function and transform over time through the interplay of historical, geographical, cultural, political, economical, and environmental forces. The subject goes beyond the factual understanding to include inquiry, interpretation, and analysis.

Students learn to source and validate information, interpret data and evidence, and construct logical explanations, thus fostering critical and reflective thinking. It also cultivates empathy, respect for diversity, and a sense of justice and responsibility—values that reflect India's intellectual traditions of reasoning, dialogue, and debate as pathways to truth and understanding.

The primary aim of Social Science education in Grades 9 and 10 is to enable learners to understand how human societies function and transform across time and space, and to equip them with the capacities to participate meaningfully in civic and social life. As outlined in the NCF-SE 2023, the aims are threefold:

1. **Understanding society:** To help students comprehend how societies function through historical, geographical, political, economical, and cultural perspectives.
2. **Developing capacities for inquiry:** To foster critical thinking, analysis, and problem-solving through disciplinary and interdisciplinary approaches.
3. **Nurturing responsible citizenship:** To cultivate the values of compassion, justice, equality, and sustainability so that learners become engaged citizens contributing to an equitable and plural society.

In alignment with the NEP 2020, Social Science education seeks to develop responsible human beings capable of rational thought and action, possessing compassion, empathy, courage, resilience, scientific temper, and creative imagination—qualities that prepare them to contribute meaningfully to the nation and humanity.

Studying Social Science is essential for developing informed, empathetic, and active citizens. It enables learners to situate themselves within broader social, cultural and environmental contexts, and to recognise their role in shaping them. Through this subject, students understand the origins of democratic values, Constitutional principles, and India's civilisational ethos of unity in diversity. They also develop awareness of pressing issues such as inequality, conflict, environmental degradation and economic challenges, and learn to respond to them with evidence-based reasoning and ethical reflection. Social Science thus, bridges knowledge and action, encouraging learners to think critically about society and participate responsibly and effectively in it.

This syllabus document aims to highlight the rationale and thought behind the curricular area of Social Science at the secondary stage. It is intended to serve as a practical guide for educators and teachers to realise the vision of the NCF-SE 2023 even at the grassroots level, ensuring that the teaching of Social Science becomes a transformative, contextually rooted, and meaningful learning experience for every learner.

Approach

The approach of the Social Science syllabus is to build the disciplinary depth alongside an interdisciplinary and holistic perspective from granular details to an integrated world view and the capacities to develop this world view. While it is understood that the approach to the content is interdisciplinary and integrated, and that it would therefore, be undesirable to strictly delineate time allocations, an indicative time allocation has been suggested as follows: History: 30 per cent; Geography: 23.33 per cent; Political Science: 23.33 per cent; Economics: 23.33 per cent. The instructional hours recommended for Grades 9 and 10 for Social Science in the secondary stage are 125 hours, i.e., 150 periods each. The allocation of the periods across the disciplines has taken this broad agreement into consideration. An introductory chapter on the nature and scope of Social Science is included in Grade 9 to orient students to the secondary stage.

It may be noted that the approach taken is to ensure that the content and pedagogy, along with formative assessment, will facilitate the acquisition of the competencies (please refer to the table below) across the entire secondary stage, and not in specific grades. This is an important aspect, since there is a progression from Grade 9 to Grade 10, and the learning outcomes achieved in each grade contribute to the attainment of the competencies.

The suggested pedagogical elements are intended to enable a student to acquire the competencies listed in the learning standards for the stage. So not all suggested pedagogical elements may appear in the textbook. The teacher may adapt these pedagogies based on the needs of students and the context. The pedagogical elements (pictures and activities) also lend themselves to formative assessments by the teacher and will help fine tune teaching strategies towards facilitating

and supporting the students in the acquisition of competencies. The in-text and end-of-chapter questions and exercises can also aid in summative assessments. For example, teachers can choose questions from these at the end of each theme to assess the knowledge, capacities and values that a student is able to demonstrate at a point in time. These markers help teachers, parents, as well as the students themselves, to get a more holistic picture of the students' progress over time.

We finally note that while the number of chapters in each grade is carefully structured with 16 chapters in each of Grades 9 and 10, they are also intended to be lighter in content, with a substantially greater use of graphics and visuals with the focus on core concepts, essential ideas or significant developments rather than on the accumulation of facts and figures.

Learning Standards

Curricular Goals	Competency	Competencies Description
CG-1 Understands and analyses the important phases in Indian history and draws insights to understand present-day India	C-1.1	Explains the historical events and processes using different types of sources with specific examples from Indian history
	C-1.2	Explains and analyses the chronology of human life on the Indian subcontinent, from prehistory to its civilisational beginnings and beyond, and its relations with other civilisations over time, such as those in Mesopotamia, Greece, Central Asia, China, Southeast Asia, Arabia, and Eastern Africa
	C-1.3	Traces aspects of continuity and change in different phases of history across the Indian subcontinent (including cultural trends, social and religious trends and reforms, and economic and political transformations)
	C-1.4	Explains the growth of new indigenous ideas across India in Mathematics, Philosophy, Science and Technology, Medicine, Architecture, Agriculture, Literature and Art, and Social Science (such as zero and the Indian number system, *ahimsa*, the six systems of Indian philosophy, Ayurveda, yoga, the

		22 *shrutis* of Indian music, horticulture, use of herbs and spices, etymology, meters, and grammar) and how they affected the course of the Indian history
CG-2 Analyses the important phases in world history and draws insights to understand the present-day world	C-2.1	Explains historical events and processes with different types of sources, with specific examples from the world history
	C-2.2	Explains and analyses the chronology of human life from its beginnings to nomadism to settled life to other phases of human civilisation
	C-2.3	Traces aspects of continuity and change in different phases of the world history (including cultural trends, social and religious reforms, and economical and political transformations)
	C-2.4	Explains the growth of new ideas and practices across the world (including humanism, mercantilism, industrialisation, scientific developments and explorations, imperialism, colonialism, the rise of the new nation states across the world, and various technologies including the most current) and how they affected the course of world history
	C-2.5	Recognises the various practices that arose, such as those in C-2.4, and came to be condemned later on (such as racism, slavery, colonial invasions, conquest, and plunder, genocides, exclusion of women from democratic and other institutions), all of which have also impacted the course of the world history and have left unhealed wounds
CG-3 Understands the idea of a nation and the emergence of the modern Indian nation	C-3.1	Analyses the meaning of nation and how the concept evolved over time across the world and in the specific context of India, including its roots in the rich civilisational history of the Indian subcontinent
	C-3.2	Identifies and analyses important phases of the Indian national freedom struggle against the British colonial rule with special reference to the movement led by Mahatma Gandhi and including other important figures as well as those that led to Independence, and understands the specific Indian concepts, values and methods (such as *swaraj*, *swadeshi*, passive resistance, fight for *dharma*, self-sacrifice, *ahimsa*) that played a part in achieving Independence

CG-4: Develops an understanding of the interrelationship between human beings and their physical environment and how that influences the livelihoods, culture, and the biodiversity of the region	C-4.1	Locates physiographical regions of India and the climatic zones of the world on a globe/map
	C-4.2	Explains important geographical concepts, characteristics of key landforms, their origin, and other physical factors of a region
	C-4.3	Draws inter-linkages between various components of the physical environment, such as climate and relief, climate and vegetation, and vegetation and wildlife
	C-4.4	Analyses and evaluates the inter-relationship between the natural environment and human beings and their cultures across regions and, in the case of India, the special environmental ethos that resulted in the practices of nature conservation
	C-4.5	Critically evaluates the impact of human interventions on the environment, including climate change, pollution, shortages of natural resources (particularly water), and loss of biodiversity; identifies practices that have led to these environmental crises and the measures that must be taken to reverse them
	C-4.6	Develops sensitivity towards the judicious use of natural resources (by individuals, societies, and nations) and suggests measures for their conservation
CG-5: Understands the Indian Constitution and explores the essence of Indian democracy and the characteristics of a democratic government	C-5.1	Understands that the Indian Constitution draws from the great cultural heritage and common aspirations of the Indian nation, and recalls India's early experiments with democracy (assemblies in Mahajanapadas, kingdoms and empires at several levels of the society, guilds, *sanghas* and *ganas*, village councils and committees, and Uthiramerur inscriptions)
	C-5.2	Appreciates fundamental Constitutional values and identifies their significance for the prosperity of the Indian nation
	C-5.3	Explains that the fundamental rights are the most basic human rights, and they flourish when people also perform their fundamental duties
	C-5.4	Analyses the basic features of a democracy and democratic government, its history in India and across the world, and compares this form of government with the other forms of government

	C-5.5	Analyses the critical role of non-state and non-market participants in the functioning of a democratic government and society, such as the media, civil society, socio-religious institutions, and community institutions
CG-6: Understands and analyses social, cultural, and political life in India over time–as well as the underlying historical Indian ethos and philosophy of unity in diversity–and recognises challenges faced in these areas in the past and present, and the efforts (being) made to address them	C-6.1	Understands how the Indian ethos and the cultural integration across India did not attempt uniformity, but respected and promoted a rich diversity in Indian society, and how this harmonisation and unity in diversity, with a historical respect for all cultures, women have counted among India's great strengths by promoting peaceful coexistence
	C-6.2	Understands that, despite C-6.1, forms of inequality, injustice, and discrimination have occurred in different sections of society at different times (due to internal as well as outside forces, such as colonisation), leading to political, social, and cultural efforts, struggles, movements, and mechanisms at various levels towards equity, inclusion, justice, and harmony, with varying outcomes and degrees of success
	C-6.3	Analyses aspects of differential treatment or discrimination that may exist in the Indian society, based on, socio-cultural background, region, language spoken, and what individuals and societies can do to eradicate such differential treatment
	C-6.4	Understands that a progressive society and nation, such as India is one that recognises not only its civilisational strengths but also its socio-economic, cultural and political challenges, and continuously makes efforts to address those challenges to become ever more prosperous, inclusive, just, and harmonious
CG-7: Develops an understanding of the economy of a nation with specific reference to India	C-7.1	Defines key features of the economy, such as production, distribution, demand, supply, trade and commerce, and factors that influence these aspects (including technology)
	C-7.2	Evaluates the importance of the three sectors of production (primary, secondary, and tertiary) in any country's economy, especially India

	C-7.3	Distinguishes between 'unorganised' and 'organised' sectors of the economy and their role in production for the local market in small, medium, and large-scale production centres (industries), and recognises the special importance of the so-called 'unorganised' sector in Indian economy and its connections with the self-organising features of the Indian society.
	C-7.4	Traces the beginning and importance of large-scale trade and commerce (including e-commerce) between one country and another—the key items of trade in the beginning and the changes from time to time
CG-8: Evaluates the economic development of a country in terms of its impact on the lives of its people and nature	C-8.1	Gathers, comprehends, and analyses data related to income, capital, poverty, and employment in one's locality, region and at the national level
	C-8.2	Understands and analyses the concepts and practices of the range of economic systems—from free market to entirely state-controlled markets
	C-8.3	Understands these features in the context of ancient India, with its thriving trade, both internal and external, and its well-established trade practices and networks, business conventions, and diverse industries, all of which made India one of the world's leading economies up to the colonial period
	C-8.4	Describes India's recent path towards becoming one of the three largest economies of the world again, and how individuals can contribute to this economic progress
	C-8.5	Appreciates the connections between economic development and the environment, and the broader indicators of societal well-being beyond GDP growth and income
CG-9: Understands and appreciates the contributions of India through history and present times, to the overall field of Social Science, and the disciplines that constitute it	C-9.1	Knows and explains the significant contributions of India to all matters (concepts, explanations, methods) studied within the curriculum, in an integrated manner

Achievements of the Goal

Grade 9			
Part 1			
S. No.	**Theme (time allocation in instructional hours)**	**Outline/Concepts**	**Learning Outcomes CGs, Cs Students will be able to:**
1.	Understanding Social Science (4 Hours)	• Meaning, scope and relevance of Social Science • Understanding Social Science from an Indian perspective	• Explain the relevance of studying Social Science to understand society, environment, economy, and governance in our lives. • Explain the meaning and scope of Geography, History, Political Science, and Economics as disciplines and recognise their interconnections. • Appreciate diversity, inclusivity, sustainability, and equity as guiding values when studying society and making decisions.
2.	Shaping of the Earth's Surface (8 Hours)	• Theory of plate tectonics • Interior of the Earth • Role of weathering and erosion; agents of gradation — river, waves and currents, wind, glaciers, and underground water • Landforms and disasters: earthquakes, landslides, avalanches, Glacial Lake Outburst Flood (GLOF) and duststroms	C4.2 • Describe the concept of plate tectonics and analyse its relevance in understanding Earth's dynamics. • Locate major tectonic plates on a world map. • Explain processes of weathering and erosion with suitable examples. • Identify the prominent agents of gradation operating in a given region. • Describe major landforms and explain the processes involved in their formation. • Explain the causes of natural disasters and propose strategies for their mitigation.

3.	Atmosphere and Climate (7 Hours)	• Structure and composition; elements of weather and climate • Seasons of India and monsoons • Climate change • Floods • Carbon footprint	C4.3, C4.4, C4.5 • Explain the different atmospheric layers and represent them using sketches and diagrams. • Observe and analyse local winds and their impact. • Understand the impact of the Indian monsoon on life, agriculture, and livelihoods across different regions. • Explain the causes and effects of climate change. • Represent climatic data (temperature, rainfall, etc.) through appropriate graphs, charts, or diagrams. • Analyse how climate change influences the frequency and intensity of natural disasters.
4.	Early Humans and Beginning of Civilisation (9 Hours)	• Cultural development from 2 million years ago • Early human history, periodisation: Archaeological ages • Who are human ancestors? • Palaeolithic hunter-gatherers and use of stone tools • Mesolithic transition to food production: Mesolithic sites and tools • Neolithic and the beginning of farming: Neolithic revolution domestication of plants and animals • Harappan and contemporary cultures • Mesopotamian, egyptian, and chinese civilisation	C1.2, C2.1, C2.2, C2.3 • Describe how prehistoric time divisions are organised. • Explain how humans lived before the invention of writing • Understand the beginning of the settled life with development of agriculture, and domestication of plants and animals. • Explore the factors of urban development and transformation through time. • Appreciate the diversity of crafts and trade, and their role the establishment of prosperous economy. • Understand the diversity of food habits. • Describe the social, political, and religious structures of the civilisations of Egypt and Mesopotamia.

5.	State and Society (upto 1000 CE) (9 Hours)	• Vedic Age—geography; texts; rituals; political institutions, and social order • Administrative structure of early empires • Quest for knowledge—educational heritage, institutions, knowledge traditions, and cultural practices • Traders and trade routes, guilds and merchants, crafts and industries	C1.3, C2.3, C3.1, C1.4 • Explain various facets of Vedic society and polity. • Appreciate the achievements of Indian empires and their cultural legacy. • Understand the knowledge traditions and practices of India. • Understand the foundations of the Indian social and political institutions and their continuity.
6.	Democracy (9 Hours)	• Meaning features and types of democracy • Roots of democracy in India • Challenges to democracy in India • Democratic systems in the world	C5.1, C5.2 • Understand the features of democracy. • Appreciate early democratic traditions in India and how they influenced modern democracy. • Differentiate between parliamentary and presidential systems. • Identify examples of both systems across countries, such as India, USA, France, Russia, and Canada.
7.	Elections (9 Hours)	• Factors of importance of elections • Electoral systems • Delimitation Commission • Election Commission of India and its role • Constituency, electoral rolls, enumerators • Party system in India	C5.2, C5.3, C5.4, C5.5, C6.2, C6.3, C6.4, C9.1 • Identify factors highlighting importance of elections in a democracy. • Categorise three types of electoral systems and list examples. • Identify the major laws that govern the conduct of elections in India. • Describe the main provisions of the Representation of the People Acts. • Define the concept of delimitation and its purpose in the Indian electoral system. • Identify the role and functions Election Commission of India (ECI) in the electoral process. • Explain constituency, electoral roll, enumerator. • Understand the party system in India. • Explain the meaning and features of a coalition government in the Indian

			political system. Explain key provisions of the Anti-Defection Law with reference to political instability and the need for anti-defection measures.
8.	Building Blocks in Economics (7 Hours)	• Scarcity of resources, opportunity cost and the need for making choice. What do economists do? • What to produce, how to produce, and for whom to produce? • Difference between market, centrally planned, and mixed economic systems • Welfare economy	C8.2 • Explain the meaning of scarcity, choice, and opportunity cost in everyday life, and economic decision-making. • Describe what economists do and how they study production, distribution, and consumption of goods and services. • Recognise how economic analysis helps in policy-making and solving real-world issues. • Describe the three central problems of an economy—what to produce, how to produce, and for whom to produce. • Identify and differentiate the characteristics of planned, free market, and mixed economic systems. • Explain the concept of a welfare economy and the importance of social safety nets.
9.	The Price Puzzle: What Drives the Market (8 Hours)	• Laws of demand and supply • Real-world deviations from textbook theory, such as in case of necessities, luxury goods, perishable items, and expectations • Some related concepts—price ceilings and market failures (externalities, information asymmetry, public goods)	C7.1 • Explain the Law of Demand and Law of Supply with the help of real life examples. • Interpret how changes in price affect the quantity demanded and quantity supplied of goods and services. • Identify the equilibrium price and quantity where demand and supply intersect. • Analyse how changes in market conditions (e.g., increase in demand or supply) lead to surplus or shortage and affect equilibrium. • Explain the concept of price ceilings and how they can lead to shortages or black markets. • Understand market failures and identify their main types. • Understand public goods (non-excludable and non-rival goods like parks or street lighting).

Grade 9			
Part 2			
S. No.	**Theme (time allocation instructional hours)**	**Outline/Concepts**	**Learning Outcomes (pertinent) CGs, Cs** **Students will be able to:**
1.	Oceans and Life (7 Hours)	• Introduction to ocean relief, movement of ocean water-waves, tides and currents • Marine resources and their significance; open seas, navigation fishing, and livelihood concerns and challenges • Cyclones and Tsunamis—early warning systems • International maritime rules and regulations	C4.1, C4.2 • Explain the movement of ocean waters, including waves, tides, and currents. • Analyse the connections between ocean currents, and global and regional climate patterns. • Understand the importance of marine resources for human livelihoods and ecosystems. • Examine the relationship between oceans, climate, livelihoods, and natural disasters. • Highlight key rules, conventions, and international agreements governing ocean navigation. and the use of marine resources. • Explain the need for international cooperation and agreements in the sustainable use of ocean resources. • Construct models or sketches representing ocean relief.
2.	Life on Earth (7 Hours)	• Biomes: Distribution and characteristics; biosphere reserves in India • Forest and ecotourism; forest dwellers, their livelihoods, and challenges • Forest and wildlife conservation • Government efforts to support forest dwellers	C4.3, C4.4, C4.5, C4.6 • Identify the major biomes of the world and describe their key climatic conditions, characteristic flora, and fauna. • Locate biosphere reserves on the map of India. • Appreciate local traditional practices related to biodiversity conservation and analyse their effects.

			• Explain the concept and importance of biosphere reserves in conserving ecosystems and biodiversity. • Analyse the concept of ecotourism and discuss its role in promoting sustainable forest ecosystem and conservation. • Investigate the causes of forest fires in the local area, and prepare a plan for mitigation and prevention.
3.	Resistance and Resilience (1000 CE–1700 CE) (9 Hours)	• Safeguarding sovereignty: resistance, alliances and confederacies • Development of art and architecture, languages and literature • The Bhakti tradition • Forts and fortifications • Expansion of Indian economy and state	C1.3, C1.4, C3.1 • Explain the cultural, political, and military contributions of regional kingdoms in India. • Appreciate how diverse communities and regions shaped India's history from 1000 CE to 1700 CE. • Explore how regional kingdoms adapted to changing political, economic, and cultural contexts over time. • Analyse the continuity of the civilisational history of India as a nation upto 18th century CE.
4.	India and the World-I (1900 BCE-1200 CE) (8 Hours)	• Trade and commerce—trade with Mesopotamia, Greece, Roman Empire, China and Southeast Asia • Cultural Connections—Interactions with Greece and Rome, Central Asia, China, and Influence on South East Asia • Indian Knowledge Systems—Medicine, Mathematics and Astronomy, Medicine, Religion	C1.2, C1.4, C6.1, C2.3, C9.1 • Explore India's relations with early civilisations of the world. • Identify the major articles of trade and the major trading ports. • Appreciate the significant contributions of India in diverse spheres in an integrated manner. • Appreciate the influence of Indian religion and culture, particularly in Southeast Asia.

5.	Authority (10 Hours)	• The Roots of Authority: in Kautilya and *shukraniti-danda* and relationship with *nyaya* and *bala*; the types of *nyaya* and *bala* • Constitutional status of justice and security since ancient times • Links the role of citizens with the elections and the democratic institutions • Types of authority—functional, sensitive, and welfare-oriented	C5.1, C5.2, C 5.3 • Explain the roots of authority in Indian political thought. • Interpret the relationship between *Danda* (discipline/force) and *Nyaya* (justice) as the twin foundations of authority, development, and security. • Trace the evolution of authority structures in India. • Understand the post-independence concept of justice and security. • Illustrate types of authority. • Develop an understanding of citizen discipline, justice, and strength. • Illustrate the role of citizens in authority.
6.	From Ideas to Startups (8 Hours)	• What is entrepreneurship and explain the resources required to start a business • Case studies of successful entrepreneurs • Creative destruction with examples • Start-up ecosystem in India. • Make in India initiative, role of MSMEs and the unorganised sector in India's economic growth. • Stages of starting and executing a business idea through a business plan • Some basic accounting concepts	C7.3 • Define entrepreneurship and explain its importance in innovation, job creation, and economic growth. • Understand the key resources for business. • Explain how resources are managed to produce goods and services. • Analyse real-world examples of successful entrepreneurs. • Describe the features of India's start-up ecosystem and initiatives like Make in India, Startup India, and Digital India. • Recognise the role of Micro, Small, and Medium Enterprises (MSMEs) and the unorganised sector in promoting employment, innovation, and inclusive growth.

			• Identify and explain the stages of starting a business from developing an idea to creating and executing a business plan. • Understand simple profit and loss. • Identify the key components of a balance.
7.	Smart Ways to Manage Your Finances (6 Hours)	• Relevance of personal financial management in daily life • Inflation and its impact on purchasing power • Simple vs. compound interest rate • Budgeting • Various savings and investment options like fixed deposit, stocks, bonds, mutual funds, etc. • Risk and insurance • Personal income tax	CG8 • Explain what personal financial management means and why it is essential in everyday life. • Recognise how managing income, spending, saving, and investment helps achieve financial stability and long-term goals. • Explain the difference between simple interest and compound interest. • Prepare a simple personal or family budget showing income, expenditure, and savings. • Identify various savings and investment instruments. • Understand the relationship between risk and return in different investment types. • Understand the concept of income tax and why citizens are required to pay it.

Pedagogy or Instructional Methods

Pedagogy for teaching geography should integrate experiential, visual, and analytical approaches to make learning more meaningful and connected to the real world. Effective geography teaching goes beyond textbooks—it involves helping students observe, analyse, and interpret the Earth's surface and human-environment relationships. The use of three-dimensional models enables students to visualise complex geographical processes, such as mountain formation, river systems, and soil profiles, thus making abstract concepts tangible. Field observation is an essential pedagogical tool that promotes experiential learning; by directly engaging with local landscapes, students develop geographical inquiry skills, observation techniques, and data collection abilities. Incorporating Bhuvan images, India's indigenous satellite imagery and mapping platform allow learners to explore their own regions using real-time geospatial data and satellite views, linking classroom knowledge to local realities. Map reading is another fundamental component, as it cultivates spatial awareness, orientation, and the ability to interpret symbols, scales, and coordinates. Likewise, photo interpretation—analysing aerial and satellite photographs—helps students understand the land-use patterns, vegetation cover, urbanisation, and environmental changes. When combined, these methods foster critical thinking, spatial reasoning, and a deeper appreciation of the dynamic Earth systems that geography seeks to explain.

For understanding the past and India's rich heritage, teachers are expected to engage students in the following ways. Firstly, they are expected to analyse inscriptions or edicts (for example, Ashoka's edicts, and Gupta records) to understand how rulers communicated policies, messages, and ethical guidelines to their subjects. Secondly, they are to encourage students to read excerpts or chapters from Indian literary sources that throw light on the social, cultural, and political life of people. Thirdly, they are expected to conduct research and present examples of forts, temples, mosques, and palaces to illustrate cultural, architectural, and political developments in the Indian history. Finally, the teachers should explore and discuss the works of artists and philosophers of the Renaissance period,

highlighting their contributions and influence. Students should be made to locate the extent of various important empires on a world map. They are also expected to investigate and explain the key Indian ideas that shaped the thinking of Western philosophers, scientists, and artists. Finally, students should be encouraged to use a world map to trace India's trade and cultural exchanges with other civilisations, and analyse their patterns and impact.

Transaction of political concepts requires connecting students with evidence, inquiry, and real-world reasoning. Document-based inquiry helps learners explore authentic sources, such as Vedic texts, constitutional excerpts, and letters from national leaders to interpret historical contexts and moral reasoning. Case-based pedagogy, using landmark judgments, maps, and data analysis, builds decision-making and analytical skills, encouraging students to apply theory to practice. Evidence-based learning engages learners with real datasets from Census, NITI Aayog, or UNDP reports to develop data literacy and link concepts like equality and representation with measurable realities. Further, multimedia and experiential approaches use podcasts, documentaries, and archival materials to connect abstract political ideas with real experiences, sharpening students' interpretive and critical listening skills. Visual and graphic organiser-based pedagogy—through charts, tables, and concept maps—supports comprehension, memory, and summarisation by converting complex ideas into structured visuals. Together, these pedagogies transform classrooms into laboratories of civic thinking, empathy, and inquiry. They nurture students as reflective citizens who can interpret evidence, question assumptions, and engage meaningfully with India's democratic processes.

The pedagogy for teaching Economics needs to be interactive, experiential, and inquiry-driven, enabling students to relate economic concepts to real-life situations. Teachers can use role-play activities—such as running a lemonade stall or simulating the circular flow of income with students acting as households, firms, banks, and the government to make ideas like production, income, and expenditure tangible. Class discussions on familiar issues, such as rising vegetable prices during monsoons, help students link classroom learning with everyday experiences and develop critical thinking. Engaging classroom activities and games, like preparing a

₹100 classroom budget, allow students to understand scarcity, choice, and opportunity cost in a fun and participatory way. The use of visual tools—including maps, pie charts, and graphs—can help students analyse data on GDP, trade, and sectoral trends. The case studies on topics like pollution as an externality, public goods like street lights, or successful entrepreneurs encourage application and deeper reflection. Surveys and field visits to local shopkeepers or MSMEs further bridge theory and practice by exposing students to real market dynamics. Incorporating current resources, such as newspaper articles or the Union Budget fosters analytical skills and awareness of contemporary economic issues. Through this diverse, hands-on approach, learners will move beyond memorisation to active understanding, making Economics relevant, engaging, and empowering.

Assessment

Assessment in the Secondary Stage, Phase 1, Grades 9 and 10, serves to certify student learning and the completion of education in Social Sciences in holistic manner. Addressing all the domains of holistic development of the child, such as awareness, sensitivity and creativity, etc., captured through various stakeholders, such as self, peer, teacher along with parent involvement. Assessment must focus on evaluating students' understanding of core ideas, facts, and concepts, as well as their ability to demonstrate an integrated understanding of how society functions. This includes an interdisciplinary blend of history and culture, geography, economics, political science, and values, emphasising the interconnectedness of social, cultural, economic, political, and geographical factors. The assessment process must align with the competencies outlined in the NCF-SE 2023 (pp. 328–331).

Students must be assessed not only on their knowledge but also on skills, such as analysis, interpretation, critical thinking, ethical reasoning, and inquiry-related dispositions. These include sourcing and interpreting evidence, tracing continuity and change, recognising spatial patterns, and respecting diversity and inclusion. Assessment methods must be varied to capture these competencies effectively. Students can demonstrate their learning through reasoning-based answers, conducting field surveys, interpreting maps, developing

geographical models, and participating in debates and discussions. Additionally, case-based and data-driven questions using real-world contexts at local, regional, national, and global levels must be included, incorporating authentic data, maps, and infographics for interpretation and evaluation.

All textbook content, including text, side boxes, images, and maps can be assessed except for quotations intended to inspire learners and technical elements like diacritical marks, Sanskritised words, and glossary terms. Assessment questions, activities and projects can be designed considering competencies even if it is required to move beyond the textbooks and integrating technology in the teaching-learning process. Assessment must be carried out the way innovative pedagogies, such as storytelling, arts integration, sports integration and integration of toy-based pedagogy is envisaged in NEP-2020 and NCF-SE 2023. Assessment must be carried out to capture experiences of learner in learning the core concepts of Social Sciences.

Assessment must cultivate a strong sense of rootedness in India, fostering pride not only in thought but also in spirit, intellect, and action. It aims to develop knowledge, skills, values, and dispositions that support responsible commitment to human rights, sustainable development, and global well-being, nurturing a global citizen mind-set.

Given the increasing depth of content and competencies at this stage, regular formative assessments play a critical role in facilitating meaningful learning and providing constructive feedback. Classroom assessments continue to be important due to the nature and complexity of the competencies involved. Moreover, self-assessment is encouraged to enable students to monitor their own progress, reflect on feedback, and adjust their learning strategies accordingly.

Assessments must be designed using diverse formats, such as case-based questions, simulations, essay-type questions, written and practical tests, projects, and open-book tests. Creativity and exploration through open-ended questions are particularly encouraged to engage students with varying interests and abilities. Summative assessments conducted at the end of each term or year, including board examinations, where applicable, will provide comprehensive evaluation. It is essential that these assessments avoid verbatim repetition of textbook questions to discourage rote learning, instead incorporating novel problems that foster inquiry and critical thinking.

While recall of facts, concepts, and procedures is vital for long-term retention, assessments must also provide opportunities for students to apply their knowledge in inquiry-based contexts. Challenging and exploratory questions at the end of chapters in the textbooks offer optional opportunities for deeper engagement, catering to students with different capacities and interests.

These guidelines aim to promote a holistic and inquiry-driven approach to assessment in Social Sciences, supporting students to develop as thoughtful, skilled, and responsible citizens with a strong foundation in knowledge and values.

विद्यया ऽ मृतमश्नुते
एन सी ई आर टी
NCERT
राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
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