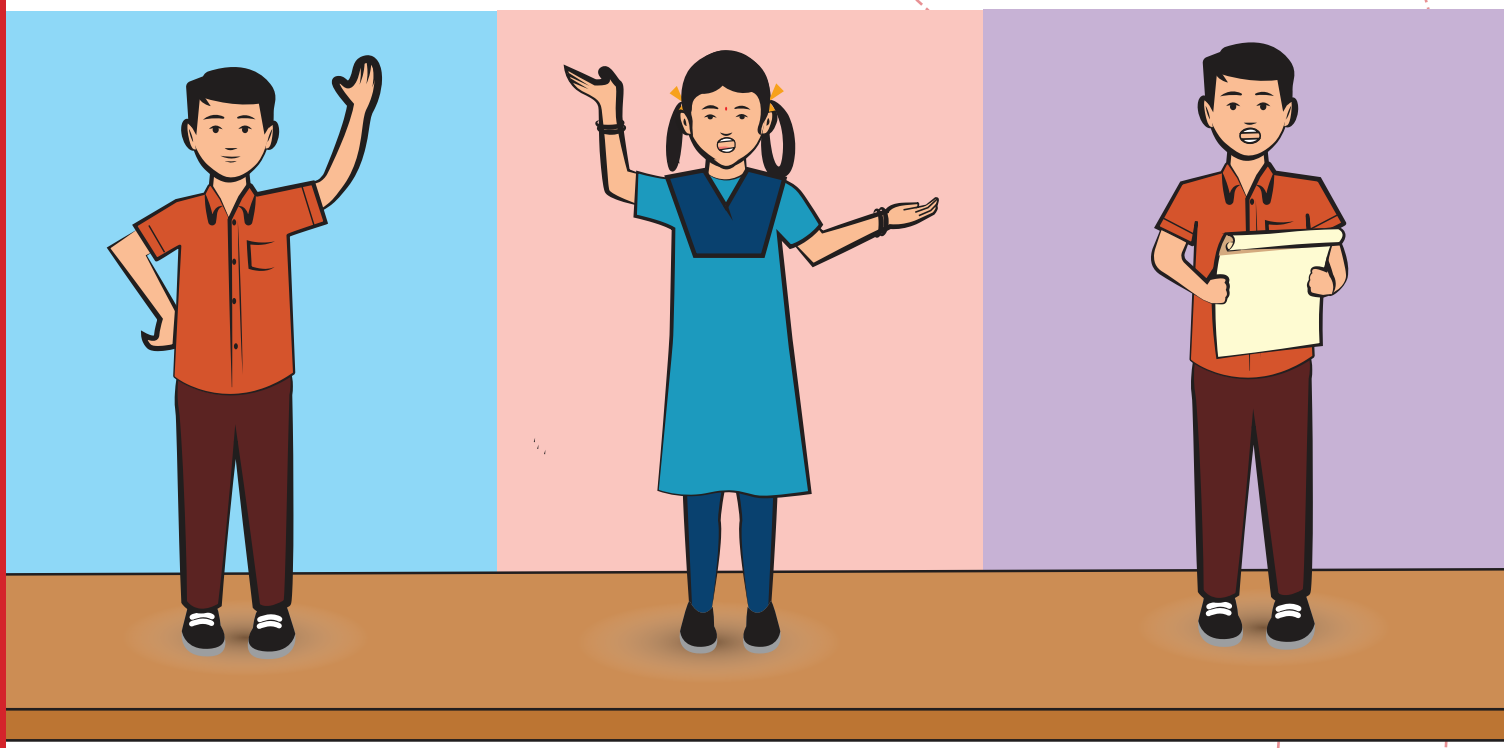
Azim Premji University



Learning Outcomes

SECONDARY STAGE

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Foreword

As a country, we have focused significantly on improving the quality of learning at the elementary stage in the last few years through several initiatives and programs at the National and State levels. One of the most significant ones, was the development of Learning Outcomes by NCERT and its adaptation and adoption across all states and union territories. Equally significant was the Learning Outcomes being used for conducting National Achievement Surveys to track student learning across the country. Results from these surveys were used to design remedial action and other efforts that would increase the learning levels of students eventually.

This pursuit of quality should effectively transit to the secondary stage as well - the country must have precise and clear expectations laid out for teachers, students and all other stakeholders of the education system of *what students should know and be able to do* at the secondary stage of education. Developing Learning Outcomes for the secondary stage is also important given the variations across State Board examinations.

Azim Premji University has designed Learning Outcomes for Secondary Stage. These have been aligned to the NCERT curriculum and draw heavily from our learnings of being a part of the development and review of the NCERT Learning Outcomes for Elementary Stages. Nonetheless, it is a draft; and can be used as a reference point in conceiving Learning Outcomes by NCERT/SCERTs.

We would be pleased to receive your comments and suggestions for the same at the email - : feedback-lo-ss@azimpremjiuniversity.org

Azim Premji University,

Bangalore

Table of Contents

1 Introduction to the document 6

1.1 Background 6

1.2 Process of developing the Learning Outcomes 6

1.2.1 Study of NCERT learning outcomes for elementary stage 7

1.2.2 Articulation of Curricular Expectations 7

1.2.3 Articulation of Learning Outcomes 7

1.2.4 Developing samples of Pedagogical Processes and Assessment Strategies 8

1.3 Possible uses of Learning Outcomes 8

2 Learning Outcomes in Language - Secondary Stage 10

2.1 Curricular Expectations 10

2.2 Learning Outcomes- Class IX & X 11

2.3 Class IX- Sample Pedagogical Processes and Assessment Strategies 13

2.4 Class X- Sample Pedagogical Processes and Assessment Strategies 15

3 Learning Outcomes in Social Science- Secondary Stage 18

3.1 Curricular Expectations 18

3.2 Learning Outcomes- Class IX 19

3.3 Class IX- Sample Pedagogical Processes and Assessment Strategies 21

3.4 Learning Outcomes - Class X 27

3.5 Class X- Sample Pedagogical Processes and Assessment Strategies 29

4 Learning Outcomes in Science- Secondary Stage 34

4.1 Curricular Expectations 34

4.2 Learning Outcomes- Class IX 35

4.3 Class IX- Sample Pedagogical Processes and Assessment Strategies 37

4.4 Learning Outcomes- Class X 42

4.5 Class X- Sample Pedagogical Processes and Assessment Strategies 44

5 Learning Outcomes in Mathematics- Secondary Stage 51

5.1 Curricular Expectations 51

5.2 Learning Outcomes- Class IX 53

5.3 Class IX- Sample Pedagogical Processes and Assessment Strategies 56

5.4 Learning Outcomes- Class X 62

5.5 Class X- Sample Pedagogical Processes and Assessment Strategies 64

6. Annexures *70*

6.1 Annexure 1- Alignment of Learning Outcomes with NCERT syllabus – Secondary Stage *70*

6.2 Annexure 2- Distribution of Learning Outcomes across subjects amd themes *81*

7. References 82

Introduction

1 Introduction to the document

1.1 Background

Development of quality standards is paramount for any system, to understand and track the learning level of students in the country. These standards should explicitly state the knowledge, skills and dispositions that the education system should strive to achieve.

Realizing the importance of this, National Council for Educational Research and Training (NCERT) pioneered the development of Learning Outcomes for Classes I to VIII in consultation with academics, practitioners, researchers and various civil society organizations across India. In addition to the outcomes, it also developed suggestive pedagogical approaches to provide guidance to teachers. Various state governments adapted their respective state curricula to these outcomes and developed contextual state specific learning outcomes.

Taking this effort ahead, Azim Premji University has attempted to draft learning outcomes for secondary stage for Languages, Social Sciences, Science and Mathematics. These outcomes are aligned to the NCERT curriculum and syllabus. It is our endeavor to advocate these outcomes across states in India in order to arrive at common standards for learning and assessment.

1.2 Process of developing the Learning Outcomes

An academically rigorous process was undertaken to arrive at the learning outcomes of secondary stage.

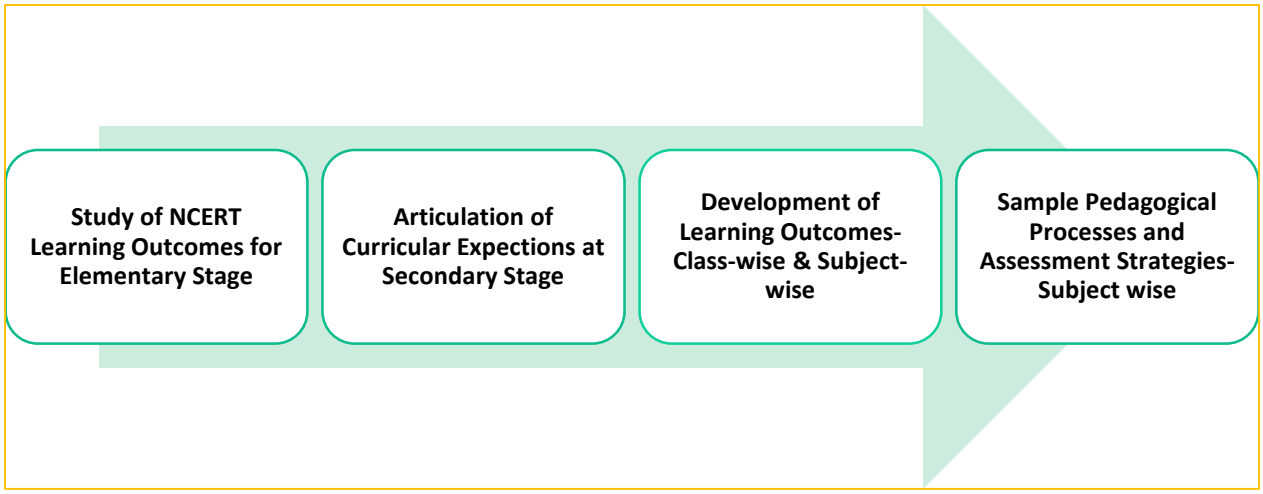


Figure 1: Process of developing Learning Outcomes

1.2.1 Study of NCERT learning outcomes for elementary stage.

NCERT Learning Outcomes of elementary stage was studied in order to derive principles for developing clear and concise learning outcomes for the secondary stage.

The following criteria were used to study the document:

- Alignment of learning outcomes with curricular expectations and the syllabus of the respective subject and class
- Nature of outcomes-
    - process oriented or product oriented
    - distribution across cognitive levels
    - measurability and demonstrability
    - choice of action verbs
- Alignment of pedagogical processes with the outcomes
- Clarity of language - in articulation of the curricular expectations, learning outcomes and pedagogical processes

1.2.2 Articulation of Curricular Expectations

Post-review, curricular expectations for each subject at the secondary stage were derived. In order to arrive at these, the National Focus Group Position Papers of different subjects, the syllabus, textbooks and other reference materials such as the '*Common Core State Standards'* of the United States, were referred to. *The curricular expectations were pitched at a broader level in order to easily distinguish these from the learning outcomes*. Also, it was ensured that the curricular expectations are derived from the goals of teaching the subjects.

1.2.3 Articulation of Learning Outcomes

Once the curricular expectations were framed, learning outcomes, aligned to the NCERT syllabus were articulated. The guiding principles for developing the learning outcomes of secondary stage were:

- Outcomes will be *aligned to the curricular expectations* which in turn should be derived from the goals of teaching the subject at the secondary stage.
- The outcomes will *emphasize the process* of learning alongside the product.
- The verbs used for articulating the learning outcomes will be *measurable and demonstrable.*
- The learning outcomes will *range across all cognitive levels from* remember and understand to evaluate and create, in *all subjects.*
- The learning outcomes will be supplemented with *sample pedagogical processes* and *assessment strategies* to provide suggestions to concretize these in the classrooms.
- The learning outcomes will be distributed across all units/themes as per the prescribed syllabus. *(details in annexure 1&2)*

1.2.4 Developing samples of Pedagogical Processes and Assessment Strategies

A deviation was taken from the NCERT elementary stage document that provides a common set of pedagogical processes for each subject. In the secondary stage, few outcomes were identified in each subject from class IX and class X and detailed pedagogical processes supplemented by assessment strategies were designed. This has been done to enable users of the document to derive principles for making the *alignment between outcomes-pedagogy and assessment*.

Such samples could assist the teacher in developing a similar approach for aligning the outcomes-pedagogy and assessment in their classrooms.

1.3 Possible uses of Learning Outcomes

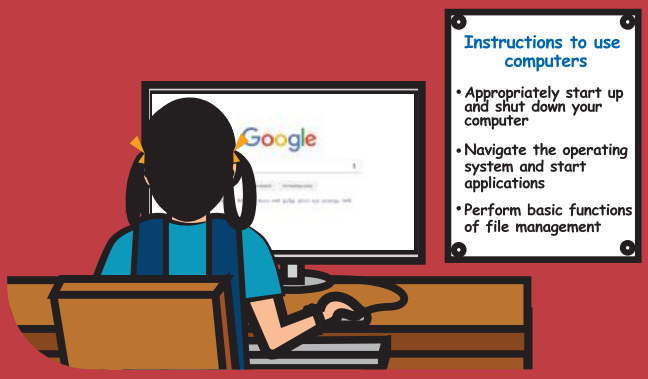
- **Reference material for NCERT and SCERT's in designing Learning Outcomes for secondary stage:** In addition to elementary stage outcomes, institutions could benefit from secondary stage outcomes that define standards for quality at the national level.

- **Developing Assessment Frameworks and tools for large scale assessments/surveys:** This document may be used for developing assessment frameworks and question papers for Board examinations of different states leading to uniformity in quality standards across states. It could be used as a framework for drawing key competencies for National Achievement Survey (NAS). Reporting the assessment data against these outcomes will provide a comprehensive picture of the overall health of the education system of the country.

- **Pre-service and In-service Teacher Professional Development:** This document can be utilized for developing content for professional development programs for teachers both at the pre-service and in-service level. The sample pedagogical processes and assessment strategies will provide student teachers as well as in-service teachers an insight on how to concretize the learning outcomes in the classroom.

- **Textbook development:** Clearly stated learning outcomes could also facilitate the review and revision of the text books used for secondary stage, and in the designing of new textbooks.

Learning Outcomes in
Language
- Secondary Stage



Instructions to use computers

- Appropriately start up and shut down your computer
- Navigate the operating system and start applications
- Perform basic functions of file management

2 Learning Outcomes in Language- Secondary Stage

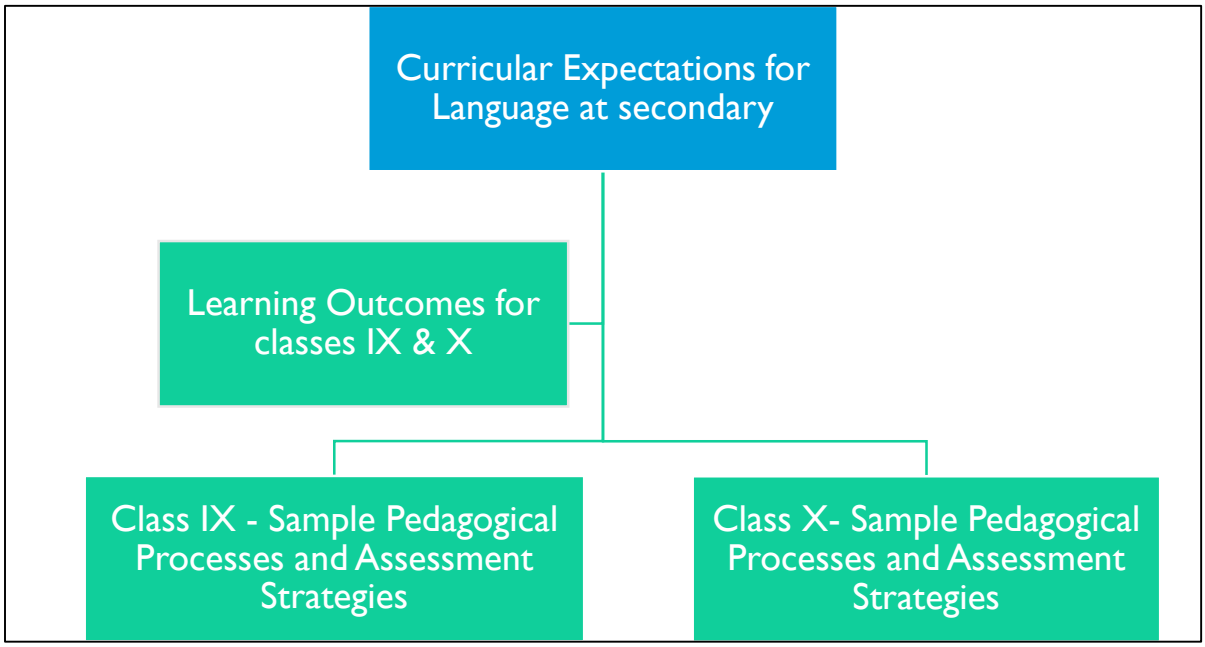


Figure 2: Overview of Language section

2.1 Curricular Expectations

Learning of language not only develops foundational skills of listening, speaking, reading and writing, but also helps in understanding, exploring, analyzing the world and solving problems. According to the NCF position paper 2005, the objectives of language teaching are to develop competence to understand what one hears, to read with comprehension and not merely decode, effortless expression, coherent writing skills, and control over different registers (innumerable varieties, shades, and colors, which surface in different domains and in different situations), creativity and sensitivity. At the secondary stage, students should be equipped to use language to express their thoughts logically, imaginatively and analytically in speech and writing in the classroom and outside.

Teachers need to be aware of these expectations and design pedagogical approaches aligned to the same. As per the Position paper on Teaching of Languages, the mother tongue should be the medium to attain proficiency in other languages, which could be the 1st/2nd/3rd language of students. Keeping the spirit of multilingualism, the learning outcomes have *not been split to suggest a hierarchy between languages*. Therefore, a common set of curricular expectations, and learning outcomes have been designed for the learning of languages.

Sl. No	Curricular expectations
CE1	Develop the interest for reading and writing different kinds of texts (e.g. fiction and non-fiction in school and home languages, literary, historical, scientific, etc.).
CE2	Develop the proficiency of listening, speaking, reading and writing using cognitive, academic and linguistic skills. (e.g. listening or reading between the lines, using interpretation, analysis, reasoning and choosing appropriate words and structures to express meaning).
CE3	Develop literary skills of analysis of content and form of literary texts e.g. story line, beginning, ending, character, action, plot, use of words, style of language etc.
CE4	Develops an awareness of grammatical structures, their form and function and shades of meaning in a text; uses this understanding across languages as well as in different subjects.
CE5	Appreciate through speech and writing the diversity and multiple perspectives of multilingual and multicultural contexts in the real and fictional world.

2.2 Learning Outcomes- Class IX & X

Since learning languages is a seamless process of acquiring greater degrees of proficiency in a particular language, the outcomes for secondary stage has not been bifurcated for Classes IX and X. However, the type of text, its complexity and context should vary across classes.

Sl.no	Learning Outcomes
LO1	Reads/listens to/watches poems, stories, travelogues, drama, reports, newspapers, in print or audio-visual aids with interest and talks about them.
LO2	Expresses his/her thoughts or personal experiences through stories, poems, one act play, reports, diary writing etc. according to the need of the situation. Can use different narrative styles or rhetorical devices.
LO3	Participates voluntarily and with enjoyment in telling stories, reciting poems, dramas, and debates, making catchy slogans, using word play, quoting poetic expression and making punch lines.
LO4	Synthesizes convergent and divergent ideas/examples of an incident/facts/ from different sources for example from newspapers, life experiences and presents them clearly and logically in spoken or written form.
LO5	Represents the central ideas and other main events from a text in different ways: graphically, pictorially or through written notes.

LO6	Identifies the theme or central idea of stories or narratives, poems, biographies and plays.
LO7	Analyses the key events which determine characters in a text and identifies the relationship between character and action or situation from a social and literary perspective.
LO8	Logically compares two stories or texts from different genres of literature citing examples of characters, incidents and expresses it in spoken or written form.
LO9	Creates new events and extends a story, or changes a character or action in a story, poem or play.
LO10	Speaks and writes about symbols, metaphors, images, language used in literary texts, advertisements, songs etc.
LO11	Uses abstract, countable and uncountable nouns, active and passive voice, relationships between verbs, position and work of adjectives, position and work of adverbs etc. in context.
LO12	Expresses in terms of speech or writing the difference between the use of words and grammatical structures in authentic material like posters, newspapers, advertisements in order to relate language to life.
LO13	Uses different structures in sentences and texts meaningfully and uses different ways of expressing the same meaning/ shades of meaning.
LO14	Make deductions about the features of grammatical structures by comparing school and home languages.
LO15	Uses appropriate word order, word formation strategies and uses different vocabulary, thought processes and grammatical structures for expressing meaning in different subjects/ disciplines.
LO16	Transforms/ translates from prose to poetry, fiction to drama, report to advertisement etc.
LO17	Writes short stories, poems, reports, essays, letters (formal and informal), speech etc. on relevant issues, thoughts, feelings.
LO18	Listens to and reads different types of texts: scientific, literary (prose, poetry, fiction, non-fiction, drama; media- advertisement, reports) or listens to, reads diverse thoughts, ideas and opinions on a topic through class room discussions and reading.
LO19	Identifies social issues in stories and nonfiction and comprehends diverse thoughts of classmates' ideas, view-points on a theme.
LO20	Logically expresses arguments in speech or writing from different perspectives while debating an issue.
LO21	Compares character, plot in stories, plays, poems and narrative styles and folk literature from different cultures and linguistic contexts.
LO22	Evaluates and talks about different ways of expressing feelings in different cultures.

LO23	Critically questions social issues and cites examples from life to reflect on different problems in society expressed in stories and poems.
LO24	Translates folk stories and poems from home languages into school languages and appreciates translation of stories and poems from different cultures and languages.

2.3 Class IX- Sample Pedagogical Processes and Assessment Strategies

A sample of one of the learning outcomes for language is worked out. Textbooks and non-textbooks materials/texts such as relevant genres, social issues, pictographs, and graphs, audio-visual aids, etc. can be referred to address this. For English Class IX, an exemplar of pedagogical process and assessment strategies based on NCERT Text Book: Bee Hive Unit VIII, Chapter 8, is provided.

Learning Outcome (LO)

LO23 Critically questions social issues and cites examples from life to reflect on different problems in society expressed in stories and poems.

Learning indicators

- Listening and reading for detail- Engages with text material based on social issues- comprehends the main ideas of the text, understands inter-connections between events, analyzes key problems/opportunities faced by characters in the text.
- Writing to compare, contrast and analyze differences- Can compare two different case-lets of local heroes on self-designed parameters.
- Synthesize thoughts to make judgments- Expresses solutions to social problems through an imaginary or real story of a similar kind.

Pedagogical Processes	**Assessment strategies**
• Facilitate a discussion on students' role models- probe students to share qualities that they find admirable in them. • Show the movie clips or trailer of the movie POORNA, https://www.youtube.com/watch?v=LRoowtgZCeU the story of a tribal girl, the youngest to scale the Everest. https://timesofindia.indiatimes.com/videos/sports/other-sports/Exclusive-In-conversation-with-mountaineer-Santosh-Yadav/videoshow/53508288.cms/ or watch the video of Santosh Yadav/ any other local hero.	• Individual Assignment: Describe the characters studied in your own words- analyze the triumphs and tribulations of their lives and how it shaped them.

• Facilitate students to read the lesson on Santosh Yadav. Divide the students into groups. Provide the students with a newspaper review of the story of POORNA and ask them to read it. • Create worksheet on the board with the following columns: problems faced, solutions devised, qualities or character traits. Students to fill up the worksheet after reading about Santosh and Poorna. • Encourage students to compare Santosh Yadav and Poorna and come up with a list of problems they had. Guide discussions to identify which of the problems were created by nature and which by family or society. E.g. Santosh was made to study in the local school while boys went off to Delhi to study, Santosh was almost forced to marry at 16. • In pairs ask the students to discuss and find examples in their own family or around them of difficulties of the same kind faced by them or their young relatives and the courage they showed. • Conduct role play with students in groups: role plays could be particular problem in Santosh's life: - Made to study in the village while boys went to schools - Almost forced to get married - Parents say that they will not pay for her education at Jaipur - Santosh's decision to join the mountaineering institute (She does not go home) Through a discussion help students bring out how to fight social discrimination through courage and determination.	• Project: Explore three similar kind of caselets (local or global) and compare them. Write in 500 words about each caselet and present in the class • Discussion: Bring out three ways to fight social discrimination or any other societal issues based on the caselets you explored. • Group assignment: write a story of courage and determination like that of Santosh Yadav or Poorna. • **Resources** - Newspaper cutting of the achievement of Santosh Yadav and Poorna Malavath, - Review of the movie Poorna, - Movie clipping or movie trailer of Poorna, interview of Santosh Yadav.

2.4 Class X- Sample Pedagogical Processes and Assessment Strategies

Any relevant content or text can be chosen to address the identified learning outcome. For English Class X, an exemplar of pedagogical process and assessment strategies based on NCERT Text Book: First flight Unit 1, Chapter 8: Nelson Mandela: Long Walk to Freedom has been provided.

Learning Outcome (LO)

LO23 Critically questions social issues and cites examples from life to reflect on different problems in society expressed in stories and poems.

Learning indicators

- Listening and reading for detail- Engages with text material based on social issues- comprehends the main ideas of the text, understands inter-connections between events, analyzes key problems/opportunities faced by characters in the text.
- Writing to compare, contrast and analyze differences- Can compare two different case-lets of local heroes on self-designed parameters.
- Synthesize thoughts to make judgments- Expresses solutions to social problems through an imaginary or real story of a similar kind.

Pedagogical Processes	Assessment strategies
• Introductory discussion regarding India's Presidents and Prime Ministers. Suggestive questions: - *Who were our Presidents and Prime Ministers?* - *Where did they come from? Which community, class, caste, and gender did they belong to? How diverse were these people*? • Asks students to listen to 'I have a dream' by Nelson Mandela. Suggestive questions: - *Is the dream fulfilled in India?* - *Nelson Mandela talks about freedom being an illusion. Is there real freedom in India? Is everybody treated equally?* Let them think about instances of injustice around them and discuss them in groups. • Use newspaper cuttings of attacks on dalits, honor killings, murder of literary figures etc. Students read and discuss such incidents.	• Individual assignment: Write a letter to a newspaper editor about class, caste and gender discrimination. • Project: Create a project about the politics of class, caste and gender observed around and present the discussion points in the classroom. • Group Assignment: Using language as a tool what are some of the measures you take up to fight against discrimination of class,

• Encourage students to read the lesson on Nelson Mandela's struggle for freedom. Motivate them to discuss the Indian Struggle for Freedom. • Facilitate group work: - *Do you see instances of discrimination or inequality around you? What should be done so that we respect each other and there is equal opportunity for everybody?* • Bring newspapers to the class. Distribute two to three to each group. Ask them to read them carefully and select any one issue that shows discrimination and discuss it adding their own experiences. • Encourage the group to talk about their issue and their solutions in front of the class. The other groups to give them suggestions, ask critical questions. • Distribute samples of 'letters to the editor' to the group. The groups observe it and write a letter to the editor on any one selected issue including the solution that they have discussed earlier.	caste and gender in the context of India. • **Resources** - Speech of Nelson Mandela 'I have a dream' in written or audio form, - Newspapers cuttings of headlines about attacks on disadvantaged communities, inter caste marriages, killing of literary figures etc. - Sample letters to editors.

Learning Outcomes in
Social Science
- Secondary Stage

3 Learning Outcomes in Social Science- Secondary Stage

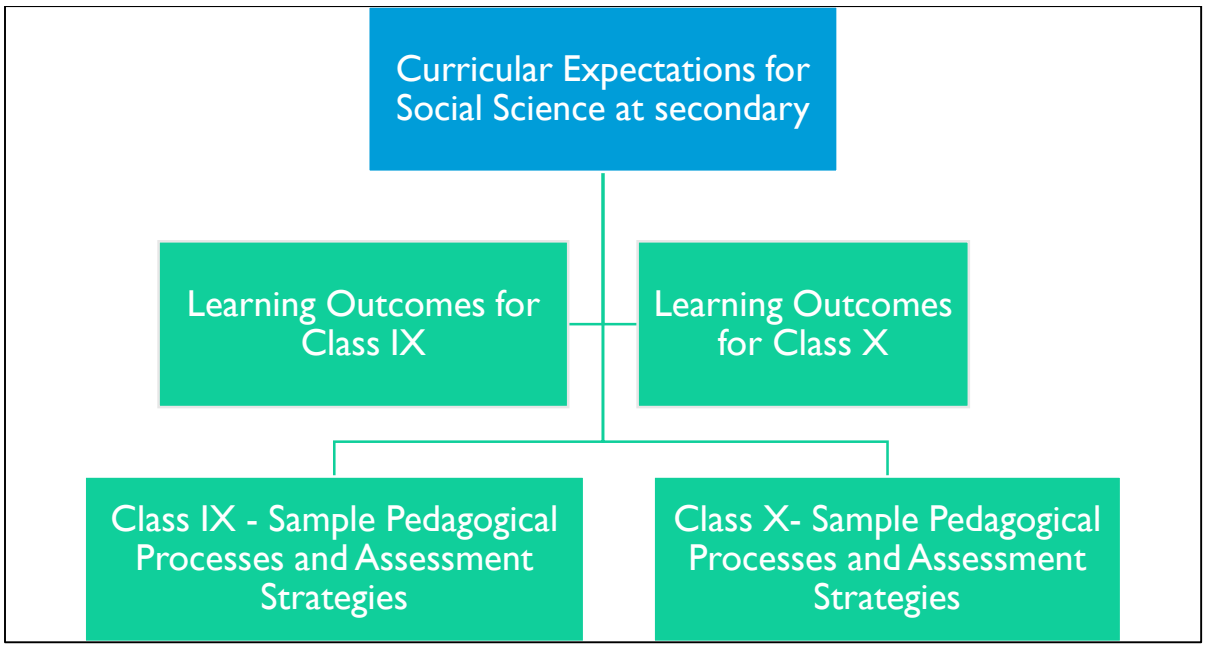


Figure 3: Overview of Social Science section

3.1 Curricular Expectations

Social sciences include a wide range of content drawn from the disciplines of geography, history, political science and economics. As per the National Focus Group Position Paper on teaching of Social Science, at the secondary stage, the main focus of the subject is on contemporary India in order to develop a deep understanding of the social and economic challenges facing the nation. In history, the emphasis is on India's nationalist movement and its developments as an independent nation in the context of developments in the modern world. Geography is taught keeping in mind the need to inculcate in the child a critical appreciation for conservation and environmental concerns. In political science the focus is on discussing the philosophical foundations that underlie the value framework of the Indian Constitution through an in-depth discussion on equality, liberty, justice, fraternity, dignity, plurality and freedom from exploitation. As the disciplinary area of economics is introduced to the child at this level, the topics discussed are basic and fundamental in nature. The National Curriculum Framework (NCF) 2005 also emphasizes that the disciplines in Social Science should not be viewed in isolation but through an inter-disciplinary approach to enable students to see the inter-connectedness between different disciplines and thereby develop a critical understanding of the society in its totality.

With reference to the National Curriculum Framework (NCF, 2005), Position Paper on Teaching of Social Science, NCERT textbooks and various other National Curriculum followed across countries, curricular expectations of Social Science can be broadly articulated as below-

Sl. No.	Curricular Expectations
CE1	Develop a nuanced understanding of the inter-dependence between natural environment and human beings- by a careful observation, analysis, and interpretation of various regions across the globe.
CE2	Oriented to understand how history gets constructed- through an analysis of sources, cause and consequences of events, and the process of continuity and change.
CE3	Develop the skill of using inquiry as a process to gather, organize, analyze, interpret, synthesize evidence and information, and make informed critical judgments.
CE4	Develop the skills to become an active and informed citizen who can influence public decision making and act for the common good within communities at the local, national, and/or global level.
CE5	Understand the economies and livelihoods of different social groups and how they respond to changes in the contemporary world.
CE6	Upholds the values enshrined in the Indian Constitution to undertake the roles and responsibilities of effective citizens of a democratic society.
CE7	Apply inter-disciplinary thinking to understand society through historical processes, economic and political systems, natural and geographical features.
CE8	Understand events, processes and forces that have helped to shape the identity of the world through the development of socialism, liberalism and democracy.

3.2 Learning Outcomes- Class IX

The learning outcomes are distributed across the 4 disciplines, with an attempt to provide adequate weightage in accordance to the depth of the content.

Serial No	Learning Outcomes	Content Area
LO1	Locates on an outline map of India: neighbouring countries of India, states and capitals, latitudes and meridians, physical features, rainfall, vegetation and soil distribution, national parks and sanctuaries, cities and population distribution.	Physical features of India, Natural Vegetation, Wild Life and Population

	Locates, labels and identifies on an outline map of France and World major historical events based on French Revolution, Russian Revolution, Nazism and the rise of Hitler.	French Revolution, Russian Revolution, Nazism and the Rise of Hitler
LO2	Analyzes how the location of India influences the country's time and trade.	India – Size and Location
LO3	Describes the structure, process of formation and relief features of the major physiographic divisions and river systems of India.	India - Physical Features of India India-Drainage, Climate, Natural Vegetation and Wildlife
LO4	Explains the difference between weather and climate, the factors affecting India's climate, the mechanism of monsoons, its characteristics and impact on human life.	
LO5	Draws interrelationship between climate, natural vegetation, soil and wildlife of a region.	
LO6	Analyzes the effects of imbalances in the ecosystem and the measures taken by the government to prevent this.	
LO7	Explains the composition of India's population (age, sex-ratio, occupational structure etc.) and how the growth rate (birth rate, death rate, migration) affects the composition and growth of population and its distribution in India.	Population
LO8	Differentiates between the factors of production, farming and non-farming activities, types of farming, and economic and non-economic activities.	The story of village Palampur, People as a resource
LO9	Examines issues related to unemployment, underemployment, poverty in India and the strategies adopted by the government to alleviate it.	People as a resource, Poverty as a challenge
LO10	Examines the existing food security system in India and the different programs initiated by the government to address the food shortage.	Food security in India
LO11	Plots and interprets data/graphs- e.g. climatic graphs and tables, demographic data tables, etc.	Plot, analyze and interpret data
LO12	Explains the major events preceding the French and the Russian Revolution and relates their significance to the development of the notions of equality and freedom.	Events and Process
LO13	Analyzes the significance of Nazism in shaping the politics of the modern world.	

LO14	Explains the rise of Socialism in the context of Industrial Revolution and its far-reaching effects on Europe.	
LO15	Analyzes the lives of the forest dwellers, pastoralists, peasants and their adaptation in the modern world economy.	Livelihoods Economies and societies
LO16	Explains the domination of the politics of power, social movements and colonialism in relationship to sports and clothing.	Everyday life, culture and politics
LO17	Evaluates the pattern of democracy in the world from last 100 years till date.	Democracy in the contemporary world
LO18	Applies the idea of democracy in everyday life. e.g. school , family.	
LO19	Analyzes the factors that contributed to the Constitutional Design of South Africa and India.	Constitutional Design
LO20	Explains the foundational values mentioned in the preamble of the Constitution of India and its relevance for citizens and the government.	
LO21	Analyzes the stages and process of electoral politics in a democratic country (India).	Electoral Politics
LO22	Evaluates the election process of India in the context of free and fair election and the role of Election Commission.	
LO23	Analyzes the role of the legislative, executive and judiciary in the effective functioning of a country.	Working of the Institutions
LO24	Analyzes key rights and responsibilities associated with citizenship, in both Indian and global context, and ways in which these rights are protected (international conventions, laws, and/or institutions *(e.g. the United Nations Universal Declaration of Human Rights [1948]).*	Democratic Rights

3.3 Class IX- Sample Pedagogical Processes and Assessment Strategies

Geography- Theme - India Climate (Monsoon)

Learning Outcomes (LO)	Pedagogical Process	Assessment Strategies
LO - Explains the factors affecting	• Initiate the topic with a brainstorm session on the different elements of weather (*temperature, pressure, wind,*	In order to assess the students' understanding

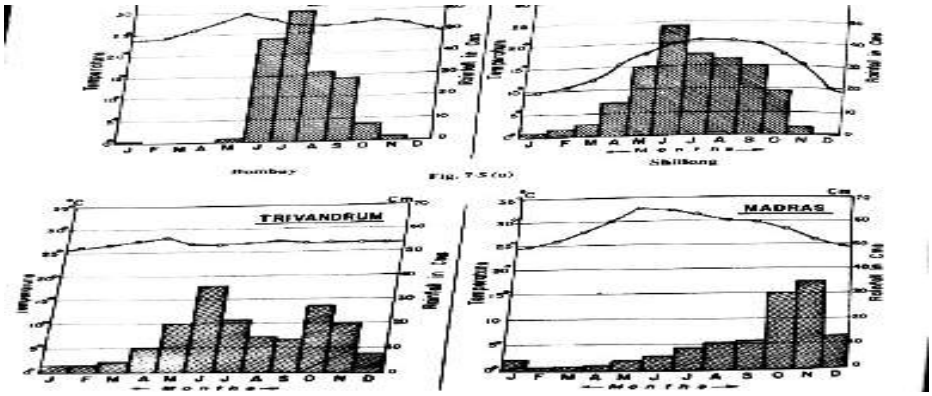
India's climate, the mechanism of monsoons, its characteristics and impact on human life. The LO can be further broken into 5 indicators: **Indicator 1** 1. Differentiates between weather and climate.	*humidity, cloud formation and precipitation*) and how these elements are inter-connected and are influenced by each other. Some key questions may be posed to the students to elicit their prior knowledge on the elements of weather and see their interconnections. **Questions for discussion** - *What are the different elements of weather?* - *How is air pressure related to the temperature of a place?* - *What is wind? How is wind different from air current?* - *How are clouds formed?* - *Does high humidity in the air and cloud formation always lead to rainfall?* - *What causes rainfall?* - *What is the difference between rainfall and precipitation?* - *What do you understand by differential heating of land and water and the movement of winds?* • Facilitate an activity by providing the students' a range of Indian weather and climate 'sources'. Ask the students to interpret the weather or climatic condition from each of the given sources with some guided questions. **Questions for activity** - *List down the components of the daily weather forecasts given to you.* - *Do the daily temperature/humidity/cloud cover/wind speed etc. remain the same or they fluctuate from day to day and time to time?* - *Record the time of the day when the temperature reaches both its maximum and minimum? (For a week)* - *Record the daily humidity level and cloud cover for 7 days.*	on the difference between weather and climate, the teacher can provide a worksheet with certain statements on weather and climate or hold a quiz. Example – In the given sentences circle /identify the appropriate word given in brackets: 1. *What a lovely (weather/climate) are we having today!* *2. I hope the (weather/climate) is sunny tomorrow.* *3. India lies in the Tropical (Climatic/Weather) Belt.* *4. Global warming is the change in the world's (weather/climate).* *5. Last month the (weather/climate) was so wet.* *6. The T.V. (climate/ weather) forecast is on after the news.* *7. Satellite photographs help us to predict tomorrow's (climate/weather).* *8. The scientists who study (weather / climate) are known as meteorologists.*

	- *Which months of the year records the maximum and minimum temperatures?* - *Which months of the year the rainfall is maximum?* - *Do you see any pattern emerging bases your observation over several years?* • Scaffold the students to see patterns emerging by analyzing the daily weather reports of a place for several years and thus help them see the distinction between weather and climate.	
Indicators 2 and 3 2. Analyzes reasons for climatic variations in India. 3. Recognizes the factors that influence the climate of India.	• Provide the students with climatic graphs showing temperature as line graphs and rainfall as bar graphs or a table showing month-wise temperature and rainfall data for five to six cities in India and ask them to analyze the data / graph with a set of questions. **Questions for activity** - *Calculate the total rainfall of the cities.* - *Calculate the annual range of temperature of the cities.* - *Compare the temperature and rainfall conditions between the different cities.* Probe them to think why the temperature and amount of rainfall varies from place to place in the given data despite having the same type of climate. • Initiate a discussion of factors that influence the climate of a place (*a generic discussion followed by specific factors affecting Indian climate with examples*).	Assignment: Summarize the factors influencing the climate of specific region in India? Eg- Thar, Himalayan region, Coastal belts? Analyze the specificities of Indian tropical monsoon climate.
Indicator 4 Describes the four main seasons in India.	• Facilitate a group work to make a collage of the seasons in India (*one group works on summer season, another group on winter etc.*). Each group can then share their work with the other groups. Each group can assess	The collage work could be given for peer review with the following set of criteria, which may be evolved both by the

	the work of the other group and give feedback based on certain criteria (criteria for assessment evolved both by the teacher and the students before the activity). • Introduce the topic on monsoon after the activity on collage making and provides explanation of the chief characteristics of the Indian Monsoon with a detailed description of the different seasons (*mechanism of monsoon – how it operates – onset and withdrawal of monsoon and the distinct seasonal patterns; variation of the monsoon rains from place to place and from year to year*). • With the help of diagrams, globes, Asia and India maps and videos the teacher can show why and how the direction of the monsoon winds change, the path followed and its reversal with the change in temperature and pressure conditions, upper air circulation and rainfall distribution and El-Nino phenomena. • Some questions during the explanation to be provided by the teacher to check whether the students are following the explanation. - *What causes wind reversals?* - *What are pre-monsoon showers?* - *What changes take place in the upper air circulation that causes the arrival of the monsoon?* - *Why does it not rain every day during the monsoon /rainy season?* - *Why the amount of rainfall varies from year to year and from places to places?*	teacher and the students': - *Does the collage depict the seasonal aspects (time of the year/ temperature/rainfall/ how the nature changes with the season, how the vegetation looks, animal habits, seasonal vegetables, flowers and fruits grown etc.)* - *Is the human aspects considered in the collage (type of clothes worn, food taken, festivals celebrated, songs and poems on the season, people's feelings etc.)* Assignment: In what ways the Indian monsoon affects the Indian economy? Provide specific examples from the student's state/region. What is El-Nino phenomena?

Indicator 5 Analyzes the influence of monsoon on human life.	• Provide case studies/newspaper clippings on the effect of monsoon on the life of people followed by discussion (*flood, cyclones and drought and how it affects the life of the people, effect of monsoon on agricultural calendar and the life of the farmers, life of the people including their festivities etc.*). • Have a discussion on how monsoon affects the economy as well as the polity. Provide songs, poetries associated with the different seasons.	Ask the students to write an essay on how the socio-cultural and economic life of people in India is influenced by the Monsoon climate. How does El-Nino phenomena affect the polity and the economy of India?
	• Wrap-up the discussion on climate of India by asking the students to make a project on 'how climate of India influences the lifestyle of the people' (food they eat, clothes they wear, difference in house types, different activities they pursue etc.).	Create a rubric for assessment of the project along with the students. Parameters: 1. Content – accurate and interesting facts, going beyond the textbook 2. Organization of the content –sequence, coherence 3. Presentation and creativity –relevant pictures, diagrams, graphs 4. Process of project completion – initiative taken, cooperativeness, participation and punctuality
Resources	1. Sources of weather and climate data: daily weather forecast report (newspaper forecast) of a place for a week, yearly temperature and rainfall data (month-wise) of a place for several years (10 to 15 years), satellite images, average July and January temperature maps. 2. Worksheet / quiz questions with statements on weather and climate.	

3. Climate Graphs:



4.Table showing month-wise temperature and rainfall data of 5 cities:

CITY		MONTHS											
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	D
Trivandrum	Temp. °C	26.7	27.3	28.3	28.7	28.6	26.6	26.2	26.2	26	26.5	26.6	26
	Rain, cms	2.3	2.0	3.8	10.5	20.7	23.6	22.3	14.5	13.7	27.3	20.5	
Delhi	Temp °C	14.2	16.8	27.7	29.2	33.9	34.4	31.0	29.8	29.0	25.9	20.1	1
	Rain, cms	2.0	2.3	1.2	0.9	0.9	6.7	18.6	16.9	13.4	1.4	0.2	
Jodhpur	Temp. °C	16.8	19.2	24.6	29.7	33.7	33.9	31.3	29.0	29.1	27.0	22.1	1
	Rain, cms	05	06	02	03	09	30	10.8	13.1	5.7	0.7	0.1	
Bombay	Temp. °C	23.9	24.1	26.2	28.1	29.6	28.7	27.3	26.9	27.0	27.9	27.2	2
	Rain, cms	0.4	0.2	0.1	0.1	1.8	46.4	61.3	32.4	28.6	6.4	1.7	
Nagpur	Temp. °C	21.5	23.9	28.3	32.7	35.5	32.5	27.7	27.3	27.9	26.7	23.2	2
	Rain, cms	1.1	2.3	1.6	1.6	2.0	22.2	37.6	28.6	18.4	5.4	1.9	

5. Maps (map of Asia and India) and globe.

6.Video: https://www.youtube.com/watch?v=RaPha6dKQSg "INDIAN MONSOON **की पूरी प्रक्रिया को जानिए** | Factors & Theories, Advancing & Retreating Monsoon".

3.4 Learning Outcomes - Class X

Serial No	Learning Outcomes	Content Area
LO1	Locates on the outline map of India - Major soil types, dams, crops, minerals, power plants, industries, software technology parks, National Highways, major ports and international airports. - Spread of Nationalism in India (1918-1930), Indian National Congress Sessions, important centers of Indian National Movement (Non-cooperation and Civil Disobedience Movement).	Resources: Soil, Forest and Wild life, Water resources ,Crops Minerals and Energy resources, Manufacturing industries, Transport and Communication Nationalism in India (1918-30)
LO2	Explains the meaning of resources and differentiates them on the basis of their distribution, uses and types.	Resources and Development
LO3	Examines the issues that cause depletion of resources (water, flora and fauna) and government programs and policies that advocate for its judicious use and sustainable development.	
LO4	Analyzes the natural, political, social and economic implications of building multipurpose projects in a region.	
LO5	Draws inter-relationship between climate, soil, types of crops and methods of farming practiced in a region.	Agriculture
LO6	Evaluates the implications of technological developments, institutional reforms and globalization in Indian agriculture.	
LO7	Analyzes the impact of mining, use of conventional and non-conventional energy resources and various industries on the environment and the people and suggest ways to mitigate it.	Minerals and Energy resources
LO8	Analyzes the reasons for the location of industries in a particular region.	Manufacturing Industries
LO9	Explains the role of transport, communication, trade and tourism in the growth of a nation.	Lifelines of National Economy
LO10	Explains the notions of economic development and ways of measuring national and human development.	Development
LO11	Reflects on the developmental goals of a region and creates a plan for sustainable development.	

LO12	Explains the interrelationship between the primary, secondary and tertiary sectors, differentiates between organized and unorganized sector; public and private sectors; unemployment and disguised unemployment.	Sectors of the Indian Economy
LO13	Draws tables and graphs from a given set of data; calculates from a given data and interprets graphs.	
LO14	Explains the modern forms of money and its linkage to the banking system; terms of credit, credit arrangement and how it affects people.	Money & Credit
LO15	Evaluates the role of globalization in the development of Indian economy.	Globalization and the Indian Economy
LO16	Analyzes situations of consumer exploitation and suggests grievance redress measures.	Consumer Rights
LO17	Examines the progress of consumer movement and the role of government to protect consumers against unethical and unfair trade practices.	
LO18	Examines the emergence of the notion of Nationalism in Europe, Indo-China and India.	Events and Processes Livelihoods, Economics and Society
LO19	Analyzes the role of social movements, aspirations of ordinary people, artists and writers in freedom movements.	
LO20	Explains the role of Gandhi in the growth of nationalism and anti-colonial movement in India.	
LO21	Analyzes the role of technology and industrialization in transforming 19th century world and the process of industrialization in India as a colony of Britain.	
LO22	Explains the growth process, characteristics and experiences of cities of the 19th century with special reference to Bombay, Calcutta, London and Paris.	
LO23	Examines the rise of print culture and its influence on communication.	Everyday Life, Culture and Politics
LO24	Interprets the role of novels in shaping Nationalism and reconstructing the history of India.	
LO25	Explains the importance and need of power sharing among legislature, executive and the judiciary in a democracy.	Power Sharing
LO26	Explains the key features of Federalism, ways in which it is practiced in India and the rationale for decentralization of powers.	Federalism

LO27	Describes the ways in which democracy responds to social differences, division and inequalities.	Democracy and Diversity
LO28	Explains the social differences like gender, religion, caste and how it gets expressed in politics.	Gender, Caste and Religion
LO29	Analyzes the role of citizens, pressure groups and movements in influencing politics.	Popular Struggles and Movements
LO30	Explains the need and importance of political parties and the role of the National and the Regional Parties in the politics of India.	Political Parties
LO31	Analyzes the outcomes of democracy with respect to quality of government, economic well–being, inequality, social differences and conflict , freedom and dignity.	Outcomes of Democracy
LO32	Explains the challenges that democracy faces (the foundational challenge, challenge of expansion and the deepening of democracy) and the steps to reform democratic politics.	Challenges to Democracy
LO33	Creates a definition of democracy and provide suggestions to overcome the challenges of democracy.	

3.5 Class X- Sample Pedagogical Processes and Assessment Strategies

History- Theme - Nationalism in India

Learning Outcome	Pedagogical Process	Assessment Strategy
Learning Outcome 1.Analyzes the role of Gandhi in the growth of nationalism and anti-colonial movement in India. Topics - Swaraj, Non-co-operation movement and the Civil Disobedience Movement The Learning Outcomes can be further simplified down to the following learning indicators:	• Initiate the discussion on emergence of Nationalism in India with the following leading questions: - *What is this country India and for whom is it meant?* - *Can the growth of nationalism be connected to anti-colonial movement in context of India?* - *Did oppression under the colonialism develop a sense of unity among different groups?* - *Is there any significance of symbols, icons and songs in defining identity and sense of belonging that*	• Essay writing: interpretation of Swaraj by students. Attempt to create a definition of their own. • Role Play: present the notion of Swaraj as interpreted by the peasants of Awadh, plantation workers of Assam and the tribals of Andhra Pradesh

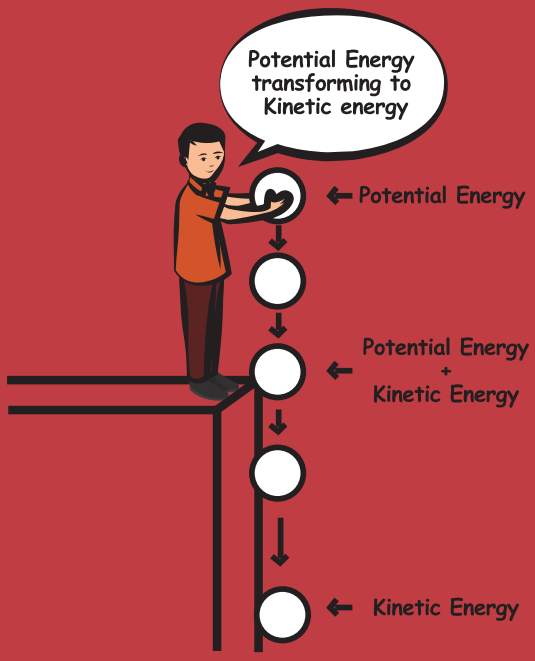
Indicator 1 Analyzes how the term 'Swaraj' had different connotation to different people (peasants, tribals and the plantation workers of Assam).	*leads to the rise of nationalism and creates national identity?* • Elicit the meaning and origin of the word 'Swaraj' from the students in different languages e.g. Hindi, Sanskrit, Malayalam, Bengali, etc. Based on this prior knowledge the concept of Swaraj can be introduced. • Provide students with case studies on the movements from the NCERT textbooks followed by critical analysis of the readings <u>Sample Case Studies: Awadh, Gudem Hills of Andhra and Plantation workers in Assam</u> After going through the case study of Awadh by the students, leading statements by the teacher. - *What was Baba Ramachandra's response to the call for Swaraj? How did the tribal peasant interpret the message of Gandhi and the idea of Swaraj?* - *What was the notion of Swaraj for the plantation workers? Groups to present their thoughts and summarize the case studies.*	
Indicator 2 Examines the aspirations of different social groups that participated in the Civil Disobedience movement.	• Facilitate group work on various readings on Civil Disobedience Movement- scaffold students to annotate, discuss and come with a write up on the 'critical analysis of the Civil Disobedience movement' based on the scaffolding questions. • Use scaffolding questions for discussions: - *Why did certain group join the movement and how did they relate to the movement (rich peasants, poor peasants, industrialists)*	• A written presentation on 'critical analysis of the Civil Disobedience Movement'(with the citation of sources and references).

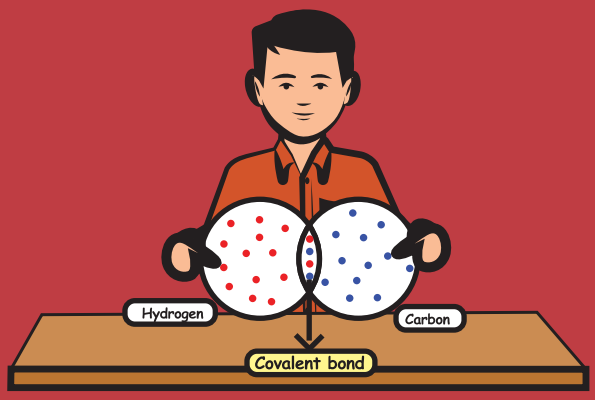
	- *Why people come together and form groups and what leads them to form their identity?* - *What was the Congress dilemma in including the workers' demand and the 'no rent campaign 'of the poor peasants in the Civil Disobedience Movement?* - *What was the role of the women in the movement and did their participation bring out any change in their position?* - *Why was Dalit and Muslim participation limited?*	
Indicator 3 Evaluates how Civil Disobedience Movement was different from the Non-Co-operation Movement	• Facilitate a discussion with the following probes: - *What is the difference between breaking law and non-co-operating?* - *How did the people support the Non-Co-Operation movement and why was it withdrawn by Gandhi? Were the people happy with Gandhi's decision?* - *What was the effect of the withdrawal?* - *Why did Gandhi violate the law by manufacturing salt by boiling sea water?*	Read the following passages 1. Thousands of students left schools, colleges and headmasters and teachers resigned. Lawyers gave up their legal practices 2. Thousands in different parts broke colonial laws. Peasants refused to pay revenue, forest people violated forest law. What is the difference between the above two situations. Which words will help you in differentiating the two movements?
Indicator 4 Critically analyzes the ideology of Gandhi in regards to the women participating in the movement	• Facilitate the following questions for students to reflect: - *Remember any instance where women had participated in movements in India and across the world. If yes who were they? To which class did they belong?* - *What was the role of the women in the Civil Disobedience Movement?*	• Prepare an oral presentation on 'the position of women in the National movement as viewed by Gandhi and the Congress'

	- *What was the class representation of the women in this movement?* - *In spite of the active participation of the women in the national movement did their position in the society undergo any change?*	

Learning Outcomes in **Science**

- Secondary Stage





4 Learning Outcomes in Science- Secondary Stage

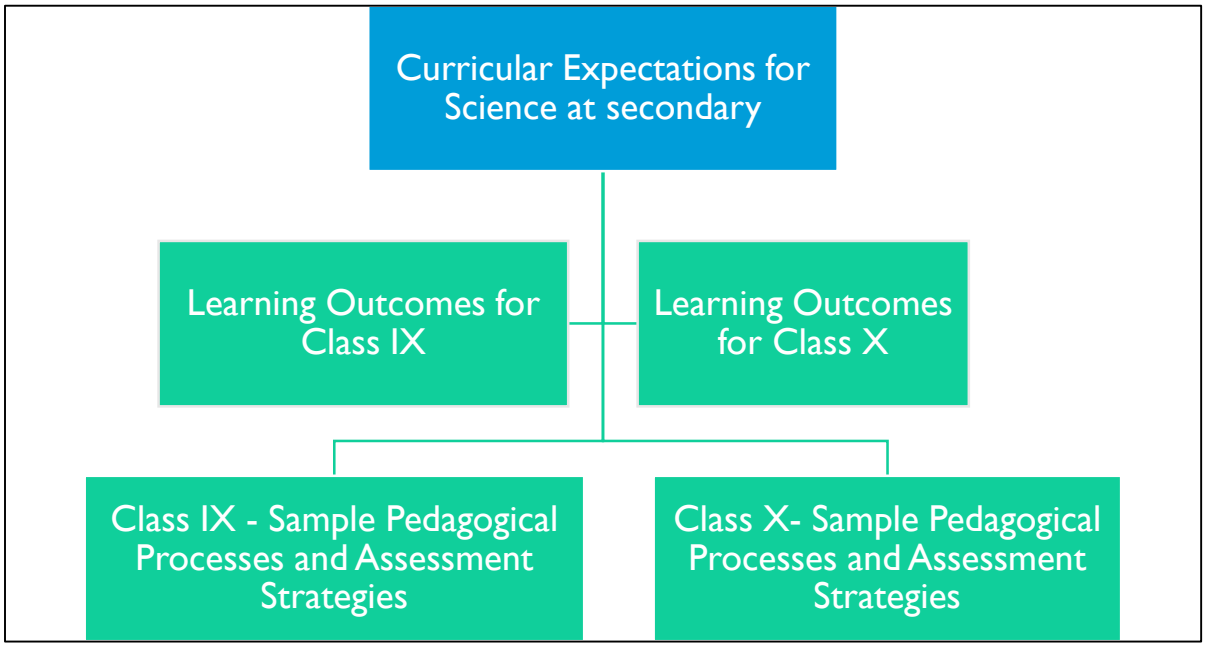


Figure 4: Overview of Science section

4.1 Curricular Expectations

Learning Science involves various interconnected steps: observation, looking for regularities and patterns, making hypotheses, devising qualitative or mathematical models, deducing their consequences, verification of theories through observations and controlled experiments and thus arriving at the principles, theories and laws governing the physical world. As per the National Focus group Position Paper on Teaching of Science, at the secondary stage, the students should be engaged in learning Science as a composite discipline, in working with hands and tools to design advanced technological modules, analysis on issues of surrounding environment and health and systematic experimentation to verify theoretical principles. The present syllabus has been designed around seven broad themes viz. Food; Materials; The World of The Living; How Things Work; Moving Things, People and Ideas; Natural Phenomenon and Natural Resources. At this stage, while science is still a common subject, the disciplines of Physics, Chemistry and Biology begin to emerge. Science education at this stage should enable students to develop a historical and developmental perspective and to enable students to view Science as a social enterprise. Students should be able to enjoy the process of knowledge building in science, cultivate scientific temper, critical thinking and freedom from fear and prejudice.

Taking the above approach into consideration, the following curricular expectations have been derived from the aims of secondary Science education as discussed in National Curriculum Framework and position paper on Teaching of Science:

Sl. No	Curricular Expectations
CE1	Comprehend concepts, principles and laws of science.
CE2	Acquire process skills in science, which includes finding patterns and relationships, hypothesizing, exploring, gaining evidence, inferring, and interpreting, quantitative reasoning, developing ideas and communicating effectively.
CE3	Understand the nature of scientific knowledge, i.e., testable, the causes of events/ phenomenon are natural rather than super-natural, incremental, social, and how scientific knowledge has evolved with time.
CE4	Develop respect for human dignity and rights, gender equity, values of honesty, integrity, cooperation and concern for life leading to a just and democratic society.
CE5	Construct deeper understanding of issues relating to the intersection of science, technology, environment and society.
CE6	Inculcate the spirit of joy, wonder and enquiry in the learning of science through an experience of its various processes.

4.2 Learning Outcomes- Class IX

Sl. No	Learning Outcomes	Content Area
LO1	Distinguishes states of matter (solids, liquids and gases) based on the physical properties (shape, volume, density, etc.) with reference to particle theory.	Materials
LO2	Investigates the nature and properties of various types of chemical substances (elements, compounds, mixtures, colloids, suspensions) through experiments.	Materials
LO3	Describes different methods of separation to get individual components from a mixture.	Materials
LO4	Carries out experiments to verify the laws of chemical combination.	Materials
LO5	Explains atoms & molecules and represents compounds using chemical formulae.	Materials
LO6	Identifies sub-atomic particle (electron, proton and neutron) using the atom models (Thomson, Rutherford, Bohr).	Materials

LO7	Outlines the best practices of farming that yield higher productivity.	Food
LO8	Demonstrates the factors influencing climatic changes (e.g. causes of rain, varying temperature of air, etc.) by conducting experiments.	Natural resources
LO9	Explains the causes and effects of pollution on air, water and soil and its impact on human and natural environment.	Natural resources
LO10	Explains the biogeochemical cycles (water cycle, nitrogen cycle, carbon cycle, and oxygen cycle) involved in the maintenance of biosphere balance.	Natural resources
LO11	Explains the features of cell (plasma membrane, nucleus, cytoplasm and cell organelles), activities inside the cell and the interactions of the cell with its environment.	The World of Living
LO12	Explains the types of plant tissues (Meristematic and Permanent) and animal tissues (Epithelial, Connective, Muscular and Nervous).	The World of Living
LO13	Identifies plant tissues (parenchyma and sclerenchyma) and animal tissues (striated muscles and nerve fibres) from the prepared slides.	The World of Living
LO14	Classifies the hierarchical architecture of the human body: cells, tissues, organs, organ systems, and organism.	The World of Living
LO15	Describes diversity and similarity in organisms for explaining hierarchical classification of living beings (plants and animals) based on their evolution and body organization.	The World of Living
LO16	Identifies acute, chronic, infectious, non-infectious diseases, their causes, types, treatment, mode of transmission and means of prevention.	The World of Living
LO17	Distinguishes different physical concepts such as distance and displacement, speed and velocity, velocity and acceleration, uniform and non-uniform motion, balanced and unbalanced forces, action and reaction forces, inertia and friction, mass and weight, thrust and pressure.	Moving things, people and ideas
LO18	Identifies types of motion (linear, uniform and non-uniform motion) from a given scenario/ table/ graphs/ equations relating position, velocity and acceleration as functions of time.	Moving things, people and ideas
LO19	Interprets distance-time, speed-time and velocity-time graphs for uniform motion and for uniformly accelerated motion.	Moving things, people and ideas

LO20	Applies Newton's laws of motion to solve real life problems.	Moving things, people and ideas
LO21	Examines different types of collisions using conservation of momentum and energy.	Moving things, people and ideas
LO22	Examines motion of an object at varying distance from the surface of the Earth under gravitational force.	Moving things, people and ideas
LO23	Explains the principles responsible for floating and sinking for some natural and constructed phenomenon with reference to relative density.	Moving things, people and ideas
LO24	Solves problems using work and power equation, kinetic and potential energy equation, principle of conservation of energy.	Moving things, people and ideas
LO25	Justifies the influence of types of medium and temperature on the speed, production, propagation and detection of sound using examples from nature and technology (production of sound by a vibrating object, drums, guitar strings, cricket, etc.).	Moving things, people and ideas

4.3 Class IX- Sample Pedagogical Processes and Assessment Strategies

Theme: Materials

Learning Outcomes Learning Indicators	**Pedagogical Processes**	**Assessment Strategies**
LO1: Distinguishes states of matter (solids, liquids and gases) based on the physical properties (shape, volume, density, etc.) with reference to particle theory. **Learning indicators:** 1.1 Explains the characteristics of particles of matter.	• Revisit previous concepts on matter, its different states and the properties of the different types of matter learnt by students and conduct discussions. **Questions for discussion:** - *In what ways materials different from each other?* - *Is there some similarity in materials?* - *In how many ways can you group the different materials you see around?* - *How do solids, liquids and gases differ from each other?* - *Can materials exist in all the three states?*	• Prepare a comparison table of different states based on (shape, density volume, intermolecular force, compressibility, etc.). • Give reasons for certain observations, e.g. *Naphthalene balls/*

1.2 Observes three states of matter due to variation in characteristics of particles of matter. 1.3 Explains change of state of matter - melting, freezing, evaporation, condensation, sublimation. 1.4 Describes effect of change of temperature and pressure on different states of matter.	- *What kinds of clothes help us keep cool?* - *Why do wet clothes make us feel cool?* • Engage students to undertake activities to understand different characteristics of matter and ask them to note their observations followed by discussion. • Demonstrate the properties of states of matter through activities with examples from daily life. Ask students to *feel the texture, observe the colour and lustre, effect of air, water and heat, etc. on each of the materials (wood, salt, paper, ice, steel, water, etc.).* • Ask the students to research more on the two new states of matter, namely plasma and Bose-Einstein Condensate and conduct a discussion in the class on the same. • Engage students (individually /in groups) to observe change of state; and record what is observed. Observe effect of heat on each of the resources. (Teacher to perform the experiment for camphor, ammonium chloride and naphthalene.)	*Iodine disappear with time without leaving any solid; We can get the smell of perfume sitting several meters away; Water at room temperature is a liquid, etc.*
LO2: Investigates the nature and properties of various types of chemical substances (mixture, solution, suspension, colloid, elements and compounds) through experiments. **Learning indicators:** 2.1 Differentiate between mixture and pure substance, homogenous and heterogeneous mixture, solution and	• Begin the lesson by recapitulating the concepts pertaining to matter. A discussion can be held on the following points: Matter, states of matter, relation between matter, atoms, molecules and compounds, properties of the different types of matter, elements, mixtures, properties of metals, non-metals and metalloids, pure substances. **Questions for discussion:** - *What are things around you made up of?* - *What are the various types of chemical substances?* • Divide the class into four groups and distribute different samples and ask them to dissolve these sample in water. Discuss the results for explaining	• Compare elements, compounds and mixtures based on what are they made up of, can they be broken down, do they lose their original properties. • Prepare a survey report based on a personally conducted survey (*survey of classrooms, industry & Science lab and prepare a*

suspension, mixtures and compounds. 2.2 Summarizes the properties of solution, suspension and colloid.	mixture, solution, suspension and colloid and their properties. • Discuss on claims, 'Air is a mixture' (Mixture of what? How can these be separated?), 'Water is compound' and 'Oxygen is an element'. • Divide the class into two groups and demonstrate the activity of burning a magnesium ribbon to introduce chemical combination of elements. Explain the difference between mixtures and compounds using this activity.	*list of various materials used in daily life*). Further classify these materials as pure substances or mixtures and pure substances into elements and compounds and then prepare a survey report. • Classify the given things into elements, compounds and mixtures.
LO3: Describes different methods of separation to get individual components from a mixture. **Learning Indicators:** 3.1 Identifies the appropriate method for separating a mixture based on its composition. 3.2 Relates the importance of method of separation in day to day life applications.	**Questions for discussion:** - *What are the common methods of separation used at home and in industries*? • Engage students in performing activities for explaining different methods to separate substances from a mixture using different methods *like evaporation, filtration, centrifugation, chromatography, fractional distillation process and crystallization*.	• Suggest the sequence of separation technique for a given mixture (*e.g. mixture of camphor, common salt and sand; kerosene oil and water; acetone and water; etc.).*
LO4: Carries out experiments to verify the laws of chemical combination. **Learning indicators:** 4.1 Explains the laws of chemical combination. 4.2 Lists the postulates of Dalton's atomic theory.	**Questions for discussion:** - *Do substances combine in a definite manner?* - *How do things combine with each other?* - *Are there any patterns which can help us guess how things will combine with each other?* - *Is the chemical combination of water from ponds, rivers, sea, wells, etc. the same?*	• Give example of chemical reactions (*hydrogen and oxygen, sodium carbonate and acetic acid, etc.)* and identify the postulates which is in agreement with the

	• Provide brief historical account including experiments of Lavoisier and Priestley. • Help students in understanding laws (law of conservation of mass and law of constant proportion) that govern how atoms combine. • Conduct simple experiments to explain the alignment between the outcome of an experiment and postulates of these laws.	observations of the experiment.
LO5: Explains atoms & molecules and represents compounds using chemical formulae. **Learning indicators:** 5.1 Explains atomic mass and atomicity. 5.2 Recognizes the symbols of ions and name the ions. 5.3 Writes the chemical formulae of simple compounds. 5.4 Calculates atomic mass, molecular mass, formula unit mass and molar mass.	• Review by eliciting the three states of matter, examples of each, what everything is made of and what matter is made of. **Questions for discussion:** - *Can we see an atom or a molecule under a microscope or by some other means?* - *What is there inside an atom?* - *How do chemists weigh and count particles of matter?* • Explain key characteristics of atoms, molecules and compounds using explanations and models of atoms and molecules. • Play a game with students for writing formulae. E.g. criss-crossing of valencies to be taught through dividing students into pairs. Each student to hold two placards: one with the symbol and the other with the valency. Keeping symbols in place, teacher to move only valencies to form the formula of a compound. • Guide students to create a correctly written chemical formula from two ions given and show calculation of molecular mass, formula unit mass and molar mass of compounds. • Summarize the topic by explaining the relation between atoms, molecules,	• Give the common names of a few substances (*e.g. Chalk, table salt, dry ice, baking soda, muriatic acid, battery acid.*) and find out its chemical formula and the elements present in these substances. • Write formulae for given compounds and names of compounds for given formulas. • Calculate mass and molar mass.

	elements and compounds. Also, discuss the laws of chemical combination and the reason why it is more convenient to refer to the quantity of a substance in terms of the number of its molecules or atoms, rather than their masses.	
LO6: Identifies sub-atomic particle (electron, proton and neutron) using the atom models (Thomson, Rutherford, Bohr). **Learning indicators:** 6.1 Describe the structure of an atom as per Thomson's atomic model and state the drawbacks of Thomson's model of an atom. 6.2 Describe the structure of an atom as per Rutherford's atomic model and state the drawbacks of Rutherford's model of an atom. 6.3 Describe the structure of an atom as per Bohr's model and how this model overcomes the drawbacks of Rutherford's model. 6.4 Distinguishes between atomic number, mass number, isotopes and isobars.	**Questions for discussion:** - *How atom model looks like?* - *How are the electrons, proton and neutron arranged inside an atom? Can you draw the model of such an atom?* • Revisit Dalton theory and explain what led to the failure of postulate related to indivisibility of atoms. • Provide brief historical account of Rutherford's experiment. Show videos to demonstrate the experiments conducted by Thomson, Rutherford and Bohr and present the features of atomic models as proposed by each of them. • Discuss rules for the distribution of electrons into different orbits. • Help students to draw electron configurations and identify the number of valence electrons for various elements. • Guide atomic number, mass number, isotopes and isobars and deriving these values for a few elements.	• How atom is neutral as a whole on the basis of Thomson's model of atom? • Draw a sketch of Thomson, Rutherford and Bohr's model of an atom and summarize the differences. • Find the valency of given set of elements.
Resources: 1. NCERT Class IX Science textbook 2. S Chand Science Laboratory Manual for Class IX		

3. Articles by Sushil Joshi and Deepak Dhar from Sandarbh
4. https://www.youtube.com/watch?v=-4Us5PTb4J8

4.4 Learning Outcomes- Class X

Sl. No	Learning Outcomes	Content Area
LO1	Derives, writes and balances the chemical equations from narrative descriptions of different types of chemical reactions (combination, decomposition, displacement, double displacement, oxidation and reduction).	Materials
LO2	Conducts experiments using various indicators to check if a given sample is acidic, basic or neutral.	Materials
LO3	Explains the importance of pH in our everyday life.	Materials
LO4	Explains the properties of salts, different types of salts, methods used to prepare them and their uses.	Materials
LO5	Contrasts the nature and chemical reactions of metals (copper, silver, iron) and non-metals (carbon).	Materials
LO6	Identifies the suitable metallurgical processes of extraction of metals from ores.	Materials
LO7	Describes the elementary idea of chemical bonding and its types.	Materials
LO8	Studies the commonly used compounds and carbon compounds, their properties and uses.	Materials
LO9	Classifies elements based on their electronic configuration and study their properties.	Materials
LO10	Describes the interdependencies of life processes in plants (photosynthesis & respiration, transpiration & translocation) and animals (respiration, digestion, transportation and excretion).	The world of living
LO11	Describes the mechanisms that control and coordinate the nervous system and hormonal processes in animals.	The world of living
LO12	Explains the coordination in plants like response to stimulus and movement due to growth.	The world of living

LO13	Compares and contrasts the various modes of asexual reproduction in plants (vegetative, fragmentation, etc.) and sexual reproduction in plants and animals.	The world of living
LO14	Lists methods of contraception and childbearing to build an awareness towards reproduction and reproductive health.	The world of living
LO15	Synthesizes characteristics of heredity and evolution and their influence on human life.	The world of living
LO16	Describes how human activities affect biogeochemical cycles.	The world of living
LO17	Formulates mathematically potential difference, Ohm's Law, total resistance, current and voltage for series and parallel circuits, power dissipation and relation between power, voltage, current and resistance.	How things work
LO18	Describes magnetic field due to current carrying through a straight conductor and circular loop and electromagnetic induction.	How things work
LO19	Describes the working of electric motor & generator.	How things work
LO20	Compares AC and DC voltage and current sources as defined by voltage polarity, current direction and magnitude over time.	How things work
LO21	Explains the natural phenomena of reflection, refraction, dispersion, scattering of light for spherical (concave and convex) mirrors, lens, and glass prism.	Natural Phenomenon
LO22	Solves numerical problems using the sign convention for reflection for spherical mirrors and lenses.	Natural Phenomenon
LO23	Describes the internal structure of eye, defects in the eye and suggested corrections to the defects.	Natural Phenomenon
LO24	Explains natural resource management to achieve sustainability by creating equilibrium between social factors, economic factors and environmental factors.	Natural resources

4.5 Class X- Sample Pedagogical Processes and Assessment Strategies

Theme: Materials

Learning Outcomes Learning Indicators	**Pedagogical Processes**	**Assessment Strategies**
LO1: Derives, writes and balances the chemical equations from narrative descriptions of different types of chemical reactions (combination, decomposition, displacement, double displacement, oxidation and reduction). **Learning indicators:** 1.1 Writes and balances chemical equation for a chemical reaction using chemical formulae. 1.2 Comprehends different kinds of chemical reactions (combination, decomposition, displacement, precipitation, neutralization). 1.3 Explains corrosion and rancidity. 1.4 Explains exothermic and endothermic reactions. 1.5 Identifies the type of reaction for a chemical reaction or equation.	• Begin the lesson by asking the students to recall their prior knowledge about chemical reactions discussed in atoms and molecules topics in class IX. Ask the students to give common examples of chemical reactions that take place around them. Discuss about the observations for determining a chemical reaction *(change in state, odour, color, temperature, etc.*). **Questions for discussion:** - *Why does iron rust?* - *Why does painted iron take longer to rust?* - *Why is burning sensation removed in stomach when one takes antacids?* - *Why do substances stop burning in the absence of air?* - *Why is flame seen when substances burn?* - *Can substances burn without flame?* - *Why does a matchstick kept in the blue part of the flame not burn?* - *Why is a red coating formed on the zinc rod when it is kept in copper sulphate solution?* - *What is the material of the coating?* • Explain the steps for deriving a chemical equation after observing a chemical reaction. Ask students to balance chemical reactions and	• Identify the type of a given chemical reaction. • For a given reaction, identify if it is an exothermic or endothermic process. • Given a description of a chemical reaction, give correct explanation for the observation. • Write the differences between different types of reactions.

	then relate to the law of conservation of mass. • Teacher to mix pairs of substances (*Turmeric, lime juice, vinegar, baking soda, washing soda, yeast, hot water)*, ask students to observe the reactions – and have a discussion on chemistry in the kitchen. • Carry out simple reactions that encompass decomposition, displacement, double displacement, precipitation, neutralization, oxidation and reduction. • Facilitate students to derive balanced chemical equations for different types of reactions. Discuss about exothermic and endothermic nature of reactions and the effects of oxidation reactions in everyday life.	
LO2: Conducts experiments using various indicators to check if a given sample is acidic, basic or neutral. **Learning Indicators:** 2.1 Explains various properties of organic and inorganic acids and bases. 2.2 Explains the reactions of acids with metals, metal carbonates, metal hydrogen carbonates and metal oxides and reactions of bases with metals and non-metallic oxides. 2.3 Conducts experiments using various acid-base indicators to check if a	• Begin the class by asking the students to mention a few acids, bases and salts, which they come across in their day-to-day life. • Conduct a quiz by asking questions regarding: Acids and their properties, acids found in natural substances, bases and their properties, litmus neutralization, examples of neutralization in everyday life. **Questions for discussion:** - *Why are some substances sour in taste (lemon) and some bitter in taste (bitter gourd)?* - *Why does soap solution feel slippery?* - *Why does seawater taste salty?* • Help students in conducting experiments to identify properties of acids, bases and salts. Facilitate students to identify the common properties of acids and bases.	• State reasons for a given phenomenon (*e.g. Tap water conducts electricity whereas distilled water does not, dry HCl gas does not turn blue litmus red whereas dilute HCl does, etc.).* • Derive and balance chemical reactions for a given description of chemical reaction. • State chemical properties for a particular use of salts (*e.g. antacid, fire extinguisher, bread, etc.).*

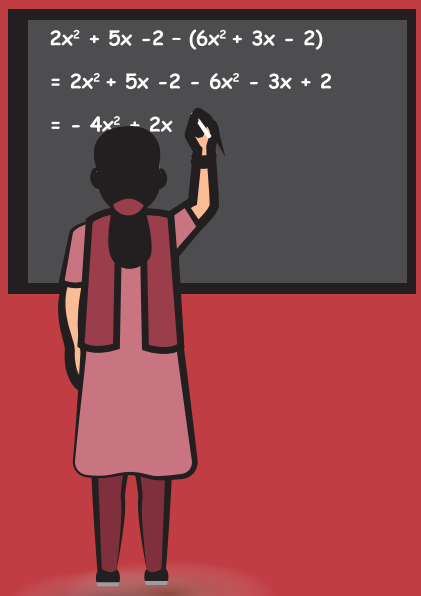
given sample is an acid or a base. 2.4 Identifies if the given sample is acidic, basic or neutral based on its pH value.	Explain how universal indicator can be used to measure the strength of given acid or base. • Help students to conduct experiments for testing different substances *(orange juice, lemon juice, soap solution, litmus solution, zinc, copper, aluminum, hydrochloric acid, sulphuric acid, nitric acid, sodium hydroxide, Common salt*) with indicators.	
LO3: Explains the importance of pH in our everyday life. **Learning Indicators:** 3.1 Identifies the influence of pH in relation to biological processes in human body. 3.2 Observes and records the pH value of various materials.	• Revisit the importance of pH scale for identifying the acidic and basic nature of a solution. • Explain how the pH value influence our digestive system, teeth, plants and animals. Facilitate a few activities to show how pH value can be increased or decreased.	• How the pH value will change for given examples and (*e.g. fresh milk has a pH of 6. If it turns into curd, how the pH value changes, how tooth decay is due to imbalance of pH in the human body, etc.*).
LO4: Explains the properties of salts, different types of salts, methods used to prepare them and their uses. **Learning Indicators:** 4.1 States the properties of salts. 4.2 Explains the methods used to prepare sodium hydroxide, sodium hydrogen carbonate, sodium carbonate and bleaching powder from sodium chloride. 4.3 Lists the uses of sodium hydroxide,	• Explains how strength of acids and bases influence the pH value of salts. Talk about the properties of salts and how are they different from acids and bases. • Informs students about Mahatma Gandhi's Dandi March and the significance of salt in our struggle of freedom. • Explains how common salt is used for making different substances such as sodium hydroxide, bleaching powder, etc. and state the uses of each of these substances.	• Describe the methods to convert salt into washing soda, how baking soda makes cakes and bread fluffy? • Write balanced chemical equations for the reactions to prepare different substances using salts.

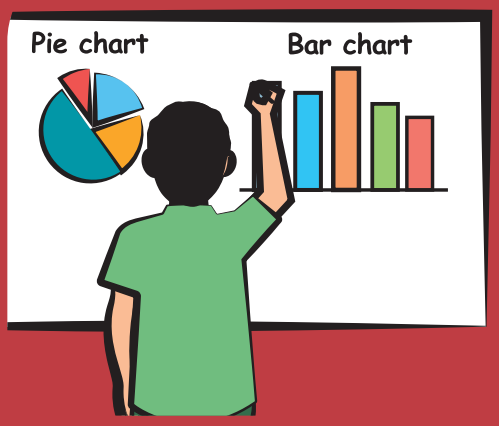
sodium hydrogen carbonate, sodium carbonate and bleaching powder.		
LO5: Contrasts the nature and chemical reactions of metals (copper, silver, iron) and non-metals (carbon). **Learning Indicators:** 5.1 Explains the physical properties of metals and non-metals. 5.2 Describes chemical properties of metals by performing activities with metal samples (aluminum, copper, iron, lead, magnesium, etc.).	• Revisits the various elements learnt in class IX and their classification into metals and non-metals. **Questions for discussion:** - *What are some uses of metals and non-metals in your daily life?* - *What properties did you think of while categorizing elements as metals or non-metals?* - *How are these properties related to the uses of these elements?* - *Can you name some metals that are used for making vessels? Do you why these metals are used?* • Help students to conduct activities with metals (*iron, copper, lead, silver, zinc, aluminum, gold), non-metals (sulphur, graphite, iodine) and ionic compounds (NaCl, $CaCl_2$, $MgCl_2$, etc.)* for understanding their physical and chemical properties.	• Compile observations regarding metals and non-metals after performing various activities. Write equations for these reactions. • Perform an activity with a set of metals (potassium, calcium, copper) and arrange these metals in the decreasing order of reactivity with water. • Why does ionic compounds have high melting points?
LO6: Explains basic metallurgical processes of extraction of metals from ores. **Learning Indicators:** 6.1 Explains steps involved in extraction of metals from ores. 6.2 Explains the difference in methods used for extracting metals in low, middle and top of the activity series. 6.3 Explains how corrosion is prevented in metals.	**Questions for discussion:** - *How do copper, silver, iron exist in nature?* - *Which part of the earth is major source of metals? How are they extracted?* • Have a detailed discussion on several steps involved in the extraction of pure metals from ores. • Conduct simple activities for explaining electrolytic refining, corrosion, etc. • Discuss about 'Iron pillar' at Delhi & Dhar (Madhya Pradesh) and discuss the process which is used for preventing rusting.	• Draw a tree diagram to summarize the steps involved in the extraction of metals from ores. • Write balanced chemical equations for the reactions involved in extraction. • Give reasons: Platinum, gold and silver are used to make jewelry. Sodium, potassium and lithium are stored under oil. Aluminum is highly

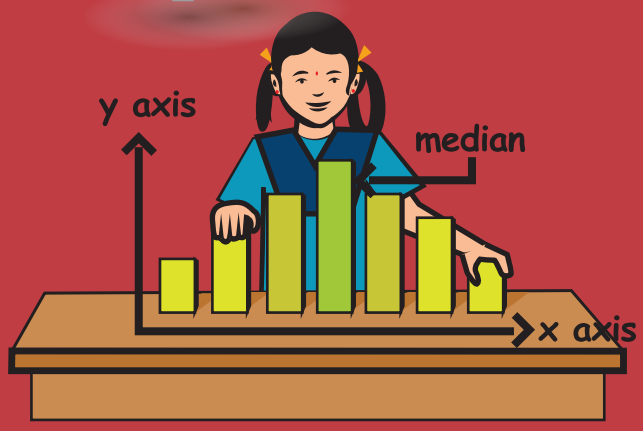
		reactive material, yet it is used to make utensils.
LO7: Describes the elementary idea of chemical bonding. **Learning Indicators:** 7.1 Studies the properties of some carbon compounds (Acetic acid, Chloroform, Ethanol and Methane). 7.2 Draws the structures of saturated and unsaturated carbon compounds. 7.3Generates the homogenous series of carbon compounds.	• Start the lesson by giving an activity to students. Make a list of ten things you have used for since morning and ask them to divide these items into three groups, metals, non-metals and others. **Questions for discussion:** - *What are the items in last column made up of?* - *Can you think of a method to test this?* - *What would be the product if a compound containing carbon is burnt?* - *Do you know of any test to confirm this?* • Conduct experiments involving reactions of carbon and its compounds with chemical reactions. • Use models of saturated compounds of carbon and hydrogen for explaining chains, branches and rings. • Conduct activities with teacher's assistance to understand the chemical properties of carbon compounds.	• What are the two properties of carbon which lead to the huge number of carbon compounds we see around us? • Is it possible to check the hardness of water using detergent? • Why are carbon and its compounds used as fuel? • Draw structures of chemical compounds. • Derive balanced equations for combustion, oxidation, and addition and substitution reaction.
LO8: Studies the commonly used compounds and carbon compounds, their properties and uses. **Learning Indicators:** 8.1 Validate the properties of commonly used compounds by observing their uses.	**Questions for discussion:** - *How is common salt obtained?* - *Besides its use in food, is it used for other purposes?* - *What makes washing soda and baking soda different materials?* - *How does bleaching powder make paper and cloth white?* - *What is the white material that is used for making casts?* - *How do soaps clean clothes?* - *Can some other material be used for cleaning clothes?*	• Why does carbon forms the maximum number of compounds? • Why are covalent compounds generally poor conductor of electricity? • Draw structure of molecules (*e.g.*

8.2 Studies the commonly used compounds, their properties and uses (soap, washing soda, baking soda, bleaching powder, alcohol, denatured alcohol). 8.3 Studies the properties of different kinds of carbon compounds (Saturated hydrocarbons, alcohols, carboxylic acids, petrol, vinegar, natural gas) by conducting experiments.	- *Why does a man lose control on his body after drinking alcohol?* - *Why do people become blind on drinking denatured alcohol?* • Use kit materials (Kit containing various materials like common salt, washing soda, baking soda, lime, lime stone, bleaching powder, plaster of Paris, soaps; alcohol.) for demonstration as well as performing of experiments by student of properties. • Plan visits to factories, water STPs, paper/ textile/ print industries.	*ethanol, methane, etc.*). • Give reasons for observations such as use of synthetic detergents causes pollution in water, air holes of a gas burner should be adjusted when the heated vessel gets blackened by the burner, etc.).
LO9: Classifies elements based on their electronic configuration and study their properties. **Learning Indicators:** 9.1 Explains the classification of elements as per Dobereiner's Triads, Newland's law of octaves and Mendeleev's periodic table. 9.2 Describes the classification of elements based on Modern Periodic Table.	**Questions for discussion:** • *How do chemists study such a large number of elements?* • Provide brief historical account, charts, films etc. • Discuss Doberiner's law of triads, Newland's law of octaves, Mendeleev's Periodic table and Modern Periodic law. Contrast and compare their features, limitations and advantages. • Ask students to predict trends on the basis of the table.	• What physical and chemical properties of elements were used for creating periodic table by Mendeleev? • Why do we classify elements? • What is meant by periodicity? • Why do all the elements of the same group have similar properties? • Predict number of valence electron, valency, group number, nature of oxide formed by it, etc. for an element when its atomic number is given.
Resources: 1. NCERT Class X Science textbook 2. S. Chand Science Laboratory Manual for Class X		

Learning Outcomes in
Mathematics
- Secondary Stage







5 Learning Outcomes in Mathematics- Secondary Stage

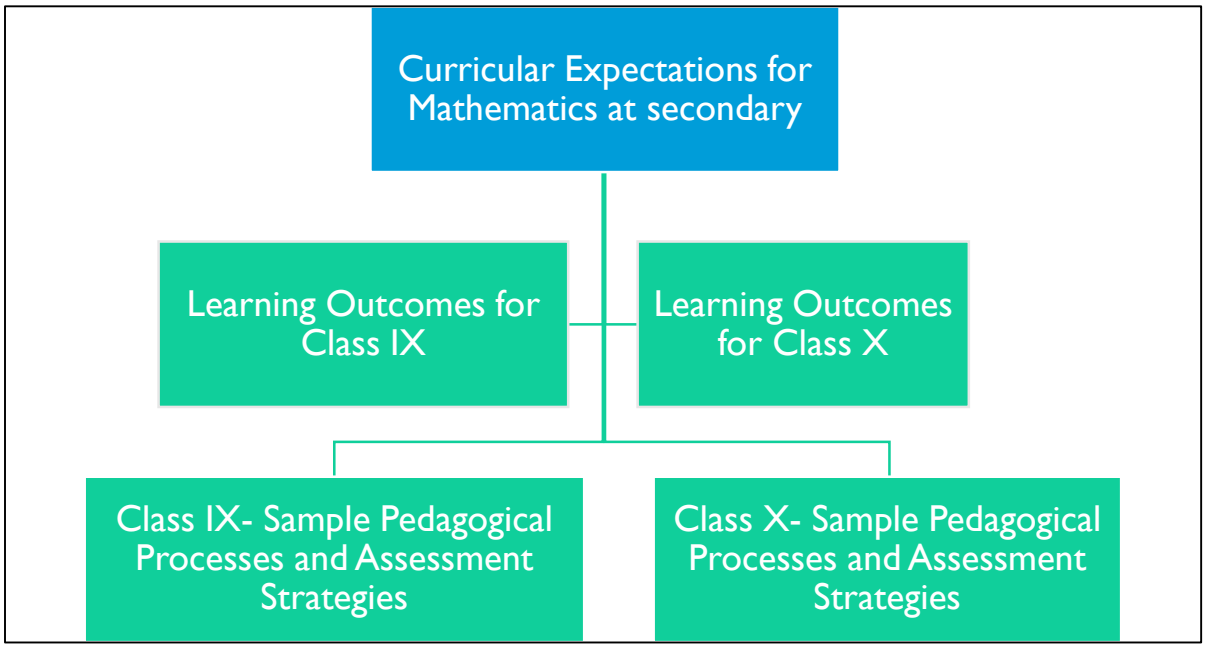


Figure 5: Overview of Mathematics section

5.1 Curricular Expectations

Mathematics is one of the school subjects which helps to develop deductive logic and rational thinking to solve problems, which one encounters not only in daily life, but also in other disciplines. As per the National Focus group Position Paper on Teaching of Mathematics, at the secondary stage, mathematics is perceived as a discipline in which argumentation and proof take a central stage. The concepts and techniques learnt in the elementary stage should be utilized at this stage to solve problems which require understanding of more than one content area in an integrated manner. Mathematics at this stage is also used to solve problems not only in daily life but those encountered in physical and social sciences. Hence, mathematical tasks should be designed in such a manner that a student's mathematical knowledge helps provide logical solutions to realistic societal problems thereby helping in informed, justified and democratic decision making.

With the above approach, the curricular expectations at the secondary stage have been articulated as below.

Sl. No.	Curricular Expectations
CE1	Develop appreciation of patterns in mathematical concepts.
CE2	Classify mathematical objects based on their characteristics.
CE3	Develop abstraction and mathematical language along with an understanding of the historical relevance of different mathematical concepts and operations.
CE4	Make independent and informed decisions by interpretation of data, prediction of outcome of events and logical and analytical thinking.
CE5	Develop ability to mathematize one's own thought process; for example 'use mathematical modelling for solving realistic societal problems and those encountered in other disciplines using mathematical thinking and interrelationships of mathematical concepts'.
CE6	Develop proofs and justification using deductive reasoning and logical thinking.
CE7	Enjoy engaging with mathematics and develop confidence in mathematical problem solving and problem posing.

The units chosen for mathematics at the secondary stage as per the NCERT syllabus are Real Number System, Algebra, Geometry, Co-ordinate Geometry, Mensuration, Statistics and Probability. In Class X, a unit of Trigonometry is included. The learning outcomes are broad indicators of achievement in each of these domains and the weightage given to these in this document is commensurate with the coverage given to each of these domains in the prescribed syllabus of NCERT. However, it may be noted that some of the outcomes especially those in the case of geometry and mensuration have been clubbed on the basis of skills being attained. The transaction of these concepts would necessitate dividing the outcomes into multiple learning indicators and the time taken to attain these outcomes would be proportional to the weightage given to these concepts in the syllabus.

5.2 Learning Outcomes- Class IX

Sl. No.	Learning Outcomes	Unit
LO1	Explains the need for each new set of numbers, distinguishes between sets of natural numbers, whole numbers, rationals and irrationals and provides examples and non-examples of these different sets.	Real Numbers
LO2	Demonstrates and explains that rational numbers are dense and can be uniquely represented on a number line (e.g. locates them on a number line, algebraically finds rational numbers between two rational numbers).	Real Numbers
LO3	Compares rational and irrational numbers based on their properties and their decimal expansions (e.g. the nature of the decimal expansion, distinguish between the expansion of rational numbers that terminate and those which recur and the decimal expansion of irrational numbers which does not terminate or recur, both sets can be uniquely represented on the number line and are dense).	Real Numbers
LO4	Simplifies expressions with rational numbers and expressions with irrational numbers by: - generalizing the laws of exponents with rational powers -rationalization of denominators	Real Numbers
LO5	Justifies truth or falsehood of a given statement on rational number & irrational numbers (e.g. every integer is a rational number, rational numbers are closed under division, every positive real number has a rational square root).	Real Numbers
LO6	Identifies a polynomial, its generalized form, its terms, coefficients, zeroes, degree, and different types of polynomials such as monomial, binomial, trinomials, constant, linear, cubic and quadratic polynomials.	Algebra
LO7	Applies remainder theorem to divide a polynomial by another polynomial, find remainder when a polynomial is divided by another polynomial.	Algebra
LO8	Applies factor theorem to identify zeroes of polynomial and for factorizing quadratic and cubic polynomials.	Algebra

LO9	Applies algebraic identities to simplify calculations and factorize polynomials.	Algebra
LO10	Identifies the points that lie on a linear equation of two variables and show that they all lie on a straight line.	Algebra
LO11	Proves that a linear equation of two variables have infinitely many solutions and express the solutions in ordered pairs.	Algebra
LO12	Represents a real life situation in the form of linear equation with both algebraic and graphical solution.	Algebra
LO13	Poses problems based on linear equations in two variables.	Algebra
LO14	Identifies the origin, x and y axis, abscissa and ordinate of a given point in the Cartesian planes.	Co-ordinate Geometry
LO15	Demonstrates understanding of the location of the position of a given point and the change in position with horizontal and vertical movement in the Cartesian plane.	Co-ordinate Geometry
LO16	Investigates if a given set of points on the coordinate plane lie on a straight line by plotting the points.	Co-ordinate Geometry
LO17	Recognizes mathematicians' including Euclid's contributions to the development of geometry.	Geometry
LO18	Identifies definitions, common/obvious notions, axioms/postulates, and theorems and establishes the relationship between axiom and theorem using examples.	Geometry
LO19	Defines geometrical concepts – point, lines, line segment, ray, angles, collinear points, non collinear points and circles with reference to Euclidean geometry.	Geometry
LO20	Uses mathematical language needed to understand, identify and discuss different geometrical concepts such as angles, triangles, quadrilaterals and circles.	Geometry
LO21	Classifies different geometrical objects (different types of quadrilaterals, angles formed when a transversal intersects two parallel lines).	Geometry
LO22	Verifies as well as proves theorems and axioms relating to lines, angles, triangles, quadrilaterals and circles.	Geometry
LO23	Constructs lines bisectors, angular bisector (60^0, 90^0, 45^0), equilateral triangles and triangles with given conditions (such as	Geometry

	base, sum difference of other two sides, perimeter and one or two base angles given) and reasons out the steps for construction.	
LO24	Solves problems on area of triangle and composite figures applying Heron's formula.	Mensuration
LO25	Derives formula to find the total surface area, curved surface area and volume of cube, cuboids, cylinders and cones, spheres and hemispheres using hands on activity (such as nets) and uses these to solve problems on surface area and volumes of solids.	Mensuration
LO26	Categorizes collected data from daily life (as primary and secondary data, grouped and ungrouped, raw data or in frequency distribution).	Statistics & Probability
LO27	Represents the grouped/ungrouped data appropriately in bar graphs, histograms and frequency polygon as per the nature of the data (e.g. selects the most appropriate graphical representation).	Statistics & Probability
LO28	Justifies which measure of central tendency is appropriate for a given context.	Statistics & Probability
LO29	Analyzes data from real life (such as census data, educational statistics) and draws conclusions and inferences.	Statistics & Probability
LO30	Explains the concept of empirical probability.	Statistics & Probability
LO31	Performs experiments in real life situations and uses real life data to obtain the empirical probability of an event.	Statistics & Probability

5.3 Class IX- Sample Pedagogical Processes and Assessment Strategies

Unit- Real Number System

Learning Outcomes and Indicators	Pedagogical Process	Assessment Strategies
LO1.Understands the need for each new set of numbers, distinguishes between rational numbers and integers and provides examples and non-examples of different number sets. **Learning Indicators** 1.1 Classifies numbers as natural, integer and rational numbers. 1.2 Defines a rational number. 1.3 Provides examples of rational numbers.	• Task 1: Start with the numbers 5 and 7 and ask students to add, subtract, multiply and divide them and then classify the sum, difference, product and quotient. [Note: The categories of classification are not given at this stage]. **Discussion:** *What are the answers you got and how did you classify them?* [Note: Students may classify them as positive and negative or natural numbers, integers and rational numbers or even as possible and impossible operations] • Probing questions: - *Are all natural numbers integers?* - *Are all integers rational numbers?* - *How are rational numbers different from set of natural numbers and integers?* • From the examples of rational numbers, define the characteristics of rational numbers and arrive at the definition of rational numbers (Note: definitions may vary at this stage. This terminology is best avoided at this stage).	Task- Related • Problems should be provided to students to check the following- - *Is the student able to apply all four operations on the numbers?* - *Is the student able to classify the numbers into natural, integers and rational correctly?* - *Is the student able to justify his/her stance?* - *Is the student able to explain with examples when the sum, difference, product and quotient of two natural numbers is not a natural number?* - *Can the student extend this to study the closure of the set of rationals under the four basic operations?* • Define natural numbers, integers and rational numbers

LO2. Demonstrates and explains that rational numbers are dense and can be uniquely represented on a number line (for ex: locates them on a number line, algebraically finds real numbers between two real numbers). **Learning Indicators**: 2.1 Locates the rational numbers on the number line. 2.2 Distinguishes between rational numbers and integers in terms of their density on the number line. 2.3 Concludes that rational numbers are dense. 2.4 Finds rational numbers between two rational numbers.	• Draw a number line and plot -3/7, 3/7, 4/7, -1/7, 5/7 on the number line. • Find the average of any two of these numbers and plot it. • Now find the average of the average and one of the numbers. Plot this new mean. • Can this process be continued indefinitely? • Is there any other way of finding a rational number between two given rational numbers?	**Probing questions:** - *Can there be another integer between two consecutive integers?* - *Can the same be said about rational numbers?* - *Can there be two consecutive rational numbers?* - *How many rational numbers can you plot between any two rational numbers?* • Write a short paragraph on the density of rational numbers and of integers, justifying your conclusions with examples.

LO3. Compares rational and irrational numbers based on their properties and their decimal expansions (for example: the nature of the decimal expansion, distinguish between the rational numbers that terminate and the ones which do not terminate, both can be uniquely represented on the number line and are dense). **Learning Indicators** 3.1 Converts rational numbers in p/q to decimals and vice versa. 3.2 Explores patterns in the decimal expansion of rational numbers. 3.3 Explores the nature of decimal expansions of square roots of non-perfect positive integers.	• Provide students with different rational numbers and have them estimate the decimal representation of the same. For example: Numbers such as 2/5, 6/11, 9/7 , 3/8, 12/5, 7/13). • Next, ask them to find the decimal representation using long division and compare their estimate with their answer. *(Students are asked to divide until they arrive at a terminating decimal or recognize a recurring pattern.)*	**Probing questions** • *Will all rational numbers be either terminating or recurring decimals? Justify your stance.* • *Which of the numbers will have terminating and which of them would be non- terminating?* • *Is there any pattern in the numbers that terminate and the numbers which have a recurring pattern?* • Investigate the decimal representations of the reciprocals of the numbers from 1 to 100 and classify the numbers based on the number of digits in the recurrence. Note: Have students observe the ones which terminate and ones which do not. • How will the patterns that you observe if the numerator is not 1?
	• Discuss the methods to convert a repeating non terminating decimal to the p/q form. (Algebraic and the short cut method must be discussed). • Encourage students to discuss the values of numbers such as and so on.	• Convert 0.45, $0.3\dot{3}$, $0.1\dot{9}$, 0.999…., 1.999… to the $\frac{p}{q}$ form. • Evaluate if the following definition of rational number is correct?

3.4 Discusses the irrationality of pi. 3.5 Plots irrational numbers and rational numbers geometrically. 3.6 Plots real numbers on the number line.		Provide arguments to support your answer • *'Any number which can be represented in the form of p/q where p and q are integers is known as rational number'.*
	• Begin a discussion on whether the square root of every positive whole number is a rational number. • Encourage students to find the square root of the following numbers by division method: *2, 5, 16, 7, 18….and explore the patterns in the decimal expansion (how different are these from decimal expansions of other rational numbers).* • Help them to arrive at the conclusion that the decimal expansions of the square roots of non-perfect square numbers follow a non-repeating non-terminating pattern. • Discuss the proof by contradiction that $\sqrt{2}$ is irrational. • Facilitate discussion about the irrationality of the number π (pi). Discuss if pi is equal to $\frac{22}{7}$? Discuss about the decimal expansion of pi. • Show the video on irrationality of pi. https://www.youtube.com/watch?v=HSuqbqENIek • Discuss if irrational numbers can be plotted on the real number line. Discuss how $\sqrt{2}$, $\sqrt{3}$ can be plotted on the number line.	• Which of these are irrational numbers? $P^2 = 0.09$, $q^2 = 0.4$, $r^2 = \frac{27}{16}$ • Plot the square root of 2.5 geometrically and explain the same algebraically. • Activity: http://azimpremjiuniversity.edu.in/SitePages/resources-ara-march-2017-spiral-of-square-roots.aspx

	• Provide opportunities to plot square root of any positive real numbers geometrically and justify the same algebraically. • Discuss how to find irrational numbers between two rational numbers. • Encourage students to visualize representation of real numbers on number line up to a given place of decimal.	
LO4.Simplifies expressions with rational numbers and expressions with irrational numbers by generalizing the laws of exponents with rational powers. -rationalization of denominators **Learning indicators:** 4.1 Explores the nature of sum, difference, product and quotient of rational numbers and irrational numbers and both. 4.2 Performs operations on real numbers. 4.3 Simplifies expressions with	• Invite discussions on the type of numbers formed when a rational and irrational number are added or subtracted, multiplied and divided. • Provide statements for discussion such as the following - *sum of rational and irrational is always rational.* - *Sum/Product of irrational and irrational is always irrational.* - *Is it possible to have a rational product of two irrational numbers?* - *Is it possible to have rational product? of a rational and irrational number?* - *What will be the nature of quotient of a rational and irrational number?* • Encourage students to perform operations on real numbers(include rational and irrational numbers. • Provide tasks to rationalize the denominator and simplify expressions and also simplify expressions with rational exponents. • For $m = 2 + \sqrt{3}$, let students explore the values of $\frac{1}{m}$, $m + \frac{1}{m}$, $m - \frac{1}{m}$ and find out if these values are rational or irrational numbers.	• Investigate in pairs whether $2 + \sqrt{3}$, $\sqrt{3} \cdot \sqrt{3}$, $\pi - 2$ are rational or irrational numbers. • Divide the students in pairs where one group provides statements as the following and the other group provides examples. - *Rational product of two irrational numbers.* - *Rational quotient of two irrational numbers.* - *Simplification tasks using rationalization of denominator and exponents with rational power may be given for practice.* • Prove that $(\sqrt{p+1} + \sqrt{p-1})$ is an irrational number, where p is a natural number.

real numbers using identities and rationalization of denominators. 4.4 Generalizes the rule of exponents to rational powers.		
LO5.Justifies truth or falsehood of a given statement on rational number & irrational numbers.	• Provide statements on rational and irrational numbers such as: - *Every integer is a rational number,* - *The set of rational numbers are closed under division,* - *Every positive real number has a rational square root.* • Ask students to discuss whether the statements are correct and provide justifications on the same. The use of counter-examples may be introduced at this point.	• Group activity: Divide students into groups and provide sentences given below in chits. Each group take turns to discuss the statements and provide justification for or against the statements. - *All integers are rational numbers but all rational numbers are not integers.* - *Rational numbers are closed under division.* - *Every positive rational number has a rational square root.* - *The product of two irrational numbers may or may not be an irrational number.* - *If p is a rational number and q is an irrational number, p + q will always be an irrational number.* Note that while one group provides justification, the other group provides

		evaluates whether the justifications are valid.
Resources	1. NCERT Text Book class IX 2. At Right Angles: A Resource for High School Mathematics 3. Video link on irrationality of pi https://www.youtube.com/watch?v=HSuqbqENIek	

5.4 Learning Outcomes- Class X

Sl. no	Learning Outcomes	Unit
LO1	Applies Euclid's division Lemma: - to find HCF of two numbers - arrive at general forms of numbers (such as odd numbers are of the form 2q +1)	Number System
LO2	Applies the Fundamental Theorem of Arithmetic for solving problems (for e.g. finding HCF and LCM of two numbers or unit digits of powers of numbers).	Number System
LO3	Proves the irrationality of √2, √3, √5 and other surds such as m+ √n etc. using the Fundamental Theorem of Arithmetic.	Number System
LO4	Explore the pattern in rational numbers which have a terminating decimal expansion and which have non terminating decimal expansion.	Number System
LO5	Interprets the geometric meaning of the zeroes of a polynomial.	Algebra
LO6	Establishes the relationship between zeroes and the coefficients of a polynomial.	Algebra
LO7	Verifies division algorithm in case of division of polynomials.	Algebra
LO8	Classifies linear equations as consistent, inconsistent and dependent and interprets their geometric meaning, the type of solutions and the relationship between the coefficients.	Algebra
LO9	Solves problems on linear equations in two variables: - Graphically	Algebra

	- Algebraically (using substitution, elimination and by cross multiplication)	
LO10	Explores the relationship between the nature of roots and the discriminant of a quadratic equation.	Algebra
LO11	Solves problems based on quadratic equations using different methods (by factorization and completing squares).	Algebra
LO12	Derives the formula for nth term and the sum of first n terms of an arithmetic progression.	Algebra
LO13	Solves real life problems based on Arithmetic Progression.	Algebra
LO14	Justifies through demonstration that the ratios of sides in a right angled triangle remain constant when the angles remain constant.	Trigonometry
LO15	Defines sine, cosine and tangent of an acute angle in general and the specific angles such as 0^0 , 30^0, 45^0, 60^0 and 90^0	Trigonometry
LO16	Proves the trigonometric identities and uses the same to establish relationships between the trigonometric ratios.	Trigonometry
LO17	Solves simple problems on heights and distances (which includes understanding of angle of elevation and depression).	Trigonometry
LO18	Derives distance formula to find distance between any two points on the co-ordinate plane and applies the same to determine: - Type of triangles - Formula for finding the area of a triangle - Whether given points are collinear	Co-ordinate Geometry
LO19	Derives the section formula and solves problems to find the mid-point of the line joining two given points or point of trisection.	Co-ordinate Geometry
LO20	Provides examples and non-examples of similar triangles and explains the conditions for two triangles to be similar.	Geometry
LO21	Proves Basic Proportionality theorem and its converse and solves problems related to the similar triangles.	Geometry
LO22	Proves Pythagoras theorem and solves problems based on the same.	Geometry
LO23	Prove theorems related to the relationships between tangent, radius, chord and sector, secant of a circle and solves related problems.	Geometry

LO24	Divides a line segment in a given ratio, constructs tangents to a circle from an external points and construct tangents to a circle from external points.	Geometry
LO25	Justifies whether given steps of a particular construction are appropriate.	Geometry
LO26	Solves problems on areas related to circle, secant and segments.	Mensuration
LO27	Derives the surface area and volume of combination of shapes such as (cube, cuboid, sphere, hemisphere, cone, and cylinder) and frustum of a cone.	Mensuration
LO28	Solves problems based on surface area and volume of different shapes and their combinations.	Mensuration
LO29	Calculates the central tendencies (mean, median and mode) of a grouped data.	Statistics & Probability
LO30	Analyzes and draws conclusions from a given data from real life (including issues such as education, midday meal, school drop outs, data on weather and climate, population) using appropriate measure of central tendency.	Statistics & Probability
LO31	Mentions the probability of certain event, impossible event, complement of an event.	Statistics & Probability
LO32	Solves problems on probability of occurrence of events.	Statistics & Probability

5.5 Class X- Sample Pedagogical Processes and Assessment Strategies

Unit - Real Number System

Learning Outcomes and Indicators	Pedagogical Processes	Suggested Assessment Strategies
LO1. Applies Euclid's division Lemma	• Divide 9 by 4 and express the relationship in the form 9 = 4 x 2 + 1; identify 9 as the dividend, 4 as divisor, 2 as quotient and 1 as remainder.	• The H.C.F of two numbers is always less than or equal to the smaller of the

i) to find HCF of two numbers. ii) arrive at general forms of numbers. (such as odd numbers are of the form 2q +1). **Learning Indicators** 1.1 Establish a linear relation between two integers. 1.2 State Euclid's division Lemma. 1.3 Use Euclid's division Lemma to find HCF of two numbers. 1.4 Arrive at general forms of numbers.	• Repeat with 12 as divisor and 38 as dividend and ask students to write the relationship as dividend = divisor x quotient + remainder. • Ask them to work in pairs and give each other similar problems. **Probing questions** - *Can there be more than one way of expressing the mathematical relationship?* - *Discuss the case when the divisor is greater than the dividend.* - *Can you add a narrative to your equation? [For example, mathematically represent the situation of distributing 9 chocolates in 4 bags, or dividing 38 chocolates in 12 bags].* - *9 = 4 x 2 + 1* - *38 = 12 x 3 + 2* • Encourage students to observe that the remainder is less than the quotient and establish the Euclid's Division Lemma : *a = bq + r , 0 ≤ r<b, where a and b are positive integers.* • Draw reference to Book VII of Euclid's elements where this lemma was first mentioned and which serves as the basis for Euclid's division algorithm. **Probing question** *Can q and/or r be 0?* • Encourage students to establish more relationship with more pairs of positive integers. • Encourage students to recall the definition of highest common factor which they have learnt in lower classes. • Provide example of any two positive integers and ask the student to find the HCF.	numbers. True or False? • The H.C.F. of two numbers is the smallest number that divides both these numbers. True or False? • Find the H.C.F. of 42 and 35 using Euclid's Division Lemma. Then, by drawing a set of 42 dots and carving out smaller sets of dots in this set, explain why 7 is the H.C.F of 42 and 35. • Prove that the sum of two odd numbers is always even. What can you say about the sum of an odd number and an even number? Justify. • Prove that the number of the form p (p-1) is always an even number, where p is a positive integer. • Prove that the square of an even number is always a multiple of 4. • Prove that the square root of an odd perfect square is always an odd number.

	• Ask students to express a = 36 and b = 18 in the form a = bq + r, 0 ≤ r<b and note down their observations. Facilitate their discussion to arrive at (i) r = 0 (ii) b is the HCF of a and b. **Probing Question**: - *Is this always so? If yes, justify your response.* - *If no, find pairs of numbers for which the divisor is the H.C.F.* - *Can this procedure be used to find the H.C.F. of any two numbers?* • Use the above question to facilitate a discussion on the procedure of finding the H.C.F. using Euclid's division lemma. Examples which may be used are 36 and 24, students may be guided to see that there is one 24 in 36 with 12 remaining. There are two 12s in 24 with no remainder and so the H.C.F is 12. • Example 2: 36 and 14. It is preferable that students use the narrative above to understand the logic of the procedure. Diagrammatic representations and the ganitmala also help students to visualize this procedure. • Have students show the following using Euclid's Lemma: *Every positive even integer is of the form 2q and every positive odd integer is of the form 2q+1.*	
LO2. Applies the Fundamental Theorem of Arithmetic for solving problems(for example: finding HCF and LCM of	• Show the video on Fundamental Theorem of Arithmetic https://www.khanacademy.org/math/in-in-grade-10-ncert/in-in-chapter-1-real-numbers/modal/v/the-fundamental-theorem-of-arithmetic-1	• State the Fundamental Theorem of Arithmetic. • Explain why 5 ×2 × 3 × 11 + 11 is a composite number.

two numbers or unit digits of powers of numbers).	• Write down your understanding of a prime number and of a composite number. Then express each of these using the Fundamental Theorem of Arithmetic. • General Reading on Twin Primes http://teachersofindia.org/en/article/twin-primes-conjecture • Find the HCF and LCM of 108 and 81 using the prime factorization method. • Prove that HCF (a, b) × LCM (a, b) = a × b. [*Students may be encouraged to begin with a numerical example]*	• Write down a general representation of a number having a zero at its unit place. • Discuss (using the prime factorization method) if 4^n will have a zero at its unit place for any value of n. • Given two numbers and their HCF, find their LCM.
LO3. Prove the irrationality of $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$ and other surds such as m+ $\sqrt{n}$ etc. using the Fundamental Theorem of Arithmetic. **Learning Indicators** 3.1 Provides justified arguments to prove theorems using Fundamental theorem of Arithmetic. 3.2 Proves irrationality of surds.	• Encourage students to prove (using numerical examples) that if a prime number p divides a^2, it also divides a, where 'a' is a positive integer. • Demonstrate to students how to prove the irrationality of $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$ using the method of contradiction.	• Prove by contradiction that 5 - $\sqrt{3}$ is irrational.

LO4. Explores the pattern in rational numbers which have a terminating decimal expansion and which have non terminating decimal expansion.	• Provide different rational numbers of the form $\frac{p}{q}$ and have students evaluate the denominators of rational numbers which terminate and the ones which do not terminate. • Probe them to arrive at the pattern that the denominators which are of the form 2^m5^n will terminate; where n and m are non-negative integers. • Make the students familiar with the theorems based on the above idea.	• Find 5 rational numbers (with different denominators) which will terminate and then modify one term in each number so that the new number will not terminate, with adequate justifications.
Resources	1. NCERT Mathematics Textbook class X 2. At Right Angles, A Resource for High School Mathematics 3. https://www.khanacademy.org/math/in-in-grade-10-ncert/in-in-chapter-1-real-numbers/modal/v/the-fundamental-theorem-of-arithmetic-1	

Annexures and References

6. Annexures

6.1 Annexure 1- Alignment of Learning Outcomes with NCERT syllabus – Secondary Stage

Mathematics - Class IX

Learning Outcomes	Alignment with syllabus
LO1,LO4	Review of representation of natural numbers, integers, and rational numbers on the number line. Explaining that every real number is represented by a unique point on the number line and conversely every point on the number line represents a unique real number
LO2, LO4, LO5	Representation of terminating/non terminating recurring decimals, on the number line. Examples of non-recurring/non terminating decimals such as $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$. Existence of non- rational numbers (irrational numbers) Existence of $\sqrt{x}$ of for a positive real number x (visual proof) to be emphasized. Definition of nth root of a real number
LO3, LO4	Recalls laws of exponents with integral powers, Rational exponents with positive real bases (allowing students) to arrive at the general laws Rationalization with precise meaning of real numbers of the type and their combination
LO6	Definition of a polynomial in one variable, its coefficients, with examples and counter examples, its terms, zero polynomial. Degree of a polynomial. Constant, linear, quadratic, cubic polynomials; monomials, binomials, trinomials. Factors and multiples. Zeros/roots of a polynomial/equation
LO7	State and motivate the Remainder Theorem with examples and analogy to integers.
LO8	Statement and proof of the Factor Theorem. Factorization of $ax^2 + bx + c$, $a \neq 0$ where a, b, c are real numbers, and of cubic polynomials using the Factor Theorem
LO9	Recall of algebraic expressions and identities. Further identities of the type: $(x + y + z)^2 = x^2+ y^2 + z^2 + 2xy + 2yz + 2zx$, $(x+/- y)^3 = x^3+/-y^3 +/-3xy(x+/-y\_$ $x^3 + y^3 + z^3 – 3xyz = (x+y+z)(x^2+y^2+z^2)$ and their use in factorization of polynomials. Simple expressions reducible to these polynomials.
LO10, LO13	Recall of linear equations in one variable. Introduction to the equation in two variables. Plotting them and showing that they seem to lie on a line.

LO11	Prove that a linear equation in two variables has infinitely many solutions, and justify their being written as ordered pairs of real numbers.
LO12	Examples, problems from real life, including problems on Ratio and Proportion and with algebraic and graphical solutions being done simultaneously
LO14, LO15	The Cartesian plane, coordinates of a point, names and terms associated with the coordinate plane, notations
LO16	Plotting points in the plane, graph of linear equations as examples; Focus on linear equations of the type ax + by + c = 0 by writing it as y =mx + c and linking with the chapter on linear equations in two variables.
LO17, LO18	Euclid' s definitions. History – Euclid and geometry in India. Euclid's method of formalizing observed phenomenon into rigorous mathematics with definitions, common/obvious notions, axioms/postulates, and theorems. The five postulates of Euclid. Equivalent versions of the fifth postulate. Showing the relationship between axiom and theorem
LO19	Properties of each of the geometrical concepts as per syllabus
LO20, LO21	Results on corresponding angles, alternate angles, interior angles when a transversal intersects two parallel lines.
LO22	Theorems on Lines and Angles, triangle congruency, angle sum property, exterior angle, mid-point theorem, parallelograms and circles.
LO23	Construction of bisectors of a line segment and angle, 60°, 90°, 45° angles etc., equilateral triangles. 2. Construction of a triangle given its base, sum/difference of the other two sides and one base angle. Construction of a triangle of given perimeter and base angles.
LO24	Area of a triangle using Heron's formula (without proof) and its application in finding the area of a quadrilateral. Surface areas and volumes of cubes, cuboids, spheres (including hemispheres) and right circular cylinders/cones.
LO25	Surface areas and volumes of cubes, cuboids, spheres (including hemispheres) and right circular cylinders/cones.
LO26	Collection of data, presentation of data – tabular form, ungrouped/ grouped, bar graphs, histograms (with varying base lengths), frequency polygons, qualitative analysis of data to choose the correct form of presentation for the collected data. Mean, median, mode of ungrouped data.
LO27,LO28, LO29	Qualitative analysis of data to choose the correct form of presentation for the collected data.
LO30, LO31	History, Repeated experiments and observed frequency approach to probability. Focus is on empirical probability.

Mathematics- Class X

Sl. no	Unit
LO1	Euclid's division Lemma
LO2	Fundamental theorem of Arithmetic – proof and examples
LO3	Proofs of results – irrationality of $\sqrt{2}$, $\sqrt{3}$, $\sqrt{5}$ and other surds
LO4	Decimal expansions of rational numbers in terms of terminating/non-terminating recurring decimals.
LO5	Zeros of polynomials
LO6	Relationship between zeros and coefficients of a polynomial with particular reference to quadratic polynomials.
LO7	Statement and simple problems on division algorithm for polynomials with real coefficients.
LO8	Pair of linear equations in two variables. Geometric representation of different possibilities of solutions/inconsistency.
LO9	Algebraic conditions for number of solutions. Solution of pair of linear equations in two variables algebraically – by substitution, by elimination and by cross multiplication.
LO10	Relationship between discriminant and nature of roots.
LO11	Standard form of a quadratic equation $ax2 + bx + c = 0$, $(a \neq 0)$. Solution of quadratic equations (only real roots) by factorization and by completing the square, i.e., by using quadratic formula.
LO12, LO13	Motivation for studying AP. Derivation of standard results of finding the nth term and sum of first n terms
LO14	Trigonometric ratios of an acute angle of a right-angled triangle. Proof of their existence (well defined); motivate the ratios, whichever are defined at 0° and 90°
LO15	Values (with proofs) of the trigonometric ratios of 30°, 45° and 60°. Relationships between the ratios.
LO16	Trigonometric Identities: Proof and applications of the identity $\sin2 A + \cos2 A = 1$. Only simple identities to be given. Trigonometric ratios of complementary angles.
LO17	Simple and believable problems on heights and distances. Problems should not involve more than two right triangles. Angles of elevation/depression should be only 300 , 450 , 600 .
LO18, LO19	Review the concepts of coordinate geometry done earlier including graphs of linear equations. Awareness of geometrical representation of quadratic polynomials. Distance between two points and section formula (internal). Area of a triangle.

LO20	Definitions, examples, counterexamples of similar triangles.
LO21	If a line is drawn parallel to one side of a triangle to intersect the other two sides in distinct points, the other two sides are divided in the same ratio. 2. (Motivate) If a line divides two sides of a triangle in the same ratio, the line is parallel to the third side. 3. (Motivate) If in two triangles, the corresponding angles are equal, their corresponding sides are proportional and the triangles are similar. If a perpendicular is drawn from the vertex of the right angle to the hypotenuse, the triangles on each side of the perpendicular are similar to the whole triangle and to each other. 7. (Prove) The ratio of the areas of two similar triangles is equal to the ratio of the squares on their corresponding sides.
LO22	In a right triangle, the square on the hypotenuse is equal to the sum of the squares on the other two sides. 9. (Prove) In a triangle, if the square on one side is equal to sum of the squares on the other two sides, the angles opposite to the first side is a right triangle.
LO23	Tangents to a circle motivated by chords drawn from points coming closer and closer to the point. 1. (Prove) The tangent at any point of a circle is perpendicular to the radius through the point of contact. 2. (Prove) The lengths of tangents drawn from an external point to a circle are equal.
LO24, LO25	Division of a line segment in a given ratio (internally). 2. Tangent to a circle from a point outside it. 3. Construction of a triangle similar to a given triangle
LO26	Motivate the area of a circle; area of sectors and segments of a circle. Problems based on areas and perimeter/circumference of the above said plane figures. (In calculating area of segment of a circle, problems should be restricted to central angle of 60°, 90° and 120° only. Plane figures involving triangles, simple quadrilaterals and circle should be taken.)
LO27, LO28	Problems on finding surface areas and volumes of combinations of any two of the following: cubes, cuboids, spheres, hemispheres and right circular cylinders/cones. Frustum of a cone. Problems involving converting one type of metallic solid into another and other mixed problems. (Problems with combination of not more than two different solids be taken.)
LO29, LO30	Mean, median and mode of grouped data (bimodal situation to be avoided). Cumulative frequency graph.
LO31, LO32	Classical definition of probability. Connection with probability as given in Class IX. Simple problems on single events, not using set notation.

Science- Class IX

Sl. No.	NCERT Syllabus
LO1	Definition of matter; solid, liquid and gas; characteristics - shape, volume, density; change of state-melting (absorption of heat), freezing, evaporation (cooling by evaporation), condensation, sublimation.
LO2	Elements, compounds and mixtures. Colloids and suspensions
LO3	Heterogeneous and homogeneous mixtures.
LO4	Law of constant proportions
LO5	Atoms and molecules, Atomic and molecular masses. Chemical formula of common compounds. Mole concept
LO6	Electrons, protons and neutrons, valency, chemical formula of common compounds. Isotopes and Isobars.
LO7	Plant and animal breeding and selection for quality improvement and management; Use of fertilizers and manures; Protection from pests and diseases; Organic farming.
LO8	Physical resources: Air, Water, Soil. Air for respiration, for combustion, for moderating temperatures; movements of air and its role in bringing rains across India.
LO9	Air, Water and Soil pollution (brief introduction). Holes in ozone layer and the probable damages.
LO10	Bio-geo chemical cycles in nature: water, oxygen, carbon, nitrogen.
LO16	Health and Diseases: Health and its failure. Infectious and Non-infectious diseases, their causes and manifestation. Diseases caused by microbes (Virus, Bacteria and Protozoans) and their prevention; Principles of treatment and prevention. Pulse Polio programs
LO11	Cell - Basic Unit of life: Cell as a basic unit of life; prokaryotic and eukaryotic cells, multicellular organisms; cell membrane and cell wall, cell organelles and cell inclusions; chloroplast, mitochondria, vacuoles, endoplasmic reticulum, Golgi apparatus; nucleus, chromosomes - basic structure, number.
LO12, LO13	Biological Diversity: Diversity of plants and animals - basic issues in scientific naming, basis of classification. Hierarchy of categories / groups, Major groups of plants (salient features) (Bacteria, Thallophyta, Bryophyta, Pteridophyta, Gymnosperms and Angiosperms). Major groups of animals (salient features) (Nonchordates upto phyla and chordates upto classes).
LO14, LO15	Diffusion/exchange of substances between cells and their environment, and between the cells themselves in the living system; role in nutrition, water and food transport, excretion, gaseous exchange.
LO17,LO 18	Uniform and non-uniform motion, Distance and displacement, Speed and velocity, Balanced and unbalanced forces, Inertia and friction, Thrust and pressure. Action and reaction forces, Mass and weight. Acceleration, equations of motion by graphical method. Distance-time and velocity time graphs for uniform and uniformly accelerated motion.
LO19, LO20	Relationship among displacement, time, acceleration and velocity Newton's laws of motion

LO21	Elementary idea of conservation of momentum
LO22	Force of gravitation of the earth (gravity), acceleration due to gravity, Free fall
LO23	Archimedes' principle, buoyancy, elementary idea of relative density.
LO24	Work done by a force, energy, power; kinetic and potential energy; law of conservation of energy.
LO25	Nature of sound and its propagation in various media, speed of sound, range of hearing in humans; ultrasound; reflection of sound; echo and sonar. Structure of the human ear (auditory aspect only).

Science – Class X

Sl. No.	NCERT Syllabus
LO1	Chemical reactions: Chemical equation, Balanced chemical equation, implication of a balanced chemical equation, types of chemical reactions: Combination, decomposition, displacement, double displacement, precipitation, neutralization, oxidation and reduction.
LO2	Acids, bases and salts : Their definitions in terms of furnishing of H+ and OH- ions, General properties, examples and uses, concept of pH scale
LO3	Importance of pH in everyday life
LO4	Preparation and uses of Sodium Hydroxide, Bleaching powder, Baking soda, Washing soda and Plaster of Paris.
LO5	Metals and nonmetals: Properties of metals and non-metals;
LO6	Basic metallurgical processes; Corrosion and its prevention.
LO7	Carbon compounds: Covalent bonding in carbon compounds.
LO8	Nomenclature of carbon compounds containing functional groups (halogens, alcohol, ketones, aldehydes, alkanes and alkynes), difference between saturated hydrocarbons and unsaturated hydrocarbons.
LO9	Periodic classification of elements: Need for classification, Early attempts at classification of elements (Dobereiner's Triads, Newland's Law of Octaves, Mendeleev's Periodic Table), Modern periodic table, gradation in properties, valency, atomic number, metallic and non-metallic properties.
LO10	Define 'living' things; Basic concept of nutrition, respiration, transport and excretion in plants and animals.
LO11	Control and coordination in animals: voluntary, involuntary and reflex action, nervous system; chemical coordination: animal hormones.
LO12	Tropic movements in plants; Introduction to plant hormones.
LO13	Reproduction in plants and animals.
LO14	Need for and methods of family planning. Safe sex vs. HIV/ AIDS. Childbearing and women's health.

LO15	Heredity; Origin of life: brief introduction; Basic concepts of evolution.
LO16	Our Environment: Environmental problems, what can we do? Bio degradable, non-biodegradable. Ozone depletion.
LO17	Potential difference, potential, Ohm's law, Series combination of resistances, Parallel combination of resistances. Power dissipated due to current. Inter relation between P, V, I and R.
LO18	Magnetic field, Field lines.
LO19	Electric motor & generator Direct current
LO20	Alternating current; frequency of AC. Advantage of AC over DC. Domestic electric circuits.
LO21	Images formed by a concave mirror; related concepts centre of curvature, principal axis. Optical centre, focus, focal length. Refraction; laws of refraction. Images formed by a convex lens; Dispersion of light. Scattering of light.
LO22	Related concepts centre of curvature, principal axis. Optical centre, focus, focal length. velocity of light; refractive index;
LO23	Functioning of lens in human eye; problems of vision and remedies.
LO24	Management of natural resources. Conservation and judicious use of natural resources. Forest and wild life, coal and petroleum conservation. Big dams: advantages and limitations; alternatives if any. Water harvesting. Sustainability of natural resources.

Social Science - Class IX

S.no.	NCERT Syllabus
LO1	Geography: Locates and labels on an Outline map of India - the states and capitals, Tropic of Cancer, Standard Meridian, important physical features (mountains, plateaus, coastal plains, rivers and lakes), cities, identifies areas receiving less than 20 cms. to over 400 cms. of rainfall, Vegetation types, National Parks, Bird and Wildlife Sanctuaries, locates and labels states based on population density, sex ratio and areas. History: Locates, labels and identifies - French Revolution (on an Outline map of France), Socialism in Europe and the Russian Revolution, Nazism and the Rise of Hitler (on an Outline map of World).
LO2	India – Size and Location, Latitudinal and longitudinal extension, Indian Standard Time, India and the world, India's neighbours, Trans-Indian ocean routes, strategic central location of India
LO3	India: physical features, plate-tectonic movements, formation of the Himalayas, major physiographic divisions (Himalayan Mountains, The Northern Plains, The Peninsula Plateau, The Indian Desert, The Coastal Plains and The Islands) India Drainage: major rivers and their tributaries, lakes and seas, role of rivers in the economy, pollution of rivers, measures to control river pollution.

LO4	India: climate – Factors influencing the climate; monsoon, its characteristics, rainfall and temperature distribution, seasons, climate and human life.
LO5	India: climate – Factors influencing the climate; monsoon, its characteristics, rainfall and temperature distribution, seasons, climate and human life Natural Vegetation – Vegetation types, distribution as well as altitudinal variation, need for conservation and various measures Wildlife: Major species, their distribution, need for conservation and various measures.
LO6	Natural Vegetation – Vegetation types, distribution as well as altitudinal variation, need for conservation and various measures Wildlife: Major species, their distribution, need for conservation and various measures
LO7	Population – size, distribution, age-sex composition, population change – migration as a determinant of population change, literacy, health, occupational structure and national population policy; adolescents as under-served population group with special needs
LO8	The Economic Story of Palampore: Economic transactions and its interaction with the rest of the world through which the concept of production including the factors of production are introduced People as a resource: Introduction of how people become resource/ asset; economic activities done by men and women
LO9	People as a resource: economic activities done by men and women; unpaid work done by women; quality of human resource – role of health and education; unemployment as a form of non-utilization of human resource – socio-political implication in simple form Poverty as a challenge facing India: Who is poor, indicators; absolute poverty – why people are poor – unequal distribution of resources; comparison between countries; steps taken by government for poverty alleviation
LO10	Food Security: Source of food grains – variety – across the nation – families in the past – the need for self- sufficiency – role of government in food security – procurement of food grains – overflowing of granaries and people without food – public distribution system – role of cooperatives in food security, ration shops
LO11	Data and graphs on climate, factors of production, population and poverty
LO12	French Revolution and the Russian Revolution: The French society in the 18 century, transition of polity from monarchy to constitutional monarchy and finally to a republic, Declaration of Rights, Role of philosophers- Locke, Rousseau, Hobbs and Voltaire, Liberals, Radicals and Conservatives, Industrial Society and Social Change
LO13	Nazism and the rise of Hitler: Birth of the Weimar Republic, Political Radicalism and Economic Crises, Hitler's rise to power and the destruction of democracy, the Nazi world view, the racial utopia, the art of propaganda
LO14	Russian Revolution: The Coming of Socialism to Europe, Karl Marx (1818-1883) and Friedrich Engels (1820-1895) Economy and Society, Socialism in Russia,

LO15	Peasants and Farmers, Forest, Society and Colonialism Pastoralism and the Modern World: The rise of commercial forestry, Forest rules, New Trades, New Employments and New Services, Pastoral nomads and their movements, How did the life of pastoralists change under colonial rule and how did they adapt to the changes? The coming of the modern agriculture, the introduction of machines in agriculture and its aftermath
LO16	History and Sport: The story of cricket: Cricket in the Victorian world, cricket ,race and religion, decolonization and sports, commerce ,media and cricket Clothing: A Social History: Clothing a notion of beauty, transformations in colonial period, caste, conflict and dress change, British Rule and Dress Codes, designing the national dress, Swadeshi movement ,Mahatma Gandhi's Experiments with Clothing, Not All could Wear Khadi
LO17	Democracy in the contemporary world: Two tales of democracy-Chile and Poland, Changing map of democracy, Democracy at the global level
LO18	What is democracy? Why democracy: Why define democracy? Features of Democracy ,arguments in favor and against democracy Broader meaning of democracy, usage of democracy in everyday life
LO19	Constitutional Design: Nelson Mandela from apartheid to democracy, Constitutional Design: Why do we need a constitution? Making of the Indian Constitution, Guiding values of the Constitution, Philosophy of the Constitution and the Preamble
LO20	Constitutional Design: Why do we need a constitution? Making of the Indian Constitution, Guiding values of the Constitution, Philosophy of the Constitution and the Preamble
LO21	Electoral Politics: Why Elections? What is our system of elections, Different stages of election
LO22	Electoral Politics: What makes elections in India democratic? Challenges to free and fair election
LO23	Working of Institutions: How is a major policy decision taken? Needs of Political Institutions, Parliament, Lok Sabha, Rajya Sabha, Judiciary, Permanent and Political executive, Prime Minister, President, the rule of Law and Judicial Review
LO24	Democratic Rights: Life without rights, Guantanamo Bay, Saudi Arabia and Kosovo Rights in a democracy, What are Rights? Rights in the Indian Constitution, Expanding scope of Rights

Social Science- Class X

S. No.	NCERT Syllabus
LO1	Map Skill - Locates on the outline Political Map of India Geography: Major soil types, dams, crops, minerals, power plants, industries, software technology parks, National Highways, major ports, International airports History: Nationalism in India (1918-1930), Indian National Congress Sessions, important centres of Indian National Movement (Non-cooperation and Civil Disobedience Movement

LO2	Resource and Development – Types and classification of resources; sustainable development of resources; resource planning and conservation of resources
LO3	Resource and Development – Types and classification of resources; sustainable development of resources; resource planning and conservation of resources Forest and Wildlife Resources – Flora and Fauna in India; depletion of forests and fauna; conservation of forest and wildlife; types and distribution of forests and wildlife resources; community and conservation
LO4	Water Resources: Water scarcity and the need for water conservation and management; Multi-Purpose River Projects And Integrated Water Resources Management; Rainwater harvesting
LO5	Agriculture: Types of Farming; Cropping Pattern; Major Crops; Technological and Institutional Reforms in Agriculture; Contribution of agriculture to the national economy, employment and output; Food Security; Impact of Globalisation on Agriculture
LO6	Agriculture: Technological and Institutional Reforms in Agriculture; Contribution of agriculture to the national economy, employment and output; Food Security; Impact of Globalisation on Agriculture
LO7	Minerals and Energy Resources: What is a mineral; Classification of minerals; Mode of occurrence of minerals; Distribution and uses of minerals; Conservation of Minerals; Energy Resources: Conventional Sources of Energy and Non- Conventional Sources of Energy; Conservation of Energy Resources
LO8	Manufacturing Industries: Contribution of Manufacturing to National Economy; Industrial Location; Classification of Industries; Manufacturing Processes of selected Industries; Industrial Pollution and Environmental Degradation; Control of Environmental Degradation
LO9	Lifelines of National Economy: Transport; Means of Transport; Communication and Trade
LO10	Development: Meaning of Development and Developmental Goals for Different People; National Development; Comparing Countries – the different attributes of comparison (income, public facilities, human development)
LO11	Development: Developmental Goals for Different People and Sustainability of Development
LO12	Sectors of the Indian Economy: Sectors of Economic Activities; Historical Change in Sectors; Organized and Unorganized Sectors; Employment and Unemployment
LO13	Sectors of the Indian Economy: Draws tables and graphs from a given set of data; calculates from a given data and interprets graphs Development: Meaning of Development and Developmental Goals for Different People; National Development; Comparing Countries – the different attributes of comparison (income, public facilities, human development)
LO14	Money and Credit: Money as a medium of exchange; Modern Forma of Money; Loan Activities of Banks; Formal and Informal Credit
LO15	Globalization and the Indian Economy: Multi-National Companies (MNCs); Meaning of Globalization and Factors enabling Globalization; Liberalization of Foreign Trade and Foreign Investment Policy; Impact of Globalization in India

LO16	Consumer Rights: Consumer exploitation , Consumer Rights; Learning to become well-informed Consumers
LO17	Consumer Rights: Consumer Movement; Consumer Rights; Learning to become well-informed Consumers
LO18	The Rise of Nationalism in Europe, The Nationalist movement in Indo-China, Nationalism in India-The idea of nation
LO19	The Rise of Nationalism in Europe, Nationalism in India-Visualizing the nation, The sense of collective belonging The Nationalist movement in Indo-China, Nationalism in India-Peasants, tribals, Industrialist, the Working class, Dalits, National movement against the colonial rule of the French and the British
LO20	Nationalism in India: Concept of Swarajya ,The Non-Cooperation and Civil Disobedience Movement and the role of Gandhi
LO21	The making of a Global World: The pre-modern world ,the process of globalization, Silk routes and Food travels, The 19 century(1815-1914), role of technology, The age of Industrialization
LO22	Work, life and leisure: Industrialization and the rise of the modern cities, transport, politics in the city, Bombay: the prime city of India, Land reclamation in India, Bombay as the city of dreams, the world of cinema and culture, Haussmanization of Paris
LO23	Print culture and the modern world: The first printed books, Print comes to Europe, Gutenberg and the printing press, Religious debates and the fear of print
LO24	Novels, Society and History: The world of the novel, novels for young, the novel comes to India, the nation and its history, the novel and nation making
LO25	Power Sharing; forms of power sharing, case study-Belgium and Sri Lanka
LO26	Federalism: What makes India a federal country ,features of Federalism and How is it practiced in India ,third tier of government, local government
LO27	Democracy and Diversity: Origins of social differences, overlapping and cross-cutting differences, Politics of social division and range of outcomes
LO28	Gender, Religion and Caste: Gender and politics, religion, communalism and politics ,caste in politics and politics in caste
LO29	Political Struggles and Movements: Popular struggles in Nepal and Bolivia, sectional interest groups and public interest groups, Movement groups, Is there influence healthy?
LO30	Political Parties: Why do we need political parties? Challenges to political parties, national and regional parties
LO31	Outcomes of democracy: Assessing democratic governments, accountable responsive and legitimate government, economic growth and development, reduction of inequality and poverty, dignity and freedom of citizens
LO32	Challenges to democracy: foundational challenges, challenge of expansion and deepening of democracy
LO33	Challenges to democracy: Thinking about political reforms and redefining democracy

6.2 *Annexure 2- Distribution of Learning Outcomes across subject and themes*

1. Social Science- Number of learning Outcomes under each area- Class IX & X

Nos.		Class IX	Class X
Sl. No.	**Subjects**	**No of Learning Outcomes**	**No. of Learning Outcomes**
1.	History	5	07
2.	Geography	6	09
3.	Economics	5	08
4.	Political Science	8	09
	Total	**24**	**33**

2. Science- Number of Learning Outcomes under each theme- Class IX & X

Nos.		Class IX	Class X
Sl. No.	**Themes**	**No of Learning Outcomes**	**No of Learning Outcomes**
1.	Materials	6	9
2.	Food	1	7
3.	Natural resources	3	4
4.	The world of living	6	3
5.	Moving, things, people and ideas	9	1
	Total	**25**	**24**

3. Mathematics- Number of Learning Outcomes under each unit Class IX & X

Nos.	Class IX		Class X	
Sl. No	**Units**	**No of Learning Outcomes**	**Units**	**No of Learning Outcomes**
1.	Real Number	5	Number System	4
2.	Algebra	8	Algebra	9
3.	Co-ordinate Geometry	3	Trigonometry	4
4.	Geometry	7	Co-ordinate Geometry	2

5.	Mensuration	2	Geometry	6
6.	Statistics and Probability	6	Mensuration	3
	Total	**31**	Statistics and Probability	4
			Total	**32**

7. References

1. NCERT (2005). National Curriculum Framework, New Delhi.
2. NCERT (2006).National Focus Group, *Position Paper on Examination Reform*, New Delhi.
3. NCERT (2006).National Focus Group, *Position Paper on Teaching of Mathematics*, New Delhi.
4. NCERT (2006).National Focus Group, *Position Paper on Teaching of Social Sciences*, New Delhi.
5. NCERT (2006).National Focus Group, *Position Paper on Teaching of Sciences*, New Delhi.
   NCERT (2006).National Focus Group, *Position Paper on Teaching of Language*, New Delhi
6. http://www.ncert.nic.in/rightside/links/syllabus.html
7. http://ncert.nic.in/textbook/textbook.htm

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