

## Learning Outcomes – Secondary Grades



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# I Introduction to the document

## I.1 Background

Development of quality standards is paramount for any system, to understand and track the learning levels 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 grades 1 to 8 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 in alignment to these outcomes and developed contextual state specific learning outcomes.

Taking this effort ahead, Azim Premji Foundation has attempted to develop learning outcomes for grades 9 and 10 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 at the secondary stage.

## I.2 Process of developing the Learning Outcomes

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

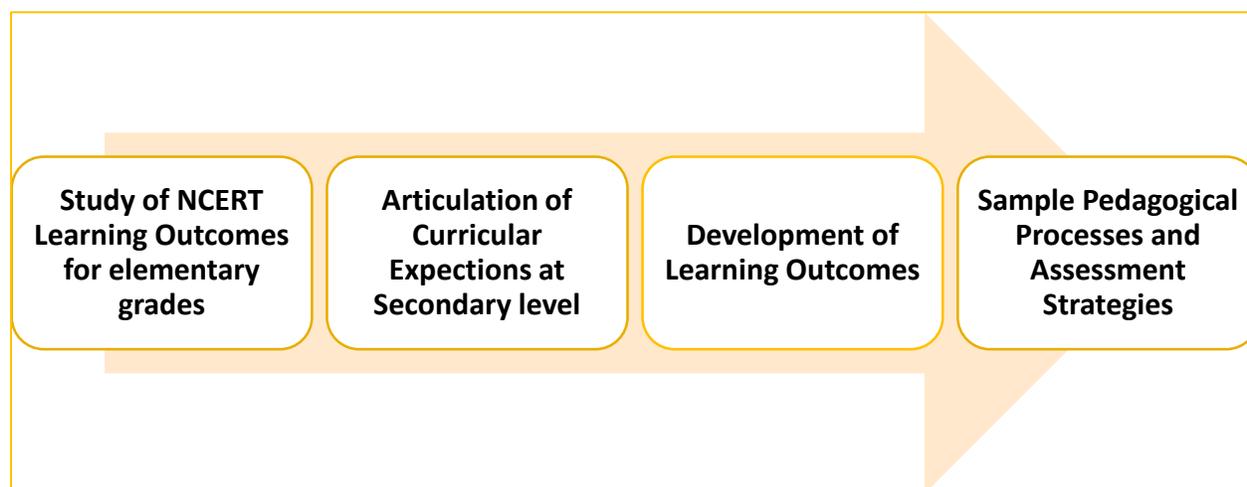


Figure 1: Process of developing learning outcomes

### 1.2.1 Study of NCERT learning outcomes for elementary grades.

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

The following criteria were used to study the document:

- Alignment of learning outcomes with curricular expectations and the syllabus of the respective subject and grade
- Nature of outcomes-
  - process oriented or product oriented
  - distribution across cognitive levels
  - Measurability and demonstrable
  - 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 level were derived. In order to arrive at these, the position papers of different subjects, the syllabus 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 has been ensured that these 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 grades were:

- Outcomes will be *aligned to the curricular expectations* derived from the goals of teaching the subject at the secondary stage
- It will be pitched at level that could be further segmented into indicators in order to enable the teacher to structure her/his instructional strategies against the shorter milestones which will lead to attaining the outcome
- The outcomes will *emphasize the process* of learning alongside the product
- The verbs used for articulating the learning outcomes will be *measurable and observable*

#### Key highlights

- *Most of the learning outcomes were mapped to the curricular expectations*
- *Majority of the learning outcomes were process oriented*
- *Barring a few exceptions, the verbs used for articulation of the outcomes were measurable and observable*
- *Weightage given to different cognitive levels showed variations across subjects*
- *Some of the curricular expectations appeared to be very specific; making them read as learning outcomes*
- *A few of the pedagogical processes had no alignment with the learning outcomes and in few cases they could be interchanged as outcomes.*

*(For detailed analysis, refer to annexure I)*

- The learning outcomes will *range across all cognitive levels from remember and understand through evaluate and create across all subjects*
- The learning outcomes will be supplemented with *sample pedagogical processes and assessment strategies* to provide insights to concretize these in the classrooms.
- The number of learning outcomes for each concept/content area in a subject will be proportionate to their weightage in the NCERT syllabus with few exceptions (*details in annexure 2 & 3*)

#### 1.2.4 Developing samples of Pedagogical Processes and Assessment Strategies

Unlike the NCERT elementary level document that provides a common set of pedagogical processes for each subject, the secondary level outcomes have restricted to a few outcomes to demonstrate focused pedagogical processes. In order to do this, a few outcomes were selected in each subject from class 9 and class 10 and a detailed teaching approach supplemented by assessment strategies were designed.

Such samples could assist the teacher in developing a similar strategy for addressing the other outcomes in the class.

### 1.3 Possible uses of Learning Outcomes

- **Reference material for NCERT and SCERT's in designing Learning Outcomes for secondary grades:** In addition to elementary level outcomes, the country could benefit from secondary level 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 on assessment 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 grades, and in the designing of new textbooks.

## 2 Learning Outcomes in Language- Secondary Stage

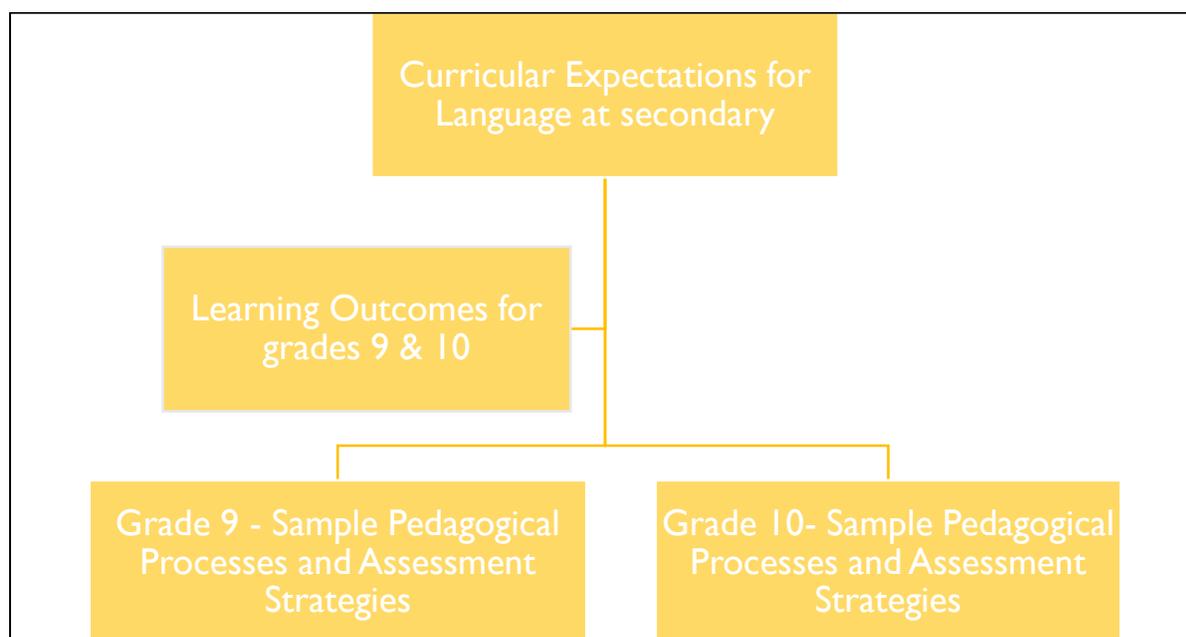


Figure 2: Overview of Language section

### 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 1<sup>st</sup>/2<sup>nd</sup>/3<sup>rd</sup> 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
<b>CE1</b>	Develop the interest and passion for reading and writing different kinds of texts (eg. fiction and non-fiction in school and home languages, literary, historical, scientific, etc.).
<b>CE2</b>	Develop the proficiency of listening, speaking, reading and writing using cognitive, academic and linguistic skills. (eg. listening or reading between the lines, using interpretation, analysis, reasoning and choosing appropriate words and structures to express meaning).
<b>CE3</b>	Develop literary skills of interpretation of plot, character, action, language and expresses them in writing and in discussions.
<b>CE4</b>	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.
<b>CE5</b>	Develop an understanding of diversity and multiple perspectives through reading of multilingual and multicultural texts.

## 2.2 Learning Outcomes- Grade 9 & 10

Since learning languages is a seamless process of acquiring greater degrees of proficiency in a particular language, the outcomes for secondary grades have not been bifurcated for grades 9 and 10. However, the type of text, its complexity and context should vary across grades.

Sl.no	Learning Outcomes
<b>LO1</b>	Reads/listens to/watches poems, stories, travelogues, drama, reports, newspapers, in print or audio-visual aids with interest and talks about them.
<b>LO2</b>	Expresses his/her thoughts or personal experiences through stories, poems, one act play, reports, diary writing etc.
<b>LO3</b>	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.
<b>LO4</b>	Synthesizes convergent and divergent ideas/examples of an incident/ideas/facts/ from different sources eg. newspaper, life experiences and presents them clearly and logically in spoken or written form.
<b>LO5</b>	Represents the central ideas and other main events from a text in different ways: graphically, pictorially or through written notes.
<b>LO6</b>	Identifies the theme or central idea of stories or narratives, poems, biographies and plays.
<b>LO7</b>	Analyses the key events which determine characters in a text and identifies the relationship between character and action or situation.

<b>LO8</b>	Evaluates characters, incidents from two stories, genres of literature and expresses it in spoken or written form.
<b>LO9</b>	Creates new events and extends a story, or changes a character or action in a story, poem or play.
<b>LO10</b>	Speaks and writes about symbols, metaphors, images, language used in literary texts, advertisements, songs etc.
<b>LO11</b>	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.
<b>LO12</b>	Compares examples of use of verbs, nouns or adjectives in authentic materials like advertisements, newspapers, notices, hoardings and becomes aware of the differences between usage in real life and in grammar books in order to relate language to life.
<b>LO13</b>	Uses different structures in sentences and texts meaningfully and uses different ways of expressing the same meaning/ shades of meaning.
<b>LO14</b>	Makes deductions about the features of grammatical structures by comparing school and home languages.
<b>LO15</b>	Uses appropriate word order, word formation strategies and uses different vocabulary, thought processes and grammatical structures for expressing meaning in different subjects/ disciplines.
<b>LO16</b>	Transforms/ translates from prose to poetry, fiction to drama, report to advertisement etc.
<b>LO17</b>	Writes short stories, poems, reports, essays, letters (formal and informal), speech etc. on relevant issues, thoughts, feelings.
<b>LO18</b>	Listens to and reads different types 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.
<b>LO19</b>	Identifies social issues in stories and nonfiction and comprehends diverse thoughts of classmates, ideas, view-points on a theme.
<b>LO20</b>	Debates different view-points and reasons about her understanding about the issue.
<b>LO21</b>	Compares character, plot in stories, plays, poems and folk literature from different cultures in different languages.
<b>LO22</b>	Evaluates and talks about different ways of expressing feelings in different cultures.
<b>LO23</b>	Critically questions social issues and cites examples from life to reflect on different problems in society expressed in stories and poems.

## 2.3 Grade 9- Sample Pedagogical Processes and Assessment Strategies

A sample of one of the learning outcomes for language is worked out. Textbooks and non-textbooks materials/text such as relevant genres, social issues, pictographs, and graphs, audio-visual aids, etc. can be referred to address this. For English Class 9, 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
<ul style="list-style-type: none"> <li>• Facilitate a discussion on students' role models- probe students to share qualities that they find admirable in them.</li> <li>• Show the movie clips or trailer of the movie POORNA, <a href="https://www.youtube.com/watch?v=LRoowtgZCeU">https://www.youtube.com/watch?v=LRoowtgZCeU</a> the story of a tribal girl, the youngest to scale the Everest. <a href="https://timesofindia.indiatimes.com/videos/sports/other-sports/Exclusive-In-conversation-with-mountaineer-Santosh-Yadav/videoshow/53508288.cms/">https://timesofindia.indiatimes.com/videos/sports/other-sports/Exclusive-In-conversation-with-mountaineer-Santosh-Yadav/videoshow/53508288.cms/</a> or watch the video of Santosh Yadav/ any other local hero</li> <li>• Facilitate students to read the lesson on Santosh Yadav. Divides the students into groups. Provide the students with a newspaper review of the story of POORNA and asks them to read it.</li> <li>• Create worksheet on the board with the following columns: problems faced, solutions devised, qualities or character traits. Students fill up the worksheet after reading about Santosh and Poorna.</li> <li>• Encourage students to compare Santosh Yadav and Poorna and come up with a list of problems they had. Guide discussions to identify</li> </ul>	<ul style="list-style-type: none"> <li>• Individual Assignment: Describe the characters studied in your own words- analyze the triumphs and tribulations of their lives and how it shaped them?</li> <li>• 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</li> <li>• Discussion: Bring out three ways to fight social discrimination or any other societal</li> </ul>

<p>which of the problems were created by nature and which by family or society. Eg. 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.</p> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Conduct role play with students in groups: role plays could be particular problem in Santosh's life: <ul style="list-style-type: none"> <li>- Made to study in the village while boys went to schools</li> <li>- Almost forced to get married</li> <li>- Parents say that they will not pay for her education at Jaipur</li> <li>- Santosh's decision to join the mountaineering institute (She does not go home)</li> </ul> </li> </ul> <p>Through a discussion helps children to bring out how to fight social discrimination through courage and determination.</p>	<p>issues based on the caselets you explored.</p> <ul style="list-style-type: none"> <li>• <b>Group assignment:</b> write a story of courage and determination like that of Santosh Yadav or Poorna.</li> <li>• <b>Resources</b> <ul style="list-style-type: none"> <li>- Newspaper cutting of the achievement of Santosh Yadav and Poorna Malavath,</li> <li>- Review of the movie Poorna,</li> <li>- Movie clipping or movie trailer of Poorna, interview of Santosh Yadav.</li> </ul> </li> </ul>
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## 2.4 Grade 10- 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
<ul style="list-style-type: none"> <li>• Introductory discussion regarding India's Presidents and Prime Ministers.</li> </ul> <p>Suggestive questions:</p> <ul style="list-style-type: none"> <li>- <i>Who were our Presidents and Prime Ministers?</i></li> <li>- <i>Where did they come from? Which community, class, caste, and gender did they belong to? How diverse were these people?</i></li> </ul> <ul style="list-style-type: none"> <li>• Asks students to listen to 'I have a dream' by Nelson Mandela.</li> </ul> <p>Suggestive questions:</p> <ul style="list-style-type: none"> <li>- <i>Is the dream fulfilled in India?</i></li> <li>- <i>Nelson Mandela talks about freedom being an illusion. Is there real freedom in India? Is everybody treated equally?</i></li> </ul> <p>Let them think about instances of injustice around them and discuss them in groups.</p> <ul style="list-style-type: none"> <li>• Use newspaper cuttings of attacks on dalits, inter caste marriages intolerance, killing of literary figures etc. Students read and discuss such incidents.</li> <li>• Encourage students to read the lesson on Nelson Mandela's struggle for freedom. Motivate them to discuss the Indian Struggle for Freedom.</li> <li>• Facilitate group work: <ul style="list-style-type: none"> <li>- <i>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?</i></li> </ul> </li> <li>• Brings 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.</li> <li>• Encourage the group talk about their issue and their solutions in front of the class. The other groups give them suggestions, ask critical questions.</li> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• Individual assignment: Write a letter to a newspaper editor about class, caste and gender discrimination.</li> <li>• Project: Create a project about the politics of class, caste and gender observed around and present the discussion points in the classroom.</li> <li>• Group Assignment: Using language as a tool what are some of the measures you take up to fight against discrimination of class, caste and gender in the context of India.</li> </ul> <ul style="list-style-type: none"> <li>• <b>Resources</b> <ul style="list-style-type: none"> <li>- Speech of Nelson Mandela 'I have a dream' in written or audio form,</li> <li>- newspapers cuttings of headlines about attacks on disadvantaged communities, inter caste marriages, killing of literary figures etc.</li> <li>- sample letters to editors.</li> </ul> </li> </ul>

### 3 Learning Outcomes in Social Science- Secondary Stage

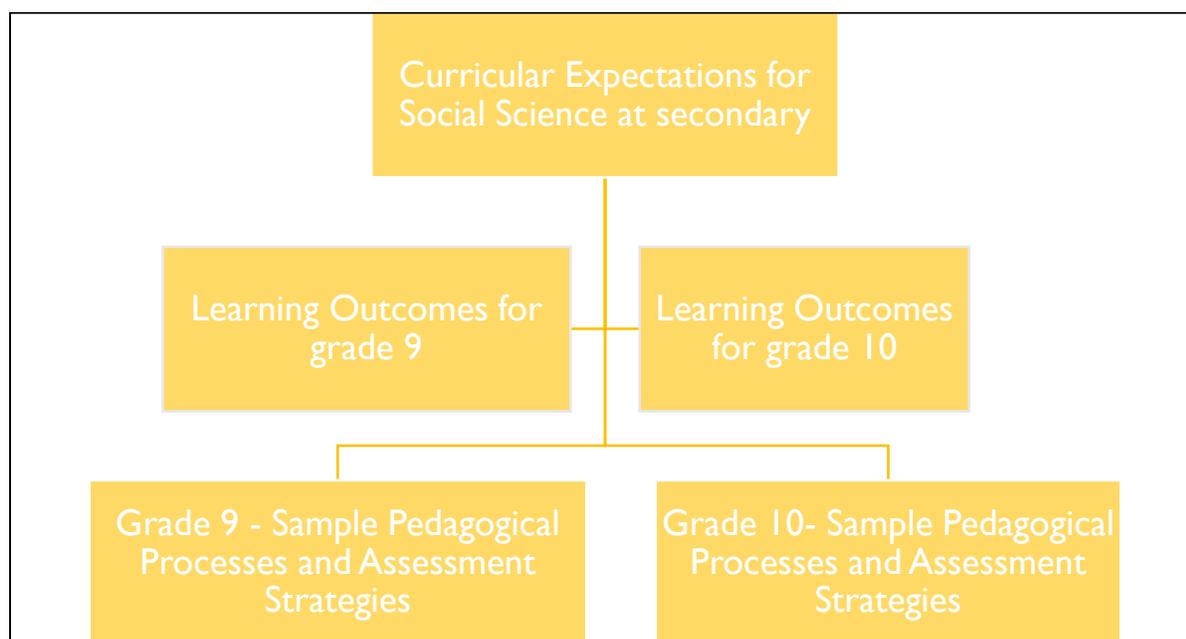


Figure 3: Overview of Social Science section

#### 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 Curricular 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
<b>CE1</b>	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.
<b>CE2</b>	Oriented to understand how history gets constructed- through an analysis of sources, cause and consequences of events, and the process of continuity and change.
<b>CE3</b>	Develop the skill of using inquiry as a process to gather, organize, analyze, interpret, synthesize evidence and information, and make informed critical judgments
<b>CE4</b>	Develop the skills to become an active and informed citizens who can influence public decision making and act for the common good within communities at the local, national, and/or global level.
<b>CE5</b>	Understand the economies and livelihoods of different social groups and how they respond to changes in the contemporary world.
<b>CE6</b>	Upholds the values enshrined in the Indian Constitution to undertake the roles and responsibilities of and effective citizens of a democratic society.
<b>CE7</b>	Apply inter-disciplinary thinking to understand society through historical processes, economic and political systems, natural and geographical features.
<b>CE8</b>	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- Grade 9

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
<b>LO1</b>	Locates on an outline map 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
<b>LO2</b>	Analyzes how the location of India influences the country's time and trade.	India – Size and Location
<b>LO3</b>	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
<b>LO4</b>	Explains the factors affecting India's climate, the mechanism of monsoons, its characteristics and impact on human life.	
<b>LO5</b>	Draws interrelationship between climate, natural vegetation, soil and wildlife of a region.	
<b>LO6</b>	Analyzes the effects of imbalances in the ecosystem and the measures taken by the government to prevent this.	
<b>LO7</b>	Explains how the growth rate (birth rate, death rate, migration) affects the growth of population and its distribution in India	Population
<b>LO8</b>	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
<b>LO9</b>	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
<b>LO10</b>	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
<b>LO11</b>	Plots and interprets data/graphs- eg. climatic graphs and tables, demographic data tables, etc.	Plot, analyze and interpret data
<b>LO12</b>	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
<b>LO13</b>	Analyzes the significance of Nazism in shaping the politics of the modern world	
<b>LO14</b>	Explains the rise of Socialism in the context of Industrial Revolution and its far-reaching effects on Europe	

<b>LO15</b>	Analyzes the lives of the forest dwellers, pastoralists, peasants and their adaptation in the modern world economy	Livelihoods Economies and societies
<b>LO16</b>	Explains the domination of the politics of power , social movements and colonialism in relationship to sports and clothing	Everyday life, culture and politics
<b>LO17</b>	Evaluates the pattern of Democracy in the world from last 100 years till date	Democracy in the contemporary world
<b>LO18</b>	Applies the idea of democracy in everyday life. e.g. school , family	
<b>LO19</b>	Analyzes the factors that contributed to the Constitutional Design of South Africa and India	Constitutional Design
<b>LO20</b>	Explains the foundational values of the Constitution and its relevance for citizens and the government	
<b>LO21</b>	Analyzes the stages and process of electoral politics in a democratic country	Electoral Politics
<b>LO22</b>	Evaluates the election process of India in the context of free and fair election and the role of Election Commission	
<b>LO23</b>	Analyzes the role of the legislative, executive and judiciary in the effective functioning of a country	Working of the Institutions
<b>LO24</b>	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 Grade 9- Sample Pedagogical Processes and Assessment Strategies

#### Geography- Theme - India Climate (Monsoon)

Learning Outcomes (LO)	Pedagogical Process	Assessment Strategies
LO - Explains the factors affecting India's climate, the mechanism of monsoons, its characteristics and	<ul style="list-style-type: none"> <li>Initiate the topic with a brainstorm session on the different elements of weather (<i>temperature, pressure, wind, humidity, cloud formation and precipitation</i>) and how these elements are inter-connected and are influenced by each other. Some key questions may be posed to the</li> </ul>	In order to assess the students' understanding on the difference between weather and climate the teacher can provide a worksheet with certain

<p>impact on human life</p> <p>The LO can be further broken into 5 indicators</p> <p><b>Indicator I</b></p> <p>I. Differentiates between weather and climate</p>	<p>students to elicit their prior knowledge on the elements of weather and see their interconnections.</p> <p><b>Questions for discussion</b></p> <ul style="list-style-type: none"> <li>- <i>What are the different elements of weather?</i></li> <li>- <i>How is air pressure related to the temperature of a place?</i></li> <li>- <i>What is wind? How is wind different from air current?</i></li> <li>- <i>How are clouds formed?</i></li> <li>- <i>Does high humidity in the air and cloud formation always lead to rainfall?</i></li> <li>- <i>What causes rainfall?</i></li> <li>- <i>What is the difference between rainfall and precipitation?</i></li> <li>- <i>What do you understand by differential heating of land and water and the movement of winds?</i></li> <li>• 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.</li> </ul> <p><b>Questions for activity</b></p> <ul style="list-style-type: none"> <li>- <i>List down the components of the daily weather forecasts given to you.</i></li> <li>- <i>Do the daily temperature/humidity/cloud cover/wind speed etc. remain the same or they fluctuate from day to day and time to time?</i></li> <li>- <i>Record the time of the day when the temperature reaches both its maximum and minimum? (For a week)</i></li> <li>- <i>Record the daily humidity level and cloud cover for 7 days</i></li> <li>- <i>Which months of the year records the maximum and minimum temperatures?</i></li> <li>- <i>Which months of the year the rainfall is maximum?</i></li> <li>- <i>Do you see any pattern emerging bases your observation over several years?</i></li> <li>• Scaffold the students to see patterns emerging by analyzing the daily weather reports of a place</li> </ul>	<p>statements on weather and climate or hold a quiz in the class and ask the students to identify whether they are statements related to weather or climate.</p> <p>Example – In the given sentences circle /identify the appropriate word given in brackets:</p> <ol style="list-style-type: none"> <li>1. What a lovely (weather/climate) are we having today</li> <li>2. I hope the (weather/climate) is sunny tomorrow</li> <li>3. India lies in the Tropical (Climatic/Weather) Belt</li> <li>4. Global warming is the change in the world's (weather/climate)</li> <li>5. Last month the (weather/climate) was so wet</li> <li>6. The T.V. (climate/ weather) forecast is on after the news</li> <li>7. Satellite photographs help us to predict tomorrow's (climate/weather)</li> <li>8. The scientists who study (weather / climate) are known as meteorologists.</li> </ol>
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	for several years and thus help them see the distinction between weather and climate.	
<p><b>Indicators 2 and 3</b></p> <p>2. Analyzes reasons for climatic variations in India</p> <p>3. Recognizes the factors that influence the climate of India</p>	<ul style="list-style-type: none"> <li>• 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.</li> </ul> <p><b>Questions for activity</b></p> <ul style="list-style-type: none"> <li>- Calculate the total rainfall of the cities</li> <li>- Calculate the annual range of temperature of the cities</li> <li>- Compare the temperature and rainfall conditions between the different cities</li> </ul> <p>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.</p> <ul style="list-style-type: none"> <li>• Initiate a discussion of factors that influence the climate of a place (<i>a generic discussion followed by specific factors affecting Indian climate with examples</i>).</li> </ul>	<p>Assignment:</p> <p>Summarize the factors influencing the climate of specific region in India? Eg- Thar, Himalayan region, Coastal belts?</p> <p>Analyze the specificities of Indian tropical monsoon climate?</p>
<p><b>Indicator 4</b></p> <p>Describes the four main seasons in India</p>	<ul style="list-style-type: none"> <li>• Facilitate a group work to make a collage of the seasons in India (<i>one group works on summer season, another group on winter etc.</i>).</li> </ul> <p>Each group can then share their work with the other groups. Each group can assess 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).</p> <ul style="list-style-type: none"> <li>• 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 (<i>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</i>).</li> </ul>	<p>The collage work could be given for peer review with the following set of criteria, which may be evolved both by the teacher and the students’:</p> <ul style="list-style-type: none"> <li>- Does the collage depict the seasonal aspects (<i>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.</i>)</li> </ul>

	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Some questions during the explanation to be provided by the teacher to check whether the students' are following the explanation. <ul style="list-style-type: none"> <li>- <i>What causes wind reversals?</i></li> <li>- <i>What are pre-monsoon showers?</i></li> <li>- <i>What changes take place in the upper air circulation that causes the arrival of the monsoon?</i></li> <li>- <i>Why does it not rain every day during the monsoon /rainy season?</i></li> <li>- <i>Why the amount of rainfall varies from year to year and from places to places?</i></li> </ul> </li> </ul>	<p>- <i>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.)</i></p> <p>Assignment: In what ways the Indian monsoon affects the Indian economy? Provide specific examples from the student's state/region.</p> <p>What is El-Nino phenomena? How does it affect the polity and the economy of India?</p>
<p><b>Indicator 5</b></p> <p>Analyzes the influence of monsoon on human life</p>	<ul style="list-style-type: none"> <li>• Provide case studies/newspaper clippings on the effect of monsoon on the life of people followed by discussion (<i>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.</i>).</li> <li>• Have a discussion on how monsoon affects the economy as well as the polity. Provide songs, poetries associated with the different seasons</li> </ul>	<p>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.</p>
	<ul style="list-style-type: none"> <li>• Wraps-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.)</li> </ul>	<p>Create a rubric for assessment of the project along with the students.</p> <p>Parameters:</p> <ol style="list-style-type: none"> <li>I. Content – accurate and interesting facts, going beyond the textbook</li> </ol>

		<ol style="list-style-type: none"> <li>2. Organization of the content –sequence, coherence</li> <li>3. Presentation and creativity –relevant pictures, diagrams, graphs</li> <li>4. Process of project completion – initiative taken, cooperativeness, participation and punctuality</li> </ol>
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<b>Resources</b>	<ol style="list-style-type: none"> <li>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.</li> <li>2. Worksheet / quiz questions with statements on weather and climate.</li> <li>3. Climate Graphs:           <div data-bbox="430 976 1347 1375" data-label="Figure"> <p>The figure contains four climate graphs, each with Temperature (C) on the left y-axis and Rainfall (Cm) on the right y-axis. The x-axis represents months from J to D.</p> <ul style="list-style-type: none"> <li><b>Bombay:</b> Shows a peak in rainfall in July and August, with temperatures ranging from approximately 15°C to 28°C.</li> <li><b>Shillong:</b> Shows a peak in rainfall in July, with temperatures ranging from approximately 10°C to 25°C.</li> <li><b>TRIVANDRUM:</b> Shows a peak in rainfall in July, with temperatures ranging from approximately 15°C to 30°C.</li> <li><b>MADRAS:</b> Shows a peak in rainfall in July, with temperatures ranging from approximately 15°C to 35°C.</li> </ul> </div> </li> <li>4. Table showing month-wise temperature and rainfall data of 5 cities:</li> </ol>
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CITY		MONTHS											
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
Trivandrum	Temp. °C	26.7	27.3	28.3	28.7	28.6	26.6	26.2	26.2	26	26.5	26.6	26.5
	Rain, cms	2.3	2.0	3.8	10.5	20.7	23.6	22.3	14.5	13.7	27.3	20.5	7.4
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	14.9
	Rain, cms	2.0	2.3	1.2	0.9	0.9	6.7	18.6	16.9	13.4	1.4	0.2	0.8
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	18.2
	Rain, cms	05	06	02	03	09	30	10.8	13.1	5.7	0.7	0.1	0.2
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	25.4
	Rain, cms	0.4	0.2	0.1	0.1	1.8	46.4	61.3	32.4	28.6	6.4	1.7	0.2
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	20.6
	Rain, cms	1.1	2.3	1.6	1.6	2.0	22.2	37.6	28.6	18.4	5.4	1.9	0.9

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 - Grade 10

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	

<b>LO5</b>	Draws inter-relationship between climate, soil, types of crops and methods of farming practiced in a region	Agriculture
<b>LO6</b>	Evaluates the implications of technological developments, institutional reforms and globalization in Indian agriculture	
<b>LO7</b>	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
<b>LO8</b>	Analyzes the reasons for the location of industries in a particular region	Manufacturing Industries
<b>LO9</b>	Explains the role of transport, communication, trade and tourism in the growth of a nation	Lifelines of National Economy
<b>LO10</b>	Explains the notions of economic development and ways of measuring national and human development	Development
<b>LO11</b>	Reflects on the developmental goals of a region and creates a plan for sustainable development	
<b>LO12</b>	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
<b>LO13</b>	Draws tables and graphs from a given set of data; calculates from a given data and interprets graphs	
<b>LO14</b>	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
<b>LO15</b>	Evaluate the role of globalization in the development of Indian economy	Globalization And the Indian Economy
<b>LO16</b>	Analyzes situations of consumer exploitation and suggests grievance redress measures	Consumer Rights
<b>LO17</b>	Examines the progress of consumer movement and the role of government to protect consumers against unethical and unfair trade practices	
<b>LO18</b>	Examines the emergence of the notion of Nationalism in Europe, Indo-China and India	Events and Processes and Economies, livelihoods and society
<b>LO19</b>	Analyzes the role of social movements, aspirations of ordinary people, artists and writers in freedom movements	

<b>LO20</b>	Explains the role of Gandhi in the growth of nationalism and anti-colonial movement in India	
<b>LO21</b>	Analyzes the role of technology and Industrialization in transforming 19 <sup>th</sup> century world and the process of Industrialization in India as a colony of Britain	
<b>LO22</b>	Explains the growth process, characteristic and experiences of cities of the 19 <sup>th</sup> century with special reference to Bombay, Calcutta, London and Paris	
<b>LO23</b>	Examines the rise of print culture and its influence on communication	Everyday Life, Culture and Politics
<b>LO24</b>	Interprets the role of novels in shaping nationalism and reconstructing the history of India	
<b>LO25</b>	Explains the importance and need of power sharing among legislature, executive and the judiciary in a democracy	Power Sharing
<b>LO26</b>	Explains the key features of Federalism, ways in which it is practiced in India and the rationale for decentralization of powers	Federalism
<b>LO27</b>	Describes the ways in which democracy responds to social differences, division and inequalities	Democracy and Diversity
<b>LO28</b>	Explains the social differences like gender, religion, caste and how it gets expressed in politics	Gender, Caste and Religion
<b>LO29</b>	Analyzes the role of ordinary citizens, pressure groups and movements in influencing politics	Popular Struggles and Movements
<b>LO30</b>	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
<b>LO31</b>	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
<b>LO32</b>	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
<b>LO33</b>	Creates a definition of democracy and provide suggestions to overcome the challenges of democracy	

### 3.5 Grade 10- Sample Pedagogical Processes and Assessment Strategies

#### History- Theme - Nationalism in India

Learning Outcome	Pedagogical Process	Assessment Strategy
<p>Learning Outcome</p> <p>I.Analyzes the role of Gandhi in the growth of nationalism and anti-colonial movement in India (Topics- Swaraj , Non-cooperation movement and the Civil Disobedience Movement</p> <p>The Learning Outcomes can be further simplified down to the following learning indicators:</p> <p>Indicator I</p> <p>Analyzes how the term ‘Swaraj’ had different connotation to different people (peasants, tribals and the plantation workers of Assam)</p>	<ul style="list-style-type: none"> <li>• Initiate discussion with leading questions posed by the teacher               <ul style="list-style-type: none"> <li>- <i>Can the growth of nationalism be connected to anti-colonial movement in context of India?</i></li> <li>- <i>-Did oppression under the colonialism develop a sense of unity among different groups?</i></li> <li>- <i>-Is there any significance of symbols, icons and songs in defining identity and sense of belonging that leads to the rise of nationalism and creates national identity?</i></li> </ul> </li> <li>• Elicit the meaning and origin of the word ‘Swaraj’ from the students in different languages e.g. Hindi, Sanskrit, Malayalam, and Bengali. Based on this prior knowledge the concept of Swaraj can be introduced</li> <li>• Provide students with case studies on the movements from the NCERT textbooks followed by critical analysis of the readings</li> </ul> <p><u>Sample Case Studies : Awadh, Gudem Hills of Andhra and Plantation workers in Assam</u></p> <p>After going through the case study of Awadh by the students, leading statements by the teacher.</p> <ul style="list-style-type: none"> <li>- <i>The non-cooperation movement in Awadh led by Baba Ramachandra was against the British? If not, then why?</i></li> </ul>	<ul style="list-style-type: none"> <li>• Essay writing: interpretation of Swaraj by students. Attempt to create a definition of their own.</li> <li>• Role Play: present the notion of Swaraj as interpreted by the peasants of Awadh ,plantation workers of Assam and the tribals of Andhra Pradesh</li> </ul>

	<ul style="list-style-type: none"> <li>- <i>How did the tribal peasant interpret the message of Gandhi and the idea of Swaraj?</i></li> <li>- <i>What was the notion of Swaraj for the plantation workers? Groups to present their thoughts and summarize the case studies.</i></li> </ul>	
<p>Indicator 2</p> <p>Examines the aspirations of different social groups that participated in the civil disobedience movement</p>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Use scaffolding questions for discussions: <ul style="list-style-type: none"> <li>- <i>Why did certain group join the movement and how did they relate to the movement (rich peasants, poor peasants, industrialists)</i></li> <li>- <i>What was the Congress dilemma in including the workers' demand and the 'no rent campaign 'of the poor peasants in the Civil Disobedience Movement?</i></li> <li>- <i>What was the role of the women in the movement and did their participation bring out any change their position?</i></li> <li>- <i>Why was Dalit and Muslim participation limited?</i></li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• A written presentation on 'critical analysis of the Civil Disobedience Movement'(with the citation of sources and references )</li> </ul>
<p>Indicator 3</p> <p>Evaluates how Civil Disobedience Movement was different from the Non-Co-operation Movement</p>	<ul style="list-style-type: none"> <li>• Facilitate a discussion with the following probes: <ul style="list-style-type: none"> <li>- <i>What is the difference between breaking law and non-co-operating?</i></li> <li>- <i>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?</i></li> </ul> </li> </ul>	<p>Read the following passages</p> <ol style="list-style-type: none"> <li>1. Thousands of students left schools, colleges and headmasters and teachers resigned. Lawyers gave up their legal practices</li> <li>2. Thousands in different parts broke colonial laws. Peasants</li> </ol>

	<ul style="list-style-type: none"> <li>- <i>What was the effect of the withdrawal?</i></li> <li>- <i>Why did Gandhi violate the law by manufacturing salt by boiling sea water?</i></li> </ul>	<p>refused to pay revenue, forest people violated forest law.</p> <p>What is the difference between the above two situations.</p> <p>Which words will help you in differentiating the two movements?</p>
<p>Indicator 4</p> <p>Critically analyzes the ideology of Gandhi in regards to the women participating in the movement</p>	<ul style="list-style-type: none"> <li>• Facilitate the following questions for students to reflect</li> <li>- <i>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?</i></li> <li>- <i>What was the role of the women in the Civil Disobedience Movement?</i></li> <li>- <i>What was the class representation of the women in this movement?</i></li> <li>- <i>In spite of the active participation of the women in the national movement did their position in the society undergo any change?</i></li> </ul>	<ul style="list-style-type: none"> <li>• Prepare an oral presentation on 'the position of women in the National movement as viewed by Gandhi and the Congress'</li> </ul>

## 4 Learning Outcomes in Science- Secondary Stage

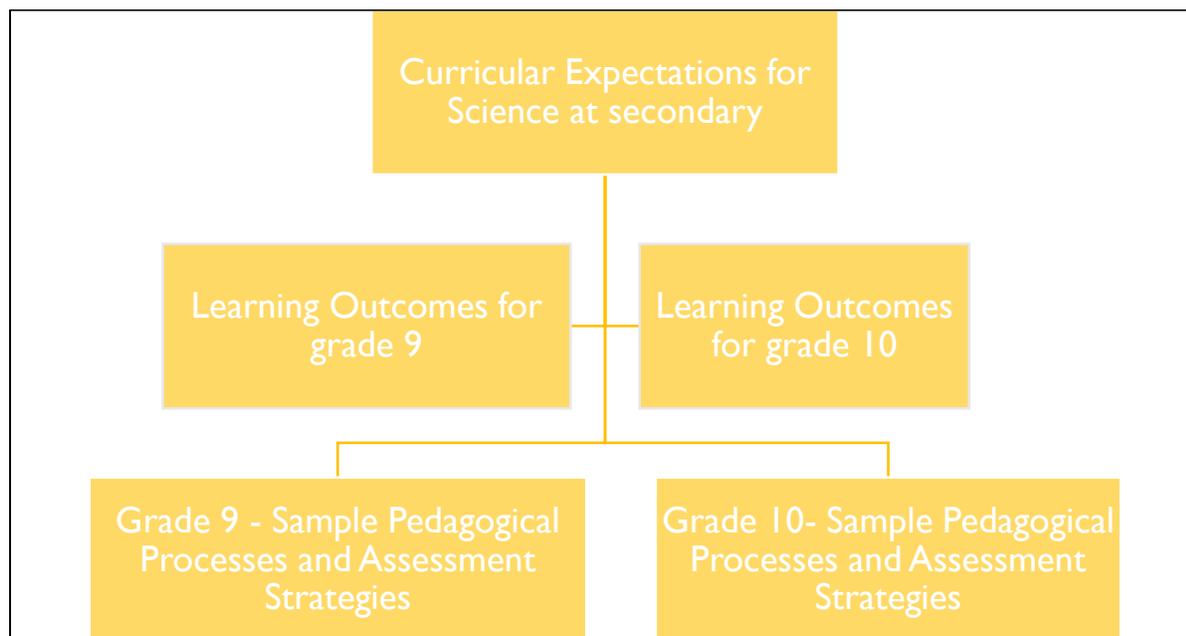


Figure 4: Overview of Science section

### 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. Student 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
<b>CE1</b>	Comprehend concepts, principles and laws of science.
<b>CE2</b>	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.
<b>CE3</b>	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
<b>CE4</b>	Develop respect for human dignity and rights, gender equity, values of honesty, integrity, cooperation and concern for life leading to a just democratic society.
<b>CE5</b>	Construct deeper understanding of issues relating to the intersection of science, technology, environment and society.
<b>CE6</b>	Inculcate the spirit of joy, wonder and enquiry in the learning of science through an experience of its various processes.

## 4.2 Learning Outcomes- Grade 9

Sl. No	Learning Outcomes	Content Area
<b>LO1</b>	Distinguishes states of matter (solids, liquids and gases) based on the physical properties (shape, volume, density, etc.) with reference to particle theory.	Materials
<b>LO2</b>	Investigates the nature and properties of various types of chemical substances (elements, compounds, mixtures, colloids, suspensions) through experiments.	Materials
<b>LO3</b>	Describes different methods of separation to get individual components from a mixture.	Materials
<b>LO4</b>	Carries out experiments to verify the laws of chemical combination.	Materials
<b>LO5</b>	Explains atoms & molecules and represents compounds using chemical formulae.	Materials
<b>LO6</b>	Identifies sub-atomic particle (electron, proton and neutron) using the atom models (Thomson, Rutherford, Bohr).	Materials
<b>LO7</b>	Outlines the best practices of farming that yield higher productivity.	Food
<b>LO8</b>	Demonstrates the factors influencing climatic changes (e.g.: causes of rain, varying temperature of air, etc.) by conducting experiments.	Natural resources

<b>LO9</b>	Explains the causes and effects of pollution on air, water and soil and its impact on human and natural environment.	Natural resources
<b>LO10</b>	Explains the biogeochemical cycles (water cycle, nitrogen cycle, carbon cycle, and oxygen cycle) involved in the maintenance of biosphere balance.	Natural resources
<b>LO11</b>	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
<b>LO12</b>	Explains the types of plant tissues (Meristematic and Permanent) and animal tissues (Epithelial, Connective, Muscular and Nervous).	The World of Living
<b>LO13</b>	Identifies plant tissues (parenchyma and sclerenchyma) and animal tissues (striated muscles and nerve fibres) from the prepared slides.	The World of Living
<b>LO14</b>	Classifies the hierarchical architecture of the human body: cells, tissues, organs, organ systems, and organism.	The World of Living
<b>LO15</b>	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
<b>LO16</b>	Identifies acute, chronic, infectious, non-infectious diseases, their causes, types, treatment, mode of transmission and means of prevention.	The World of Living
<b>LO17</b>	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
<b>LO18</b>	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
<b>LO19</b>	Interprets distance-time, speed-time and velocity-time graphs for uniform motion and for uniformly accelerated motion.	Moving things, people and ideas
<b>LO20</b>	Applies Newton's laws of motion to solve real life problems.	Moving things, people and ideas
<b>LO21</b>	Examines different types of collisions using conservation of momentum and energy.	Moving things, people and ideas
<b>LO22</b>	Examines motion of an object at varying distance from the surface of the Earth under gravitational force.	Moving things, people and ideas
<b>LO23</b>	Explains the principles responsible for floating and sinking for some natural and constructed phenomenon with reference to relative density.	Moving things, people and ideas

<b>LO24</b>	Solves problems using work and power equation, kinetic and potential energy equation, principle of conservation of energy.	Moving things, people and ideas
<b>LO25</b>	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 Grade 9- Sample Pedagogical Processes and Assessment Strategies

#### Theme: Materials

<b>Learning Outcomes Learning Indicators</b>	<b>Pedagogical Processes</b>	<b>Assessment Strategies</b>
<p><b>LO1:</b> Distinguishes states of matter (solids, liquids and gases) based on the physical properties (shape, volume, density, etc.) with reference to particle theory.</p> <p><b>Learning indicators:</b></p> <p>1.1 Explains the characteristics of particles of matter.</p> <p>1.2 Observes three states of matter due to variation in characteristics of particles of matter.</p> <p>1.3 Explains change of state of matter - melting (absorption of heat), freezing, evaporation (cooling by evaporation), condensation, sublimation</p> <p>1.4 Describes effect of change of temperature and pressure on different states of matter.</p>	<ul style="list-style-type: none"> <li>Revisit previous concepts on matter, its different states and the properties of the different types of matter learnt by students and conduct discussions.</li> </ul> <p><b>Questions for discussion:</b></p> <ul style="list-style-type: none"> <li><i>In what ways materials different from each other?</i></li> <li><i>Is there some similarity in materials?</i></li> <li><i>In how many ways can you group the different materials you see around?</i></li> <li><i>How do solids, liquids and gases differ from each other?</i></li> <li><i>Can materials exist in all the three states?</i></li> <li><i>What kinds of clothes help us keep cool?</i></li> <li><i>Why do wet clothes make us feel cool?</i></li> </ul> <ul style="list-style-type: none"> <li>Engage students to undertake activities to understand different characteristics of matter and ask them to note their observations followed by discussion.</li> <li>Demonstrate the properties of states of matter through activities with examples from daily life. Ask students to <i>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.).</i></li> </ul>	<ul style="list-style-type: none"> <li>Prepare a comparison table of different states based on (shape, density volume, intermolecular force, compressibility, etc.).</li> <li>Give reasons for certain observations, e.g.: <i>Naphthalene balls 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.</i></li> </ul>

	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.)</li> </ul>	
<p><b>LO2:</b> Investigates the nature and properties of various types of chemical substances (mixture, solution, suspension, colloid, elements and compounds) through experiments.</p> <p><b>Learning indicators:</b></p> <p>2.1 Differentiate between mixture and pure substance, homogenous and heterogeneous mixture, solution and suspension, mixtures and compounds.</p> <p>2.2 Summarizes the properties of solution, suspension and colloid.</p>	<ul style="list-style-type: none"> <li>• 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.</li> </ul> <p><b>Questions for discussion:</b></p> <ul style="list-style-type: none"> <li>- <i>What are things around you made up of?</i></li> <li>- <i>What are the various types of chemical substances?</i></li> <li>• Divide the class into four groups and distribute different samples and ask them to dissolve these sample in water. Discuss the results for explaining mixture, solution, suspension and colloid and their properties.</li> <li>• Discuss on claims, 'Air is a mixture' (Mixture of what? How can these be separated?), 'Water is compound' and 'Oxygen is an element'.</li> <li>• Divide the class into two groups and perform an activity with iron fillings and sulphur powder to introduce chemical combination of elements. Explain the difference between mixtures and compounds using this activity.</li> </ul>	<ul style="list-style-type: none"> <li>• Compare elements, compounds and mixtures based on what are they made up of, can they be broken down, do they lose their original properties.</li> <li>• Prepare a survey report based on a personally conducted survey (<i>survey of their homes and prepare a list of various materials used in daily life</i>). Further classify these materials as pure substances or mixtures and pure substances into elements and compounds and then prepare a survey report.</li> <li>• Classify the given things into elements, compounds and mixtures.</li> </ul>

<p><b>LO3:</b> Describes different methods of separation to get individual components from a mixture.</p> <p><b>Learning Indicators:</b></p> <p>3.1 Identifies the appropriate method for separating a mixture based on its composition.</p> <p>3.2 Relates the importance of method of separation in day to day life applications.</p>	<p><b>Questions for discussion:</b></p> <ul style="list-style-type: none"> <li>- <i>What are the common methods of separation used at home and in industries?</i></li> <li>• Engage students in performing activities for explaining different methods to separate substances from a mixture using different methods like <i>evaporation, filtration, centrifugation, chromatography, fractional distillation process and crystallization.</i></li> </ul>	<ul style="list-style-type: none"> <li>• Suggest the sequence of separation technique for a given mixture (e.g.: <i>mixture of camphor, common salt and sand, kerosene oil and water, acetone and water, etc.</i>)</li> </ul>
<p><b>LO4:</b> Carries out experiments to verify the laws of chemical combination.</p> <p><b>Learning indicators:</b></p> <p>4.1 Explains the laws of chemical combination</p> <p>4.2 Lists the postulates of Dalton's atomic theory</p>	<p><b>Questions for discussion:</b></p> <ul style="list-style-type: none"> <li>- <i>Do substances combine in a definite manner?</i></li> <li>- <i>How do things combine with each other?</i></li> <li>- <i>Are there any patterns which can help us guess how things will combine with each other?</i></li> <li>• Provide brief historical account including experiments of Lavoisier and Priestley.</li> <li>• Help students in understanding laws (law of conservation of mass and law of constant proportion) that govern how atoms combine.</li> <li>• Conduct simple experiments to explain the alignment between the outcome of an experiment and postulates of these laws.</li> </ul>	<ul style="list-style-type: none"> <li>• Give example of chemical reactions (<i>hydrogen and oxygen, sodium carbonate and acetic acid, etc.</i>) and identify the postulates which is in agreement with the observations of the experiment.</li> </ul>
<p><b>LO5:</b> Explains atoms &amp; molecules and represents compounds using chemical formulae.</p> <p><b>Learning indicators:</b></p> <p>5.1 Explains atomic mass and atomicity</p> <p>5.2 Recognizes the symbols of ions and name the ions</p>	<ul style="list-style-type: none"> <li>• Review by eliciting the three states of matter, examples of each, what everything is made of and what matter is made of.</li> </ul> <p><b>Questions for discussion:</b></p> <ul style="list-style-type: none"> <li>- <i>Can we see an atom or a molecule under a microscope or by some other means?</i></li> <li>- <i>What is there inside an atom?</i></li> <li>- <i>How do chemists weigh and count particles of matter?</i></li> </ul>	<ul style="list-style-type: none"> <li>• Give the common names of a few substances (e.g.: <i>Chalk, table salt, dry ice, baking soda, muriatic acid, battery acid.</i>) and find out its chemical formula and the elements present in these substances.</li> <li>• Write formulae for given compounds and</li> </ul>

<p>5.3 Writes the chemical formulae of simple compounds.</p> <p>5.4 Calculates atomic mass, molecular mass, formula unit mass and molar mass.</p>	<ul style="list-style-type: none"> <li>• Explain key characteristics of atoms, molecules and compounds using explanations and models of atoms and molecules.</li> <li>• 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.</li> <li>• 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.</li> <li>• Summarize the topic by explaining the relation between atoms, molecules, 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.</li> </ul>	<p>names of compounds for given formulas.</p> <ul style="list-style-type: none"> <li>• Calculate mass and molar mass.</li> </ul>
<p><b>LO6:</b> Identifies sub-atomic particle (electron, proton and neutron) using the atom models (Thomson, Rutherford, Bohr).</p> <p><b>Learning indicators:</b></p> <p>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.</p> <p>6.2 Describe the structure of an atom as per Rutherford's atomic model and state the drawbacks of</p>	<p><b>Questions for discussion:</b></p> <ul style="list-style-type: none"> <li>- <i>How atom model looks like?</i></li> <li>- <i>How are the electrons, proton and neutron arranged inside an atom?</i></li> <li>• Revisit Dalton theory and explain what led to the failure of postulate related to indivisibility of atoms.</li> <li>• 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.</li> <li>• Discuss rules for the distribution of electrons into different orbits.</li> </ul>	<ul style="list-style-type: none"> <li>• How atom is neutral as a whole on the basis of Thomson's model of atom?</li> <li>• Draw a sketch of Thomson, Rutherford and Bohr's model of an atom and summarize the differences.</li> <li>• Find the valency of given set of elements.</li> </ul>

<p>Rutherford's model of an atom.</p> <p>6.3 Describe the structure of an atom as per Bohr's model and how this model overcomes the drawbacks of Rutherford's model.</p> <p>6.4 Distinguishes between atomic number, mass number, isotopes and isobars</p>	<ul style="list-style-type: none"> <li>• Help students to draw electron configurations and identify the number of valence electrons for various elements.</li> <li>• Guide atomic number, mass number, isotopes and isobars and deriving these values for a few elements.</li> </ul>	
<p><b>Resources:</b></p> <ol style="list-style-type: none"> <li>1. NCERT Class IX Science textbook</li> <li>2. S Chand Science Laboratory Manual for Class 9</li> <li>3. <a href="https://www.youtube.com/watch?v=-4Us5PTb4J8">https://www.youtube.com/watch?v=-4Us5PTb4J8</a></li> </ol>		

#### 4.4 Learning Outcomes- Grade 10

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	Explains basic 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

<b>LO9</b>	Classifies elements based on their electronic configuration and study their properties.	Materials
<b>LO10</b>	Describes the interdependencies of life processes like respiration, digestion, transportation and excretion in plants and animals.	The world of living
<b>LO11</b>	Compares and contrasts the mechanisms that control and coordinate the nervous system and hormonal processes in animals.	The world of living
<b>LO12</b>	Explains the coordination in plants like response to stimulus and movement due to growth.	The world of living
<b>LO13</b>	Describes the various modes of asexual reproduction in plants (vegetative, fragmentation, etc.) and sexual reproduction in plants and animals.	The world of living
<b>LO14</b>	Lists methods of contraception and childbearing to build an awareness towards reproduction and reproductive health.	The world of living
<b>LO15</b>	Synthesizes characteristics of heredity and evolution and their influence on human life.	The world of living
<b>LO16</b>	Describes how human activities affect biogeochemical cycles.	The world of living
<b>LO17</b>	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
<b>LO18</b>	Describes magnetic field due to current carrying through a straight conductor and circular loop and electromagnetic induction.	How things work
<b>LO19</b>	Describes the working of electric motor & generator.	How things work
<b>LO20</b>	Compares AC and DC voltage and current sources as defined by voltage polarity, current direction and magnitude over time.	How things work
<b>LO21</b>	Explains the natural phenomena of reflection, refraction, dispersion, scattering of light for spherical (concave and convex) mirrors, lens, and glass prism.	Natural Phenomenon
<b>LO22</b>	Solves numerical problems using the sign convention for reflection for spherical mirrors and lenses.	Natural Phenomenon
<b>LO23</b>	Describes the internal structure of eye, defects in the eye and suggested corrections to the defects.	Natural Phenomenon
<b>LO24</b>	Explains natural resource management to achieve sustainability by creating equilibrium between social factors, economic factors and environmental factors.	Natural resources

## 4.5 Grade 10- Sample Pedagogical Processes and Assessment Strategies

Theme: Materials

Learning Outcomes Learning Indicators	Pedagogical Processes	Assessment Strategies
<p><b>LO1:</b> Derives, writes and balances the chemical equations from narrative descriptions of different types of chemical reactions (combination, decomposition, displacement, double displacement, oxidation and reduction).</p> <p><b>Learning indicators:</b></p> <p>1.1 Writes and balances chemical equation for a chemical reaction using chemical formulae.</p> <p>1.2 Comprehends different kinds of chemical reactions (combination, decomposition, displacement, precipitation, neutralization).</p> <p>1.3 Explains corrosion and rancidity.</p> <p>1.4 Explains exothermic and endothermic reactions.</p> <p>1.5 Identifies the type of reaction for a chemical reaction or equation.</p>	<ul style="list-style-type: none"> <li>• 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 (<i>change in state, odour, color, temperature, etc.</i>)</li> </ul> <p><b>Questions for discussion:</b></p> <ul style="list-style-type: none"> <li>- Why does iron rust?</li> <li>- Why does painted iron not rust?</li> <li>- Why is burning sensation removed in stomach when one takes antacids?</li> <li>- Why do substances stop burning in the absence of air?</li> <li>- Why is flame seen when substances burn?</li> <li>- Can substances burn without flame?</li> <li>- Why does a matchstick kept in the blue part of the flame not burn?</li> <li>- Why is a red coating formed on the zinc rod when it is kept in copper sulphate solution?</li> <li>- What is the material of the coating?</li> </ul> <ul style="list-style-type: none"> <li>• Explain the steps for deriving a chemical equation after observing a chemical reaction. Ask students to recall law of conservation of mass and explain how it relates with balancing chemical reactions.</li> <li>• Teacher to mix pairs of substances (<i>Turmeric, lime juice, vinegar, baking soda, washing soda, yeast, hot water</i>), ask students to observe the reactions – and</li> </ul>	<ul style="list-style-type: none"> <li>• Identify the type of a given chemical reaction.</li> <li>• For a given reaction, identify if it is an exothermic or endothermic process.</li> <li>• Given a description of a chemical reaction, give correct explanation for the observation.</li> <li>• Write the differences between different types of reactions.</li> </ul>

	<p>have a discussion on chemistry in the kitchen, chemistry inside our bodies.</p> <ul style="list-style-type: none"> <li>• Carry out simple reactions that encompass decomposition, displacement, double displacement, precipitation, neutralization, oxidation and reduction.</li> <li>• 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.</li> </ul>	
<p><b>LO2:</b> Conducts experiments using various indicators to check if a given sample is acidic, basic or neutral.</p> <p><b>Learning Indicators:</b></p> <p>2.1 Explains various properties of organic and inorganic acids and bases.</p> <p>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.</p> <p>2.3 Conducts experiments using various acid-base indicators to check if a given sample is an acid or a base.</p> <p>2.4 Identifies if the given sample is acidic, basic or neutral based on its pH value</p>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• 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.</li> </ul> <p><b>Questions for discussion:</b></p> <ul style="list-style-type: none"> <li>- <i>Why are some substances sour and some bitter in taste?</i></li> <li>- <i>Why does soap solution feel slippery?</i></li> <li>- <i>Why does seawater taste salty?</i></li> <li>• Help students in conducting experiments to identify properties of acids, bases and salts. Facilitate students to identify the common properties of acids and bases. Explain how universal indicator can be used to measure the strength of given acid or base.</li> <li>• Help students to conduct experiments for testing different substances (<i>orange juice, lemon juice, soap solution, litmus solution, zinc, copper, aluminum, hydrochloric acid, sulphuric acid, nitric acid, sodium hydroxide, Common salt</i>) with indicators.</li> </ul>	<ul style="list-style-type: none"> <li>• State reasons for a given phenomenon (e.g.: <i>Tap water conducts electricity whereas distilled water does not, dry HCl gas does not turn blue litmus red whereas dilute HCl does, etc.</i>)</li> <li>• Derive and balance chemical reactions for a given description of chemical reaction.</li> <li>• State chemical properties for a particular use of salts (e.g.: <i>antacid, fire extinguisher, bread, etc.</i>)</li> </ul>

<p><b>LO3:</b> Explains the importance of pH in our everyday life.</p> <p><b>Learning Indicators:</b></p> <p>3.1 Identifies the influence of pH in relation to biological processes in human body.</p> <p>3.2 Observes and records the pH value of various materials.</p>	<ul style="list-style-type: none"> <li>• Revisit the importance of pH scale for identifying the acidic and basic nature of a solution</li> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• How the pH value will change for given examples and (e.g.: <i>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.</i>)</li> </ul>
<p><b>LO4:</b> Explains the properties of salts, different types of salts, methods used to prepare them and their uses.</p> <p><b>Learning Indicators:</b></p> <p>4.1 States the properties of salts.</p> <p>4.2 Explains the methods used to prepare sodium hydroxide, sodium hydrogen carbonate, sodium carbonate and bleaching powder from sodium chloride</p> <p>4.3 Lists the uses of sodium hydroxide, sodium hydrogen carbonate, sodium carbonate and bleaching powder</p>	<ul style="list-style-type: none"> <li>• 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.</li> <li>• Informs students about Mahatma Gandhi's Dandi March and the significance of salt in our struggle of freedom.</li> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• Describe the methods to convert salt into washing soda, how baking soda makes cakes and bread fluffy?</li> <li>• Write balanced chemical equations for the reactions to prepare different substances using salts.</li> </ul>
<p><b>LO5:</b> Contrasts the nature and chemical reactions of metals (copper, silver, iron) and non-metals (carbon).</p> <p><b>Learning Indicators:</b></p> <p>5.1 Explains the physical properties of metals and non-metals</p> <p>5.2 Describes chemical properties of metals by performing activities with</p>	<ul style="list-style-type: none"> <li>• Revisits the various elements learnt in class IX and their classification into metals and non-metals.</li> </ul> <p><b>Questions for discussion:</b></p> <ul style="list-style-type: none"> <li>- <i>What are some uses of metals and non-metals in your daily life?</i></li> <li>- <i>What properties did you think of while categorizing elements as metals or non-metals?</i></li> <li>- <i>How are these properties related to the uses of these elements?</i></li> </ul>	<ul style="list-style-type: none"> <li>• Compile observations regarding metals and non-metals after performing various activities. Write equations for these reactions.</li> <li>• Perform an activity with a set of metals (potassium, calcium, copper, mercury) and arrange these metals in the decreasing order</li> </ul>

<p>metal samples (aluminum, copper, iron, lead, magnesium, etc.).</p>	<p>- <i>Can you name some metals that are used for making vessels? Do you why these metals are used?</i></p> <ul style="list-style-type: none"> <li>• Help students to conduct activities with metals (<i>iron, copper, lead, silver, zinc, aluminum, gold</i>), <i>non-metals (sulphur, graphite, iodine)</i> and <i>ionic compounds (NaCl, CaCl<sub>2</sub>, MgCl<sub>2</sub>, etc.)</i> for understanding their physical and chemical properties.</li> </ul>	<p>of reactivity with water.</p> <ul style="list-style-type: none"> <li>• Why does ionic compounds have high melting points?</li> </ul>
<p><b>LO6:</b> Explains basic metallurgical processes of extraction of metals from ores.</p> <p><b>Learning Indicators:</b></p> <p>6.1 Explains steps involved in extraction of metals from ores.</p> <p>6.2 Explains the difference in methods used for extracting metals in low, middle and top of the activity series.</p> <p>6.3 Explains how corrosion is prevented in metals.</p>	<p><b>Questions for discussion:</b></p> <p>- <i>How do copper, silver, iron exist in nature?</i></p> <p>- <i>Which part of the earth is major source of metals? How are they extracted?</i></p> <ul style="list-style-type: none"> <li>• Have a detailed discussion on several steps involved in the extraction of pure metals from ores.</li> <li>• Conduct simple activities for explaining electrolytic refining, corrosion, etc.</li> <li>• Discuss about ‘Iron pillar’ at Delhi and discuss the process which is used for preventing rusting.</li> </ul>	<ul style="list-style-type: none"> <li>• Draw a tree diagram to summarize the steps involved in the extraction of metals from ores.</li> <li>• Write balanced chemical equations for the reactions involved in extraction.</li> <li>• 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.</li> </ul>
<p><b>LO7:</b> Describes the elementary idea of chemical bonding.</p> <p><b>Learning Indicators:</b></p> <p>7.1 Studies the properties of some carbon compounds (Acetic acid, Chloroform, Ethanol and Methane).</p> <p>7.2 Draws the structures of saturated and unsaturated carbon compounds.</p>	<ul style="list-style-type: none"> <li>• 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.</li> </ul> <p><b>Questions for discussion:</b></p> <p>- <i>What are the items in last column made up of?</i></p> <p>- <i>Can you think of a method to test this?</i></p> <p>- <i>What would be the product if a compound containing carbon is burnt?</i></p> <p>- <i>Do you know of any test to confirm this?</i></p>	<ul style="list-style-type: none"> <li>• What are the two properties of carbon which lead to the huge number of carbon compounds we see around us?</li> <li>• Is it possible to check the hardness of water using detergent?</li> <li>• Why are carbon and its compounds used as fuel?</li> <li>• Draw structures of chemical compounds.</li> </ul>

<p>7.3 Generates the homogenous series of carbon compounds.</p>	<ul style="list-style-type: none"> <li>• Conduct experiments involving reactions of carbon and its compounds with chemical reactions.</li> <li>• Use models of saturated compounds of carbon and hydrogen for explaining chains, branches and rings.</li> <li>• Conduct activities with teacher's assistance to understand the chemical properties of carbon compounds.</li> </ul>	<ul style="list-style-type: none"> <li>• Derive balanced equations for combustion, oxidation, and addition and substitution reaction.</li> </ul>
<p><b>LO8:</b> Studies the commonly used compounds and carbon compounds, their properties and uses.</p> <p><b>Learning Indicators:</b></p> <p>8.1 Validate the properties of commonly used compounds by observing their uses.</p> <p>8.2 Studies the commonly used compounds, their properties and uses (soap, washing soda, baking soda, bleaching powder, alcohol, denatured alcohol).</p> <p>8.3 Studies the properties of different kinds of carbon compounds (Saturated hydrocarbons, alcohols, carboxylic acids, petrol, vinegar, natural gas) by conducting experiments.</p>	<p><b>Questions for discussion:</b></p> <ul style="list-style-type: none"> <li>- <i>How is common salt obtained?</i></li> <li>- <i>Besides its use in food, is it used for other purposes?</i></li> <li>- <i>What makes washing soda and baking soda different materials?</i></li> <li>- <i>How does bleaching powder make paper and cloth white?</i></li> <li>- <i>What is the white material that is used for making casts?</i></li> <li>- <i>How do soaps clean clothes?</i></li> <li>- <i>Can some other material be used for cleaning clothes?</i></li> <li>- <i>Why does a man lose control on his body after drinking alcohol?</i></li> <li>- <i>Why do people become blind on drinking denatured alcohol?</i></li> </ul> <ul style="list-style-type: none"> <li>• 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.</li> <li>• Plan visits to factories.</li> </ul>	<ul style="list-style-type: none"> <li>• Why are covalent compounds generally poor conductor of electricity?</li> <li>• Draw structure of molecules (e.g.: ethanol, methane, etc.)</li> <li>• 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.).</li> </ul>
<p><b>LO9:</b> Classifies elements based on their electronic configuration and study their properties.</p> <p><b>Learning Indicators:</b></p> <p>9.1 Explains the classification of elements as per</p>	<p><b>Questions for discussion:</b></p> <ul style="list-style-type: none"> <li>• <i>How do chemists study such a large number of elements?</i></li> <li>• Provide brief historical account, charts, films etc.</li> <li>• Discuss Doberiner's law of triads, Newland's law of octaves, Mendeleev's</li> </ul>	<ul style="list-style-type: none"> <li>• What physical and chemical properties of elements were used for creating periodic table by Mendeleev?</li> <li>• Why do we classify elements?</li> </ul>

<p>Dobereiner's Triads, Newland's law of octaves and Mendeleev's periodic table.</p> <p>9.2 Describes the classification of elements based on Modern Periodic Table.</p>	<p>Periodic table and Modern Periodic law. Contrast and compare their features, limitations and advantages.</p> <ul style="list-style-type: none"> <li>• Ask students to predict trends on the basis of the table.</li> </ul>	<ul style="list-style-type: none"> <li>• What is meant by periodicity?</li> <li>• Why do all the elements of the same group have similar properties?</li> <li>• Predict number of valence electron, valency, group number, nature of oxide formed by it, etc. for an element when its atomic number is given.</li> </ul>
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**Resources:**

1. NCERT Class X Science textbook
2. S. Chand Science Laboratory Manual for Class 10

## 5 Learning Outcomes in Mathematics- Secondary Stage

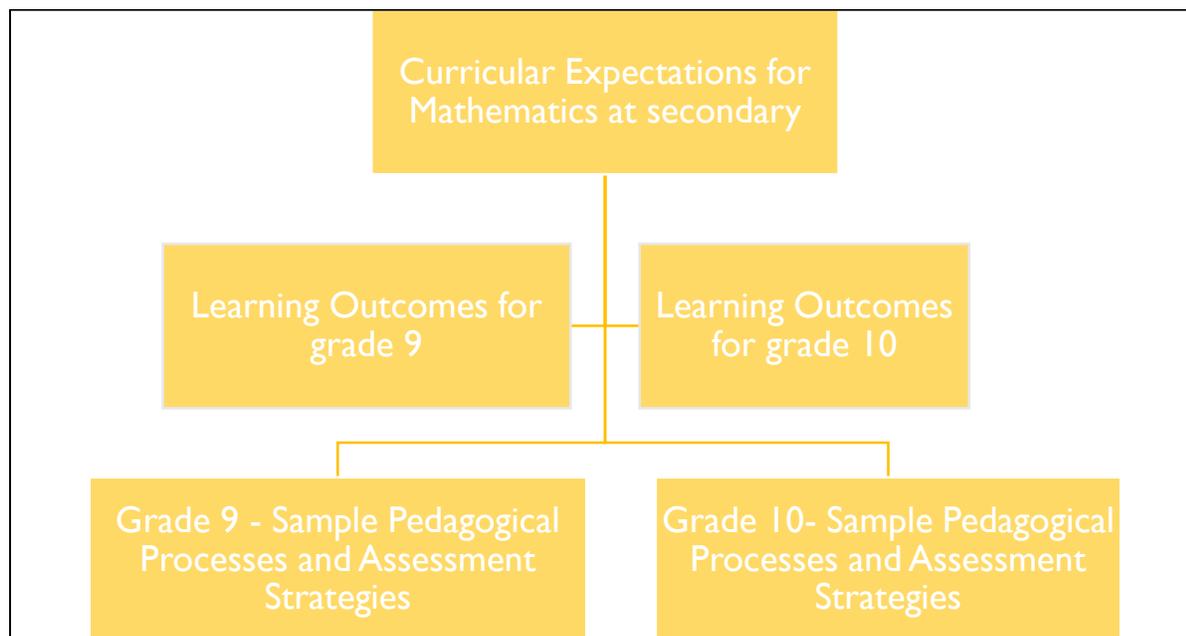


Figure 5: Overview of Mathematics section

### 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 grades mathematics is perceived as a discipline in which argumentation and proof take a central stage. The concepts and techniques learnt in the lower grades 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
<b>CE1</b>	Develop appreciation of patterns in mathematical concepts.
<b>CE2</b>	Classify mathematical objects based on their characteristics.
<b>CE3</b>	Develop abstraction, mathematical language and symbolic representation along with an understanding of the historical relevance of different mathematical concepts and operations.
<b>CE4</b>	Make independent and informed decisions by interpretation of data, prediction of outcome of events and logical and analytical thinking.
<b>CE5</b>	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'.
<b>CE6</b>	Develop proofs and justification using deductive reasoning and logical thinking.
<b>CE7</b>	Enjoy engaging with mathematics and develop confidence in mathematical problem solving and problem posing.

The units chosen for mathematics at the secondary grades as per the NCERT syllabus are Real Number System, Algebra, Geometry, Co-ordinate Geometry, Mensuration, Statistics and Probability. In grade 10, 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- Grade 9

Sl. No.	Learning Outcomes	Unit
<b>LO1</b>	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.	Real Numbers

<b>LO2</b>	Demonstrates and explains that rational numbers are dense and can be uniquely represented on a number line (for eg: locates them on a number line, algebraically finds rational numbers between two rational numbers).	Real Numbers
<b>LO3</b>	Compares rational and irrational numbers based on their properties and their decimal expansions ( for eg: 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).	Real Numbers
<b>LO4</b>	Simplifies expressions with rational numbers and expressions with irrational numbers by: - generalizing the laws of exponents with rational powers -rationalization of denominators	Real Numbers
<b>LO5</b>	Justifies truth or falsehood of a given statement on rational number & irrational numbers ( for eg: every integer is a rational number, rational numbers are closed under division, every positive real number has a rational square root).	Real Numbers
<b>LO6</b>	Identifies a polynomial, its terms, coefficients, zeroes, degree, and different types of polynomials such as monomial, binomial, trinomials, constant, linear, cubic and quadratic polynomials, factors, multiples, zeroes and roots of a polynomial equation.	Algebra
<b>LO7</b>	Applies remainder theorem to divide a polynomial by another polynomial, find remainder when a polynomial is divided by another polynomial.	Algebra
<b>LO8</b>	Applies factor theorem to identify zeroes of polynomial and for factorizing quadratic and cubic polynomials.	Algebra
<b>LO9</b>	Applies algebraic identities to simplify calculations and factorize polynomials.	Algebra
<b>LO10</b>	Identifies the points that lie on a linear equation of two variables and show that they all lie on a straight line.	Algebra
<b>LO11</b>	Proves that a linear equation of two variables have infinitely many solutions and express the solutions in ordered pairs.	Algebra

<b>LO12</b>	Represents a real life situation in the form of linear equation with both algebraic and graphical solution.	Algebra
<b>LO13</b>	Poses problems based on linear equations in two variables	Algebra
<b>LO14</b>	Identifies the origin, x and y axis, abscissa and ordinate of a given point in the Cartesian planes.	Co-ordinate Geometry
<b>LO15</b>	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
<b>LO16</b>	Investigates if a given set of points on the coordinate plane lie on a straight line by plotting the points.	Co-ordinate Geometry
<b>LO17</b>	Recognizes mathematicians' including Euclid's contributions to the development of geometry.	Geometry
<b>LO18</b>	Identifies definitions, common/obvious notions, axioms/postulates, and theorems and establishes the relationship between axiom and theorem using examples.	Geometry
<b>LO19</b>	Defines geometrical concepts – point, lines, line segment, ray, angles, collinear points, non collinear points and circles with reference to Euclidean geometry.	Geometry
<b>LO20</b>	Uses the language needed to understand, identify and discuss different geometrical concepts such as angles, triangles, quadrilaterals and circles.	Geometry
<b>LO21</b>	Classifies different geometrical objects (different types of quadrilaterals, angles formed when a transversal intersects two parallel lines).	Geometry
<b>LO22</b>	Proves and applies theorems and axioms related to lines and angles, parallel lines, angle sum property, exterior angle property of triangles and quadrilaterals, triangle congruency, mid-point theorem, properties of parallelograms, parallelograms with same base and within the same parallels, relationship between chords and angles subtended, distance of chords from centre and relationships between angles in cyclic quadrilaterals.	Geometry

<b>LO23</b>	Constructs lines bisectors, angular bisector ( $60^\circ$ , $90^\circ$ , $45^\circ$ ), equilateral triangles and triangles with given conditions (such as base, sum difference of other two sides, perimeter and one or two base angles given ) and reasons out the steps for construction.	Geometry
<b>LO24</b>	Solves problems on area of triangle and composite figures applying Heron's formula.	Mensuration
<b>LO25</b>	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
<b>LO26</b>	Categorizes collected data from daily life (as primary and secondary data, grouped and ungrouped, raw data or in frequency distribution).	Statistics & Probability
<b>LO27</b>	Represents the grouped/ungrouped data appropriately in bar graphs, histograms and frequency polygon as per the nature of the data (eg: selects the most appropriate graphical representation).	Statistics & Probability
<b>LO28</b>	Justifies which measure of central tendency is appropriate for a given context.	Statistics & Probability
<b>LO29</b>	Analyzes data from real life (such as census data, educational statistics) and draws conclusions and inferences.	Statistics & Probability
<b>LO30</b>	Explains the concept of empirical probability.	Statistics & Probability
<b>LO31</b>	Performs experiments in real life situations and uses real life data to obtain the empirical probability of an event.	Statistics & Probability

### 5.3 Grade 9- Sample Pedagogical Processes and Assessment Strategies

#### Unit- Real Number System

Learning Outcomes and Indicators	Pedagogical Process	Assessment Strategies
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<p>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</p> <p><b>Learning Indicators</b></p> <p>I.1 Classifies numbers as natural, integer and rational numbers</p> <p>I.2 Defines a rational number</p> <p>I.3 Provides examples of rational numbers</p> <p>I.4 Identifies whether a given number is rational number or not</p>	<ul style="list-style-type: none"> <li>• 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].</li> </ul> <p><b>Discussion:</b> <i>What are the answers you got and how did you classify them?</i></p> <p>[Note: Students may classify them as positive and negative or natural numbers, integers and rational numbers or even as possible and impossible operations]</p> <ul style="list-style-type: none"> <li>• Probing questions: <ul style="list-style-type: none"> <li>- <i>Are all natural numbers integers?</i></li> <li>- <i>Are all integers rational numbers?</i></li> <li>- <i>How are rational numbers different from set of natural numbers and integers?</i></li> </ul> </li> <li>• 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).</li> </ul>	<p>Task- Related</p> <ul style="list-style-type: none"> <li>• Problems should be provided to students to check the following- <ul style="list-style-type: none"> <li>- <i>Is the student able to apply all four operations on the numbers?</i></li> <li>- <i>Is the student able to classify the numbers into natural, integers and rational correctly?</i></li> <li>- <i>Is the student able to justify his/her stance?</i></li> <li>- <i>Is the student able to explain with examples when the sum, difference, product and quotient of two natural numbers is not a natural number?</i></li> <li>- <i>Can the student extend this to study the closure of the set of rationals under the four basic operations?</i></li> </ul> </li> <li>• Define natural numbers, integers and rational numbers</li> </ul>
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<p>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)</p> <p><b>Learning Indicators:</b></p> <p>2.1 Locates the rational numbers on the number line</p> <p>2.2 Distinguishes between rational numbers and integers in terms of their density on the number line</p> <p>2.3 Concludes that rational numbers are dense</p> <p>2.4 Finds rational numbers between two rational numbers</p>	<ul style="list-style-type: none"> <li>• Draw a number line and plot <math>-3/7</math>, <math>3/7</math>, <math>4/7</math>, <math>-1/7</math>, <math>5/7</math> on the number line.</li> <li>• Find the average of any two of these numbers and plot it.</li> <li>• Now find the average of the average and one of the numbers. Plot this new mean.</li> <li>• Can this process be continued indefinitely?</li> <li>• Is there any other way of finding a rational number between two given rational numbers?</li> </ul>	<p><b>Probing questions:</b></p> <ul style="list-style-type: none"> <li>- <i>Can there be another integer between two consecutive integers?</i></li> <li>- <i>Can the same be said about rational numbers?</i></li> <li>- <i>Can there be two consecutive rational numbers?</i></li> <li>- <i>How many rational numbers can you plot between any two rational numbers?</i></li> </ul> <ul style="list-style-type: none"> <li>• Write a short paragraph on the density of rational numbers and of integers, justifying your conclusions with examples.</li> </ul>
<p>LO3. Compares rational and irrational numbers based on their properties and their decimal expansions (</p>	<ul style="list-style-type: none"> <li>• Provide students with different rational numbers and have them estimate the decimal representation of the same. For example: Numbers such as <math>2/5</math>, <math>6/11</math>, <math>9/7</math>, <math>3/8</math>, <math>12/5</math>, <math>7/13</math>).</li> </ul>	<p><b>Probing questions</b></p> <ul style="list-style-type: none"> <li>• <i>Will all rational numbers be either terminating or recurring decimals? Justify your stance</i></li> </ul>

<p>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)</p> <p><b>Learning Indicators</b></p> <p>3.1 Converts rational numbers in <math>p/q</math> to decimals and vice versa</p> <p>3.2 Explores patterns in the decimal expansion of rational numbers</p> <p>3.3 Explores the nature of decimal expansions of square roots of non-perfect positive integers.</p>	<ul style="list-style-type: none"> <li>• Next, ask them to find the decimal representation using long division and compare their estimate with their answer. (<i>Students are asked to divide until they arrive at a terminating decimal or recognize a recurring pattern.</i>)</li> </ul>	<ul style="list-style-type: none"> <li>• <i>Which of the numbers will have terminating and which of them would be non-terminating?</i></li> <li>• <i>Is there any pattern in the numbers that terminate and the numbers which have a recurring pattern?</i></li> <li>• 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.</li> </ul> <p>Note: Have students observe the ones which terminate and ones which do not.</p> <ul style="list-style-type: none"> <li>• How will the patterns that you observe if the numerator is not 1?</li> </ul>
<p>3.4 Discusses the irrationality of <math>\pi</math></p> <p>3.5 Plots irrational numbers and rational numbers geometrically</p> <p>3.6 Plots real numbers on the number line</p>	<ul style="list-style-type: none"> <li>• Discuss the methods to convert a repeating non-terminating decimal to the <math>p/q</math> form. (Algebraic and the short cut method must be discussed).</li> <li>• Encourage students to discuss the values of numbers such as <math>\pi</math> and so on.</li> </ul>	<ul style="list-style-type: none"> <li>• Convert 0.45, 0.33, 0.19, 0.999..., 1.999... to the <math>\frac{p}{q}</math> form.</li> <li>• Evaluate if the following definition of rational number is correct? Provide arguments to support your answer</li> <li>• <i>'Any number which can be represented in the form of <math>p/q</math> where <math>p</math> and <math>q</math> are</i></li> </ul>

		<p>integers is known as rational number'.</p>
	<ul style="list-style-type: none"> <li>• 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: <i>2, 5, 16, 7, 18....and explore the patterns in the decimal expansion (how different are these from decimal expansions of other rational numbers).</i></li> <li>• 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.</li> <li>• Discuss the proof by contradiction that <math>\sqrt{2}</math> is irrational.</li> <li>• Facilitate discussion about the irrationality of the number <math>\pi</math> (pi). Discuss if pi is equal to <math>\frac{22}{7}</math>? Discuss about the decimal expansion of pi.</li> <li>• Show the video on irrationality of pi <a href="https://www.youtube.com/watch?v=HSuqbqENlek">https://www.youtube.com/watch?v=HSuqbqENlek</a></li> <li>• Discuss if irrational numbers can be plotted on the real number line. Discuss how <math>\sqrt{2}</math> , <math>\sqrt{3}</math> can be plotted on the number line.</li> <li>• Provide opportunities to plot square root of any positive real numbers</li> </ul>	<ul style="list-style-type: none"> <li>• Which of these are irrational numbers: <math>P^2 = .09</math>, <math>q^2 = 0.4</math> , <math>r^2 = \frac{27}{16}</math></li> <li>• Plot the square root of 2.5 geometrically and explain the same algebraically.</li> <li>• Activity: <a href="http://azimpremjiuniversity.edu.in/SitePages/resources-ara-march-2017-spiral-of-square-roots.aspx">http://azimpremjiuniversity.edu.in/SitePages/resources-ara-march-2017-spiral-of-square-roots.aspx</a></li> </ul>

	<p>geometrically and justify the same algebraically.</p> <ul style="list-style-type: none"> <li>• Discuss how to find irrational numbers between two rational numbers</li> <li>• Encourage students to visualize representation of real numbers on number line up to a given place of decimal</li> </ul>	
<p>LO4.Simplifies expressions with rational numbers and expressions with irrational numbers by generalizing the laws of exponents with rational powers</p> <p>-rationalization of denominators</p> <p><b>Learning indicators:</b></p> <p>4.1 Explores the nature of sum, difference, product and quotient of rational numbers and irrational numbers and both</p> <p>4.2 Performs operations on real numbers</p> <p>4.3 Simplifies expressions with real numbers using identities and</p>	<ul style="list-style-type: none"> <li>• Invite discussions on the type of numbers formed when a rational and irrational number are added or subtracted, multiplied and divided.</li> <li>• Provide statements for discussion such as the following <ul style="list-style-type: none"> <li>- <i>sum of rational and irrational is always rational</i></li> <li>- <i>Sum/Product of irrational and irrational is always irrational</i></li> <li>- <i>Is it possible to have a rational product of two irrational numbers?</i></li> <li>- <i>Is it possible to have rational product of a rational and irrational number?</i></li> <li>- <i>What will be the nature of quotient of a rational and irrational number?</i></li> </ul> </li> <li>• Encourage students to perform operations on real numbers( include rational and irrational numbers</li> <li>• Provide tasks to rationalize the denominator and simplify expressions and also simplify expressions with rational exponents.</li> <li>• For <math>m = 2 + \sqrt{3}</math>, let students explore the values of <math>\frac{1}{m}</math>, <math>m + \frac{1}{m}</math>, <math>m - \frac{1}{m}</math> and find out if these values are rational or irrational numbers.</li> </ul>	<ul style="list-style-type: none"> <li>• Investigate in pairs whether <math>2 + \sqrt{3}</math>, <math>\sqrt{3} \cdot \sqrt{3}</math>, <math>\pi - 2</math> are rational or irrational numbers</li> <li>• Divide the students in pairs where one group provides statements as the following and the other group provides examples <ul style="list-style-type: none"> <li>- <i>Rational product of two irrational numbers.</i></li> <li>- <i>Rational quotient of two irrational numbers</i></li> <li>- <i>Simplification tasks using rationalization of denominator and exponents with rational power may be given for practice</i></li> </ul> </li> <li>• Prove that <math>(\sqrt{p+1} + \sqrt{p-1})</math> is an irrational number, where <math>p</math> is a natural number</li> </ul>

<p>rationalization of denominators</p> <p>4.4 Generalizes the rule of exponents to rational powers</p>		
<p>LO5. Justifies truth or falsehood of a given statement on rational number &amp; irrational numbers</p>	<ul style="list-style-type: none"> <li>• Provide statements on rational and irrational numbers such as: <ul style="list-style-type: none"> <li>- <i>Every integer is a rational number,</i></li> <li>- <i>The set of rational numbers are closed under division,</i></li> <li>- <i>Every positive real number has a rational square root</i></li> </ul> </li> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• 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 <ul style="list-style-type: none"> <li>- <i>All integers are rational numbers but all rational numbers are not integers</i></li> <li>- <i>Rational numbers are closed under division</i></li> <li>- <i>Every positive rational number has a rational square root</i></li> <li>- <i>The product of two irrational numbers may or may not be an irrational number</i></li> <li>- <i>If <math>p</math> is a rational number and <math>q</math> is an irrational number, <math>p + q</math> will always be an irrational number</i></li> </ul> </li> </ul> <p>Note that while one group provides justification, the other group provides evaluates whether the justifications are valid.</p>

Resources	1. NCERT Text Book class 9 2. At Right Angles: A Resource for High School Mathematics 3. Video link on irrationality of pi <a href="https://www.youtube.com/watch?v=HSuqbqENlek">https://www.youtube.com/watch?v=HSuqbqENlek</a>
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## 5.4 Learning Outcomes- Grade 10

Sl. no	Learning Outcomes	Unit
<b>LO1</b>	Applies Euclid's division Lemma: <ul style="list-style-type: none"> <li>- to find HCF of two numbers</li> <li>- arrive at general forms of numbers ( such as odd numbers are of the form <math>2q + 1</math>)</li> </ul>	Number System
<b>LO2</b>	Applies the Fundamental Theorem of Arithmetic for solving problems (for eg: finding HCF and LCM of two numbers or unit digits of powers of numbers).	Number System
<b>LO3</b>	Proves the irrationality of $\sqrt{2}$ , $\sqrt{3}$ , $\sqrt{5}$ and other surds such as $m + \sqrt{n}$ etc. using the Fundamental Theorem of Arithmetic.	Number System
<b>LO4</b>	Explore the pattern in rational numbers which have a terminating decimal expansion and which have non terminating decimal expansion.	Number System
<b>LO5</b>	Interprets the geometric meaning of the zeroes of a polynomial.	Algebra
<b>LO6</b>	Establishes the relationship between zeroes and the coefficients of a polynomial.	Algebra
<b>LO7</b>	Verifies division algorithm in case of division of polynomials.	Algebra
<b>LO8</b>	Classifies linear equations as consistent, inconsistent and dependent and interprets their geometric meaning, the type of solutions and the relationship between the coefficients.	Algebra
<b>LO9</b>	Solves problems on linear equations in two variables: <ul style="list-style-type: none"> <li>- Graphically</li> <li>- Algebraically (using substitution, elimination and by cross multiplication)</li> </ul>	Algebra

<b>LO10</b>	Explores the relationship between the nature of roots and the discriminant of a quadratic equation.	Algebra
<b>LO11</b>	Solves problems based on quadratic equations using different methods (by factorization and completing squares).	Algebra
<b>LO12</b>	Derives the formula for nth term and the sum of first n terms of an arithmetic progression.	Algebra
<b>LO13</b>	Solves real life problems based on Arithmetic Progression.	Algebra
<b>LO14</b>	Justifies through demonstration that the ratios of sides in a right angled triangle remain constant when the angles remain constant.	Trigonometry
<b>LO15</b>	Defines sine, cosine and tangent of an acute angle in general and the specific angles such as $0^\circ$ , $30^\circ$ , $45^\circ$ , $60^\circ$ and $90^\circ$	Trigonometry
<b>LO16</b>	Proves the trigonometric identities and uses the same to establish relationships between the trigonometric ratios.	Trigonometry
<b>LO17</b>	Solves simple problems on heights and distances (which includes understanding of angle of elevation and depression).	Trigonometry
<b>LO18</b>	Derives distance formula to find distance between any two points on the co-ordinate plane and applies the same to determine: <ul style="list-style-type: none"> <li>- Type of triangles</li> <li>- Formula for finding the area of a triangle</li> <li>- Whether given points are collinear</li> </ul>	Co-ordinate Geometry
<b>LO19</b>	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
<b>LO20</b>	Provides examples and non-examples of similar triangles and explains the conditions for two triangles to be similar.	Geometry
<b>LO21</b>	Proves Basic Proportionality theorem and its converse and solves problems related to the similar triangles.	Geometry
<b>LO22</b>	Proves Pythagoras theorem and solves problems based on the same.	Geometry
<b>LO23</b>	Prove theorems related to the relationships between tangent, radius, chord and sector, secant of a circle and solves related problems.	Geometry

<b>LO24</b>	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
<b>LO25</b>	Justifies whether given steps of a particular construction are appropriate.	Geometry
<b>LO26</b>	Solves problems on areas related to circle, secant and segments.	Mensuration
<b>LO27</b>	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
<b>LO28</b>	Solves problems based on surface area and volume of different shapes and their combinations.	Mensuration
<b>LO29</b>	Calculates the central tendencies (mean, median and mode) of a grouped data.	Statistics & Probability
<b>LO30</b>	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
<b>LO31</b>	Mentions the probability of certain event, impossible event, complement of an event.	Statistics & Probability
<b>LO32</b>	Solves problems on probability of occurrence of events.	Statistics & Probability

## 5.5 Grade 10- Sample Pedagogical Processes and Assessment Strategies

### Unit- Real Number System

Learning Outcomes and Indicators	Pedagogical Processes	Suggested Assessment Strategies
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<p>LO1. Applies Euclid's division Lemma</p> <p>i) to find HCF of two numbers</p> <p>ii) arrive at general forms of numbers (such as odd numbers are of the form <math>2q + 1</math>)</p> <p><b>Learning Indicators</b></p> <p>I.1 Establish a linear relation between two integers</p> <p>I.2 State Euclid's division Lemma</p> <p>I.3 Use Euclid's division Lemma to find HCF of two numbers</p> <p>I.4 Arrive at general forms of numbers</p>	<ul style="list-style-type: none"> <li>• Divide 9 by 4 and express the relationship in the form <math>9 = 4 \times 2 + 1</math>; identify 9 as the dividend, 4 as divisor, 2 as quotient and 1 as remainder.</li> <li>• Repeat with 12 as divisor and 38 as dividend and ask students to write the relationship as dividend = divisor <math>\times</math> quotient + remainder.</li> <li>• Ask them to work in pairs and give each other similar problems.</li> </ul> <p><b>Probing questions</b></p> <ul style="list-style-type: none"> <li>- <i>Can there be more than one way of expressing the mathematical relationship?</i></li> <li>- <i>Discuss the case when the divisor is greater than the dividend</i></li> <li>- <i>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].</i></li> <li>- <math>9 = 4 \times 2 + 1</math></li> <li>- <math>38 = 12 \times 3 + 2</math></li> <li>• Encourage students to observe that the remainder is less than the quotient and establish the Euclid's Division Lemma :  <math display="block">a = bq + r, 0 \leq r &lt; b</math> <i>Where a and b are positive integers.</i></li> <li>• 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.</li> </ul> <p><b>Probing question</b></p> <p><i>Can q and/or r be 0?</i></p>	<ul style="list-style-type: none"> <li>• The H.C.F of two numbers is always less than or equal to the smaller of the numbers. True or False?</li> <li>• The H.C.F. of two numbers is the smallest number that divides both these numbers. True or False?</li> <li>• 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.</li> <li>• 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.</li> <li>• Prove that the number of the form <math>p(p-1)</math> is always an even number, where p is a positive integer.</li> <li>• Prove that the square of an even number is always a multiple of 4.</li> </ul>
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	<ul style="list-style-type: none"> <li>• Encourage students to establish more relationship with more pairs of positive integers.</li> <li>• Encourage students to recall the definition of highest common factor which they have learnt in lower grades.</li> <li>• Provide example of any two positive integers and ask the student to find the HCF.</li> <li>• Ask students to express <math>a = 36</math> and <math>b = 18</math> in the form <math>a = bq + r</math>, <math>0 \leq r &lt; b</math> and note down their observations. Facilitate their discussion to arrive at <ul style="list-style-type: none"> <li>(i) <math>r = 0</math></li> <li>(ii) <math>b</math> is the HCF of <math>a</math> and <math>b</math>.</li> </ul> </li> </ul> <p><b>Probing Question:</b></p> <ul style="list-style-type: none"> <li>- <i>Is this always so? If yes, justify your response.</i></li> <li>- <i>If no, find pairs of numbers for which the divisor is the H.C.F</i></li> <li>- <i>Can this procedure be used to find the H.C.F. of any two numbers?</i></li> <li>• 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.</li> <li>• 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.</li> </ul>	<ul style="list-style-type: none"> <li>• Prove that the square root of an odd perfect square is always an odd number.</li> </ul>
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	<ul style="list-style-type: none"> <li>Have students show the following using Euclid's Lemma: <i>Every positive even integer is of the form <math>2q</math> and every positive odd integer is of the form <math>2q+1</math></i></li> </ul>	
<p>LO2. Applies the Fundamental Theorem of Arithmetic for solving problems (for example: finding HCF and LCM of two numbers or unit digits of powers of numbers)</p>	<ul style="list-style-type: none"> <li>Show the video on Fundamental Theorem of Arithmetic <a href="https://www.khanacademy.org/math/in-in-grade-10-ncert/in-in-chapter-1-real-numbers/modal/v/the-fundamental-theorem-of-arithmetic-1">https://www.khanacademy.org/math/in-in-grade-10-ncert/in-in-chapter-1-real-numbers/modal/v/the-fundamental-theorem-of-arithmetic-1</a></li> <li>Write down your understanding of a prime number and of a composite number. Then express each of these using the Fundamental Theorem of Arithmetic.</li> <li>General Reading on Twin Primes <a href="http://teachersofindia.org/en/article/twin-primes-conjecture">http://teachersofindia.org/en/article/twin-primes-conjecture</a></li> <li>Find the HCF and LCM of 108 and 81 using the prime factorization method.</li> <li>Prove that <math>\text{HCF}(a, b) \times \text{LCM}(a, b) = a \times b</math></li> </ul> <p><i>[Students may be encouraged to begin with a numerical example]</i></p>	<ul style="list-style-type: none"> <li>State the Fundamental Theorem of Arithmetic</li> <li>Explain why <math>5 \times 2 \times 3 \times 11 + 11</math> is a composite number.</li> <li>Write down a general representation of a number having a zero at its unit place.</li> <li>Discuss (using the prime factorization method) if <math>4^n</math> will have a zero at its unit place for any value of <math>n</math>.</li> <li>Given two numbers and their HCF, find their LCM.</li> </ul>
<p>LO3. Prove the irrationality of <math>\sqrt{2}</math>, <math>\sqrt{3}</math>, <math>\sqrt{5}</math> and other surds such as <math>m + \sqrt{n}</math> etc. using the Fundamental Theorem of Arithmetic</p> <p><b>Learning Indicators</b></p>	<ul style="list-style-type: none"> <li>Encourage students to prove (using numerical examples) that if a prime number <math>p</math> divides <math>a^2</math>, it also divides <math>a</math>, where 'a' is a positive integer.</li> <li>Demonstrate to students how to prove the irrationality of <math>\sqrt{2}</math>, <math>\sqrt{3}</math>, <math>\sqrt{5}</math> using the method of contradiction.</li> </ul>	<ul style="list-style-type: none"> <li>Prove by contradiction that <math>5 - \sqrt{3}</math> is irrational.</li> </ul>

<p>3.1 Provides justified arguments to prove theorems using Fundamental theorem of Arithmetic</p> <p>3.2 Proves irrationality of surds</p>		
<p>LO4. Explores the pattern in rational numbers which have a terminating decimal expansion and which have non terminating decimal expansion</p>	<ul style="list-style-type: none"> <li>• Provide different rational numbers of the form <math>\frac{p}{q}</math> and have students evaluate the denominators of rational numbers which terminate and the ones which do not terminate.</li> <li>• Probe them to arrive at the pattern that the denominators which are of the form <math>2^m 5^n</math> will terminate; where n and m are non-negative integers.</li> <li>• Make the students familiar with the theorems based on the above idea.</li> </ul>	<ul style="list-style-type: none"> <li>• 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.</li> </ul>
<p>Resources</p>	<ol style="list-style-type: none"> <li>1. NCERT Mathematics Textbook class 10</li> <li>2. At Right Angles, A Resource for High School Mathematics</li> <li>3. <a href="https://www.khanacademy.org/math/in-in-grade-10-ncert/in-in-chapter-1-real-numbers/modal/v/the-fundamental-theorem-of-arithmetic-1">https://www.khanacademy.org/math/in-in-grade-10-ncert/in-in-chapter-1-real-numbers/modal/v/the-fundamental-theorem-of-arithmetic-1</a></li> </ol>	

## 6. Annexures

### 6.1 Annexure I- Review of Learning Outcomes of Elementary Grades

The NCERT learning outcomes for grades 1-8 has three areas under each subject section- a) curricular expectations b) Learning Outcomes c) Pedagogical processes.

A detailed review of the learning outcomes of each of the sections has been carried out against the following parameters:

- a) Nature of the curricular expectations
- b) Alignment of the learning outcomes with curricular expectations
- c) Quality of the learning outcomes
- d) Alignment of the pedagogical processes with the learning outcomes

The purpose of this exercise is expected to provide inputs to come up with clear and concise learning outcomes for grades 9<sup>th</sup> and 10<sup>th</sup>. The strengths of this document shall be incorporated in the subsequent learning outcomes for grades 9<sup>th</sup> and 10<sup>th</sup> and an attempt would be made to minimize the gaps emerging from the review.

The following section details out the main points emerging from the review of the subject specific learning outcomes.

#### i) Language

**Nature Of the curricular expectations:** Curricular expectations (CE) for primary and upper-primary stages have been articulated in the document. The primary stage expectations are well written and pitched at the right level, however the upper primary stage expectations are not articulated in proper manner. The verbs used in developing the upper primary expectations are sounding more like learning outcomes. For example, recite poems, dialogues; speak and write language chunks (phrases, sentences from stories, plays, speeches, etc.); understand the central idea and locate details in the text (familiar and unfamiliar).

It has been observed that use of multilingualism in the classroom has been missed out in the curricular expectations of this stage.

**Alignment of the learning outcomes with curricular expectations:** At the primary stage, the learning outcomes are gradually aligned with the curricular expectations. By class 4 and 5, all the curricular expectations are mapped with the learning outcomes. Same approach has been taken up at the upper primary stage also. However, here, some of the curricular expectations and learning outcomes are not aligned. For instances, Class 6 LO8. *Uses synonyms, antonyms appropriately deduces word meanings from clues in context while reading a variety of texts; LO9 Writes words / phrases / simple sentences and short paragraphs as dictated by the teacher,* etc. are not aligned with the curricular expectations.

The CE 10 Develops sensitivity towards their culture and heritage, aspects of contemporary life, gender, and social inequality of upper primary level is not expressed in the Los or PPs anywhere in detail. It is dealt with in token form in Class VII LO 19 writes descriptions / narratives showing sensitivity to gender, environment and appreciation of cultural diversity. There is no pedagogical process corresponding to this. In fact this CE is so important that it should have been reflected in every class LOs and PPs.

**Quality of the learning outcomes:** The learning outcomes are articulated in a manner that the process and product of learning has been taken care of. However, at the upper primary stage, the process of learning has given more importance. This is as it should be because in the early literacy years the child is also learning to write and recognize words, the alphabet and spellings. The child is also acquiring the fine

and gross motor skills. Although this has not been mentioned anywhere in keeping with the philosophy and approach of a balanced literacy pedagogy the product skills have a larger share in the lower classes. One could argue for a 70/30 better balance of process product in higher classes as in these classes correct spellings, usage of words in theoretical discussions are expected.

At the primary stage, ~97% of the learning outcomes are observable and measurable. Very few are ambiguous. For example, class 1 LO1. *Associates words with pictures*. All the learning outcomes of upper primary level are observable and measurable but some of the learning outcomes are pitched at broader level. For instance, Class 8 LO25. *Develops a skit (dialogues from a story) and story from dialogues*. It has been observed that some of the learning outcomes use combination of the verbs which are of different cognitive levels like, *reads and expresses opinions; reads, compares, contrasts, thinks critically and relates ideas to life*. Few learning outcomes sound like pedagogical processes, for example, Class 8 LO 26. *Visits a language laboratory*.

In the beginning of primary level learning outcomes, ~70% of cognitive domains are remember. However, gradually, all the cognitive domains spread appropriately in the later stage. By the end of elementary schooling, ~ 50% of cognitive domains are of analyze, evaluate, apply, create.

**Alignment of the pedagogical processes with the learning outcomes:** The suggestive pedagogical processes do not align one to one with the learning outcomes. It has been observed that across the grades some of the pedagogical processes are not mapped with the learning outcomes. For example, Class 3, LO8, *Uses meaningful short sentences in English, orally and in writing*; Class 8 LO 11. *Narrates stories (real or imaginary) and real life experiences in English*.

The pedagogical process sound exactly like the learning outcomes. They need to be clear and illustrative with concrete classroom examples. E.g. LO 9 in Class VIII is *Narrates stories and real life experiences in English*; PP 9 is *reads stories and narrates them*. If PP had been expressed as *Teacher asks students whether they have read any stories about kite flying. The students narrate the stories. The teacher asks them to talk to each other about their own experiences related to kite flying. Teacher observes group interaction*.

A very important point missing in the document is assessment strategies. Without mentioning assessment strategies for each of the LO s, the pedagogical processes are not going to be robust. E.g. LO 19 Class VIII (last part) *attempts extrapolative writing*.

If the assessment strategy does not clarify the percentage of award to creativity and to layout or correctness then the LO will not be tested or taught.

The assessment strategy will ask the teacher to look out for creativity, analysis of character, interpretation or event or dialogue revealing character traits. The teacher will be asked not to penalize grammar and spelling errors.

## ii) EVS and Science

**Nature of the curricular expectations:** Curricular expectations (CE) are long-term goals that students need to acquire over a period of time, and are therefore spelt out stage-wise. Curricular expectations for EVS written for primary grades and curricular expectations for Science written for upper primary grades are well written and pitched at the right level.

**Alignment of the learning outcomes with curricular expectations:** EVS learning outcomes for grade 3 to 5 were reviewed to see the alignment to the curricular expectation. It was observed that sixth curricular expectation which is related to equality, justice and respect for human dignity and rights is not addressed by any of the learning outcomes. Also, the extent to which each of the curricular expectation

were addressed varied. For example, across all the grades, it was observed that most of the learning outcomes were mapped to CE1 (acquire awareness about immediate/wider surroundings through lived experiences on various themes related to daily life, e.g., family, plants, animals, food, water, travel, and shelter etc.) and CE3 (develop various processes/skills, e.g., observation, discussion, explanation, experimentation, logical reasoning, through interaction with immediate surroundings.). There were similar observation for Science learning outcomes of class 6 to 8. Most of the learning outcomes were mapped to CE3 (process skills of science which includes observation(s), posing question(s), searching various resources of learning, planning investigations, hypothesis formulation and testing, using various tools for collecting, analyzing and interpreting data, supporting explanations with evidences, critically thinking to consider and evaluate alternative explanations, reflecting on their own thinking.), while the fourth curricular expectation was not addressed by one of the learning outcomes.

**Quality of the learning outcomes:** All the learning outcomes for primary and upper primary grades are measurable and observable. A few learning outcomes from class III were ambiguous such as *guesses properties of materials/activities in daily life*. A good spread of cognitive domains was observed for the learning outcomes for primary and upper primary grades. Most of the learning outcomes were pitched at higher cognitive levels. More than 50% of the learning outcomes were from 'Apply' cognitive level while around 10% weightage was given to Analyze, Evaluate and Create cognitive domains.

**Alignment of the pedagogical processes with the learning outcomes:** Some suggestive pedagogical processes are provided in the NCERT learning outcomes document. These pedagogical processes are suggestive and do not correspond one-to-one with the learning outcomes. The elementary level learning outcomes were mapped to the pedagogical processes. It was observed that some of the pedagogical processes were not mapped to any of the learning outcomes while few learning outcomes were not reflected in any pedagogical practice. For example, there was no pedagogical practice mentioned for grade 7 learning outcome '*discusses and appreciates stories of scientific discoveries*'

### iii) Social Science

**Nature of the curricular expectations:** The curriculum expectations for the Upper Primary are well articulated in the document. The curricular expectations are pitched at a higher and broader level. However, mapping skills, data interpretation, disaster management, natural calamities are not addressed in the document and less weightage is given to geography.

**Alignment of the learning outcomes with curricular expectations:** There is an alignment of the learning outcomes with the curricular expectations but there are few instances where some of the learning outcomes do not correspond with any curricular expectations. For example, there is no curricular expectation which aligns with the outcome '*analyses factors contributing to pollution in their surroundings and lists measures to prevent it*' and

**Quality of the learning outcomes:** The verbs used in the learning outcomes are measurable and observable and there is no ambiguity. The inquiry process is articulated well in the learning outcomes.

But, many areas for instance like Neolithic revolution, pottery, division of labor are not captured in the learning outcomes. Across grades it was observed that the outcomes were pitched at various levels. The outcomes were mostly process oriented. However some of the outcomes across grades were also product oriented.

**Alignment of the pedagogical processes with the learning outcomes:** An extensive set of Pedagogical processes is suggested but all of them do not correspond to each other and are inappropriate as well. For example '*explains the significance of equality in democracy*,

distinguishes between political equality, economic equality, and social equality as an outcome; the pedagogy suggested is - participate in a discussion on the concepts of democracy, equality, State Government, gender, media and advertising and prepare posters with drawings and pictures on the significance of the Constitution, Preamble, right to equality and struggles for equality .

Pedagogical processes like discuss events and processes in groups and as a whole in the classroom situation are ambiguous in nature

No definition of kingdoms, dynasties, rulers and subjects and importantly of nation are mentioned in the Learning Outcomes while pedagogical processes on these are provided

#### iv) Mathematics

**Nature of the curricular expectations:** The curricular expectations for primary and upper primary grades have been articulated in the document. It was observed that the curricular expectations across primary and upper primary stages are pitched at a higher level such as '*develop a connection between daily life contexts and mathematical thinking*'. However there were also instances of very specific curricular expectations such as '*identifies space as region enclosed within boundaries of a shape*' which appear more as a learning outcome.

**Alignment of the learning outcomes with curricular expectations:** While most of the learning outcomes are mapped to the curricular expectations, surprisingly in the primary grades, there was no curricular expectation to which the important concept of measurement could be mapped. While there was a curricular expectation based on estimation on number operations, it could have been made slightly broader to encompass measurement by widening the scope to estimation and measurement of quantities. In doing so, the outcomes on measurement of length, mass, capacity and time could be aligned to the curricular expectations.

**Quality of the learning outcomes:** The articulation of the learning outcomes in case of mathematics is done in a manner that the process as well as the product of learning has been taken care of.

The learning outcomes have been articulated with great deal of precision with usage of measurable and observable verbs. However there were a few exceptions to this as in some cases the outcomes were slightly broader. For example an outcome in class I has been articulated as 'develop the concept of zero.' Whenever a combination of verbs is used for articulating an outcome care has been taken to ensure that these belong to the same cognitive domains. However there were couple of instances where 'apply and analyze' have been used together for articulating the same outcome.

Across grades, a preponderance of outcomes intended to test understanding was observed. Almost more than 50% of the outcomes were pitched at this level with a slight variation in grade 8 where application level takes precedence with 50% weightage. Outcomes intending to test remember and higher order levels (analyze, evaluate and create) were restricted to little less than 10% across grades.

**Alignment of the pedagogical processes with the learning outcomes:** The pedagogical processes mentioned alongside the outcomes, though do not have a one to one correspondence with the outcomes as has been mentioned in the document, across grades it was noticed that some of the pedagogical practices suggested are not aligned to any of the outcomes. For example in class 7, there are pedagogical process for teaching symmetry but the concept has not been addressed through any of the learning outcomes.

Some of the pedagogical processes are articulated in such a manner that they cannot be distinguished from outcomes. For example: *Read and write a large number, records data using tally marks, extends patterns in simple shapes and numbers.*

Based on the above analysis, the following aspects need to be taken into consideration for developing the learning outcomes of grades 9 and 10

- The curricular expectations for secondary grades should be extracted from position paper on 'Teaching of Science' and the syllabus document.
- The learning outcomes for secondary grades should be aligned to the curricular expectations so that subject specific knowledge, skills and attitudes are well addressed
- A set of pedagogical processes should be included along with the secondary grade learning outcomes. It is proposed to include an additional section on pedagogical process for a concept (more than one learning outcomes can be there for a concept). The pedagogical process for this concept will also encompass the assessment strategies.
- Well-articulated learning outcomes should be written for secondary grades which will ensure better measurement of students' learning. They should be written starting with verbs that are measurable or that describe an observable action.
- Process oriented learning outcomes should be written for secondary grades which will be useful for the teachers to align their pedagogical approaches to these outcomes to ensure meaningful learning.
- The learning outcomes should spread across all cognitive domains from remember to create to ensure deep and meaningful conceptual learning.

## 6.2 Annexure 2- Alignment of Learning Outcomes with NCERT syllabus – Secondary Stage

### Mathematics - Grade 9

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	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 learner) to arrive at the general laws Rationalization with precise meaning of real numbers of the type and their combination

LO5	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
LO6	State and motivate the Remainder Theorem with examples and analogy to integers.
LO7	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
LO8	Recall of algebraic expressions and identities. Further identities of the type: $(x + y + z)^2 = x^2 + y^2 + z^2 + 2xy + 2yz + 2zx$ , $(x \pm y)^3 = x^3 \pm y^3 \pm 3xy(x \pm y)$ $x^3 + y^3 + z^3 - 3xyz = (x+y+z)(x^2+y^2+z^2)$ and their use in factorization of polynomials. Simple expressions reducible to these polynomials.
LO9	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.
LO10	Prove that a linear equation in two variables has infinitely many solutions, and justify their being written as ordered pairs of real numbers,
LO11	Examples, problems from real life, including problems on Ratio and Proportion and with algebraic and graphical solutions being done simultaneously
LO12	Examples, problems from real life, including problems on Ratio and Proportion and with algebraic and graphical solutions being done simultaneously
LO13	The Cartesian plane, coordinates of a point, names and terms associated with the coordinate plane, notations
LO14	Plotting points in the plane, graph of linear equations as examples;
LO15	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.
LO16	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
LO17	The five postulates of Euclid. Equivalent versions of the fifth postulate. Showing the relationship between axiom and theorem
LO18	Euclid’s definitions
LO19	Properties of each of the geometrical concepts as per syllabus
LO20	Results on corresponding angles, alternate angles, interior angles when a transversal intersects two parallel lines.
LO21	Theorems on Lines and Angles, triangle congruency, angle sum property, exterior angle, mid-point theorem, parallelograms and circles.
LO22	Construction of bisectors of a line segment and angle, $60^\circ$ , $90^\circ$ , $45^\circ$ 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.
LO23	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.

LO24	Surface areas and volumes of cubes, cuboids, spheres (including hemispheres) and right circular cylinders/cones.
LO25	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.
LO26	Mean, median, mode of ungrouped data.
LO27,LO28	Qualitative analysis of data to choose the correct form of presentation for the collected data.
LO29	History, Repeated experiments and observed frequency approach to probability. Focus is on empirical probability. (A large amount of time to be devoted to group and to individual activities to motivate the concept; the experiments to be drawn from real-life situations, and from examples used in the chapter on statistics).
LO30	

### Mathematics- Grade 10

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 $ax^2 + bx + c = 0$ , ( $a \neq 0$ ). Solution of quadratic equations (only real roots) by factorization and by completing the square, i.e., by using quadratic formula. Problems related to day-to-day activities to be incorporated.
LO12	Motivation for studying AP. Derivation of standard results of finding the nth term and sum of first n terms
LO13	
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 $0^\circ$ and $90^\circ$
LO15	Values (with proofs) of the trigonometric ratios of $30^\circ$ , $45^\circ$ and $60^\circ$ . Relationships between the ratios.

LO16	Trigonometric Identities: Proof and applications of the identity $\sin^2 A + \cos^2 A = 1$ . 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 $30^\circ$ , $45^\circ$ , $60^\circ$ .
LO18	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.
LO19	
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 angle.
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	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
LO25	
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 $60^\circ$ , $90^\circ$ and $120^\circ$ only. Plane figures involving triangles, simple quadrilaterals and circle should be taken.)
LO27	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.)
LO28	
LO29	Mean, median and mode of grouped data (bimodal situation to be avoided). Cumulative frequency graph.
LO30	
LO31	Classical definition of probability. Connection with probability as given in Class IX. Simple problems on single events, not using set notation.
LO32	

## Science- Grade 9

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.
LO11	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
LO12	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.
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	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.
LO15	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
LO16	Acceleration, equations of motion by graphical method
LO17	Distance-time and velocity time graphs for uniform and uniformly accelerated motion,

LO18	Relationship among displacement, time, acceleration and velocity Newton's laws of motion
LO19	Elementary idea of conservation of momentum
LO20	Force of gravitation of the earth (gravity), acceleration due to gravity, Free fall
LO21	Archimedes' principle, buoyancy, elementary idea of relative density.
LO22	Work done by a force, energy, power; kinetic and potential energy; law of conservation of energy.
LO23	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 – Grade 10

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 <sup>+</sup> and OH <sup>-</sup> 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	Ethanol and Ethanoic acid (only properties and uses), soaps and detergents.
LO9	Nomenclature of carbon compounds containing functional groups (halogens, alcohol, ketones, aldehydes, alkanes and alkynes), difference between saturated hydrocarbons and unsaturated hydrocarbons.
LO10	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.
LO11	Define 'living' things; Basic concept of nutrition, respiration, transport and excretion in plants and animals.
LO12	Control and coordination in animals: voluntary, involuntary and reflex action, nervous system; chemical coordination: animal hormones.
LO13	Tropic movements in plants; Introduction to plant hormones;
LO14	Reproduction in plants and animals.

LO15	Need for and methods of family planning. Safe sex vs. HIV/ AIDS. Childbearing and women's health.
LO16	Heredity; Origin of life: brief introduction; Basic concepts of evolution.
LO17	Our Environment: Environmental problems, what can we do? Bio degradable, non-biodegradable. Ozone depletion.
LO18	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.
LO19	Magnetic field, Field lines, Field due to a
LO20	Direct current. Alternating current; frequency of AC. Advantage of AC over DC. Domestic electric circuits.
LO21	Electric motor & generator
LO22	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.
LO23	Related concepts centre of curvature, principal axis. Optical centre, focus, focal length. velocity of light; refractive index;
LO24	Functioning of lens in human eye; problems of vision and remedies.
LO25	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 - Grade 9

S.no.	NCERT Syllabus
LO1	<p>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.</p> <p>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).</p>
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- Grade 10

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

### 6.3 Annexure 3- NCERT Syllabus mapping with proposed Learning Outcomes

#### 1. Social Science- Number of learning Outcomes under each area- Grade 9 & 10

Disciplines	No of Learning Outcomes	No of Classroom Hours as per syllabus	No. of Learning Outcomes	No of Classroom Hours as per syllabus
History	05	60	07	60
Geography	06	55	09	55
Economics	04	50	08	50
Political Science	08	50	09	50
<b>Total</b>	<b>23</b>	<b>215</b>	<b>33</b>	<b>215</b>

#### 2. Science- Number of Learning Outcomes under each theme- Grade 9 & 10

Sl. No.	Themes	No of Classroom Hours	No of Learning Outcomes	No of Classroom Hours	No of Learning Outcomes
1.	Materials	50	6	55	9
2.	Food	10	1	50	7
3.	Natural resources	15	3	32	4
4.	The world of living	45	6	23	3
5.	Moving, things, people and ideas	60	9	20	1
	<b>Total</b>	<b>180</b>	<b>25</b>	<b>180</b>	<b>24</b>

### 3. Mathematics- Number of Learning Outcomes under each unit Grade 9 & 10

Sl. No	Units	No of Periods	No of Learning Outcomes	Units	No of Periods	No of Learning Outcomes
1.	Number System	20	5	Real Number System	15	4
2.	Algebra	37	8	Algebra	44	9
3.	Co-ordinate Geometry	9	3	Trigonometry	26	4
4.	Geometry	75	7	Co-ordinate Geometry	15	2
5.	Mensuration	14	2	Geometry	31	6
6.	Statistics and Probability	25	6	Mensuration	24	3
	<b>Total</b>	<b>180</b>	<b>31</b>	Statistics and Probability	25	4
				<b>Total</b>	<b>180</b>	<b>32</b>

## 7. References

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4. NCERT (2006).National Focus Group, *Position Paper on Teaching of Social Sciences*, New Delhi.
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