

## Theme 1: Introduction to Chemistry

Chemistry finds applications in day-to-day life as well as in industries. Chemicals from simple to complex, are used in food, medicines, cosmetics, textile industry, agriculture, cleansing agents, etc. This theme will help children understand applications of Chemistry in their lives.

### Learning Outcomes:

Children will be able to:

- ✓ discuss the importance of Chemistry in daily life and its role in different industries and life processes;
- ✓ list important applications of Chemistry in day to day life;
- ✓ list some industrial applications of Chemistry;
- ✓ discuss the bio-sketches of some great scientists and their works;
- ✓ appreciate the patience, perseverance, sacrifices and ethical conduct of scientists.

### Introduction to Chemistry

Key Concepts / Concerns	Pedagogy/ transactional strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Chemistry – meaning and importance.</li> <li>➤ Development of Chemistry- A historical perspective.</li> <li>➤ Notable chemists/</li> </ul>	<ul style="list-style-type: none"> <li>➤ Discussing with children and explaining the meaning and importance of Chemistry in day to day life.</li> <li>➤ Asking children to make a list of products used daily– pencil, rubber, paper, ink, shampoo, deodorants, perfumes, toothpaste, cosmetics. Discussing how Chemistry plays a role.</li> <li>➤ Discussing the development of Chemistry from the historical perspective with facts -when alchemists attempted to convert cheap metals to gold using philosopher stone, find a chemical that would enable people live longer etc. However, they could not succeed in their efforts to find such miraculous techniques. But they were successful to some extent in developing processes to extract metals and prepare alloys which proved of great use. Refer to the iron pillar near Qutab Minar.</li> <li>➤ Asking children to get photographs</li> </ul>	<ul style="list-style-type: none"> <li>➤ Children's own experiences.</li> <li>➤ Products used in daily life since the morning.</li> <li>➤ Visit to Qutab Minar</li> <li>➤ Visit to a Chemical plant/ industry under supervision.</li> <li>➤ Photographs of scientists.</li> <li>➤ Videos/PPTs.</li> </ul>

## Introduction to Chemistry

Key Concepts / Concerns	Pedagogy/ transactional strategies*	Suggested Learning Resources
<p>scientists and their contributions to Chemistry (at least 3 scientists).</p> <p>➤ Food and Chemistry.</p> <p>➤ Cosmetics and Chemistry.</p> <p>➤ Clothing and Chemistry.</p> <p>➤ Chemicals as Medicines.</p> <p>➤ Chemicals in Industries.</p>	<p>of great chemists such as Mendeleev, Lavoisier, Dalton and discussing their works in class.</p> <p>➤ Providing common examples of food preservatives, food processing. Common food products like salt, sugar, tea, milk, jams etc.</p> <p>➤ Discussing some common examples like the constituents of talcum powder (names only).</p> <p>➤ Discussing the journey from cotton to synthetic fabric such as terylene.</p> <p>➤ Giving examples of simple chemicals such as aspirin, paracetamol in medicines.</p> <p>➤ Giving examples of: cleansing agents (soaps and detergents), stain removals, etc.</p> <p>➤ Organizing a visit to chemical industry (dye, plastic, fertilizer, detergents and drugs.).</p> <p>➤ Advising children to note the number of starting materials used to create products and the final products that are formed.</p>	

**Integration:** Languages, Biology, Geography,



## Theme 2: Elements, Compounds and Mixtures

All materials / objects found around us are either in solid, liquid or gaseous form and occupy space and have mass. In science, the term matter is used for all these materials. Chemically, matter can be classified as element, compound and mixture. In nature, matter occurs mostly in the form of mixture. Importantly, substances are required in their pure form that is done by the separation of the components of a mixture by different techniques. The use of any particular separation technique depends upon the properties of the components of the mixture.

### Learning Outcomes:

Children will be able to:

- ☒ define elements as made up of identical atoms;
- ☒ classify elements as metals and non-metals on the basis of their properties;
- ☒ define compound and mixture and discuss the points of difference between the two;
- ☒ use symbols of elements and molecular formulae of the compounds to represent their names as short hand notations;
- ☒ separate different components of samples of some mixtures;
- ☒ discuss the reasons for opting for a particular technique for separation of components of the mixture.

### Elements, Compounds and Mixtures

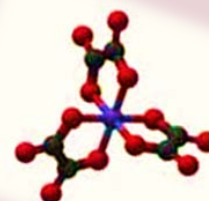
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<p>➤ Element (a substance made up of identical atoms).</p> <p>➤ Use of symbols as short hand notations of writing names of elements.</p> <p>➤ Origin of symbols of elements.</p> <p>➤ Names and symbols of first 20 elements.</p> <p>➤ Molecules of elements contain atoms of the same element (<math>O_2</math>, <math>N_2</math>, <math>H_2</math>).</p> <p>➤ Compound (two or more than two elements combine in fixed definite proportions to form a compound. Original properties of the constituent elements are</p>	<p>➤ Showing samples of iron powder, sulphur powder and zinc granules.</p> <p>➤ Taking examples of certain elements e.g. iron and discussing with children that it is made up of only one type of atoms i.e. iron atoms. Likewise, discussing other examples of elements also.</p> <p>➤ Introducing symbols and emphasising that every element has a symbol. Showing the periodic table and drawing children's attention towards the symbols of elements.</p> <p>➤ Explaining the basis on which symbols of the elements have been given and qualitative meaning of symbols which represent the name, with examples.</p> <p>➤ Using the molecular model kit to show the models of some atoms and molecules (<math>O_2</math>, <math>N_2</math>, <math>H_2</math>).</p> <p>➤ Discussing that the molecules of compounds are made up of atoms of different elements in a fixed proportion. Examples of <math>H_2O</math>, <math>CO_2</math>, <math>NO_2</math>, <math>CaO</math>, <math>ZnCl_2</math>, etc.</p>	<p>➤ Different samples of some metal and non-metals.</p> <p>➤ Literature related to language of Chemistry.</p> <p>➤ Periodic table of elements with names and symbols of elements.</p> <p>➤ Molecular model kit If molecular kit is not available, balls and sticks models can be used. Models of some compounds using the kit.</p>

## Elements, Compounds and Mixtures

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<p>lost and a substance with new properties is formed).</p> <ul style="list-style-type: none"> <li>➤ Molecules of compounds contain atoms of different elements. (<math>\text{H}_2\text{O}</math>, <math>\text{CO}_2</math>, <math>\text{NO}_2</math>, <math>\text{CaO}</math>, <math>\text{ZnCl}_2</math>).</li> <li>➤ Mixture (components of more than one substance combine in any proportion, original properties of the components are retained).</li> <li>➤ Difference between mixtures and compounds (on the basis of proportion of combination of components and their properties).</li> <li>➤ Separation techniques of mixtures into their components:                         <ul style="list-style-type: none"> <li>➤ Sieving</li> <li>➤ Sedimentation</li> <li>➤ Decantation</li> <li>➤ Filtration</li> <li>➤ Evaporation</li> <li>➤ Magnetic Separation</li> <li>➤ Sublimation</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>➤ Taking examples of some mixtures such as solution of sugar, honey, milk and pointing out that the concentration of the components of the mixture can be different.</li> <li>➤ Differentiating between mixtures and compounds by taking examples to emphasise that in compounds, elements are combined in fixed proportion and properties of the compounds are quite different from those of the elements formed. Example of <math>\text{C} + \text{O}_2 \rightarrow \text{CO}_2</math></li> <li>➤ Discussing details of the activity of the formation of <math>\text{FeS}</math> by heating <math>\text{Fe}</math> and <math>\text{S}</math>.</li> <li>➤ Providing opportunities to children to perform simple activities:                         <ul style="list-style-type: none"> <li>➤ Filtration – (sand and water)</li> <li>➤ Sedimentation (link to purification of water)</li> <li>➤ Decantation (Tea brewing)</li> <li>➤ Sublimation (Iodine crystals/ ammonium chloride, Naphthalene balls, Camphor).</li> <li>➤ Evaporation (Salt water)</li> <li>➤ Sieving (Rice powder/stones)</li> <li>➤ Magnetic separation (Iron and sulphur)</li> </ul> </li> <li>➤ Discussing reasons for preferring a particular technique over another.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Some samples of mixtures and compounds.</li> <li>➤ Iron powder, sulphur and iron sulphide to show different properties of iron sulphide. Iron gets attracted towards magnet, sulphur is yellow in colour and floats over water. But iron sulphide has altogether different properties.</li> <li>➤ Separation: filter paper, sieve, bar magnet, iodine, ammonium chloride, salt, tea leaves.</li> </ul>

**Integration:** Geography

**Skills:** Critical thinking, observation, systematic procedural development.



## Theme 3: Matter

This theme focuses on enabling children to understand that matter around exists in different physical forms. i.e. solids, liquids and gases. One form can be converted into another. Matter expands on heating and on cooling, it contracts. Besides the physical changes, matter can also undergo chemical changes on heating.

### Learning Outcomes:

Children will be able to:

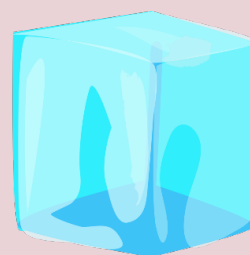
- ✓ discuss the properties of solids, liquids and gases;
- ✓ classify the matter into solid, liquid and gas;
- ✓ discuss the inter-conversion of one state of matter into another;
- ✓ explain the effect of heat on matter showing change of state, expansion and chemical change.

Matter		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<b>States of Matter</b> <ul style="list-style-type: none"> <li>➤ Classification of matter into solid, liquid and gas on the basis of properties (shape, volume). Factors responsible for the existence of matter in different states.</li> <li>➤ Arrangement of atoms/ molecules in solids, liquids and gases: - intermolecular space, cohesive forces).</li> <li>➤ There is space between the particles of matter.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Collecting samples of some solids, liquids and gases and asking children to group them on the basis of their properties. Listing the properties on the basis of which children have done classification. From children's responses, concluding that volume and shape of the samples are the basic properties for their classification.</li> <li>➤ Discussing these properties with reference to solids, liquids and gases in detail. (Egg in a bottle – Egg can be kicked out by blowing air inside the bottle)</li> <li>➤ Demonstrating and then carrying out activities with children of inter conversion of solid (ice), liquid (water) and gas (vapour): children should arrive at the conclusion that solids have definite volume and shape, liquids have definite volume but no definite shape while gases have neither definite volume nor definite shape; use of a knife to cut a solid and a liquid (Apple, Milk).</li> <li>➤ Discussing and explaining reasons for the difference in properties of the three states of matter is intermolecular forces, cohesive forces and Brownian movement among particles constituting matter.</li> <li>➤ Smaller particles occupy spaces</li> </ul>	<ul style="list-style-type: none"> <li>➤ Different samples of solid, liquid, gases.</li> <li>➤ Solid – wood, common salt, pen, pencil.</li> <li>➤ Liquid – water, milk.</li> <li>➤ Gas – balloons.</li> <li>➤ Water and burner.</li> <li>➤ Sugar, pebbles, beaker, burner.</li> <li>➤ Ball and ring apparatus.</li> <li>➤ Test tube, cork, capillary tube, burner.</li> <li>➤ Apple, milk in a container.</li> </ul>

Matter		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<p>➤ Effect of heat on matter (expansion, change of state and chemical change)</p>	<p>between the bigger particles.</p> <p>➤ Carrying out activities such as: -</p> <ul style="list-style-type: none"> <li>➤ Adding sugar to pebbles taken in a plastic beaker.</li> <li>➤ Adding sand to glass balls. Sugar and sand go into the space between the pebbles and glass balls respectively. (Intermolecular spaces are occupied).</li> </ul> <p>➤ Carrying out activities relating to: expansion of matter on heating, evaporation and condensation, freezing and sublimation.</p> <p>➤ For solid- activity using ball and ring apparatus.</p> <p>➤ For liquid- heating water filled in a test tube up to its brim. Mouth of the test tube is fitted with a cork with a capillary at the centre of the cork. On heating, water rises into the capillary.</p> <p>➤ For gas- The mouth of an empty test tube is fitted with a cork having a capillary at its centre. Pouring some coloured water into the capillary. On heating the tube, water rises in the capillary.</p> <p>➤ Change of state- changing of ice to water to steam and reverse can be shown/ recalled.</p> <p>➤ Chemical change – Burning of candle.</p>	

**Integration:** Physics, Languages

**Life skills:** Cooperation and working together, creative thinking, decision making, conclusion drawing.



## Theme 4: Water

The theme focuses on enabling children to understand that water is essential for sustenance of life. It is considered as a universal solvent due to its capacity to dissolve a large number of compounds in it. They will also appreciate that water is becoming scarce day by day and therefore it is important to use it judiciously, conserve it and keep our water resources clean.

### Learning Outcomes:

Children will be able to:

- ☑ define 'solute', 'solvent' and 'solution';
- ☑ infer that solution is a homogeneous mixture of solute and solvent;
- ☑ discuss different examples of solutions;
- ☑ state reasons for pollution of water resources and suggest ways to conserve water.

Water		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Importance of water in everyday life (household purpose, industry, watering plants, etc.).</li> <li>➤ Water resources (well, river, hand pump, lakes, pond, etc.).</li> <li>➤ Capacity to dissolve many salts in it.</li> <li>➤ Definition of Solute, Solvent and Solution.</li> <li>➤ Importance of water for sustenance of life on earth.</li> <li>➤ Reasons for water pollution; its prevention; conservation of water.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Asking children to list out their activities since morning in which water has been used.</li> <li>➤ Giving group work/activity to children to conduct a survey of the water resources in their neighbourhood/ town/ city.</li> <li>➤ Conducting an activity in front of the whole class/in groups to show the dissolution of salts like sodium chloride, sodium carbonate, sodium sulphate etc. e.g. sea water has many salts dissolved in it.</li> <li>➤ Encouraging children to derive definitions from the following activities: <ul style="list-style-type: none"> <li>☛ Preparing a solution of copper sulphate in which copper sulphate is solute and water is solvent.</li> <li>☛ Taking common examples from daily life to identify solute, solvent and solution. Explaining that the component present in larger quantity in the solution is the solvent.</li> </ul> </li> <li>➤ Initiating a class discussion/debate on the importance of water for sustenance of life, its scarcity, pollution, etc.</li> <li>➤ Assigning every child Project work on conducting a water audit at their homes</li> </ul>	<ul style="list-style-type: none"> <li>➤ Sodium chloride, sodium carbonate, sodium sulphate etc.</li> <li>➤ Copper sulphate, water, beaker, glass rod.</li> <li>➤ Survey.</li> <li>➤ Audio-videos/Films.</li> <li>➤ Projects.</li> <li>➤ Visit to Eco park</li> </ul>

Water		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
	<p>by: Preparing a table of the amount of water used (approximate) for different purpose at home; drinking, bathing, washing, toilets, cleaning floors, car washing, etc. per day. After the audit is complete discussing in class and identifying ways to reduce water consumption at home.</p> <p>➤ Showing films/audio-videos on aspects related to water pollution and initiating brainstorming to create awareness amongst children towards conservation of water, rain water harvesting, prevention of water pollution.</p>	

**Integration:** Geography, Languages

**Life skills:** cooperation and working together, concern for others, environmental awareness, problem solving



## Theme 5: Air and Atmosphere

This theme will enable children to know about the atmosphere around us and what air consists of and its importance. Air which is a mixture of different gases such as nitrogen, oxygen, helium, carbon dioxide, argon, moisture. Air is essential for sustenance of life on earth. They will also appreciate the need to keep air clean and that they should take the responsibility of making it free of pollutants.

### Learning Outcomes:

Children will be able to:

- ☒ describe different components of air and their composition;
- ☒ state the importance of air for sustenance of life and for other physical and chemical processes;
- ☒ describe the uses of oxygen and nitrogen;
- ☒ discuss the causes of increase of carbon dioxide into the atmosphere.

Air and Atmosphere		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Air is present everywhere around us.</li> <li>➤ Air - a mixture of gases namely, nitrogen, oxygen, carbon dioxide, water vapour; dust and smoke as pollutants.</li> <li>➤ Percentage composition of air.</li> <li>➤ Uses of the components present (importance of nitrogen to plants to be mentioned).</li> <li>➤ Definition of atmosphere as layer of air around the earth.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Performing an activity in front of all the children: - Turn an empty glass bottle upside down in water and tilt it. Air bubbles come out of bottle and water goes inside it.</li> <li>➤ Demonstrating an experiment to the children to show the presence of oxygen – lighting a candle in a shallow container. Filling some water in it. Putting an inverted glass over the lighted candle. The candle burns for some time and then extinguishes. When O<sub>2</sub> gets consumed, the candle extinguishes. Followed by a discussion on the experiment.</li> <li>➤ Nitrogen- a major part of air is still present above the water level which does not support combustion. N<sub>2</sub> does not support burning of candle. Discussing that nitrogen is an essential element for the plants where it is found in form of Protein, enzymes etc.</li> <li>➤ CO<sub>2</sub>- turning of lime water milky by bubbling air in it shows the presence of CO<sub>2</sub> in air. It is produced due to our day-to-day activities like burning of fuel. Smoke contains many harmful gases.</li> <li>➤ Discussing how air is essential for life and other physical and chemical processes.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Bottle, a tub containing water.</li> <li>➤ Literature related to composition of air and description of uses of the components of air.</li> <li>➤ All equipment for doing simple experiments.</li> </ul>

**Integration:** Biology, Geography

**Life skills:** Sensitivity towards environment

## Theme 1: Matter and its Composition

This theme focuses on informing and making children aware of the different types of matter/objects found in their surroundings such as stones, water, soil, oil, sugar, air. Some of them have common characteristics in terms of states, some are solids, liquids and some are gases. These states vary in their shape, volume and texture. All these are made up of some materials which have mass and occupy space. Children will also realize that the study of their composition is of great importance in their daily lives.

### Learning Outcomes:

Children will be able to:

- ☑ describe matter;
- ☑ discuss the constituents (atoms/molecules) of matter;
- ☑ explain the forces which keep atoms/molecules in matter together.

Matter and its Composition		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Definition of matter.</li> <li>➤ Matter has mass and occupies space - Explanation.</li> <li>➤ Composition of matter – brief introduction</li> </ul>	<ul style="list-style-type: none"> <li>➤ Demonstrating that air in a balloon occupies space. It can be shown that any matter like a solid or liquid has mass.</li> <li>➤ Discussing that matter is made up of tiny particles. They are tightly packed in solids, loosely packed in liquids and have random motion in gases. The intermolecular attraction between the particles keeps them together (reference: solids, liquids and gases).</li> <li>➤ Asking children to prepare charts showing above.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Samples of solids, liquids and examples of gases.</li> <li>➤ Charts.</li> <li>➤ Experiments.</li> </ul>

**Integration:** Physics

**Life skills:** Cooperation and working together, drawing conclusion.



## Theme 2: Physical and Chemical Changes

The theme focuses on informing children and making them aware about the different types of changes physical and chemical that are regularly observed occurring in the environment. Some occur on their own and some are caused due to human activities to meet their requirements. Keeping in view the unending role of these changes, it becomes worthwhile that children learn about them.

### Learning Outcomes:

Children will be able to:

- ☑ differentiate between physical and chemical changes;
- ☑ perform activities related to physical and chemical changes;
- ☑ classify changes such as respiration, preparation of solution of sugar, burning of paper ripening of fruit, spoiling of food materials as physical and chemical changes;
- ☑ discuss that in a chemical change, a new substance with different properties is formed.

### Physical and Chemical Changes

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Physical and chemical changes.</li> <li>➤ Chemical change - formation of a new product with new properties.</li> <li>➤ Differentiating between physical and chemical change.</li> <li>➤ Classification as physical &amp; chemical change.</li> <li>➤ Types of change involved when there is a change of state of matter.</li> <li>➤ Types of change involved when there is a change of energy.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Asking children to classify the following changes as: (i) Desirable and Undesirable (ii) Physical and Chemical change: drying of clothes; melting of ice; evaporation of water as physical changes; rusting of iron; burning of fuels &amp; fireworks; curd from milk; reaction of iron powder with sulphur powder as chemical changes. Discussing about the formation of a new compound in a chemical change.</li> <li>➤ Conducting demonstrations/ experiments and discussing with children to classify changes: respiration, burning, dissolution of sugar, boiling an egg, other daily life examples into physical and chemical changes.</li> <li>➤ Conducting simple experiments with children and asking them to observe and study the interchange of state of water, sublimation of ammonium chloride or iodine.</li> <li>➤ Demonstrating and discussing the processes of: melting, boiling, reversible, irreversible, dissolution of quick lime in water, ammonium chloride in water, burning of match stick, etc.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Experiments to show that changes in state, colour, size, shape, evolution of heat, light, gases and change in taste indicate physical and chemical changes.</li> <li>➤ Assembly of apparatus. <i>(to show sublimation of ammonium chloride.)</i></li> <li>➤ Paper, common salt, chalk, iron, sulphur, ice, copper.</li> </ul>

**Integration:** Physics, Geography, Biology

**Life skills:** Problem solving, critical thinking

### Theme 3: Elements, Compounds and Mixtures (experimental techniques)

This theme will enable children to understand that the earth mainly consists of mixtures containing elements and compounds. These are of different types and many a times the separation of components of mixtures is required for practical utility. They will also know about and discuss the different techniques for separation of the components of a mixture to get the pure components.

#### Learning Outcomes:

Children will be able to:

- ✓ identify elements and compounds on the basis of their properties and the type of atoms present in them;
- ✓ differentiate between mixtures and compounds on the basis of their properties and composition of constituents;
- ✓ provide examples of elements, compounds and mixtures from daily life;
- ✓ discuss different techniques for separation of components of mixtures;
- ✓ justify the reason for the use of a particular technique in separation of a mixture;
- ✓ explain chromatography and its importance.

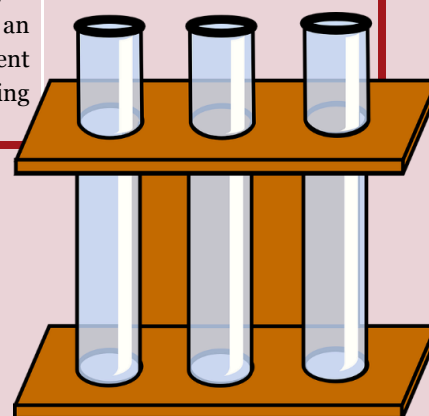
#### Elements, Compounds and Mixtures (experimental techniques)

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Identification of elements, and compounds from representation of their symbols and formulae.</li> <li>➤ Mixtures and compounds: difference between mixtures and compounds on the basis of the chemical composition of constituents.</li> <li>➤ Recall that a mixture is formed when two or more substances are mixed in any proportion such that their particles are in intimate contact with one another without</li> </ul>	<ul style="list-style-type: none"> <li>➤ Revisiting previous concepts Building on children's previous learning.</li> <li>➤ Preparing a list of elements and compounds with their symbols &amp; formulae by the teacher and then asking children to classify them as elements and compounds. On the basis of their knowledge of class VI, they should be able to do this classification. Discussing the basis of classification to strengthen the concept. Classification using the names may also be attempted.</li> <li>➤ Illustrating the meaning of the terms mixtures and compounds based on the proportions of their components using common examples from daily life such as honey, water, milk, rust, etc.</li> <li>➤ Demonstrating through the activity of mixing of iron and sulphur. It is a mixture when mixed in any proportion. Next take iron and sulphur in</li> </ul>	<ul style="list-style-type: none"> <li>➤ List of the symbols and formulae of elements and compounds.</li> <li>➤ List- elements: iron, aluminium, copper and compounds: water, plaster of paris, sodium chloride, calcium oxide, sodium sulphate, sodium hydrogen carbonate.</li> <li>➤ Different Mixtures e.g.: mixture of (i) salt and sugar, (ii) sand and salt, honey, milk, butter, cough syrup, etc.</li> <li>➤ Iron powder, sulphur, burner, tongs.</li> <li>➤ Some homogeneous mixtures- alloys, sugar solution and acetic acid in water, milk.</li> <li>➤ Heterogeneous mixtures: - sand &amp; salt, sand &amp; water, kerosene &amp; water, chalk powder &amp; water etc.</li> </ul>

## Elements, Compounds and Mixtures (experimental techniques)

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<p>undergoing a chemical change.</p> <p>➤ Types of mixtures: -</p> <ul style="list-style-type: none"> <li>Homogeneous &amp; Heterogeneous mixtures</li> <li>On the basis of State: Solid –solid; Solid-liquid; Liquid-liquid.</li> </ul> <p>➤ Separation techniques:</p> <ul style="list-style-type: none"> <li>evaporation,</li> <li>distillation,</li> <li>use of separating funnel,</li> <li>sublimation,</li> <li>fractional distillation.</li> </ul> <p>➤ Examine the principle behind each separation technique.</p> <p>➤ Chromatography as a separation technique; Paper chromatography.</p>	<p>stoichiometric quantities and heat. The compound iron sulphide is formed.</p> <p>➤ Differentiating some mixtures as homogeneous and heterogeneous and explaining the differences between them.</p> <p>➤ Collecting samples of solid-solid, solid-liquid, liquid-liquid types of mixtures from daily life.</p> <p>➤ Demonstrating some separation techniques:</p> <ul style="list-style-type: none"> <li>Evaporation - separate salt from water.</li> <li>Distillation - obtain pure liquid (water) from impure liquid (impure water).</li> <li>Separating funnel - two immiscible liquids (kerosene/oil &amp; water).</li> <li>Sublimation- ammonium chloride.</li> <li>Fractional distillation - two miscible liquids (alcohol &amp; water)</li> </ul> <p>➤ Organising a discussion of the preference and order of use of separation techniques in the separation of two or three component mixtures and explaining the reason for preferring that particular order of technique.</p> <p>➤ Discussing the principle of Paper Chromatography, and characteristics of stationary phase, mobile phase; – demonstration: Performing an experiment for separation of different colours of a marker pen. Discussing the solvent system used.</p>	<p>➤ Apparatus: beaker, china dish, glass rod, tripod stand, wire gauze, R.B. flask, cork, bent glass tube, boiling tube funnel, distillation apparatus, Separating funnel.</p> <p>➤ Chemicals: alcohol, ammonium chloride, kerosene, common salt.</p> <p>➤ A small jar/ petri dish, pigment/ ink, suitable solvent/ water. Whatman no. 1 paper.</p>

**Integration:** Geography



## Theme 4: Atomic Structure

This theme will enable children to understand that every matter is made up of tiny particles known as atoms and molecules. Molecules are also made up of atoms. Hence atoms are the building blocks of matter. The physical and chemical properties of matter are governed by atoms. Therefore, the knowledge of the concepts of atoms of elements, molecules of elements and compounds and radicals of compounds is necessary to understand different processes and principles of Chemistry.

### Learning Outcomes:

Children will be able to:

- ☒ define atom, molecule and radical;
- ☒ discuss the significance of valency of elements and radicals;
- ☒ define valency in terms of number of hydrogen atoms combined or replaced by one atom of the element;
- ☒ apply the definition based on hydrogen atom to find out the valency of other elements and radicals;
- ☒ correlate the valency of the elements with group number of periodic table.

Atomic Structure		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<b>Atoms, Molecules and Radicals</b> <ul style="list-style-type: none"> <li>➤ An atom is the smallest particle of an element.</li> <li>➤ It is not capable of independent existence.</li> <li>➤ The properties of an element depend upon the atoms constituting it.</li> <li>➤ A molecule is the smallest particle of an element or compound, capable of independent existence. It consists of one or more than one atom of the same or different elements.</li> <li>➤ A radical is a single atom of an element or a group of atoms of different elements behaving as single charged unit.</li> <li>➤ Atomicity (no. of atoms in an entity) of elements and compounds – mono atomic, di atomic, tri atomic, polyatomic.</li> <li>➤ Associate the first 20 elements in the periodic table with their names and symbols</li> <li>➤ Valency is the combining capacity of an element or the number of hydrogen atoms with which it combines or replaces.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Discussing about atoms, molecules and radicals and explain the difference between them.</li> <li>➤ Discussing different examples of elements having mono, di, tri and poly atomicity.</li> <li>➤ Preparing a list of some elements and radicals which have valency of 1, 2, 3 and 4.</li> <li>➤ Explaining the meaning of valency and correlating the valency with the group number of the periodic table.</li> <li>➤ Discussing that development of the periodic table is a classification of the element and is based on their physical and chemical properties.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Periodic table.</li> <li>➤ Valency cards made by writing name, symbol and valency of an element. Children can play a game of identifying the card of a specific element and score a point.</li> </ul>

**Integration:** Physics

## Theme 5: Language of Chemistry

Chemistry involves the study of a large number of elements and compounds that also have been learnt earlier with their representation by their short hand notations i.e. symbols and formulae. This theme will enable children to understand that it is not convenient to write the full names of the elements and compounds, and the use of symbols has made the job of the chemists much easier. In addition, they will further realize that Chemistry also involves the occurrence of a large number of chemical reactions that are written in the form of equations known as chemical equations. The writing of chemical equations involves writing of reactants and products as their symbols and formulae. Thus symbols and formulae have also made writing of chemical equations in Chemistry very convenient.

### Learning Outcomes:

Children will be able to:

- ☒ identify the names of reactants and products of different chemical reactions;
- ☒ write a chemical reaction in the form of a chemical word equation;
- ☒ recognize the usefulness of a word equation.

Language of Chemistry		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<p>Chemical reactions</p> <ul style="list-style-type: none"> <li>➤ A chemical reaction may take place when two or more reactants come in contact with one another and transfer of energy takes place.</li> <li>➤ Characteristics of occurrence of a chemical reaction: Change of: <ul style="list-style-type: none"> <li>☛ Colour</li> <li>☛ State</li> <li>☛ Smell</li> <li>☛ Evolution of gas</li> <li>☛ Precipitate formed</li> <li>☛ Heat evolved / released</li> </ul> </li> <li>➤ Chemical Equations: <ul style="list-style-type: none"> <li>☛ Writing word equations for chemical reactions and emphasize on the observational skills and the names of products formed</li> <li>☛ Some examples of word equations for practice.</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>➤ Demonstration by teacher: Adding dilute HCl to solid sodium carbonate taken in a test tube. A reaction takes place with the evolution of gas.</li> <li>➤ Demonstration by teacher of these changes through activities: <ul style="list-style-type: none"> <li>☛ Colour: KI + Lead acetate reaction. Yellow colour formed. Precipitate is also formed.</li> <li>☛ Heat <math>\text{NH}_4\text{Cl}</math>. <math>\text{NH}_3</math> gas is evolved.</li> <li>☛ <math>\text{HCl} + \text{NaOH}</math>; heat is evolved.</li> </ul> </li> <li>➤ Guiding children to identify the reactants and products of the reaction, put an arrow in between the reactants and products with the arrow pointing towards the products side.</li> <li>➤ Involving each child to write word equations of some simple reactions.</li> </ul>	<ul style="list-style-type: none"> <li>➤ HCl, solid <math>\text{Na}_2\text{CO}_3</math>,</li> <li>➤ KI, Lead acetate, <math>\text{NH}_4\text{Cl}</math>, NaOH, Dilute HCl.</li> <li>➤ Test tube, burner.</li> </ul>

**Integration:** Physics

## Theme 6: Metals and Non-Metals

In day-to-day life many elements are commonly found such as iron, aluminium, zinc, lead, chlorine, carbon, sulphur etc. and their compounds. The elements have been classified in two classes, namely metals and non-metals. In this theme children will learn the classification of elements as metals and non-metals on the basis of their properties.

### Learning Outcomes:

Children will be able to:

- ☑ differentiate between metals and non-metals on the basis of their physical properties such as lustre, conduction of electricity and heat, malleability, ductility, sonority, melting point, boiling point, density, strength;
- ☑ describe common uses of some of the metals and non-metals;
- ☑ describe the cause of corrosion of iron and other metals;
- ☑ list different ways of preventing corrosion of metallic articles used in daily life;
- ☑ list some properties and uses of metalloids.

Metals and Non-Metals		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<p><b>Metals, non-metals</b></p> <ul style="list-style-type: none"> <li>➤ Properties</li> <li>➤ Distinguish between metals and non-metals with the general properties (lustre, conduction of electricity, heat, malleability, ductility, sonority, melting point, boiling point, density, strength.)</li> <li>➤ Classification of elements as metals &amp; non-metals.</li> <li>➤ Corrosion of iron (rusting); ways to prevent rusting (oiling, painting, chrome plating, galvanization, tinning) (avoiding contact with air and water vapour).</li> <li>➤ Uses of certain metals (iron, gold, copper, aluminium, zinc, lead, magnesium).</li> <li>➤ Metalloids: elements that show the properties of both metals and non-metals – e.g. silicon, germanium,</li> </ul>	<ul style="list-style-type: none"> <li>➤ Asking children to name some metals that they know of/have seen being used in daily life.</li> <li>➤ Examining the properties of metals and non-metals through activity: <ul style="list-style-type: none"> <li>☛ Taking a small iron nail, a coal piece, aluminium wire, and pencil lead. Beating each separately with a hammer and recording the observations. (malleability).</li> <li>☛ Making separate electric circuits using a metal and a non-metal (Al wire, coal piece) - (conductivity).</li> <li>☛ Dropping the above samples one by one. Noting the sound produced –(sonority).</li> </ul> </li> <li>➤ Classifying elements on the basis of their properties.</li> <li>➤ Demonstrating that moisture and oxygen in air are responsible for the corrosion; reaction of corrosion in words:</li> </ul> <p><b>Activity:</b> Take three test tubes. Iron nails are placed in them. In 1<sup>st</sup> iron nails are dipped in water, in 2<sup>nd</sup>, put a piece of quick lime so as to make the tube moisture free, in 3<sup>rd</sup> tube, add water and a few drops of dilute acid. Keep the test tubes aside for a few days and ask</p>	<ul style="list-style-type: none"> <li>➤ Collection of some metals such as copper, iron nail, a coal piece, aluminium wire, and pencil lead.</li> <li>➤ Collection of rusted articles made of iron.</li> <li>➤ Article made of copper.</li> <li>➤ Water pipes used in houses to show that they are galvanized to prevent rusting.</li> <li>➤ Iron pieces, grease, paint.</li> </ul>

## Metals and Non-Metals

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
tungsten, antimony); uses.	<p>children to observe and then draw conclusions.</p> <p>The basic nature of rust can be tested using litmus paper.</p> <ul style="list-style-type: none"> <li>➤ In case of copper, green deposit on the surface of articles made of copper can be observed.</li> <li>➤ Discussing examples such as the iron pillar at Qutab Minar which has not rusted for the last 1600 years. It highlights the achievements of ancient India in technology.</li> <li>➤ Discussing that rusting of iron can be prevented if the metal does not come in direct contact with air and water. This can be shown experimentally by applying grease/ coating of paint on the surface of an iron object.</li> <li>➤ Iron pipes used in homes to carry water are galvanized to prevent rusting. Refer to cooler in homes.</li> <li>➤ Asking children to identify some metals used in daily life.</li> <li>➤ Discussing some properties of silicon, germanium, tungsten and antimony to justify them as metalloids.</li> </ul>	

**Integration:** Physics, Geography



## Theme 7: Air and Atmosphere

Air is a mixture of some gaseous components which have wide use in daily life. For example, nitrogen is an important constituent of fertilizers and oxygen is essential for our body for sustenance of life. These gases have important physical and chemical properties and uses.

### Learning Outcomes:

Children will be able to:

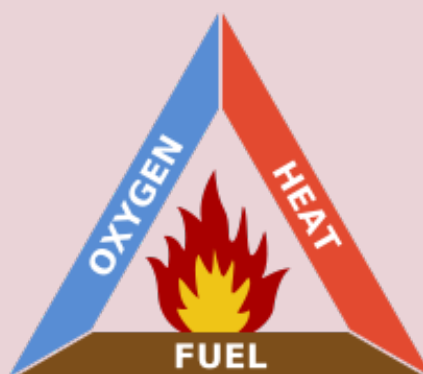
- ✓ review that air is a mixture of gases;
- ✓ recall the components of air;
- ✓ discuss the use of oxygen and nitrogen in different life processes;
- ✓ explain from an activity that mass change takes place on combustion;
- ✓ express the reaction in the form of word equation;
- ✓ describe the preparation of oxygen in the laboratory using potassium chlorate/ hydrogen peroxide and manganese dioxide as a catalyst;
- ✓ understand the concept of catalyst.

Air and Atmosphere		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Air a mixture of gases.</li> <li>➤ Composition of air and uses of its components.</li> <li>➤ Oxygen is needed for combustion.</li> <li>➤ Mass change during burning (burning of magnesium and candle).</li> <li>➤ Word equations for reactions of metals and non-metals (S, C, P, Na, K, Ca, Mg) with O.</li> <li>➤ Products formed in acid rain; effects of acid rain.</li> <li>➤ Air quality.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Revisiting earlier concepts.</li> <li>➤ Building on children's previous learning.</li> <li>➤ Discussing that concentration of components of air is not fixed at all places. Hence it is a mixture.</li> <li>➤ Making a Pie chart presentation to show the composition of air and discussing the same with children.</li> <li>➤ Preparing a list of the uses of oxygen, nitrogen and carbon dioxide.</li> <li>➤ Activity: placing a candle in a plate of water. Candle goes off when oxygen is used up. (Recall demonstration in class VI).</li> <li>➤ Demonstration: Weighed quantity of magnesium is burnt in air and magnesium dioxide so formed is weighed. There is an increase in mass due to gain of oxygen from the atmosphere in the formation of MgO.</li> <li>➤ Guiding the children to write word equations of the reactions.</li> <li>➤ Identifying that in acid rain, the acidic oxides, namely SO<sub>2</sub>, CO<sub>2</sub>, nitrogen oxides dissolve in rain water. The acids so formed damage the heritage</li> </ul>	<ul style="list-style-type: none"> <li>➤ Pie chart.</li> <li>➤ Candle in plate of water.</li> <li>➤ Magnesium ribbon.</li> <li>➤ Burner, tongs, weighing scale.</li> <li>➤ Apparatus to prepare O<sub>2</sub> gas.</li> <li>➤ Potassium chlorate, manganese dioxide and hydrogen peroxide.</li> <li>➤ Project.</li> </ul>

## Air and Atmosphere

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Study the properties of oxygen: (physical properties to include colour, odour).</li> <li>➤ Distinguish between:                             <ul style="list-style-type: none"> <li>☛ Respiration and combustion,</li> <li>☛ Combustion and rusting.</li> </ul> </li> </ul>	<p>buildings like the Taj Mahal. The stone of Taj Mahal is <math>\text{CaCO}_3</math> which reacts with acids present in rain.</p> <ul style="list-style-type: none"> <li>➤ Preparing a report in groups on the effects of acid rain on Taj Mahal and the efforts of the Government. Waste gases from factories, emission from vehicles contributing to the change in the composition of air and damaging environment.</li> <li>➤ Organising children's activity – assigning in groups on a Project on the consequences of acid rain on bridges, cars, machines, coral reef, aquatic organisms, agriculture and presenting the findings in class.</li> <li>➤ Demonstrating reactions of combustion of wood and rusting of spade.</li> </ul>	

**Integration:** Physics, Geography, Biology, Languages



## Theme 1: Matter

In earlier classes, Matter was introduced and discussed as composed of atoms/molecules and that it is found in the forms of solids, liquids and gases. In this class the aim of the theme is to enable children to understand that these states are compared on the basis of inter particle state and inter particle collision. The Kinetic theory of matter will be introduced to explain the change of state. They will understand that in a physical and chemical change, the total mass before and after the change remains the same which is known as the law of conservation of mass. Explanation of this theory and law would help them in understanding other behaviour of matter.

### Learning Outcomes:

Children will be able to:

- ☑ describe the main postulates of the kinetic theory of matter;
- ☑ explain the reason of change of one state of the matter to another and vice-versa on the basis of inter particle space and inter particle attraction and collision;
- ☑ define and explain the law of conservation of mass using an example.

Matter		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Main postulates of kinetic molecular theory of matter.</li> <li>➤ Explanation of change of state of the matter on the basis of inter particle space and inter particle attraction and collision.</li> <li>➤ Law of conservation of mass. (statement and explanation with examples).</li> </ul>	<ul style="list-style-type: none"> <li>➤ Describing and discussing the main postulates of kinetic theory of matter.</li> <li>➤ Discussing inter particle space and inter particle attraction and collision. (Inter particle space and inter particle attraction varies from one state of matter to another. Hence the conditions of change of state of a matter are different from the other.)</li> <li>➤ Stating the law of conservation of mass. Activity to show that there is no change in total mass when a physical and chemical change takes place. (If the reaction involves combustion in presence of air, the mass of O<sub>2</sub>/N<sub>2</sub> is also to be considered) Total mass of reactants including the mass of atmospheric gases if any, will be equal to the mass of the products formed.</li> <li>☞ Taking the example of reaction of barium chloride with sodium sulphate.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Film on the collision of particles and the exchange of energy.</li> <li>➤ Chemicals and glass wares, barium chloride, sodium sulphate, weighing balance, test tubes, distilled water, filter paper, funnel and beaker.</li> </ul>

**Integration:** Physics

## Theme 2: Physical and Chemical Changes

This theme will enable children to understand that there are different types of changes in our surroundings which are slow/fast, reversible/irreversible, periodic/non-periodic and physical/chemical. In physical changes, no new substance is formed while in chemical change, a new substance with properties different from the element forming that substance is formed. Learning of these changes will also help in developing different scientific skills amongst them.

### Learning Outcomes:

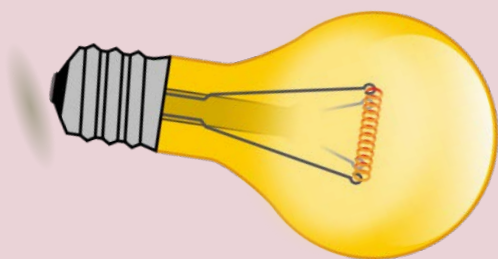
Children will be able to:

- ☒ illustrate different changes occurring in nature with examples learned in previous classes;
- ☒ perform some activities to show some well-known changes;
- ☒ differentiate between physical and chemical changes and classify the changes.

### Physical and Chemical Changes

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"><li>➤ Revise and review the topic on Physical and Chemical Changes taught in earlier classes.</li><li>➤ Physical and Chemical changes – Classification with examples.</li></ul>	<ul style="list-style-type: none"><li>➤ Providing opportunities to children to recapitulate their previous knowledge during group discussion. Bridging any gaps in their understanding.</li><li>➤ Building on children's previous learning.</li><li>➤ Providing a list of changes like- inflated balloon will burst when brought near a lighted bulb.</li></ul>	<ul style="list-style-type: none"><li>➤ List of physical and chemical changes:<ul style="list-style-type: none"><li>➤ Formation of curd from milk</li><li>➤ Curdling of milk</li><li>➤ Rotting of eggs</li><li>➤ Rusting of iron</li><li>➤ Melting of ice</li><li>➤ Formation of vapours</li><li>➤ Sublimation of camphor</li></ul></li></ul>

**Integration:** Geography, Biology, Languages



### Theme 3: Elements, Compounds and Mixtures

In previous classes, children were informed about the classification of matter into – elements, compounds and mixtures. Mixture is an important class of matter as most of the matter in nature is found in the form of mixture. In this class children will be enabled to understand that there are various techniques by which components of mixture can be separated.

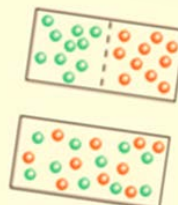
#### Learning Outcomes:

Children will be able to:

- ☑ recall previous knowledge related to elements, compounds and mixtures;
- ☑ classify substances into elements, compounds and mixtures on the basis of their properties;
- ☑ perform activities to separate components of a mixture;
- ☑ explain the principle involved in using a particular technique in separating a mixture.

#### Elements, Compounds and Mixtures

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"><li>➤ Revision of Elements, Compounds and Mixtures taught in earlier classes.</li><li>➤ Elements, compounds and mixture – a brief explanation.</li><li>➤ Separation of the components of a mixture.</li><li>➤ Emphasis on the principle of separation.</li></ul>	<ul style="list-style-type: none"><li>➤ Revisiting earlier concepts.</li><li>➤ Building on children's previous learning.</li><li>➤ Organising the discussion of the topic concerned by question- answer method.</li><li>➤ Give feedback to the children about the gaps found in their learning.</li><li>➤ Activities performed by children to separate the components of 2-3 mixtures involving different techniques. E.g.-<ul style="list-style-type: none"><li>☛ <math>\text{CaCO}_3</math> and <math>\text{NaCl}</math></li><li>☛ kerosene and water</li></ul></li><li>➤ Discussing the principle of the techniques involved in separation of different mixtures.</li></ul>	<ul style="list-style-type: none"><li>➤ Collection of samples of some elements, compounds and mixtures.</li></ul>



## Theme 4: Atomic Structure

This theme focuses on developing children's understanding about the atom as the building block of all types of matter. Therefore, in science, it becomes important to know about the atom and its structure.

In fact, everything on this earth is made up of atoms. It is the atom of an element that takes part in chemical reactions.

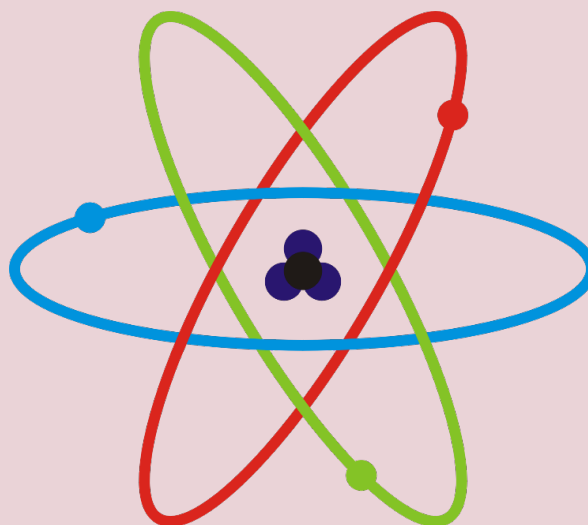
### Learning Outcomes:

Children will be able to:

- ✓ describe that an atom consists of electrons, protons and neutrons;
- ✓ define atomic number and mass number;
- ✓ discuss valency of elements and radicals with respect to the number of hydrogen atoms combining with one atom of the element.

Atomic Structure		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"><li>➤ Fundamental subatomic particles present in an atom: electrons, protons, neutrons.</li><li>➤ Nucleus and extra nuclear parts.</li><li>➤ Atomic number and mass number.</li></ul>	<ul style="list-style-type: none"><li>➤ Discussing historical perspective of discovery of electrons, protons and neutrons.</li><li>➤ Identifying that a nucleus consists of protons and neutrons. Electrons are present in its extra nuclear part.</li><li>➤ Describing that atomic number (Z) is the number of protons in an atom. It is also equal to the number of electrons in an atom.</li><li>➤ Mass number: it is the sum of the number of protons and neutrons in an atom.</li></ul>	<ul style="list-style-type: none"><li>➤ Books of science /Chemistry</li><li>➤ Charts/Models showing the structure of atom</li></ul>

**Integration:** Physics.







## Theme 5: Language of Chemistry

In previous classes, discussions about the symbols of elements and the formulae of compounds help in expressing their long names as short-hand notations which forms the language of Chemistry. In this class children will develop the ability to derive the Formulae of compounds if symbols of elements/radicals forming the compound and their valencies are known. They will also be able to write chemical equations if the reactants and products and their symbols/ formulae are known to them.

### Learning Outcomes:

Children will be able to:

-  recall the symbols of different elements;
-  derive the formulae of compounds on the basis of valencies of elements and radicals;
-  write chemical equation of a reaction;
-  balance chemical equations by applying the law of conservation of mass.

Language of Chemistry		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Symbols of elements.</li> <li>➤ Formulae of compounds.</li> <li>➤ Chemical equations (from word equations).</li> <li>➤ Law of conservation of mass.</li> <li>➤ Balancing simple equations</li> <li>➤ Relate the law to the balancing of simple equations.</li> <li>➤ Information gathered from a chemical equation.</li> <li>➤ Limitations of a chemical equation: Catalyst, conditions for the reaction, state of the reactants and products, nature of the chemical reaction are not gathered from the equation.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Revisiting earlier concepts.</li> <li>➤ Building on children's previous learning.</li> <li>➤ Organising competitions to recapitulate the symbols of elements in the class by using valency cards. (symbols and valency of first twenty elements).</li> <li>➤ Encouraging children to derive Formulae of compounds from valency and symbols/ formulae of elements/ radicals under the guidance of teacher.</li> <li>➤ Writing word equations followed by writing the chemical equation.</li> <li>➤ Explaining the law of conservation of mass and its importance in balancing a chemical equation.</li> <li>➤ Giving practice in balancing simple equations.</li> <li>➤ Specifying the state of the reactants and products as (s), (l) and (g) for solid, liquid and gas respectively by writing them after their symbols/ formulae.</li> <li>➤ Using an equation to discuss with children the information provided and the limitations by/of a chemical equation.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Valency cards.</li> <li>➤ Charts depicting the important and simple chemical equations in which the state of reactants and products is also shown.</li> </ul>

**Integration:** Mathematics, Physics

## Theme 6: Chemical Reactions

This theme will enable children to understand that several oxides, carbonates and hydrates on heating are converted to other compounds. Oxides of metals and non-metals have basic and acidic character respectively. They will also realize and appreciate that there are different types of reactions such as combinations, decomposition, displacement, double displacement, exothermic and endothermic reactions.

### Learning Outcomes:

Children will be able to:

- ✓ describe different types of chemical reactions with examples;
- ✓ identify the type of chemical reaction;
- ✓ identify different oxides as basic, acidic, amphoteric and neutral;
- ✓ explain the effect of heat on oxides of some metals.

Chemical Reactions		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Types of reactions:                             <ul style="list-style-type: none"> <li>☛ Combination</li> <li>☛ Decomposition</li> <li>☛ Displacement</li> <li>☛ Double displacement.</li> </ul> </li> <li>➤ Reactivity series:                             <ul style="list-style-type: none"> <li>☛ In reactivity series metals are arranged in order of their reactivity.</li> <li>☛ The metal that displaces the metal ion from the solution is more reactive.</li> </ul> </li> <li>➤ Predict the reactivity of metals.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Explaining that chemical reactions involve breaking of existing bonds and formation of new bonds with absorption or release of energy normally in the form of heat or light. Explaining with examples using chemical equations.</li> <li>➤ Giving examples of reactions from daily life - burning of fuel.</li> <li>➤ Showing burning of a magnesium ribbon.</li> <li>➤ Explaining the different types of reactions with examples and activities:                             <ul style="list-style-type: none"> <li>☛ <b>Synthesis</b>  <math>\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2</math>  <math>\text{Ca(OH)}_2 + \text{CO}_2 \rightarrow \text{CaCO}_3 + \text{H}_2\text{O}</math>  <math>\text{C} + \text{O}_2 \rightarrow \text{CO}_2</math> </li> <li>☛ <b>Decomposition</b>                                  Decomposition of <math>\text{CaCO}_3</math>, <math>\text{PbO}</math>.                             </li> <li>☛ <b>Displacement</b>                                  Displacement of Cu from <math>\text{CuSO}_4</math> by Zn.                             </li> <li>☛ <b>Double displacement</b>                                  Both the ions are displaced - <math>\text{NaCl} + \text{AgNO}_3</math> </li> </ul> </li> <li>➤ Asking children to arrange metals - Cu, Ag, Al, Mg, Fe in decreasing order of their reactivity by consulting the table of reactivity series.</li> <li>➤ Conducting experiments for different metals with metal salt solution.</li> <li>➤ Demonstrating through activity:</li> </ul>	<ul style="list-style-type: none"> <li>➤ Magnesium wire, match box.</li> <li>➤ Limestone, tongs, test tube, burner.</li> <li>➤ <math>\text{CuO}</math>, <math>\text{ZnO}</math>, <math>\text{Al}_2\text{O}_3</math>, litmus paper.</li> </ul>

## Chemical Reactions

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Endothermic and exothermic processes/ reactions.</li> <li>➤ Neutralization reaction.</li> <li>➤ Decomposition reactions to form Oxides.</li> <li>➤ Classification of oxides:                         <ul style="list-style-type: none"> <li>➤ Acidic</li> <li>➤ Basic</li> <li>➤ Amphoteric</li> <li>➤ Neutral.</li> </ul> </li> </ul> <p>Metal oxides are basic; non-metal oxides are acidic in nature.</p> <p>Acidic oxides react with base and basic oxides react with acids. some oxides such as ZnO, PbO react both with acids and bases. These are amphoteric oxides.</p>	<ul style="list-style-type: none"> <li>➤ neutralization of an acid with a base as an exothermic reaction.</li> <li>➤ dissolution of <math>\text{NH}_4\text{Cl}</math> in water is an endothermic process.</li> <li>➤ Heating metal carbonates, nitrates, sulphates yield oxides and carbon dioxides.</li> </ul> <p>Oxides are also formed by heating element in presence of air.</p> <ul style="list-style-type: none"> <li>➤ Activity-1 Heating limestone strongly over the flame - CaO is formed</li> <li>➤ Activity-2: Heating Lead carbonate strongly - PbO is formed.</li> </ul> <li>➤ Dissolving the oxide in water and testing the acidic, basic and neutral oxide with litmus paper.</li>	

**Life skills:** Critical thinking, observation, interpretation, analysis



## Theme 7: Hydrogen

This theme focuses on enabling children to know about one gas- Hydrogen and that it is an important constituent of several compounds. It is found in acids and organic compounds. It acts as a fuel which makes its study useful.

### Learning Outcomes:

Children will be able to:

- ✓ describe the preparation of hydrogen from electrolysis of water;
- ✓ prepare hydrogen in the lab. using zinc and acid;
- ✓ describe properties and uses of hydrogen;
- ✓ correlate concepts of oxidation and reduction with addition and removal of oxygen or removal and addition of hydrogen.

Hydrogen		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Preparation of hydrogen, from water – electrolysis (Introduction to terms electrode, electrolyte, electrolysis - detailed process not required).</li> <li>➤ Preparation of hydrogen in the laboratory.</li> <li>➤ Preference of zinc as the metal to be used (with reasons).</li> <li>➤ Choice of dilute acids (other than dil. nitric acid).</li> <li>➤ Bosch's process.</li> <li>➤ Properties and uses of hydrogen.</li> <li>➤ Oxidation and Reduction.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Preparing hydrogen by the electrolysis of acidified water.</li> <li>➤ Demonstrating activity to prepare hydrogen by the reaction of Zinc with acid. (It is collected by the downward displacement of water as it is lighter than air)</li> <li>➤ Discussing properties and uses of hydrogen.</li> <li>➤ Correlating the concept of oxidation and reduction with addition and removal of oxygen or removal and addition of hydrogen.</li> <li>➤ Explaining the concept by using the example of one student gaining oxygen and the other losing oxygen, thereby getting oxidised and reduced respectively.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Experimental assembly set up in the lab.</li> <li>➤ Charts on preparation of Hydrogen.</li> </ul>

**Integration:** Physics

## Theme 8: Water

Water is the one of the most important resources and is a universal solvent. Children will know and understand that water is important for all living beings (animals, human beings, plants and trees), comes from different sources and has many uses. There are different sources of water such as sea, well, river, lake, pond, rain. We use it daily for washing, bathing, drinking and in industries. Water helps in controlling the temperature of the atmosphere.

### Learning Outcomes:

Children will be able to:

- ✓ describe that water dissolves many substances and it is a universal solvent;
- ✓ identify a solution, suspension and colloid on the basis of properties;
- ✓ state the differences between saturated, unsaturated and supersaturated solutions;
- ✓ describe water of crystallization;
- ✓ write equations of metals with cold water and steam;
- ✓ describe hard and soft water;
- ✓ discuss the different methods of softening of water.

Water		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Dissolution of salts in water – meaning and explanation.</li> <li>➤ Universal solvent – meaning.</li> <li>➤ Solutions, suspensions, colloids.</li> <li>➤ Differentiate unsaturated/saturated and supersaturated solutions.</li> <li>➤ Suspensions and colloids.</li> <li>➤ Water of crystallisation.</li> <li>➤ Hydrated and Anhydrous substances, hygroscopic.</li> <li>➤ Reactivity of metals with cold water, hot water and steam (with products formed).</li> <li>➤ Hard and soft water and methods of softening of hard water.</li> <li>➤ Disadvantage of using hard water.</li> <li>➤ Removing hardness of water by boiling or by treating with washing soda.</li> </ul>	<ul style="list-style-type: none"> <li>➤ Revisiting earlier concepts.</li> <li>➤ Building on children's previous learning.</li> <li>➤ Recognising dissolving capacity of water by conducting experiments on dissolving a number of salts in water.</li> <li>➤ Differentiating between suspension and colloid on the basis of the size of solute particles.</li> <li>➤ Asking children to collect samples of colloids and suspensions under guidance and supervision.</li> <li>➤ Differentiating between saturated, unsaturated and supersaturated solutions on the basis of the quantity of the solute dissolved.</li> <li>➤ Showing children that by heating blue crystals of hydrated copper sulphate, when it turns white due to the loss of water of crystallisation.</li> <li>➤ Showing reaction of metals (e.g. iron, calcium) with cold water and steam.</li> <li>➤ Taking example of <math>\text{CaCl}_2</math> for absorbing water from salts.</li> <li>➤ Discussing the presence of silica gel in bottles to absorb moisture.</li> <li>➤ Determining the reactivity of Na, Mg, <math>\text{MgO}</math>, <math>\text{CaO}</math> etc. with water to show different chemical reactivity.</li> <li>➤ Differentiating between the ability to form lather by hard and soft water to be shown by an activity.</li> </ul>	<ul style="list-style-type: none"> <li>➤ <math>\text{NaCl}</math>, <math>\text{KCl}</math>, <math>\text{Na}_2\text{CO}_3</math> etc.</li> <li>Sugar, water, broken glass rod, burner.</li> <li>➤ Collection of samples of solutions, suspensions, colloids.</li> <li>➤ Copper sulphate crystals.</li> <li>➤ Soap solution, clay in water</li> <li>➤ <math>\text{CaCl}_2</math>.</li> <li>➤ Silica gel pouch in water bottles.</li> <li>➤ Sodium metal, magnesium ribbon, <math>\text{MgO}</math>, <math>\text{CaO}</math>.</li> <li>➤ Washing soda.</li> </ul>

## Theme 9: Carbon and its Compounds

In this theme children will learn the importance of carbon and some of its compounds. It is a constituent of all plants and animals. In fact, a large number of compounds are made up of carbon. It is a very versatile element.

Products such as paper, wooden furniture, soaps, food items are made up of carbon as one of their elements and used extensively in daily life activities. The fuel that is used in cars and trucks is also made of carbon.

### Learning Outcomes:

Children will be able to:

- ☒ explain the term allotropy;
- ☒ describe different Allotropes of Carbon;
- ☒ state the properties of Graphite and Diamond;
- ☒ prepare carbon dioxide in a laboratory;
- ☒ describe the uses of carbon dioxide;
- ☒ demonstrate different reactions of carbon dioxide with lime water and litmus solutions.

### Carbon and its Compounds

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> <li>➤ Allotropes of Carbon - definition and explanation.</li> <li>➤ Crystalline and amorphous nature of allotropes of carbon.</li> <li>➤ Uses of diamond, graphite, coke, coal, soot.</li> <li>➤ Laboratory preparation, properties and uses of carbon dioxide</li> <li>➤ Physical properties of Carbon dioxide.</li> <li>➤ Chemical properties of</li> </ul>	<ul style="list-style-type: none"> <li>➤ Defining allotropes and explaining it with different examples, -diamond, graphite, coal, etc.</li> <li>➤ Emphasising on different physical properties but same chemical properties of allotropes.</li> <li>➤ Explaining that the properties such as electric and thermal conductivity of the two allotropes are different.</li> <li>➤ Emphasising that the difference in physical properties is due to their different structures. Showing the models of structures and discussing the differences.</li> <li>➤ Making models using clay dough / other molecular models.</li> <li>➤ Discussing the classification of crystalline and amorphous nature of carbon.</li> <li>➤ Defining Allotropes on the basis of their Crystalline and amorphous nature.</li> <li>➤ Making a list of the uses of diamond, graphite, coke, coal, soot from the literature and internet.</li> <li>➤ Demonstrating the preparation of CO<sub>2</sub> from marble/ Na<sub>2</sub>CO<sub>3</sub> and dil. HCl and showing its collection by upward</li> </ul>	<ul style="list-style-type: none"> <li>➤ Models of structures of Diamond and Graphite.</li> <li>➤ Sample of Graphite as an electrode.</li> <li>➤ Woulff bottle/ R.B. flask, delivery tube, thistle funnel, jar. Dil. HCl, marble pieces/ Na<sub>2</sub>CO<sub>3</sub></li> </ul>

## Carbon and its Compounds

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<p>Carbon Dioxide.</p> <ul style="list-style-type: none"> <li>➤ Acidic nature.</li> <li>➤ Reaction with lime water.</li> <li>➤ Properties and uses of Carbon monoxide.</li> <li>➤ Emphasis on use as reducing agent in the extraction of iron.</li> <li>➤ Emphasize the harmful properties of Carbon monoxide when inhaled - Asphyxia.</li> </ul>	<p>displacement of air.</p> <ul style="list-style-type: none"> <li>➤ Showing physical properties of <math>\text{CO}_2</math> with its sample along with its fire extinguishing properties.</li> <li>➤ <math>\text{CO}_2</math> shows many important chemical reactions such as:                             <ul style="list-style-type: none"> <li>➤ It reacting with basic oxides such as <math>\text{Na}_2\text{O}</math>, <math>\text{MgO}</math> to form metal carbonates.</li> <li>➤ Action on lime water: - showing that it turns lime water milky and on passing excess <math>\text{CO}_2</math>, the milkiness disappears.</li> </ul> </li> <li>➤ Explaining Fuel, if not burnt in a good supply of oxygen may lead to the formation of <math>\text{CO}</math>. (<i>traditional cooking methods in villages using cow dung or wood</i>).</li> <li>➤ Using it in industries as a reducing agent- in metallurgy of iron.</li> <li>➤ Explaining why we should not stand behind a running engine of a vehicle.</li> <li>➤ Discussing Government's efforts to spread the use of LPG even to remote areas of the country.</li> </ul>	

**Integration:** Geography, Biology

