

Chemistry

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"> ▶ Chemistry – meaning and importance. ▶ Development of Chemistry- A historical perspective. ▶ Notable chemists/ 	<ul style="list-style-type: none"> ▶ Discussing with children and explaining the meaning and importance of Chemistry in day to day life. ▶ 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. ▶ 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. ▶ Asking children to get photographs 	<ul style="list-style-type: none"> ▶ Children’s own experiences. ▶ Products used in daily life since the morning. ▶ Visit to Qutab Minar ▶ Visit to a Chemical plant/ industry under supervision. ▶ Photographs of scientists. ▶ Videos/PPTs.

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

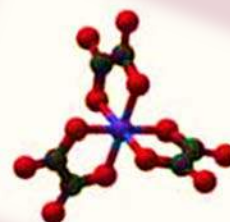
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> ▶ Element (a substance made up of identical atoms). ▶ Use of symbols as short hand notations of writing names of elements. ▶ Origin of symbols of elements. ▶ Names and symbols of first 20 elements. ▶ Molecules of elements contain atoms of the same element (O_2, N_2, H_2). ▶ Compound (two or more than two elements combine in fixed definite proportions to form a compound. Original properties of the constituent elements are 	<ul style="list-style-type: none"> ▶ Showing samples of iron powder, sulphur powder and zinc granules. ▶ 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. ▶ Introducing symbols and emphasising that every element has a symbol. Showing the periodic table and drawing children's attention towards the symbols of elements. ▶ Explaining the basis on which symbols of the elements have been given and qualitative meaning of symbols which represent the name, with examples. ▶ Using the molecular model kit to show the models of some atoms and molecules (O_2, N_2, H_2). ▶ Discussing that the molecules of compounds are made up of atoms of different elements in a fixed proportion. Examples of H_2O, CO_2, NO_2, CaO, $ZnCl_2$, etc. 	<ul style="list-style-type: none"> ▶ Different samples of some metal and non-metals. ▶ Literature related to language of Chemistry. ▶ Periodic table of elements with names and symbols of elements. ▶ Molecular model kit If molecular kit is not available, balls and sticks models can be used. Models of some compounds using the kit.

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"> ☛ Molecules of compounds contain atoms of different elements. (H₂O, CO₂, NO₂, CaO, ZnCl₂). <p>➤ Mixture (components of more than one substance combine in any proportion, original properties of the components are retained).</p> <p>➤ Difference between mixtures and compounds (on the basis of proportion of combination of components and their properties).</p> <p>➤ Separation techniques of mixtures into their components:</p> <ul style="list-style-type: none"> ☛ Sieving ☛ Sedimentation ☛ Decantation ☛ Filtration ☛ Evaporation ☛ Magnetic Separation ☛ Sublimation 	<ul style="list-style-type: none"> ➤ 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. ➤ 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 $C+O_2 \rightarrow CO_2$ ➤ Discussing details of the activity of the formation of FeS by heating Fe and S. ➤ Providing opportunities to children to perform simple activities: <ul style="list-style-type: none"> ☛ Filtration – (sand and water) ☛ Sedimentation (link to purification of water) ☛ Decantation (Tea brewing) ☛ Sublimation (Iodine crystals/ ammonium chloride, Naphthalene balls, Camphor). ☛ Evaporation (Salt water) ☛ Sieving (Rice powder/stones) ☛ Magnetic separation (Iron and sulphur) ➤ Discussing reasons for preferring a particular technique over another. 	<ul style="list-style-type: none"> ➤ Some samples of mixtures and compounds. ➤ 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. ➤ Separation: filter paper, sieve, bar magnet, iodine, ammonium chloride, salt, tea leaves.

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.

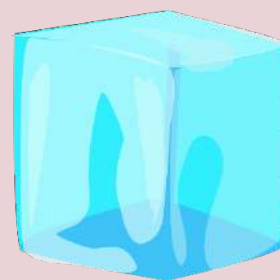
Matter		
Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<p>States of Matter</p> <ul style="list-style-type: none"> ▶ Classification of matter into solid, liquid and gas on the basis of properties (shape, volume). Factors responsible for the existence of matter in different states. ▶ Arrangement of atoms/ molecules in solids, liquids and gases: - intermolecular space, cohesive forces). ▶ There is space between the particles of matter. 	<ul style="list-style-type: none"> ▶ 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. ▶ 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) ▶ 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). ▶ 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. ▶ Smaller particles occupy spaces 	<ul style="list-style-type: none"> ▶ Different samples of solid, liquid, gases. ▶ Solid – wood, common salt, pen, pencil. ▶ Liquid – water, milk. ▶ Gas – balloons. ▶ Water and burner. ▶ Sugar, pebbles, beaker, burner. ▶ Ball and ring apparatus. ▶ Test tube, cork, capillary tube, burner. ▶ Apple, milk in a container.

Matter

Key Concepts / Concerns	Pedagogy/ Transactional Strategies*	Suggested Learning Resources
<ul style="list-style-type: none"> ▶ Effect of heat on matter (expansion, change of state and chemical change) 	<p style="text-align: center;">between the bigger particles.</p> <ul style="list-style-type: none"> ▶ Carrying out activities such as: - <ul style="list-style-type: none"> ▶ Adding sugar to pebbles taken in a plastic beaker. ▶ Adding sand to glass balls. Sugar and sand go into the space between the pebbles and glass balls respectively. (Intermolecular spaces are occupied). ▶ Carrying out activities relating to: expansion of matter on heating, evaporation and condensation, freezing and sublimation. ▶ For solid- activity using ball and ring apparatus. ▶ 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. ▶ 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. ▶ Change of state- changing of ice to water to steam and reverse can be shown/ recalled. ▶ Chemical change – Burning of candle. 	

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"> ▶ Importance of water in everyday life (household purpose, industry, watering plants, etc.). ▶ Water resources (well, river, hand pump, lakes, pond, etc.). ▶ Capacity to dissolve many salts in it. ▶ Definition of Solute, Solvent and Solution. ▶ Importance of water for sustenance of life on earth. ▶ Reasons for water pollution; its prevention; conservation of water. 	<ul style="list-style-type: none"> ▶ Asking children to list out their activities since morning in which water has been used. ▶ Giving group work/activity to children to conduct a survey of the water resources in their neighbourhood/ town/ city. ▶ 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. ▶ Encouraging children to derive definitions from the following activities: <ul style="list-style-type: none"> ☛ Preparing a solution of copper sulphate in which copper sulphate is solute and water is solvent. ☛ 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. ▶ Initiating a class discussion/debate on the importance of water for sustenance of life, its scarcity, pollution, etc. ▶ Assigning every child Project work on conducting a water audit at their homes 	<ul style="list-style-type: none"> ▶ Sodium chloride, sodium carbonate, sodium sulphate etc. ▶ Copper sulphate, water, beaker, glass rod. ▶ Survey. ▶ Audio-videos/Films. ▶ Projects. ▶ Visit to Eco park

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"> ▶ Air is present everywhere around us. ▶ Air - a mixture of gases namely, nitrogen, oxygen, carbon dioxide, water vapour; dust and smoke as pollutants. ▶ Percentage composition of air. ▶ Uses of the components present (importance of nitrogen to plants to be mentioned). ▶ Definition of atmosphere as layer of air around the earth. 	<ul style="list-style-type: none"> ▶ 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. ▶ 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 O₂ gets consumed, the candle extinguishes. Followed by a discussion on the experiment. ▶ Nitrogen- a major part of air is still present above the water level which does not support combustion. N₂ 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. ▶ CO₂- turning of lime water milky by bubbling air in it shows the presence of CO₂ in air. It is produced due to our day-to-day activities like burning of fuel. Smoke contains many harmful gases. ▶ Discussing how air is essential for life and other physical and chemical processes. 	<ul style="list-style-type: none"> ▶ Bottle, a tub containing water. ▶ Literature related to composition of air and description of uses of the components of air. ▶ All equipment for doing simple experiments.

Integration: Biology, Geography

Life skills: Sensitivity towards environment