Chapter 1 Syllabus for NLSO

Syllabus for National Level ScienceX Olympiads (NLSO)

Welcome to ScienceX Olympiads! Here's a breakdown of our tentative syllabi for different subjects:

1. **Physics, Chemistry, and Biology (SPO, SCO, and SBO):** Our syllabi for these Olympiads align closely with the senior secondary level, which includes content up to and including Class 12 of the Central Board of Secondary Education (CBSE). Additionally, a solid foundation in Mathematics up to this level is expected.
2. **Astronomy (SAO) for Class 11 & 12:** The SAO syllabus primarily encompasses Physics and Mathematics, akin to the Senior Secondary School level (up to and including class XII of CBSE India Board). It also includes introductory Astronomy concepts, such as the positions of stars, constellations, and night sky observation.
3. **ScienceX Olympiad in Science (SO):** Our Science Olympiad syllabus broadly corresponds to the secondary level, comprising topics up to and including Class 10 of the Central Board of Secondary Education (CBSE). We also include essential content from lower classes in our syllabus for all subjects.

Prepare yourself for the exciting challenges of ScienceX Olympiads with our comprehensive and engaging syllabi that cover a wide range of science and mathematics topics.

Detailed syllabus of each subject is given below.

Note:

It must be noted that questions and problems in ScienceX Olympiads, while circumscribed by syllabi given below, are usually non-conventional and of high difficulty level, sometimes comparable to the international Standards.

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1.1 BIOLOGY | Level-4

In addition to following, general understanding of Science topics studied till Class 10 and Mathematics topics studied till Class 12 is expected.

I. Diversity of Living Organisms The Living World:

What is living? Biodiversity; Need for classification; three domains of life; taxonomy and systematics; concept of species and taxonomical hierarchy; binomial nomenclature and tools for study of taxonomy.

Biological Classification:

Five kingdom classification; Salient features and classification of Monera, Protista and Fungi into major groups: Lichens, Viruses and Viroids.

Plant Kingdom:

Salient features and classification of plants into major groups – Algae, Bryophyta, Pteridophyta, Gymnospermae and Angiospermae.

Animal Kingdom:

Salient features and classification of animals, non-chordates up to phyla level and chordates up to class level.

II: Structural Organization in Animals and Plants Morphology and anatomy of Flow

Morphology and modifications: Morphology of different parts of flowering plants: root, stem, leaf, inflorescence, flower, fruit and seed. Anatomy and functions of different tissues and tissue systems. Structural Organisation in Animals:

Animal tissues; Morphology, anatomy and functions of different systems (digestive, circulatory, respiratory, nervous and reproductive) of animals.

III. Cell: Structure and Function

Cell-The Unit of Life: Cell theory and cell as the basic unit of life:

Structure of prokaryotic and eukaryotic cells; Plant cell and animal cell; cell envelope; cell membrane, cell wall; structure and function of all cell organelles. Cellular respiration – glycolysis, fermentation (anaerobic), TCA cycle and electron transport system (aerobic); energy relations – number of ATP molecules generated; amphibolic pathways; respiratory quotient.

Biomolecules:

Chemical constituents of living cells: biomolecules, structure and function of proteins, carbohydrates, lipids, nucleic acids; Enzymes- types, properties, enzyme action.

Cell Cycle and Cell Division:

Cell cycle, mitosis, meiosis and their significance.

IV. Plant Physiology

Transport in Plants:

Movement of water, gases and nutrients; cell to cell transport, diffusion, facilitated diffusion, active transport; plant-water relations, imbibition, water potential, osmosis, plasmolysis; long distance trans-

port of water – Absorption, apoplast, symplast, transpiration pull, root pressure and guttation; transpiration, opening and closing of stomata; Uptake and translocation of mineral nutrients – Transport of food, phloem transport, mass flow hypothesis.

Mineral Nutrition:

Essential minerals, macro- and micronutrients and their role; deficiency symptoms; mineral toxicity; elementary idea of hydroponics as a method to study mineral nutrition; nitrogen metabolism, nitrogen cycle, biological nitrogen fixation.

Photosynthesis and Respiration in Higher Plants:

Photosynthesis as a means of autotrophic nutrition; site of photosynthesis, pigments involved in photosynthesis (elementary idea); photochemical and biosynthetic phases of photosynthesis; cyclic and non-cyclic photophosphorylation; chemiosmotic hypothesis; photorespiration; C3 and C4 pathways; factors affecting photosynthesis; exchange of gases.

Plant – Growth and Development:

Seed germination; phases of plant growth and plant growth rate; conditions of growth; differentiation, dedifferentiation and redifferentiation; sequence of developmental processes in a plant cell; growth regulators; seed dormancy; vernalisation; photoperiodism.

V. Human Physiology

Digestion and Absorption:

Alimentary canal and digestive glands, role of digestive enzymes and gastrointestinal hormones; Peristalsis, digestion, absorption and assimilation of proteins, carbohydrates and fats; calorific values of proteins, carbohydrates and fats; egestion; nutritional and digestive disorders.

Breathing and Exchange of Gases:

Respiratory system in humans; mechanism of breathing and its regulation in humans – exchange of gases, transport of gases and regulation of respiration, respiratory volume; disorders related to respiration.

Body Fluids and Circulation:

Composition of blood, blood groups, coagulation of blood; composition of lymph and its function; human circulatory system – Structure of human heart and blood vessels; cardiac cycle, cardiac output, ECG; double circulation; regulation of cardiac activity; disorders of circulatory system.

Excretory Products and Their Elimination:

Modes of excretion – ammonotelism, ureotelism, uricotelism; human excretory system – structure and function; urine formation, osmoregulation; regulation of kidney function – renin – angiotensin, atrial

natriuretic factor, ADH and diabetes insipidus; role of other organs in excretion; disorders of excretory system; dialysis and artificial kidney, kidney transplant.

Locomotion and Movement:

Types of movement – ciliary, flagellar, muscular; skeletal muscle- contractile proteins and muscle contraction; skeletal system and its functions; joints; disorders of muscular and skeletal system. Neural Control and Coordination:

Neuron and nerves; Nervous system in humans – central nervous system; peripheral nervous system and visceral nervous system; generation and conduction of nerve impulse; reflex action; sensory perception; structure and functions of sense organs.

Chemical Coordination and Integration:

Endocrine glands and hormones; human endocrine system; mechanism of hormone action; role of hormones as messengers and regulators, hypo – and hyperactivity and related disorders.

VI. Reproduction

Reproduction in Organisms:

Reproduction, a characteristic feature of all organisms for continuation of species; modes of reproduction – asexual and sexual reproduction; asexual reproduction – binary fission, sporulation, budding, gemmule formation, fragmentation; vegetative propagation in plants.

Sexual Reproduction in Flowering Plants:

Flower structure; development of male and female gametophytes; pollination – types, agencies and examples; outbreeding devices; pollen-pistil interaction; double fertilization; post fertilization events – development of endosperm and embryo, development of seed and formation of fruit; special modes-apomixis, parthenocarpy, polyembryony; Significance of seed dispersal and fruit formation.

Human Reproduction:

Male and female reproductive systems; microscopic anatomy of testis and ovary; gametogenesis – spermatogenesis and oogenesis; menstrual cycle; fertilisation, embryo development upto blastocyst formation, implantation; pregnancy and placenta formation; parturition; lactation.

Reproductive Health:

Need for reproductive health and prevention of Sexually Transmitted Diseases (STDs); birth control – need and methods, contraception and medical termination of pregnancy (MTP); amniocentesis; infertility and assisted reproductive technologies – IVF, ZIFT, GIFT.

VII. Genetics and Evolution Heredity and variation:

Mendelian inheritance; deviations from Mendelism – incomplete dominance, co- dominance, multiple alleles and inheritance of blood groups, pleiotropy; elementary idea of polygenic inheritance; chromosome theory of inheritance; chromosomes and genes; Sex determination – in humans, birds and honey bee; linkage and crossing over; sex linked inheritances; Mendelian disorders in humans.

Molecular Basis of Inheritance:

DNA as genetic material; Structure of DNA and RNA; DNA packaging; DNA replication; Central dogma; transcription, genetic code, translation; gene expression and regulation – lac operon; Genome; DNA fingerprinting.

Evolution:

Origin of life; biological evolution and evidences for biological evolution (paleontology, comparative anatomy, embryology and molecular evidences); Darwin's contribution, modern synthetic theory of evolution; mechanism of evolution – variation (mutation and recombination) and natural selection with examples, types of natural selection; Gene flow and genetic drift; Hardy – Weinberg's principle; adaptive radiation; human evolution.

VIII. Biology and Human Welfare Human Health and Diseases:

Pathogens; parasites causing human diseases (malaria, dengue, chikungunya, filariasis, ascariasis, typhoid, pneumonia, common cold, amoebiasis, ringworm) and their control; Basic concepts of immunology – vaccines; cancer, HIV and AIDS; Adolescence – drug and alcohol abuse.

Strategies for Enhancement in Food Production:

Improvement in food production: Plant breeding, tissue culture, single cell protein, Biofortification, Apiculture and Animal husbandry.

Microbes in Human Welfare:

In household food processing, industrial production, sewage treatment, energy generation and microbes as bio-control agents and bio-fertilizers. Antibiotics; production and judicious use. Biotechnology – Principles, processes and applications:

Genetic Engineering (Recombinant DNA Technology); Application of biotechnology in health and agriculture: Human insulin and vaccine production, stem cell technology, gene therapy; genetically modified organisms – Bt crops; transgenic animals; biosafety issues, bio piracy and patents.

IX. Ecology and Environment Organisms and Populations:

Organisms and environment: Habitat and niche, population and ecological adaptations; population interactions – mutualism, competition, predation, parasitism; population attributes – growth, birth rate and death rate, age distribution.

Ecosystems:

Patterns, components; productivity and decomposition; energy flow; pyramids of number, biomass, energy; nutrient cycles; ecological succession; carbon fixation, pollination, seed dispersal.

Biodiversity and its Conservation:

Biodiversity-Concept, patterns, importance; loss of biodiversity; biodiversity conservation; hotspots, endangered organisms and extinction.

Environmental Issues:

Air pollution and its control; water pollution and its control; agrochemicals and their effects; solid waste management; radioactive waste management; greenhouse effect and climate change impact and mitigation; ozone layer depletion; deforestation.

1.2 CHEMISTRY | LEVEL-4

In addition to following, general understanding of Science topics studied till Class 10 and Mathematics topics studied till Class 12 is expected.

I. Some Basic Concepts of Chemistry

General Introduction: Importance and scope of chemistry.

Nature of matter, laws of chemical combination, Dalton's atomic theory: concept of elements, atoms and molecules.

Atomic and molecular masses, mole concept and molar mass, percentage composition, empirical and molecular formula, chemical reactions, stoichiometry and calculations based on stoichiometry.

II. Structure of Atom

Bohr's model and its limitations, concept of shells and subshells, dual nature of matter and light, de Broglie's relationship, Heisenberg uncertainty principle, concept of orbitals, quantum numbers, shapes of s, p and d orbitals, rules for filling electrons in orbitals – Aufbau principle,

Pauli's exclusion principle and Hund's rule, electronic configuration of atoms, stability of half-filled and completely filled orbitals.

III. Classification of Elements and Periodicity in Properties

Modern periodic law and the present form of periodic table, periodic trends in properties of elements -atomic radii, ionic radii, inert gas radii, Ionization enthalpy, electron gain enthalpy, electronegativity, valency. Nomenclature of elements with atomic number greater than 100

IV. Chemical Bonding and Molecular structure

Valence electrons, ionic bond, covalent bond, bond parameters, Lewis structure, polar character of covalent bond, covalent character of ionic bond, valence bond theory, resonance, geometry of covalent molecules, VSEPR theory, concept of hybridization, involving s, p and d orbitals and shapes of some simple molecules, molecular orbital theory of homonuclear diatomic molecules (qualitative idea only), hydrogen bond.

V. States of Matter: Gases and Liquids

Three states of matter, intermolecular interactions, types of bonding, melting and boiling points, role of gas laws in elucidating the concept of the molecule, Boyle's law, Charles law, Gay Lussac's law, Avogadro's law, ideal behaviour, empirical derivation of gas equation, Avogadro's number, ideal gas equation.

Deviation from ideal behaviour, liquefaction of gases, critical temperature, kinetic energy and molecular speeds (elementary idea)

Liquid State: vapour pressure, viscosity and surface tension (qualitative idea only, no mathematical derivations)

VI. States of Matter: Solid State

Classification of solids based on different binding forces: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea). Unit cell in two dimensional and three dimensional lattices, calculation of density of unit cell, packing in

solids, packing efficiency, voids, number of atoms per unit cell in a cubic unit cell, point defects.

VII. Chemical Thermodynamics

Concepts of System and types of systems, surroundings, work, heat, energy, extensive and intensive properties, state functions. First law of thermodynamics

-internal energy and enthalpy, heat capacity and specific heat, measurement of U and H, Hess's law of constant heat summation, enthalpy of bond dissociation, combustion, formation, atomization, sublimation, phase transition, ionization, solution and dilution. Second law of Thermodynamics (brief introduction).Introduction of entropy as a state function, Gibb's energy change for spontaneous and non-spontaneous processes, criteria for equilibrium.

Third law of thermodynamics (brief introduction).

VIII. Equilibrium

Equilibrium in physical and chemical processes, dynamic nature of equilibrium, law of mass action, equilibrium constant, factors affecting equilibrium- Le Chatelier's principle, ionic equilibrium- ionization of acids and bases, strong and weak electrolytes, degree of ionization, ionization of poly basic acids, acid strength, concept of pH, Henderson Equation, hydrolysis of salts (elementary idea), buffer solution, solubility product, common ion effect (with illustrative examples).

IX. Solutions

Types of solutions, expression of concentration of solutions of solids in liquids, solubility of gases in liquids, solid solutions, colligative properties – relative lowering of vapour pressure, Raoult's law, elevation of boiling point, depression of freezing point, osmotic pressure, determination of molecular masses using colligative properties, abnormal molecular mass, Van't Hoff factor.

X. Electrochemistry

Redox reactions: Concept of oxidation and reduction, oxidation number, balancing redox reactions, in terms of loss and gain of electrons and change in oxidation number, applications of redox reactions.

conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis (elementary idea), dry cell-electrolytic cells and Galvanic cells, lead accumulator, EMF of a cell, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, fuel cells, corrosion.

XI. Chemical Kinetics

Rate of a reaction (Average and instantaneous), factors affecting rate of reaction: concentration, temperature, catalyst; order and molecularity of a reaction, rate law and specific rate constant, integrated rate equations and half-life (only for zero and first order

reactions), concept of collision theory (elementary idea, no mathematical treatment). Activation energy, Arrhenius equation.

XII. Surface Chemistry

Adsorption – physisorption and chemisorption, factors affecting adsorption of gases on solids, catalysis, homogenous and heterogenous activity and selectivity; enzyme catalysis colloidal state distinction between true solutions, colloids and suspension; lyophilic, lyophobic

multi-molecular and macromolecular colloids; properties of colloids; Tyndall effect, Brownian movement, electrophoresis, coagulation, emulsion – types of emulsions.

XIII. s-Block Elements (Alkali and Alkaline Earth Metals)

Position of hydrogen in periodic table, occurrence, isotopes, preparation, properties and uses of hydrogen, hydrides-ionic covalent and interstitial; physical and chemical properties of water, heavy water, hydrogen peroxide – preparation, reactions and structure and use; hydrogen as a fuel.

Group 1 and Group 2 Elements General introduction, electronic configuration, occurrence, anomalous properties of the first element of each group, diagonal relationship, trends in the variation of properties (such as ionization enthalpy, atomic and ionic radii), trends in chemical reactivity with oxygen, water, hydrogen and halogens, uses.

Preparation and properties of some important compounds: Sodium Carbonate, Sodium Chloride, Sodium Hydroxide and Sodium Hydrogencarbonate, Biological importance of Sodium and Potassium.

Calcium Oxide and Calcium Carbonate and their industrial uses, biological importance of Magnesium and Calcium.

XIV. p -Block Elements

General Introduction to p -Block Elements

Group 13 Elements: General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous properties of first element of the group,

Boron – physical and chemical properties, some important compounds, Borax, Boric acid, Boron Hydrides,

Aluminium: Reactions with acids and alkalies, uses.

Group 14 Elements: General introduction, electronic configuration, occurrence, variation of properties, oxidation states, trends in chemical reactivity, anomalous behaviour of first elements. Carbon-catenation, allotropic forms, physical and chemical properties; uses of some important compounds: oxides.

Important compounds of Silicon and a few uses: Silicon Tetrachloride, Silicones, Silicates and Zeolites, their uses.

Group -15 Elements: General introduction, electronic configuration, occurrence, oxidation states, trends in physical and chemical properties; Nitrogen preparation properties and uses; compounds of Nitrogen: preparation and properties of Ammonia and Nitric Acid.

Group 16 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties, dioxygen: Preparation, Properties and

uses, classification of Oxides, Ozone, Sulphur -allotropic forms; compounds of Sulphur: Preparation Properties and uses of Sulphur-dioxide, Sulphuric Acid: industrial process of manufacture, properties and uses; Oxoacids of Sulphur (Structures only).

Group 17 Elements: General introduction, electronic configuration, oxidation states, occurrence, trends in physical and chemical properties; compounds of halogens, Preparation, properties and uses of Chlorine and Hydrochloric acid, interhalogen compounds, Oxoacids of halogens (structures only).

Group 18 Elements: General introduction, electronic configuration, occurrence, trends in physical and chemical properties, uses.

XV. ‘d’ and ‘f’ Block Elements

General introduction, electronic configuration, occurrence and characteristics of transition metals, general trends in properties of the first row transition metals – metallic character, ionization enthalpy, oxidation states, ionic radii, colour, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and properties of $K_2Cr_2O_7$ and $KMnO_4$.

Lanthanoids – Electronic configuration, oxidation states, chemical reactivity and lanthanoid contraction and its consequences.

Actinoids – Electronic configuration, oxidation states and comparison with lanthanoids.

XVI. General Principles and Processes of Isolation of Elements

Principles and methods of extraction – concentration, oxidation, reduction

-electrolytic method and refining; occurrence and principles of extraction of aluminium, copper, zinc and iron

XVII. Coordination Compounds

Coordination compounds – Introduction, ligands, coordination number, colour, magnetic properties and shapes, IUPAC nomenclature of mononuclear coordination compounds. Bonding, Werner's theory, VBT, and CFT; structure and stereoisomerism, importance of coordination compounds (in qualitative inclusion, extraction of metals and biological system).

XVIII. Organic Chemistry – Some Basic Principles and Techniques

General introduction, methods of purification, qualitative and quantitative analysis, classification and IUPAC nomenclature of organic compounds.

Electronic displacements in a covalent bond: inductive effect, electromeric effect, resonance and hyperconjugation. Homolytic and heterolytic fission of a covalent bond: free radicals, carbocations, carbanions, electrophiles and nucleophiles, types of organic reactions.

XIX. Hydrocarbons

Classification of Hydrocarbons Aliphatic Hydrocarbons:

Alkanes – Nomenclature, isomerism, conformation (ethane only), physical properties, chemical reactions including free radical mechanism of halogenation, combustion and pyrolysis.

Alkenes – Nomenclature, structure of double bond (ethene), geometrical isomerism, physical properties, methods of preparation, chemical reactions: addition of hydrogen, halogen, water,

hydrogen halides (Markownikov's addition and peroxide effect), ozonolysis, oxidation, mechanism of electrophilic addition.

Alkynes – Nomenclature, structure of triple bond (ethyne), physical properties, methods of preparation, chemical reactions: acidic character of alkynes, addition reaction of – hydrogen, halogens, hydrogen halides and water.

Aromatic Hydrocarbons: Introduction, IUPAC nomenclature, benzene: resonance, aromaticity, chemical properties: mechanism of electrophilic substitution. Nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation, directive influence of functional group in monosubstituted benzene. Carcinogenicity and toxicity.

XX. Haloalkanes and Haloarenes

Haloalkanes: Nomenclature, nature of C-X bond, physical and chemical properties, mechanism of substitution reactions, optical rotation.

Haloarenes: Nature of C-X bond, substitution reactions (Directive influence of halogen in monosubstituted compounds only).

Uses and environmental effects of – dichloromethane, trichloromethane, tetrachloromethane, iodoform, freons, DDT.

XXI. Alcohols, Phenols and Ethers

Alcohols: Nomenclature, methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration, uses with special reference to methanol and ethanol.

Phenols: Nomenclature, methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses of phenols.

Ethers: Nomenclature, methods of preparation, physical and chemical properties, uses.

XXII. Aldehydes, Ketones and Carboxylic Acids

Aldehydes and Ketones: Nomenclature, nature of carbonyl group, methods of preparation, physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes, uses.

Carboxylic Acids: Nomenclature, acidic nature, methods of preparation, physical and chemical properties; uses.

XXIII. Organic compounds containing Nitrogen

Amines: Nomenclature, classification, structure, methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

Cyanides and Isocyanides – preparation and reactions.

Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

XXIV. Biomolecules

Carbohydrates – Classification (aldoses and ketoses), monosaccharides (glucose and fructose), D-L configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); Importance of carbohydrates.

Proteins -Elementary idea of – amino acids, peptide bond, polypeptides, proteins, structure of proteins – primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins; enzymes. Hormones – Elementary idea excluding structure. Vitamins – Classification and functions.

Nucleic Acids: DNA and RNA.

XXV. Polymers

Copolymerization, some important polymers: natural and synthetic like polythene, nylon, polyesters, bakelite, rubber. Biodegradable and non- biodegradable polymers.

XXVI. Environmental Chemistry

Environmental pollution – air, water and soil pollution, chemical reactions in atmosphere, smog, major atmospheric pollutants, acid rain, ozone and its reactions, effects of depletion of ozone layer, green-

house effect and global warming- pollution due to industrial wastes, green chemistry as an alternative tool for reducing pollution, strategies for control of environmental pollution.

XXVII. Chemistry in Everyday life

Chemicals in medicines – analgesics, tranquilizers antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines.

Chemicals in food – preservatives, artificial sweetening agents, elementary idea of antioxidants.Cleansing agents- soaps and detergents, cleansing action.

1.3 Science-Level-3

We anticipate a fundamental grasp of mathematical concepts and operations typically covered up to Class 9 & 10. These topics include:

1. Polynomials
2. Linear equations
3. Quadratic equations
4. Number systems
5. Triangles
6. Trigonometry
7. Circles
8. Surface areas and volumes
9. Statistics

Furthermore, we assume a broad understanding of Science and Mathematics subjects studied up to Class 8.

Matter-Nature and Behaviour

- 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.
- Nature of matter: Elements, compounds and mixtures; heterogeneous and homogeneous mixtures, colloids and suspensions; solutions, concentration of solutions; separation of components of a mixture.
- Particle nature, basic units: Atoms and molecules, law of constant proportions, atomic and molecular masses; mole concept: relationship of mole to mass of the particles and numbers.
- Structure of atoms: Electrons, protons and neutrons; valency, chemical formula of common compounds; isotopes and Isobars.

Chemical Substances – Nature and Behaviour

- Chemical reactions: Chemical equation, balanced chemical equation, implications of a balanced chemical equation; types of chemical reactions: combination, decomposition, displacement, double displacement, precipitation, neutralization, oxidation and reduction.

- Acids, bases and salts: Their definitions in terms of furnishing of H+ and OH– ions; general properties, examples and uses, concept of pH scale, importance of pH in everyday life; preparation and uses of sodium hydroxide, bleaching powder, baking soda, washing soda and Plaster of Paris.
- Metals and nonmetals: Properties of metals and non-metals; reactivity series; formation and properties of ionic compounds; basic metallurgical processes; corrosion and its prevention.
- Carbon compounds: Covalent bonding in carbon compounds; versatile nature of carbon; homologous series; nomenclature of carbon compounds containing functional groups (halogens, alcohol, ketones, aldehydes, alkanes and alkynes), difference between saturated hydrocarbons and unsaturated hydrocarbons; chemical properties of carbon compounds (combustion, oxidation, addition and substitution reaction), ethanol and ethanoic acid (only properties and uses), soaps and detergents.
- 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.

Organization in the Living World

- 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.
- Tissues, Organs, Organ System, Organism: Structure and functions of animal and plant tissues.

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) (Non-chordates upto phyla and chordates upto classes).

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 programmes.

Life Processes

- Basic concept of nutrition, respiration, transport and excretion in plants and animals.
- Control and coordination in animals and plants: Tropic movements in plants; introduction of plant hormones; control and coordination in animals: nervous system; voluntary, involuntary and reflex action; chemical coordination: animal hormones.

Reproduction: Reproduction in animals and plants (asexual and sexual) reproductive health-need and methods of family planning; safe sex vs HIV/AIDS; child bearing and women's health.

Heredity and Evolution: Heredity; Mendel's contribution: Laws for inheritance of traits: sex determination: brief introduction; basic concepts of evolution.

Motion, Force and Work Motion: Distance and displacement, velocity; uniform and non-uniform mo-

tion along a straight line; acceleration, distance-time and velocity-time graphs for uniform motion and uniformly accelerated motion, derivation of equations of motion by graphical method; elementary idea of uniform circular motion.

Force and Newton's laws : Force and motion, Newton's laws of motion, action and reaction forces, inertia of a body, inertia and mass, momentum, force and acceleration. elementary idea of conservation of momentum.

Gravitation: Gravitation; Universal law of gravitation, force of gravitation of the earth (gravity), acceleration due to gGravity; mass and Weight; free fall.

Floatation: Thrust and pressure. Archimedes' principle; buoyancy; elementary idea of relative density.

Work, energy and power: Work done by a force, energy, power; kinetic and potential energy; law of conservation of energy.

Sound: 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).

Effects of Current Electric current, potential difference and electric current. Ohm's law; resistance, resistivity, factors on which the resistance of a conductor depends. Series combination of resistors, parallel combination of resistors and its applications in daily life. Heating effect of electric current and its applications in daily life. Electric power, interrelation between P, V, I and R.

Magnetic effects of current : Magnetic field, field lines, field due to a current carrying conductor, field due to current carrying coil or solenoid; force on current carrying conductor, Fleming's left hand rule, electric motor, Electromagnetic induction. induced potential difference, induced current.

Fleming's right hand rule, electric generator; direct current; alternating current: frequency of AC. Advantage of AC over DC. Domestic electric circuits.

Light Reflection of light by curved surfaces; images formed by spherical mirrors, centre of curvature, principal axis, principal focus, focal length, mirror formula (derivation not required), magnification.

Refraction; laws of refraction, refractive index;

Refraction of light by spherical lens; image formed by spherical lenses; lens formula (derivation not required); magnification. power of a lens.

Functioning of a lens in the human eye, defects of vision and their corrections, applications of spherical mirrors and lenses.

Refraction of light through a prism, dispersion of light, scattering of light, applications in daily life.

Our Environment Physical resources: Air, water, soil. Air for respiration, for combustion, for moderating temperatures; movements of air and its role in bringing rains across India. Air, water and soil pollution (brief introduction). Holes in ozone layer and the probable damages.

Biogeochemical cycles in nature: Water, Oxygen, Carbon and Nitrogen.

Natural Resources Sources of energy: Different forms of energy, conventional and non-conventional sources of energy: fossil fuels, solar energy; biogas; wind, water and tidal energy; nuclear energy. Renewable versus

non-renewable sources of Energy.

Our environment: Eco-system, environmental problems, ozone depletion, waste production and their solutions. Biodegradable and non-biodegradable substances.

Management of natural resources: Conservation and judicious use of natural resources. Forest and

wildlife; Coal and Petroleum conservation. Examples of people's participation for conservation of natural resources. Big dams: advantages and limitations; alternatives, if any; water harvesting; sustainability of natural resources.

Food Production Plant and animal breeding and selection for quality improvement and management; use of fertilizers and manures; protection from pests and diseases; organic farming.