16. Science

Secondary Education Curriculum

Science

Grade 9 and 10 **Subject code: Sci. 205 (Grade 9) Sci. 206 (Grade 10)**

Credit hour: 4 **Annual working hours: 128**

1. Introduction

Natural phenomena and the activities of human life are guided by scientific principles, rules and facts. Therefore, it is important to develop the basic knowledge, skills and attitudes of science among children from the school level by developing their interests in such events and activities. For this, science is considered as an important subject in school education, and hence, made compulsory. Moreover, it is necessary to provide additional content of different areas of science for those students who have a special interest and plan to pursue further studies in science related subject areas. This curriculum has been prepared for grades 9 and 10 as an optional subject to provide the necessary foundation and basic knowledge for those students who wish to have of higher studies in science. It is hoped that this curriculum will enhance the students' interest, skills and create awareness to participate in scientific research. This optional science curriculum is an advanced form of compulsory science at the school level.

The curriculum covers various subjects in the following areas of science.

a. Physics b. Chemistry c. Biology d. Geology and Astronomy.

To promote hands-on experience and effective learning activities in science teaching, 25% of working hours have been allocated for internal assessment. Internal assessment covers the students' participaton, project works, practical activities, and trimester test. As one of the national objectives of school education is to create scientific and research-oriented manpower, this curriculum focuses on the practical application of scientific concepts, facts, skills, principles and technologies.

The curriculum also emphasizes the use of internal assessment tools in wchich formative assessment is an integral part of learning activities. To achieve the expected learning outcomes, it focuses on student-centered learning activities such as experiments, researches and project-based learning, group discussions, field visits, group work and presentations, etc. The curriculum has clearly defined the contents which are essential to produce basic knowledge of science and technology in children and the skills to give scientific reasonings, solve problems scientifically and carry out researches scientifically.

2. Level wise competences

After completion of this course students are expected to have the following competencies;

1. Enhance scientific research and thought through the acquisition of the basic knowledge of scientific concepts, theories, and rules.
2. Aware of surrounding physical activities of scientific concepts, facts, skills, theories, and knowledge and their applications in daily life.
3. Identify, evaluate and demonstrate the understanding of properties of substances and use them in practical life.

4. Demonstrate understanding of the basic aspects of life, life process, heredity and internalize their importance.
5. Demonstrate the understanding of the interrelationships between organic and inorganic elements of the environment and help in protecting the environment.
6. Acquire and develop knowledge of the basic practical aspects of life sciences and apply them in daily life properly.
7. Acquire information about the past, present and future of the earth and the universe.

3. Grade Wise Learning Outcomes

Grade 9		Grade 10	
Area and Units	**Learning outcomes**	**Area and Unit**	**Leaning outcomes**
Biology			
1. Cell Biology	1.1 Introduce prokaryotic and eukaryotic cell. 1.2 Explain structure and fuctions of cell organelles. 1.3 Relate the functions of cell with life processes.	**1. Cell Biology**	1.1 Explain the stages of mitosis cell division 1.2 Explain the stages of meiosis cell division. 1.3 Mention the significance of mitosis and meiosis cell division. 1.4 Relate sexual reproduction with genetic variation and asexual reproduction along with formation of clone.
2. Life and life process	2.1 Introduce microbiology and its importance. 2.2 Explain the mode of reproduction of virus, bacteria and fungi. 2.3 Grow a mucor to demonstrate its life cycle. 2.4 Investigate the advantages and disadvantages of mucor.	**2. Life and life process**	2.1 Explain the life cycle of spirogyra and entamoeba. 2.2 Perform the experiments to demonstrate the osmosis and transpiration process in plants and describe their importance. 2.3 Introduce the intracelluar respiration.
3. Genetics	3.1 Introduce chromosome and describe its types. 3.2 Introduce genetics. 3.3 Describe the relation between gene and chromosome.	**3. Genetics**	3.1 Explain the Mendel's law of independent assortment and verify it with dihybrid cross. 3.2 Analyze the detail structure of RNA and DNA. 3.3 Describe the types of RNA with their functions. 3.4 Explore the role of DNA in genetics. 3.5 Introduce sex linked inheritance and its process.
4. Ecology	4.1 Describe ecology and ecosystem with examples. 4.2 Interrelate the population and community of living organisms with environment. 4.3 Explain the decomposition process of organic matters. 4.4 Describe wetland ecosystem.	**4. Ecology**	4.1 Introduce biological pyramid and its types. 4.2 Illustrate energy transfer through different trophic level in ecosystem. 4.3 Explain Biogeochemical cycles.

5. Applied Biology	5.1 Explore the role of skin, blood and mucus membrane present in respiratory tract in defence mechanism of human body. 5.2 Introduce immunity and vaccination and find their importance. 5.3 Introduce Anti Biotics and mention their advantages and disadvantages.	**5. Applied Biology**	5.1 Introduce DNA finger printing and explore its importance. 5.2 Conceptualize cloning and genetic engineering and explain their ethical issues. 5.3 Explain the fact that Cloning minimizes the variation in organisms and evaluate its effects. 5.4 Conceptualize bio weapons. 5.5 Introduce organ transplantation and mention its importance.
Chemistry			
6. Atomic structure	6.1 Explain Dalton's atomic theory and its modification. 6.2 Introduce subatomic particles and their properties. 6.3 State the postulates of Rutherford's atomic model 6.4 Explain Bohr's atomic model. 6.5 Clarify the concept of atomic number, atomic mass, isotopes, isobar, and isotones.	**6. Periodic Table**	6.1 Introduce modern periodic table. 6.2 Write the electronic configuration of elements up to atomic number 30 based on s, p, d, f. 6.3 Introduce s-block, p-block, d-block, and f-block elements and describe their characteristics. 6.4 Explain the variation of periodic properties of elements in various groups and periods in terms of atomic size, valency, ionization potential, electron affinity, and electronegativity. 6.5 Explain the chemical reactivity of elements in various groups and periods.
7. Gas laws	7.1 Introduce Boyle's law and Charles's law of gas and explain their applications. 7.2 Derive combined gas equation. 7.3 Introduce the concept of standard temperature and pressure (STP). 7.4 State the assumptions of kinetic theory of gases. 7.5 Introduce the concept of real and idea gases. 7.6 State Graham's law of diffusion of gas and illustrate its applications.	**7. Chemical Bonding**	7.1 Illustrate the formation of covalent bond and describe its types. 7.2 Describe the formation of Co-ordinate covalent bond. 7.3 Explain the characteristics of covalent compounds. 7.4 Introduce mole concept (grams mole, gram atom, molar volume). 7.5 State Avogadro's law and solve related numerical problems.

8. Electrolysis	8.1 Differentiate between electrolytes and non-electrolytes with examples. 8.2 Differentiate between strong and weak electrolytes with examples. 8.3 Explain Arrhenius theory of electrolysis. 8.4 Explain application of electrolysis.	**8. Chemical Reaction**	8.1 Introduce precipitation reaction, hydrolysis reaction, catalytic reaction, photochemical reaction, oxidation reaction, reduction reaction and electrolytic reaction. 8.2 Introduce monomer, polymer, and polymerization. 8.3 Illustrate the applications of polymers.
9. Organic compounds	9.1 Introduce organic compounds. 9.2 Explain unique properties of carbon. 9.3 Introduce alkyl group, functional group and homologous series. 9.4 Give IUPAC name, condensed formula, and structural formula of alkane, alkene, alkyne, alcohol, ether, aldehyde, ketone, and carboxylic acid.	**9. Organic compounds**	9.1 Introduce open chain and closed chain organic compounds. 9.2 Identify aromatic hydrocarbon based on Huckel's rule. 9.3 Describe chain, position and functional isomers. 9.4 Illustrate addition, substitution and elimination reactions of aliphatic organic compounds.
10. Inorganic materials	10.1 Describe the general chemical properties of oxygen, sulphur, chlorine, water, HCl, NaOH and NaCl. 10.2 Illustrate alloys and its types. 10.3 Explain the application of alloys.	**10. Metallurgy**	10.1Introduce steps of metallurgy. 10.2Explain the steps of extraction of iron. 10.3Explain physical properties, chemical properties with application of iron, copper, aluminium, silver and gold.
11. Force	11.1 Introduce vector and scalar quantities. 11.2 Add and subtract vectors. 11.3 Calculate acceleration, average velocity and distance from the velocity-time graph. 11.4 Define and calculate moment of a force. 11.5 Define couple and give examples of couple in daily life. 11.6 Conceptualize linear momentum and explain its relation to force. 11.7 State the law of conservation of linear momentum and apply it to solve simple	**11. Force**	11.1 Describe a simple pendulum. 11.2 Identify and describe periodic motions. 11.3 Identify and describe circular motions. 11.4 Demonstrate and explain centripetal force and give examples of its application in daily life. 11.5 Describe gravitational field intensity and solve simple mathematical problems related to it. 11.6 Explain gravitational potential, escape velocity and their relationship. 11.7 Introduce center of gravity and relate it to stability of an object.

	problems in daily life.		
12. Radioactivity	12.1 Introduce alpha (α), beta (β) and gamma (γ) radiation as nuclear radiation. 12.2 State the characteristics of alpha (α), beta (β) and gamma (γ) radiations and explain their applications. 12.3 Describe the health hazards of radioactive materials and the method of handling and storing them safely.	**12. Heat**	12.1 Define evaporation and investigate the impact of evaporation on the temperature of the liquid. 12.2 Describe the factors affecting the rate of evaporation. 12.3 Differentiate between evaporation and boiling. 12.4 Explain thermal expansion in terms of molecular motion and describe different types of thermal expansion. 12.5 Explore impacts of thermal expansion in daily life. 12.6 Define latent heat and explain it in terms of kinetic molecular theory. 12.7 State and apply heat equation to solve simple mathematical problems.
13. Light	13.1 Define refraction of light and state Snell's law. 13.2 Describe and demonstrate total internal reflection of light. 13.3 Give the meaning of critical angle and solve mathematical problems related to refractive index and critical angle. 13.4 Determine the refractive index of glass. 13.5 Explain real and apparent depth with examples and solve simple mathematical problems related to it.	**13. Light**	13.1 Describe types, power and magnification of lens with examples and solve related simple mathematical problems 13.2 Use lens formula to solve related numerial problems. 13.3 Describe the function and the basic structure of compound microscope, and astronomical telescope.
14. Electricity and magnetism	14.1 Define electric field of a point charge and describe the field pattern around positive and negative point charges. 14.2 Relate the magnitude of electrostatic force between two point charges to the	**14. Electricity and magnetism**	14.1 Recognize secondary cell as a source of electricity. 14.2 Describe the structure and the chemical processes that occur during charging and discharging of a lead acid cell.

	magnitude of their charges and their separation distance. 14.3 Introduce capacitor as a charge storing device and give examples of its application in daily life. 14.4 Sketch magnetic lines of forces around a bar magnet. 14.5 Describe the magnetic field of the Earth. 14.6 Define angle of dip and the angle of declination and explain the process of finding their values.		14.3 State the advantages of secondary cell over primary cell. 14.4 Use galvanometer, ammeter and voltmeter in electric circuit. 14.5 Explain the structure of a galvanometer. 14.6 Explain the process of conversion of a galvanometer to ammeter and voltmeter. 14.7 Introduce semiconductor, diode and transistor and give examples of their daily life applications. 14.8 Describe paramagnetic and ferromagnetic materials in terms of molecular structure.
15. Geology	15.1 Define geology and explain its importance. 15.2 Describe tectonic plates and explain how their collision leads to formation of Fold Mountains. 15.3 Describe the cause of volcanic eruptions and earthquakes and their impact on people and the environment 15.4 Explain what can be done to reduce the impacts of earthquakes and volcanoes	**15. Geology and Astronomy**	15.1 Explain geochronology. 15.2 Describe fossils, process of formation of fossils and their importance. 15.3 Describe the fossils found in Nepal and explain their significance. 15.4 Explain the meaning and importance of carbon dating. 15.5 Explain the chronology of space exploration.

4. Scope and Sequence of Contents

Unit	Contents	Unit		Contents	
		CH			CH
1. Cell Biology	1.1 Prokaryotic and eukaryotic cell - introduction 1.2 Structure and function of cell organelles - cell wall - cell membrane - mitochondria - plastids - nucleus - golgibodies - centrosome - lysosome - vacuole - ribosome - endoplasmic reticulum 1.3 Relation of cell functions with respiration, excretion, reproduction, and photosynthesis	**10**	**1. Cell Biology**	1.1 Mitosis cell division - Introduction - Different stages (Interphase, Karyokinesis (prophase, metaphase, anaphase, telophase) and cytokinesis) 1.2 Meiosis of cell division: - Introduction - Meiosis-I (Interphase, Karyokinesis (Prophase-I, Metaphase-I, Anaphase-I, Telophase-I) - Meiosis-II (Prophase-II, Metaphase-II, Anaphase-II, Telophase-II, cytokinesis) 1.3 Significance of mitosis and meiosis cell division. 1.4 Role of sexual and asexual reproduction (genetic variation and formation of clone).	**10**
2. Life and life process	2.1 Microbiology - introduction and importance 2.2 Mode of reproduction of virus (lytic cycle of bacteriophase), bacteria (fission in E. coli) and fungi (budding in yeast) 2.3 Life cycle of mucor 2.4 Advantages and disadvantages of mucor	**10**	**2. Life and Life process**	2.1 Life cycle of Spirogyra and *Entamoeba*. 2.2 Osmosis and Transpiration process: Demonstration and Importance. 2.3 Intracelluar respiration - Introduction - Advantages	**7**
3. Genetics	3.1 Chromosome and its types (On the basis of structure and function)	**4**	**3. Genetics**	3.1 Mendel's law - Law of independent assortment	**8**

	3.2 Introduction to Genetics 3.3 Relation between gene and chromosome			- Phylogenetic chart of dihybrid cross - verification of Mendel's law of independent assortment. 3.2 RNA and DNA: Detail structure with nitrogen bases, sugar, phosphoric acid and bonding among them 3.3 RNA: Types (mRNA, rRNA and tRNA) and Function. 3.4 Role of DNA in genetics. 3.5 Sex linked inheritance - Introduction - types on the basis of location and process (colour blindness and haemophilia)	
4. Ecology	4.1 Ecology and ecosystem with examples. 4.2 Effects of increase and decrease in population of one species over other on ecosystem with the help of food chain and food web. 4.3 Bacterial and fungal decomposition process of organic matter. 4.4 Wetland ecosystem.	**8**	**4. Ecology**	4.1 Biological pyramid: Introduction and types 4.2 Energy transfer through different trophic level in ecosystem with illustration. 4.3 Biogeochemical cycle - Oxygen cycle - Carbon cycle - Nitrogen cycle	**5**
5. Applied Biology	5.1 Role of skin and mucus membrane in defense mechanism of human body 5.2 Role of blood in defense mechanism of human body (Phagocytosis, Antibody production) 5.3 Immunity and Vaccination: Introduction and Importance 5.4 Antibiotics: Introduction, Advantages and Disadvantages	**8**	**5. Applied Biology**	5.1 DNA finger printing: Introduction and Importance. 5.2 Cloning and Genetic Engineering - Concept and Related ethical issues. - Characteristics of clones 5.4 Minimization of variation in organisms due to cloning and evaluation of its effects 5.5 Bio weapons	**10**

				- Inroduction - History - Advantages and disadvantages 5.6 Organ transplantation: Introduction and Importance 5.7 Process and Importance of Kidney transplantation	
Total		**40**			**40**
Chemistry					
6. Atomic structure	6.1 Dalton's atomic theory - Postulates - Modifications 6.2 Subatomic particles - Introduction - Properties. 6.3 Rutherford's atomic model - Postulates 6.4 Bohr's atomic model - Postulates 6.5 Concept of - Atomic number - Atomic mass - Isotopes - Isobar - Isotones	7	**6. Periodic table**	6.1 Periodic table - Modern periodic law - Modern periodic table 6.2 Electronic configuration - s, p, d, f electronic configuration of elements up to atomic number 30 6.3 s-block, p-block, d-block, and f-block elements - Description - Characteristics. 6.4 Variation of periodic properties of elements in various groups and periods in terms of - Atomic size - Valency - Ionization potential - Electron affinity - Electronegativity. 6.5 Chemical reactivity of elements (1,2,15,16 and 17 group elements) in period and groups.	8

7. Gas laws	7.1 Boyle's law and Charles's law - Statement - Explain - Applications 7.2 Combined gas equation. - Derivation - Numerical problems 7.3 Standard temperature and pressure (STP). - Introduction - Concept 7.4 Kinetic theory of gases. - Assumptions 7.5 Real and idea gases - Introduction - Concept 7.6 Graham's law of diffusion of gas - Statement - Applications	8	**7. Chemical Bonding**	7.1 Covalent bond - Formation - Examples of covalent compounds - Characteristics of covalent compounds - Types (sigma and pi) 7.2 Co-ordinate covalent bonds. - Formation - Examples of co-ordinate covalent compounds 7.3 Mole concept - Grams mole - Gram atom - Molar volume 7.4 Avogadro's law - Statement - Numerical problems	8
8. Electrolysis	8.1 Electrolytes and non-electrolytes - Statement - Examples - Differences 8.2. Strong electrolytes and Weak electrolytes - Statement - Examples - Differences 8.3 Arrhenius theory of electrolysis	10	**8. Chemical reaction**	8.1 Chemical reaction and chemical equation - Introduction - Examples 8.2 Introduction to some Chemical reactions - Precipitation reaction - Hydrolysis reaction - Catalytic reaction - Photochemical reaction	7

	- Postulates 8.4 Application of electrolysis - Electroplating - Electrorefining Electrotyping			- Electrolytic reaction - Oxidation reaction - Reduction reaction 8.3 Monomer, polymer, and polymerization - Introduction - Examples - Types of polymers (natural and man-made) - Application of polymers	
9. Organic compounds	9.1 Organic compounds - Introduction - Examples 9.2 Unique properties of carbon - Tetracovalency of carbon - Catenation - Multiple bonding 9.3 Introduction to - Alkyl group - Functional group - Homologous series. 9.4 IUPAC name, condensed formula and structural formula for - Alkane - Alkene - Alkyne - Alcohol - Ether - Aldehyde - Ketone	**10**	**9. Organic compounds**	9.1 Organic compounds - Introduction - Examples 9.2 Open chain organic compounds - Statement and examples 9.3 Closed chain organic compounds (alicyclic and aromatic) - statement and examples 9.4 Huckel's rule - Statement - Identification of aromatic hydrocarbon based on Huckel's rule. 9.5 Description of - Chain isomerism - Position isomerism - Functional isomers 9.6 Introduction to some organic reactions - addition reaction (addition of homo-	11

	- Carboxylic acid			atomic molecules) - Substitution reaction - Elimination reactions of aliphatic organic compounds.	
10. Inorganic materials	10.1 general chemical properties of oxygen, sulphur, chlorine, water, HCl, NaOH and NaCl. 10.2 Alloys - Introduction and type - Application	**5**	**10. Metallurgy**	10.1 Metallurgy - Introduction 10.2 Extraction of iron - Steps of extraction of iron with chemical reaction 10.3 Physical properties and uses of iron, copper, aluminium, silver and gold. 10.4 Chemical properties of iron, copper, aluminium and silver with only dilute hydrochloric acid, sulphuric acid and nitric acid) and reaction of gold with aquaregia.	6
Total		40			**40**
Physics					
11. Force	11.1 Vector and scalar qualities - Definition and examples - Addition and subtraction of vectors 11.2 Velocity-time graph - Plotting - Determination of acceleration, average velocity and distance from v-t graph 11.3 Turning effect of force - Definition and calculation of moment of a force - Definition and daily life examples of Couple	12	11. Force	11.1 Simple pendulum - Description 11.2 Periodic motion - Definition - Examples 11.3 Circular motion - Definition - Examples 11.4 Centripetal force - Definition - Examples - Demonstration	12

	11.4 Linear momentum - Definition - Relation between linear momentum and force (Newton's Second law of motion) - Law of conservation of linear momentum and its application to solve simple daily life problems			- Daily life application 11.5 Gravitational field intensity - Introduction - Simple mathematical problems 11.6 Gravitational potential of the Earth - Concept - Definition - Meaning of escape velocity and its relation to gravitational potential 11.7 Centre of gravity - Meaning - Method of its determination in simple objects like pencil, ruler, etc. - Relationship with stability of an object	
12. Radioactivity	12.1Introduction of nuclear radiation - Types of nuclear radiations (alpha (α), beta (β) and gamma (γ)) - Characteristics (charge, mass, penetration and ionization power) of alpha (α), beta (β) and gamma (γ) radiations - Uses of nuclear radiations - Health hazards of nuclear radiations - Methods of safely handling and storing nuclear materials	6	12. Heat	12.1 Evaporation - Definition - Impact of evaporation on the temperature of the liquid - Factors affecting the rate of evaporation - Different between evaporation and boiling 12.2 Thermal expansion - Explanation in terms of molecular motion - Linear, superficial and cubical thermal expansions (no mathematical treatment but only meaning, demonstrations and examples) - Impacts of thermal expansion in daily life 12.3 Latent heat - Definition	10

				- Molecular explanation 12.4 Heat equation - Statement - Simple mathematical problems	
13. Light	13.1 Refraction - Definition - Snell's law 13.2 Total internal refraction of light - Demonstration - Meaning of critical angle - Simple numerical problems related to refractive index and critical angulation 13.3 Determination of refractive index of glass 13.4 Real and apparent depth - Meaning - Numerical problems	8	13. light	13.1 Lens - Types - Power - Magnification - Simple mathematical problems on power and magnification - Use of lens formula to solve related numerical problem 13.2 Optical instruments - Function and the basic structure of compound microscope - Function and the basic structure of astronomical telescope	9
14. Electricity and magnetism	14.1 Electric field and lines of force - Concept and definition - Field pattern around positive and negative point charges - Direction of electrostatic force between two like point charges and unlike point charges - Relation between magnitude of electrostatic force and the magnitude of charges and the distance between two point charges 14.2 Capacitor - Introduction as a charge storing device - Definition of capacitance - Unit of capacitance	14	14. Electricity and magnetism	14.1 Magnetic materials - Concept of molecular magnetism - Paramagnetic and ferromagnetic materials – examples and their molecular structure. 14.2 Secondary cell - Meaning, types and applications - General structure - Chemical processes that occur during charging and discharging of a lead acid cell - Advantages of secondary cell over primary cell 14.3 Use of ammeter and voltmeter. 14.4 Galvanometer	9

	- Examples of uses of capacitors in daily life 14.3 Magnetic lines of forces around a bar magnet 14.4 Magnetic field pattern of the Earth 14.5 Angle of dip and the angle of declination - Concept and definitions - Uses - Measurement			- Use - Structure - Process of converting it to ammeter and voltmeter 14.5 Semiconductor, diode and transistors - Meaning, examples and applications	
Total		40			40
Geology and Astronomy					
15. Geology	15.1 Meaning and importance of geology 15.2 Tectonic plates 15.3 Process of formation of a fold mountain 15.4 Volcanic eruptions - Causes - Effects on people and the environment - Measures to reduce the impacts 15.5 Earthquakes - Causes - Effects on people and the environment - Measures to reduce the impacts	8	15. Earth and the Universe	15.1 Geochronology – meaning and importance 15.2 Fossils - Definition - Process of formation - Importance - Types of fossils found in Nepal and their significance 15.3 Carbon Dating - meaning and importance 15.4 Planetarium – meaning and uses 15.5 Chronology of space exploration	8
Total Credit Hours (CH)		**128**			**128**

5. Practical and Project Work Activities

Grade 9		Grade 10	
1.	To observe permanent slide of Prokaryotic and Eukaryotic cell under microscope and draw the well labeled diagram based on observation.	1.	To observe the permanent slide of different stages of mitosis and meiosis and draw well labeled diagram based on observation.
2.	Prepare model of prokaryotic cell with cell organelles using locally available materials	2.	Prepare model of different stages of mitosis and meiosis by using locally available materials
3.	Prepare model of eukaryotic cell with cell organelles using locally available materials	3.	To observe the structure of spirogyra under microscope by collecting water from nearby water resource and draw a well labeled structure of it.
4.	Study the structure and characteristics of virus using reference material and prepare a report on it.	4.	To observe the permanent slide of life cycle of and Spirogyra and *Entamoeba* and draw a well labeled diagram of it.
5.	Study the structure and characteristics of bacteria using reference material and prepare a report on it.	5.	To demonstrate osmosis process in plants.
6.	Prepare a model of baceteriophase by using locally available material.	6.	To demonstrate transpiration process in plants.
7.	To grow mucor on the surface of bread/roti and demonstrate the life cycle of mucor and draw well labeled diagram of it.	7.	Prepare a model of Mendel's dihybrid cross with the help of available beans or other materials and demonstrate it
8.	Prepare a model of different types of chromosome by using locally available materials and present it in the classroom.	8.	Observe the ecosystem found in your surroundings and prepare a chart of biological pyramid and energy transfer in different trophic levels of that ecosystem
9.	Observe the ecosystem nearby your school and prepare a chart.	9.	Study the concept of cloning and genetic engineering and ethical issues of them with the help of reference materials and prepare a short report.
10.	Prepare a report on antibiotics with the help of reference mateirals and present it in the classroom	10.	Study the importance of organ transplantation and the practices done in Nepal and prepare a short report with the help of

			reference materials.
11.	Prepare a report on vaccines with the help of reference materials and present it in the classroom		
Chemistry			
12.	To display Rutherford's alpha rays scattering experiment on a chart paper.	11.	To display in a chart paper showing periodic trend of the periodic properties.
13.	To demonstrate effect of pressure in the volume of gas.	12.	To display in a chart paper showing the process of formation of sigma and pi bond.
14.	To demonstrate effect of temperature in the volume of gas.	13.	To display the structure of O_3 and SO_3 in a chart paper.
15.	To demonstrate the effect of catalyst in the chemical reaction	14.	To prepare the model to show the bonds of alkane, alkene and alkyne.
16.	To demonstrate effect of heat, solution and surface area on the chemical reaction.	15.	To display all possible structural isomers of C_5
17.	To display application of alcohol and carboxylic in a chart paper.	16.	To demonstrate that MP and BP of organic compounds is less than inorganic compounds.
18.	To show that organic compounds are insoluble in water but inorganic compounds are soluble in water.	17.	To demonstrate photochemical reaction using silver compounds.
19.	To identify strong and weak electrolytes between ammonium chloride and sodium chloride.	18.	To prepare a model of aliphatic and alicyclic compounds.
20.	To show copper plating over iron.	19.	To show the flow sheet of extraction of iron.
21.	To show electrolysis of water.	20.	Determination of centre of gravity of simple objects.
Physics			
22.	Draw the velocity time graph of given data using graph paper.	21.	Draw the ray diagram of compound microscope
23.	Make a chart showing the characteristics of alpha (α), beta (β)	22.	Draw the ray diagram of astronomical telescope.

	and gamma (γ) radiations		
24.	Demonstrate total internal reflection of light using water and laser beam / using test tube, water, beaker and marble or coloured object.	23.	Make a chart showing the advantages of secondary cell over primary cell
25.	Find the refractive index of glass.	24.	Draw the molecular structure of paramagnetic and ferromagnetic materials.
26.	Draw the magnetic lines of forces around a bar magnet using magnetic compass and a bar magnet		
27.	Find the value of angle of dip.		
28.	Make a chart showing the names of rocks and mineral found in different part of Himalayan region of Nepal.		
29.	Finding angle of dip.		

6. Learning Facilitation Process and Method

Learning facilitation process in science is the technique which enables the students for acquiring the knowledge, developing desired skills and scientific attitudes. It also encourages the students for learning from themselves, through interacting with natural world and forming their own thoughts and ideas. Every individual is different, so effective learning facilitation process selected by teachers' plays vital role to achieve optimum learning outcomes among diverse students.

The strategies of teaching may differ from one teacher to another but some strategies or methods are common in science teaching learning process. Some common strategies can be used in different units; however, some specific methods need to be used for specific content areas. Every teacher should be aware of following aspects for the effective facilitation of learning science in their respective classroom;

a. learning environment of the classroom
b. student's interest in subject matter
c. student's capacity to understand the subject
d. trust on selected strategies to success the teaching learning process
e. Encouraging students, developing creative thinking, inculcating collaborative, cooperative and supportive behaviors among the students
f. support student to explore their inherent character
g. emphasis to use locally available materials

In teaching learning process of science, varieties of approaches, methods, techniques can be used based on the nature of the content. Some are as follows;

a. Experiment method
b. Discussion method
c. Demonstration method
d. Question answer method
e. Field study method
f. Case study method
g. Observation method
h. Project method
i. Problem solving method
j. Inquiry method
k. Collaborative and cooperative method
l. Satellite method

Aforesaid methods are some examples that can be used for teaching learning of science. In addition, teacher can choose other appropriate, suitable and innovative methods of teaching science. Most importantly, local context and locally available materials should be emphasized

Twenty-five percent times is allocated for experiments /practical work. To develop science process skills in the student, practical activities should incorporate following tasks as far as possible.

a. observation
b. classification
c. grouping
d. reasoning
e. interpretation/presentation
f. drawing
g. reporting
h. identification
i. verification
j. inferring
k. prediction
l. material collection
m. description
n. record keeping

7. Evaluation Process

Evaluation is a process of assessing the students' learning progress and should be used as an integral part of teaching-and learning. Both formative and summative evaluation should be carried out to assess the students' learning.

Internal Evaluation

The main purpose of formative evaluation is to improve the student's learning. Formal as well as informal evaluation strategies will be used in formative evaluation. For assessing the students' learning by formative evaluation, different evaluation tools can be used. These includes classwork, observation of students' work and performance, homework, project work, oral test, unit test, monthly test and trimester examinations, self and peer assessment and so on. A portfolio (record keeping) of each student should be maintained by the teacher. The portfolio consists of the details on students' performance in different assessment areas given in the table below. The record of student's practical work, project work, students' performance in activities and achievement in test should be kept in his/her portfolio. The weightage of practical work is 25%. In this curriculum practical work includes the project works and practical tasks.

Assessment criteria of internal evaluation

Criteria of internal evaluation are given below:

S. N.	Criteria of assessment		weightage
1	Participation (Attendance and participation in learning activities)		3
2	Practical and project works	Collection and arrangement of materials for practical activities, testing, observation, tabulation, and drawing conclusion.	6
		Report/ Material Development • Reporting of practical / project works (topic, objective, procedures, results and conclusion), chart making, model making, materials construction	6
		Presentation: • Demonstration of one practical work and viva • Spotting (Drawing, classification, description of characteristics • Presentation of any one project work	4
3	Trimester test		6
			25

Final examination

Final evaluation will be carried out to assess the cognitive domain of the students. Out of 100, theoretical evaluation covers 75 percentage of the weight. The tool for external evaluation of theoretical learning will be a written examination. Questions for the external examination will be based on the specification grid developed by Curriculum Development Centre.

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