National School Curriculum

Department of School Education
Ministry of Education and Skills Development, Royal Government of Bhutan

INSTRUCTIONAL GUIDE FOR SCIENCE

CLASSES VII-VIII

“Your parents, relatives, and friends would be very proud of what you have achieved. At your age, to have completed your studies is your personal accomplishment. Your knowledge and capabilities are a great asset for the nation. I congratulate you for your achievements.

Finally, your capabilities and predisposition towards hard work will invariably shape the future of Bhutan. You must work with integrity, you must keep learning, keep working hard, and you must have the audacity to dream big.”

- His Majesty Jigme Khesar Namgyel Wangchuck

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Foreword

The erstwhile Royal Education Council (REC) developed Adapted and Prioritised curriculum for schools so that students can continue learning during the disruptions caused by the COVID-19 pandemic from March 2020. With the commencement of the 2021 academic session, the new normal curriculum, later renamed the National School Curriculum (NSC), was embraced as a paradigm shift of education from conventional knowledge-based learning to competency-based open source and experiential learning leveraged on digital technologies. In order to facilitate the effective implementation of the curriculum change, Instructional Guides were developed in all subjects, and the teachers were oriented through virtual and short contact modes as per the prevailing pandemic situations. The curricula were aimed at minimising the learning loss for learners as it was designed for implementation in different situations - during school closure or during regular contact instructional hours.

While these measures served as a solution to problems brought about by the pandemic and the changing global trend in education, resilient and more dynamic curricula and instructions remain the current priority of the Government. In cognizance of some of the shortfalls in the provisional edition of Instructional Guides (IG), the Department of Curriculum and Professional Development reviewed and revised the existing Instructional Guides across all subjects with the aim of enforcing the competency-based learning, and making teaching-learning happen 'anytime anywhere' commensurate to an inclusive education so that all learners are provided with the opportunity to learn at their pace and situation.

The revised Instructional Guides have drawn ideas and inspiration from various educational philosophies and principles, particularly the Delors Report, **Learning: The Treasure Within** (1996). The report prioritises the development of the whole person and not just academic knowledge through the four pillars: "learning to know", "learning to do", "learning to be", and "learning to live together". Therefore, the New Curriculum and the Instructional Guide is an attempt to transform education from the teaching of "what" to learning of "how" and "why" towards empowering learners with transversal competencies and 21st-century skills and preparing them to be lifelong learners.

It must be noted that the New Curriculum and the Instructional Guide are not just a response to the pandemic, but a culmination of the curriculum reform work for the last four years by the Royal Education Council. The school curricula are to be perceived as integrated and based on themes and problems that inspire learners to learn and to live in peace with our common humanity and our common planet. This has the potential the develop a strong base of knowledge about one's self and about the world, the purpose of learning, and being better able to participate in the social and political milieu. Thus, this initiative is envisaged to orient our educational process towards nurturing 'nationally rooted and globally competent citizens.

Wish all our learners and teachers a life-enriching teaching and learning.

Tashi Delek

Tashi Namgyal
Director

conventional education, which is predominantly knowledge-based and examination-centred teaching and learning has been the time old practises. The stress of this model is on the learning of textual information perceived by educators important for the grade. On the other hand, with the advancement in ICT, the world is flooded with such information, which is widely read by all at their leisure. What learners cannot acquire from the multiple sources are the skills, values and change of behaviour, which are crucial in facilitating learners to realise their potential to be socially responsible and productive individuals, and optimise their contribution to the nation-building processes – economic, social, and political development. In the contemporary world, textbook-based, knowledge-based education compromises the development of psychomotor and affective domains of learning, affecting the holistic development and psychosocial well-being of learners.

The pandemic situation also explicated that the old ways of working, teaching and learning, and lifestyle have limitations. Consequently, new ways of how we work and live, teach and learn, and stay connected are contemporary traditions. In this context, an overhaul of how we think and do is imperative, not a choice. The transformation of classroom instruction from teacher-centred to that learner-centred learning however calls for the following adjustment or even the overhaul of some of the practices.

i. Reduction of learning content to facilitate deep learning as opposed to the width of the teaching and learning through active engagement of learners.
ii. Integration of ICT as tools and end of the learner's education. The use of multimedia and ICT software are commonly utilised in teaching and learning as innovation to introduce variation in stimuli, and sustain learners' interest and zeal in learning.
iii. Adoption of theme-based learning content facilitates broadening the horizon of learning beyond the four walls and stimulates the transfer of the learnt concepts to the learner's immediate environment. This arrangement makes learners aware of the realities of the social, political, economic and cultural practices and ethos of the society. Being aware of the immediate environment of the scopes and challenges, learners are sensitised to the opportunities and issues.
iv. Consideration to ground the curriculum design and instruction approaches on the epistemological theories is imperative to facilitate deep learning as opposed to factual learning. The selection and use of them, however, are subject to the nature of the subject. For instance, constructivism is more apt for science, while connectivism may be relevant for languages and ICT curricula to facilitate deep learning and inspire the generation of new knowledge and ideas.
v. Active engagement of learners is imperative for competency-based education and learning. Inevitably, summative assessment has limitations in gauging the progressive development of the learner. This is achieved objectively by the use of continuous formative assessment (CFA). However, if summative assessment evidence is used to provide feedback to help learners in learning, it can serve as one of the techniques of CFA.

The curriculum is grounded on the wisdom and principles of competency-based learning, built on the reality of the immediate environment, and the belief system of the society, promotes personalised learning;

fosters life-enriching experiences, which inspires youth to generate new knowledge and create new ideas to innovate as young scientists or enterprising individuals.

Towards this, learning is facilitated through the "Instructional Guide" with learners taking responsibility for their learning. The roles of teachers are facilitation, guidance, evaluation in the course of learners' active engagement, and assess the performance for improvement and enhance learners' learning. Therefore, the NSC Science Instructional Guide (SCI IG) is an attempt to transform education from the teaching of "what" to learning of "how" and "why" towards empowering learners with the transversal competencies and the 21st-century skills and preparing them to be lifelong learners.

Purpose of the Instructional Guide

In the National School Curriculum, deep learning synonymous with "less is more" is facilitated with the use of an Instructional Guide for each subject and specific class. The content of the instruction in the guide for respective subjects is aligned with the subject's curriculum framework. Therefore, the Science IG is purported to achieve the following objectives towards facilitating uninterrupted teaching and learning:

i. Strengthen competency-based learning and experiential learning to foster sensitivity to realities of life and environment.
ii. Strengthen blended learning and flip classrooms with multimedia, digital pedagogies and ICT devices and websites as tools and ends of the learning.
iii. Prioritise learning content with an emphasis on creating time and space for deep learning and raising the sensitivity to the realities of the world around them through the active engagement of learners.
iv. Facilitate the use of CFA for learning using diverse appropriate assessment techniques and tools commensurate with individual differences in learning, and gather evidence to guide the planning of educational programs and activities for learners.
v. Promote inclusive learning through blended learning which facilitates learning anywhere, any time with the learner being responsible for the learning.
vi. Inspire teachers to assume the roles of facilitation, guide, motivator and evaluator.
vii. Guide both teachers and parents in facilitating the learning of their children.

Experiential and personalised learning practices are widely used around the world and are grounded on different models. One such model that suits the current situation and expectation of education for the 21st century is the ADDIE model (Analyse, Design, Develop, Implement and Evaluate).

How to Use an Instructional Guide?

The National School Curriculum (NSC) is inspired by the ideologies of competency-based education and the experiential learning ethos of educational practices. Therefore, the function of the NSC Instructional Guide (IG) is to facilitate deep learning and foster the learning of how to learn through active engagement and provisioning of diverse learning experiences. They include but are not limited to, real-time interaction with life realities, designing and modelling of artefacts, knowledge hunt through diverse sources – books and digital, and the epistemological processes of investigation and analysis to generate knowledge and create ideas of doing things differently to suit the situation and the problems.

The NSC IG is arranged and aligned with the NSCF in a progressive manner, encompassing all the aspects of competency-based learning and assessment. The content of the Instructional Guide for Science is organised as follows:

1. Theme

Each Theme is introduced with a broad overview of the bigger ideas, issues and concerns setting the context of the learning and sensitising learners of what learning experiences they are to engage in. The context is also to raise curiosity and be concerned with issues and challenges related to the content, society and the environment.

The teacher presents the theme with brief explanations, sensitization, or questions to stimulate the learner's thinking and curiosity. Learner also reads the overview and formulates expectations he or she aspires to gain from the theme.

2. Topic

Each theme contains two to five topics in order to cover the desired fundamental concepts and principles. Each topic begins with an overview of the fundamental concepts, ideas, laws and principles, issues and concerns to set the context of the learning and sensitise learners of what learning experiences they are to engage in.

The teacher presents the topic with brief explanations, sensitization, or questions to stimulate the learner's thinking and curiosity. Learner also reads the overview and formulates questions and hypotheses answers to the questions, and validates during the course of learning.

3. Competency

Based on the topic, a set of competency statements are outlined as the expected outcome of the chapter. Competency per se is the ability to analyse and synthesise information and apply the knowledge, skills and abilities required to successfully perform tasks in diverse situations. It is generally framed based on three domains of learning; cognitive/intellectual, performance, social and emotional, and behavioural competencies.

These competencies are the basis for the identification and selection of competencies that the learner is expected to achieve as the desired outcome. Teachers must develop a clear understanding of the expected competencies.

4. Scope

Scope in each topic informs of the expected key concepts, ideas, laws, laws, principles and issues that the topic is expected to emphasise. This serves as the basis for formulating learning objectives both for the formal instruction and the informal setting.

5. Learning objectives

The learning objectives are statements of what learners will know, be able to do, and be able to display by the end of every lesson of experiential learning. Every learning objective contains action words relevant to the domain of competency-based learning, which includes cognitive, psycho-motor and affective.

The learning objectives under every topic are aligned with the competencies identified. The learning objectives inform the design and selection of learning experiences that the learner is envisaged to engage with. It also informs teachers, learners and parents of the target or purpose of their teaching and learning.

6. Learning experiences

This section is crucial in the NSC IG. Learning experiences are a wide variety of experiences across different contexts and settings which transform the perceptions of the learner, facilitate conceptual understanding, yield emotional qualities, and nurture the acquisition of knowledge, skills and attitudes. In educational settings, learning experiences are ideally challenging, interesting, rich, engaging, meaningful, and appropriate to learner needs. Previous learning experiences are considered to be key factors in predicting further learning. As such, learning experiences in SCI IG are based on specific content knowledge and skills that facilitates experiential and deep learning. Such experiences foster the development of critical thinking and problem solving, creativity and innovation, communication, collaboration, citizenship and sensitivity to social and cultural values and practise.

The epistemology of NSC informs that teachers assume the roles of facilitation, guide, motivator and evaluator. Learners are active players in the competency-based learning paradigm. In order to facilitate uninterrupted learning as influenced by the situation, the design of the SCI IG and selection of learning experiences are based on the Blended Learning and Flip Classroom modes of instruction delivery. Therefore, cognizant of the ideology of experiential learning, the need for uninterrupted learning, and helping learners learn how to learn, the NSC IG provides only the suggestive pedagogical strategies and approaches arranged based on a spiral curriculum for progressive learning, with digital technologies as one of the main drivers. Therefore, teachers have the freedom to deploy diverse teaching methods, mechanism of classroom management, and implementation of continuous formative assessment.

By this token, learners are expected to participate in every learning activity, choose a wide range of forms and means of recording their experiences and communicating with others, and reflect on the learning. Further, teachers need to inform learners that based on the progressive step-by-step organisation of the learning experiences, learners can continue learning anytime, anywhere.

The blended learning and flip classroom modes of lesson delivery mandate that teachers develop their own tutorial audio-visual materials and use them to inspire learners. They also upload any audio-visuals in the Google classroom or in any of the recommended social media to support learning. One crucial role of a teacher is to guide learners using various sources of information and ideas by using websites and library resources as stipulated by learning experiences. The teacher also digitises assessments. Owing to the heavy reliance of pedagogies on digital technologies, particularly the use of apps and online tools, teachers need to develop digital competencies. At the same time, teachers and schools need to ensure that accessibility and connectivity are not the learning barrier.

Based on the subject nature, the SCI IG envisages that the learner participates in real-time research studies, interaction with the environment and stakeholders, and investigations. During field visits and trips, school administration, local authorities and parents support and facilitate the conduct of studies in the community setting. Teachers and learners must plan and get all necessary approvals and consensus by taking all the safety measures and protocols into consideration. The teacher also conducts reflection sessions by asking a few questions and follow-up lessons based on the topic.

7. Questions

Learning experiences, whether visual viewing or reading, classroom task completion, investigations or field observations, are concluded with a set of questions. These questions are fundamental to facilitate learners to construct knowledge and create ideas. Teachers are to use these questions to evaluate the learner's actual participation in the learning processes and hence assess their learning. They can serve as the means of assessment as an integral part of CFA, or learners can use them to stimulate reflection to strengthen their metacognition of learning.

8. Assessment and Reporting

In the context of competency-based learning, assessment of intellectual, psychomotor, social and emotional competencies are imperatives; unfortunately, they cannot be assessed summative, but rather must be assessed on a real-time basis when learners are displaying their competencies and dispositions. Continuous formative assessment (CFA) is conducted throughout the educational process with a view to enhancing student learning. It implies: eliciting evidence about learning to close the gap between current and desired performance; providing feedback to students; and involving students in the assessment and learning process (CCSSO 2008).

Uncertain of the diversity of learners and the purpose and context of assessment, the IG does not provide specific assessment techniques and tools, rather the teacher can use appropriate assessment tools and techniques of CFA based on the topics and lessons. The assessment must happen in a continuous mode in accordance with the assessment section in the NSCF for Science (REC 2021).
Teachers use any appropriate techniques and tools leveraging on digitised assessment, both for gauging learning progress on a quarterly basis, recording and reporting.

9. Resources

This section provides an overview of resources, digital - online and offline, and physical materials. It must be noted that in the NSC, textbooks are to be used as one of the resources. This discourages textbook teaching but promotes the facilitation of learners in learning.

10. Challenge Your Thinking

This section provides suggestive questions covering all the topics to assess learners' intellectual, psychomotor, social and emotional competencies. It has a mix of knowledge-based and competency-based and intellectually challenging questions. Challenging your Thinking can help learners understand and be aware of their performance, and of the areas for improvement. The diversity of questions is to stimulate learners to use critical thinking, creativity, analysis, making connections and drawing conclusions as the means to generate knowledge and ideas.

11. Annexure / Appendix

In helping the teacher and learners in effective teaching and learning, there is a need for pertinent information, ideas and clues which cannot be covered in the main text. Such resources are generally annexed for ready reference and information.

The teacher and learners refer to sample assessment techniques and tools in using CFA during the teaching and learning process, clarify their misconception by referring to the assessment scheme and modes with the assessment matrix, and plan lessons based on the topic-wise weighting and instructional time for each topic.

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Life Processes

1.1 Cells

Our surroundings have different kinds of living organisms. All living organisms are made up of cells. Generally, cells are so small that they cannot be seen with naked eyes. They can be seen only with the help of a microscope. Some organisms are made up of a single cell while others are made up of many cells. Cells vary in shape and size.

Inside a cell, there are several essential structures which carry out different functions for the survival of organisms. Are cells the same in all animals? Why are cells important for living organisms?

Competencies:

Explore various cell types and compare the plant and animal cells to grasp the importance of cells in the survival of organisms.

1.1.1 Types, Structures and Functions

Scope: This topic introduces cells, unicellular organisms and multicellular organisms, the shapes and size of cells, structures and parts of plant and animal cells. It also focuses on how to handle a compound microscope during the activity of preparation and observation of temporary slides.

Learning Objectives:

- *Explain the cell.*
- *Compare unicellular and multicellular organisms.*
- *Explore different shapes and sizes of the cells.*
- *Examine different parts of an animal cell.*
- *State the significance of animal cells in maintaining the life processes of an organism.*
- *Examine different parts of a plant cell.*
- *Compare plant cells and animal cells.*
- *State the importance of plant cells for the survival of organisms.*
- *Identify the parts of the microscope and their scientific uses.*
- *Prepare a temporary slide of onion cell and cheek cell.*
- *Draw to compare an onion cell and cheek cell as observed under the microscope.*

Learning Experiences

Cells are invisible to the naked eye; therefore, they are usually observed under the microscope. The structure and different cell organelles of plant and animal cells are visible when it is observed under the microscope or electron microscope. Do you think plant and animal cells are the same? Have you ever wondered how plants and animals grow?

The learner explores the parts and functions of a compound microscope by watching the video with the link https://bit.ly/3GHmqPD and then answers the following questions.

1. Draw a compound microscope and label all its parts.
2. Explain the function of each part.

Then the learner explores the concepts of cell, unicellular and multicellular organisms, shapes and sizes of cells from any relevant sources and answers the following questions:

1. What is a cell?
2. Differentiate between unicellular and multicellular organisms with some examples.
3. Why do cells have different shapes and sizes?

The learner uses the link https://bit.ly/33D8w30 to learn the procedure of preparing temporary slides. Then the learner prepares temporary slides of plant and animal cells (using onion and cheek) and observes them under the compound microscope. In addition, the learner may also observe permanent slides of plant and animal cells.

Then the learner also uses the apps such as 'Cell World', 'Cell organelles and ' 3DCell organelles' or any relevant sources like https://bit.ly/33XDwub, to explore the structure of plant and animal cells to correlate with the structure of cells observed in the slides provided by the teacher.

The learner compares and contrasts the structure of an animal and a plant cell based on the observations from the activities carried out using the web link http://surl.li/ptzbz on how to prepare temporary slides and answers the following questions:

1. Identify the common cell organelles in plant and animal cells and explain their functions.
2. Explain the structural differences between a plant cell and an animal cell.
3. Relate the significance of plant and animal cells as the fundamental units of life.

Cells are the basic units of living organisms. Cells give structure and carry out functions in living organisms. There are many tiny structures in plant and animal cells with specific functions. There are structural similarities and differences between plant and animal cells. Cells are very important for the functioning and survival of living organisms.

Learners explore the resources from the suggested link https://bit.ly/-animalcell_stu or any other relevant resources to learn different cell organelles and its function. After watching the video of animal cells, learners illustrate the animal cells, its parts and list their function. Further the learners complete the following questions:

1. Why are mitochondria often referred to as the powerhouse of the cell?
2. Which cell organelle do you think is the most important in animal cells? Justify.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of cell, unicellular and	• Assess the learner's ability to prepare temporary slides and correctly use a	• Assess the learner's understanding of the significance of the cell and

multicellular organisms, cell organelles and their functions in plant and animal cells.	compound microscope to observe them. In addition, assess the learner's ability to compare and contrast plant cells and animal cells to find out their differences.	its organelles in the survival of an organism.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Seven (2020), REC
4. Apps: Cell world, Cell organelles, 3D cell organelles
5. Parts and functions of a compound microscope: https://bit.ly/3GHmqPD
6. Preparation of temporary slides of cells: https://bit.ly/33D8w30
7. Cell organelles and functions: https://bit.ly/33XDwub

Challenge Your Thinking

1. Explain cells as the fundamental unit of life.
2. Bacteria, viruses, and amoeba exist freely in diverse conditions and substrates. Explain how and why these phenomena.
3. Why do plant cells have an additional layer surrounding the cell membrane? What is the layer known as?
4. Cells consist of many organelles, yet we do not call any of these organelles structural and functional unit of living organisms. Explain.
5. What are the main functional regions of a cell? Explain.
6. Read the following statements and write the appropriate term against each statement.
    a. I control the functions of a cell. Who am I?
    b. I am like a policeman. I do not allow everything to get in and out of the cell. Who am I?
    c. I transfer characters from parents to offspring. Who am I?
7. Sonam tried to observe a temporary slide of a plant under the microscope, but she could not see all the cell organelles found in the plants. Explain.
8. Compare plant and animal cells and explain the structural and functional differences.
9. How are the cells of a multicellular organism different from the cells of a unicellular organism?

1.2. Humans as Organism

Humans belong to the most advanced group of organisms on the planet. The human body has different types of cells that make up different organs and organ systems like the skeletal system, respiratory system, nervous system, and reproductive system. Our bodies require nutrients, which are obtained from the foods we consume. Nutrition, healthy behaviours, physical activity, and personal hygiene are all important for good health. Lack of nutrients and unhygienic conditions can cause various diseases.

Competencies:

Explore nutrition, health, and organ systems to understand how they contribute to the proper functioning of the human body.

1.2.1 Nutrition

Scope: This topic covers food nutrients [carbohydrates, proteins, fats, minerals, vitamins, water, roughage /fibre] and their deficiency diseases and excess consumption of food nutrients significance in organisms' survival. It also focuses on testing foods for the presence of carbohydrates, fats, and proteins.

Learning Objectives:

- *Explain the significance of nutrition for proper growth and development of the human body.*
- *Explain the causes of diseases related to insufficient consumption of food nutrients.*
- *Investigate the presence of carbohydrates, fats, and proteins in foods.*

Learning Experiences

All living organisms need food to live and grow. The process of intake of food, and converting it into energy and other vital nutrients which are used by the body is called nutrition. Most food contains a mixture of different nutrients; each nutrient has a role to play in keeping the body healthy. Both the lack of proper nutrients and the excess consumption of nutrients can cause diseases. In order to be healthy, it's essential to eat the right food. Think about your eating habits. Are you eating the right food?

The learner gathers information on the causes of deficiency diseases from the suggested web link https://bit.ly/3EQjS00 and https://bit.ly/31vrsQ6, or any other relevant resources. The learner records the information in the following format:

Table 2.1. Deficiency Diseases

Nutrients	Sources	Importance	Deficiency Diseases

The learner shares the information with the class and invites discussion. After understanding deficiency diseases, the learner explores information on diseases caused by excessive consumption of food nutrients.

Based on the information, the learner prepares a PowerPoint presentation on the common diseases caused by excessive consumption of food nutrients and presents it to the class. Then the learner answers the following questions:

1. Differentiate between Kwashiorkor and marasmus.
2. Discuss two common diseases caused by the excess consumption of food nutrients.
3. Discuss the diseases caused by the deficiency of minerals and vitamins.
4. Explain the significance of nutrition in the proper growth and development of our body.

Next, the learner carries out an experiment to investigate the presence of nutrients such as carbohydrates, proteins and fats in various foods. The learners refer to any relevant sources to help them with the procedure to carry out the experiment. The learner records their findings in the following format.

Table 2.2. Carbohydrate test

Food item	Observation	Conclusion

Table 2.3. Fat test

Food item	Observation	Conclusion

Table 2.4. Protein test

Food item	Observation	Conclusion

After the experiment, the learner shares their findings with the class and then answers the following questions:

1. What conclusions can you draw from the three experiments?
2. Explain the importance of testing food items.
3. What were the variables used in the experiment?

Food is the source of all the nutrients required by the body. Some nutrients are required in large amounts and some are required in small amounts. Overnutrition as well as undernutrition can cause diseases. For good health, it is important to eat the right kind and right amount of food.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's ability to explain that both overnutrition and undernutrition can cause diseases with examples and	• Assess the learner's creativity and critical thinking in making the PowerPoint presentation and their honesty and	• Assess the learner's interest in adopting healthy eating habits after understanding the significance of nutrition for the

the significance of nutrition for the proper growth and development of the human body.	observation skills while carrying out the experiment on a food test.	proper growth and development of our body.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Seven (2020), REC
4. How food nutrients affect our body: https://bit.ly/3EQjS00
5. Deficiency diseases: https://bit.ly/31vrsQ6

1.2.2 Movement

Scope: This topic deals with the parts of the human skeleton: Axial Skeleton-skull (cranium and facial bones), rib cage [true ribs, floating ribs, and sternum], and vertebral column (back bone). Appendicular Skeleton-pectoral girdles (clavicle and scapula), pelvic girdles (hip bone, sacrum, and coccyx), bones of limbs [forelimbs and hind limbs] and their functions.

Learning Objectives:

- *Identify different parts of the human skeleton.*
- *State the functions of the parts of the human skeleton.*
- *Describe the importance of the human skeleton.*

Learning Experiences

The human body is supported by a framework of bones called the skeleton. It provides support, gives shape, protects the organs and produces blood cells. The skeleton works in collaboration with the muscles to help in movement. The human skeleton is divided into two categories which are the axial and appendicular skeleton. Different types of bones have specific functions to perform for the movement to be possible. Will our body function without the skeleton?

The learner explores apps on the skeletal system from the google play store and instals the most appropriate one on their phone. They explore the different parts and functions of the skeleton. Based on the information gathered, the learner uses a skeleton model to identify the different bones and explains their functions.

In addition, the learner uses an assessment worksheet from the link https://bit.ly/3HGZVuv and checks their understanding of the skeletal system. Finally, the learner answers the following questions:

1. Draw the skeleton of a human and label the axial skeleton, appendicular skeleton and other parts of the skeletal system.
2. Compare and contrast the bones and function of the appendicular and axial skeleton.
3. Explain the significance of the skeleton in the movement of the body and for one's own well-being.

The movement of our body is possible due to the collective actions of muscles and bones. Together, they support our body's weight, maintain our posture and help us to move. There are 206 bones in the human body and each bone has specific functions to carry out for the movement of the human body.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's ability to explain the functions of different parts of the skeleton.	• Assess the learner's observation and analysing skills while completing the worksheet and using the app on the skeletal system.	• Assess the learner's understanding of the significance of the skeleton in our daily lives.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Seven (2020), REC
4. App: The skeletal system
5. Skeleton worksheet: https://bit.ly/3HGZVuv

1.2.3 Breathing and Respiration

Scope: This topic highlights what breathing and respiration are, parts of the human respiratory system and their functions. It also includes the mechanism of breathing.

Learning Objectives:

- *Identify different parts of the human respiratory system.*
- *List the functions of different parts of a human respiratory system.*
- *Demonstrate the mechanism of breathing with the help of a model of the human respiratory system.*
- *Explain the significance of the human respiratory system.*

Learning Experiences

What does our body require to carry out various tasks in our daily lives? The food we consume provides energy to our bodies. The cells do not have direct access to the energy of the body. Cells use oxygen to release energy from the digested food through a process called respiration. Breathing is the process of exchange of gases by inhaling oxygen and exhaling carbon dioxide. Breathing and respiration are ongoing processes that occur in all living things.

Thus, the process of respiration makes the energy available to plant and animal bodies. How does respiration take place in humans? What would happen to us if there is an insufficient supply of oxygen?

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The learner gathers information on the process of respiration and breathing from the web link https://bit.ly/33uoLio or from other relevant sources. Explains the difference between breathing and respiration to the class.

The learner then answers the questions given below:

1. How do we get the energy to perform our daily activities?
2. Explain the process of breathing.
3. How is respiration different from breathing?
4. Relate your life experiences of being in a place where there has been insufficient oxygen. Explain the consequences on your body.

The learner then collects information on parts of the human respiratory system and their functions from the suggested web link https://bit.ly/3f09DM6 or from other relevant resources. Identifies the different parts and their functions and shares them to the class.

As a follow-up activity, the learner then answers the following questions:

1. What happens if one part of the respiratory system fails to carry out its function properly?
2. The walls of the trachea do not collapse even when there is less air in it. Why?
3. A smoker develops damage to several alveoli, which gradually do not function. How does this affect the gas exchange?
4. What information useful to your life did you gain from this lesson?

Next, the learner in the team explores how breathing happens in our body from the suggested web link https://rb.gy/7xbdi8 or from other relevant sources.

After watching the video, the learner then develops a model of the human respiratory system with the available materials to explain the mechanism of breathing. The team presents their model to the class and explains the mechanism of breathing.

Respiration is necessary for living beings to survive. It releases energy from the food. Glucose is broken down into carbon dioxide and water using the oxygen we breathe in. During the process, energy is released. The breakdown of glucose takes place in an organism's cells.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's understanding of the parts and functions of the human respiratory system, mechanism of breathing and types of respiration in plants.	• Assess the learner's ability to construct and demonstrate the mechanism of breathing with a model.	• Assess the learner's creativity in developing the working model of the human respiratory system.

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For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Seven (2020), REC
4. Breathing and respiration: https://bit.ly/33uoLio
5. Parts of the human respiratory system: https://bit.ly/3f09DM6
6. The working mechanism of breathing: https://rb.gy/7xbdi8
7. Types of respiration in plants: https://bit.ly/3nNJrJn

1.2.4 Reproduction

Scope: This topic includes the functions of different parts of the male and female reproductive systems. It also touches on the phases of the menstrual cycle and the ways to promote health and hygiene.

Learning Objectives:

- *Identify different parts of human reproductive organs.*
- *Mention the functions of the human reproductive organs.*
- *Differentiate between primary and secondary sexual characteristics.*
- *Describe the phases of the menstrual cycle.*
- *Recognize ways of maintaining personal health and hygiene during menstruation.*

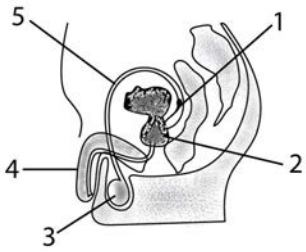
Learning Experiences

Reproduction maintains the continuity of life on Earth. Reproduction is the process by which living organisms produce young ones of their own kind. Fertilisation, which is the fusion of male and female gametes, is an important process in sexual reproduction. The male gamete produced by males is called sperm, and the ovum (plural: ova) is the female gamete produced in the female body.

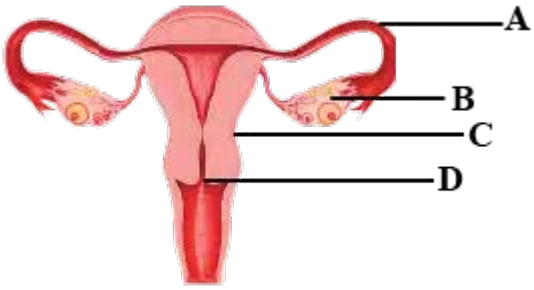
The male and female have separate reproductive systems. People often use the terms “sex” and “gender” interchangeably. However, sex and gender are different. “Sex” refers to the physical differences between males, females, or intersex. A person typically has their sex assigned at birth based on their physiological characteristics, including their genitalia. Gender refers to socially constructed roles, behaviours, expressions and identities.

The learner explores the parts and functions of the male and female reproductive systems from the suggested web links: https://bit.ly/3GGESbe and https://bit.ly/3FBGz8q respectively. Using the information from the two videos the learner completes the live worksheets in the link: https://bit.ly/3FxCuCc and https://bit.ly/3KrhqRI to check their understanding of the concept.

The learner answers the following questions as a follow-up activity:



a. What is the function of the part labelled 4?
b. What will happen if part 5 is cut off?
c. Which part is responsible for producing the sperm?



a. In which part does the development of the embryo take place?
b. What is the function of the part labelled B?
c. What would happen if the part labelled A is cut off?
d. Differentiate between primary and secondary sexual characteristics.

The onset of sexual maturity in an individual is called puberty. It is accompanied by the onset of menstruation in girls. It is important to maintain personal hygiene during menstruation to promote health and social stigma.

The learner explores the phases of the menstrual cycle from the video link https://bit.ly/3q70pnN to understand the significance of each phase. The learner in teams discusses the phases of the menstrual cycle. The girls in the team lead the discussion to facilitate people to talk about menstruation openly.

Next, in teams, they discuss the ways of maintaining personal health and hygiene during menstruation and prepare an awareness poster to display in any strategic locations in the school.

Further, the learners explore an app on the period tracker in the google play store and install whichever is user-friendly on their phones and use it to track their period duration and time, so that they can be prepared for the next period.

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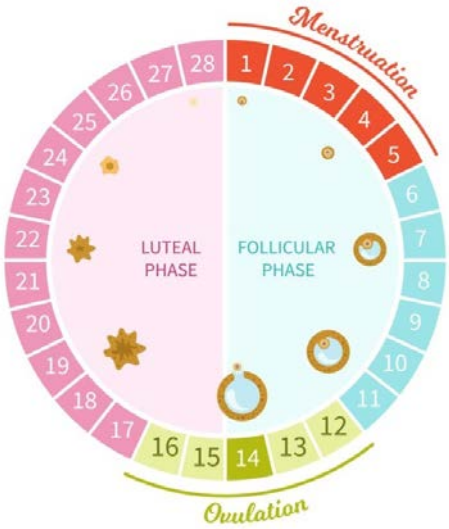
After the activity, the learner responds to the following questions based on the figure given below.



a. What happens during the follicular phase?
b. A mature egg is released from the ovary. Which phase is the statement describing?
c. Is the menstruation duration the same for all women? Explain.
d. What is the significance of the luteal phase?

1. Why is it necessary to maintain personal hygiene during menstruation?
2. Menstruation is a natural phenomenon and we have to support girls during menstruation time. Do you agree with the statement? Explain.
3. Discuss the advantages and disadvantages of using Period Trackers Apps.

During the menstrual cycle, a woman or girl undergoes a time of anxiety and worries about disposing of waste in safe places. If it is to be reused, it needs to be washed, dried and stored, ready for reuse. Why do we need to manage menstrual waste?

The learner in teams explores innovative and creative ideas to manage menstrual waste through a small-scale study. They deploy a Design Thinking method.

The teams can share their ideas with the neighbouring schools too. The learners answer the following questions:

1. Write the research questions that the team used.
2. Explain the steps that you used in designing the innovative ways of managing menstruation wastes.
3. What can we do to manage menstrual waste at home?
4. Suggest a few ways in which we can manage menstrual waste in the school.
5. Identify some of the emotional stress people undergo during the menstrual cycle. Suggest ways to overcome them.
6. What can peers, parents and elders do to prevent distress during the cycle?

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's ability to explain the functions of different parts of male and female reproductive systems, explain the differences between sex and gender and describe the phases of the menstrual cycle.	• Assess the learner's creativity and innovative skills in creating ideas for managing menstrual waste in school.	• Assess the learner's interest in recognising menstruation as a natural phenomenon, and respect and show concern for girls and women.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Seven (2020), REC
4. Male reproductive system: https://bit.ly/3GGESbe
5. Female reproductive system: https://bit.ly/3FBGz8q
6. Male reproductive system worksheet: https://bit.ly/3FxCuCc
7. Female reproductive system worksheet: https://bit.ly/3KrhqRI
8. Menstrual cycle: https://bit.ly/3q70pnN

1.2.5 Nervous System

Scope: This topic highlights the parts of the human nervous system - brain (limited to cerebrum, cerebellum and medulla oblongata), spinal cord (just a cross-sectional structure in terms of long and cylindrical structure made of fluids, tissues, and nerve cells); nerves, types of nerves and their functions - sensory nerves, motor nerves and mixed nerves.)

Learning Objectives:

- *Describe the structures and functions of the human nervous system.*
- *Identify different types of nerves and their function.*
- *Explain the importance of a healthy nervous system for the emotional well-being of a person.*

Learning Experiences

The nervous system is the main regulating, coordinating and communicating organ system in the human body. It controls and coordinates almost all the activities of the body. For example, it helps you ride a bicycle using various body parts in a smooth coordinated manner. It is also the centre of our thoughts, learning and memory. The brain, the spinal cord and the nerves are the main parts of the nervous system. Do you know how the nervous system does all these complex functions in the body?

The learner explores the information on the brain, spinal cord and nerves of the human nervous system and their functions by using any reliable source.

Then the learner explores different types of nerves including sensory, motor and mixed nerves, and their functions as the fundamental part of the nervous system from the suggested web link https://bit.ly/3qBHkdr. Based on the information gathered, the learner identifies and writes about the parts and functions of the brain and the different types of nerves in the body.

Later the learner answers the following questions:

1. Explain the parts of the brain and their functions.
2. Differentiate between sensory and motor nerves.
3. How is the brain different from the spinal cord in terms of its structure and function?
4. Identify a few diseases related to nervous disorders.

The nervous system is the controlling and coordinating system of the body. It mainly consists of the brain, the spinal cord and the nerves. There are three types of nerves. The nervous system plays an important role in the normal functioning of all the functions in the body.

Importance of a healthy nervous system. *The health of the nervous system is crucial for the emotional well-being of a person because the nervous system plays a fundamental role in regulating and responding to emotions. The nervous system is divided into two main components: the central nervous system (CNS), which includes the brain and spinal cord, and the peripheral nervous system (PNS), which includes nerves that extend throughout the rest of the body.*

Here are several ways in which the health of the nervous system impacts emotional well-being:

1. *mood disorders such as depression and anxiety.*
2. *regulating involuntary bodily functions, including heart rate, digestion, and respiratory rate.*
3. *the "fight or flight" response.*
4. *ability to reorganise and adapt.*

In summary, the health of the nervous system is intricately linked to emotional well-being. Disruptions or imbalances in the nervous system can contribute to the development and exacerbation of emotional disorders. Conversely, promoting a healthy nervous system through lifestyle choices, stress management, and mental health practices can positively impact emotional well-being.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of the parts of the brain, spinal	• Assess the learner's skill of gathering and interpreting	• Assess the learner's understanding of the significance of the nervous

cord, types of nerves and their functions.	the information gathered from different sources.	system.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Seven (2020), REC
4. Nerve, types of nerves and their functions link: https://bit.ly/3qBHkdr

1.2.6 Health

Scope: This topic introduces communicable and non-communicable diseases and their causes, symptoms, and preventions. Common communicable diseases include diarrhoea, typhoid, AIDS, common cold and chickenpox, ringworm, malaria. Common non- communicable diseases include diabetes, blood pressure, asthma, cancer, stroke and obesity.

Learning Objectives:

- *Explain causes, symptoms, and preventions of communicable diseases.*
- *Explain causes, symptoms, and preventions of non-communicable diseases.*
- *Design strategies to mitigate the outbreak of communicable diseases due to climate change.*

Learning Experiences

Human health is affected by many kinds of diseases. Some of these diseases are transmitted from person to person, such as the Common cold, AIDS, ringworm, etc. Some are not, such as diabetes, cancer, blood pressure, etc. Every disease has its own cause, signs and symptoms, and preventive measures. The prevalence of diseases in society has many adverse impacts on the economy, well-being and daily human affairs. Diseases are spread more by the events of climate changes. Is it possible for humans to stay disease free? If yes, how can we do it?

The learner explores the suggested link https://www.youtube.com/watch?v=BTH4DqOMp94or https://tinyurl.com/bdvd46vz or any other relevant resources to gather information on communicable and non-communicable diseases.

The learner plans and conducts a survey in their locality to study the prevalence of communicable and non-communicable diseases. The learner analyses the data gathered from the survey and triangulates the data with the information explored from relevant sources on the causes, symptoms and preventive measures. The learners relate the communicable diseases that are spread more by the events of climate change and create strategies to mitigate communicable diseases caused by climate change.

Then, the learner in groups present the findings to the class and answers the following questions:

1. Explain how a communicable disease is different from a non-communicable disease with an example each.

2. What are some common risk factors for diabetic and hypertension people?
3. If a person is suffering from COVID-19, what measures can the person and the family have to take to prevent the spread of the disease?
4. If diseases are prevalent in a society, how would the people and society be affected by the situation?

Now, explore the indigenous health practices in your community. Discuss the pros and cons of these practices.

Many diseases affect human health. Some of these diseases are communicable and some are not. Most of these diseases can be prevented. Diseases can have adverse impacts on society. Learners watch the video using the link Global warming risk of infectious diseases to understand how communicable diseases are spread more by the events of climate change. Learners then design a poster on how communicable diseases are spread during climate change, and possible mitigation strategies. The teams display their posters and presents in the class and also answer the following questions:

1. How does global warming contribute to the increased risk of infectious diseases?
2. What are some specific examples of infectious diseases that are expected to become more prevalent or widespread due to climate change?
3. How do changes in temperature and precipitation patterns influence the spread of vector-borne diseases in the context of climate change?
4. What role does the alteration of ecosystems play in the connection between climate change and the emergence of new infectious diseases?
5. How can global efforts to mitigate climate change also contribute to reducing the risk of infectious diseases?

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of common communicable and noncommunicable diseases, their causes, symptoms and preventive measures.	• Assess the learner's ability to gather information on the diseases from various sources, carry out the survey and organise the information collected and present it using an appropriate presentation tool in a creative way.	• Assess the learner's understanding of the impacts of communicable and non-communicable diseases on various aspects of society.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science, (2022)
2. REC repository
3. Science Class Seven (2020), REC
4. Climate Change: *Global warming risk of infectious diseases*

Challenge Your Thinking

1. Critique on Bhutanese eating habits in the context of nutrient intake.
2. The table below shows a mess menu of Mendribling Middle Secondary School. The study, and answer the questions that follow.

Days of a week	Breakfast	Lunch	Dinner
Monday	Bread, jam, egg and milk	Rice, dal, beef, vegetable curry and fruits	Rice, dal and mixed vegetable curry
Tuesday	Rice, suja and fried vegetable	Rice, dal, and vegetable curry	Rice, vegetable curry
Wednesday	Rice, chickpea and milk tea	Rice, dal and vegetable curry	Rice, pork and vegetable curry
Thursday	Fried rice and milk tea	Rice, dal, ema datsi and fruits	Rice, dal and vegetable curry
Friday	Rice, fried, vegetable and suja	Rice, dal, pork, and fruits	Rice, dal, papad and vegetable curry
Saturday	Bread, jam and milk tea	Rice, dal and vegetable curry	Rice, dal and Kewa Datshi
Sunday	Fried rice, chickpea and milk tea	Rice, dal, fish, vegetable curry and fruits	Rice, kewa datshi, fish, curd and fruits

   a. On which days do the students get more protein?
   b. Which is the most common nutrient on the menu? Identify its source.
   c. What nutrients would be missing if the vegetables were not on the menu?
   d. What deficiency disease are students likely to get if fruits are missing from the menu?
3. There are deficiency diseases as well as diseases caused by excess consumption of food. Which types of diseases are rampant these days? Why?
4. Bones protect the vital organs of our body. Why do the organs need protection?
5. Explain the difference between sex and gender.
6. Society has recently accepted marriages between the same sexes, but they can never become biological parents. Explain.

7. In schools, it is difficult to manage menstrual waste. Suggest some ways to manage menstrual waste efficiently.
8. Analyse the role of teachers in creating awareness regarding menstruation and menstrual waste management in school.
9. If the spinal cord of a person is damaged, how would it affect the functioning of the body?
10. Explain why the nervous system is considered the controlling and coordinating system of the body.
11. It is not advisable to hit the head of a person. Why?
12. How are communicable diseases similar and different from each other?
13. Cells perform various functions like digestion, excretion, reproduction, and transport. This is the reason why cells in organisms need energy. What is the source of the energy which is utilised by the cells?
14. Dorji did heavy exercise continuously for three hours, and then after some time, he experienced muscle cramps. What could be the reason for experiencing cramps in the muscles?
15. Karma recorded that at rest, he was breathing in and out at the rate of 18 times per minute. After playing football for 15 minutes, his breathing rate increased up to 27 times per minute. What could be the reason for this change in the breathing rate?
16. How does climate change contribute to the emergence and re-emergence of infectious diseases?
17. In what ways does climate change impact waterborne diseases and their transmission?
18. How does climate change influence the geographic distribution of vector-borne diseases?

1.3. Green Plants

Green plants are referred to as producers or autotrophs. Plants require specific substances in addition to sunshine, carbon dioxide, and water for regular growth and development. These elements are called nutrients. The nutrients in the soil are taken as a solution by the roots of the plants. These nutrients are obtained by the soil from dead plants and animals, as well as fertilisers. Plants get ill and show deficiency signs when they don't acquire enough nutrients.

A developed seed goes into dormancy, which is a state of rest. It remains dormant until the conditions for germination are favourable. The process through which a dormant seed develops into a new plant or seedling is known as germination.

Competencies:

Investigate the conditions required for the photosynthesis and germination of seeds to understand their importance in plant life.

Explain nutrients, its type and deficiency diseases to understand the significance in growth and development of plants.

1.3.1 Nutrition and Photosynthesis

Scope: This topic covers macronutrients - primary and secondary, micronutrients- and their roles and deficiency symptoms in plants. It also includes photosynthesis, equations - word as well as chemical, and factors affecting the process of photosynthesis and its importance.

Learning Objectives:

- *Explain macronutrients and micronutrients.*
- *Identify the source, roles and deficiency symptoms of macronutrients and micronutrients.*
- *Explain photosynthesis.*
- *Explain the significance of photosynthesis.*
- *Investigate the factors affecting the process of photosynthesis.*

Learning Experiences

Plants require as many as seventeen important elements, which are categorised into two groups, for growth. There are several nutrients that plants require in enormous quantities. They're divided into two categories: primary nutrients and secondary nutrients. On the other side, there are some nutrients that plants only require in little amounts. Have you ever wondered why certain plants grow slowly and have short roots and stems?

The learner finds information on macronutrients and micronutrients, their roles and deficiency symptoms in plants from the web link https://bit.ly/3q0Nofl or from other relevant sources and shares this information to other learners in a team.

The learner then answers the following questions:

1. Explain macronutrients and micronutrients with examples.
2. What happens to a plant if the soil lacks potassium and nitrogen?
3. What important role does sulphur play in plants?
4. How do you know what nutrients plants lack?

The learner in a team visits the school agriculture garden, or any other agriculture field nearby the school to observe the deficiency symptoms of primary nutrients in plants.

The learner records the observations in the table given below:

Table 2.5. Primary nutrients

Nutrient	Deficiency Symptoms

After the observation, the learner answers the following questions:

1. What is the most common nutrient deficiency found in plants?
2. How do you know that a plant is suffering from nitrogen deficiency disease?
3. How would you know that the soil lacks phosphorus and potassium?
4. Suggest ways to address the nutrient deficiencies in plants.

The learner explores photosynthesis from the web link http://surl.li/prxak or from other relevant sources and explains the process to the class. The learner then answers the questions given below:

1. What are the raw materials used by plants for photosynthesis?
2. Which gas is produced during the process?
3. Illustrate the word as well as the chemical equation of photosynthesis.

4. Explain the significance of photosynthesis for all life forms.

In order to investigate the factors affecting photosynthesis, the learner in teams predicts factors that influence photosynthesis. Then watch the video from the web link http://surl.li/prxiz or from other relevant sources to verify the predictions made earlier.

The learner then designs and carries out an experiment to investigate the factors affecting photosynthesis. For example, sunlight and carbon dioxide are necessary for photosynthesis. Records the observations made during the experiment and draws inferences to generate explanations derived from the experiments.

Plants require nutrients in the same way as animals do for them to grow and develop. Photosynthesis is important for the production of food from sunlight, carbon dioxide, and water in the atmosphere. The oxygen produced by photosynthesis is vital to human survival.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's understanding of the roles and deficiency symptoms of nutrients and factors affecting photosynthesis.	• Assess the learner's ability to investigate the factors affecting photosynthesis.	• Assess the learner's understanding on the significance of nutrients and photosynthesis in plants.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Seven (2020), REC
4. Macronutrients and micronutrients: https://bit.ly/3q0Nofl
5. Photosynthesis: http://surl.li/prxak
6. Factors affecting photosynthesis: http://surl.li/prxiz

1.3.2 Germination

Scope: This topic begins with what germination is, hypogeal and epigeal germination, and the conditions required for germination of seeds.

Learning Objectives:

- *Compare hypogeal and epigeal germination.*
- *Investigate conditions necessary for epigeal and hypogeal germination.*

- *Explain the significance of germination.*

Learning Experiences

A developed seed goes into dormancy, which is a state of rest. It remains dormant until the conditions for germination are favourable. The process through which a dormant seed develops into a new plant or seedling is known as germination. Seed germinates in two ways depending on the position of the cotyledons. Epigeal and hypogeal germination are the two types of germination. What type of germination do you observe in the germination of beans and maize?

The learner explores information on germination from the web link https://bit.ly/3quw1nz, and on epigeal and hypogeal germination from the web link https://bit.ly/3Gql7EF or from other relevant resources.

Based on the information gathered, the learner answers the questions provided below:

1. Explain germination and its importance.
2. How is epigeal germination different from hypogeal germination?
3. What is the advantage of epigeal germination?
4. Write the characteristics of the seed that germinates by epigeal type.

The learner then in a team investigates the conditions necessary for the germination of seed. Does the learner frame question on the conditions required for the germination of seed? Predicts the answers to the question(hypothesise) and then designs an experiment to determine the conditions required for germination. The learner collects data for the next few days through observation and analyses whether the collected data supports the hypothesis developed earlier. Finally, the learner draws conclusions from the experiment and shares findings with other teams in the class.

The learner also checks understanding of the topic by attempting the quiz from the web link https://bit.ly/3KzF9zd.

There are two types of germination: epigeal germination, in which the hypocotyl elongates first and pushes the cotyledons above the soil, and hypogeal germination, in which the epicotyl elongates first and the cotyledons stay below the soil. Germination requires favourable conditions which are water, oxygen, air, and temperature.

Germination is a crucial biological process in the life cycle of plants, representing the emergence and development of a seed into a seedling. This phase holds significant importance for several reasons:

Initiation of Growth: Germination marks the beginning of a plant's growth cycle. Under favorable conditions, the dormant seed absorbs water, swells, and activates metabolic processes to initiate the growth of a new plant.

Energy Activation: During germination, stored nutrients within the seed, such as starches and proteins, are mobilised and converted into forms that can be used for energy. This energy is essential for the seedling to break through the seed coat and establish itself in the surrounding environment.

Establishment of Seedling: Germination results in the emergence of a seedling, which develops roots for nutrient absorption and shoots for sunlight exposure. This establishes the plant in its environment and allows it to access essential resources for further growth.

Photosynthesis Initiation: As the seedling emerges, it begins to perform photosynthesis, a vital process where plants convert light energy into chemical energy. This process is fundamental for the synthesis of carbohydrates, which serve as the primary source of energy for the plant's ongoing growth and development.

Genetic Variation: Germination is a critical step in the reproduction of plants. It leads to the formation of a new individual with genetic variation, as the seed carries a unique combination of genetic material from both parent plants.

Environmental Adaptation: The timing and conditions of germination are influenced by environmental factors such as temperature, light, and moisture. This adaptability allows plants to synchronize their growth with favourable conditions, enhancing their chances of survival.

In summary, germination is a pivotal process that kick-starts the growth of a plant, providing the necessary energy and metabolic activities for the seedling's establishment and subsequent development into a mature plant.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's understanding of germination and its type.	• Assess the learner's ability to investigate the conditions required for germination.	• Assess the learner's curiosity while investigating the conditions necessary for the germination of seed.

For recording and reporting, refer to the National School Curriculum Framework in Science.

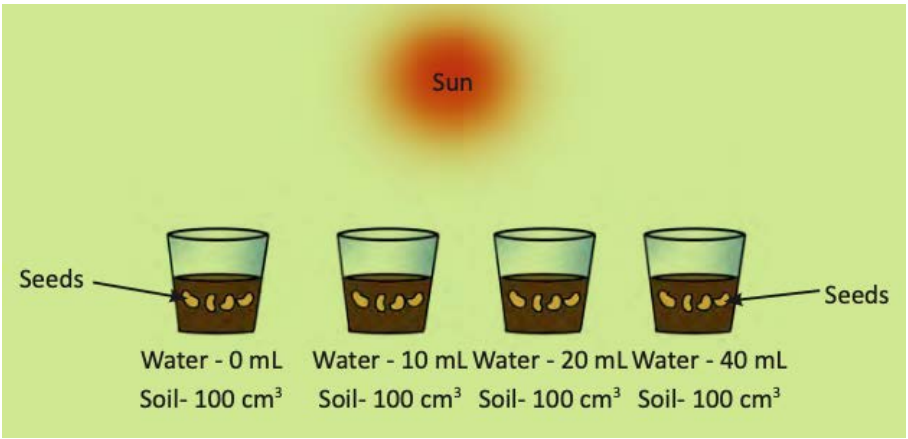
Resources:

1. National School Curriculum Framework for Science, (2022)
2. REC repository
3. Science Class Seven (2020), REC
4. Germination: https://bit.ly/3quw1nz
5. Epigeal and hypogeal germination: https://bit.ly/3Gql7EF
6. Conditions required for germination: https://bit.ly/3n3XJ8v
7. Quiz: https://bit.ly/3KzF9zd

Challenge Your Thinking

1. Life cannot be possible without green plants. Give reasons.
2. How do plants photosynthesize in winter when they shed their leaves?
3. During a visit to the vegetable garden, Karma noticed a plant X with yellow leaves. Karma concluded that plant X lacked some nutrients, although it received enough sunlight, water and carbon dioxide.
    a. Name the nutrient deficient in the plant X.
    b. How can you improve the health of plant X?
4. A student takes a green leaf from the plant and boils it in an alcohol bath for the removal of chlorophyll. The student then adds a few drops of iodine to the boiled leaf. After some time, the student observes that the leaf turns blue-black in colour. What has been evaluated by this experimental setup?
5. Explain why germination is essential for the continuity of plant species?
6. How do you demonstrate that oxygen and water are necessary for seeds to germinate?
7. A farmer, while ploughing the field, makes the soil loose before sowing seeds. What could be the reason for this?

8. A student sets up an experiment to learn about plant growth. The student added different amounts of water to four identical containers, each containing four seeds in 100 cubic centimetres of dry soil as shown in Figure below. All of the containers were placed in the same sunny location.



    a. State a hypothesis being tested in this experiment.
    b. Identify one variable that is being held constant in this experiment.
    c. Explain why this variable needs to be held constant.

1.4. Living Things and their Environment

We find a variety of organisms living on this planet - the Earth. All these organisms exist and are interconnected within ecosystems. The variety of life on the Earth is the result of billions of years of evolution. Evolution brings about drastic changes that occur at the genetic level. On the contrary, adaptation is a short-term process where the changes that occur are usually reversible. All living organisms have adaptive features that help them to survive and reproduce on the Earth.

Organisms need to change themselves with the constantly changing environment irrespective of their differences from the parent organisms. Do you know why plants and animals are the way they are?

Competencies:

Analyse adaptation, variation and ecosystem to understand the significance of interdependence for the survival of organisms.

1.4.1 Adaptation and Variation

Scope: This topic introduces adaptation, and variation. It includes the study of adaptive features of organisms. It further discusses global warming and the causes and risk of climate change.

Learning Objectives:

- *Explain adaptation and variation and their significance for the balance of the ecosystem.*
- *State the adaptive features of organisms in different habitats.*
- *Explain global warming as the cause of climate change.*
- *Investigate the human activities that contribute to climate change in the locality.*
- *Suggest measures to mitigate the human activities that contribute towards climate change impact.*

Learning Experiences

Adaptations can help an organism find food and water, protect, or survive in extreme environments. Physical and behavioural are the two types of adaptation observed in organisms. Organisms which can develop adaptive features to their changing environment survive, while those organisms that cannot adapt to changing environments either struggle to survive or become extinct.

The differences shown by individuals of one kind of organism are called variations. Variations are due to hereditary and non-hereditary characteristics. What causes variation among a population of living things?

From any relevant sources, the learner works in a team to explore information on i. adaptation, ii. variation. The learner prepares a presentation to explain the above terms and their significance in balancing the ecosystems for further discussion.

After that the learner answers the following questions:

1. Explain adaptation and variation with examples.
2. Explain physical and behavioural adaptations with examples.
3. Explain the reason behind the long neck of the giraffe.
4. How does variation in a species help in its survival?

Next, the learner uses any relevant sources or the suggested links https://encr.pw/0POez for animals and https://rb.gy/nkof8x for plants to collect information on organism's adaptive features in different habitats and make comparisons. Then the learner generalises the adaptive characteristics of organisms based on their habitats and physical features.

later, the learner presents the work to the class for feedback and comments and then answers the following questions:

1. Describe the adaptive features of any two animals and plants which help them to survive in their habitat.
2. What would happen if yaks were brought to a warmer place?
3. The plants that are found in higher altitudes have narrow leaves. Give reasons.

The variation within a species helps them to adapt to its changing environment and therefore survive. But these changes do not happen quickly. Although small changes can happen within a few generations, big changes take a long time to happen. The learners watch the video on climate change from the web link http://surl.li/ptzsj or http://surl.li/ptzuj and answer the following questions:

1. How does climate change impact the habitats of plants and animals?
2. Explain the concept of migration in animals as an adaptation to climate change.
3. How climate change alters flowering seasons or the availability of pollinators?
4. Explain the relationship between climate change and the timing of life cycle events in plants and animals?

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's ability to explain adaptation, variation, evolution, and speciation with examples and the adaptive features of plants and animals.	• Assess the learner's ability to study the adaptive features of organisms in different habitats and make comparisons.	• Assess the learner's understanding of the significance of interdependence in the environment.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science, (2022)
2. REC repository
3. Science Class Seven (2020), REC
4. Animals' adaptive features in habitat: https://encr.pw/0POez
5. Plants' adaptive features in habitat: https://rb.gy/nkof8x

1.4.2 Ecosystems

Scope: This topic introduces biotic and abiotic components and types of ecosystems.

Learning Objectives:

- *Explain biotic and abiotic components of an ecosystem.*
- *Investigate the biotic and abiotic components in an ecosystem in the locality.*
- *Identify different types of ecosystems.*

Learning Experiences

An ecosystem includes all the living things in a given area, interacting with each other, and with their non-living environments. In an ecosystem, each organism has its own niche or role to play. Ecosystems contain biotic or living things, as well as abiotic things or non-living things. How do biotic and abiotic things work together to make an ecosystem?

The learner explores the information on types of ecosystems and the role of biotic and abiotic components from the suggested web links https://rb.gy/8hp5au or https://tinyurl.com/2p8vtymh or any other relevant materials. Based on the collected information the learner describes the types of ecosystems and the role of biotic and abiotic factors in maintaining a balanced ecosystem.

The learner answers the following questions to check their understanding of the lesson:

1. Describe the different types of ecosystems.
2. Explain biotic and abiotic factors with examples.
3. Explain the role of biotic and abiotic factors in maintaining the balance of the ecosystem.

The learner carries out field visits to study different types of ecosystems and the role of biotic and abiotic things in maintaining a healthy ecosystem. Based on their observation, the learner designs a healthy ecosystem through illustration with presentation software and presents it to the class.

The learner answers the following questions:

1. Describe the common habitat found in the locality.
2. How do biotic and abiotic work together to make an ecosystem?

Ecosystems are created by the interrelationships between living organisms and the physical environments they inhabit. Ecosystems require a source of energy to make them work.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes

• Assess the learner's ability to describe the types of ecosystems and explain the role of biotic and abiotic factors in maintaining a balanced ecosystem.	• Assess the learner's ability to study the different ecosystems in their locality and design an ecosystem using illustrations.	• Assess the learner's understanding of the significance of interdependence in the environment.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Seven (2020), REC
4. Ecosystems: https://rb.gy/8hp5au or https://tinyurl.com/2p8vtymh

Challenge Your Thinking

1. Deer and goats look similar, but they do not belong to the same species. Why?
2. If there were more tertiary consumers in the forest ecosystem, what would happen to the ecosystem?
3. The human settlements in one part of Trongsa Dzongkhag are in constant fear of losing their cattle to natural predators like Tigers. If there were a sudden decline in the population of Tigers, which ecological imbalance would most likely occur in the habit?
4. Identify five prominent threats to the ecological balance brought about by human activities in Bhutan.
5. Why do you think it takes a long time for a species to adapt and change to its changing environment?
6. Explain how abiotic factors affect biotic factors in an ecosystem.
7. Analyse factors that are critical for a healthy ecosystem.
8. Study the diagrams representing two ecosystems aquatic (A) and desert (B).

A

B

a. Describe the key adaptive features of plants and animals in A and B ecosystems.
b. How do the biotic and abiotic components of them interact to maintain sustainable ecosystems?

Materials and their Properties

2.1. Classifying Materials

All the materials that make up the universe are termed matter. The matter is made up of very tiny particles irrespective of their size, colour and form. The arrangement and nature of these particles determine the physical and chemical properties of matter. The states of matter and its inter-conversion can be explained on the basis of particle theory.

Matter can be classified as elements, compounds, or mixtures based on its composition and properties. Metals and non-metals can be either elements or mixtures.

Competencies:

- Demonstrate an understanding of particle theory of matter to analyse the interconversion of matter, gas pressure and diffusion, and relate its relevance in everyday life.
- Illustrate the atomic structure with subatomic particles to understand more about metals and non-metals and their uses in the everyday life of people.

2.1.1 Particle Theory of Matter

Scope: This topic introduces the particle theory of matter. It covers interconversion of matter i.e., melting, freezing, evaporation, condensation, sublimation, and deposition. It also explores gas pressure and diffusion based on particle theory.

Learning Objectives:

- *Explain the states of matter based on the particle theory of matter.*
- *Investigate the process of interconversion of matter, gas pressure and diffusion based on the particle theory.*
- *Relate diffusion and gas pressure to everyday life experiences to understand their significance.*

Learning Experiences

Anything that has mass occupies space and can be perceived by our senses is known as matter. Matter makes up most of the things in the universe. Matter can be classified as solid, liquid and gas. Each state has its own unique properties which make them different. These properties are defined by the nature and the arrangement of particles in each state.

On the basis of the arrangement and behaviour of particles, scientists have put forward the particle theory of matter. This theory helps us to explain the composition and properties of three states of matter.

Learner watches the video from the weblinks https://rb.gy/qi1w2z and https://rb.gy/6ypjye to understand the postulates of particle theory of matter and properties of three states of matter. Particle theory models the arrangement and movement of particles in solids, liquids and gases. It explains the properties of

substances in these different states, and what happens during changes of state. The learner may further explore particle theory from the link https://rb.gy/wcnyc9.

The learners use a PhET simulation to understand the interconversion of matter using the link https://rb.gy/bnvd0i. The learners design an experiment and investigate the interconversion of matter, diffusion and gas pressure using available materials. Further, learners share their investigation with the class.

The learner answers the following questions:

3. Compare the arrangement of particles in solid, liquid, and gas as per the particle theory.
4. What happens to the particles when the temperature is increased? Why?
5. Some solids directly change to gas while heating. Explain this process based on the particle theory of matter.
6. Explain the working of a pressure cooker based on the particle theory of matter.
7. Why does a solid substance occupy less space than the same substance in its gaseous form?

Learners carry out an experiment using available resources to understand gas pressure and its significance in daily life. After carrying out an activity, learners answer the following questions.

1. Explain the gas pressure in your own words.
2. What happens to gas pressure when temperature increases?
3. Sprays and perfumes should not be exposed to direct sunlight. Why?
4. Analyse the significance of gas pressure in your day-to-day life.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of the particle theory of matter and interconversion among three states of matter.	• Assess the learner's ability to demonstrate the process of interconversion among three states of matter based on particle theory of matter.	• Assess the learner's ability to explain the importance of the interconversion of matter in our daily life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Postulates of particle theory: https://rb.gy/qi1w2z

6. Particle theory in the interconversion of the matter: https://rb.gy/6ypjye
7. PhET simulation: https://rb.gy/bnvd0i
8. The particle theory of matter: https://rb.gy/wcnyc

2.1.2 Elements and Atomic Structure

Scope: This topic covers elements and their symbols [first thirty elements] along with their atomic and mass number. Furthermore, it delves into atomic structure representing the location of the subatomic particles [proton, neutron and electron, and their charges]. This topic also includes the properties of metal and non-metal, and their examples.

Learning Objectives:

- *Identify names, symbols, atomic numbers, and mass numbers for the first 30 elements in the periodic table.*
- *Develop models to describe the atomic composition of atoms of common elements.*
- *Classify elements as metals and non-metals based on their physical properties.*
- *Evaluate the significance of metals and non-metals in daily life.*

Learning Experiences

Substances in this universe are classified either as pure substances or mixtures depending upon their compositions. A pure substance is a substance in which all the molecules or atoms are of the same kind. A pure substance can be either an element or a compound. A pure substance made up of only one type of atom is called an element.

At present, there are about 118 elements. Each of the elements is given a name and a symbol unique to it. A symbol is a short form or abbreviated name of an element. The symbol actually represents the atom of an element. Along with the symbol, atomic number and mass number are used to represent the elements as ${}_{Z}X^{A}$, where X represents the symbol of an element, Z represents the atomic number and A represents the mass number. Do you know all the elements in a periodic table are arranged in increasing order of their atomic numbers?

The learners use the suggested weblink https://tinyurl.com/4absfjc4 to identify the names and symbols of the first thirty elements with their atomic numbers and mass numbers. Learners in groups create mnemonics to remember the elements and the symbols and share with the class.

The learners explore subatomic particles and their location in an atom from the suggested weblink https://tinyurl.com/5n84dyke. After identifying the location of subatomic particles in an atom, the learner develops a model of some common elements to describe the atomic composition of an element. Explore and use software to design simulation, illustration and/or graphic models of an atom. Then answers the following questions:

1. An element with the symbol Z is represented as ${}_{10}Z^{20}$. What are the atomic number and mass number of this element? Name an element.
2. Describe the charges of subatomic particles and their location in an atom.

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All elements can be classified into metals and nonmetals. Humans have been using metals and non-metals for thousands of years for making tools, machines, utensils, houses, jewellery, etc. The usefulness of metals and non-metals depends on their properties.

Learner uses the web link https://tinyurl.com/yckntdz6 or https://tinyurl.com/ycktu8ta to explore properties and differences between metals and non-metals. After exploring the properties of metals and nonmetals, learners evaluate the significance of metal and nonmetal in daily life through group discussion.

Further, learners answer the following questions:

1. Explain the properties of metals and non-metals to understand their differences.
2. Boron and silicon are examples of metalloids. Explain the properties of boron and silicon.
3. Explain the uses of metalloids.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of names and symbols of atoms, general representation of elements, subatomic particles and their locations, and properties of metals and non-metals.	• Assess the learner's ability to develop the model of atoms showing the location of subatomic particles.	• Assess the learner's ability to evaluate the significance of metal and non-metal in our daily life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Atomic Numbers: https://tinyurl.com/4absfjc4
6. The Structure of the Atom: https://tinyurl.com/5n84dyke
7. Differences between Metals and Non-metals: https://tinyurl.com/yckntdz6
8. Metals Versus Non-metals: https://tinyurl.com/ycktu8ta

Challenge Your Thinking

1. A balloon when blown expands and then finally it bursts. Give a scientific explanation for this phenomenon.

2. Smoke flows easily in all directions. Explain the phenomenon based on particle theory.
3. List down application of gas pressure in our daily life.
4. Copper is one of the metals widely used for various purposes. Identify the properties of copper which make it widely used for different purposes.
5. Leakage of Liquid Petroleum Gas (LPG) can be detected by a person from a distance. Name the process and write two applications of this process in our day-to-day life.
6. Use the particle theory to explain why milk powder dissolves more rapidly in hot water than in cold water.
7. From the elements given in the box, select the most suitable element or elements that relate to the following context.

gold, tin, nitrogen, hydrogen, sodium, oxygen, aluminium, mercury, diamond, sulphur, chlorine, helium

   a. Two non-metals that combine to form water.
   b. A liquid metal is used in a thermometer.
   c. A metal which is used in making cans to store foods.
   d. An element that is used in making cooking utensils.
   e. A metal which is expensive and used to make ornaments.
   f. An element without neutrons.
   g. Non-metal that shines brilliantly and is used in jewellery.

2.2. Materials and Change

Every day, we see a number of changes happening around us. However, changes differ from one another in a number of aspects. Some changes are fast, others are slow. Some of them are temporary, others are permanent. Some are periodic, others are non-periodic. Some are natural, others are man-made. Some are reversible, others are irreversible.

Change may be categorised into a chemical or a physical change depending on how the properties of a subject alter when it undergoes the change. For a change to take place, there must be the interaction of matter. This interaction results in changes in the shape, size, colour and composition of the matter.

Competencies:

Investigate the conditions and features of physical and chemical changes, and relate them to everyday phenomena occurring in the natural environment.

2.2.1 Physical and Chemical Change

Scope: This topic highlights the characteristics of physical and chemical change, and the conditions required for physical and chemical change - moisture, heat, temperature, pressure, force and air, etc.)

Learning Objectives:

- *Differentiate between physical and chemical change.*
- *Explore various conditions necessary for physical and chemical changes.*
- *Design an experiment to demonstrate physical and chemical changes.*
- *Relate the changes to everyday phenomena occurring in the natural environment.*

Learning Experiences

Physical and chemical changes occur constantly in the environment around us. These changes are essential parts of our daily lives, for example, digesting food, burning, osmosis, and phase changes. Physical change is a type of change where the physical properties of a substance change but the composition remains the same. A chemical change is a permanent change that forms new substances due to a change in chemical composition. It is an irreversible change like the burning of wood, cooking of food, curdling of milk, etc.

The number of matters before and after the change remain the same in both physical and chemical change. The law of conservation of mass states that matter can neither be created nor destroyed by physical transformation or chemical reactions. Thus, mass is always conserved.

The learner watches the video from the link https://rb.gy/ianmpm to learn more about physical and chemical changes and discuss the properties of physical and chemical changes. The learner then designs and perform an experiment to observe the processes in a physical and a chemical change. The learner also looks for the conditions that are responsible for bringing about change. The learner explains the process and observation of the experiments and shares it with the whole class. The learners also relate the physical and chemical changes to everyday phenomena occurring in the natural environment.

The learner answers the following questions:

1. Compare the properties of physical and chemical change with the help of an example.
2. Temperature is one of the conditions that affect both physical and chemical change. Support the statement with an example.
3. If you leave a nail outside for a few days, it undergoes some change. Identify the type of change and the conditions that brought about the change.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's ability to identify and explain the conditions required for change and processes in a physical and a chemical change.	• Assess the learner's ability to design experiments and investigate the conditions required for change.	• Assess the learner's ability to explain the importance of various conditions in bringing change.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC

5. Physical and chemical changes: https://rb.gy/ianmpm

Challenge Your Thinking

1. Explain light as a condition required for change with a few examples.
2. Your father wanted to use iron bars to fence his garden but he is worried that the iron may rust. What would be your suggestions to prevent iron from rusting and why?
3. Pema added sugar to the beaker containing water. She stirred the mixture thoroughly and the sugar completely dissolved in the water. Is it an example of physical or chemical change? Justify
4. A burning candle is an example of chemical change. Explain.
5. Plants prepare their food through a process called photosynthesis. This is a chemical change. Identify the conditions required for this change to take place.
6. Identify some physical and chemical changes occurring in the locality and explain.

2.3. Patterns in Chemistry

In the early eighteenth century, few elements were discovered and known. Therefore, it was easy to study the properties of elements. However, with the discovery of more elements with the pace of time, the study of elements became difficult. Thus, this led to the classification of elements in various manners. A turning point came when Mendeleev put forward his ideas for the periodic table. This was later modified by Moseley, and is now known as the modern periodic table. This classification of elements aids in understanding and predicting the characteristics of the elements.

Chemical compounds can be divided into acids, bases and salts. Acids are sour in taste, corrosive in nature, and change blue litmus to red. Bases are generally slippery in nature, bitter in taste, and change red litmus to blue. The reaction of acids and bases with other substances helps us to understand their properties and their uses in our lives.

Competencies:

Analyse the patterns of the periodic table to explain the trends across the period and down the groups.
Analyse the properties of acids and bases to provide scientific reasons for their uses in day-to-day life.

2.3.1 Patterns in the Periodic Table

Scope: This section focuses on the arrangement of elements in the periodic table and its early attempts in classification. It also emphasises the features [concept of group and period] of the modern periodic table based on atomic number.

Learning Objectives:

- *Explore the classification of elements and explain the importance of a periodic table.*
- *Explain the group and period features of a modern periodic table to understand the properties of elements.*
- *Differentiate between the groups and periods as the fundamental layout of the periodic table.*

Learning Experiences

Chemists observed patterns in different properties of elements as they were arranged. Numerous efforts were made to classify the discovered elements. Yet, time and again, their classification failed to facilitate the study and correlate their properties between and amongst elements. Have you wondered why sodium, lithium and potassium are in one group? And what is the significance of placing them in one group?

The learners explore the classification of elements and its early attempts in the generation of modern periodic tables through https://tinyurl.com/2p9f9dmf or other relevant resources. The findings are presented to the class.

Based on the above information, learners answer the following questions.

1. What were the shortcomings of the Mendeleev periodic table?
2. Analyse the significance of the law of triads and octaves in the foundation of the modern periodic table.
3. Explain the advantages of the modern periodic table.
4. Analyse which of the models of the periodic table is useful in the field of science.

Based on the understanding of the classification of elements, explore features of modern periodic tables to understand the properties of elements through https://youtu.be/IdS9roW7IzM or https://youtu.be/7mLPC74GHMo or any other relevant resources and draw the modern periodic table. The learners in groups differentiate between groups and periods indicating it as a fundamental layout of the periodic table and share their understanding with the class.

Based on understanding of the above concept, learners answer the following questions:

1. State the features of the modern periodic table.
2. How many groups and periods are there in the modern periodic table? Which is the shortest period?
3. Name the group that Noble gases are placed in?

Elements are classified based on their atomic number in the modern periodic table. It has seven periods and eighteen groups with distinguishing characteristics.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of the arrangement of elements on a modern periodic table.	• Assess the learner's ability to classify elements into metals and non-metals after understanding groups and periods.	• Assess the learner's ability to appreciate the pioneers in developing the modern periodic table and its significance.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Early classification of elements: https://tinyurl.com/2p9f9dmf
6. Modern Periodic Table: https://youtu.be/IdS9roW7IzM
7. Periods and groups: https://youtu.be/7mLPC74GHMo

2.3.2 Acids and Bases

Scope: This topic presents the classification of acids into organic and inorganic. It also includes properties and usage of acids and bases. Additionally, the neutralisation reaction and its application and application of pH [in medicines, agriculture, food preservation and living organisms] will be covered.)

Learning Objectives:

- *Classify acids into organic and inorganic acids with examples.*
- *Tests acids and bases to understand their properties through experimental observation.*
- *Explore the application of neutralisation reactions in daily life.*
- *Analyse the use of acids and bases in various fields.*

Learning Experiences

Acids and bases play important roles in our lives and the environment around us. If you have tasted lemon or washed your hands with soap, you have experienced acids and bases. Scientists classified substances as acids and bases or neutral, depending on the characteristics such as taste and pH. But have you ever wondered why antacid is given by doctors to people suffering from stomach bloating or indigestion or irritable bowel movement? Or, why is vitamin C prescribed by a physician?

The learners explore more about acid and base through the given weblink https://tinyurl.com/3vm6uc2r. Based on the information gathered, note the properties of acid and base, and answer the following questions:

1. How can we identify organic acid from inorganic acid?
2. List at least five organic acids and their sources.
3. Why should inorganic acids be handled carefully?
4. Explain the application of bases with at least three examples.

The learners in the team design an experiment to investigate the properties of acids and bases. The learners demonstrate the tests and explain the properties of acid and base to the class.

The learners explore pH through the given weblink https://tinyurl.com/39tjddtd or any other relevant resources. Based on the information gathered, answer the following questions:

1. What are pH and pH indicators?
2. List at least ten food items with their pH values that you use in everyday life.
3. How can we confirm the acidity and basicity of a substance using a pH indicator and pH scale?

4. What is the pH level of the human body? Is it acidic, basic or neutral?

In addition, the learner explores neutralisation through the given weblink https://youtu.be/r3hirzlWILM. Based on the information gathered, analyse the significance of pH in medicine, agriculture, food preservation and living organisms and present it to the class.

Learners watch the application of the neutralisation reaction in real life through the web link https://youtu.be/r3hirzlWILM or any other relevant resources

The teacher provides learners with the different items to study the use of acid and base and guides them to test its acidity and basicity using litmus paper.

Acids and bases are known by their characteristic properties. However, to determine acidity and basicity, a pH scale and other indicators are used. To reduce the effect of acidity and basicity, it is necessary to neutralise the solution.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of acids and bases and application of neutralisation.	• Assess the learner's ability to carry out an experiment to investigate the properties of acids and bases.	• Assess the learner's ability to realise the significance of pH and neutralisation in everyday life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Properties of acids and bases: https://tinyurl.com/3vm6uc2r
6. pH in everyday life: https://youtu.be/r3hirzlWILM
8. What is pH? https://tinyurl.com/39tjddtd

Challenge Your Thinking

1. Several attempts had been made by eminent scientists to classify and arrange the discovered elements in the form of the periodic table. State some importance of the periodic table.
2. The elements such as lithium, sodium, and potassium are placed in the same group I in the table. Why are they grouped together?
3. How does toothpaste help you in preventing tooth decay?
4. Some people rinse their freshly shampooed hair in diluted lemon juice or vinegar. Why is this done?

5. In a soil testing laboratory, four soil samples from a horticulture farm were tested for their relative acidity and alkalinity. Quick lime is an alkaline agrochemical used to control soil pH. Which soil is unlikely to need quick lime to make it neutral for healthy plant growth?
   A. Soil pH 6.7.
   B. Soil pH 5.2.
   C. Soil pH 4.7.
   D. Soil pH 3.2.

7. Digestion of food in the stomach is ruled by the principles of acid-base chemistry. Justify the statement.

2.4. Separating Mixtures

Many of the substances we use every day are either elements or mixtures. A mixture can simply be defined as a substance that consists of two or more elements or compounds that are physically combined. A mixture may be a solid, liquid, gas, or some combination of those states.

Separating substances from mixtures is an important part of chemistry and modern industry. Some of the important terms used in this topic include mixtures and solutions, and various separating techniques like simple distillation, steam distillation and fractional distillation.

Competencies:

- Explain types of solution, solubility and factors affecting solubility to understand the significance of solubility and solution in day-to-day life.
- Analyse homogeneous and heterogeneous mixtures and ways to separate them for the purpose of using it in our daily life.

2.4.1 Solutions and Solubility

Scope: This topic outlines the concept of solubility and types of solutions - dilute and concentrated aqueous and non-aqueous, saturated and unsaturated solutions. The students also investigate the effect of temperature, stirring and particle size on solubility.)

Learning Objectives:

- *Explain solution, solubility and types of solutions*
- *Prepare different types of solutions.*
- *Investigate the effects of temperature, stirring and particle size on the solubility.*
- *Explain the significance of solubility and solution in our everyday life.*

Learning Experiences

A solution is a mixture of two or more substances. A solution consists of a solute and solvent. The solute is a dissolved substance and the solvent is the agent that dissolves the solute. In lower concentration, less amount of solute is present in the solution; in a higher concentration of the solution, there is more number of solutes. For example, in a saline solution, salt is the solute dissolved in the solvent waster. In which

solvent, would the sugar dissolve faster, hot water or cold water? Will stirring the solution affect the solubility?

The learner explores solubility from the link https://youtu.be/fc2zyrVR4kA and types of solutions from the link https://tinyurl.com/2p8t2xsa.

Then the learner carries out an experiment in preparing different types of solutions. Based on the understanding the learner answers the following questions.

1. What is the difference between saturated and unsaturated solutions?
2. Give an example each for aqueous and non-aqueous solutions.
3. Compare dilute and concentrated solutions?

Learners in groups prepare one type of solution using provided materials [alcohol, sugar, water, beaker and glass rod] and present their observations to the class.

Based on group presentation, learners answer the following questions

1. Differentiate between aqueous and non-aqueous solutions.
2. Do you think saturated and unsaturated solutions can be distinguished looking at the colour? Justify.

Then the learner watches the video from the link https://youtu.be/qL5-lcc_TfY or https://tinyurl.com/45tp8s42 and understands the effect of temperature, stirring and particle size on the solubility of a substance. Learners also carry out hands-on activity to understand the effect of temperature, stirring and size of particles on the solubility of a substance.

Answer the following questions to test your understanding.

1. What are the factors that affect the solubility of a substance?
2. Would stirring increase the solubility of a substance? Justify your answer.
3. What are the effects of temperature and particle size on the solubility of a substance? How are they different from one another?
4. Every morning we begin our day with a cup of tea which is made up of different components. Identify the process involved and mention its significance.

The learner designs and conducts an experiment to demonstrate the effect of temperature, stirring and particle size on solubility. The learner observes and explains the effect of various factors on the solubility of a substance, and shares their findings through a PowerPoint presentation to the class.

Solutions are of different types such as dilute and concentrated, saturated or unsaturated, and aqueous and non-aqueous solutions. The solubility of a substance can be altered by factors such as temperature, stirring and particle size. Further, learners also analyse the importance of solubility and solutions in our day-to-day life.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of solubility, types of solution and effects on temperature, stirring and particle size on solubility.	• Assess the learner's ability to design an experiment to demonstrate the effects of temperature, stirring and particle size on solubility.	• Assess the learner's understanding of the application of solubility in everyday life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework in Science
2. REC repository
3. Science Class VII (2020), REC.
4. Solutions and solubility https://youtu.be/fc2zyrVR4kA
5. Types of solution https://tinyurl.com/2p8t2xsa
6. Factors that affect solubility https://youtu.be/qL5-lcc_TfY
7. Experiments to demonstrate solubility https://tinyurl.com/45tp8s42

2.4.2 Mixtures

Scope: This topic covers mixtures and its type - homogeneous and heterogeneous. It also includes its characteristics with examples. This section will also focus on different types of distillation - simple distillation, steam distillation and fractional distillation.

Learning Objectives:

- *Explain homogeneous and heterogeneous mixtures with examples.*
- *Classify various mixtures found in the surrounding into homogeneous and heterogeneous mixture.*
- *Explain types of distillation to understand its application in daily life.*
- *Carry out an experiment to demonstrate simple distillation.*

Learning Experiences

Almost every element or compound found naturally is in an impure state, such as a mixture of two or more substances. Mixtures may contain two or more components, which are physically combined. They usually mix to form different substances called mixtures. It can be separated by physical means such as evaporation, filtration, decantation, sedimentation, hand-picking, sieving, magnetic separation, etc.

The learner gathers information on the homogeneous and heterogeneous mixture from the web link https://youtu.be/-p9vJB2jY0c. From the video, learners also identify and list the examples of each type of mixture.

Then the learner classifies various mixtures found in the surroundings into homogeneous and heterogeneous mixtures. Based on the understanding, the learner answers the following questions:

1. Explain homogeneous and heterogeneous with two examples each.
2. Why is separating heterogeneous mixtures easier compared to the homogeneous mixture?
3. Narrate incidences where you used both types of mixtures in your life.

The learner watch the video from the web link https://youtu.be/eQlnHr9g6Io and https://youtu.be/OVQC-6qIq-Y to understand and identify the separating techniques such as simple distillation, fractional distillation and steam distillation.

The learner carries out an experiment to demonstrate simple distillation and also discuss the application of distillation in our daily life

Based on the understanding of mixtures, learners answer the following questions:

1. Explain the similarities and differences between simple distillation and fractional distillation.
2. How can you extract essential oil from plants? Explain the method in detail.
3. What are the fundamental criteria used in the separation of heterogeneous mixtures?

There are two types of mixtures, homogeneous and heterogeneous that can be separated using the scientific methods of simple distillation, fractional distillation and steam distillation.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of homogeneous and heterogeneous mixtures and separating methods like simple distillation, fractional distillation and steam distillation.	• Assess the learner's ability to classify the materials into homogenous and heterogeneous mixtures and demonstrate separating methods to separate the mixtures.	• Assess the learner's understanding of the ways to separate the mixtures and their application in everyday life.

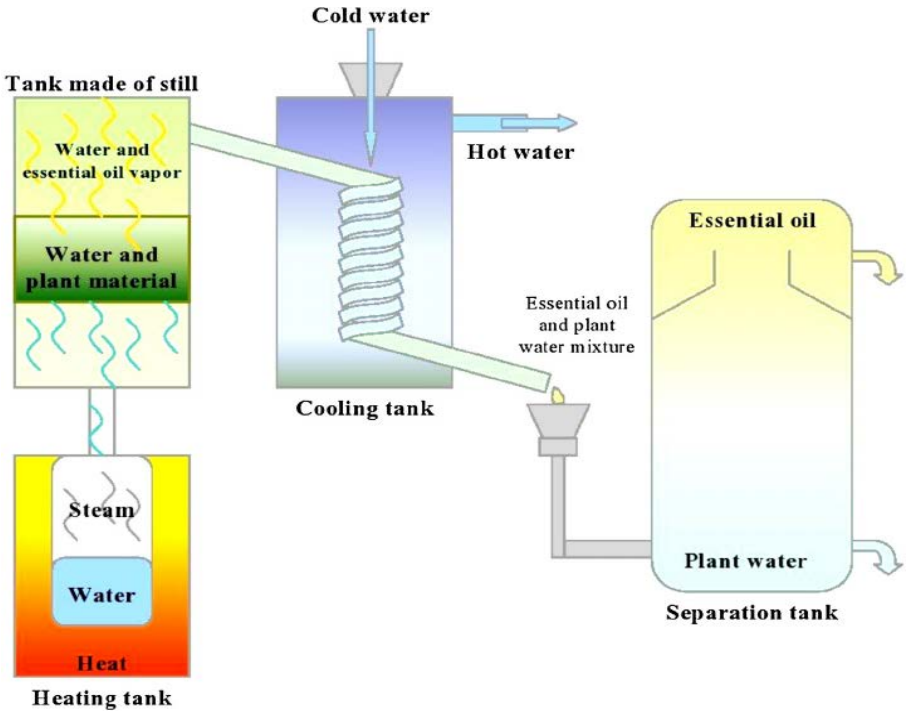
For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Textbook for Class VII (2020), REC
4. Types of mixture https://youtu.be/-p9vJB2jY0c
5. Distillation simple and fractional mixtures-606106outu.be/eQlnHr9g6Io
6. Steam distillation https://youtu.be/OVQC-6qIq-Y

Challenge Your Thinking

1. What differentiate a homogeneous mixture from heterogeneous mixture?
2. The laboratory assistant in your school has accidentally mixed alcohol with water in a beaker. Unfortunately, the school science laboratory ran out of the alcohol stock, which is required for starch tests in the leaf. If you are asked to help the laboratory assistant in separating the mixture,
    a. Which method will you use?
    b. Which component is separated first? Why?
    c. Give an example of another mixture, which can be separated by the same method.
    d. Draw a labelled diagram of the apparatus you would use to obtain pure alcohol from the mixture of alcohol and water.
3. Tashi wants to prepare a sugar solution for immediate use. Explain the factors that he should consider to prepare the solution.
4. Give some applications of solubility used in our daily life.
5. Study the figure below and answer the questions that follow.



a. Why is this process used instead of fractional distillation for the extraction of essential oil?
b. Why is the condenser in the form of a coil?

6. A student adds a mixture of oil, sand and salt to a beaker of water and stirs it. The student stops stirring and observes that the salt is no longer visible. It is also observed that the oil floats on the top and the sand sinks to the bottom of the beaker.
   a. Why does oil float on water?
   b. Why is salt no longer visible after the stirring?
   c. How can you separate the components of this mixture?
7. People adulterate milk with water but they cannot adulterate oil with water. Give reasons.

Physical Processes

3.1. Forces and Motion

In our surroundings, objects are either at rest or in motion. Objects at rest can be set into motion, or objects in motion can be brought to rest by applying forces. Force can change the shape and size of an object, change the direction of motion of an object, or make a moving body move faster or slower. People have explored, devised and invented many simple machines to make work easier.

Every object that exists on the Earth is made up of small particles and has some weight and mass of its own. Some objects sink in water and some float on water. All objects can be compared to each other based on their heaviness or lightness. The heaviness and lightness of the objects depend on the mass contained in each object. One of the unique properties of a material is its density.

Competencies:

- Demonstrate the understanding of force, distance, speed, average speed and types of motion, and density of substances, and analyse their applications in our daily activities.
- Identify the types of simple machines, calculate the mechanical advantage, velocity ratio and efficiency of simple machines, and justify how they help us in our daily activities.

3.1.1 Force and Linear Motion

Scope: This topic deals with concepts of force, distance and speed and average speed, balanced and unbalanced force, linear and non-linear motion, and rotational motion, and their applications.

Learning Objectives:

- *Explore force, distance, speed, and average speed and draw their relationship.*
- *Calculate the speed and average speed in different situations.*
- *Explain balanced and unbalanced force, linear and non-linear motion and rotational motion and their applications in daily life.*

Learning Experiences

One of the effects of force is the change in the speed of a body. This effect can be verified by measuring the speed of a body. We use average speed to describe the rate of such motion, which has a different speed at different intervals of time. Do you observe the various speeds of the vehicle while you are travelling in it?

The learner carries out the activity to calculate the speed by making friends run and uses the following table to record the data:

Table 1.1 Observation of time and distance

Sl. No	Name	Distance (metre)	Time taken (second)	Position

The learner enters the data in the MS Excel sheet and generates a curve to calculate the slope that represents the speed of a runner. The learner calculates the speed of a runner using the relationship between distance and time.

Then the learner answers the following questions:

1. Identify the fastest runner. How do you determine it?
2. Calculate the average speed of runners by drawing a relationship between distance, time and average speed.
3. Relate speed, time and distance from the graph drawn.

The movement of a body is determined by the magnitude of the force and the line of action of the force. The learner watches the video in the weblink https://bit.ly/3t16JPv for an understanding of the balanced and unbalanced forces.

Then the learner browses the link https://bit.ly/3HH7Zv5 to demonstrate the effect of balanced and unbalanced forces by setting the body into motion and rest and writing their observations in the worksheet. The learner explains the effects of balanced and unbalanced force on the state (rest or motion) of an object based on the observations from the above-given link. States a few examples based on this effect.

Then the learner answers the following questions:

1. What factor determines the motion as uniform and non-uniform linear motion?
2. Give two examples of linear motion and two examples of non-linear motion.
3. What is the state of the body when the net force is zero?
4. Give some examples of balanced and unbalanced forces?

The learner lists five examples of linear, non-linear and rotational motion from the observation of their surroundings and justify their choices

The change in the position of a body will depend on the magnitude of the unbalanced forces. When a force is applied to a rigid body such that the body rotates about an axis, then the body is said to be in rotational motion. Do you see rotational motion in your classroom?

The learner identifies any two objects in the classroom that he/she thinks will rotate and apply force on one of the objects so that it rotates. Then draw a diagram of the object and indicate the point of application of force, direction of motion, and the axis of rotation.

The learner also relates the effects of balanced and unbalanced forces to rotational motion through a few examples. The learner answers the following questions:

1. Explain rotational motion based on your understanding.
2. How are the balanced or unbalanced forces related to rotational motion?
3. List THREE examples of rotational motion that you have observed around.

The speed increases with an increase in the distance covered at the same time and decreases with an increase in the time required to cover the same distance. The unit of speed and average speed is metres per second which are represented as m/s or ms^{-1}.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of speed, distance, balanced and unbalanced force, and linear and rotational motion.	• Assess the learner's ability to calculate speed, distance, time and average speed and investigate balanced and unbalanced forces.	• Assess the learner's understanding of the significance of speed and distance and the effects of balanced and unbalanced force while the learner demonstrates and explains the effects.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Balanced and unbalanced force: https://bit.ly/3t16JPv
6. Effects of balanced and unbalanced force: https://bit.ly/3HH7Zv5

3.1.2 Simple Machine

Scope: This topic covers the concept of simple machines - lever, pulley: single and fixed, gears; mechanical advantage, velocity ratio, efficiency, calculations, and activity on efficiency of simple machines.

Learning Objectives:

- *Explore to identify the types of levers.*
- *Investigate the mechanical advantage, velocity ratio and efficiency of levers to assess their application in daily life.*
- *Demonstrate how levers multiply force and increase efficiency.*
- *Explore the concept of pulley and its types.*
- *Investigate the mechanical advantage, velocity ratio and efficiency of pulleys to assess their application in daily life.*
- *Demonstrate how pulleys multiply force and increase efficiency.*

Learning Experiences

Simple machines are tools that make work easier. They have few or no moving parts. These machines usually use less energy to work and increase the efficiency of the work done. Simple machines are designed and built for specific tasks. How do simple machines make our work easier?

Learners explore the concepts and terms related to lever and identify the types of lever, its applications from the web link Types of Levers and Relationship between efficiency, mechanical advantage and velocity ratio.

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Using the think-pair-share strategy, learners discuss the following questions to reflect on their understanding of the concepts in the videos.

The learner watches the video from the web link https://bit.ly/3JH8xTw to understand the relationship between mechanical advantage, velocity ratio and efficiency of a simple machine. The learner further watches the video from the web link https://bit.ly/3HJjZw2 to understand the mechanical advantage, velocity ratio and efficiency of various simple machines and record data for MA, VR and Efficiency as follows:

Table 1.2 Data record of simple machines

Sl. No.	Type	Load	Effort	MA	Displacement of effort	Displacement of Load	VR	Efficiency %
1								
2								

Using the information from the spreadsheet, the learner plots a graph to show how simple machines multiply force, gain speed, and increase efficiency.

Then the learner answers the following questions:

1. Identify the most efficient machine.
2. Classify the levers into force multiplier and distance multiplier?
3. Identify and explain the benefit of using each lever.
4. Classify simple machines that you see around and explain their uses.

The learner explores from the web link https://bit.ly/3qZB66l to understand the working of pulleys and carries out the activity to investigate how pulleys multiply the force, change the speed and increase the efficiency. Fills in the data in the worksheet given in the link.

The learner also explores the web link https://bit.ly/3qY9Wwj to understand how gears multiply force, change the speed and increase efficiency and make a presentation to the class. Then, the learner answers the following questions:

1. A single fixed pulley is neither a force multiplier nor a distance multiplier. Why is it still used?
2. Mention some uses of a single fixed pulley.
3. How would you arrange a single movable pulley such that effort is applied downward resulting in the same mechanical advantage and efficiency? Draw a diagram to show your arrangement of pulleys.
4. Design a model to explain the working of a gear.
5. Gear ‘A’ has 30 teeth and gear ‘B’ has 20 teeth. If gear A turns one revolution, how many times will gear B turn? If you want to gain speed, which gear will you use as driving gear?

Simple machines not only multiply force but also multiply distance and speed. The value of the mechanical advantage of a simple machine can be one, greater than one or less than one. The mechanical advantage has no unit of measurement.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of mechanical advantage, velocity ratio and efficiency of simple machines and how pulleys and gears multiply force, change speed and increase efficiency	• Assess the learner's ability to classify simple machines as a force multiplier and distance multiplier, ability to classify the lever into first, second and third-class levers, and ability to gather and interpret information and ability to solve problems related to MA, VR and efficiency of pulleys and levers and ability present the information in the class	• Assess the learner's understanding of the application of simple machines in various activities.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Class VII (2020), REC
5. Relationship between mechanical advantage, velocity ratio and efficiency of simple machines: https://bit.ly/3JH8xTw
6. MA, VR and Efficiency of various simple machines: https://bit.ly/3HJjZw2
7. Working of gears: https://bit.ly/3qY9Wwj
8. Working of pulleys: https://bit.ly/3qZB66l

3.1.3 Relative Density

Scope: This topic highlights the concept of relative density, activity on investigating relative density and its applications.

Learning Objectives:

- *Explain relative density with examples.*
- *Determine relative density of materials used.*

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- *Explain the significance of relative density in everyday life.*

Learning Experiences

Density is the property of a substance which is defined by mass per unit volume. The property of the body to float or sink on the liquid is dependent on the ratio of the density of an object to that of liquid. Did you ever wonder why a heavy log floats in a river, while a pebble sinks?

The learner calculates the density of each object by using its mass and volume. Objects can be glass blocks, wooden blocks, stone, etc., and records the reading in tabular form. Then the learner compares the density of objects and the pure water to understand the meaning of relative density.

The learner watches the video from the web link https://bit.ly/3qUQdhb for further understanding of relative density. The learner then designs a model of boats that floats on a surface of water based on the concept of density.

The learner answers the following questions:

1. What is the relationship between the density of an object and the relative density of a substance?
2. An object with a mass of 40 g has a volume of 80 cm^3. Will the object float or sink in water? Why?

Density is the property of a substance that differentiates heavy substances from light ones. Therefore, density is directly proportional to mass and inversely proportional to volume. The unit of density is gcm^{-3}. The bigger unit of density is kg-3 (kilogram per cubic metre).

Learners explore significance of relative density in everyday life.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of density and relative density.	• Assess the learner's ability to design experiments to compare the density and relative density.	• Assess the learner's understanding of the application of relative density in daily life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Class VII (2020), REC
5. Relative density: https://bit.ly/3qUQdhb

Challenge Your Thinking

1. If a bus covers a distance of 150m in 5s, calculate:
    a. speed of the bus
    b. time is taken by the bus to cover a distance of 300 m at the same speed
2. The mass of 25 cm^3 of brass is 210 g. Calculate the density of the brass.
3. Why do some objects float or sink relative to other objects?
4. How is density important to aquatic life in the ocean?
5. Dema took 2 minutes at a speed of 10 m/s to reach a shop from her house. How far is the shop from Dema's house?
6. A person driving to the store travels 200 metres in 300 seconds. Then they go to another store travelling an extra 400 metres in 500 seconds. What is their average speed?
7. Suppose a truck travels in segments that are described in the following table. Calculate the average speed of the truck

Segment	Distance (Km)	Time (hour)
1	30	1
2	45	2
3	50	1

8. Dorji runs to school which is at a distance of 500 m. He takes 50 seconds to reach the school. At what speed does Dorji run?
9. Explain how a crowbar, a first-class lever, can be used as a second-class lever?
10. A pair of scissors has a short effort arm, while a plier used to cut wires has a long effort arm. Explain.
11. Explain the application of the principle of the lever in our arms and legs.
12. If the total length of a crowbar is 150 cm and the distance of the fulcrum from the load is 25 cm, calculate the mechanical advantage of the crowbar.
13. The density of mercury is 13.6 g cm-3. What do you understand by this statement?
14. If the unbalanced opposing forces of 270N and 360N are applied to the cart at the same time, what will happen? Identify two types of motion when the cart is in motion.
15. State three ways in which machines are useful to us.
16. Sonam and Dorji were using a stapler to staple their papers together. Sonam pressed down at the end of the stapler while Dorji pressed down near the middle of the stapler as shown in Figure 10.26. Sonam finished the job faster, and his fingers were less tired as compared to Dorji's. Why?
17. Dema takes a piece of wood to find its density. She records the observation as given below: Length of wood piece= 5 cm Breadth of wood piece= 2 cm Height of wood piece= 2 cm
    a. Can Dema find the density from the above recording? Why?

b. Dema places wood pieces on a pan balance. Reading on the pan balance is 45 g. Will the wood float in water? Why?

18. What are the advantages of having a bicycle with gears?

3.2. Work and Energy

We perform various types of work in our daily life. To perform work, we need energy. Work is said to be done when the forces act upon an object to cause a displacement. In its simplest form, work is often represented as the product of force and displacement.

Energy is the capacity of doing work. Energy and work are measured in terms of a joule (J). All living beings and machines use energy in different forms. Humans get energy from food which is prepared by plants. Machines get energy from electricity, coal and other sources. How can we examine or investigate different situations where work is done?

Competencies:

Explore various sources of energy and their types to understand the sustainable use of energy in real life.

Explain work by drawing its relationship with force and displacement and relate its application in daily activities.

3.2.1 Work

Scope: This topic deals with concepts on distance, displacement, work done and simple calculations and experimental verification related to work done.

Learning Objectives:

- *Define displacement.*
- *Differentiate between distance and displacement with examples.*
- *Calculate the work done with respect to force and displacement in different situations.*
- *Justify that the scientific meaning of work is different from everyday meaning of work done in daily life.*

Learning Experiences

Scientifically, work is said to be done only when an object is moved over a distance by an external force, or when an applied force displaces the body in the direction of the force. To express this concept mathematically, work done (W) is equal to the force times the displacement, or Work = force X displacement.

To understand the work, it is important to know about the distance and displacement. Displacement is the distance covered in a defined direction; hence it is a vector quantity. Distance is a scalar quantity in any direction. These two quantities play vital roles in doing work.

The learner watches the video from a web link https://bit.ly/3II7B04 or from other relevant sources to understand the differences between distance and displacement as different quantities.

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The learner conducts some activities to investigate the differences between distance and displacement. The learner answers the question.

1. Explain the difference between distance and displacement with an example.
2. Which of these two quantities can be zero? Justify your answer.

The learner watches the video from a given web link https://bit.ly/3q61ex5 and https://bit.ly/3JV23R1 or from other relevant sources to explain the concept of work done in our daily life.

After watching the video or exploring other relevant sources, the learner deduces and explains the mathematical formula of the work. Investigates the work done by performing some physical activities.

The learner answers the following questions

1. What are the factors that contribute to doing work?
2. An ant is dragging a housefly to its hive, and the elephant is pushing a big tree which is not moving. Who is doing the work, the ant or the elephant? Justify your answer.
3. Sonam has done work of 1000 J in pushing a table with 300 N force. Find the distance covered by the table along the direction of the force.

Work done is defined as the product of the applied force and the displacement of the body. Therefore, work is done only if both force and displacement exist simultaneously. One joule of work is said to be done if a force of one newton displaces a body by one metre in the direction of the force applied.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• The learner is assessed on the conceptual understanding of work done, force, distance and displacement with examples.	• Assess the learner's ability to investigate work done by performing activities and calculate work done, force and displacement.	• Assess the learner's participation in the learning activity and ability to explain the importance of work.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Distance & Displacement: https://bit.ly/3II7B04
6. Work and Energy: https://bit.ly/3Ild2Sq
7. What is work done: https://bit.ly/3FXSUEp

3.2.2 Sources of Energy

Scope: This topic deals with the sources and classification of energy. It also evaluates sources of energy contributing to climate change and suggests ways to become a sustainable energy consumer.

Learning Objectives:

- *Explore various sources of energy.*
- *Classify energy into renewable and non-renewable sources.*
- *Evaluate sources of energy contributing to climate change.*
- *Suggest ways for sustainable use of energy.*

Learning Experiences

We use machines for doing most of our work. Due to this, the demand for energy is growing at a tremendous rate. This growing demand for energy is largely met by traditional sources of energy. Energy sources can be either renewable or non-renewable sources depending on their ability to replenish. Why is it necessary to study energy resources and their conservation?

Learners may watch the video from the given web links https://bit.ly/3q4UI9z and https://bit.ly/3eZm5vH or other relevant sources to understand different sources of energy and their applications in our life.

The learner lists different energy sources explored from video or other sources. Categories these sources into renewable and non-renewable sources.

The learners also explore various forms of energy found in their locality and record the information as exemplified by the sample table.

Table 2.1: Forms of Energy

Source of energy	Renewable/non-renewable	Conventional/non-conventional sources	Application /uses

The learners in the team prepare the presentation based on the information from the above table using MS PowerPoint or chart paper and present it to the class.

The learner creates posters or presentations on the usage of energy sustainably as an advocacy program.

The learner answers the following questions

1. The construction of wind energy farms is not ideal in places like Phuentsholing. Give a reason.
2. Which sources of energy that you learnt are feasible to harness in your area? Why?
3. Why is it better to use more renewable energy resources rather than non-renewable resources?
4. Give one advantage of using wind turbines to generate electricity compared with using fossil fuel power stations.

Learners watch the video on climatic change from the weblink https://youtu.be/G4H1N_yXBiA or any other relevant sources and answer the following questions.

1. How is global warming related to energy consumption?

2. How can we achieve sustainable energy consumption?
3. Describe evidence that shows climatic change in your locality.

Learners in groups list different ways of using energy sustainably.

Non-renewable sources of energy are those energy sources, which are limited and exhausted with use over time. Renewable sources of energy are those, which can be replenished over a short period.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• The learner is assessed on the conceptual understanding of sources of energy, conventional and non-conventional sources, renewable and non-renewable sources of energy.	• Assess learners' ability to advocate for people through presentations or designing posters to create awareness on the importance of using energy resources wisely.	• Learners are assessed based on their interest through participation in teamwork, and ability to advocate people about using energy wisely for future generations.

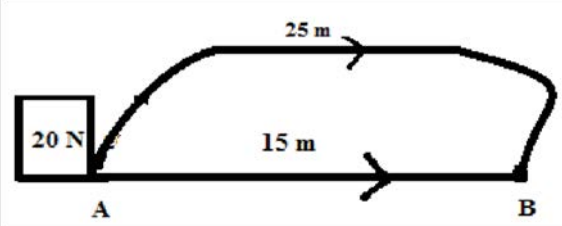
For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

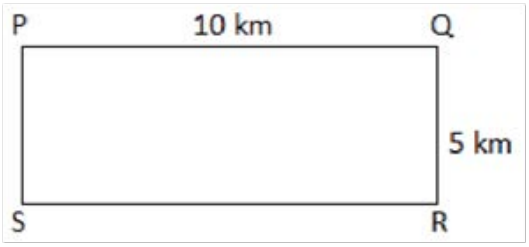
1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Introduction to Energy Sources: https://bit.ly/3q4UI9z
6. Energy Sources: https://bit.ly/3eZm5vH

Challenge Your Thinking

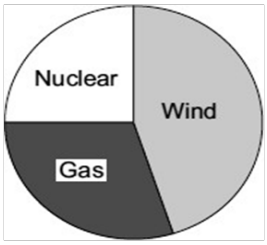
1. Mr. Khenrab Jamphel moves the wooden box from point A to point B as shown in Figure below. He applied 20N of force. What is the amount of work done by him?



2. Mr Sangay drove his car from P to Q, Q to R and then finally from R to S as shown in Figure. What is the shortest route from P to S?



3. Demand for energy is on the increase with increasing technological progress day by day. Explain this statement based on your understanding
4. Hydropower and fossil fuel are two sources of energy. Justify which one is eco-friendly.
5. Why is renewable energy considered clean energy, and how will you make sure that these energy resources are preserved for our future generations?
6. Pema stands still holding a bucket of water. She applies force to hold the bucket. Is she doing work? Why?
7. Describe the relationship between work, force and displacement.
8. Find out the magnitude of the force acting on a box when 1000 J of work is done to displace it by 5 m.
9. A load of mass 30 kg is lifted up by 7.0 m. Calculate the work done. (Take g = 9.8 m s.)
10. An electricity company claims to generate electricity from environmentally friendly energy sources. The energy sources used by the company are shown in the pie chart



a. Do you think that the claim made by the company is appropriate in context to Bhutan? Explain the reason for your answer.

3.3. Electricity and Magnetism

Electrical energy is one of the important forms of energy that people use at homes, industries, offices, and in many other places. Electrical energy is said to be clean energy but it can be dangerous if used without safety. Electricity is brought to our homes through electrical wires and used to operate electrical devices like rice cookers, television, radio, etc. Electrical energy is measured in a unit called watt (W) and the electric current is measured in ampere (A). The potential difference or the voltage across the ends of the conductor is measured in volt (V).

Electricity is of two types: current electricity and static electricity. You might hear a crackling noise while removing a nylon shirt or stockings in winter. Similarly, we often get mild shocks from the knob of the car door. Why do you think so?

Competencies:

Construct electrical circuits with electrical components like ammeter, voltmeter, resistor, conducting wire, bulb, and switch to understand their functions, investigate electrical energy transformation and the effects of static electricity.
Explain the molecular theory of magnetism to understand the process of magnetisation, properties and strength of magnets and relate how it is used in our life.

3.3.1 Electric Circuits

Scope: This topic deals with what are electric current, voltage and resistance and their relationship. It also includes measuring current and voltage in series and parallel circuits, and transformation of electrical energy.

Learning Objectives:

- *Explain the concept of resistance.*
- *Deduce the relationship amongst current, voltage and resistance.*
- *Construct parallel and series circuits*
- *Compare the current and voltage in parallel and series connection.*
- *Investigate transformation of electrical energy in different electrical appliances.*

Learning Experiences

Circuits are closed paths for electricity to flow through. All the electrical appliances at home are connected to a battery or mains supply with the help of wires to form a complete circuit. In a series circuit, appliances are connected one after another. In this type of circuit, an equal current flow through all the electrical appliances while the voltage gets distributed across all the appliances. In the parallel circuit, the current gets divided among the appliances while an equal amount of voltage is received by the appliances.

The learner uses the video link https://bit.ly/31qmunG to understand the concept of current, voltage and resistance. The learner then explains voltage, current and resistance based on their understanding.

The learner answers the following questions:

1. What is the function of the voltage source in the electric circuit?
2. What is an electric current?
3. What is electrical resistance?

The learner uses the link https://bit.ly/3zvNkYc to study how series and parallel are constructed using pHET simulation. Then, the learner constructs parallel and series circuits using the pHET simulation link https://bit.ly/3qu9Fm8 to see their effects on voltage and current.

The learner uses the science textbook for class VII or the link https://bit.ly/3tqdbQf or other relevant sources to explore symbols and functions of basic electrical components. After gathering the information, the learner then draws the symbols and functions of different electrical components such as voltmeter, ammeter, switch, cell, batteries and wires.

The learner answers the following questions to check their understanding.

1. What is the function of the voltmeter?
2. What is the difference between a cell and a battery?

3. What is the function of an ammeter?
4. What is the function of the switch in the circuit?

Learners work in groups, pairs or individually to construct a virtual simple electric circuit with resistor, a light bulb, wires and batteries in the simulation from the link Circuit Construction Kit: DC. Learners draw the circuit diagram based on the virtual construction.

From the simulation, learners measure and record voltage and current with units. In the following tables, learners measure the current by varying the voltage without changing the resistance (Resistance constant). Learners measure the current by varying the resistance without changing the voltage (voltage constant). From the observation, learners draw a relation among current, voltage and resistance. Learners share their observations and results to the class. *Reading of current with respect to resistance at constant voltage*

Further, the learner carries out an experiment in the laboratory using available resources to measure the current and voltage in parallel and series circuits to investigate the distribution of voltage and current through it.

The learner answers the following questions based on the series and parallel circuits.

1. How is current distributed in the parallel and series circuits?
2. How is voltage distributed across parallel and series circuits?
3. Which circuit would you prefer? Why?

The learner watches the video from the link https://bit.ly/3frX9gx to understand the energy transformation taking place in electrical appliances. Then, the learner investigates the electrical energy transformation in different appliances.

The learner answers the following questions:

1. State the electrical energy transformation in the following appliances:
    a. rice cooker
    b. electric heater
    c. washing machine
    d. loudspeaker
    e. hair dryer
    f. television
    g. Fan
    h. LED bulb

Our life is dependent on electricity and electric circuits. The smartphone, the computer, the television set, the video cameras that capture images, the electric wiring in your house, the street lights in our town, and the medical equipment at the hospital, all make use of electric circuits and electricity. Thus, electricity plays a very important role in the lives of people and makes our lives comfortable.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of electric current, voltage, resistance, distribution of current and voltage in parallel and series circuits.	• Assess learners' ability to design and carry out experiments to measure current and voltage in parallel and series circuits, drawing the parallel and series circuits using PhET simulation and drawing symbols of different electrical components.	• Assess the learners' understanding of the energy transformation in electrical appliances in relevance to the practical application.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Current, Voltage and Resistance: https://bit.ly/31qmunG
6. Series and parallel circuit: https://bit.ly/3zvNkYc
7. Circuit construction kit: https://bit.ly/3qu9Fm8
8. Circuit symbols and functions: https://bit.ly/3tqdbQf
9. Electrical energy transformation: https://bit.ly/3frX9gx

3.3.2 Static Electricity

Scope: This topic deals with the concept of static electricity and its effect and application in natural phenomena.

Learning Objectives:

- *Explore the effect and application of static electricity in day-to-day life.*

Learning Experiences

Some people experience mild shocks when they touch the car door right after driving. Likewise, if a comb is brought near small pieces of paper after combing the dry hair, it attracts the paper pieces. Why does this happen? When different insulating materials are rubbed against each other, they become electrically charged by friction. These charges remain static on the objects on which they are developed.

The learner uses the video link https://bit.ly/34VYxWR to understand the origin of static electricity. The learner watches the video link https://bit.ly/34KRznb to understand the uses of static electricity.

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The learner demonstrates the presence of charges in different materials by rubbing two substances. The learner answers the following questions to check their understanding.

1. Explain the origin of static electricity based on the structure of atoms.
2. Mention a few uses of static electricity in our daily life.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of static electricity.	• Assess learners' ability to demonstrate the presence of charges in different materials by the generation of static electricity.	• Assess the learners' understanding of the effect and applications of static electricity in day-to-day life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Origin of static electricity: https://bit.ly/34VYxWR
6. Uses of static electricity: https://bit.ly/34KRznb

3.3.3 Magnetism

Scope: This topic comprises the concept of molecular theory of magnetism, magnetisation, and investigation of particle arrangement in a magnet.

Learning Objectives:

- *Explain the molecular theory of magnetism and magnetization.*
- *List some practical applications of magnetism.*

Learning Experiences

In lower classes, you have learnt that the force around a magnet is called a magnetic field. The entire magnetic field of any magnet is represented by the imaginary lines of force around the magnet. The point of a magnet where the magnetic force is the strongest are called poles. Substances that are attracted by the magnets are called magnetic substances, while those that are not attracted are called non-magnetic substances. Magnetic substances like iron and steel are composed of many small magnets known as molecular magnets arranged randomly. However, when a magnet is brought near the magnetic substance, the molecular magnets start to rearrange themselves in an orderly manner.

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The learner watches the video lesson from the link https://bit.ly/3ePUgWo to understand the concept of molecular magnets.

The learner explains the molecular theory of magnetism and carries out experiments to demonstrate the process of magnetization and demagnetization.

The learner answers the following questions to check their understanding.

1. Explain the molecular theory of magnets in your own words.
2. Explain the process of magnetization and demagnetization.
3. Explain the disadvantages of magnetisation in our daily life.

Learners list some applications of magnetism in their daily life.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of molecular magnets.	• Assess learners' ability to carry out experiments to demonstrate the process of magnetization.	• Assess the learners' understanding of the uses of magnets in day-to-day life.

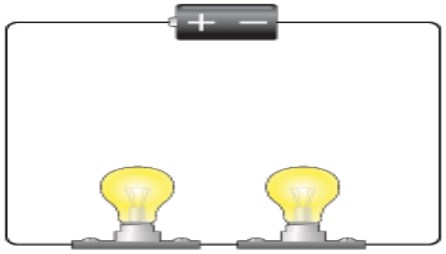
For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Molecular magnets: https://bit.ly/3ePUgWo

Challenge Your Thinking

1. Magnets are used in an electric doorbell as well as in a magnetic compass. State three differences between the two magnets.
2. A teacher in the science laboratory notices a student dropping a bar magnet on the floor. The teacher advises the student to handle the magnet carefully. How does the rough handling of a magnet affect its quality?
3. Draw diagrams to illustrate the molecular magnets in magnetic materials and in magnets.
4. Study the diagram given below and answer the questions.



a. Trace the energy transformation in the figure.
b. If you replace the existing wire with a longer wire, what changes do you expect to see in the brightness of the bulbs?

5. How should the voltmeter and ammeter be connected in the circuit to measure voltage and current? Why?
6. Explain ONE use of static electricity with the help of an example.

3.4. Light and Sound

Light travels in straight lines in all directions at different speeds in different media including vacuum. Objects become visible in the presence of light. When light falls on different surfaces it is scattered at the same angle, or in different directions depending on the nature of the surface. It may be absorbed by a surface fully or partially.

A sound is a form of energy that is produced by a vibrating body. Unlike light, sound requires a material medium for transmission. It is propagated through a medium in the form of waves. The range of hearing for different animals is different. While sounds can help to communicate and provide enjoyable experiences for people, loud sounds can have a negative impact on living things and the environment. Have you ever thought about what could be some of the impacts of loud sounds?

Competencies:

Investigate the properties of light and sound to draw their significance and applications in daily life.

3.4.1 Light and its Properties

Scope: This topic comprises the concept of propagation of light, reflection and its types, investigating laws of reflection, reflection through plane mirror, terms and general rules of spherical mirrors, and uses of spherical mirrors.

Learning Objectives:

- *Demonstrate the laws of reflection of light.*
- *Construct a ray diagram to illustrate the formation of images by a spherical mirror.*
- *List the uses of concave and convex mirrors in a variety of situations.*

Learning Experiences

When light falls on the surface of an object, some of it returns to the same medium, some of it passes through the object and the rest is absorbed. The bouncing back of light into the same medium after striking a surface is called a reflection of light. Have you heard about the laws of reflection?

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The learner watches the video from the following web link https://rb.gy/mizqdo. After watching the video, the learner in teams carries out an activity to investigate and confirm the laws of reflection learnt from the video.

The learner answers the following questions as a follow-up of the activity:

1. What relation do you see between the angle of incidence and the angle of reflection?
2. What would be the result if a ray of light is incident on the normal?
3. Does reflection occur from all surfaces? Explain

When we stand in front of a mirror, we see our image in it. But have you ever thought about its properties? What are the different properties of an image that is formed in a plane mirror? The learner watches the video on the properties of the image formed by a plane mirror from the following web link https://rb.gy/rkgcwe.

The learner then answers the following question:

1. Describe the image formed.
2. Why does lateral inversion occur?
3. Will the image formed by any reflecting surface like a pool of water or a coloured screen have the same properties?

A mirror in which the reflecting surface is part of a sphere is called a spherical mirror. If the inner surface is the reflecting surface, it is called a concave mirror. If the outer surface is a reflecting surface, it is called a convex mirror. These types of mirrors obey the laws of reflection exactly the same way as the plane mirror.

The learner watches the video https://www.youtube.com/watch?v=H1eRmNbTkm0 and takes note of the terms used in spherical mirrors. The learner then watches the following video on the rules of drawing ray diagrams for spherical mirrors https://rb.gy/wvh5y3.

Based on the information from the video above, the learner in the team conducts an experiment to investigate reflection from the curved surfaces and the type of images formed. Using the rules of drawing ray diagrams, the learner draws the formation of the image (concave and convex) and takes note of the properties of the image formed when the object is at the following places:

- Object at infinity
- Object beyond the centre of curvature
- Object at the centre of curvature
- Object between the centre of curvature and principal focus.

The learner after carrying out the activity looks for information on the application of concave and convex mirrors in daily life.

The learner then answers the following questions:

1. What kind of mirrors are used as rear-view mirrors in vehicles? Why?
2. Why do dentists use concave mirrors instead of convex mirrors?

The learner explores how spherical mirrors can be used in the immediate surrounding. A concave mirror is also called a converging mirror since it converges all the light rays to a single point, while a convex mirror is called a diverging mirror since it diverges the light rays falling on it.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of reflection and its laws.	• Assess the learner based on the ability to investigate the laws of reflection and draw the ray diagram of how images are formed by concave and convex mirrors.	• Assess the learner's ability to explain the application of mirrors in day-to-day life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Laws of reflection: https://rb.gy/mizqdo
6. Properties of the image formed by a plane mirror: https://rb.gy/rkgcwe
7. Terms used in reflection: https://www.youtube.com/watch?v=H1eRmNbTkm0
8. Rules for drawing ray diagram: https://rb.gy/wvh5y3

3.4.2 Sound and Hearing

Scope: This topic consists of concepts of production and propagation of sound, wave patterns of different sound, range of audibility, uses of ultrasonic and infrasonic sound, and effect of loud sound.

Learning Objectives:

- *Describe the properties of sound waves.*
- *Explore the wave pattern of sounds produced by different instruments.*
- *Analyse the different forms of sound based on the wave patterns.*
- *Explain how noise pollution causes damage to health*
- *Propose ways to reduce noise pollution in the locality.*
- *Explain the uses of ultrasonic and infrasonic sound.*

Learning Experiences

We live in the world of sound. Sound travels in the form of waves. Wave is a disturbance that moves through a medium. Different sounds are produced from different sources and these result in different wave patterns.

The learner uses the PhET simulation https://rb.gy/w2bdbg to understand the wave patterns produced by different sounds. Hit the school bell and experience how it produces sound.

1. What would be the wave pattern of a baby's cry and an adult's cry? Draw and explain.

2. Explore how sound travels through different media and make comparisons of sound through different media.

Have you heard about sounds, which humans cannot hear? These sounds are ultrasonic and infrasonic? Why do you think that these sounds cannot be heard?

The learner looks for information on what ultrasonic and infrasonic sounds are and why they cannot be heard, from the internet or any other resources. The learner then explores the uses of ultrasonic and infrasonic sounds and notes them.

With lots of human activities around us, we produce different types of sounds. Unpleasant sound is considered noise. Too much noise leads to noise pollution. The learner in teams carries out a survey on the types of noise produced in the locality and the impact it has on human life and the environment.

The learner answers the following questions as a follow-up:

1. What are some of the impacts of noise pollution on humans and the environment?
2. How can the impact of noise pollution on humans and the environment be reduced?

Using differentiated instruction, learners are provided with diverse sources of information such as newspaper clippings, library books, videos from the link Noise Pollution or any other relevant sources. Learners in groups compile the information on the impact of noise on the society and environment based on their convenience and choice. Learners suggest solutions to reduce negative impacts and ideas to enhance the positive impacts. Learners present their findings with valid reasons in the form of a report or poster. Learners display their work in the subject corner

Sound is propagated through different media such as gas, liquid and solid. Some materials like air, water and iron can easily transmit sound energy from one place to another. On the other hand, materials like blankets and thick curtains absorb most of the sound energy, therefore, they do not transmit sound energy easily.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual knowledge of wave patterns, ultrasonic and infrasonic sounds, and noise pollution and its impact.	• Assess the learner's based on their ability to conduct the survey on noise pollution.	• Assess the learner's ability to find solutions to the problems of noise pollution.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. PhET (Wave pattern): https://rb.gy/w2bdbg

Challenge Your Thinking

1. Why is the speed of light different in different media? Explain.
2. Why do we see lightning first and then hear thunder only after some time, though they occur simultaneously?
3. How can we make a non-luminous object luminous?
4. An astronaut on the moon saw two huge asteroids collide with great force but did not hear the sound. Why was the sound not heard? Explain.
5. Although music adds joy to life, it sometimes leads to noise. Justify the statement.
6. Why is the spelling of AMBULANCE written in its mirror image (ECNALUBMA)?
7. Animals like elephants and birds can foretell the incoming storm, but humans stay unconcerned. How do they know it?

3.5. The Earth and Beyond

The Solar System is a part of the Milky Way. It makes people wonder about what is out there, and how they affect the lives on the Earth. We see billions of stars shining in the sky at night. There are planets and other heavenly bodies moving around the Sun. All these heavenly bodies together with the Sun are called the Solar System. The Sun is at the centre of the Solar System. It is a primary source of heat and light energy.

The Sun exerts a strong gravitational pull on the planets and other objects in our solar system. This gravitational pull is what causes the planets to orbit around the sun instead of going off into space.

Competencies:

Explain the solar system based on its features and distance of planets from the sun to understand their significance in everyday life.

3.5.1 Beyond Earth

Scope: This topic deals with the formation of the solar system, concept of sun, satellites, and types of satellites (Natural and Artificial), asteroids, meteoroids, comets and planets.

Learning Objectives:

- *Describe the formation of the solar system and appreciate their co-existence.*
- *Explore satellites and their types, asteroids, meteoroids, planets and the sun.*
- *Explore the significance of the solar system on life on Earth.*

Learning Experiences

The solar system consists of eight planets and their moons in orbit around the sun, together with smaller bodies in the form of asteroids, comets, meteoroids, and dwarf planets. The name planets come from the Greek word "planets", which means wanderer. The planets are in three groups: the inner planets, Mercury, Venus, the Earth and Mars; the gas giants, Jupiter and Saturn; and the outer planets, Uranus, and Neptune.

Our solar system is always in motion. The sun is a member of the Milky Way galaxy. The Moon is the Earth's natural satellite and there are many human-made satellites. Have you ever wondered how our Solar System was formed?

The learner watches the video from the web link https://bit.ly/3mWu9Sh or https://bit.ly/3qLJZQP and http://surl.li/pubep to understand the formation of the solar system. Then the learner writes the formation of the solar system and constructs a model of the solar system to demonstrate the distance of planets from the Sun.

Next, the learner explores satellites and their types, asteroids, meteoroids, comets, dwarf planets and the sun from the relevant sources. The learners note the important points and answer the following questions:

1. Explain asteroids, meteoroids, comets, and dwarf planets.
2. Why do you think the Sun is important in the solar system?
3. What are satellites and explain the natural and artificial satellites with an example?
4. What are the uses of artificial satellites for humans?

Similarly, when we talk about natural satellites, we are referring to a body that orbits another in space, just like the Moon, our own natural satellite. Except for Mercury and Venus, all the planets in the Solar System each have their own natural satellites. Natural satellites influence the tides and keep the Earth stable.

Learners in a team, explore designing and modelling a telescope by using different types of lenses in your science laboratory. Display and explain the telescope made in class.
Learners write one-minute papers on the significance of co-existence amongst the celestial bodies.

Compared to other stars in the universe, the Sun is unremarkable. But for the Earth and the other planets that revolve around it, the Sun is a powerful centre of attention. It holds the solar system together, providing life by giving light, heat and energy to the Earth. The artificial satellites in the modern world have aided innovation for geologic purposes such as monitoring storms and crop fields, providing data which can save lives from natural disasters etc.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the conceptual understanding of the formation of the solar system, the concept of sun,	• Assess the learner's ability to gather information and construct the model of the solar system. Identify	• Assess the learner's ability to understand the importance of the solar system and other heavenly

asteroids, comets, meteoroids, dwarf planets and satellites.	planets based on their features and distance from the Sun.	bodies in everyday life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Textbook for Class VII (2020), REC
5. Formation of the Solar System: https://bit.ly/3mWu9Sh
6. Solar System-National Geographic: https://bit.ly/3qLJZQP
7. Satellites and their types: http://surl.li/pubep

Challenge Your Thinking

1. What would happen if the planet did not revolve around the Sun?
2. Why is the sun the primary source of energy?
3. Do you think life is possible on all the planets? Give a reason.
4. What is the importance of asteroids, meteors and comets for us?
5. Explain the importance of artificial satellites with some examples.
6. Does Bhutan have any artificial satellites? If any, write a brief report on it.
7. Why is the solar system important for the universe?
8. Why is the tail of comets formed, when it comes closer to the sun?
9. To weigh roughly two-thirds less than what you do on the Earth, which planet would you be on?
10. Name two things that would become impossible without artificial satellites.

INSTRUCTIONAL GUIDE – SCIENCE FOR CLASS VIII

Life Processes

1.1 Cells

Organisms are composed of structural and functional units called cells. In an organism, the cells are organised into bigger and more complex structures or sub-systems called the levels of the organisation. These levels of the organisation carry out different functions in an organism and ensure its survival. Studying these levels of the organisation is important for understanding the functioning of an organism.

Competencies:

Explain the levels of organisation of cells of an organism to understand their relationships in maintaining the overall function and survival of an organism.

1.1.1 Levels of Organisation

Scope: This topic covers the functions of cell organelles, levels of Organisation: cells, tissues, organs, organ systems of both plants and animals with greater emphasis on plant and animal tissues and their functions.

Learning Objectives:

- *Identify the structures and functions of plant cells and animal cells.*
- *Construct a model of plant and animal cells.*
- *Examine the level of organisation in organisms.*
- *Identify the structure and functions of different plant tissues.*
- *Observe the permanent slides of plant tissues under the microscope (limited to dicot stem).*
- *Describe the structure and functions of animal tissues*
- *Observe the permanent slides of animal tissues under the microscope*

Learning Experiences

Higher plants and animals are made up of many cells. These cells organise themselves into bigger and more complex structures called the levels of the organisation. Each level carries out a number of specific functions. Do you know what our body is made up of? Can you name some of the levels of the organisation?

Learners share and discuss the structures and functions of cells learnt from the web links shared by a teacher a week before the lesson. In continuation, learners answer the questions in their notebooks. In the next activity, learners construct scientific models of a plant cell and animal cell.

(Teacher shares the web link(s) https://bit.ly/plantcell_html animal cells with students one-week before the lesson with students through Google Classroom or any social media. Teacher informs the learners to read about the structures and functions of plant and animal cells from the given links, and asks them to complete the worksheets as provided in the tables below. **Plant Cell**

Parts	**Description**	**Role(s)**

Cell wall		
Cell membrane		
Cytoplasm		
Nucleus		

Please add rows for other cell organelles and fill up the columns accordingly.

Animal Cell

Parts	**Description**	**Role(s)**
Cell membrane		
Cytoplasm		
Nucleus		
Mitochondria		

Please add rows for other cell organelles and fill up the columns accordingly

The learner gathers information on the levels of an organisation with examples of plants and animals from the suggested link https://bit.ly/353EhT7 and other sources.

Based on the information gathered, the learner develops a model that explains the hierarchical relationships amongst cells, tissues, organs, and organ systems and answers the following questions:

1. Which level is the lowest and the simplest? Why?
2. Why is the organ more complex than the tissue?
3. Rearrange the following from the lowest level to the highest level.
    a. brain, nerve, nervous system, neuron, bird
    b. Tree, leaf, mesophyll cell, phloem, shoot system)
4. How do these levels of organisation help an organism survive?

The learner then observes some permanent slides of plant and animal tissues under a compound microscope and draws them. Then gathers information on plant and animal tissues and their functions from any relevant sources such as reference books, the internet, hand out, etc. and answer the following questions:

1. Describe plant tissues and their functions.
2. Describe animal tissues and their functions.
3. Differentiate between plant and animal tissues.
4. Relate the relationships amongst cells to social values.

The learner explores the idea of making temporary slides. Prepares the slides and seeks the teacher's guidance. Draws the diagram of the specimen.

An organism has five levels of organisation arranged in a hierarchical order. The cell is the lowest and the simplest level, and the organism is the highest and the most complex level. All these levels carry out different functions for the survival of an organism.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of the hierarchical relationships amongst cells, tissues, organs, and organ systems in plants and animals. Also, the conceptual understanding of the various tissues and their functions in plants and animals.	• Assess the learner's ability to observe slides and identify the plant and animal tissues and the ability to collect information from various sources and organise it into useful concepts.	• Assess the learner's understanding of the significance of the levels of organisation and tissues in plants and animals.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Levels of organisation in animals: https://bit.ly/353EhT7

1.2 Humans as Organisms

The human body is an amazing coalition of many different systems that work together to keep everything functioning for good health. Our bodies are made up of eleven basic organ systems that manage all the essential body functions. All the systems work together to maintain balance within the body, thereby maintaining homeostasis.

Several factors, such as the environment and changing lifestyles, have an impact on an individual's health. All these systems are interdependent and work in coordination. When one is not functioning properly, others attempt to correct the problem. Understanding organs and organ systems in our body is important to understand their roles and ways of taking care of them for the growth and development of our body.

Competencies:

Explain various life processes (human digestive system, movement, respiratory system and reproduction), sense organs, environment, lifestyle and health to understand their significance in proper functioning of the human body.

1.2.1 Digestive System

Scope: This topic covers what digestion is, parts of the digestive system and their functions, and the process of digestion in the mouth, stomach, and small intestine.

Learning Objectives:

- *Explain the structures and functions of the human digestive system.*
- *Explain the significance of the digestive system in humans.*

Learning Experiences

Humans need nutrients to grow and remain healthy. These nutrients are obtained from the food that we eat. Most of the food is in a complex insoluble form, which has to be changed into a simpler soluble form. The conversion of food from complex to simpler soluble form is known as digestion. The process of digestion takes place in the digestive system. This system consists of the mouth, alimentary canal and digestive glands. Why do we have to break down the food we consume?

The learner watches the video from the suggested web link https://bit.ly/3334vUT to understand the digestive system and their functions. Based on the information gathered the learner prepares a presentation with an illustration of the functions of the different parts of the digestive system and presents it to the class.

To check the understanding of the lesson, the learner answers the following questions:

1. Explain the relationships between the functions of the large intestine with the small intestine.
2. How would infection of the oesophagus affect the process of digestion?
3. Food that we consume is a complex compound. How is the food made absorbable by cells?
4. Rearrange the sequence of the digestive process
   (Mouth—stomach–large intestine–oesophagus–small intestine-rectum)

The learner recollects a situation when one had indigestion problems. Make a narration of how the food travels through the digestive channel, and what happens to the food in each segment till it is defecated as waste. Hypothesise what might have caused your indigestion problems. Make a presentation to the class.

Learners choose one of the common issues of stomach indigestion, write its possible causes, and design solutions to mitigate such issues. Learners share their ideas to the class and critique each other's ideas and solutions.

Digestion is important for converting complex foods into soluble substances which can be easily absorbed by the body. Different parts of the digestive system and secretion from digestive glands work together to carry out the process of digestion.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's ability to identify different parts of the digestive system and their functions, and explain the process of digestion.	• Assess the learner's creativity and presentation skills based on the presentation.	• Assess the learner's understanding of the role of digestion in the functioning of the human body.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science, (2022)
2. REC repository
3. Science Class Eight (2020), REC
4. Human Digestive system link: https://bit.ly/3334vUT

1.2.2 Muscles, Joints and Movements

Scope: This topic includes the types of muscles and joints, their characteristics, and functions. It also includes the working of antagonistic muscles in the body.

Learning Objectives:

- *Identify different types of muscles.*
- *Describe the characteristics and the functions of muscles.*
- *Explain the working principle of antagonistic muscles.*
- *Explain the types, characteristics, and functions of joints.*
- *Describe the significance of muscles and joints for the survival of organisms.*

Learning Experiences

Bones, muscles and joints make up the musculoskeletal system, along with cartilage, tendons, ligaments and connective tissue. This system gives your body its structure and supports its movement of the body. There are different types of muscles, each with different functions, but they all work to produce movement of the body or to stabilise the body. Why are muscles important for the movement of the bones?

The learner explores muscles, joints and the working principle of antagonistic muscles from the suggested weblinks: https://cle.clinic/3IU6aeQ, https://bit.ly/3gayKwg and https://bbc.in/3KWyCi5 or from any other relevant sources and works in a team to prepare a PowerPoint presentation on the following areas:

a. Muscles: Types, characteristics and their functions.
b. Joints: Types, characteristics and their functions.
c. Antagonistic muscle: Working principle

The team shares their presentation with the class and answers the following questions to check the understanding of the lesson:

1. How many types of joints are there? list examples for each.
2. Explain smooth, cardiac and skeletal muscles in your own words.
3. Why are skeletal muscles known as voluntary muscles?
4. How do the antagonistic muscles work in order to produce movement of the body parts?
5. Which type of joints allow movement in one direction?

Learners in pairs carry out a physical experiment to closely study how an individual is able to lift an object or walk around. With the help of illustration, the pair makes a presentation to the class.

Bones, muscles and joints provide stability to the skeleton and allow movement. Injuries and various illnesses can damage bones, muscles and joints. Therefore, it is important to take care of it so that the locomotion of individuals is not affected.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's ability to identify different types of muscles, and joints and their characteristics and function, and explain the working principle of antagonistic muscles.	• Assess the learner's analysing skills, presentation skills and creativity based on the presentation.	• Assess the learner's understanding of the role of the musculoskeletal system in the proper functioning of the human body.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Muscles: https://cle.clinic/3IU6aeQ
5. Joints: https://bit.ly/3gayKwg
6. Antagonistic muscles: https://bbc.in/3KWyCi5

1.2.3 Respiratory System

Scope: This topic focuses on the process of external respiration, internal respiration, and cellular respiration. It also includes the types of respiration in plants and animals- aerobic respiration and anaerobic respiration.

Learning Objectives:

- *Explain external respiration, internal respiration, and cellular respiration.*
- *Explain how ATP is generated during cellular respiration.*
- *Explore respiration and its types in plants and animals.*
- *Differentiate between aerobic respiration and anaerobic respiration in the plants and animals.*
- *Explain the significance of respiration for the survival of an organism.*

Learning Experiences

The digested food after reaching the cells is oxidised to release energy, carbon dioxide, and water. The oxidation of food in cells occurs in the presence of oxygen. The oxygen reaches the cells through the process of gaseous exchange in the lungs. Inhalation is the breathing in of air and exhalation is the breathing out of air. Why is breathing important for gaseous exchange? The learner watches the video on external and internal respiration in the link https://www.youtube.com/watch?v=bmLbSDX95kcThe learner watches the video on generation of ATP during cellular respiration in the link https://www.youtube.com/watch?v=JagPP3MX5ks

The learner watches the video of gaseous exchange in the link https://bit.ly/3pZuA07 and prepares a presentation to explain the process of gaseous exchange to the class.

The learner answers the following questions after watching the video and the presentation.

1. What happens in the alveoli?
2. Why do we feel suffocated in a room without proper ventilation?
3. What are inhalation and exhalation of air?
4. Why is gaseous exchange important?

Explore an experiment to test that the exhaled air contains carbon dioxide. Identify variables and precautions needed during the fair test. The learner answers the following questions.

1. What hypothesis did you make?
2. Why did you choose those variables?
3. How can you verify your hypothesis?

During the gaseous exchange, oxygen from the alveoli of the lungs moves to the bloodstream. At the same time, carbon dioxide from the blood is transferred to the lungs. This happens in the lungs between the alveoli and a network of tiny blood vessels called capillaries located in the walls of the alveoli. The gaseous exchange allows the body to replenish the oxygen and eliminate the carbon dioxide.

Learners in groups discuss the previously studied concept of the human respiratory system and after the group discussion, they respond to the questions stated below:

1. What are the parts of the human respiratory system?
2. What is the role of the lungs?
3. Explain the process of respiration in humans.

After answering the above questions, the teacher explains that like animals, plants also require energy to carry out different activities. This energy is made available by the process of respiration. The teacher further explains that all the live cells in a plant, including the roots, stems, leaves, buds, germination-stage seeds, and fruits, respire day and night. The plant primarily absorbs oxygen during respiration through its stomata and root surfaces, while also exhaling carbon dioxide.

Learners watch a video on respiration in plants from the link https://bit.ly/3HYg9Cu and then in teams discuss the answers to the following questions to enhance their understanding of the concept.

1. In which cell structure does respiration occur?
2. Mention the raw materials used in respiration.
3. What are the products of respiration?
4. What is the role of respiration in plant growth and development?

After understanding the process of respiration in plants, learners then further explore the types of respiration.

Learners visit the ICT lab or use any other relevant sources to explore aerobic and anaerobic respiration. They note the differences between these two types of respirations. They use the table given below for the activity and respond to the questions that follow.

Aerobic respiration	***Anaerobic respiration***

1. Which type of respiration does not require oxygen?
2. Which type of respiration uses oxygen to break down food substances?
3. What are the products of anaerobic respiration?
4. Write the word equation for aerobic and anaerobic respiration.
5. Which type of respiration would you consider more efficient – aerobic or anaerobic? Why?

Learners then in teams conduct experiments to investigate what gas is used during respiration and what gas is released during respiration. They gather the materials required for the experiment and carry them out in the science laboratory. Learners record their observations and finally present their results to the class.

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Learners list the importance of respiration for survival of living organisms.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's understanding of respiration and its type. • Assess the learner's ability to explain the process of gaseous exchange.	• Assess the learner's ability to investigate the gas used and produced during respiration. • Assess the learner's presentation skill and creativity in preparing the presentation.	• Assess the learner's ability to justify the importance of respiration in plants. • Assess the learner's understanding of the importance of the process of gaseous exchange in the survival of an organism.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Gaseous exchange: https://bit.ly/3pZuA07
5. Respiration: https://bit.ly/3HYg9Cu

1.2.4 Reproduction

Scope: This topic introduces fertilisation, stages of foetal development and teenage pregnancy.

Learning Objectives:

- *Explain fertilisation and its process.*
- *Explain the different stages of foetal development.*
- *Discuss the consequences of teenage pregnancy and ways to prevent it.*

Learning Experiences

Human beings reproduce sexually. Reproduction in human beings begins with the production of the male gamete (sperm) and the female gamete (ovum) followed by fertilisation of the ovum with the sperm. An embryo is formed which develops into a foetus in the womb of the female.

The learner explores the process of fertilisation from the weblinks https://bit.ly/3zybvVV and the stages of foetal development from the web link https://bit.ly/3rDVV7E or from other relevant sources. Based on the knowledge gained, the learner answers the following questions:

1. Where does fertilisation take place?

2. Explain the stages of foetal development in humans.
3. Describe the function of the placenta.
4. How is fertilisation different from implantation?
5. Explain the roles of parents during the development of a foetus.

Teenage pregnancy is taken as a social curse. In order to understand teenage pregnancy, the learner reads a news article from the web link https://bit.ly/3t6XPA6. Learners in a team discuss the causes and effects and identify preventive measures outlined in the report.

Finally, the learner in a team discusses the issues of teenage pregnancy in the community and suggests ways in which learners can become responsible for preventing pregnancy. Learners answer the following questions and present them to the class:

1. What are the causes of teenage pregnancy?
2. Discuss the consequences of teenage pregnancy.
3. What is the impact of teenage pregnancy on society?
4. What kind of life skills are required to prevent teenage pregnancy?
5. Suggest ways to avoid teenage pregnancy through a short video.

Fertilisation is the fusion of sperm and egg in the fallopian tube which later forms a zygote. The zygote then divides repeatedly to form an embryo which attaches to the wall of the uterus by the process of implantation. The embryo develops into a foetus and finally gives birth to a baby.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's understanding of fertilisation and the stages of foetus development.	• Assess the learner's ability to create a short video on ways to avoid teenage pregnancy.	• Assess the learner's critical analysis of the effects of teenage pregnancy and importance of fertilisation for the continuity of life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Process of fertilisation: https://bit.ly/3zybvVV
5. Stages of foetal development: https://bit.ly/3rDVV7E
6. News article on teenage pregnancy: https://bit.ly/3t6XPA6

1.2.5 Sense Organs

Scope: This topic includes the structure, parts and functions of eyes, ears, tongue, nose and skin.

Learning Objectives:

- *Develop models that explain the structures and functions of human eyes and ears. (Limited to structures of eyeball; external, middle, and internal structures of a ear)*
- *Explains the structures and functions of the human nose, tongue, and skin (hair and basic internal chambers of nose; parts of tongue and taste buds, and skin (hair, epidermis, and dermis).*
- *Suggest ways to care for the sense organs.*
- *Explain the importance of sense organs*

Learning Experiences

The sense organs are the windows to the outside world. The sense organs, in coordination with the nervous system, help the body to interact with the external world by receiving information from outside and responding to it accordingly. The eye, ear, tongue, nose and skin are the five sense organs responsible for vision, hearing, tasting, smelling and feeling respectively. Do you know how the sense organs help us make sense of the environment around us?

The learner explores information on the structure of the eye, ear, nose and tongue; identifies their parts and functions, and the significance of each sense organ. The learner may use the web link https://bit.ly/3tByxdu or any other learning resources.

Based on the information gathered, the learner develops a model (illustration) using MS word, MS paint and Smart draw with pop-up text on different parts of the eye, ear, and nose tongue, with their functions and presents it to the class.

After the presentation, the learner answers the following questions:

1. Explain the functions of each sense organ.
2. Draw diagrams of parts of the sense organs.
3. How would the loss of hearing affect a person?
4. Discuss how one should treat a person with disabilities with any of the sense organs?

Learners in a team design an experiment to verify the consequences if any of the sense organs is not functioning well. Based on the experiment, answer the following questions.

1. Share the experiences that you had due to the absence of any of the sense organs.
2. What hypothesis did you base your experiment on?
3. What conclusion did you draw from the experiment?
4. How do sense organs help us in appreciating the beautiful world?

Sense organs are very important for us to interact with the environment and respond to it accordingly for survival. Therefore, it is very important to take care of them.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of the structure (parts) and the functions of all the sense organs.	• Assess the learner's skill of gathering and interpreting information and skills of making models with ICT tools.	• Assess the learner's understanding of the significance of the sense organs in interacting with the environment.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Parts and functions of sense organs link: https://bit.ly/3tByxdu

1.2.6 Lifestyle and Health

Scope: This topic deals with health, and effects on health due to substance abuse and domestic violence.

Learning Objectives:

- *Explain substance abuse and its effects on the wellbeing of an individual and social issues in the society.*
- *Justify consequences of substance abuse and power dynamics as the causes of domestic violence and social discrimination to suggest ways to prevent them.*

Learning Experiences

Health is the overall physical, mental and social well-being of a person. It is influenced by various factors such as environmental pollution, personal habits and lifestyles. Unhealthy habits and lifestyles, particularly substance abuse, affect our health adversely. In addition, substance abuse also leads to domestic violence in families by changing the power dynamics amongst the family members.

The learner explores unhealthy habits, lifestyles, diseases and domestic violence by designing survey questions and carrying out the survey. Then the learner analyses the data collected and presents the findings to the class using relevant ICT presentation software.

After the presentation, the learner answers the following questions:

1. What hypothesis did you use for the study?
2. What is the most common unhealthy habit in the community? What do you think could be the possible reasons?
3. How is health affected by unhealthy habits and lifestyles?
4. Relate substance abuse with domestic violence and health.
5. Suggest ways to reduce substance abuse in the locality.

6. Suggest how one can behave responsibly in society.

Learners either design a poster or PowerPoint presentation to show different substances abused and ways to mitigate domestic violence and social discrimination. Learners present their work either through online platforms or gallery walks.

Health is the overall well-being of a person. It is affected by many factors such as unhealthy habits and lifestyles. Besides health, substance abuse also leads to social problems such as domestic violence which further affects the psychological and physical health of the victims.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of how pollution and substance abuse affect health and the environment.	• Assess the learner's skill of gathering and interpreting the information gathered from different sources. The learner ICT and presentation skills are also assessed.	• Assess the learner's understanding of the negative impacts of substance abuse and pollution on health and environment.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Pollution and its impact: https://bit.ly/34tradK

Challenge Your Thinking

1. Multiple choice questions:

I. The small intestine has three parts. The first part is called
   a. larynx.
   b. jejunum.
   c. duodenum.
   d. oesophagus.

II. Spicy food, coupled with anxiety, may lead to _____.
   a. ulcers
   b. seizures
   c. indigestion
   d. hypotension

III. The enzyme which is present in the mouth is called

a. bile.
b. amylase.
c. proteases.
d. salivary enzyme.

IV. Which of the following is NOT a type of muscle?
a. Smooth muscle
b. Rough muscle
c. Cardiac muscle
d. Skeletal muscle

V. How many muscles work together to move a bone?
a. One
b. Two
c. Three
d. Four

VI. The forward and backward movement of our head is possible because of the presence of
a. pivotal joint where our neck joins the head
b. hinge joint where our neck joins the head
c. ball and socket joint where our neck joins the head
d. immovable joints where our neck joins the head.

VII. Which of the following is an example of a ball and socket joint?
a. Knee joint
b. Ankle joint
c. Skull joint
d. Shoulder joint

VIII. Gaseous exchange is held by _____.
a. osmosis
b. simple diffusion
c. facilitated diffusion
d. cotransport

2. Why is energy not released soon after eating food?
3. Why is chewing food an important part of the digestive process?
4. Suggest some ways to keep our bones and muscles healthy.
5. Compare the knee joint and the closing and opening of the door.
6. Old people usually complain about joint aches. What is your hypothesis on this?
7. Heart is also a muscle but it is not involved in the movement of the body parts. Why?
8. Explain breathing during the physical exercises.
9. What role can you play as a student to prevent teenage pregnancy in your community?
10. Our government has legalised the age for marriage for girls and boys. Give reasons as to why one should get married after a certain age.

1.3 Green Plants

Plants require a variety of nutrients in order to grow, develop and reproduce normally. Roots absorb dissolved nutrients from the soil, which are then transferred through the transport vessel - the xylem, to various sections of the plant. These nutrients in the soil are replenished naturally, or by adding manure, or chemical fertilisers.

Plants can reproduce sexually as well as asexually. Sexual reproduction occurs through the fusion of gametes in flowers. Asexual reproduction occurs without the fusion of gametes. Some reproduce asexually by developing new plants from their vegetative parts such as stems, roots and leaves.

Green plants are critical not only for humans but also have long-term importance for the health of environmental systems. Green plants absorb carbon dioxide from the environment and produce oxygen, which is essential for living. Green plants provide both nutrition and protection.

Competencies:

Explain the functions of roots, reproduction, and its types in plants, highlighting their roles in the growth and development of plant life.

Analyse the functions and significance of farming types in delivering valuable benefits to human agriculture and ecosystems.

1.3.1 Absorption by Roots

Scope: This topic includes the types of roots, and their functions.

Learning Objectives:

- *Identify different parts of a root.*
- *Explain the types of roots in plants.*
- *Explain the functions of roots.*
- *Demonstrate the functions of a root through osmosis.*

Learning Experiences

A plant has a shoot system above the earth and the root system submerged in it. The green part of the plant above the earth is the stem. The non-green underground component of the plant is called the root. Some plants, however, have roots that are exposed to the air, while others have a portion of the shoot that is hidden in the earth.

Taproot systems and fibrous root systems are the two basic forms of root systems. What kind of root system is in a radish and maize plant?

The learner gathers information on the taproot systems and fibrous root systems from the web link https://bit.ly/3HYCn4v or from other relevant sources. Notes the characteristics of each type of root system.

The learner then collects different types of plants from the school campus to identify tap roots and fibrous roots. To further enhance the understanding, the learner answers the following questions:

1. How is the tap root system different from the fibrous root system?

2. Which root system do you think is stronger? Why?
3. Propose a hypothesis, on which type of roots would be the best in preventing erosion of surface soil.
4. Explain what plant roots are used as food in the community?

The learner explores how roots absorb water from the soil from the web link https://bit.ly/31ybvZk and minerals from the web link https://bit.ly/3zxbyRC or from other relevant sources. Identify physiological processes involved in each activity.

The learner then answers the following questions:

1. What process is responsible for water intake by roots?
2. How does diffusion help in the absorption of minerals by roots?
3. Why do plants have numerous root hairs?

With the information gathered from the above sources, the learner in a team design and carries out an experiment to investigate how roots absorb water through the process of osmosis. The learner observes the set-up carefully, explains the process observed in the experiment and infers how roots absorb water through osmosis.

Design an experiment to identify conditions necessary for osmosis to occur in the plant roots. Propose a hypothesis for the experiment.

The two main types of root systems in plants are the tap root system and the fibrous root system. The tap roots have the main root while it is absent in fibrous roots. Roots absorb water through the process of osmosis and minerals through diffusion. They also anchor and support the plant.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's understanding of the tap root system and fibrous root system and the absorption of water and minerals by roots.	• Assess the learner's ability to investigate the absorption of water by roots.	• Assess the learner's critical analysis of the significance of roots in plants.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Tap root system and fibrous root system: https://bit.ly/3HYCn4v
5. Absorption of water by roots: https://bit.ly/31ybvZk
6. Absorption of minerals by roots: https://bit.ly/3zxbyRC

1.3.2 Organic and Inorganic Farming

Scope: This topic introduces organic and inorganic farming, methods of organic farming, and advantages of organic farming and disadvantages of inorganic farming.

Learning Objectives:

- *Explain organic and inorganic farming to understand their advantages and disadvantages for the plant.*
- *Explain different methods of organic farming and their significance.*
- *Assess the impacts of inorganic farming on the quality of soil and the environment.*

Learning Experiences

Plants use nutrients from the soil, which are replaced by using organic or chemical fertilisers. Organic fertiliser is made from decayed organic matter that improves the condition and texture of the soil. Inorganic fertiliser is made by using chemicals. Based on the choice of fertilisers in the farming practices, farming is categorised as organic and inorganic farming. Which type of farming is practised at your home?

The learner reads information on organic farming from the web link https://bit.ly/3nqOOxR and inorganic farming https://bit.ly/3qQMClv or from other relevant sources. Identifies differences between organic farming and inorganic farming.

The learner then answers the following questions:

1. What are the different methods of organic farming?
2. How does organic farming improve soil fertility?
3. Why is it not advisable to eat inorganic farm products?
4. Which of the farming methods has a greater negative impact on the environment?

The learner in a team visits the school garden or nearest agriculture farm and interviews the focal person or the farmer to understand the farming methods used. During the field visit, learners gather information for the following questions.

1. What is the farming method used?
2. What are the reasons for the selection of the method used?
3. How has the farming practice affected the yield?
4. How has the farming practice affected the soil quality?

Prepare a presentation to share your experiences with suggestions for ways to improve the yield. Identify the advantages and disadvantages of the farming method used.

Learners explore the information from the web link https://bit.ly/methods-organicfarming to understand different methods of organic farming like weeding, mulching, composting, crop rotation and biological pest control to improve the production of crops

Chemicals are used as fertilisers and insecticides in inorganic farming. Therefore, eating inorganic farm products is harmful to our health. Organic farm products are good for our health since chemicals are not used and they are cultivated using biological methods.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of organic and inorganic farming and different methods of organic farming.	• Assess the learner's ability to interview and gather data on the practices of farming.	• Assess the learner's critical analysis of preferring organic farming over inorganic farming.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Organic farming and inorganic farming links: https://bit.ly/3nqOOxR / https://bit.ly/3qQMClv

1.3.3 Reproduction

Scope: This topic includes sexual and asexual reproduction. An asexual reproduction highlights natural vegetative propagation - stems, roots, leaves; and artificial vegetative propagation - stem cutting, layering, grafting. It also deals with advantages and disadvantages of vegetative propagation.

Learning Objectives:

- *Explain sexual and asexual reproduction in plants.*
- *Explain the natural and artificial vegetative propagation in plants.*
- *Investigate the propagation of plants through stem cutting.*

Learning Experiences

Sexual and asexual reproduction are the two modes of reproduction in plants. Sexual reproduction is a type of reproduction that involves sex cells or gametes. Asexual reproduction is a type of reproduction that does not include gametes. Plants proliferate by vegetative parts such as roots, stems, leaves, and buds in asexual

reproduction, which is known as vegetative reproduction or vegetative propagation. Vegetative propagation is classified into natural and artificial based on the methods of propagation. How is rose propagated? What are the benefits of vegetative propagation?

The learner explores reproduction in plants from the web link https://bit.ly/3zxfz8K or from other relevant sources and notes differences between sexual and asexual reproduction. The learner then explores types of vegetative propagation: natural and artificial vegetative propagation from the web link http://surl.li/psvff or from other relevant sources. Identifies the methods used in each type of vegetative propagation.

At the end of the activity, the learner answers the questions provided below:

1. Why is reproduction important for living organisms?
2. How do plants reproduce sexually?
3. What are the natural ways by which plants reproduce vegetatively?
4. Why is artificial vegetative propagation practised by florists in our communities?

The learner gathers information on the advantages and disadvantages of vegetative propagation from the web link https://bit.ly/3f2OYXU or from other relevant sources and writes it down. The learner then discusses the points with other learners in a team.

Finally, the learner in the team tries different methods of artificial vegetative propagation such as stem cutting, layering, and grafting, with suitable plants in the school. Seek help from the nearest Agriculture Extension Centre or a competent person. The learner takes care of the vegetatively propagated plants and observes their growth and development throughout the year. Record the observations with pictures or drawings.

Asexual propagation methods generate new plants from the parent vegetative parts, such as leaves, stems, and roots. These methods are generally referred to as vegetative propagation. Many plants can reproduce this way naturally, but vegetative propagation can also be artificially induced.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of sexual and asexual reproduction, natural and artificial vegetative propagation, and advantages and disadvantages of vegetative propagation.	• Assess the learner's ability to carry out artificial vegetative propagation in the school.	• Assess the learner's critical analysis of the significance of asexual reproduction in plants.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Sexual and asexual reproduction in plants: https://bit.ly/3zxfz8K
5. Types of vegetative propagation: http://surl.li/psvff
6. Advantages and disadvantages of vegetative propagation: https://bit.ly/3f2OYXU

Challenge Your Thinking

1. Plants with fibrous roots are more easily damaged by some herbivores. Make a logical case to support this claim.
2. What would happen if living cells of a plant were placed first in a strong sugar solution, and then in water?
3. Some desert plants have taproots that extend up to 20–30 feet underground. Others have fibrous root systems that cover wide areas. What are the advantages of a deep taproot and the advantages of a fibrous root system in the desert?
4. If you are a school agriculture focal person, what type of farming would you suggest to the school? Give reasons.
5. Ap Pema has been practising inorganic farming. He gets a good crop yield and makes a good profit every year. As a concerned citizen, what environmental problems do you foresee in his farming practice?
6. How would people in your village benefit from artificial vegetative propagation?

1.4 Living Things and their Environment

Our environment is home to thousands of plant and animal species. Organisms have acquired adaptive characteristics through the process of evolution and adapted to live in various habitats of the Earth. The variety of life forms on the Earth is called biodiversity. It describes the richness and variety of life on Earth. It is the most complex and important feature of our planet. Without biodiversity, life would not sustain.

However, increasing population and human activities remain one of the major threats to our environment. As a result, habitats are being lost constantly and plant and animal species are becoming extinct. Bhutan has a rich biodiversity of flora and fauna. The majority of the people in Bhutan depend on forest products and agriculture. Improved varieties of crops and animals are being raised to increase the income of our people.

Competencies:

Examine how species within an ecosystem adapt and employ feeding strategies to comprehend the crucial interdependence among living organisms, both among themselves and with their surroundings.

1.4.1 Adaptation and Survival

Scope: This topic highlights on adaptation - structural, physiological, behavioural; adaptive features and natural selection through competition - intraspecific, interspecific, and predation.

Learning Objectives:

- *Explain how plants and animals adapt to their habitats.*
- *Differentiate between intraspecific and interspecific competition.*
- *Explain how climate change effects adaptation, and intraspecific and interspecific competition*

Learning Experiences

Adaptation is the physical or behavioural characteristics of an organism that helps an organism to survive better in the environment. Through adaptation, an organism can find food and water, protect itself, or overcome extreme environments. Organisms with better adaptive features survive, while those organisms that cannot adapt to changing environments either struggle to survive or become extinct. This was the theory proposed by Charles Darwin known as Survival of the Fittest.

Organisms adapt to their habitat either through a physical change in body parts or a change in behaviour. For example, camouflage is the protective colouration that helps an organism blend into its environment and protect it from predators. The change in behaviour is due to the actions of other species. For example, migration and hibernation of animals.

The learner in the team chooses animals and plants in their local ecosystems and investigates their adaptive features. In the process of investigation, the learner records and creates short clips on adaptive features and their significance for survival, and shares them with the class for discussion.

Next, the learner watches the suggested video links https://tinyurl.com/y9hvctpa or https://tinyurl.com/8sbyebca or explores the web link https://tinyurl.com/3wwr8b82 or any other relevant resources to collect information on interspecific and intraspecific competitions and predation. With the gathered information the learner uses it to identify the types of competition and predation in their locality.

Then the learner shares their findings with the class and answers the following questions:

1. Mention one adaptive feature of plants and animals which helps them to survive in their habitat.
2. Differentiate between intraspecific competition and interspecific competition with examples.
3. A farmer observed an equal number of brown grasshoppers and green grasshoppers in his maize field. After a few days, he noticed a decrease in the number of brown grasshoppers. Write the possible reasons for his observation.

This hands-on activity is to demonstrate how climate change can affect the availability of food sources for birds and how this influences the adaptation of their beak shapes. Learners will simulate variations in environmental conditions and observe the impact on bird populations with different beak shapes.

Title: "Climate Change Simulation: Impact on Bird Beak Adaptations"

Adaptation is the process by which a species becomes fit to its environment; it is the result of natural selection by which features become heritable variation passed through several generations. These adaptive

features may be behavioural or physical in nature. Competition and predation among organisms result in the survival of the fittest.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's ability to explain the significant role of adaptive features and the different modes for natural selection.	• Assess the learner's ability to investigate animal and plant adaptation in the ecosystem based on their adaptive features.	• Assess the learner's ability to realise the significance of adaptive features in survival.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Interspecific and intraspecific competition, and predation links: https://tinyurl.com/y9hvctpa, https://tinyurl.com/8sbyebca and https://tinyurl.com/3wwr8b82

1.4.2 Feeding and Relationships

Scope: This topic includes what biomagnification is, its causes and effects with examples.

Learning Objectives:

- *Explain the causes and effects of biomagnification.*
- *Analyse the impacts of biomagnification in an ecosystem.*

Learning Experiences

Biomagnification is the increase of contaminated substances or toxic chemicals at different trophic levels through the food chains. It is the build-up of toxins in a food chain through contaminated environments.

As the trophic level increases in a food chain, the amount of toxic builds increases. Because these compounds aren't digested, they accumulate within the animals that ingest them and become more and more concentrated as they pass along the food chain when animals eat and are eaten in turn. Predators accumulate higher toxins than prey. Biomagnification happens in all ecosystems and food chains. Though seafood is considered nutritious, it is not advisable to consume it in large quantities. Why?

The learner uses the suggested video link https://www.youtube.com/watch?v or web link https://rb.gy/mfpmbh and https://tinyurl.com/yc3wwxsy or any other relevant resources to explore information on the cause

and effect of biomagnification on the health of organisms. Based on the information, the learner presents their understanding to the class in the form of a presentation for feedback and comments.

Then the learner answers the following questions after the presentation:

1. Describe biomagnification and its causes and effects.
2. Explain how pesticides enter a food chain and subsequently get into our bodies.
3. How does biomagnification affect organisms belonging to different trophic levels, particularly the tertiary consumers?
4. Which organism in the food web would contain the highest concentration of chemical pollutants?

Teacher provides an activity called "Biomagnification Simulation" and instructs the class about the activity or use from the link https://bit.ly/3O83Hm8 to discuss the concept of biomagnification and the potential impacts on living organisms.

Through the food chain, contaminated substances due to the pollution of air, water and land reach human bodies. These substances have diverse effects on human health. Therefore, environmental pollution needs to be controlled for our health and a sustainable environment.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of causes and effects of biomagnification.	• Assess the learner's ability to analyse the impacts of biomagnification on feeding relationships.	• Assess the learner's ability to appreciate the interdependence in nature.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Biomagnification video link: https://www.youtube.com/watch?v
5. Biomagnification web links: https://rb.gy/mf pmbh and https://tinyurl.com/yc3wwxsy

1.4.3 Biodiversity

Scope: The topic introduces biodiversity, its role in the ecosystem and how sustainable development helps in conserving biodiversity.

Learning Objectives:

- *Explain biodiversity and its role in the ecosystem.*
- *Evaluate sustainable development practices in the locality in conserving the local biodiversity.*
- *Evaluate the religious and cultural practices that contribute to conservation of biodiversity.*

Learning Experiences

Every organism in one way or another is dependent on each other. Our Earth is home to thousands of varieties of flora and fauna. This vast variety of life on the Earth is called biodiversity. Bhutan has a rich biodiversity of flora and fauna due to varied altitude and climatic conditions. It is the policy of our government to preserve the rich biodiversity of our country through the sustainable utilisation of resources. The constitution of Bhutan mandates 60 per cent of the land area be maintained under forest cover for all times. So, what role should citizens have in the restoration of an ecosystem?

The learner uses the suggested video link https://rb.gy/yld8i9 or web link https://rb.gy/nthnvt or any other relevant resources to collect information on biodiversity and its role in the ecosystem. And, the significance of sustainable development for the conservation of biodiversity. The learner prepares a presentation on biodiversity and its role in the ecosystem and the significance of sustainable development to biodiversity conservation. Presents it in the class for feedback and comments.

The learner carries out field visits to the nearby area to study the developmental activities and their impact on the biodiversity of the locality.

The following suggestive questions may be used to probe the responses:

1. What are the different developmental activities carried out in the community?
2. Are the developmental activities in the community sustainable? Why?
3. What are the impacts of developmental activities on biodiversity?
4. What are the precautions put in place to minimise the negative impacts on biodiversity in the community?

In this activity learners explore different sustainable development practices (*Conservation Policies, Protected Areas, Community-Based Natural Resource Management, Carbon Neutrality and Renewable Energy, Organic Farming, Bhutan for Life, Bhutan Trust Fund for Environmental Conservation (BTFEC), Education and Awareness, Zero Waste Strategy and International Cooperation)* implemented in Bhutan to conserve biodiversity, beforehand. Teacher asks learners to research on the above-mentioned topics from the home. Learners then present their findings

Biodiversity is essential for all life forms on Earth, including humans. However, as the human population increases, biodiversity is exploited beyond the carrying capacity of an ecosystem and poses a greater threat to it. Therefore, the practice of sustainable consumption and legal regulations are important for the conservation of biodiversity.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of the roles of biodiversity in the ecosystem,	• Assess the learner's ability to engage in discussion and valid argument.	• Assess the learner's ability to realise the importance of conserving biodiversity.

and sustainable development and their roles in conserving biodiversity.		

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Sustainable Development: https://rb.gy/yld8i9
5. Biodiversity: https://rb.gy/nthnvt

1.4.4 Breeding

Scope: The topic covers what breeding is, selective breeding and its role in crop and livestock improvement. It also includes the merits and demerits of selective breeding.

Learning Objectives:

- *Explain selective breeding.*
- *Identify examples of hybrid plants and animals.*
- *Discuss advantages and disadvantages of selective breeding.*

Learning Experiences

The process by which living things reproduce to create offspring of the same kind is known as breeding. For animals, breeding happens when two animals have offspring either through live birth like in mammals and some fish, and snake species, or hatched from eggs like in birds and reptiles. In plants, breeding happens when male pollen is transferred to the female parts of the flower. Most food products like cereals, vegetables, fruits and spices are obtained from plants. Other food products such as milk, eggs and meat are derived from animals. The practice of growing crops, and rearing livestock is called agriculture, and approximately 80% of the Bhutanese depend on them for their livelihood.

With an increase in the world's population, there is growing demand for food and livestock. In order to meet the food demand, different farming methods are practised to improve the production of crops and livestock. Humans have selectively bred plants and animals for thousands of years including crop plants with better yields, and farm animals that produce more and better-quality meat or wool. Do you know that broccoli is human innovation and a man-made food through the selective breeding of wild cabbage?

The learner watches a video from the web link https://bit.ly/3qW6Bhk or any other relevant resources to gather information on breeding, selective breeding, and its role in the improvement of crops and livestock.

Based on the information gathered, the learner answers the following questions:

1. What are breeding and selective breeding?

2. Explain the basic process involved in selective breeding?
3. Explain how selective breeding enhances the production of crops and livestock?
4. Justify the survival of the fittest phenomena observed in the local ecosystem.

Learners gather some common examples of hybrid plants and animal from their locality.

The learner in two teams debates the merits and demerits of selective breeding and how it impacts the society, economy and environment in the class. Based on the debate, the learner represents the ideas with a flow chart diagram.

Selective breeding is human-driven intervention aimed to adapt an organism's characteristics in a way that is desirable to humans.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's ability to explain selective breeding with its significant role in improving crops and livestock production.	• Assess the learner's ability to analyse the resources and make a presentation on selective breeding.	• Assess the learner's ability to realise the implication of selective breeding in society, economy and education.

For recording and reporting, refer to the National School Curriculum Framework in Science.

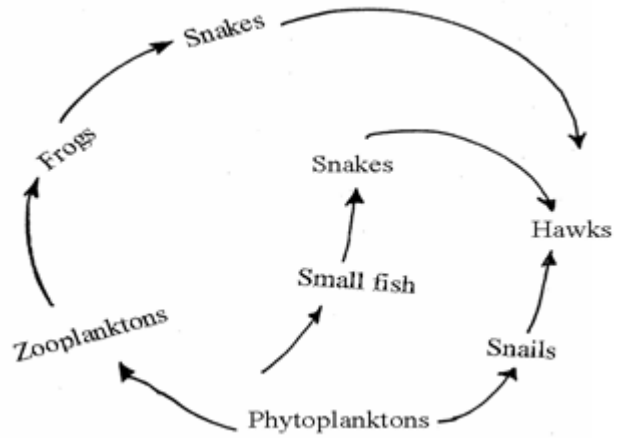
Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Selective breeding video: https://bit.ly/3qW6Bhk

Challenge Your Thinking

1. Bhutan defines sustainable development as the capacity and political will to effectively address present development and environmental problems, and tomorrow's challenges, without compromising the unique cultural integrity and historical heritage, or the quality of life of future generations of Bhutanese citizens. How can your community contribute to sustainable development?
2. Describe the evolutionary effects of intraspecific and interspecific competition.
3. How does the use of chemical control impact an ecosystem?

4. Sea life is an important human food resource. How does biomagnification impact the safety of seafood, and consequently human health?
5. Why is biodiversity so important and worthy of protection?
6. What are some common concerns about selective breeding?
7. How do humans benefit from selective breeding?
8. What adaptations do plants have that allow them to survive during cold or hot seasons?
9. What might go wrong if a breed of animal or variety of plant is constantly used to breed others?
10. Why do farmers prefer to rear hybrid pigs over local pigs?
11. Lions live in groups (pride). The dominant male lions sometimes chase away some of the male cubs as they approach sexual maturity. Why do you think this is so?
12. The diagram below represents a feeding relationship in an ecosystem.



a. Name the type of ecosystem represented by the above food web.
b. Name the organisms in the food web that:
   i. are producers
   ii. occupies the highest trophic level
c. Write a food chain that ends with the hawk as a quaternary consumer.
d. State two short-term effects on the above ecosystem if all the small fishes were removed.

2. Materials and Properties

2.1. Classifying Materials

According to the atomic theory by John Dalton, every matter is composed of very small particles called atoms. The atoms were regarded to be tiny, indivisible and indestructible particles. With the development of science, scientists have proven that an atom consists of further smaller particles such as electrons, protons, and neutrons. These smaller particles are called subatomic particles. Atoms of an element have a fixed number of protons, but may have different numbers of neutrons. Atoms combine to form molecules. The formation of molecules or compounds can be represented by chemical equations.

Competencies:

Explain the chemical composition and reaction (atomic structure, chemical formula and chemical equation) of chemical substances to comprehend the importance of chemical reactions in daily life.

2.1.1 Atomic Structure

Scope: This topic explains mass number and atomic number based on the number of electrons, protons and neutrons, and their relationship. It further includes an electronic configuration in the form of K, L, M, and N notation following electron distribution rules in shells. Concept of Isotopes and their application.

Learning Objectives:

- *Explain mass number and atomic number based on the number of electrons, protons, and neutrons.*
- *Draw the atomic structure of common elements to understand their electronic configuration.*
- *Explain isotopes and their properties.*
- *Explain various applications of isotopes in different fields.*

Learning Experiences

Atoms consist of a nucleus containing protons and neutrons, surrounded by electrons in the shells of an atom. The number of subatomic particles in an atom can be calculated from the atomic number and mass number of an atom.

To understand the concept of atomic number, mass number and isotopes, learners explore from the weblink https://tinyurl.com/y99r6bkk and https://tinyurl.com/2p8jh577 and share the understanding with the class. Learners engage in discussion and draw the relationship of subatomic particles with the atomic number and mass number.

After exploring the concept, learner answers the following questions:

5. Explain atomic number and mass with examples.
6. What determines the mass of an atom?
7. Lithium has an atomic number of 3 and a mass number of 7. How many electrons, protons and neutrons are present in a lithium atom?

The electrons are not scattered around the nucleus. They are distributed in different shells in an orderly manner as per certain rules. The distribution of electrons in various shells of an atom is known as electronic configuration. The learner explores the rules of writing the electronic configuration from the web link

https://tinyurl.com/4mwj4muc and shares the rules with the class. After watching the video, learners answer the following questions.

1. What is the mechanism of distributing electrons in various shells of an atom?
2. Calcium atom contains 20 electrons. What is the possible number of electrons in the 'M' shell?
3. Aluminium is represented by the symbol $_{13}Al^{27}$. What is its atomic number and mass number? How many electrons, protons and neutrons are found in this atom?
4. Calculate the number of electrons in respective shells by following the rules of electronic configuration.
5. Why is an atom considered to be electrically neutral?

Atoms can be represented in the form of a diagram showing all the subatomic particles. This diagrammatic representation of an atom is called atomic structure. The learner watches the video from the suggested link https://rb.gy/gow2jt to learn how to draw atomic structures for elements showing all the subatomic particles and answer the following questions:

1. The element X has 11 protons and 12 neutrons.
2. What would be the atomic number of this element?
3. How many electrons are expected in this element?
4. Calculate the mass number of the element.
5. Draw an atomic structure of this element.
6. Identify the element. Give a reason.
7. Show electronic configuration or use the periodic table and draw an atomic structure for the following atoms.
    a. Carbon
    b. Neon
    c. Magnesium
    d. Nitrogen

Learners explore various applications of isotopes in different fields.

Atomic number is the number of protons present in the nucleus of an atom and is denoted by "Z". Whereas, the sum of the number of protons and neutrons present in the nucleus of an atom is called the mass number and denoted by "A". Furthermore, the distribution and arrangement of electrons in various shells of an atom are known as electronic configurations. Some elements have two or more atoms with the same atomic number but have different mass numbers due to differences in neutron numbers, such atoms are referred to as isotopes.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess learner's conceptual understanding of atomic number, mass number, and	• Assess the learner's ability to draw atomic structures for some common elements.	• Assess the learner's ability to identify the applications

their relationship to the numbers of subatomic particles.		of isotopes in different fields.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Atomic Number and Mass Number: https://tinyurl.com/y99r6bkk
5. Isotope Applications: https://tinyurl.com/2p8jh577
6. Electron Configuration: https://tinyurl.com/4mwj4muc
7. Atomic Structure: https://rb.gy/gow2jt

2.1.2 Elements, Compound and their Formulae

Scope: This topic explores what valency and radical are, and two types of radicals - simple and compound; and the formation of ions - cations and anions. The topic further explains the steps to write chemical formulae for compounds.

Learning Objectives:

- *Explain chemical formula, valency, and radicals with examples.*
- *Identify the valencies of elements and radicals of compounds.*
- *Explain the formation of cations and anions.*
- *Write the chemical formulae of chemical substances based on the rules.*
- *Analyse the chemical composition of a compound based on the chemical formula.*

Learning Experiences

Pure substances can be either elements or compounds. If the pure substance contains only one type of atom, it is called an element. However, two or more atoms of different elements chemically combine in a fixed proportion to form a compound. For example, sodium chloride (common salt) is a compound. It is made up of two elements, sodium and chlorine. All the things that people use in their daily life are made up of elements, compounds, or mixtures.

In order to illustrate elements and compounds, chemists use symbols and formulae. Water is a compound of two atoms of hydrogen and one atom of oxygen. So, its chemical formula is H_2O. **Chemical formula** is a shorthand for representing the number and types of atoms in a molecule of an element or a compound. To write the formula of compounds, we need to know more about **valency** and **radicals**.

The learner watches the video from the link https://rb.gy/4p4tiy to understand about valency. After watching the video, learners engage in discussing about the valency and share their understanding with the class. Learners answer the following questions.

1. Draw the electronic configuration of the following elements and find their valency.

$_{7}N^{14}$ $_{8}O^{16}$ $_{15}P^{31}$ $_{10}Ne^{20}$ $_{17}Cl^{35}$

2. Explain the difference between valency and valence electrons.

Atoms either loss or gain electrons in order to gain stability. This process results in the formation of ions. An ion is an atom or a molecule which has gained or lost electrons. Thus, typically metals lose electrons to nonmetals, thereby forming positive ions. Nonmetals form negative ions by gaining electrons.

To understand the concept of formation of ions, learners watch the video from the link https://youtu.be/bnudaqeTyto. After watching the video, learners discuss the concept and share with the class. Learners answer the following questions.

$_{13}Al^{27}$ $_{2}He^{4}$ $_{9}F^{19}$ $_{30}Zn^{64}$

1. Illustrate the formation of cations and anions for the given elements using diagrams.
2. Classify the given elements into metals and non-metals. Give reasons.
3. Is carbon a metal or a nonmetal? Justify your answer.
4. Compare cations and anions.

Ions are also known as **radicals**. Generally, a radical is an atom or a group of atoms which carries a positive or negative charge and behaves as a single unit. For example, in a molecule of sodium carbonate (Na_2CO_3), sodium radical (Na^+) is a positive radical, and carbonate radical (CO_3^{2-}) is a negative radical, each behaves as a single unit.

Radicals are classified into simple radicals and compound radicals. A radical which contains only a single type of atom is called a simple radical. Example, Na+, K+, Cl-, I-, etc. A radical which contains atoms of more than one element is called a compound radical. For example, CO_3^{2-}, NO_3^{-}, SO_4^{2-}, NH_4^{+}, etc. Do you think you will be able to write chemical formulas without knowing about radicals?

The learners watch the video from the video link https://rb.gy/7bhcqe to understand more about radicals and valency and how to use them to write chemical formulae for compounds. After watching the video, learners write the chemical formula of some common element and compounds.

The learner tests their understanding by answering the following questions.

1. Differentiate between simple and compound radicals. Write examples for each.
2. What is a chemical formula? What information is conveyed by the formula $NaHCO_3$?
3. Write the chemical formula for the following compounds indicating all the steps:
    a. Ammonium hydroxide
    b. Copper (I) sulphate
    c. Aluminium chloride
4. What is the valency of oxygen and aluminium in Al_2O_3?
5. Write the names of the following compounds.
    a. Na_3PO_4
    b. $NaHCO_3$
    c. KOH
    d. $Mg(OH)_2$

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The learner may watch the video from the link https://rb.gy/xcqboz and https://rb.gy/2fehe0 to strengthen the understanding of radicals and chemical formulas of different compounds.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess learner's conceptual understanding of valency, radicals, cations and anions, and chemical formulas.	• Assess the learner's ability to depict the formation of cations and anions, identify positive and negative radicals and the valency of different elements. Also assess the ability to write chemical formulae for compounds.	• Assess the learner's ability to understand the importance of writing chemical formulae.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Valency: https://rb.gy/4p4tiy
5. Ions: https://youtu.be/bnudaqeTyto
6. Valency, radical, writing chemical formula for compounds: https://rb.gy/7bhcqe
7. Radical and chemical formula: https://rb.gy/xcqboz
8. Radical, ions, valency and chemical formula: https://rb.gy/2fehe0

2.1.3 Chemical Equation

Scope: This topic covers the identification of reactant and product in chemical equations, followed by a procedure to balance chemical equations as per the Law of conservation of mass.

Learning Objectives:

- *Explain the chemical equation by identifying reactants and products.*
- *Write balanced chemical equations.*
- *Explain significance of chemical equation.*
- *Explain the importance of the law of conservation of mass in chemical equations*

Learning Experiences

During a chemical change, elements combine to form compounds, or compounds split to form elements. The chemical interaction of elements or compounds to produce new substances is called a **chemical reaction.** In chemical reactions, the substances which undergo a reaction are called **reactants** and the new substance(s) formed are called **products**. The chemical reaction can also be represented by using symbols and formulae. Representation of a chemical reaction by means of symbols and formulae is called a **chemical equation**.

The learners explore the concept of writing the chemical equation from the web link https://tinyurl.com/2e9c94f3. Learners discuss in a group and share with the class. Further, learners identify the reactants and products in a chemical reaction and answer the following questions.

Then the learner answers the following questions:

1. Write a word and chemical equation to show the reaction between hydrochloric acid and sodium hydroxide. Identify the reactants and products in this reaction.
2. What would be the properties of the products after the reaction?

This activity helps learners to understand the representation of chemical reactions as chemical equations and identify the reactant(s) and product(s). The intent of the activity is achieved by watching the video from http://surl.li/pogkm. After watching the video, learners write the definition of chemical equation, reactant and product for a chemical reaction, and also the importance of representing a chemical reaction with a chemical equation.

Learners share their understanding in the class. After the presentation, learners answer the following questions.

The number of atoms of reactants and the number of atoms of products must be balanced in order to fulfil the **law of conservation of mass.** The learner explores the web link https://tinyurl.com/2p8b7v6z to understand the Law of conservation of mass. To understand the steps of balancing the chemical equation, learners also explore the web links https://tinyurl.com/yrtrtbx3, https://tinyurl.com/2rzhb5h7, discuss in the group on balancing the chemical equation and share with the class.

Further, learners answer the following questions:

1. Iron (Fe) reacts with Oxygen (O_2) to form iron (III) oxide (Fe_2O_3). Identify reactants and products in this reaction. Write a word and a balanced chemical equation for this reaction.
2. Balance the following chemical equations.
    a. $Mg + O_2 \rightarrow MgO$
    b. $Zn + HCl \rightarrow ZnCl_2 + H_2$
    c. $KClO_3 \rightarrow KClO_4 + KCl$
    d. $Na_2CO_3 + HCl \rightarrow NaCl + H_2O + CO_2$
3. Why do chemical equations need to be balanced? What information is conveyed by a balanced chemical equation?

The learners in a group discuss the importance of chemical equations and share with the class members.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of reactants and products in chemical reactions or chemical equations, and the law of conservation of mass.	• Assess the learner's ability to write balanced chemical equations.	• Assess the learner's ability to explain the significance of balanced chemical equations.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science, (2022)
2. REC repository
3. Science Class Eight (2020), REC
4. Chemical Equations: https://tinyurl.com/2e9c94f3
5. The Law of Conservation of Mass: https://tinyurl.com/2p8b7v6z
6. Balancing Equations: https://tinyurl.com/yrtrtbx3
7. Balancing Chemical Equations: https://tinyurl.com/2rzhb5h7

Challenge Your Thinking

1. Why do isotopes of the same element have the same chemical properties? Write at least three applications of isotopes.
2. Is it possible to write the electronic configuration of an atom if its atomic number is known? Give reasons.
3. Write the electronic configuration and draw the atomic structure of:
   a. Chlorine
   b. Calcium
   c. Oxygen
   d. Phosphorus
4. What is the difference between 2O and O_2?
5. What does the chemical formula $Ca_3(PO_4)_2$ tell us about the number of atoms of each element present?
6. $FeSO_4$ and $Fe_2(SO_4)_3$ are the compounds of iron (Fe). What are the valences of Fe and SO_4 in each compound?
7. The atomic number and mass number of five elements are given in a table below. The letters A, B, C, D and E represent the elements.

Element	Atomic number	Mass number
A	3	7
B	9	19
C	12	24
D	16	32
E	19	39

Study the table carefully and answer the following questions:

a. Which element contains the highest number of neutrons?
b. Which element contains the least number of protons?
c. Which of these elements contain an equal number of electrons and neutrons?
d. In which group and period does E belong in the periodic table?
e. The valency of element 'A' is 1. If it combines with an element 'D' with a valency of 2, write down the chemical formula of the compound.
f. Write an electronic configuration and draw the atomic structure of an element B.

8. Write the balanced chemical equations for the following word equations
   a. Sodium + Sulphuric acid → Sodium sulphate + Hydrogen
   b. Copper carbonate + Sulfuric acid → Copper sulphate + Carbon dioxide + Water
   c. Copper oxide + Sulphuric acid → Copper sulphate + Water

2.2. Materials and Change

Substances undergo either physical or chemical change. In a physical change, no new substances are formed, but in a chemical change, new substances are formed. Both physical and chemical changes are brought about by various factors such as temperature, size, contact area, etc. Any chemical reaction is a chemical change. A chemical reaction takes place when two or more substances interact to form one or more new substances.

Competencies:

Analyse types of chemical reactions and indicators to relate to chemical changes occurring in our everyday life.

2.2.1 Chemical Reaction

Scope: This topic underlines the concept and types of chemical reactions - synthesis, decomposition and displacement. It also encompasses indicators of chemical reactions such as a change in colour, odour, state, temperature - exothermic and endothermic; effervescence and importance of disposing chemical waste safely..

Learning Objectives:

- *Investigate synthesis, decomposition, and displacement reactions.*
- *Construct empirical evidence to prove the law of conservation of mass in chemical reaction.*

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- *Identify different types of indicators of chemical reactions.*
- *Carry out an experiment to demonstrate exothermic and endothermic reactions.*
- *Relate exothermic and endothermic reactions to daily life applications.*
- *Explain the importance of disposing chemical waste safely in the environment*

Learning Experiences

Chemical reactions occur all around us. Some chemical reactions are fast and visible, like an explosion or a firework display. Other chemical reactions are slow to be noticed such as rusting of iron and fading of colour from clothes. In a chemical reaction, atoms of the reacting substance rearrange themselves to form products. This can occur only if the bonds in the reacting substances are broken and new bonds are formed. A bond is an attractive force, which binds the atoms in a molecule.

The learner explores different types of chemical reactions by watching the video from the web link https://rb.gy/0ptcgf. After watching the video, learners design and carry out experiments to investigate different types of chemical reactions. The learner also investigates and constructs empirical evidence to prove the law of conservation of mass in chemical reactions.

The learner records the results of the experiment in the table given below. The teacher may provide questions as per the experiments designed.

Table: Types of Chemical Reactions

Experiment No.	Procedure	Observation/chemical equation	Inference/Type of chemical reaction

After conducting the experiment, learner answers the following questions:

1. Explain briefly what happens during a chemical reaction.
2. Explain the synthesis reaction with the help of a chemical equation.
3. What type of reaction does the chemical equation represent? Why?

   $CaCO_3 \rightarrow CaO + CO_2$
4. Why is there no change in mass during chemical reactions?

When a chemical reaction takes place, there are some changes that indicate and confirm the occurrence of the reaction. These changes are called the indicators of a chemical reaction.

The learner explores the indicators of chemical reactions from the weblink https://rb.gy/dohm6o and lists them with a brief explanation for each.

A change in temperature is also an indicator that a chemical reaction is taking place. Based on this, chemical reactions can be further classified as exothermic and endothermic. The learners watch the video from the web link https://rb.gy/t2inzv to understand exothermic and endothermic reactions. Then designs and carries out a simple experiment to demonstrate exothermic and endothermic reactions.

The learner answers the following questions:

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1. Explain exothermic and endothermic reactions with examples.
2. What are the indicators of exothermic and endothermic reactions?
3. Is photosynthesis an exothermic or endothermic reaction? Why?
4. A student mixed two chemicals. The temperature before the reaction was 20°C. The temperature after the reaction was 15°C. What type of reaction is it? Why?

Learners in groups explore the importance of exothermic and endothermic reactions in daily activities and share with the class. Further, learners explore the significance of disposing the chemical waste safely in the environment and share with the class.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of chemical reactions, types of chemical reactions and the indicators of a chemical reaction.	• Assess the learner's ability to gather information and design and carry out experiments.	• Assess the learner's ability to explain the importance of chemical reactions and managing chemical waste.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Type of chemical reactions: https://rb.gy/0ptcgf
5. Indicators of chemical reactions: https://rb.gy/dohm6o
6. Exothermic and endothermic reactions: https://rb.gy/t2inzv

Challenge Your Thinking

1. Identify the following reactions as synthesis, decomposition and displacement reactions.
   a. $8\ Fe + S_8 \rightarrow 8\ FeS$
   b. $Zn + 2\ HCl \rightarrow ZnCl_2 + H_2$
   c. $H_2CO_3 \rightarrow H_2O + CO_2$
2. Why is the heat absorbed or released during chemical reactions?
3. Chemical reaction is a chemical change. Justify with an example.
4. Name a biological process which is exothermic in nature.
5. In a reaction, 25 grams of reactant AB breaks down into 10 grams of product A and an unknown amount of product B. How much does product B weigh? Why?

6. Why should we dispose of chemical waste in a safe place?
7. Suggest some ways to dispose of chemical waste.
8. Word equation for the reaction between sodium hydroxide and copper sulphate is given below.

   Sodium hydroxide + copper sulphate → copper hydroxide + sodium sulphate

   a. What type of reaction is it?
   b. Write the balanced chemical equation and calculate the molecular mass of reactants and products. (Atomic mass of copper = 63.5, sodium = 23, sulphur =32, oxygen=16 and hydrogen =1)
   c. What can you conclude from the above reaction?

2.3. Patterns in Chemistry

The law of the modern periodic table states that the properties of elements are the periodic function of their atomic number. There are seven horizontal periods and eighteen vertical groups that aid us in the study of the properties of elements in the periodic table. In the modern periodic table, elements on the left-hand side are more metallic in nature, whereas those on the right-hand side are more non-metallic in nature. Metallic elements form basic oxides and non-metallic elements form acidic oxides. The periodic table is useful to predict the likelihood of types of chemical reactions that a particular element can produce when reacted with any other reactant.

Acids and Bases are encountered daily in chemistry and in our everyday life. They are important for changes to occur with substances whether inside or outside of our body. From the formation of food to the decomposition of any substance, acids and bases play a crucial role in our everyday life.

Competencies:

- Demonstrate the understanding of periodic trends to predict the properties and chemical reactivity of elements.
- Investigate the properties of acid and base to understand their classification and impact on the environment.

2.3.1 Patterns in the Periodic Table

Scope: This topic focuses on trends of atomic size, metallic and non- metallic character across the period and down the group and introduction to the terms: ionisation potential, electronegativity and electron affinity

Learning Objectives:

- *Explain atomic radius, metallic and non-metallic character of elements.*
- *Explain the trends of atomic radius, metallic character across and down the periodic table.*
- *Explain ionisation potential, electronegativity and electron affinity.*
- *Explain the significance of learning periodic properties of elements.*

Learning Experiences

According to modern periodic law, when elements are arranged in increasing order of their atomic number, the elements with similar properties can be seen repeated at certain regular intervals. Knowing the properties of an element in a period in the periodic table can help us predict the properties of other elements in the same period. This applies to elements in the same group.

The learner explores from the web link https://tinyurl.com/mvfysp56 and http://tinyurl.com/3xmdydkt or any other relevant resources to understand the atomic size, ionisation potential, electronegativity and electron affinity, and their trends in the periodic table.

Based on the information gathered, answer the following questions:

1. Explain atomic size, ionisation potential, electronegativity and electron affinity.
2. Write what happens to atomic size, ionisation potential, electronegativity and electron affinity across the period and down the group.
3. Which atom is larger in size, sodium or chlorine? Give a reason.
4. Write the differences between electronegativity and electron affinity.
5. What is the significance of learning periodic properties in the field of science?

Learners explore the trends of atomic radius, metallic character across and down the periodic table from the given weblink http://tinyurl.com/nuashr6m . Learners take note of the key points on the trends in periodic table and answer the following questions:

1. What happens to the metallic character of elements across the period and down the group?
2. What happens to atomic radii of elements across the period and down the group?
3. Why do elements in the same group have similar metallic characteristics?
4. Why do group 1 elements are generally more metallic than group 2 elements based on atomic radius trends?

Learners discuss and list the significance of learning periodic properties of elements.

Atomic size is the distance between the centre of the nucleus of an atom and its outermost shell. Ionisation energy is the amount of energy required to remove an electron from the outermost shell. The tendency of an atom in a molecule to attract the shared pair of electrons towards itself is known as electronegativity. The amount of energy released when an electron is added to a neutral atom to form an anion is called electron affinity.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of the atomic radius, ionisation	• Assess the learner's ability to identify the elements with different periodic properties.	• Assess the learner's ability to analyse the significance of the periodic properties of the elements.

potential, electronegativity and electron affinity.		

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science
3. REC repository
4. Science Class Eight (2020), REC
5. Periodic Trends in the Properties of Elements: https://tinyurl.com/mvfysp56

2.3.2 Acids and Bases

Scope: This topic focuses on the classification of acids and bases with respect to strength and concentration. It also includes the chemical reactions of acids and bases with metals, metal oxides, carbonates and bicarbonates. It further includes the formation of acid rain.

Learning Objectives:

- *Classify acids and bases based on strength and concentration.*
- *Investigate the reaction of acids with other elements and compounds.*
- *Investigate the reaction of bases with other elements and compounds.*
- *Explain the causes, impact and prevention of acid rain.*
- *Design a poster or other means to create awareness to mitigate the causes of acid rain.*

Learning Experiences

Acids and bases play a central role in chemistry and biological processes. You have learned that hydrochloric acids are present in the stomach and water that you drink from the tap is alkaline. Have you wondered what would happen if the production of HCl in the stomach increases and water alkalinity increases to a pH of 14?

The learner explores the classification of acids and bases based on their chemical properties through the given weblink https://tinyurl.com/cmfe8rff or any other relevant resources. Learners discuss in groups and share with the class.

Based on the information gathered, learners answer the following questions:

1. Using the flowchart classify and explain acids and bases with examples.
2. Explain with examples which acids and bases should be cautiously handled.
3. List down at least five examples of bases and identify them as strong and weak bases.
4. Identify two examples of acids and bases that we use at home.

Furthermore, learners investigate the reaction of acid with other elements and compounds such as metals, metal oxides, carbonates and bicarbonates.

Based on the above activity, learners answer the following questions:

1. What are the end products of a reaction between acids and metal?
2. With the help of a balanced chemical equation, explain what happens when dilute hydrochloric acid reacts with sodium and iron.
3. Name the products formed when dilute hydrochloric acids react with sodium carbonate with the help of a chemical equation.

In addition, the learner designs an experiment to demonstrate the chemical reaction of bases with metals, metal oxides, carbonates and bicarbonates.
Based on the above activity, answer the following questions.

1. Identify the end product when the base reacts with acid and carbon dioxide.
2. Write the balanced chemical reaction when sodium hydroxide reacts with ferrous sulphate and ammonium chloride.

After understanding the chemical properties of acids, the learners explore acid rain through the given link https://youtu.be/1PDjVDIrFec or https://tinyurl.com/2p9eyp63. After exploring the links, learners discuss in the group and share to the class.

Based on the information gathered, learners answer the following questions.

1. What are the main chemicals in air pollution that form acid rain?
2. Explain acid rain formation with the help of chemical reactions.
3. Analyse the effects of acid rain on the environment and on building materials?
4. Analyse the vulnerability of acid rain in our country.
5. Calcium carbonate is the major component of limestone and marble. Sulphuric acid is one of the major components of acid rain. Write a balanced chemical equation that shows how sulphuric acid reacts with calcium carbonate.

Using the information from the video and relevant resources, the learner in groups designs an action plan to conduct an awareness campaign in the community on the causes and effects of acid rain and how to prevent it.

Based on the degree of ionisation, acids are classified as a strong and weak acids, similarly, if there is a high percentage of acid in an aqueous solution it is referred to as concentrated acid and on the contrary, if there is a low percentage of acid in an aqueous solution, it is referred as dilute acid. Besides, bases can be classified as strong and weak based on the degree of ionisation, similarly, based on the percentage of the base in an aqueous solution, it can be further classified as a weak and strong base. Acid rain is any form of rain that is more acidic than normal with a pH lower than 5.6.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess learner's conceptual understanding of acid and	• *A*ssess the learner's ability to design the awareness	• Assess the learner's ability to analyse the impact of acid

base chemical properties and its classification, and formation of acid rain.	program to prevent acid rain.	rain.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. What is acid rain: https://youtu.be/1PDjVDIrFec
5. An increasing number of vehicles impacts air quality: https://tinyurl.com/yskwr3et
6. Whatever happened to acid rain: https://tinyurl.com/2p9eyp63

Challenge Your Thinking

1. Analyse the trends in the periodic properties of elements.
2. Which will be more electronegative, sodium or chlorine? Give a reason.
3. Study the section of a periodic table given and answer the following questions. The letters shown in the table are not symbols of the elements.

X						A	E
Y	T	C	D	E	F	B	G
Z	I	J	K	L	M	C	F

   a. Which will be more electronegative, Y or G? Give a reason.
   b. Identify which element will have the largest size.
4. Acid rain is caused equally by natural and man-made activities. Justify the statement with two reasons.
5. With the help of a balanced chemical equation, explain what happens when
   a. zinc metal is treated with dilute sulphuric acid.
   b. sodium is treated with dilute hydrochloric acid.
   c. calcium oxide is treated with dilute nitric acid

Read the following passage and answer the following questions.

Rapid increase in the number of cars is deteriorating the air quality, according to the Bhutan State of the Environment Report 2016. The report says increasing vehicle population adds to greenhouse gas emissions in the air. Over 1,000 grams of greenhouse gas are emitted with over 28 cars hitting the road every day. Rubbers from worn-out tires and brakes add to the contamination. National Environment Commission's Tshewang Dorji said vehicle emission contributes a lot to air pollution because vehicle emission contains both particulate and gaseous material. He said gaseous material when in the atmosphere undergoes some chemical reaction forming a substance that is not desirable. "When you live in places with high pollution, it becomes difficult for young and adults, especially those with asthma." Despite an increase in the number of

vehicles, re-suspended road dust from unpaved roads, industrial and mine activities, forest fires and transboundary pollution contributes to air pollution in the country (BBS, 06/10/2016).

a. How is air pollution related to acid rain?
b. What consequences can be faced if the emission by car continues?
c. As a concerned citizen, design a plan for ways to reduce the production of harmful gases that form acid rain.

2.4. Separating Mixtures

Most materials we use are mixtures. A mixture is a physical combination of two or more pure substances. For example, the air is a mixture of oxygen, nitrogen, carbon dioxide, etc. Mixtures can be either homogeneous or heterogeneous. Most of the mixtures that you come across are heterogeneous. The homogeneous mixtures are mostly in the form of solutions. The components of a mixture can be separated by using physical means, such as filtration, distillation, chromatography, fractional distillation etc.

Competencies:

Investigate different types of mixture and compound, and techniques of separating mixture to relate their significance in our everyday life.

2.4.1 Separating Mixtures

Scope: This topic focuses on differences between mixture and compound through investigation followed by separation methods like filtration and chromatography with their applications.

Learning Objectives:

- *Differentiate between mixture and compound.*
- *Carry out an experiment to differentiate between compounds and mixture.*
- *Identify applications of mixture and compound.*
- *Carry out an experiment to understand the process of filtration and chromatography.*
- *Explore the applications of filtration and chromatography in various fields.*

Learning Experiences

In lower classes, you have learnt that all the substances which occur in nature do not exist in a pure state but mostly exist in the form of mixtures. Mixtures may contain two or more components, which are physically combined and can be separated by physical means such as evaporation, filtration, decantation, sedimentation, hand-picking, sieving, magnetic separation, etc.

Learners watch a video from the link https://youtu.be/TkUiz_yBSrU and https://youtu.be/C2RqAE0wbqk to understand the properties of mixture and compounds. Then the learner investigates the available materials from the surroundings and identifies them as mixtures and compounds based on their properties.

The learner answers the following questions:

1. Compare mixtures and compounds and state their examples.
2. Categorise sodium chloride and sodium chloride solution into mixture and compound. Justify.

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The learners watch a videos from the web link https://youtu.be/lrnt9QswVZ8 and https://studiousguy.com/filtration-examples/ to understand filtration and its application. The learner design and carries out an experiment to investigate the filtration processes.
Then learner answers the following questions:

1. Explain the filtration process and its application in daily life.
2. What types of mixtures can be separated by filtration?
3. What characteristics of components of mixtures are used in filtration?

The learners watch the video from the web link https://youtu.be/PvHvx7k7UPU and https://youtu.be/2R2iq_XR1IY to understand paper chromatography and column chromatography respectively. The learner designs and carries out an experiment to separate the mixture using paper chromatography and column chromatography.

The learner discusses the uses of chromatography from the link https://tinyurl.com/2p8xm3d7 and share with the class. Learner answers the following questions:

1. Explain processes of paper chromatography and column chromatography.
2. Write two applications of paper chromatography.
3. What characteristics of components of mixtures are used in paper chromatography?
4. Draw a mind map on separating techniques and their application in daily life on Google Docs or in a PowerPoint presentation. Then share your work with the rest of the learners in the class.

The term chromatography is derived from the Greek word “chroma” meaning colour and “graph” meaning writing. A mixture of colours or two or more soluble solids can be separated by chromatography. Chromatography is also used for the separation of different dissolved components of a mixture.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner’s conceptual understanding of mixture and compound, and separating methods like filtration and chromatography.	• Assess the learner's ability to separate the mixture using filtration and chromatography.	• Assess the learner’s ability to understand and relate the applications of filtration and chromatography in the real world.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. Continuous Formative Assessment Guide, Classes PP-VI (2020), REC
2. National School Curriculum Framework for Science, (2022)
3. REC repository
4. Science Class Eight (2020), REC

5. Compound and mixture: https://youtu.be/TkUiz_yBSrU
6. Activity to distinguish compound and mixture: https://youtu.be/C2RqAE0wbqk
7. Filtration: https://youtu.be/lrnt9QswVZ8
8. Application of filtration: https://studiousguy.com/filtration-examples/
9. Chromatography: https://youtu.be/PvHvx7k7UPU
10. Column chromatography: https://youtu.be/2R2iq_XR1IY
11. Application of chromatography: https://tinyurl.com/2p8xm3d7

Challenge Your Thinking

1. Classify the following materials into a mixture or compound and state a reason for each: Tap water, sodium nitrate, rust, distilled water, paint, sugar, carbon dioxide, brine, apple juice, petrol, ink, and alcohol.

   Table: Classification of materials into mixture and compound

Mixture	Compound	Reason

2. Identify a suitable technique such as simple distillation/ fractional distillation/ filtration/chromatography, to separate the following mixtures:
   a. the constituent of colouring matter of ink.
   b. petrol from crude oil.
   c. sodium chloride from seawater.
   d. dust particles from the air.
3. Figures below show the results of a chromatography experiment. Figure 1 shows mixture A and B and figure 2 shows pure substances C, D, E and F. The distance travelled by the component of the mixtures will be the same to that of the pure substance if that pure substance is present in the mixture.

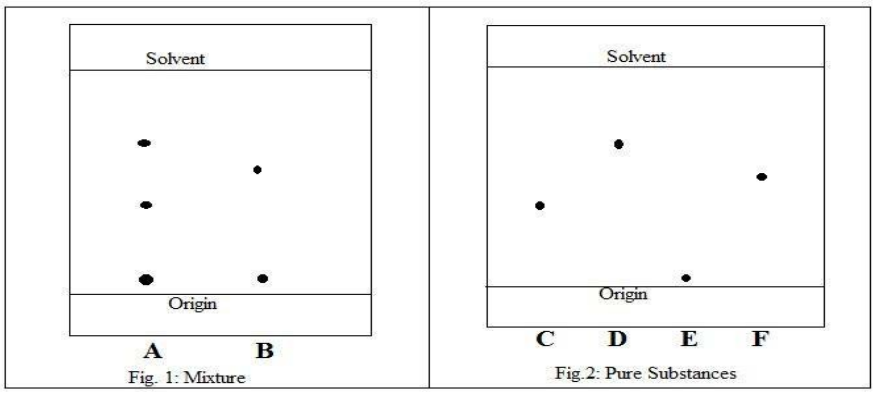

Fig. 1: Mixture

Fig.2: Pure Substances

   i. Which pure substance is:
      a. in both the mixtures
   ii. ii. Which pure substances are there
      a. in mixture B?

b. in mixture A?

4. Which face mask can best prevent coronavirus, cloth or surgical mask? Justify.

Cloth mask

Surgical mask

3. Physical Processes

3.1. Forces and Motion

Throughout our lives, forces have been acting on us and have been working with them. The gravitational force of the Earth keeps us on the surface of the Earth. Gravity is present along with other forces such as stretch, squeeze, friction, etc. These forces explain why a marble falls faster than a piece of paper, and why weights differ at different places.

Competencies:

Explore the effects of frictional forces and gravity on a body and establish a relationship amongst force, area, and pressure to comprehend its significance on daily life applications.

3.1.1 Force and Linear Motion

Scope: This topic delves into the concept of velocity, acceleration due to gravity and factors affecting it, interpreting displacement time graphs (physical quantities: scalar and vector), relating mass and force to gravity.

Learning Objectives:

- *Explain velocity.*
- *Explore the concept of acceleration due to gravity.*
- *State the factors affecting the acceleration due to gravity.*
- *Interpret the weight of a body in terms of mass, force and gravity.*
- *Explain the importance of the gravitational force of the Earth.*

Learning Experiences

The speed of any moving body tells us the distance covered by the body in a unit of time but does not indicate the direction of the body. Do all the moving bodies have direction and magnitude?

The learners watch the video from the web link https://bit.ly/3sZkU7E to understand the differences between speed and velocity. Learners reflect on differences and similarities between speed and velocity with examples.

The learners watch the video from the web link https://bit.ly/3zyQOsM to understand the displacement-time graph. Further, the learner uses the PhET simulation https://bit.ly/3t1c8WN to study the relationship between displacement and time.

The learner answers the following question:

8. Interpret the displacement - time graph and write the relationship between displacement and time.
9. What happens to the car after six seconds in Traffic: Velocity 2? Why?
10. Calculate the average velocity of blue and red cars in Traffic: Velocity 3.
11. Interpret the graph for red cars in Traffic Velocity 10.

The learner in a team design and carries out an experiment to illustrate displacement-time graph. Further, the learner interprets the graph to describe the motion of the object.

Our Earth attracts all the objects toward its centre by a force called gravity. This force acting on a mass of a body is known as its weight. Acceleration due to gravity is denoted by the letter 'g'. The value of the 'g' of the Earth is approximately 9.8 ms^{-2}. The acceleration due to gravity on the Moon's surface is nearly $\frac{1}{6}^{th}$ of the acceleration due to gravity on the Earth. Do you know that objects from greater heights fall with higher velocity than those falling from lesser heights?

The learners watch the video from the web link https://bit.ly/3qV3sOV to understand factors affecting acceleration due to gravity, and explore the web link https://bit.ly/3n0prmA to understand the effects of gravity on mass and weight. Based on the information gathered, the learner prepares a presentation and presents to the class.

Then the learner answers the following questions:

1. Explain the differences between mass and weight with examples.
2. Derive the relationship among weight, mass and acceleration due to gravity.
3. A man weighs 600 N on the Earth. What would be his approximate weight on the Moon?
4. State the significance of gravitational force on the Earth.

The learners in the team explore the importance of the gravitational force of earth and share with the class.

The unit of velocity is metres per second (ms^{-1}). When a body moves away from its initial position, the displacement is positive therefore velocity is also positive. The velocity of the body is negative if the body moves towards its initial position. The velocity of a stationary body is zero because the displacement is zero.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of the difference between speed and velocity, the relationship between displacement and time and factors affecting acceleration due to gravity and the effects of gravity on mass and weight.	• Assess the learner's ability to interpret displacement-time graphs and present them in the classroom.	• Assess the learner's understanding of the application of velocity and displacement and the effects of gravitational force in daily life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC

4. Speed and Velocity video link: https://bit.ly/3sZkU7E
5. Displacement-time graph video link: https://bit.ly/3zyQOsM
6. PhET simulation: displacement and time: https://bit.ly/3t1c8WN
7. Factors affecting acceleration due to gravity video link: https://bit.ly/3qV3sOV
8. Effect of gravity on mass and weight video link: https://bit.ly/3n0prmA

3.1.2 Fluid Friction

Scope: This topic covers the concept of fluid friction, effects of fluid friction, factors affecting fluid friction, and reduction of fluid friction.

Learning Objectives:

- *Explore the concept of fluid friction*
- *Explain the factors that affect the fluid friction on moving objects.*
- *Investigate the effects of fluid friction on moving objects.*
- *Suggest the ways to reduce fluid friction.*

Learning Experiences

Friction is the force that opposes the motion between the two surfaces which are in contact with each other. Will a body move in fluid and experience friction?

The learners watch the videos from the web link https://bit.ly/3qTDwmH and https://bit.ly/3zxvdB9 to understand the concept of fluid friction and factors affecting the fluid friction. After watching the video, learner's discus in the group and answers the following questions:

1. Explain the factors affecting fluid friction.
2. What are the effects of fluid friction?
3. "The fluid friction increases with the viscosity of the liquid ". Design an experiment to prove the above statement. Write the complete procedure and the materials used for your experiment.

Based on the information gathered from the videos, the learner designs an experiment to demonstrate the effect of fluid friction on moving objects and also investigate ways to reduce fluid friction.

Fluids offer resistance that opposes the motion of a body moving through them. As a result, friction is produced between the moving body and the surface of the fluid in contact. The degree of friction due to fluid is determined by the shape of the moving body and the viscosity of the fluid.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes

• Assess the learner's conceptual understanding of the effects of fluid friction on moving objects and ways to reduce fluid friction.	• Assess the learner's ability to design an experiment to reduce fluid friction.	• Assess the learner's understanding of the application of fluid friction in daily life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Fluid Friction video: https://bit.ly/3qTDwmH
5. Fluid Friction web: https://bit.ly/3zxvdB9

3.1.3 Force and Pressure

Scope: This topic deals with the concept of pressure, investigating pressure and factors affecting it, and designing simple machines using the concept of pressure.

Learning Objectives:

- *Investigate the relationship between force, area, and pressure.*
- *State the applications of pressure in daily life.*

Learning Experiences

Pressure is the amount of force acting perpendicular on a unit area of a surface. When a body is placed on a surface, it exerts a force equal to its weight. The unit of pressure is Nm^{-2} or pascal (Pa). Have you ever thought of why school bags are designed with broad straps?

The learners watch the video from the web link https://bit.ly/3qTFIuw to understand the pressure. After watching the video, learners discuss the application of pressure in daily activities and share with the class.

The learner designs an experiment to investigate the relationship between force, area and pressure and share the findings to the class. Further, learners watch the video from the web link https://bit.ly/3L3Jj2t to enhance their understanding and answers the following questions:

1. Explain pressure with examples.
2. How is force, area and pressure related?
3. It is easier to drive sharp nails into a piece of wood than blunt ones. Give reasons.
4. Write three applications of pressure in our daily lives.
5. A block with length, l = 1.5 m, width, w = 1 m, height, h = 0.5 m has a mass m = 300 kg and is placed on a table. Calculate the pressure exerted by the block on the table.

Design and make a working model by using your knowledge of force and pressure. Describe the process used in making the model.

Pressure is directly proportional to the force exerted on the surface and inversely proportional to the area of contact.

Learners in groups explore the daily applications of pressure.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of force, pressure and area.	• Assess the learner's ability to design and carry out an experiment to draw the relationship between force, pressure and area.	• Assess the learner's understanding of the application of force and pressure in various activities.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Pressure video: https://bit.ly/3qTFIuw
5. Relationship between force, pressure and area: https://bit.ly/3L3Jj2t

Challenge Your Thinking

1. Wangchuk participated in the 'Move for Health' walk. He covered a distance of 10 km due west in 1 hour.
    a. What was the walking speed of Wangchuk?
    b. How long will it take to cover a distance of 833 m due west, if he walks at the same speed?
    c. How much time will he take to cover 1500 m to the east, if he walks with the velocity of 10 m/s due east?
2. The distance between the Earth and the Moon is 384,400 km. How long does a rocket travelling from the Earth with a velocity of 3,000 km/h take to reach the Moon?
3. If a stone and a pencil are dropped simultaneously in a vacuum from the top of a tower, which of the two will reach the ground first? Why?
4. A wooden cube is weighed at the North Pole by a beam balance and then by a spring balance. The reading on the beam balance is 6000 g and the reading on the spring balance is 60 N. At a point on the equator, the beam balance gives the same value while the spring balance records 59.8 N. Explain these differences.
5. Mass of an object remains the same, whereas the weight of an object varies from place to place on the surface of the Earth. Justify the statement.

6. Dorji weighs 1500 N. If the total surface area of the soles of his qis 0.5 m^2, what is the pressure exerted by his body on the ground?
7. Tshewang is sitting on the floor and drawing. His weight is 1000 N. If he exerts a pressure of 100,000 Pa on the floor, calculate the area of contact with the floor.
8. A girl of mass 50 kg is standing on pencil heels, each of cross-sectional area of 1cm^2, and another girl of the same mass on wide heels. Each of the cross-sectional areas of the heels is 5 cm^2. Compare the pressure exerted by them on the floor. [Take the value of 'g' = 10 ms^{-2}]

3.2. Work and Energy

The quantity of work done is the effect of force causing an object to move through a displacement. The work done is equal to the amount of energy transferred by the force to an object. Thus, Work is directly proportional to Energy. How can we explain the relationship between force, displacement, work done and power?

What would happen to our Earth without heat? Heat energy is used for cooking, warming, running automobiles, and for many other purposes. Like any other form of energy, heat can be transformed into other useful forms of energy. For instance, heat energy from natural gas is converted to electrical energy. These conversions mainly take place through the transfer of heat.

Competencies:

Explain the relationship among work, power, and energy through calculation to understand their applications in daily activities.

3.2.1 Work and Power

Scope: This topic covers the concept of work and power, units for work and power, calculation related to work and power.

Learning Objectives:

- *Explore work and power to explain their roles in everyday activities.*
- *Calculate power in terms of the rate of work done using instances from real-life activities.*

Learning Experiences

Work is done whenever a force moves an object through some distance. You can calculate the energy transferred, or work done, by multiplying the force and the distance moved in the direction of the force. Power is the rate at which work is done. How are force and power related or how do they affect work?

Work can be calculated with the equation: **Work = Force × Distance**. The SI unit for work is the joule (J), or Newton metre (Nm).

The power depends on the amount of work done and the time taken to complete the work. Therefore, power is defined as the rate of doing work.

Power = $\frac{Workdone\ (J)}{Time\ (s)}$ or **Power= Force** X **Velocity.**

The SI unit for power is the watt (W), which equals 1 joule of work per second (J/s).

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The learner watches the video from the web link https://bit.ly/3GjthyR or other relevant sources to understand the relationship between work and power. After watching the video or referring to sources, the learner derives the formula to calculate work and power.

The learner identifies the factors that affect work and power.

The learner performs various physical activities and collects data to investigate work and power and complete the given table.

Table 2.1. Investigating Work and Power

Activity	Time (s)	Displacement(m)	Work (J)	Power(W)

The learner answers the following questions.

1. Explain the relationship between work and power.
2. A tired squirrel (mass of approximately 1 kg) does push-ups by applying a force to elevate its centre of mass by 5 cm in order to do a mere 0.50 Joule of work. If the tired squirrel does all this work in 2 seconds, then determines its power.
3. A force of magnitude 750 N pulls a car up along a slope at a constant speed of 9 m/s. Given that the force acts parallel to the direction of the motion, find the power developed in kW.

One joule equals the amount of work that is done when 1 N of force moves an object over a distance of 1 m.

1. A girl lifts a 160-N load at a height of 1 m in a time of 0.5 s. What power does the girl produce?
2. Powerful people or powerful machines are simply people or machines which always do a lot of work. Is this statement True /False? Explain.
3. Explore to investigate the relationships between energy and power. Describe the relationship and explain the application of the relationship.

Work and energy are the two sides of a coin as both are interconnected to each other. When an object moves towards the direction of the force applied, it is said that work is done. To do this work, the same amount of energy is needed.

Power is the energy that is consumed per unit of time. It is a scalar quantity as it does not have any direction. Power may be measured in a unit called horsepower. One horsepower is the amount of work a horse can do in 1 minute, which equals 745 watts of power.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes

• Assess the learner's conceptual understanding about the relationship between work done and power along with their units.	• Assess learners' ability to investigate and calculate work and power.	• Assess the learner's understanding of the significance of work and power in life.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Power: https://bit.ly/3GjthyR

3.2.2 Mechanical and Heat Energy

Scope: This topic deals with mechanical energy [potential energy and kinetic energy]. It also deals with transfer of heat energy (conduction, convection, and radiation) and dissipation of energy.

Learning Objectives:

- *Explore mechanical energy.*
- *Calculate potential and kinetic energy.*
- *Explain conduction, convection and radiation of heat.*
- *Demonstrate the process of conduction, convection and radiation of heat.*
- *Describe the importance of heat transfer to understand its applications.*
- *Explain dissipation of energy.*
- *Determine ways to minimise the energy dissipation.*

Learning Experiences

Mechanical energy can be either kinetic energy or potential energy. Objects have mechanical energy if they are in motion and/or if they are at some position. Potential energy depends on the height of the object, so its formula is:

Potential Energy = mgh

Kinetic energy is directly proportional to an object's mass and the square of its velocity.

Kinetic Energy = 1/2 mv².

Both potential and kinetic energy are measured in Joule(J).

The learner watches the video from the web links https://bit.ly/3nJBaGh and https://bit.ly/3tJhFBv to understand mechanical energy. Learners discuss in the group and share with the class and answer the following questions.

1. Explain the factors that affect kinetic energy and potential energy.
2. What is the kinetic energy of the object having a mass of 4 kg thrown with a velocity of 15 m/s?
3. Narrate 3 to 5 events under the effects of potential and kinetic energy. Assess how they affect our life.

Heat is a form of energy which can be transferred from one body to another body. Heat energy flows from a body of higher temperature to a body of lower temperature. With an energy transformer device, heat energy can be transformed into mechanical energy.

The transfer of heat can take place in three different modes. The learner watches the video from other relevant sources or from the given link https://bit.ly/3FMIszo to understand the modes of heat transfer..

The learner designs an experiment to investigate heat transfer through conduction, convection and radiation using locally available materials.

Learners answer the following questions:

1. Explain the differences between conduction and convection with examples.
2. Which mode of heat transfer is responsible for making us feel the warmth of the fire? Justify.
3. Analyse how heat energy conduction, convection and radiations are used at home.

The learners watch the video from the given web link or from other relevant sources https://bit.ly/3fEJu5N to understand the dissipation of energy and find ways to minimise energy dissipation.

The learner carries out an activity to investigate energy conversion and analyse how energy is being dissipated while using energy from the sources.

The learner in the team explores ideas to innovate ways to minimise the dissipation of energy and presents them to the class.

Learners brainstorm on how the transfer of heat is important in daily lives. The teacher asks the question - what would happen if transfer of heat did not occur? Learners make a list in groups using RoundTable. Learners stop their activity at the end of a duration specified by the teacher.

Learners present their groups list and paste their write-up in the subject corner.

Heat can be transferred in three ways: by conduction, by convection, and by radiation**.** Conduction is the transfer of energy from one molecule to another by direct contact. Convection is the movement of heat by a fluid such as water or air. Radiation is the transfer of heat by electromagnetic waves.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the conceptual understanding of mechanical energy and modes of transfer of heat.	• Assess the learner's ability to investigate mechanical energy and investigate heat transfer from different modes by designing experiments.	• Assess the learner's understanding of the application of mechanical energy and heat transfer in our daily life.

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For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Potential energy: https://bit.ly/3nJBaGh
5. kinetic energy: https://bit.ly/3tJhFBv
6. Mode of heat transfer: https://bit.ly/3FMIszo
7. Dissipation of energy: https://bit.ly/3fEJu5N

Challenge Your Thinking

1. How would you measure the strength of the strongest man?
    a. A man pulls a log with a constant force of 45000 N along a road through a distance of 10 m.
    b. Find out the work done by the man.
2. What is the power of the man if he takes 15 seconds to complete the work?
3. When doing a *chin-up*, a student lifts her 42.0kg body to a height of 0.25 metres in 2 seconds. What is the power delivered by the student's biceps?
4. Why do you think it's important to use energy resources judiciously at home?
5. What is the potential energy of an object with a mass of 15 kg, when kept at a height of 200 m above the surface of the Earth? [Take g = 10 m/s^2]
6. A coin is dropped from a height of 90 m. How fast will it fall, just before it hits the ground? [Take g = 10 m/s2, Hint: For a falling body, the total PE at the greatest height will be equal to the K.E., just before it touches the ground]
7. Give an example of energy transformation where there is no dissipation of energy. Explain.
8. Identify any of the energy-transforming devices. How can you improve its efficiency?
9. A person of mass 70 kg runs up a flight of stairs with a vertical height of 5m. If the trip takes 7s to complete, calculate the person's power.
10. By using a car as the reference, explain all the energy conversions, work done, and energy dissipation in making the car move.

3.3. Electricity and Magnetism

Electricity and magnetism are separate yet interconnected phenomena. A moving electric charge produces a magnetic field. A magnetic field induces electric charge movement and produces current. In 1820, Hans Oersted, a Danish physicist and chemist found that electricity and magnetism are related. In 1830, Michael Faraday and Joseph Henry discovered that a changing magnetic field produces current in a coil of wire. This idea ultimately led to the making of dynamos. This discovery of the relationship between magnetism and electricity is one of the greatest achievements in science.

Competencies:

Investigate principles and applications of electricity and explain magnets to understand their use in different appliances.

3.3.1 Circuits

Scope: This topic includes the concepts of potential difference, electric current, electric resistance, Ohm's law and its numerical problems. It also includes energy transfer in batteries, and construction of simple cells.

Learning Objectives:

- *Explain potential difference, electric current and Ohm's law.*
- *Investigate the relationship between current, voltage and resistance to understand Ohm's law.*
- *Solve numerical problems related to Ohm's law to determine resistance, current, and voltage.*
- *Analyse transfer of energy in a battery and its exhaustion.*

Learning Experiences

A conductor has a large number of free electrons that can move from one end to the other end. The electric current flows through a conductor in a circuit when the circuit is completed. Water flows from a greater height to a lower height, similarly the current flows from the region of its higher potential to the lower potential. However, the direction of the flow of electrons is opposite to the direction of the flow of the current. It flows from the region of its lower potential to its higher potential. Do you know why this happens?

The learners watch the video from the web link https://bit.ly/3HEY2OC to understand the concept of potential difference and electric current. Then, the learner explains the electric potential and potential differences in their own words.

In order to understand Ohm's law, the learner watches the video from the web link https://bit.ly/3KaMODO and https://bit.ly/3q5A1KV. The learner then explains Ohm's law based on their understanding.

In order to check the understanding the learner answers the following questions based on the video.

1. How is the flow of electric current determined by the potential differences?
2. State Ohm's law.
3. What is the condition required for Ohm's law to be valid?
4. Based on Ohm's Law, establish the relationship between current, voltage and resistance.
5. Explain how the length and diameter of a conductor affect the current flow.

In addition, the learner uses the PhET simulation link https://bit.ly/3n3evVi to study the relationship between voltage, current and resistance (V=IR) in Ohm's law.
The learner then answers the following questions based on Ohm's law to check their understanding.

1. How are voltage and current related?
2. What happens to the current when the voltage is increased by increasing the number of cells in the circuit?
3. How are current and resistance related?
4. What are dependent, independent and controlled variables while investigating Ohm's law?
5. A current of 0.5 A flows through a 22 Ω resistor. What is the value of voltage across it?

Further, the learner uses the link https://bit.ly/3ePTcSD or other relevant resources to investigate energy transfer and exhaustion in batteries.

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The learner investigates a cell to understand different materials used for the construction of the cell and describes how energy is transferred in a cell.

The learner also uses the link https://bit.ly/3HZ4jVy to understand the role of resistance in electrical appliances. After reading the notes from the link, the learner answers the following questions based on their understanding.

1. Why is electrical resistance used in electrical appliances?
2. Identify 2 to 3 electrical appliances used at home. What do they represent in an electric circuit?

A device called an ammeter is used to measure the current flowing through the circuit. The unit of current is Ampere (A). Voltmeter is a device used to measure the potential difference across the ends of a conductor. Using equipment of his own creation, Ohm found that there is a direct proportionality between the potential difference (voltage) applied across a conductor and the resultant electric current. This relationship is known as Ohm's law, and the ohm, the standard unit of electrical resistance, is named after him.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of electric potential, potential difference, voltage, resistance and Ohm's law.	• Assess the learner's ability to use PhET simulation to investigate the relationship between current, resistance and voltage in an electric circuit.	• Assess the learner's understanding of the energy transformation in a cell and importance of electrical resistance in different electrical appliances.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Potential difference and electric current: https://bit.ly/3HEY2OC
5. Circuits and Ohm's Law: https://bit.ly/3KaMODO
6. Verification of Ohm's Law: https://bit.ly/3q5A1KV
7. PhET simulation on Ohm's Law: https://bit.ly/3n3evVi
8. How do batteries work: https://bit.ly/3ePTcSD
9. Resistance: https://bit.ly/3HZ4jVy

3.3.2 Mains Electricity

Scope: This topic deals with types of current, domestic electric supply, colour codes of electrical wires, electrical safety, fuse, electrical insulation, earthing, electrical heating for domestic purpose and calculation on electrical energy consumption.

Learning Objectives:

- *Compare direct and alternating current with reference to electricity supply.*
- *Explain the use of live, neutral and earth wires in electric circuits.*
- *Explain the importance of insulation, earthing, fuses, and circuit breakers used in electric circuits.*
- *Calculate electrical energy consumption at home and school based on electric bill.*

Learning Experiences

The electricity generated by power stations and transported around the country through the grid is called mains electricity. It is an alternating current (a.c). Everyone connects to the mains electricity when we plug in appliances such as television, charging mobile phones, etc. Mains electricity is an alternating current. The positive and negative are live and neutral wires of an electrical circuit. The live and neutral wire delivers current to the device. Earthing wire is for safety and is connected to the Earth. Depending on how much electrical energy is consumed at home and schools, the number of electrical bills can be calculated.

The learner watches the video from the web link https://bit.ly/3qTexjB or https://www.youtube.com/watch?v=gNMwfINKkBQ to understand the differences between alternating current and direct current, draws the graph of current and time and writes the differences.

The learner answers the following questions to check their understanding of the types of current.

1. Compare alternating and direct current with reference to the electricity supply at home.
2. Identify the advantages and disadvantages of the two types of current.

The learner further explores the web link https://images.app.goo.gl/ to understand the colour coding of the live, neutral and earth wires and their functions in the domestic electricity supply and answers the following questions:

1. What is the function of the neutral wire?
2. What will happen to the connection if the live wire is not connected?
3. Is it necessary to use all three wires in an electrical connection?

The learner explores the importance of insulation, earthing, fuses and circuit breakers used in electric circuits from the following weblink https://bit.ly/3FVBlFA.

The learner then answers the following questions:

1. What should be the nature of fuse wire?
2. Why are electrical safety devices important in an electric circuit?
3. What is electrical insulation?
4. How does earthing provide safety to electrical appliances?

Next, the learner refers to the class VIII science textbook for the formula to calculate electrical energy consumed at homes and schools and the cost of the electrical energy consumed based on the monthly electric bill. The learner uses the formula to solve the following questions:

1. A tube light of 50 watts and a bulb of 100 watts are connected to 250 Volts mains and operate for an average of 3 hours a day. If the cost of the energy is Nu. 2 per unit, calculate the electric bill for a day.
2. Draw the current and time graph of direct and alternating current using a relevant ICT tool.

Electricity is a good servant if used cleverly and carefully. However, careless and negligent use of it is dangerous. Therefore, it is important to use electric devices that have safety protection.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of mains electricity, types of current, colour coding of wire, electrical safety devices and electrical energy consumed.	• Assess the learner's ability to calculate electrical energy consumed.	• Assess the learner's understanding on the safe use of electricity.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Domestic electric supply: https://images.app.goo.gl/
5. Differences between ac and dc: https://bit.ly/3qTexjB
6. Electrical safety devices: https://bit.ly/3FVBlFA

3.3.3 Magnetism

Scope: This topic includes concepts of magnetisation, differences and use of temporary and permanent magnet, and application of electromagnet.

Learning Objectives:

- *Explain the process of magnetization.*
- *Differentiate temporary and permanent magnets and their uses at homes and industries.*
- *Investigate the factors that affect the strength of electromagnets.*
- *Design and construct a simple electric bell based on the concept of electromagnet.*

Learning Experiences

Magnet is a material which has the properties to attract materials that are magnetic in nature. Magnets can be both natural like lodestone (Fe_3O_4), and man-made. Many magnets are of different shapes and sizes made

from natural magnets. Magnets are either permanent or temporary. Magnetic materials can be magnetised through different methods.

The learner investigates magnetization methods such as single touch and double methods using bar magnet and a nail.

The learner watches the video from the link https://bit.ly/3zxtKuk to understand how electromagnets are prepared and carry out the following task:

1. Design electromagnets using available materials in your locality.
2. Explain how one can increase the strength of an electromagnet.
3. Identify the uses of electromagnets at home.

The learner watches the video from the link https://bit.ly/3zvCnpj on the applications of the electromagnet in the electric bell.

Then, the learner designs a model of an electric bell to understand its working principle. Displays and explains to the class. Maintains records in the science journal.

Magnets have many applications in our lives. Electromagnet is used in devices such as an electric bell, telephone, loudspeakers, electric motors, dynamos, etc.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's conceptual understanding of magnetization, temporary and permanent magnets and electromagnets.	• Assess the learner's ability to design electromagnets and electric bells.	• Assess the learner's understanding of the uses of magnets and electromagnets at homes and for commercial purposes.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. How to make electromagnets: https://bit.ly/3zxtKuk
5. How does an electric bell work?: https://bit.ly/3zvCnpj

Challenge Your Thinking

1. Explain why a fuse is always connected to the live wire and not the neutral wire.
2. Calculate the potential difference across 10 Ω resistors carrying a current of 2.5 A.

3. What is the appropriate filament resistance of a light bulb if it operates from a 110V source and 0.6 A of current is flowing?
4. Draw a circuit diagram to verify Ohm's law.
5. Is electrical resistance good or bad? justify your answer.
6. Use the table to calculate the electrical energy consumed and the cost for using different electrical appliances. (Cost for 1 unit = Nu. 1.5)

Table 1: Calculation of electrical energy consumption.

Electrical appliance	Power Rating (W)	Duration of Use Everyday	Electrical Energy (kWh)	Cost (Nu)
Bulb	60	7 hrs	…….	……
Rice Cooker	1100	3hrs	……..	……
Heater	250	12 hrs	……	……

7. Explain the importance of colour coding in electric wire.
8. 'Saving electricity in our homes is saving our money'. Mention five ways of saving electrical energy.
9. How can you increase the strength of an electromagnet?
10. Explain why magnets are made into different shapes, sizes and strengths.

3.4. Light and Sound

Life on the Earth depends on light and sound. Light is important because it is a primary source of energy. Every living thing depends on plants for their source of energy, and the plants in turn depend on light.

Sound is equally important in people's lives as it is used for communication. Seeing and hearing are the fundamental senses of life.

Competencies:

Investigate the properties and effects of light and sound in different situations to use it in daily life.

3.4.1 Refraction of Light

Scope: This topic deals with refraction of light through (glass slab, prism, lenses, liquids, and air), formation of image by lenses (ray diagrams), dispersion of white light, colours, and pigments, investigating the transmission of light through different colour filters.

Learning Objectives:

- *Investigate the refracting properties of light through different media.*
- *Describe various natural phenomena around us that occur as a result of refraction.*
- *Construct ray diagrams to illustrate the characteristics of images formed by convex and concave lenses.*
- *Differentiate between spectral colours and pigments.*
- *Illustrate the appearance of coloured objects in white light and in other colours of light.*

Learning Experiences

When the light falls on a medium with different densities, a portion of the light is reflected, some of it passes through the medium, while the rest of it is absorbed by the medium. The light rays passing through the media change their path and are called refracted rays. Refraction of light is the phenomenon in which the direction of the ray of light changes when it travels from one medium to another medium with different densities. Refraction occurs at the boundary of two different media due to the change in the speed of light. How does light behave in different media?

The learner watches the following video to understand the refractive property of light in different media: https://rb.gy/6lyygd.

After watching the video, the learner in the team designs an experiment to investigate the refraction of light through a prism.

The learner then answers the following question:

1. Why does light refract?
2. Why does the speed of light change in different media?
3. How does a light ray change its path from a rarer to a denser medium, and from a denser to a rarer medium? Support your answer with ray diagrams.

The learners watch the following two videos to understand how lenses work and the rules for the construction of ray diagrams by a lens: https://rb.gy/dlimwq and https://rb.gy/3vm5vk.

After watching the video, the learner uses the rules for the construction of a ray diagram by a lens to draw the formation of an image by convex and concave lens when the objects are at the following positions:

a. Object at infinity
b. An object beyond $2F_1$
c. The object between $2F_1$ and F_1

The learner answers the following questions:

1. What difference do you see between the images formed by a convex lens and the concave lens?
2. Is it possible to get a virtual image using a convex lens? Explain with a diagram.
3. Explore the application of lenses in daily life.
4. Explore some examples of natural phenomena that take place as a result of refraction.

The learner then watches the video on how objects would appear in different coloured lights https://rb.gy/rw4eta and designs an experiment to further investigate the effects of different coloured lights on objects.

The learner then answers the following questions:

1. Why does a red rose appear black under green light?
2. Why does a banana look yellow?
3. Differentiate between colours and pigments.

Learners in the team design a toy by using the knowledge of light and colour. Display and explain to the class.

For a person to see any object, light reflected by the object must enter the eye of the viewer. When light falls on opaque objects, they reflect a certain portion of incident light and absorb the rest. The colour of the object depends on the colours of the light reflected by the objects.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the conceptual understanding of the learner on the refractive property of light in different media and how objects appear in different colours.	• Assess the learner based on the learner's ability to investigate the refraction of light through a prism, design experiments to investigate the effects of coloured lights on objects and draw ray diagrams for the formation of images by a lens.	• Assess the learner's ability to explain the application of lenses in daily life and follow the rules in drawing ray diagrams.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Why does refraction occur: https://rb.gy/6lyygd
5. Lenses: https://rb.gy/dlimwq
6. Rules for constructing ray diagrams: https://rb.gy/3vm5vk
7. Colours of objects in different coloured lights: https://rb.gy/rw4eta

3.4.2 Sound

Scope: This topic includes sound wave, loudness and amplitude, frequency and pitch of the sound, factors affecting speed of sound - (nature of medium, elastic properties and densities, temperature, wind), investigate variation in sound produced by different tuning forks.

Learning Objectives:

- *Explore the concepts of the sound wave, loudness of sound, amplitude, frequency and pitch.*
- *Explain the factors affecting the speed of sound.*
- *Formulate the relationship between the loudness of the sound and the amplitude.*
- *Investigate the relationship between the pitch of the sound and the frequency using tuning forks.*

Learning Experiences

Sound from a source is characterised by loudness, pitch and timbre. Sounds from different sources can be distinguished from each other by those characteristics. The properties of each sound wave are described by its wavelength, frequency and amplitude.

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The learner watches the video from the web link https://rb.gy/32rls8 to understand the concept of wavelength, frequency, pitch, loudness and amplitude of the sound.

The learner in a team designs an experiment to investigate how the intensity of pitch, loudness and frequency of sound can be increased or decreased and describe the experimental process.

The learner designs and carries out an experiment to investigate different factors that affect the speed of sound by exploring information from relevant sources.

The learner then writes how different factors affect the speed of sound in our daily life. As a follow-up, the learner answers the following questions:

1. What is the relationship between amplitude and loudness of sound?
2. What differences will you hear in a sound if there is an increase in
    a. Amplitude
    b. frequency

The learner in the team designs an experiment to investigate the relation between pitch and frequency using tuning forks or other materials, and answers the question.

1. What relation do you notice between pitch and frequency?
2. Can we have high-pitched sounds with low frequency? Explain.

The learner in teams then designs a musical instrument by using locally available resources. The learner displays and demonstrates the instrument made.

Sound waves are generated by any vibrating body. Vibrations can be represented in the form of waves. The type and properties of the waves depend on the vibrations that produce them.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's ability to explain the concept of wavelength, frequency, pitch, loudness and amplitude, and factors affecting the speed of sound.	• Assess the learner based on investigating the relationship between pitch and frequency.	• Assess the learner's ability to explain the importance of pitch, timbre and amplitude in bringing about pleasure in life through music.

For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC
4. Sound: https://rb.gy/32rls8

Challenge Your Thinking

1. How do wavelength and frequency affect the pitch of sound?
2. How is the refraction of light and seeing related?
3. Explain the effects of the refraction of light.
4. If sound travels faster in solids than in liquids, can liquids be frozen to make sound travel faster? Justify your answer.
5. Why is the speed of sound in the air faster in summer than in winter?
6. Design an experiment to demonstrate the refraction of light in a bottle of water.

3.5. The Earth and Beyond

Our solar system was formed around 4.6 billion years ago from a massive cloud of hydrogen gas and a huge swirling cloud of dust left over as per the Big Bang theory. The solar system comprises the Sun, comets, meteors, asteroids, satellites, and eight planets. The heavenly bodies that round around the Sun, and do not have the light of their own. They have the ability to reflect the light of the Sun that falls on them. Similar to the Earth, all the heavenly bodies move around the Sun in different orbits and rotate on their own axis.

Competencies:

Investigate sources of light in the solar system and natural forces of planetary motion to understand why the heavenly bodies revolve and are stationed on their respective orbits.

3.5.1 The Planetary Motion

Scope: This topic discusses the visibility of heavenly objects, luminous and non-luminous objects, and the natural forces in planetary motion:

- gravity
- centripetal force
- centrifugal force
- inertia

Learning Objectives:

- *Explain luminous and non-luminous objects.*
- *Explore different sources of light in the universe and their uses.*
- *Investigate the natural forces involved in planetary motion.*
- *Analyse the significance of natural forces in maintaining the solar system in position by which the Earth can sustain all forms of life.*

Learning Experiences

The Sun and stars emit a large amount of light and the Moon reflects the sunlight. All the planets and other non-luminous heavenly bodies are visible to us with different brightness. The lighter object orbits the heavier one, similarly, the Moon and satellites scientists launch being lighter than the Earth orbits the Earth. Do you know what body orbits around the other body? Or have you ever realised, why the Earth orbits the Sun? This was first explained by a German Scientist known as Johannes Kepler who derived the first law of planetary motion that explains the planetary motion of the Earth.

The learner explores the information from the web link https://bit.ly/31n1RZp to understand luminous and non-luminous objects and writes what are luminous and non-luminous objects with examples.

Then, the learner watches the video from the web link https://bit.ly/3HS1HZL and https://bit.ly/3qKiLdc to understand the existence of natural forces (centripetal and centrifugal force) involved in planetary motion.

The learner designs an experiment to investigate centripetal and centrifugal forces and demonstrates it to the class. Describe the process of the experiment and precautions needed to be considered.

After watching the video, the learner designs an experiment to investigate forces in a circular motion. The learner answers the following questions:

1. Explain the planetary motion and its significance.
2. Explain the existence of natural force involved in planetary motion?
3. Explain luminous and non-luminous objects with examples.

Learners explore the significance of natural forces in maintaining the solar system in position by which the Earth can sustain all forms of life.

Kepler's laws of planetary motion govern the orbits of planets around the Sun. At first, Kepler expected the planets to move around the Sun in perfect circles. After years of observation, he found that this was not true. Kepler's first law of planetary motion states that the path of each planet around the Sun is an ellipse with the Sun at one focus. Kepler also found that the planets do not move around the Sun at a uniform speed, but move faster when they are closer to the Sun and slower when they are farther away.

Assessment and Reporting

The teacher may use rubrics, checklists or any other assessment tools to assess the learner in the following three domains.

Scientific knowledge	Working scientifically	Scientific values and attitudes
• Assess the learner's understanding of luminous, non-luminous objects, centripetal force and centrifugal force in relation to planetary motion.	• Assess the learner's ability to plan and investigate the forces in a circular motion.	• Assess the learner's understanding of the importance of planetary motion on the lives of people.

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For recording and reporting, refer to the National School Curriculum Framework in Science.

Resources:

1. National School Curriculum Framework for Science
2. REC repository
3. Science Class Eight (2020), REC.
4. Luminous and non-luminous objects: https://bit.ly/31n1RZp
5. Centripetal and centrifugal force: https://www.youtube.com/watch?v
6. Kepler's Laws of Planetary Motion: https://bit.ly/3HS1HZL

Challenge Your Thinking

1. What affects the gravitational pull of heavenly bodies?
2. Why do you think planets do not collapse into the Sun?
3. What are the factors on which the visibility of heavenly objects from the Earth depends?
4. Why do you think the planets move around the Sun and the moon moves around the Earth?
5. Galaxies look stationary, so why do scientists say that they rotate?
6. Hot red iron is a luminous object whereas a tree is a non-luminous object. Justify
7. Explain two conditions that enable us to see the objects. Provide some examples from the solar system.
8. Does the influence of gravity extend out forever?
9. Why is gravity the strongest force?
10. When a boy rotates a stone tied to a string by swirling the string, what force does his hand exert on the string?

Appendices I: Assessment

Assessment

Assessment in science involves testing of scientific knowledge, skills, values and attitudes. The assessment should be able to diagnose the learning progress or gap of the learner in terms of expected core competencies and learning outcomes. Consequently, it is imperative to use appropriate assessment techniques and tools to provide relevant feedback to the learners and to assess the impact of teaching-learning processes. Holistic assessment entails assessing all three domains of learning: cognitive, psychomotor and affective. Thus, the assessment practice in science assesses the Scientific Knowledge (SK), Working Scientifically (WS), and Scientific Values and Attitudes (SV) of the learners.

The purpose of Assessment

Assessment is used to

i. inform and guide the teaching and learning process.
ii. gauge the efficacy of the teaching and learning process.
iii. assess the relevance of curriculum materials.
iv. help learners set learning goals.
v. monitor learners' progress in achieving learning outcomes.
vi. generate reports on learners' performance.

Areas of Assessment

The assessment in science focuses on the three domains of learning reflected as scientific knowledge (cognitive), working scientifically (psychomotor) and scientific values and attitudes (affective) as detailed below:

i. **Scientific Knowledge (SK):** The learner meets the requirements reflected in the learning objectives and expected learning outcomes under each unit, chapter, and topic. The learner is able to provide expected scientific information through various ways such as presentation, questioning, test, concept mapping, journals/scrapbook, projects, etc.
ii. **Working Scientifically (WS):** The learner demonstrates scientific skills such as observing, predicting, inquiring, questioning, investigating, experimenting, measuring, classifying, recording, analysing, inferring, communicating, etc. and explain how science works.
iii. **Scientific Values and Attitudes (SV):** The learner exhibits interest, curiosity, intellectual drive, creativity, exploring possibilities, inquisitiveness, finding facts, coherent presentation of ideas, reasoning skills, collaborative skills, respect and concern for all, etc.

Benchmarking Learning Achievements

Learning achievements are measured through benchmarks based on measurable standards against the subject learning competencies or outcomes and goals. Benchmark assessment is a technique used worldwide to evaluate learners' competency and performance in a specified area of study. Using this method, teachers identify individual learner behaviours and learning styles and implement the best guidance, learning techniques, and teaching styles to accommodate the learners' needs. It allows educators

to identify learners' strengths and weaknesses, which can then inform future instruction. The benchmarking informs teachers on how best to interact with and help in their assigned groups.

Performance levels of learners are graded by using an "Absolute grading" grade based on the predetermined cut-off levels. Each point value is assigned a letter grade. It is based on a fixed percentage scale that may be constraining for learners who all receive a high grade or a low grade. For instance, an absolute grading system assigns an "A" for marks 90-100, a "B" for marks 80-89, and so on.

In the current Continuous Formative Assessment (CFA) for classes PP - 3, the competencies of learners are benchmarked in Five Levels, namely Beginning, Approaching, Meeting, Advancing and Exceeding as means of grading learners. These levels correspond to five groups of scores from 0-19, 20-39, 40-59, 60-79 and 80-100. These groups of scores are assigned letter grades of A to E and numerical score points of 0-4. For alignment to the international benchmarking and equivalency, the learner pass mark and grading system, and the number of instructional hours along with other factors is used to calculate the Grade Point Average (GPA).

The learner pass mark and grading system is as provided in the Table given below.

Learner Competencies

Competency Level	Percentage Score (Range)	Grade	Score Points (GPA)	Description of the competency achievement level
Exceeding	**80 -100**	**A**	**4**	The learner has extensive knowledge and understanding of the content and can readily apply this knowledge at any given time. In addition, the learner has achieved a very high level of competency in the processes and skills and can apply them in new situations. The learner has achieved a high level of critical thinking, and creativity, and is able to communicate and collaborate effectively in all situations. Further, the learner is culturally and spiritually sensitive and responsive through one's behaviour and conduct in society.
Advancing	**60 - 79**	**B**	**3**	The learner has a thorough knowledge and understanding of the content and a relatively high level of competency in the processes and skills. In addition, the learner is able to apply this knowledge and these skills in most situations. The learner displays critical thinking, and creativity, and communicates and collaborates appropriately in almost all situations.

				Further, the learner is socially sensitive to one's behaviour and conduct in society.
Meeting	**40 - 59**	**C**	**2**	The learner possesses foundational and functional knowledge and understanding of the main areas of academic content with an adequate level of competency in the processes and skills. The learner possesses a certain degree of critical thinking, and creativity, and is able to communicate and collaborate in most situations. Further, the learner is sensitive to one's behaviour and conduct in the society.
Approaching	**20 - 39**	**D**	**1**	The learner possesses basic knowledge and understanding of the academic content and has achieved a limited level of competency in the processes and skills. The learner is able to collaborate with close friends and has limited communication skills. Further, the learner has limited awareness of one's behaviour and conduct in the classroom.
Beginning	**0 - 19**	**E**	**0**	The learner possesses limited basic knowledge and understanding in a few areas of the content; has achieved very limited competency in most of the processes and skills. The learner possesses limited communication and collaboration skills. Further, the learner is aware of oneself with limited sensitivity to others.

Assessment Modalities

The assessment focuses on diagnosing the learning gap through Continuous Formative Assessment (CFA), Continuous Summative Assessment (CSA) and Summative Assessment (SA) using appropriate assessment tools. At the end of each quarter, the teacher consolidates the continuous summative assessment records maintained using different assessment modalities (assignment, class activities, test, project work, scrapbook/journal), and records the cumulative marks of the learners as given in the assessment matrix.

Specifically, the assessment is carried out in the following ways:

i. **Assignment:** It includes extended learning activities such as homework, model making, preparing materials for presentation etc. which encourages independent learning and responsibility to complete the task. The task is assigned only to topics that require extra time and energy. It is assessed using appropriate assessment tools such as rubrics, rating scales, and checklists.

ii. **Class Activities:** It is a hands-on experience given to the learner to test, develop, and apply scientific theories. It includes learning activities such as group discussions, experiments, presentations, individual work etc. which are carried out during class hours. It enhances deeper understanding of scientific ideas which culminates in the development of scientific skills, temper and positive attitudes, and values. It can be assessed using appropriate assessment tools.

iii. **Journal:** A journal is an informal written record of personal thoughts, experiences, and observations. The learners are free to express their ideas related to science and the entries can be simple and short, written or sketched based on their observations. Therefore, the science journal probes learners to document their observations about the scientific concepts, events and phenomena that they observe and experience in their daily lives.

This activity is carried out throughout the academic session with a total of 8 entries, which is assessed quarterly. An exercise book is maintained by each learner to make the journal entries. The journal may be carried forward to the next level to track the learner's progress. While maintaining a journal, learners are expected to include the cover page, table of content (serial number, content, page number, score) and entries (date, topic, scientific explanation and reflection). Teachers must assess and provide feedback and follow up on it.

The teacher may design their own rubrics or use the sample rubrics provided to assess the journal.

Sample Rubrics

Domains	Key Areas	Performance rating				
		Exceeding (5)	Advancing (4)	Meeting (3)	Approaching (2)	Beginning (1)

SK	**Knowledge of concepts**	Contains relevant and accurate information and demonstrates clear and sequential conceptual understanding.	Contains relevant information that is accurate and demonstrates conceptual understanding.	Contains minimum relevant information with fair conceptual understanding.	Contains less information without conceptual understanding.	The information contained is irrelevant.
WS	**Scientific process**	Exhibits specific evidence of questions, predictions and results supported with appropriate illustrations and pictures.	Exhibits evidence of questions, predictions and results supported with appropriate illustrations and pictures.	Exhibits and demonstrates evidence of only questions or predictions and the results are supported with illustrations or pictures.	Exhibits ideas with illustrations and pictures.	Not able to exhibit the ideas and concepts with illustrations and pictures.
SK	**Scientific language**	Uses appropriate scientific language, conceptual and mathematical information, throughout the journal to communicate ideas and personal expression.	Uses scientific language, and conceptual and mathematical information to communicate ideas and personal expression.	Uses scientific language, either conceptual or mathematical information to communicate ideas and personal expression.	The scientific language used is not clear and coherent.	Scientific language is not used.
SV	**Neatness and organisation**	Contains original, creative ideas and diverse entries that are legible with title and date.	Contains creative ideas and diverse entries that are legible with titles and dates.	Contains diverse entries that are legible with title and dates.	Contains some entries that are legible with or without title and date.	Entries are not legible, and dates and title are missing.
SV	**Reflection**	Demonstrates a full understanding of scientific concepts that are insightful with relevant connections to personal life and the wider world.	Demonstrates some understanding of scientific concepts with relevant connections to personal life and the wider world.	Demonstrates fair understanding of scientific concepts and relates to personal life and the wider world.	Demonstrates fair understanding of scientific concepts and lacks connection with real life.	Does not demonstrate an understanding of scientific concepts and connect with real life.

iv. **Project work:** It is an opportunity for the learner to learn and explore the basics of science through the scientific process of observation, investigation, analysis, and synthesis to generate scientific

knowledge and understanding. The learner chooses one topic based on their interest in the beginning of the academic session which has to be completed in one academic session with quarterly assessment. It is mandatory to assess both the process and product of the project work.

The process for the project work write-up must include the scientific process of **observation, questioning, hypothesis, background information, design, data collection, analysis, conclusion and sharing.**

The product of the project work must be inclusive of write-ups, illustrations, models or collections of real objects.

The teacher may design their own rubrics or use the sample rubrics provided to assess the project work.

Domains	Key Areas	Performance Rating				
		Exceeding	**Advancing**	**Meeting**	**Approaching**	**Beginning**
SV	**Observe**	Phenomena observed are systematic, objective and verifiable.	The Phenomenon observed is systematic, objective but not verifiable.	The phenomena observed are objective but not systematic and not verifiable.	Phenomena observed are subjective and not verifiable.	Phenomena observed are not reflected at all
SV	**Question**	Clearly stated, focused, and relates to variables	Loosely stated, focused, and relates to variables	Loosely stated and relates to variables	Loosely stated and does not relate to variables	No question or not explorable
SK	**Hypothesize**	Feature variables and predict the relationship between variables with explanation	Predict the relationship between variables with explanation	Feature the variables are explained	Variables are not explained	Makes no sense
WS	**Design**	Procedure is detailed and sequential.	The procedure is not detailed and sequential.	Lack of detailed and sequential procedure	Procedure mentioned is insufficient	Procedure is not shown
	Collect data	Appropriate method, relevant and sufficient data	Appropriate method, relevant but not sufficient data	Inappropriate method, sufficient but irrelevant data	Inappropriate method, insufficient and irrelevant data	Data is not recorded at all

	Analyse	Appropriate mathematical procedures or appropriate charts with clear interpretation	Appropriate mathematical procedures or appropriate charts but no clarity in interpretation	Inappropriate mathematical procedures or charts but no clarity in interpretation	Inappropriate mathematical procedures or charts and unclear no interpretation	Analysis is not clear and insufficient
	Conclude	Restate the hypothesis, support or refute it, and explain the role of the test in making the decision.	Restate the hypothesis, supports or refute it,	Supports or refute the hypothesis	Restate the hypothesis	No conclusion is drawn
	Share	Focus on communicating the central idea, using evidence in the logical format	Focus on communicating the central idea with evidence	Focus on the central idea with some evidence	Focus on a central idea without any evidence	No focus on central idea

v. **Test and Examination:** It is a procedure intended to establish the quality, performance, or reliability of a learner's learning. It is used to test the conceptual understanding and competencies of learners in subject matters. Tests are generally administered at the end of every chapter while the examinations are conducted at the end of each term.

Appendices II: Assessment Tools

Assessment Tool

It is important to use appropriate assessment criteria and tools to obtain the right information on the progress of the learners. This is because the quality of information acquired through assessment is determined by the tools and descriptors chosen for assessment. The assessment tools and samples are given below:

i. **Checklist:** It offers a 'yes' or 'no' format in relation to the achievement of specific criteria by a learner. It can be used for recording observations of an individual, a group, or the whole class.

		Criteria										**Teacher's Feedback**
	Domains	**SV**	**SK**	**SK**	**WS**	**WS**	**WS**	**SV**	**SV**	**SK**	**WS**	

Sl. no.	Key Areas Name	Required materials are taken	Relevant information is read prior to the field trip	Knowth e expected learning outcome	Ask relevant questions	Record the information	Demonstrate observation skills	Respect others views	Ensure safety of self, others and environment	Draws proper conclusion	Communicate the ideas	
1	Ram											
2	Dorji											
3	Dechen											

ii. **Rating scale:** It allows teachers to indicate the degree or frequency of the behaviours, skills, and strategies displayed by the learner. It has scale-based criteria to describe the quality or frequency of the work with precise and reliable descriptive words. The teachers can use it to record observations and the learners can use it for self-assessment.

		Performance Rating	Remarks

Domainns	Criteria	Exceeding	Advancing	Meeting	Approaching	Beginning	
WS	Carry out the activity						
	Explore different ways of conducting the experiment						
	Innovate new ideas to carry out the assigned task						
	Follow experimental procedures						
	Interpret the information collected from the experiment						
SK	Provide justification for the findings						
	Deduce conclusion						
WS	Communicate the findings						
SV	Show collaborative skills						

iii. **Anecdotal Record:** It helps to record specific observations of a learner based on behaviour, skills, and attitudes in relation to the expected learning outcome. It provides cumulative information and direction for further instruction. It can be used for ongoing observations.

Anecdotal Records are detailed, narrative descriptions of an incident involving one or several learners. They are focused narrative accounts of a specific event. They are used to document the unique behaviours and skills of a learner or a small group of learners. Anecdotal Records may be written as the behaviour occurs or at a later time and must have the following components:

Anecdotal Record Developmental Domain: …….

Learner's Name: …….. **Learner's Age:** ……..

Time: …… **Observer:** ……

Setting: …….

Anecdotal: …… ……..……..

(Describe exactly what you see and hear; do not summarise behaviour. Use words conveying exactly what a learner said and did. Record what the learner did when playing or solving a problem. Use specific language to describe what the learner said and did including facial expression and tone of voice; avoid interpretations of the learner's behaviour; For example, "He put on a firefighter's hat and said, "Let's save someone!" or "He looked towards the puzzle piece and then looked toward the puzzle. He put the puzzle piece on the puzzle and turned the piece until it fit. He took the puzzle piece out". Avoid using judgmental language).

Interpretation: …… ……..……..

(What specific inferences can you make from this anecdotal record? What does it tell you about this learner's growth and development? The inferences must be directly related to the domain designated in the anecdote and refer to a specific aspect of the domain.)

Implication for Planning: ……..……..……..

(Give a specific activity that you would incorporate into curriculum planning as a result of what you learned about this learner. Be sure the plan is directly related to the area of development described in the anecdote. Be sure the activity is a different activity than the one in the anecdote. Include a brief explanation of why you would create the specific activity.)

Sample

Anecdotal Record Developmental Domain: Cognitive
Learner's Name: Kinley **Date:** 22/8/2020
Learner's Age: 10 **Time:** 2:00 pm
Observer: Mrs Dema

Setting: *Experiment on floating and sinking in the science room.*

Anecdotal: *Kinley entered the science room with a notebook in his hand. He sat next to Dorji near the door. He put his pencil in a bucket of water which was kept on the table. With a smile on his face, he told Dorji, 'Look my pencil did not sink in the water'.*

Interpretation: *Kinley is curious and enjoys exploring new things. He has some ideas on objects that float and sink.*

Implication for Planning: *In the next lesson, Kinley will be provided with enough materials to find out objects that sink and floats. This would deepen his understanding of the concepts of sinking and floating.*

iv. **Rubric:** It presents a set of criteria with a fixed measurement scale and a detailed description of each level of performance. It helps to increase the consistency and reliability of scoring.

a. Presentation

Domain	Key Areas	Criteria					Remarks
		Exceeding	**Advancing**	**Meeting**	**Approaching**	**Beginning**	
SK	**Preparedness**	Demonstrate clear and logical flow of ideas supported by relevant visual aids.	Contains any three components	Contains any two components	Contains any one component	Not ready at all with no confidence	
	Content	Present variety of ideas that are relevant to the topic.	Presents some ideas that are relevant to the topic.	Presents limited ideas that are relevant to the topics.	Could not present the ideas on the topic clearly	Presents ideas that are not relevant to the topic.	
WS	**Presentation skills**	Communicate the ideas attained to the audience using proper gestures and completing within time.	Contains any three components	Contains any two components	Contains any one component	Could not communicate or present at all	
SV	**Collaboration**	Seek suggestions, responds to the queries and shows positive learning attitude.	Contains any three components	Contains any two components	Contains any one component	Could not display any of the stated components	

b. ICT Integration

		Criteria	

Domains	Key Areas	Exceeding	Advancing	Meeting	Approaching	Beginning	Remarks
SK	**Concept**	Demonstrate exceptional understanding of the concept from the video	Demonstrate a clear understanding of the concept from the video	Demonstrate partial understanding of the concept from the video	Demonstrate vague understanding of the concept from the video	Irrelevant to the concept	
WS	**Interpretation**	Identify the message, interprets it clearly in their own words and relates to some principles and processes.	Identify the message and interprets it clearly in their own words	Identify the message and interpret it with limited clarity.	Identify the message but cannot interpret it.	Does not contain the message or interpretation	
WS	**Conclusion**	Draw an appropriate conclusion and communicate it by relating to some principles or processes.	Draw an appropriate conclusion and communicates it with some reasoning.	Draw appropriate conclusions and communicates it.	Draw an appropriate conclusion but cannot explain.	No unsubstantiated conclusion is drawn	
SV	**Values**	Actively participates in the discussion, answers questions and respects others' opinions.	Missing one	Missing two	Tried to display the mentioned components fairly	Missing almost all	

c. Science Fair/Exhibition/Model Making

	Key Areas	Criteria

Domains			Exceeding	Advancing	Meeting	Approaching	Beginning	Remarks
SK	Concept	The ideas are shown						
		The ideas are consistent and relevant						
		The principle has been portrayed well						
	Information	Enough information is provided by the model/display.						
WS	Display and explanation	The model/display illustrates aspects of the principle						
SV		The originality and quality are visible						
WS	Presentation	Communicates the ideas coherently						
SK	Conclusion	Draws clear conclusion						

d. Debate

Domain	Key Areas	Performance Rating					
		Exceeding	Advancing	Meeting	Approaching	Beginning	Remarks
WS	Presentation	Organised, relevant, confident and clear.	One missing	Two missing	Three missing	Not able to present the idea clearly	
WS	Argument	4 or more arguments presented to support proposition	3 arguments presented to support proposition	2 arguments presented to support proposition	1 argument presented to support proposition	No arguments were included	

SK	**Evidence**	Offers 4 evidences based on argument to refute opposing points.	Offers 3 evidences based on argument to refute opposing points.	Offers 2 evidence based on argument to refute opposing points.	Offers 1 evidence based on argument but refutes opposing points.	No evidences to support the points put forward	
SV	**Body language**	Eye contact, intonation, gesture and persuasion were used.	One component is missing	Two component s missing	Three components are missing	No gesture shown during the presentation	

e. Homework

Dom ains	**Criteria**	**Performance Rating**				
		Exceeding	**Advancing**	**Meeting**	**Approaching**	**Beginning**
SV	**Completion**	All of the assigned work is complete	Most of the assigned work is complete	Some of the assigned work is complete	Little or a few of the assigned task is complete	The assigned task is not done at all
SK	**Accuracy**	All of the answers are correct	Most of the answers are correct	Some of the answers are correct	Little or a few of the answers are correct	Not his or her genuine work
WS	**Presentation**	Work is neat, error free and legible with relevant illustrations	One component is missing	Two components are missing	Three components are missing	Missing almost all the required components
WS	**Originality**	Display of original and creative ideas.	Partial display of original and creative ideas.	Little display of original and creative ideas.	Contains creativity but could not communicate	No display of original and creative ideas.
SV	**Submission date**	Submitted on due date	Submitted one day after the due date	Submitted two days after the due date	Submitted three days after the due date	Not submitted at all

Appendices III: Assessment Matrix (Class VII and VIII)

Assessment Matrix for Key Stage III (Class VII and VIII)								
Terms	CFA (In all the lessons for feedback and support)	CA (Scheduled performance level assessment) 40%					SA 60 %	CA + SA
	Technique	Technique	Domain			Total		
			SK	WS	SVA			
Term I	Assignment, Class activity (Practical work, Experiment, etc.) Project work, Journal, test, etc.	Assignment	2	2	2	20	30	50
		Class activity	2	4	3			
		Project work	1	1	1			
		Journal	0.5	1	0.5			
Term II	Assignment, Class activity (Practical work, Experiment, etc.) Project work, Journal, test, etc.	Assignment	2	2	2	20	30	50
		Class activity	2	4	3			
		Project work	1	1	1			
		Journal	0.5	1	0.5			
Grand Total			11	16	13	40	60	100

Note: Scientific Knowledge (SK), Working Scientifically (WS), Scientific Values and Attitude (SVA)

Appendices IV: Disciplinary Core Idea Wise Weighting and Instructional Time for Class VII

Strand	Core Concept	Time Allocation (Mins)	Weighting (%)
Life Science	1. Cells	480	6
	2. Humans as Organism	960	7
	3. Green Plants	520	6

	4. Living Things and their Environment	560	6
Materials and their Properties	1. Classifying Materials	440	7
	2. Materials and Change	200	5
	3. Patterns in Chemistry	400	8
	4. Separating Mixtures	480	6
Physical Process	1. Force and Motion	560	6
	2. Work and Energy	480	6
	3. Electricity and Magnetism	520	7
	4. Light and Sound	560	6
	5. The Earth and beyond	240	4
Total		**6400**	**80**

The actual teaching 6400 minutes or 160 periods of 40 minutes in a period

Appendices V: Disciplinary Core Idea Wise Weighting and Instructional Time for Class VIII

Strand	Core Concept	Time Allocation (Mins)	Weighting (%)
Life Science	1. Cells	320	4

	2. Human as Organism	920	8
	3. Green Plants	720	7
	4. Living Things and their Environment	640	6
Materials and their Properties	1. Classifying Materials	640	9
	2. Materials and Change	240	5
	3. Patterns in Chemistry	400	7
	4. Separating Mixtures	160	5
Physical Process	1. Force and Motion	520	6
	2. Work and Energy	400	5
	3. Electricity and Magnetism	720	7
	4. Light and Sound	640	7
	5. The Earth and beyond	160	4
Total		**6480**	**80**

The actual teaching is 6480 minutes or 162 periods of 40 minutes in a period