Discover and Learn

SCIENCE

First Preparatory - Second Term

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Teacher's Guide

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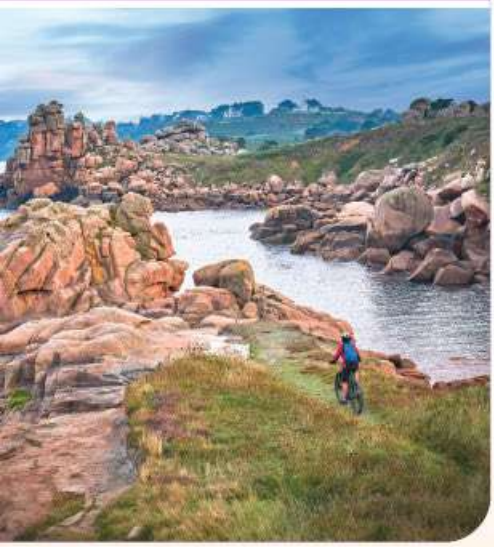


Natural Cycles

Introduction: Teacher's Guide
for the First Preparatory Grade Science Book

Introduction to the Guide

This guide serves as a reference for the preparation, implementation, and evaluation of science lessons for first year preparatory students. It is not a rigid document that teachers must adhere to verbatim; rather, it is a tool to uncover the teacher's potential and professional creativity, allowing them to develop and enrich ideas, whether those presented in the guide or those generated during practical fieldwork, thereby elevating their performance from the stage of teaching to the stage of learning.

Philosophy of the Guide

This guide is based on participation and partnership between the student and the teacher to activate the role of the "student" in all stages and educational situations by applying active learning strategies.

The guide is founded on a set of principles:

- Next Generation Science Standards: These aim to achieve a vision of science and engineering education in students over multiple years in school, where they actively engage in scientific and engineering practices and apply crosscutting concepts to deepen their understanding of core ideas. Learning experiences enable students to engage in essential questions about the world, understanding how scientists seek answers to those questions, and providing them with opportunities to conduct research and scientific and engineering projects related to the central idea.

  - Cross-Cutting Concepts: These are a set of concepts that connect the fields of (physical sciences, life sciences, earth and space sciences, engineering, and technology). They explain all scientific topics, enabling the student to develop a cumulative and coherent understanding. There are seven crosscutting concepts:

- **Structure and Function:** This concept addresses the relation between the structure of an object and how it operates and performs its function.
- **Patterns:** These are the repetition of characteristics in a specific arrangement.
- **Measurement, Proportion, and Quantity:** Recognizing the impact of changes in size, ratio, or quantity on the structure of a system or its performance..
- **Cause and Effect:** This is used to understand how events and phenomena are related to one another. This concept helps explain why things happen (the cause) and what results from that event or action (the effect).
- **Systems and Their Models:** Studying interactions among components within the boundaries of a system. Models provide students with a tool to understand and test ideas, comprehend how a system operates, predict its behavior, and analyze the impact of various changes.
- **Energy and Matter:** Our understanding of the universe relies on understanding how each interacts with and transforms into the other. Tracking the pathways of energy and matter transformations within and outside systems helps in understanding the capabilities of systems and their operational methods.
- **Stability and Change:** This concept addresses the relation between stable states (stability) and dynamic states (change) and how they affect different systems.

- 21st Century Skills: The objectives of education have changed; whereas previously the focus was on acquiring knowledge and information, we now hear about life skills and continuous learning skills, more broadly referred to as 21st century skills that enable learners to adapt to a changing world and prepare them for competition in the job market.

- Inquiry and Scientific Research Skills: Through experimentation and observation, as well as posing questions and seeking explanations, predicting outcomes, and searching for supporting evidence for the information obtained.

- **Application of Science Curriculum Content in Daily Life:** The guide emphasizes the various applications of science and technology in daily life, developing students' technological design capabilities and understanding the interrelationship between science and technology, as well as recognizing the role of each in advancing and enriching the other.

- **Nature of Science:** The guide provides a set of activities and learning resources that help students understand science as a human endeavor and the contributions made by scientists in changing our lives in ways that surpass those of nonscientists.

- **Development of Critical and Creative Thinking:** This is achieved by presenting a range of science activities that provide multiple opportunities to solve problems in new and unconventional ways, and to make the right decisions based on specific scientific criteria.

- **Attention to Information and Communication Technology:** The guide emphasizes that there is no single source of scientific knowledge, such as factory activities, plant life in farms, gardens, books in libraries, museum contents, research centers, and the experiences of community scientists, etc. The guide draws attention to a selected group of distinguished scientific websites on the internet that teachers can direct students to for more information on lesson topics.

- **Integration Between Sciences and Other Subjects:** The guide focuses on achieving integration among all branches of science together, as well as their integration with other academic fields, both scientific and social, to highlight the unity of human knowledge.

- **Active Learning:** A method of learning that helps students engage in group, pair, or individual activities that encourage selfdirected learning, thinking, and researching what they learn... and teaches them how to learn along with many life skills, while also making learning enjoyable.

- **Sustainable Development:** Sustainable development represents a significant shift in the approach to education and is an important step towards an education that encourages critical thinking and positive action in the face of environmental, social, and economic challenges. It enhances awareness of the importance of preserving natural resources and the environment, promotes social and environmental responsibility among students, and enables them to develop the skills and knowledge necessary to build a sustainable and prosperous future for humanity and the planet. Sustainable development is incorporated into curricula through its various dimensions, which are as follows:
  - **Environmental Dimension:** Concerned with preserving the environment and reducing the negative environmental impacts of human activities, and raising awareness of issues such as climate change, pollution, and biodiversity loss.
  - **Economic Dimension:** Includes concepts of green economy and sustainable economic development without sacrificing limited natural resources.
  - **Social Dimension:** Focuses on promoting equality and social justice, and ensuring that the needs of current generations are met without compromising the ability of future generations to meet their own needs.
  - **Cultural Dimension:** Relates to understanding cultural diversity and respecting different cultures, contributing to the building of tolerant and multicultural societies.

- **Entrepreneurial Skills:** The middle school curriculum addresses entrepreneurship in greater depth by incorporating targeted learning outcomes across various subjects, emphasizing that the content of textbooks should present the processes of entrepreneurship step by step. It should utilize realworld projects and facilitate dialogues with young and experienced entrepreneurs, as well as include visits to their project sites through organized school trips. The units should culminate in projects carried out by learners in teams.

- **Environmental/Water Awareness:** Environmental and tourism awareness has been addressed through various fields and centrally, including several targeted learning outcomes related to the environmental role of living organisms, the consequences of ecosystem destruction, and its impact on biodiversity and ecological imbalance.

- **Health Awareness:** By raising health awareness among learners and linking this learning to life behaviors.

How to Use This Guide

- Familiarize yourself with the contents and form a comprehensive idea about it.
- Read the introduction and philosophy of the guide carefully to understand the concept and reasons for its compilation.
- Read the components of the guide and the theoretical framework attentively, considering how to apply the theoretical ideas within the chapter.
- Read the lesson plans and experiment with the ideas contained within them during teaching, while recording observations during implementation; in preparation for modification and development, and noting any new ideas that may contribute to enriching the educational situation.

Components of the Lessons

- **Inquiry Learning Outcomes:** These serve as indicators that clarify what the student should know or be able to do as a result of learning, which is expected to be achieved by the student after completing a lesson, unit, or educational course. Learning outcomes are used to guide the teaching and assessment process and help determine the success of the educational process.

- **Learning Resources:** These are the materials and tools used to support the learning and teaching process. These resources help clarify concepts, enhance understanding, and motivate students to learn. Learning resources can be traditional or modern and vary to suit the different learning styles among students, whether they are tools, models, images, videos, websites, or human resources.

- **Lesson Terminology:** This clarifies the most important new terms for students in the lesson.

- **Misconceptions or Incorrect Concepts:** These are ideas or inaccurate understandings that students have about a particular topic. Such misconceptions may arise from previous experiences, misinterpretation of information, inaccurate teaching, or reliance on everyday and intuitive knowledge that may not be scientifically correct.

- **Diagnostic Assessment:** This is a type of assessment used at the beginning of the educational process or before starting to teach a particular topic, aimed at determining the students' level and understanding their prior skills and knowledge, as well as identifying any misconceptions or learning difficulties they may have. This type of assessment aims to diagnose the educational status of students to plan teaching in a way that meets their needs and provides appropriate support.

- **Lesson Introduction:** This is the preliminary stage or introduction conducted by the teacher at the beginning of the lesson, aimed at capturing students' attention, stimulating their interest, and motivating them to focus on the new topic to be addressed. The lesson introduction plays a vital role in psychologically and mentally preparing students to engage in the learning process and helps connect new content to their previous experiences and knowledge. It serves as an introduction to the lesson's topic that stimulates students' motivation and can take the form of an image, story, game, question, reallife situation, questions about the previous lesson, homework review, etc.

- **Lesson Implementation:** This refers to all activities carried out to achieve the lesson's objectives, whether inside or outside the classroom, and whether performed by the teacher, the student, or both together. Activities are presented in the guide in a coherent manner, with each activity being a natural result of the previous one, serving as a logical introduction to the next activity.

- **Closure of the Lesson:** This involves the actions or statements made by the teacher with the intent to conclude the lesson appropriately, during which the teacher emphasizes the main points of the lesson and reviews what has been inferred and concluded.

- **Evaluation:** Each lesson plan includes a method for assessing the lesson to indicate the extent to which the lesson's objectives have been achieved, not to pass judgment on the students, but to identify strengths to reinforce and weaknesses to overcome. The lesson assessment includes oral and written questions.

Active learning Strategies

Active learning is considered one of the modern teaching strategies, which positions the learner at the center of the educational process, unlike traditional strategies. Active learning activates the processes of teaching and learning, engaging the learner and encouraging them to participate actively in the educational process.
Learning should be an active process in which the student interacts with their environment and thus creates their own knowledge through this interaction. This means that the student engages in an internal process of knowledge creation. A child who learns through experimentation and exploration, and through observation and inference, and who has the opportunity to compare their results with those of their peers and discuss them, is the one who learns in a genuine way. On the other hand, a student who merely repeats what they heard from the teacher or what they memorized from the book is far removed from the spirit of the educational process.

Active learning strategies are based on the following pillars:

- The student's activity and positivity during the educational process.
- The student interacted with the educational material in a positive, planned, and purposeful manner.
- The learner's effort, both mental and manual, to build knowledge in their mind, and to engage their intellect in understanding scientific material, things, phenomena, and solving problems.

One of the active learning strategies that you, dear teacher, can use:

1 – **Cooperative learning:** It is an educational strategy in which students are divided into small, heterogeneous groups to achieve common goals, which are the completion of the required tasks. Each member is responsible for their own learning and for the learning of their peers through their contributions towards accomplishing this task.

- The students in the class are divided into equal groups (4-6) of different levels.
- Explain to the students the educational task required from the group.
- Assign a role to each student in the group.
- Ask each group to present their observations and conclusions to the other groups and discuss them with each other.
- The students discussed what they had reached.
- Correct the students' incorrect answers.

2 – **Numbered Heads Strategy:** It is a cooperative educational strategy that makes each student responsible for learning the material. This strategy ensures that every member knows the answers to the problems or questions posed by the teacher. Since no one knows the number that will be called, all team members must be prepared.

- Divide the students into small groups (4-6).
- Each member takes a certain number, for example (1, 2, 3, 4), and so on. They memorize it instead of their name.
- Ask the students the question.
- Then the students put their heads together to think collectively and agree on the answer.
- Specify a number and ask the students who have that number from each group to present their answers.
- Identify the group that earned the most points in the lesson and assign grades based on the groups.

3 – **Think-Pair-Share Strategy:** It is a cooperative educational strategy where students work together to answer a question about the assigned reading.

- Ask each student to think individually about the answer to each of the five questions.
- Ask each student to discuss their answer with another student.
- Ask the students to share their thoughts with their peers in the classroom.

4 - Use role-playing strategy: It refers to a pattern of practicing reality, where the learner adopts one of the roles present in this real situation and interacts with others within the limits of the relationship between their role and theirs. This method is considered effective in helping learners understand themselves and understand others.

- A number of students chose each to play the role of one.
- Ask each of them to talk about themselves.

5 – Concept maps: They are diagrams that highlight the relationships between concepts, where lower concepts are placed under higher concepts, and connections between concepts are made with words that clarify the relationship. These maps are based on organizing concepts and their relationships in a clear framework and in a hierarchical manner from the most general to the least general, helping students to understand these concepts and recognize the relationships between them.

6 – Learning Cycle Strategy: This method is based on presenting examples and then discussing them with the students, looking for the similarities and differences between them until reaching the general rule.

- **Discovery phase:**
  - Divide the class into groups.
  - Distribute the required tools for the activity.
  - Ask the students to carry out the activity procedures.
  - Ask the students to record the results.
  - Ask the students to extract the common traits.
- **Concept presentation phase:** Explain to the students the correct definition of the concept.
- **Concept application phase:** Give the students a set of correct and incorrect examples of the concept and ask the students to identify which examples belong to the concept.

7 – Discussion Strategy: It is a teaching method modified from the lecture method, relying on dialogue between the teacher and the learner or among learners themselves under the teacher's supervision, aiming to retrieve old information or reach new information, and it relies on questions prepared for this purpose.

- The teacher defines the objectives of the discussion.
- The teacher divides the discussion topic into several elements.
- Ensures the formulation of questions that suit the discussion elements.
- Arranges the questions in a gradual manner from simple to complex.
- Provides learners with the rules of discussion.
- The teacher poses questions to the learners.
- Learners discuss each element separately in light of the posed questions.
- Learners summarize what has been reached while linking concepts and ideas.

8 – Use brainstorming strategy: It is a method used to generate the largest amount of ideas regardless of their type or level to address a topic in an atmosphere of freedom and safety in presenting ideas away from censorship and evaluation.

- **Generating ideas:** Ask the students an open-ended question, request them to mention as many answers as possible, accept all answers as there is no ideal response, and do not neglect or ignore any idea or answer.
- **Filtering and sorting:** Ask the students to gather the answers and reorganize them by eliminating repeated ideas and merging similar ones.
- **Critique and evaluation:** Evaluate the students' answers at the end of the brainstorming session.

9 – **Use the strategy of similarities:** a strategy that focuses on linking unfamiliar concepts to familiar ones. It emphasizes the interconnectedness of cognitive structure and seeks to maintain the impact of learning.

- Present the concept to be learned.
- Provide the appropriate similarity for it.
- Identify the common characteristics between the concept to be learned and the appropriate similarity for it.

It should be noted here that there is no one best method, but there is a more suitable method for a specific teaching situation.

Teaching Strategies for Gifted and Talented Students:

- **The most difficult strategy first:**

It is used to identify outstanding and gifted learners in a regular classroom, and it relies on the teacher allowing learners to attempt to solve some of the more difficult questions or exercises first before they work on the rest of the questions. This is done by the teacher marking those questions or exercises with a distinctive sign. If the learner successfully solves the problem according to the conditions set by the teacher, they receive a grade as if they had completed all the assignments. Thus, the learner enjoys the advantage of saving time and can use the remaining time to choose educational activities they select themselves.

- **Study Guide Strategy:**

It relies on the teacher creating a guide for a study unit that includes the most important concepts in the textbook. Learners who qualify according to the standards set by the teacher will be allowed to spend time away from the classroom to gather relevant information on the unit's topic, while the teacher teaches the rest of the learners from the textbook. The advanced learners in this case will be referred to as "evaluating experts," and they will be tasked with presenting a report on the information they have gathered about the assigned topic to the rest of the class for discussion and timely evaluation.

- **Organizing content into key themes:**

Where information is gathered from different study subjects (Arabic, social studies, sciences, etc.) in a meaningful and integrated manner; where the advanced and gifted learner enjoys these themes.

- **Learning Contracts:**

This strategy relies on an agreement between the teacher and the advanced and gifted learner, which includes the expected outcomes and results that the learner is to achieve after studying a specific unit or topic. The written contract between the two parties specifies the rules governing the work (the tasks that can be completed at home and at school, the number and nature of the resources to be referred to, the time required to complete the task, success criteria, and the schedule for consultation meetings, etc.).

- **Independent Study Method:**

It relies on the teacher determining various study topics in the form of a visual diagram that illustrates the main topics and the subtopics that fall under them; so that the learner can choose the topic that suits their interests, with the teacher guiding the learner to develop an independent work plan. If the learner chooses desk research, the teacher should discuss the main axes of this work with them and follow up at all stages. If it is a laboratory experiment, the teacher should review the experiment in light of laboratory safety elements.

- **Method of Mentoring:**

  It takes several forms and relies on connecting the learner with another person. Some forms of this connection include:

  - **Connection with an Expert:** This involves organizing a connection between an expert in a certain field and a learner interested in that field; the expert follows the learner and continues to educate them, allowing the learner to benefit from their experiences and research to be mentored by them. This method strengthens the relationship between the learner and the expert, thus providing the learner with an opportunity to advance toward a potential career in the future, equipping them with sources of learning, advice, guidance, and a model to emulate.
  - **Connection with a Retiree:** This relies on connecting a talented learner interested in a specific field with a retiree who has worked in the same field and possesses significant experience, such as in law, aerospace engineering, etc. Generally, retirees welcome the opportunity to share their experiences with new generations.
  - **Reading Biographies:** This relies on learners reading the biographies of creative figures and studying their innovative ideas in various fields, which helps motivate them and serves as a model for them to continue their journey toward creative excellence, providing them with tools that drive them toward further success.

Teaching Strategies for Individuals with Disabilities and Slow Learners Integrated into General Education Classes and Schools.

- **Peer Teaching:** This method relies on exchanging experiences among learners by assigning one or some learners to teach and explain to their peers who face difficulties in understanding due to clear individual differences among disabled learners.
- **Task Analysis:** This involves breaking down a task into smaller tasks or steps. This strategy relies on analyzing the educational task or skill to be imparted to the learner into subcomponents or organized sequential steps; the first subtask is identified, followed by the next subtasks until the learner achieves the main skill.
- **Modeling and Simulation:** Modeling is defined as a process that involves learning new responses by observing and imitating a model. It is a strategy based on observing and mimicking a behavior, where the teacher or model teaches the learner to perform a behavior by imitating what they have observed.
- **Individualized Instruction:** This relies on planning an individualized educational plan for the learner with a disability based on the deficiencies they suffer from, aiming to maximize their potential capabilities.
- **Play-Based Approach:** This relies on educational games, whether traditional or electronic.
- **Dramatic Approach:** This relies on acting and theater activities in all their forms, whether theatrical content, creative drama, social issue drama, or puppetry.
- **Environmental Approach:** This relies on planning and implementing diverse educational activities through purposeful outings for the learner to their surrounding environment; to gain educational experiences from their original sources, helping to diversify experiences and resist forgetting for as long as possible.
- **Storytelling Approach:** Using illustrated paper stories or electronic stories.

Special interventions for integrated categories

• Target groups:

The integrated categories include those with one or more of the following disabilities: (visual impaired, hearing impaired, intellectual disability, motor disability, and cerebral palsy), or autism spectrum and slow learning, in addition to those with learning difficulties, as well as those with attention deficit and hyperactivity.

• What the teacher should know to integrate diverse students: characteristics and educational needs:

Categories	Characteristics	Educational needs
Visual impaired (competent and visually impaired students)	• General intelligence level is normal, sensory memory is strong, and there is a motivation to learn. • Deficiency in forming some concepts such as distances and colors, depending on the degree of vision. • Deficiency in employing gestures, signals, and facial expressions. • Deficiency in the development of higher mental processes such as perception and imagination, which depend on the sense of sight. • Deficiency in the nature and extent of experiences acquired, and a deficiency in the ability to interact with the environment, self-control, and the environment, which significantly affects the ability to perceive relationships based on shape, size, and position in space. • Deficiency in the blind person's perception of their environment and its possibilities, which restricts their adaptation to a narrow framework; leading to feelings of insecurity, isolation, and introversion. • Inability to move freely, which marks their life with varying degrees of dependence. • Deficiency in the person's ability to be stimulated and emotionally interact; these processes depend on seeing movement and enjoying observation.	• Training on sensory performances for the blind and closely for the visually impaired. • Instructions for activities and task assignments are done orally. • Describing the images of the tools included in the content orally for the blind and presenting them enlarged for the visually impaired without details. • Converting written texts to audio, writing assignments and texts in Braille, and oral responses for the blind. • Using modern technological applications for the blind such as (screen readers, programs for describing images, programs for following text reading supported by highlighting the targeted words to assist the visually impaired in reading, etc.). • Using technological applications that help the blind recognize objects to enrich their ability to understand the environment, which affects interaction with the environment and its vocabulary. • Providing safety and security factors within the environment to enhance the blind person's ability to move safely within it.
Hearing impaired (hearing impaired students)	• Students in this category face difficulties in oral learning and struggle to connect spoken words with their written symbols. • The hearing impaired perceive visual stimuli and initially assign a general meaning to them, then move on to perceiving details. • Their ability to learn and abstract thinking is not affected if presented through visual language. • Hearing impairment significantly affects visual and spatial processing of sensory stimuli (copying from the board or books, accurately identifying information from images, diagrams, graphs, etc.), depending on the severity of their hearing loss. • Their ability to focus attention on verbal stimuli (audible, written, read) is weakened. • They find it difficult to remember information unless it is presented through visual education.	• Speaking while facing the learner so they can read lips, especially when introducing new terms. • Adding some visual hints to the visual content such as arrows, circles, coloring some words either in the student's book or highlighting them on the board. • Providing visual symbols agreed upon by the teacher and students. • Presenting the visual image for the hearing impaired as a whole and then analyzing it into parts. • Presenting information directly, in sequence, and transitioning from the tangible to the abstract. • Adapting skill concepts by presenting a performance model in front of the students. • Reducing the number of elements presented in the image and avoiding numerous elements that distract attention within visual scenes, ensuring that the educational situation is rich with visual stimuli familiar to the hearing impaired. • Developing the other senses of students with hearing disabilities to perform what the hearing sense (which is lost) should have done, resulting in increased visual abilities and the subsequent enhancement of their capacity to form visual perceptions.

Categories	Characteristics	Educational needs
	• The academic achievement of the hearing-impaired is affected by the degree of their sensory deprivation; this is due to the limited experiences they gain through vision compared to their hearing peers. Cognitive and social development, especially in early childhood, relies on hearing as it interacts with the sounds they hear, allowing them to acquire skills and information that enable communication with those around them. • Students in this category face difficulties in understanding approximately 50% of classroom discussions, which decreases if they are followed visually and closely depending on the severity of the disability. • They suffer from a limited vocabulary and face challenges in expressive language and group discussions due to their restricted verbal dictionary.	• It is important to use images and figures as much as possible to attract the attention of the hearing-impaired when explaining concepts to them. • It is essential to provide a variety of educational activities and games accompanied by reinforcement at every step. • Avoid focusing on verbal, symbolic, and abstract stimuli, as hearing-impaired students find it difficult to perceive these stimuli. • Connect new experiences with the previous experiences of the hearing-impaired to ensure retention and transfer of learning effects, reviewing previously learned information when presenting skill concepts and linking them to new concepts in a life-related manner with simplified examples from the student's environment. • Repetition and emphasis on new terms, providing simple examples of them in multiple ways. • The teacher should select detailed illustrative video clips for the steps of performing the skill. • Provide more time for processing information. • Specify tasks, separate them, break them down and rely on visual input in teaching. • Introduce the vocabulary included in the topic at the beginning of the lesson. • Allow more time for processing the information included in the lesson. • Summarize instructions in specific and simple points. • Condense content without compromising learning outcomes. • It is important to introduce the hearing-impaired student to the topic before starting the discussion, and to have the hearing-impaired student sit close to and face the teacher or peers during the discussion, so they can observe lip movements and facial expressions. • Prepare for presenting activities and specify tasks before starting to practice them, clarifying those tasks through images.
Intellectual Disability	• Students in this category experience a delay in the development of certain functions and processes necessary for school work, such as the ability to remember auditory and visual stimuli, generalization, verbal ability, and understanding some hints and language. • Long-term memory is better than short-term memory; they have difficulty understanding abstract ideas. • They suffer from weak motor and physical abilities due to direct sensory deficiencies that affect movement and perception.	• Analyze tasks, break them down, and focus on sensory activities from easy to difficult. • Provide clear and specific instructions, along with enough time to complete their tasks. • Avoid student failure whenever possible, instead, present them with tasks they can succeed in first to encourage them to continue performing the required tasks and feel successful. • Continuous repetition of new terms. • Review previously taught skills, retrieve and reinforce them, and transfer information from short-term to long-term memory. • Continuous and rapid review to transfer information to long-term memory as it is better retained there than in short-term memory. • Incorrect assessment of a student's abilities leads to their failure when teaching them other skills. • Use visual aids such as short videos and real-life images of the concepts to be learned and practiced by the student. • When assessing or asking questions, allow them to provide answers consisting of a single word or allow them to circle the answer instead of writing it, or ask them to point to the answer instead of expressing it verbally.

Categories	Characteristics	Educational needs
Motor disability and cerebral palsy	• Students are unable to perform the task at hand all at once. • Students experience difficulties in the area of language; sometimes their speech is unclear to the extent that others cannot understand it due to poor control of the tongue, lips, throat, and facial expressions.	• Assign tasks based on their health condition, giving them enough time to complete those tasks. • Integrate the student into group activities that rely on interaction, monitoring the acceptance of peers towards them. • Reduce homework and classwork, providing them with enough time to complete their tasks. • Simplify responses which may be verbal, gestures, hand movements, connections, or using a computer if possible.
Autism spectrum	• Difficulties in the ability to perceive space and move within it, and the inability to adjust their body position when hearing an auditory-visual stimulus. • Difficulty in focusing attention, making it hard for them to process and remember long and complex verbal instructions. • Lack of desire to participate in tasks and activities that do not hold meaning for them. • Sensory reactions and some tactile behaviors such as putting objects in their mouth. • Shows sensory reactions to strong and intense scent stimuli. • They do not understand danger and do not perceive risks inside or outside the home.	• Focus on sensory activities and use pictures in teaching, with illustrated activity schedules for daily activities instead of language or words. The teacher should speak to them in short sentences, emphasizing key words, pronouncing them in a high tone, placing them at the end of the sentence, and explaining the activity before starting it in specific tasks. • They should not be asked to look and listen at the same time due to their inability to process incoming information through sight and hearing simultaneously, and ensure their attention. • Rely on visual learning and use visual aids such as flashcards, short videos, and illustrated timelines to facilitate understanding. • Adopt alternative communication methods such as signs or illustrated schedules to enhance communication with the student. • Stabilize the tools used by the autistic student in terms of shape and color; the shape or color that the student is accustomed to playing with should not be changed. • Provide students with written instructions so they can refer to them during their activities; some students respond better when these instructions are printed in clear font. • Prior knowledge of the content of the upcoming lesson helps alleviate anxiety about new things and begins to absorb information before presenting it to their peers, completing activities that require more time to finish. • Monitor the student closely and identify their reactions to stimuli to readjust the materials used in activities. • Continuously develop awareness of safety and security rules and present them on illustrated cards for the prevention of accidents and risks such as tampering with tools, electrical currents, or sharp objects when using embroidery tools or preparing meals scheduled for study. • When asking the student to complete a project, show them an illustrative example of the completed project so that they can understand what is required of them. • When evaluating or asking for answers to questions, allow them to provide answers consisting of one word, or allow them to circle the answer instead of writing it, or ask them to point to the answer instead of expressing it verbally.

Categories	Characteristics	Educational needs
Attention Deficit and Hyperactivity	• Lack of attention, focus, memory, and difficulty organizing and completing assigned tasks. • Continuous and constant movement, tendency to climb, swing, and be in constant motion. • Some may find it difficult to form friendships with peers, as well as difficulty playing or sharing with others in activities they engage in quietly, and also difficulty in adaptive behavior and life skills.	• Ensuring that instructions and directives are communicated correctly to the student. • Using engaging activities and educational tools to capture attention, breaking down tasks and assignments into less complex units. • Rewarding the student after completing each step correctly, seating them in designated areas, and using appropriate reinforcers to manage their movement within the classroom, along with providing a daily activity plan and repeating it to the student. • Setting a timer to indicate the start and end time of the activity. • Defining the steps of the activity and setting specific goals for it, and allowing rest time after each successful step. • Using specific, short, and simple sentences when giving commands to make them easier to execute. • Allowing extra time to complete the activity, as students with hyperactivity and attention deficits require more time than their typically developing peers to accomplish the required tasks.
Learning Difficulties	• Students with learning difficulties suffer from difficulties in attention, concentration, memory, and concept formation, as well as verbal and visual perception and short-term memory. They also experience difficulty in understanding spoken language, linking vocabulary to behavior, distinguishing between similar words, following oral instructions, selecting expressive vocabulary, and remembering it. • They are characterized by continuous movement, rapid emotional changes or excessive calmness, social isolation, and reluctance to participate in class. • Difficulties in basic academic skills (reading, writing, reading comprehension, written expression, mathematics, and understanding mathematical and geometric concepts). • Difficulty in problem-solving and suggesting appropriate alternatives for solutions. • Impulsiveness and difficulty completing assigned tasks, with attention being distracted when transitioning from one task to another. • Low self-esteem and lack of self-confidence. • Difficulty in thinking, especially abstract thinking and the ability to imagine. • Difficulty generalizing learned experiences and benefiting from them in other similar situations.	• Preparing students before starting the activity, with providing incentives during and after performing the activity. • Avoiding student failure; presenting them with tasks they can succeed in first, so they continue performing the required tasks and feel successful. • Shortening sentence length, using more common words, changing tone of voice, as well as using a computer to encourage them to write on it. • Considering spaces between words and correcting spelling mistakes. • Breaking down new tasks, linking them to what has been previously learned, and moving from general to specific, and from concrete to abstract. • Activating strategies for memory development such as (linking, repetition, grouping, keywords, storytelling, note-taking). • Activating strategies to reduce impulsivity, assigning students activities that rely on following ordered steps to complete them, and training them to adhere to their role in the classroom. • Not moving to another activity until ensuring the student has completed and understood the previous activity. • Utilizing concept maps, diagrams, and tables to summarize information, and comparing similar concepts to facilitate understanding and recall.

Teaching Support Methods for Inclusive Education in Science

Support Methods	Considerations for Support Methods
Support through Visual and Auditory Media	• Segmenting videos when presenting information to suit students from inclusive categories in terms of their cognitive abilities. • Segmenting accompanying texts for inclusive categories into specific points linked to video viewing. • Supporting texts with illustrative images while ensuring minimal detail in the image. • Supporting both written and auditory texts with brief explanatory phrases. • Adding hints (circle or arrow) on parts of the drawing to indicate the target reference. • Providing illustrative images for the scientific concepts included in the curriculum. • Using illustrations that translate scientific concepts that cannot be easily conveyed to students in the classroom. • Using three-dimensional models when it is difficult for the teacher to provide real experiences. • Using models that express reality as closely as possible. • Ensuring the model is of an appropriate size so it can be clearly seen. • Pairing the presentation of the model with the corresponding video to clarify the difference between the model and the object it represents in terms of detail and size. • Supporting students with visual impairments with models that are easy to perceive or enlarged images without details, ensuring that the blind student can hold the model with both hands. • Using images in comparison lists instead of written words and employing oral comparisons for the blind. • Considering the contrast in colours used in images (shape and background) to facilitate image perception for the visually impaired. • Ensuring the use of educational media for the blind to achieve the desired performance (computer - screen reader software - visual aid software) when assigning learners to draw. • Colours for the blind will be merely information, so efforts should be made to help them benefit from this information in their practical lives.
Group Work	• Providing opportunities for inclusive students to work in groups when implementing projects or activities or practical experiments / drawing tasks, while considering the description of the drawing contents. • Considering the role assigned to inclusive categories within the group to be suitable for their sensory and cognitive abilities. • Ensuring a supportive environment for inclusive categories within each group. • Assisting the blind in performing activities based on connection through working in pairs. • Expecting differences in the responses of inclusive categories regarding the quantity and quality of answers compared to their peers due to variations in their sensory and cognitive abilities, each according to their disability.
Support for Abstract Concepts	• Presenting concepts starting with the tangible and simple, represented by the learner's environment, and reviewing the terms and vocabulary used to ensure their understanding for inclusive categories. • Identifying simple topics that suit the abilities of inclusive categories in students' research. • Considering the repetition of previously learned information for inclusive categories, especially during the preparatory stage at the beginning of the concept presentation, while ensuring their comprehension of the information. • Supporting concepts and terms with segments that include representative performances clarifying the concept. • Using multimedia for concepts that are difficult for inclusive students to perceive due to their absence in their immediate environment. • The abstract concept is presented through specific written phrases, with the importance of utilising educational media. • Obtaining information from non-readable sources (video - audio recordings - images, etc.). • Correcting any misconceptions that students may form from using models and linking the model to the lesson topic to help students understand this relationship. • Using models to form and develop specific perceptions, thus they should contribute to the formation of accurate mental images, so students should have the opportunity to see them clearly. • Ensuring that the visually impaired student successfully forms a mental image of the concept to be learned, while considering that the image is conveyed to the visually impaired in a simple manner without unnecessary details.

Principles of Science Assessment in the Intermediate Stage

- **Assessment in the Intermediate Stage is based on Learning Outcomes:**
  The targeted learning outcomes are considered the primary source for assessment tasks, whether formative or summative. Therefore, assessment tasks should vary to reflect the targeted performances outlined in the learning outcomes (e.g., classify, discuss, explain, interpret, plan, organize, relate, conclude, compare, design, etc.).

- **Formative performance assessment is part of a performance evaluation plan to achieve learning outcomes:**
  The main goal of formative assessment tasks is to support the cognitive, skill-based, and emotional growth of learners by providing them with effective feedback and developing plans to enhance their performance to achieve the learning outcome. The teacher ensures that learners understand the assessment results, by discussing these results with them and comparing them to their self-assessments and peer evaluations, as well as discussing performance development plans with them.

Assessment Strategies in the Intermediate Stage

- **Performance-based Assessment:**

  The expected performance criteria for an assessment task are essential to determine the learner's progress in the various abilities and skills included in the learning outcomes. In achievement tests, the answer model provides clear criteria for the expected answers to the questions in terms of accuracy and detail. Similarly, in any other assessment task such as research, presentations, debates, analysis of viewpoints, and other assessment tasks, the assessment task must be accompanied by criteria to evaluate the expected performance and the grades assigned to each performance criterion.

- **Non-graded Assessment:**

  The main goal of giving learners non-graded assessment tasks is to provide them with the opportunity to demonstrate what they have learned and identify weaknesses in their performance without fear of the grade awarded that contributes to their evaluation in the semester. Non-graded assessment tasks follow the same principles of assessment, focusing on learning outcomes and reflecting the knowledge, skills, and values targeted by the learning outcome. The assessment task is given to learners along with a specific description of the expected performance criteria for that task, a grading scale assigned to each performance criterion, and a model of the expected performance for learners to emulate.

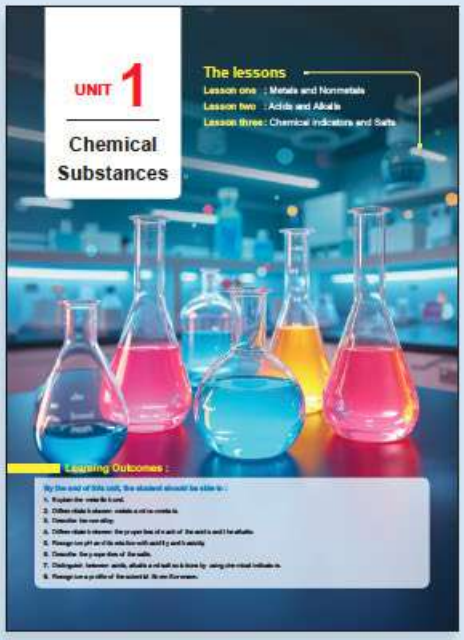
- **Self-Assessment:**

  The self-assessment strategy aims to support skills such as thinking, self-monitoring, self-direction, and self-reporting on progress in the learning process, in addition to supporting the development of values such as integrity, objectivity, and the desire to improve and enhance performance. To effectively implement the self-assessment strategy, the teacher should focus on describing the expected performance criteria for learners on assessment tasks, explaining those criteria to learners before they undertake the assessment task, and encouraging them to use these criteria to evaluate their own performance and then compare their self-assessment with the teacher's evaluations, discussing the reasons for any discrepancies in the assessment results. The self-assessment strategy helps develop important values in the learner, such as objectivity, neutrality, and integrity, alongside enhancing their abilities to understand the expected performances, the knowledge and skills required, and their ability to monitor their performance's development towards what is expected of them.

- **Peer Assessment:**

  The peer assessment strategy is used to train learners in performance evaluation skills based on specific criteria, involving a variety of activities in which learners provide feedback to their peers on their performance for a specific task based on performance criteria. To avoid favoritism and bias among learners in evaluating each other's performances, peer assessment tasks can be planned without revealing the name of the learner being assessed; this is because the primary goal of this strategy is for learners to practice performance evaluation using the expected performance criteria and grading scale. Outstanding learners can be utilized to provide feedback to their peers using clear and simple performance criteria.

Unit One:
Chemical Substances



Introduction to the Unit

Chemical substances are the basis of many processes that shape our world and they are classified into various categories based on their properties and composition. In this unit, we will learn about the classification of chemical substances into metals and nonmetals and explore the main differences between them in terms of physical and chemical properties.
We will also delve into the world of acids and alkalis to understand their nature, uses and impact on our daily lives.

In addition, we will highlight salts as compounds produced from the reaction of acids with alkalis, focusing on their importance and vital role in industry and agriculture. Through this unit, you will gain a deeper understanding of how chemical substances interact with each other and their effects on the environment around us, opening new avenues for understanding and applying chemistry in your daily life.

Learning Outcomes

1. Explain the metallic bond.
2. Differentiate between metals and nonmetals.
3. Describe the bronze alloy.
4. Differentiate between the properties of each of the acids and the alkalis.
5. Recognize pH and its relation with acidity and basicity.
6. Describe the properties of salts.
7. Distinguish between acids, alkalis and salt solutions by using chemical indicators.
8. Recognize a profile of the scientist Soren Sorensen.

Unit Lessons and Time period

The unit includes 3 lessons:

Lesson One: Metals and Nonmetals
Two periods

Lesson Two: Acids and Alkalis
Two periods

Lesson Three: Chemical Indicators and Salts
Two periods

Activities and Educational Resources

The unit includes various activities and resources, including:

Activities: Discovery, prediction, conclusion, deduction, process.

Resources: Images, videos, the internet, laboratory tools.

Teaching strategies

There are various active learning strategies, including:

Laboratory Experiments:
A method that provides students with direct sensory practical experience, by employing all senses in learning about the phenomenon being studied.

Cooperative learning:
An educational strategy in which students are divided into small heterogeneous groups to achieve common goals, completing required tasks with each member responsible for their own learning and that of their peers.

Discussion:
An educational approach that relies on dialogue between the teacher and student or among students themselves, under the teacher's supervision, aimed at recalling old information or arriving at new information, based on prepared questions for this purpose.

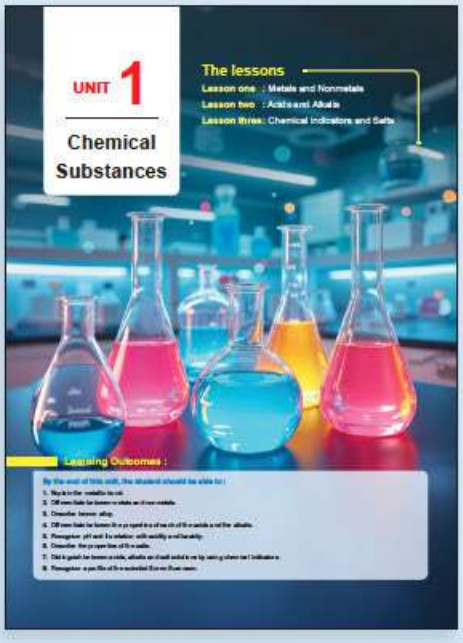
Brainstorming:
A method used to generate the largest number of ideas, regardless of their type or level, to address a topic in an environment characterized by freedom and safety in expressing ideas.

Concept Maps:
These are diagrammatic representations that highlight the relation between concepts, placing lesser concepts under higher ones and linking them with words that clarify the relation between the concepts.

Strategy of Similarities:
This strategy focuses on linking unfamiliar concepts with familiar ones. It emphasises the interconnection of cognitive structures and aims to maintain the impact of learning.

Educational Games:
An organized educational activity governed by rules chosen by the teacher to achieve the objectives of a specific lesson, relying on a spirit of friendly competition among students, either individually or in groups.

Discovery Learning:
The learner takes responsibility for their own education under the guidance of a science teacher, positioning the learner as a discoverer of information, facts and concepts and as someone who acquires skills independently.

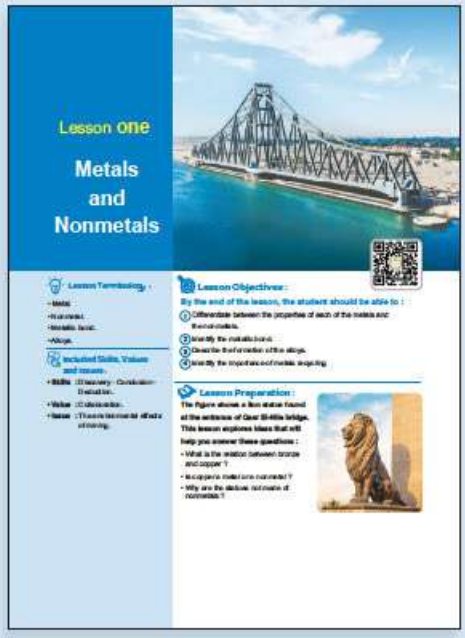


Assessment Methods

There are various assessment methods in the unit, including:

- **Diagnostic Assessment:** Pre-tests.
- **Formative Assessment:** Oral questions – assignments – research activities.
- **Summative Assessment:** End-of unit tests.
- **Self-Assessment:** Evaluate your understanding.

Lesson One:
Metals and Nonmetals



Introduction:

The first lesson of this unit addresses the topic of metals and nonmetals. Chemical elements are the fundamental building blocks of everything around us and they are divided into two main groups: metals and nonmetals. Each of these groups possesses unique properties that distinguish them and determine their uses in our daily lives.

In this lesson, we will know the metals, which are characterized by properties such as luster, strength and the ability to conduct heat and electricity, making them essential in industries and construction.

On the other hand, we will examine nonmetals, which are elements with different characteristics, such as brittleness and nonconductivity of electricity, as well as their vital role in nature and chemical applications.

Through this lesson, students will acquire a set of new concepts and the lesson aims to develop skills in discovery, deduction and inference.

Lesson Objectives:

1. Differentiate between the properties of each of metals and nonmetals.
2. Identify the metallic bond.
3. Describe the formation of alloys.
4. Identify the importance of metals recycling.

Teaching Aids and Learning Resources Used:

Data show – Films – Student book images – Internet – Science lab.

Duration and place of Teaching:

Two periods (4 sessions) – Classroom and multimedia lab – Science lab.

Lesson Terminology:

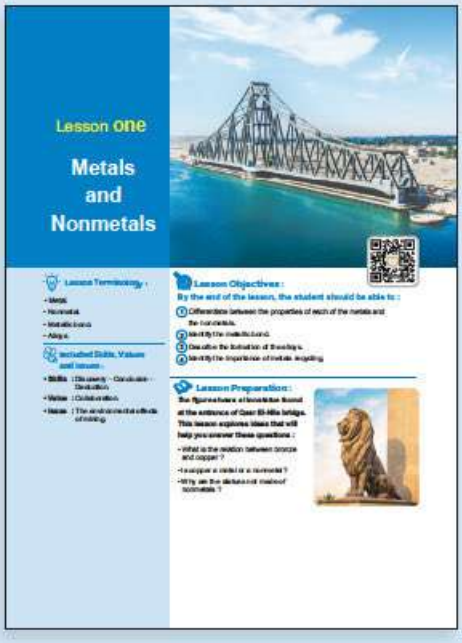
- Metal.
- Nonmetal.
- Metallic Bond.
- Alloys.

Misconceptions or Incorrect Concepts:

- **Some students believe** that all metals are solid, but in reality, there are metals in a liquid state, such as mercury.
- **Some students believe** that all metals are magnetic; however, magnet only attracts some metals only, such as iron, nickel and cobalt, while it does not attract other metals like aluminum and copper.
- **Some students believe** that all metals have similar electrical conductivity, but the degree of conductivity varies from one metal to another. For instance, some metals like silver and copper are excellent conductors of electricity, whereas others are less conductive.
- **Some students believe** that nonmetals do not conduct heat or electricity, but certain nonmetals can conduct electricity under specific conditions, such as carbon in the form of graphite.
- **Some students believe** that alloys are less hard than pure metals; this is not true, as alloys are often stronger and more strength than pure metals. For example, steel (an alloy of iron and carbon) is stronger (more strength) than pure iron.

Diagnostic Assessment:

- **Ask the students** to examine the lesson preparation image and attempt to answer the questions, as these questions as a diagnostic assessment to gauge the students' prior knowledge about the lesson and to uncover any misconceptions they may have.
- **Listen carefully** to the students' answers to these questions and ask them to explain the reasons behind their answers.
- **Clarify to them** that the correct answers to these questions will be revealed through the explanation of this lesson.



Use Diverse Teaching Strategies

You can use K.W.L strategies, discussion, cooperative learning and discovery learning.

- **At the beginning of the lesson**, use the K.W.L strategy (What do you know? – What do you want to know? – What have you learned?).
- **Draw a (K.W.L) table** on the board, reminding the students of this strategy:

What do you know? (K)	What do you want to know? (W)	What have you learned? (L)

- **Before explaining the lesson:** Ask the students to write down the knowledge they already possess about metals and nonmetals in the first column (What do you know?).
- Then, have them write the new information they wish to learn about metals and nonmetals in the second column (What do you want to know ?).
- **After explaining the lesson:** Ask the students to write down the knowledge they have gained about metals and nonmetals in the third column (What have you learned?).

Metals and Nonmetals

Lesson Preparation:

- **Review with the students what has been studied in the first term regarding the properties of metals and nonmetals.**
- **Pose the following questions for review:**

① **How many** electrons does the outermost energy level of most metals end with?

The outermost energy level in their atoms ends with 1, 2 or 3 electrons.

② **How many** electrons does the outermost energy level of most nonmetals end with?

The outermost energy level in their atoms ends with 5, 6 or 7 electrons.

③ **What is the physical state** of metals?

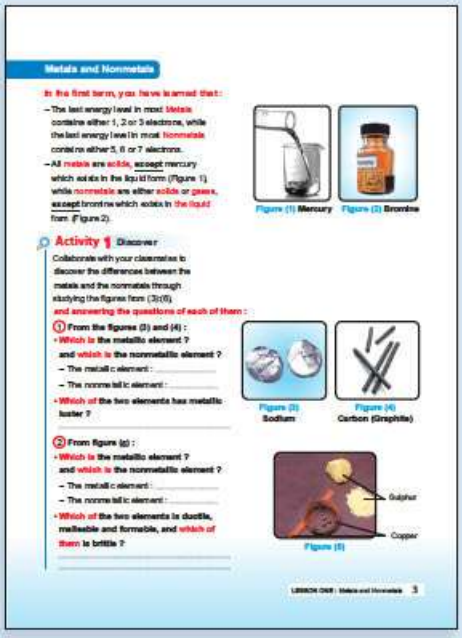
All metals are solids, except mercury, which exists in a liquid state.

④ **What is the physical state** of nonmetals?

Nonmetals exist in both solid and gaseous states, except bromine, which exists in a liquid state.

Activity 1 Discover

- This activity aims to discover the differences between metals and nonmetals.
- **Used tools:** Student book images, electrical circuit, zinc, copper, silver, sulphur, graphite, phosphorus.
- Use cooperative learning strategies and work in groups with confirmation on the principles of cooperative work:
  - * **Divide the students** in the class into equal groups (4-6) with different levels.
  - * **Ask each group** to choose a name for their group.
  - * **Ask each group to** answer questions (1-3) in the student book.
  - * **Assign a role** to each student within the group.
  - * **Ask each group** to present their observations and conclusions to the other groups and discuss them with each other.


Metals and Nonmetals

In the first term, you have learned that:

– The last energy level in most Metals contains either 1, 2 or 3 electrons, while the last energy level in most Nonmetals contains either 5, 6 or 7 electrons.

– All metals are solids, except mercury which exists in the liquid form (Figure 1), while nonmetals are either solids or gases, except bromine which exists in the liquid form (Figure 2).

Figure (1) Mercury Figure (2) Bromine

Activity 1 Discover

Collaborate with your classmates to discover the differences between the metals and the nonmetals through studying the figures from (3)to(6), and answering the questions of each of them :

① From the figures (3) and (4) :

• Which is the metallic element ? and which is the nonmetallic element ?

– The metallic element : .....

– The nonmetallic element : .....

• Which of the two elements has metallic luster ?

Figure (3) Sodium Figure (4) Carbon (Graphite)

② From figure (5) :

• Which is the metallic element ? and which is the nonmetallic element ?

– The metallic element : .....

– The nonmetallic element : .....

• Which of the two elements is ductile, malleable and formable, and which of them is brittle ?

Sulphur Copper

Figure (5)

LESSON ONE : Metals and Nonmetals 3

- * **Discuss** with the students what they have concluded.
- * **Correct** students' wrong answers.

① **Ask the students** to study (Figures 3 and 4) and identify:

- Which of the two elements is metallic ? and which is nonmetallic?
  - – The metallic element: sodium.
  - – The nonmetallic element: carbon (graphite).
- Which of the two elements has metallic luster? Sodium metal.

② **Ask the students** to study (Figure 5) and identify:

- Which of the two elements is metallic and which is nonmetallic?
  - – The metallic element: Copper.
  - – The nonmetallic element: Sulphur.
- **Which of** the two elements is ductile, malleable and formable? Copper **and which** of them is brittle? Sulphur.

③ **Ask the students** to construct an electrical circuit as shown in Figure (6), then connect the two ends (X) and (Y) by using sheets of (zinc, copper, silver) to test their electrical conductivity.

They conduct electricity.

- **Ask the students** to repeat the previous step using pieces of (sulphur, graphite, phosphorus) to test their electrical conductivity.

Sulphur and phosphorus do not conduct electricity, while graphite conducts electricity.

It is concluded from the previous that :

- **Summarize the results of the previous activity for the students:**

– Metals have a metallic luster they are malleable, ductile, formable and good electrical conductors, unlike the brittle nonmetals, which don't have metallic luster (opaque) and tend to be brittle and bad conductors of electricity, except graphite, which is used in dry cells.

– Explain to the students that metals are characterized by their high melting points and their thermal conductivity (conduct heat).

Research Activity

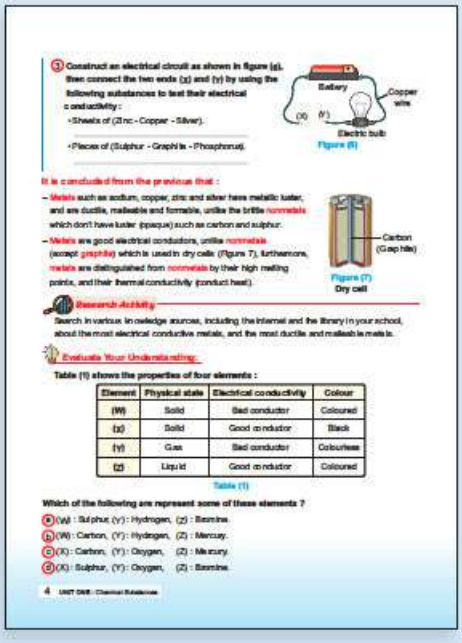
- **Ask the students** to research in various knowledge sources, including the internet and your school library, about the most electrical conductive metals and those most malleable and ductile metals.

The most electrical conductive metal is silver and the most malleable and ductile metal is gold.

Evaluate Your Understanding

- **Ask the students** to observe Table (1) and choose the correct answer.

The correct answer: (c)



③ Construct an electrical circuit as shown in figure (6), then connect the two ends (x) and (y) by using the following substances to test their electrical conductivity :

- Sheets of (Zinc - Copper - Silver).
- Pieces of (Sulphur - Graphite - Phosphorus).

Battery, Copper wire, (X), (Y), Electric bulb

Figure (6)

It is concluded from the previous that :

– Metals such as sodium, copper, zinc and silver have metallic luster, and are ductile, malleable and formable, unlike the brittle nonmetals which don't have luster (opaque) such as carbon and sulphur.

– Metals are good electrical conductors, unlike nonmetals (except graphite) which is used in dry cells (Figure 7), furthermore, metals are distinguished from nonmetals by their high melting points, and their thermal conductivity (conduct heat).

Carbon (Graphite)

Figure (7) Dry cell

Research Activity

Search in various knowledge sources, including the internet and the library in your school, about the most electrical conductive metals, and the most ductile and malleable metals.

Evaluate Your Understanding

Table (1) shows the properties of four elements :

Element	Physical state	Electrical conductivity	Colour
(W)	Solid	Bad conductor	Coloured
(x)	Solid	Good conductor	Black
(Y)	Gas	Bad conductor	Colourless
(Z)	Liquid	Good conductor	Coloured

Table (1)

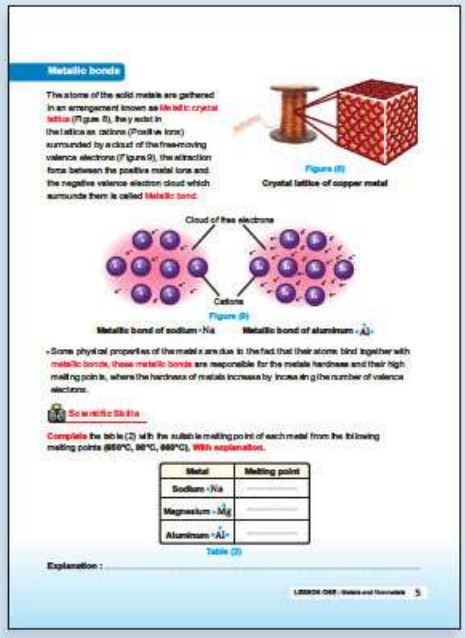
Which of the following are represent some of these elements ?

(a) (W) : Sulphur, (Y) : Hydrogen, (Z) : Bromine.
(b) (W) : Carbon, (Y) : Hydrogen, (Z) : Mercury.
(c) (X) : Carbon, (Y) : Oxygen, (Z) : Mercury.
(d) (X) : Sulphur, (Y) : Oxygen, (Z) : Bromine.

4 UNIT ONE : Chemical Reactions

Metallic Bonds

- **Remind the students that** metals are used in many everyday items such as cars, kitchen utensils, mobile phones and many other uses.
- **Ask the students:** "How do you think the properties of metals are related to their atomic structure?"
- **Mention to the students** that the reason behind these distinctive properties of metals is the presence of a "special bond" between their atoms called metallic bond.
  Today, we will learn about this bond and how it makes metals unique.
- **Explain to the students** that the atoms of solid metals are gathered in an arrangement known as the metallic crystal lattice.
- **Clarify to the students** the concept of the metallic crystal lattice, which is an arrangement of metal atoms in the form of cations surrounded by a cloud of the free-moving valence electrons.
- **Ask the students** to observe (Figure 8) in the student book that illustrates the crystal lattice of copper.
- **Ask the students** to observe (Figure 9), which shows the metallic bond in aluminum, represented by Al^{3+} cations surrounded by a cloud of the free-moving valence electrons of aluminum atoms, as well as the metallic bond in sodium, represented by Na^{+} cations surrounded by a cloud of the free-moving valence electrons of sodium atoms. There is an attraction between the cations and the electron cloud.
- **Explain to the students** that the force of attraction between the positive metal ions and the surrounding negative valence electron cloud is referred to as metallic bond.
- **Ask the students** what the difference between the number of valence electrons in sodium and aluminum metals?
  The number of valence electrons in aluminum is greater than that in sodium.
- **Ask the students** which metal is harder, sodium or aluminum? Aluminum.


Metallic bonds

The atoms of the solid metals are gathered in an arrangement known as Metallic crystal lattice (Figure 8), they exist in the lattice as cations (Positive ions) surrounded by a cloud of the free-moving valence electrons (Figure 9), the attraction force between the positive metal ions and the negative valence electron cloud which surrounds them is called Metallic bond.

Figure (8)
Crystal lattice of copper metal

Cloud of free electrons
Cations
Figure (9)
Metallic bond of sodium - Na Metallic bond of aluminum - Al

- Some physical properties of the metals are due to the fact that their atoms bind together with metallic bonds, these metallic bonds are responsible for the metals hardness and their high melting points, where the hardness of metals increases by increasing the number of valence electrons.

Scientific Skills

Complete the table (2) with the suitable melting point of each metal from the following melting points (650°C, 98°C, 660°C), With explanation.

Metal	Melting point
Sodium - Na	
Magnesium - Mg	
Aluminum - Al	

Table (2)

Explanation :

LESSON ONE : Metals and Thermometer 5

- **Explain to the students** that some physical properties of metals are due to the bonding of their atoms through metallic bonds.
- **Explain to the students** that metallic bond is responsible for the metals hardness and their high melting points.
- **Ask the students** what the relation between the number of valence electrons of a metal and its hardness?
  The hardness of metals increases by increasing the number of valence electrons.

Scientific Skills

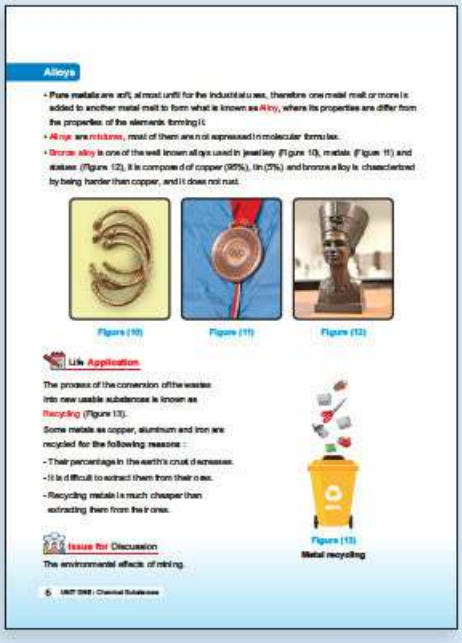
Ask the students to complete Table (2) with the suitable melting points of each metal: (650°C, 98°C and 660°C).

Metal	Melting point
Sodium Na•	98°C
Magnesium •Mg	650°C
Aluminum •Al •	660°C

Explanation: Because as the number of valence electrons in a metal atom increases, the strength of the metallic bond also increases and consequently, the melting point increases.

Alloys

- **Tell the students the following story:** "Once there was an old blacksmith who wanted to make a strong sword that wouldn't break. He tried iron on its own, but it was brittle; then he tried copper, but it was too soft. In the end, he decided to mix the metals together and succeeded in making a strong and durable sword."
- **Ask the students the following question:** Why did mixing the metals help the blacksmith create a better sword?
- **Explain to the students** that when metals are mixed, we obtain new substances called alloys, which are stronger and more useful.
- **Ask the students the following question:** Why do some metal tools not rust while others do?
- **Review examples** of things that are close to their lives, such as kitchen utensils made from stainless steel and coins.
- **Explain to the students** with a simple definition of an alloy: "An alloy is a mixture composed of the melts of two or more metals to improve their properties, such as strength, rust resistance, or appearance."
- **Explain to the students** that pure metals are often unsuitable for industrial uses because they are soft; therefore, one or more metal melts are often added to another metal melt to form alloys, which have properties different from those of the elements forming it.
- **Explain to the students** that alloys are considered mixtures and are not expressed in molecular formulas.
- **Explain to the students** that the most famous alloy is bronze, which consists of copper (95%) and tin (5%).
- **Ask the students** to observe the pictures in their books that illustrate examples of using alloys in our lives, such as in the making of jewellery, medals and statues.
- **Explain to the students that** bronze alloy is characterized by being harder than pure copper and it does not rust.


Alloys

• Pure metals are soft, almost until for the industrial uses, therefore one metal melt or more is added to another metal melt to form what is known as Alloy, where its properties are differ from the properties of the elements forming it.
• Alloys are mixtures, most of them are not expressed in molecular formulas.
• Bronze alloy is one of the well known alloys used in jewellery (Figure 10), medals (Figure 11) and statues (Figure 12), it is composed of copper (95%), tin (5%) and bronze alloy is characterized by being harder than copper, and it does not rust.

Figure (10) Figure (11) Figure (12)

Life Application

The process of the conversion of the wastes into new usable substances is known as Recycling (Figure 13).
Some metals as copper, aluminum and iron are recycled for the following reasons :
- Their percentage in the earth's crust decreases.
- It is difficult to extract them from their ores.
- Recycling metals is much cheaper than extracting them from their ores.

Figure (13)
Metal recycling

Issue for Discussion

The environmental effects of mining.

6 UNIT ONE : Chemical Substances

- **Ask the students** to find three additional examples of alloys used in their homes or daily lives and to write down the benefits of each.

Life Application

- **Ask the students** what they know about the recycling process.
- **Explain to the students** that recycling is the process of converting waste into new substances that can be used instead of disposing of them.
- **Ask the students:** about the reasons for recycling certain metals like copper, aluminum and iron (the decreasing percentage of these metals in the Earth's crust, the difficulty of extracting them from their ores and the lower cost of recycling them compared to producing them from their ores).
- **Ask the students** to find a video that shows the process of recycling aluminum metal.

Issue for Discussion

- **Dear Teacher, discuss with the students the environmental effects of mining. You may refer to the following points:**

1. Soil and water pollution: due to the discharge of chemicals resulting from mining.
2. Destruction of natural habitats: deforestation and alteration of landforms.
3. Emission of harmful gases: such as carbon dioxide during mining operations.
4. Depletion of natural resources: leading to the exhaustion of minerals over time.
5. Damage to biodiversity: due to the destruction of habitats and ecosystems.

Closure of the Lesson:

- A skill in which the teacher summarizes all the main ideas of the lesson, before concluding five minutes early.
- You can engage the students in the closure by asking them about the concepts covered in the lesson.


Alloys

• Pure metals are soft, almost unfit for the industrial uses, therefore one metal melt or more is added to another metal melt to form what is known as Alloy, where its properties are differ from the properties of the elements forming it.
• Alloys are mixtures, most of them are not expressed in molecular formulas.
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- Their percentage in the earth's crust decreases.
- It is difficult to extract them from their ores.
- Recycling metals is much cheaper than extracting them from their ores.

Figure (13)
Metal recycling

Issue for Discussion

The environmental effects of mining.

5 UNIT ONE : Chemical Substances

Answers of Evaluation Questions on Lesson One

1 (1) (c) (2) (b) (3) (c)
(4) (d) (5) (d)

2

	Metals	Nonmetals
Electrical conductivity	Good conductors of electricity	Bad conductors of electricity except for graphite, which is a good conductor
Ductility, malleability and formability	Ductile, malleable and formable	Not ductile, malleable, or formable (brittle)
Metallic luster	Have a metallic luster (shiny)	Do not have metallic luster (opaque)

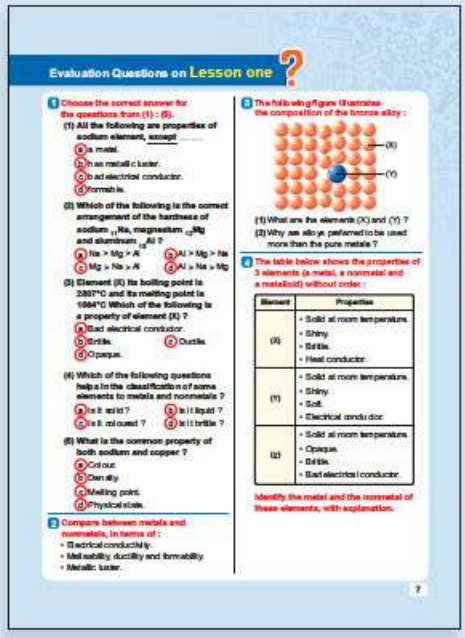
3

(1) Element (X): Copper.
Element (Y): Tin.

(2) Because alloys are harder than pure metals, which tend to be soft and often unfit for industrial uses.

4

- Element (Y): Metal, as its properties are of those of metals.
- Element (Z): Nonmetal, as its properties are of those of nonmetals.


Evaluation Questions on Lesson one

• Additional Learning Resources.

- Utilise digital learning resources such as the Egyptian Knowledge Bank, as well as educational and documented videos and films available on the internet.

Lesson Two: Acids and Alkalis

The topic of acids and alkalis is fundamental in chemistry, as it serves as a starting point for understanding chemical reactions in nature and industry. Through this lesson, students will acquire a range of new concepts and the lesson aims to develop skills in discovery, deduction and inference.

Lesson Objectives:

1. Identify atomic (polyatomic) groups.
2. conclude the molecular formulas of acids and alkalis.
3. Name the molecular formulas of the acids by knowing the names of their anions.
4. Distinguish between acids and alkalis by using two litmus strips.
5. Recognize the differences between acids and alkalis.
6. Recognize the relation between metal and nonmetal oxides and each of acids and alkalis.
7. Compare between the electrical conductivity of each of strong acids and weak acids.
8. Recognize the harmful impacts of the acid rain.

Teaching Aids and Learning Resources Used:

Data show – Films – Student book images – Internet – Science laboratory.

Duration and Place of Teaching:

Two periods (4 sessions) – Classroom and media lab Science laboratory.

Lesson Terminology:

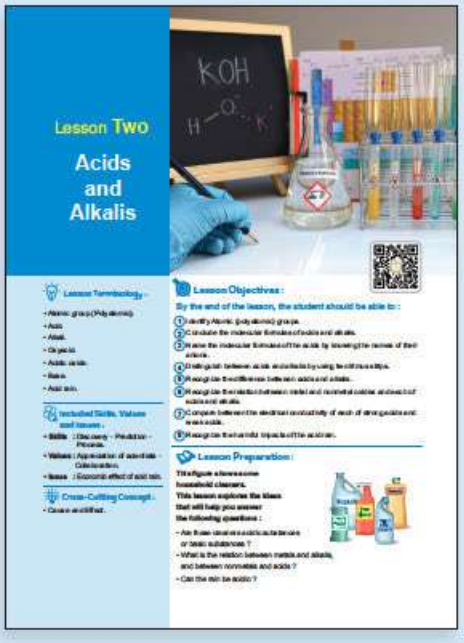
- Atomic group (Polyatomic).
- Acid.
- Alkali.
- Oxyacid.
- Acidic oxide.
- Base.
- Acid rain.

Misconceptions or Incorrect Concepts:

- **Some students believe** that all acids are dangerous and harmful, but the truth is that there are beneficial acids such as stomach acid (which participates in food digestion) and ascorbic acid (Vitamin C) found in fruits.

- **Some students think** that all acids cause burns or serious damage, but in reality, there are weak acids that are safe for consumption, such as citric acid in fruits or lactic acid in milk.
  Strong acids (like sulphuric acid) are commonly found in laboratories and require careful handling.
- **Some students confuse** the chemical concept of acidity and alkalinity with the general concept related to taste or effect on the body.
- **However, the truth** is that both acidity and alkalinity, chemically depend on the concentration of hydrogen ions (H^+) and hydroxide ions (OH^-), not just on taste or sensation.
- **Some students believe** that the taste of substances determines whether they are acidic or alkaline (acidic for a sour taste, alkaline for a bitter taste), but tasting is not a safe or scientific method to identify acids and alkalis, because some substances may be toxic.
- **Some students think** that the pH value indicates the danger of a substance; **in reality**, the pH value only indicates the degree of acidity or alkalinity of the substance, not its strength or direct effect.

Diagnostic Assessment:



- **Ask the students to examine** the lesson preparation image and attempt to answer the questions, as these questions serve as a diagnostic assessment to gauge the students' prior knowledge regarding the lesson and to uncover any misconceptions and incorrect concepts they may have.
- **Listen carefully** to the students' answers to these questions and ask them to explain the reasons behind their responses.
- **Clarify to them** the correct answers to these questions will be revealed through the explanation of this lesson.

Use Diverse Teaching Strategies:

You can use K.W.L strategies, discussion, cooperative learning and educational games.

- **At the beginning of the unit**, use the (K.W.L) strategy (What do you know?) – (What do you want to know?) – (What have you learned?).
- **Draw a (K.W.L) table** on the board, reminding the students of this strategy :

What do you know? (K)	What do you want to know? (W)	What have you learned? (L)

- **Before explaining the lesson:** Ask the students to write down the knowledge they already possess about acids and alkalis in the first column (What do you know?) And to write the new knowledge they wish to learn about acids and alkalis in the second column (What do you want to know?).
- **After explaining the lesson:** Ask the students to write down the knowledge they have learned about acids and alkalis in the third column (What have you learned?).

Acids and Alkalis

Dear Teacher :

- Svante Arrhenius was a prominent Swedish chemist and physicist, born on 19 February 1859 and died on 2 October 1927. He is considered one of the pioneers of physical chemistry, with significant contributions across multiple fields. He was awarded the Nobel Prize in Chemistry in 1903 for his outstanding contributions to understanding the nature of solutions. He played a major role in establishing a scientific definition of acids and alkalis within his theory of ionization in 1884, which was one of the first attempts to understand the nature of these substances based on their chemical properties.
- Arrhenius clarified that acids, when dissolved in water, produce positively charged hydrogen ions (H^+), while alkalis, when dissolved in water, produce negatively charged hydroxide ions (OH^-). This definition was revolutionary in chemistry as it linked the behaviour of acids and alkalis to ionization in water and provided a quantitative explanation of the interactions between acids and alkalis through ion concentration, paving the way for understanding the nature of electrical conductivity in solutions.

Lesson Preparation :

- **Pose the following questions to the students and discuss their answers:**

* Have you ever tasted lemon juice and said it is sour?

* Have you noticed how soap makes your hands soft, but it can cause dryness if used excessively?

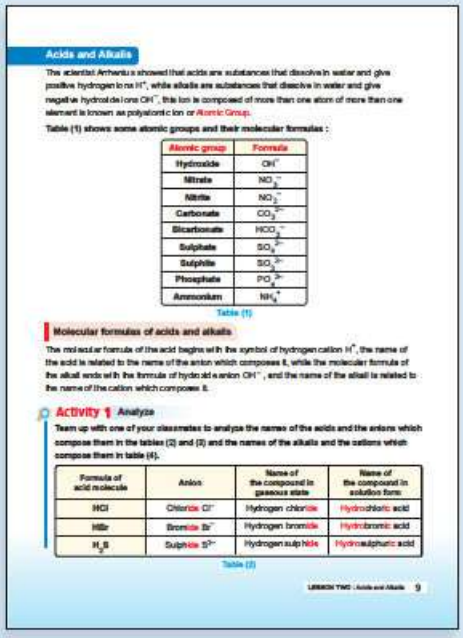
* **Explain to the students** that all of this relates to the properties of chemical substances known as acids and alkalis.

* **Clarify to the students** that this lesson will help them understand how to distinguish between acids and alkalis, as well as their properties and importance.

* **Clarify to the students** that by the end of the lesson, they will be able to do an experiment to distinguish between acids and alkalis themselves and they will understand why some substances are safe while others must be handled with caution.

* **Explain to the students** that ions composed of more than one atom from more than one element are known as polyatomic ions or atomic groups.

* **Ask the students to** examine Table (1) in the student's book to learn about atomic groups, their molecular formulas, the elements that composed them and the number of atoms of each and to record this information in the following table as illustrated in the examples.



Acids and Alkalis

The scientist Arrhenius showed that acids are substances that dissolve in water and give positive hydrogen ions H^+, while alkalis are substances that dissolve in water and give negative hydroxide ions OH^-, this ion is composed of more than one atom of more than one element is known as polyatomic ion or Atomic Group.

Table (1) shows some atomic groups and their molecular formulas :

Atomic group	Formula
Hydroxide	OH^-
Nitrate	NO_3^-
Nitrite	NO_2^-
Carbonate	CO_3^{2-}
Bicarbonate	HCO_3^-
Sulphate	SO_4^{2-}
Sulphite	SO_3^{2-}
Phosphate	PO_4^{3-}
Ammonium	NH_4^+

Table (1)

Molecular formulas of acids and alkalis

The molecular formula of the acid begins with the symbol of hydrogen cation H^+, the name of the acid is related to the name of the anion which composes it, while the molecular formula of the alkali ends with the formula of hydroxide anion OH^-, and the name of the alkali is related to the name of the cation which composes it.

Activity 1 Analyze

Team up with one of your classmates to analyze the names of the acids and the anions which compose them in the tables (2) and (3) and the names of the alkalis and the cations which compose them in table (4).

Formula of acid molecule	Anion	Name of the compound in gaseous state	Name of the compound in solution form
HCl	Chloride Cl^-	Hydrogen chloride	Hydrochloric acid
HBr	Bromide Br^-	Hydrogen bromide	Hydrobromic acid
H_2S	Sulphide S^{2-}	Hydrogen sulphide	Hydrosulphuric acid

Table (2)

LESSON TWO : Acids and Alkalis 9

Atomic Group	Molecular Formula	Its constituent Elements	No. of atoms of each element
Hydroxide	OH^-	Hydrogen Oxygen	1 1
Nitrate	NO_3^-	Oxygen Nitrogen	3 1
	NO_2^-		
	CO_3^{2-}		
	HCO_3^-		
	SO_4^{2-}		
	SO_3^{2-}		
	PO_4^{3-}		
	NH_4^+		

* **After the students complete the table, pose the following questions:**

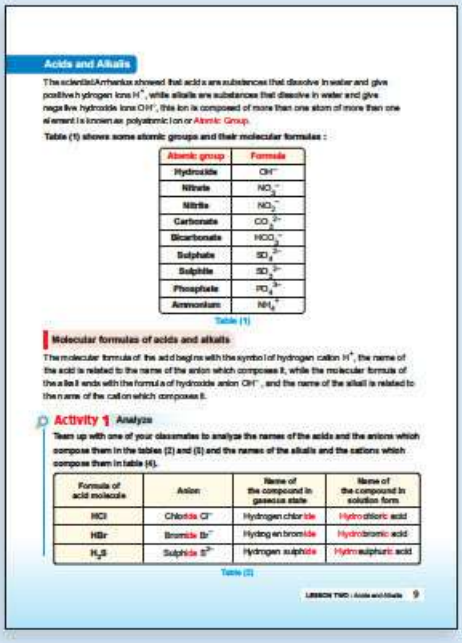
- **How** many elements make up these ions?

  More than one element.
- **How** many atoms make up these ions?

  More than one atom.
- **Explain to the students** that ions composed of more than one atom of more than one element are called an atomic group.

Molecular Formulas of Acids and Alkalis

- **Explain to the students** the importance of writing molecular formulas, which are fundamental in chemistry, such as: identifying the types of elements present in the molecule and their number of atoms, determining the chemical composition of the compound, writing chemical equations and providing evidence of the types of present bonds (covalent or ionic).
- **Explain to the students** that the molecular formula of an acid begins with the symbol of hydrogen cation and that the name of the acid is related to the name of the anion which composes it, while the molecular formula of alkali ends with the hydroxide anion and the name of the alkali is related to the name of the cation which composes it.



Acids and Alkalis

The scientist Arrhenius showed that acids are substances that dissolve in water and give positive hydrogen ions H^+, while alkalis are substances that dissolve in water and give negative hydroxide ions OH^-, this ion is composed of more than one atom of more than one element is known as polyatomic ion or Atomic Group.

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Sulphite	SO_3^{2-}
Phosphate	PO_4^{3-}
Ammonium	NH_4^+

Table (1)

Molecular formulas of acids and alkalis

The molecular formula of the acid begins with the symbol of hydrogen cation H^+, the name of the acid is related to the name of the anion which composes it, while the molecular formula of the alkali ends with the formula of hydroxide anion OH^-, and the name of the alkali is related to the name of the cation which composes it.

Activity 1 Analyze

Team up with one of your classmates to analyze the names of the acids and the anions which compose them in the tables (2) and (3) and the names of the alkalis and the cations which compose them in table (4).

Formula of acid molecule	Anion	Name of the compound in gaseous state	Name of the compound in solution form
HCl	Chloride Cl^-	Hydrogen chloride	Hydrochloric acid
HBr	Bromide Br^-	Hydrogen bromide	Hydrobromic acid
H_2S	Sulphide S^{2-}	Hydrogen sulphide	Hydrosulphuric acid

Table (2)

LESSON TWO : Acids and Alkalis 9

Activity 1 Analyze

- This activity aims to understand the method of naming acids and alkalis.
- **Used Tools:** tables from the student's book.
- Employ cooperative learning strategies and group work, with confirmation on the principles of cooperative work:

1. Divide the students in the class into equal groups (4-6) of different levels.
2. Ask each group to choose a name for their group.
3. Ask each group to analyze tables (2, 3, 4) in the student's book and answer the following questions for each table.
4. Determine a role to each student in the group.
5. Request that each group present their observations and conclusions to the other groups and discuss them with one another.
6. Discuss with the students what they have concluded.
7. Correct any incorrect answers provided by the students.

- **Ask the students to analyze table (2) and answer the questions (1 - 3) :**

(1) **Do the acids shown in table (2) contain oxygen element?**

No.

(2) **What is the suffix (letters added to the end) of each of the anion and the acid composed from it ?**

The anion ends with the suffix (ide) and the acid ends with the suffix (ic).

(3) **What is the section with which the name of the acid begins ?**

The prefix is hydro.

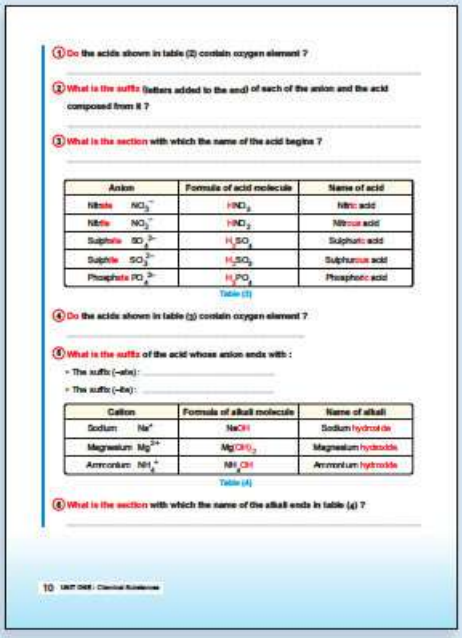
- **Ask the students to analyze Table (3) and answer questions (4) and (5) :**

(4) **Do the acids shown in Table (3) contain oxygen element?** Yes.

(5) What is the suffix of the acid whose anion ends with :

- **the suffix (-ate)?** It ends with the suffix (-ic).
- **the suffix (-ite)?** It ends with the suffix (-ous).

- Explain to the students that the names of the acids which do not contain oxygen element begin with the prefix hydro, followed by the name of the anion, replacing the suffix (-ide) with (-ic) , then the name ends with the word "acid".
- Clarify to the students that acids containing oxygen are referred to as "oxyacids," and their names begin with the name of the anion (the negatively charged atomic group) replacing the suffix (-ate) of the anion with (-ic). while, acids that contain oxygen and have an anion ending with the suffix (-ite), replacing the suffix (-ite) with (-ous), then the name ends with the word "acid".



① Do the acids shown in table (2) contain oxygen element ?

② What is the suffix (letters added to the end) of each of the anion and the acid composed from it ?

③ What is the section with which the name of the acid begins ?

Anion	Formula of acid molecule	Name of acid
Nitrate NO_3^-	HNO_3	Nitric acid
Nitrite NO_2^-	HNO_2	Nitrous acid
Sulphate SO_4^{2-}	H_2SO_4	Sulphuric acid
Sulphite SO_3^{2-}	H_2SO_3	Sulphurous acid
Phosphate PO_4^{3-}	H_3PO_4	Phosphoric acid

Table (3)

④ Do the acids shown in table (3) contain oxygen element ?

⑤ What is the suffix of the acid whose anion ends with :

- The suffix (-ate) :
- The suffix (-ite) :

Cation	Formula of alkali molecule	Name of alkali
Sodium Na^+	NaOH	Sodium hydroxide
Magnesium Mg^{2+}	$Mg(OH)_2$	Magnesium hydroxide
Ammonium NH_4^+	NH_4OH	Ammonium hydroxide

Table (4)

⑥ What is the section with which the name of the alkali ends in table (4) ?

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- **Ask the students to analyze Table (4) and answer question (6) :**

(6) **What is the section with which the name of the alkali ends?** Hydroxide.

- **Explain to the students** that alkalis begin with the name of the cation, followed by the word hydroxide.
- **Explain to the students** that the total charge of any compound molecule equals zero because the number of positive charges from the cation equals the number of negative charges from the anion.
- **Clarify to the students** that the number of hydrogen atoms in the acid molecule equals the magnitude of the charge of its anion.
- **Clarify to the students** that the number of hydroxide groups in the alkali molecule equals the magnitude of the charge of its cation.

Evaluate Your Understanding

- To evaluate students' understanding of naming acids, ask them to write the formula and the name of the acid that contains the following anions:

(1) Iodide I^- :

Hydroiodic acid (HI).

(2) Carbonate CO_3^{2-} :

Carbonic acid (H_2CO_3).

(3) Chlorite ClO_2^- :

Chlorous acid ($HClO_2$).

Integration with life Sciences

- **Dear Teacher :**

Explaining the integration between branches of science is a fundamental aspect of education and scientific research, as it highlights the relations between concepts and phenomena across different disciplines.

- Explain to students the importance of the integration between chemistry and biology, which is one of the most prominent forms of collaboration between branches of science, as it allows for a comprehensive understanding of the mechanisms of life from both chemical and biological perspectives. This integration is essential for understanding vital processes, as it explains how biological processes occur through chemical reactions, the development of medications and conducting biological research at the molecular level.
- Provide examples to students of the integration between chemistry and life sciences, such as hydrochloric acid (representing the branch of chemistry) secreted by the stomach and participates in food digestion (representing life sciences).
- Explain to students another example of the integration between chemistry and life sciences, which is lactic acid, that provides the muscles with energy during the lack of oxygen and how its accumulation in the muscles causes muscle cramps.

It is clear from the previous that :

- The acids which do not contain oxygen element and with the word acid preceded by a section with the prefix (letters added at the beginning) Hydro followed by the name of the anion with replacing the suffix (–ide) with the suffix (–ic).
- The acids which contain oxygen element (oxyacids) whose anion suffix is :
  - (–ate) : Ends with the word acid, preceded by the name of the anion with replacing the suffix (–ate) with the suffix (–ic).
  - (–ite) : Ends with the word acid, preceded by the name of the anion with replacing the suffix (–ite) with the suffix (–ous)
- Number of hydrogen atoms in the acid molecule equals the magnitude of the charge of its anion.
- Number of hydroxide groups in the alkali molecule equals the magnitude of the charge of its cation.
- The total charge of a molecule of any compound is equal to zero.

Evaluate Your Understanding:

Write the formula and the name of the acid which contains the following anions :

(1) Iodide I^- : .....

(2) Carbonate CO_3^{2-} : .....

(3) Chlorite ClO_2^- : .....

Integration with Life Sciences

Acids play important roles in human body, among them are :

- Hydrochloric acid which is secreted by the stomach and participates in food digestion.
- Lactic acid which provides the muscles with energy during their lack of oxygen, but its accumulation in the muscles causes muscle cramps (Figure 1).

Figure (1)

Properties of acids and alkalis

In your house, you will find many acids and alkalis, for example, lemon, ketchup and grapes (Figure 2) are acidic substances, while cleaners, tooth paste and baking soda (Figure 3) are alkaline substances.

Figure (2)
Acidic substances

Figure (3)
Alkaline substances

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Properties of Acids and Alkalis

Use Educational Games Strategy :

- Explain to students the rules of the classification game, which involves attempting to classify a set of cards distributed to them, with the winning group being the one that classifies correctly in the shortest time.
- Distribute to students a set of cards bearing the names of common substances (lemon, ketchup, grapes, cleaners, baking soda, toothpaste).
- Divide the class into groups of four students.
- Ask the groups to compete to classify these common substances into acids and alkalis from their perspective.
- Reward the winning group.
- Discussion: Clarify to students that not everything that appears acidic or alkaline to the eye or taste is accurate.
- Explain to students that there are many acids and alkalis in our houses; for instance, lemon, ketchup and grapes are acidic substances, while cleaners, toothpaste and baking soda are alkaline substances.

- Ask the students What is the difference between the properties of acids and alkalis ? This is what we will explore in the following activity :

Activity 2 Predict

- The aim of this activity is to understand the difference between the properties of acids and alkalis.
- **Used tools:** Figures (4, 5, 6, 7) from the student's book.
- **Ask the students** to observe Figure (4), which illustrates the dissolution of hydrogen chloride gas HCl in water, then answer the following questions :
  - **What are the ions produced** from dissolving HCl gas in water?

    H^+ cations and Cl^- anions.
  - **Predict the ions produced** from dissolving sulphuric acid H_2SO_4 in water.

    H^+ cations and SO_4^{2-} anions.
  - **What is the ion** which is common in the two solutions?

    H^+ cation
- **Ask the students** to observe Figure (6) and answer the question:
  - **What is the effect of hydrochloric acid solution on the blue litmus strip?**

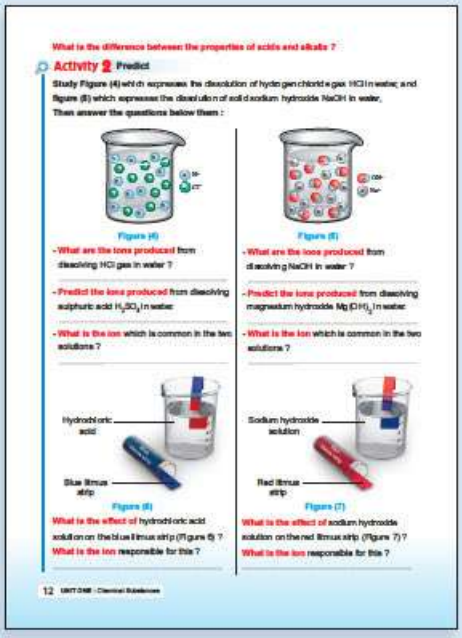
    The blue litmus strip turns red.
  - **What is the ion responsible for this?**

    Hydrogen ion H^+
- Ask the students to observe Figure (5), which illustrates the dissolution of solid sodium hydroxide NaOH in water. Then answer the following questions:
  - **What are the ions produced** from dissolving NaOH in water?

    Na^+ cations and OH^- anions.
  - **Predict the ions produced** from the dissolving magnesium hydroxide $Mg(OH)_2$ in water?

    Mg^{2+} cations and OH^- anions.
  - **What is the ion** which is common in the two solutions?

    OH^- ion.


What is the difference between the properties of acids and alkalis ?

Activity 2 Predict

Study Figure (4) which expresses the dissolution of hydrogen chloride gas HCl in water, and figure (5) which expresses the dissolution of solid sodium hydroxide NaOH in water. Then answer the questions below them :

Figure (4)

- What are the ions produced from dissolving HCl gas in water ?
- Predict the ions produced from dissolving sulphuric acid H_2SO_4 in water.
- What is the ion which is common in the two solutions ?

Figure (5)

- What are the ions produced from dissolving NaOH in water ?
- Predict the ions produced from dissolving magnesium hydroxide $Mg(OH)_2$ in water.
- What is the ion which is common in the two solutions ?

Hydrochloric acid

Blue litmus strip

Figure (6)

What is the effect of hydrochloric acid solution on the blue litmus strip (Figure 6) ?

What is the ion responsible for this ?

Sodium hydroxide solution

Red litmus strip

Figure (7)

What is the effect of sodium hydroxide solution on the red litmus strip (Figure 7) ?

What is the ion responsible for this ?

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- **Ask the students** to observe Figure (7) and answer the question:
  - **What is the effect of sodium hydroxide solution on the red litmus strip ?**

    The red litmus strip turns blue.
  - **What is the ion responsible for this?**

    Hydroxide ion OH^-
- **Explain to the students** that acids react with alkalis to form salt and water, such as the reaction of hydrochloric acid HCl with sodium hydroxide solution NaOH to produce sodium chloride salt NaCl and water H_2O. However, acids do not react with each other, neither are the alkalis.

Cross-Cutting Concepts: cause and effect

- The concept of cause and effect is used to understand how events and phenomena are interconnected. Learning this concept helps students explain why things happen (cause) and what results from this event or action (effect).
- Apply the concept of cause and effect to the previous activity.

Example for students regarding this concept:

1. An acid is a substance whose dissolution in water increases the concentration of H^+ cations in the solution (cause), which is responsible for all the properties of acids (effect).
2. An alkali is a substance whose dissolution in water increases the concentration of OH^- anions in the solution (cause), which is responsible for all the properties of alkalis (effect).

Medical Application

- Dear Teacher: Clarifying the medical applications of scientific concepts in students' lives helps connect school with real life and enhances students' appreciation for science.
- Milk of Magnesia (Figure 8) is an aqueous solution of magnesium hydroxide $Mg(OH)_2$, which is considered completely insoluble in water, but it exists in Milk of Magnesia as a suspension. It is characterized by its milky white consistency, from which it derives its name.
- Uses:

1. **As an antacid:** It reduces excess acidity in the stomach and helps in treating heartburn or acid indigestion. It reacts with hydrochloric acid HCl in the stomach to produce magnesium chloride $MgCl_2$ and water, which reducing stomach acidity. A small dose is taken as directed by a doctor or according to the medical leaflet.
2. **As a laxative:** It is used to treat constipation by increasing the amount of water in the intestines, which facilitates the passage of stool. Slightly higher doses are taken, but it is important to follow the doctor's instructions to avoid overdosing.


Cross-Cutting Concepts : Cause and Effect

- Acid is a substance that when dissolves in water, the percentage of H^+ cations in the solution increases, which are responsible for all the properties of the acids.
- Alkali is a substance that when dissolves in water, the percentage of OH^- anions in the solution increases, which are responsible for all the properties of the alkalis.
- Acids react with alkalis forming salts and water, such as the reaction of hydrochloric acid HCl with sodium hydroxide solution NaOH forming sodium chloride salt NaCl and water H_2O, but acids do not react with each other, neither are the alkalis.

Medical Application

Milk of magnesia (Figure 8) is used as a temporary treatment for neutralize the gastric acidity, as it contains magnesium hydroxide $Mg(OH)_2$

Figure (8)
Milk of magnesia

- Acids and alkalis conduct electricity to variant degrees, according to their strength.

Activity 3 Compare

Test the electrical conductivity of each of hydrochloric acid and the acetic acid (used in making vinegar), both with the same concentration (Figure 9) :

① Which acid conducts electricity more (to a higher degree) ? How can this be indicated ?

② Compare between the strength of hydrochloric acid and that of acetic acid, according to their ability to conduct electricity.

Figure (9)
Hydrochloric acid Acetic acid

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- It is advised not to overuse it as it may cause : excessive diarrhea, disturbances in the body's mineral balance (such as elevated magnesium levels). It is not suitable for kidney patients without medical consultation.

Activity 3 Compare

- This activity aims to compare acids and alkalis in terms of electrical conductivity.
- **Used tools:** Figure (9) in the student's book.
- **Dear Teacher :**

  Take the students to the school laboratory and conduct the activity with them there. Ask the students to test the electrical conductivity of both hydrochloric acid and acetic acid (used in vinegar) at the same concentration. If the necessary equipment is not available in your laboratory, you can refer to Figure (9) in the student's book and pose the following questions:

① **Which acid** conducts electricity more (to a higher degree)?

Hydrochloric acid.

How can this be indicated?

Because the light bulb connected to it glows brighter.

② **Compare between** the strength of hydrochloric acid and that of acetic acid **according to** their ability to conduct electricity.

Hydrochloric acid is a strong acid, whereas acetic acid is a weak acid.

- **Explain to the students** that strong acids such as hydrochloric acid, nitric acid and sulphuric acid are good conductors of electricity, while weak acids like vinegar (dilute acetic acid), sulphurous acid and nitrous acid are weak conductors of electricity.
- Repeat the previous step using alkaline solutions such as sodium hydroxide and ammonium hydroxide.

① **Which alkali** conducts electricity more (to a higher degree)?

Sodium hydroxide solution.

And how can this be indicated?

Because the light bulb connected to it glows brighter.

② **Compare between** the strength of sodium hydroxide and ammonium hydroxide **according to** their ability to conduct electricity.

Sodium hydroxide is a strong alkali, whereas ammonium hydroxide is a weak alkali.


Cross-Cutting Concepts : Cause and Effect

- Acid is a substance that when dissolves in water, the percentage of H^+ cations in the solution increases, which are responsible for all the properties of the acids.
- Alkali is a substance that when dissolves in water, the percentage of OH^- anions in the solution increases, which are responsible for all the properties of the alkalis.
- Acids react with alkalis forming salts and water, such as the reaction of hydrochloric acid HCl with sodium hydroxide solution NaOH forming sodium chloride salt NaCl and water H_2O, but acids do not react with each other, neither are the alkalis.

Medical Application

Milk of magnesia (Figure 8) is used as a temporary treatment for neutralizing gastric acidity, as it contains magnesium hydroxide $Mg(OH)_2$

Figure (8)
Milk of magnesia

- Acids and alkalis conduct electricity to varied degrees, according to their strength.

Activity 3 Compare

To st the electrical conductivity of each of hydrochloric acid and the acetic acid (used in making vinegar), both with the same concentration (Figure 9) :

① Which acid conducts electricity more (to a higher degree) ? How can this be indicated ?

② Compare between the strength of hydrochloric acid and that of acetic acid, according to their ability to conduct electricity.

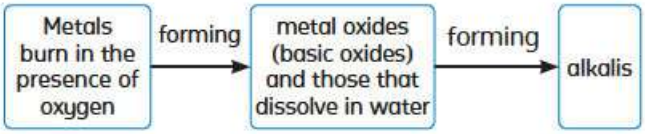
Figure (9)
Hydrochloric acid Acetic acid

LESSON TWO - Acids and Alkalis 13

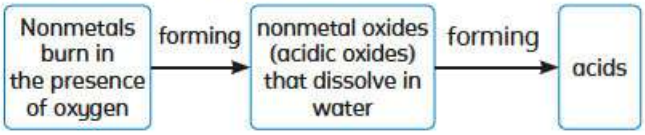
- **Explain to the students** that strong alkalis like sodium hydroxide are good conductors of electricity, while weak alkalis like ammonium hydroxide are weak conductors of electricity.

You may be wondering... ?

- Use the flowchart strategy: it is used to highlight the sequence of events or processes or steps, illustrating the relations between the initial stages and the subsequent stages of events. The name of the event or process is written inside the first rectangle, from which several rectangles flow, representing the steps in sequence from beginning to end. Sub-rectangles may also flow from the main rectangle.
- Draw a flowchart for the students that illustrates the process of burning metal, as shown below :



- Provide the students with an example of metal, such as the burning of magnesium, forming magnesium oxide MgO, which dissolves in water to form a solution of magnesium hydroxide $Mg(OH)_2$
- Draw a flowchart for the students that illustrates the process of burning nonmetal, as shown below :



- Provide the students with an example of burning nonmetal, such as the burning of sulphur, forming sulphur trioxide SO_3, which dissolves in water to form a solution of sulphuric acid H_2SO_4
- Explain to the students that metal oxides are basic oxides that react with acids but do not react with alkalis, while nonmetal oxides, which are acidic oxides, react with alkalis but do not react with acids.

Integration with Environmental Sciences

- **Ask the following question to the students:** Have you heard of acid rain? What does it mean?
- **Listen carefully to the students' answers** and discuss their prior knowledge.


It is clear from the previous that :
Strong acids, as hydrochloric acid, nitric acid and sulphuric acid, are good electrical conductors, while the weak acids as vinegar (dilute acetic acid), sulphurous acid and nitrous acid are bad electrical conductors.
By the same way ...
The electrical conductivity of sodium hydroxide solution (strong alkali) differs from the electrical conductivity of ammonium hydroxide solution (weak alkali).
You may wonder ... ?
Is there any relation between metals and alkalis, or between nonmetals and acids ?!
• Metals burn in the presence of oxygen forming metal oxides, most of them known as basic oxides, what can dissolve in water from them forms alkalis.
Such as magnesium burning forms magnesium oxide MgO (Figure 10), which dissolves in water forming magnesium hydroxide solution $Mg(OH)_2$
• Nonmetals burn in the presence of oxygen forming nonmetal oxides, most of them known as acidic oxides, which dissolve in water forming acids.
Such as sulphur burning forms sulphur trioxide SO_3 (Figure 11), which dissolves in water forming sulphuric acid solution H_2SO_4
• Metal oxides can react with acids, but they do not react with alkalis, while nonmetal oxides can react with alkalis, but they do not react with acids.
Figure (10) Magnesium burning
Figure (11) Sulphur burning
Integration with Environmental Sciences
Burning of fossil fuels (such as petrol and coal) in cars, power stations (power plants) and factories causes the evolution of acidic oxides as nitrogen dioxide NO_2 and sulphur dioxide SO_2, which dissolve in the water vapour of the atmospheric air, their accumulation in the clouds leads to what is called acid rains (Figure 12), which have very harmful impacts, where they cause destruction of forests, and harm the living organisms which live in water, in addition to the corrosion of buildings, and health problems in the human respiratory system.
14 UNIT ONE : Chemical Substances
Figure (12) Acid rains

- **Explain to the students** that when fossil fuels such as petrol and coal are burned in cars, power stations and factories, causes the evolution of acidic oxides such as nitrogen dioxide NO_2 and sulphur dioxide SO_2
- **Clarify to the students** that these oxides dissolve in the water vapour of the atmospheric air, their accumulation in clouds, lead to fall rains known as acid rains.
- **Summarize for the students** the damage caused by acid rain, as it leads to the destruction of forests, harms living organisms in aquatic ecosystems, corrosion of buildings and causes health problems in the human respiratory system.

Closure of the Lesson:

- The teacher summarizes all the main ideas of the lesson five minutes before concluding.
- You may involve the students in closing the lesson by asking them about the concepts covered in the lesson.

Answers of Evaluation Questions on Lesson Two

1 (1) (a)
(2) (a)
(3) (c)
(4) (c)
(5) (a)

---

2 (1) Carbonic acid.
(2) Hydrochloric acid.
(3) Magnesium hydroxide.
(4) Lithium hydroxide.

---

3 (1) H_2SO_4
(2) NaOH

---

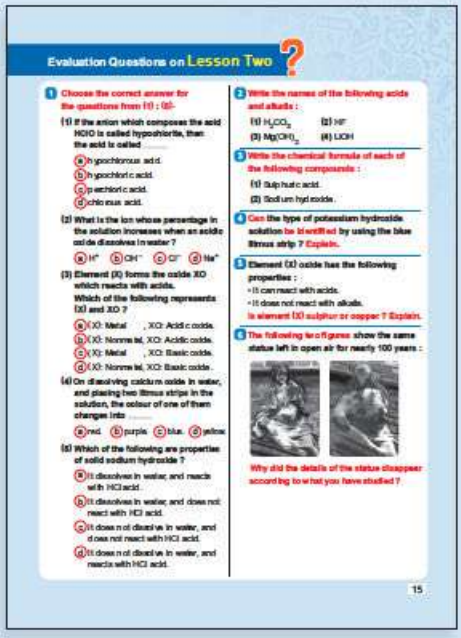
4 No / Because potassium hydroxide solution is an alkaline solution that does not change the colour of blue litmus strip.

---

5 The element (X) is copper / Because copper oxide is a basic oxide that reacts with acids but does not react with alkalis.

---

6 Due to acid rains which result from the dissolution of acidic oxides in atmospheric water vapour.



Evaluation Questions on Lesson Two

1 Choose the correct answer for the questions from (1) : (5):

(1) If the anion which composes the acid HClO is called hypochlorite, then the acid is called .....
(a) hypochlorous acid.
(b) hypochloric acid.
(c) perchloric acid.
(d) chloreux acid.

(2) What is the ion whose percentage in the solution increases when an acidic oxide dissolves in water ?
(a) H^+ (b) OH^- (c) Cl^- (d) Na^+

(3) Element (X) forms the oxide XO which reacts with acids.
Which of the following represents (X) and XO ?
(a) (X): Metal , XO: Acidic oxide.
(b) (X): Nonmetal, XO: Acidic oxide.
(c) (X): Metal , XO: Basic oxide.
(d) (X): Nonmetal, XO: Basic oxide.

(4) On dissolving calcium oxide in water, and placing two litmus strips in the solution, the colour of one of them changes into .....
(a) red (b) purple (c) blue (d) yellow

(5) Which of the following are properties of solid sodium hydroxide ?
(a) It dissolves in water, and reacts with HCl acid.
(b) It dissolves in water, and does not react with HCl acid.
(c) It does not dissolve in water, and does not react with HCl acid.
(d) It does not dissolve in water, and reacts with HCl acid.

2 Write the names of the following acids and alkalis :
(1) H_2CO_3 (2) HF
(3) $Mg(OH)_2$ (4) LiOH

3 Write the chemical formula of each of the following compounds :
(1) Sulphuric acid.
(2) Sodium hydroxide.

4 Can the type of potassium hydroxide solution be identified by using the blue litmus strip ? Explain.

5 Element (X) oxide has the following properties :
- It can react with acids.
- It does not react with alkalis.

Is element (X) sulphur or copper ? Explain.

6 The following two figures show the same statue left in open air for nearly 100 years :

Why did the details of the statue disappear according to what you have studied ?

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Additional Learning Resources:

Utilising digital learning resources such as the Egyptian Knowledge Bank, as well as educational and documented videos and films available on internet webs.

Lesson Three: Chemical Indicators and Salts

The third lesson in this unit addresses the topic of chemical indicators and salts, which are fundamental subjects in chemistry that help us understand the nature of the materials around us. Chemical indicators are compounds that reveal the properties of substances by changing colour when added to acids or alkalis. Salts, on the other hand, are compounds produced from the reaction of acids with alkalis and play an important role in our daily lives, whether in food, industry, or the environment. In this lesson, we will explore the types of chemical indicators and how to use them and we will investigate the properties of salts and their role in chemical reactions. Through this lesson, students will acquire a range of new concepts and the lesson aims to develop skills in discovery, inference and deduction.

Lesson Objectives:

1. Recognize the concept of the indicators.
2. Compare between the effect of gases on indicators.
3. Recognize the pH
4. Differentiate between the different types of solutions in terms of the pH value.
5. Describe the properties of salts.
6. Differentiate between the different types of solutions by using indicators.

Resources and Learning Materials Used:

Data show – Films – Student book images – Internet – Science laboratory.

Duration and place of Teaching:

Two periods (4 sessions) – Classroom and media lab – Science laboratory.

Lesson Terminology:

- Indicator
- Litmus
- Universal indicator
- pH scale
- Salts

Misconceptions or Incorrect Concepts:

- **Some students believe** that chemical indicators change colour with any substance, but they only react with acidic or alkaline substances and do not change with neutral substances.
- **Some students think** that chemical indicators exist only in liquid state, but they can also be in solid state, such as litmus strips.
- **Some students believe** that colour change is the only function of chemical indicators, while other changes, such as the appearance of a smell or the formation of a precipitate, can occur in certain cases.
- **Some students think** that all salts are soluble in water, but there are insoluble salts, such as calcium carbonate and silver chloride.
- **Some students believe** that salts are always neutral, but some salts can be acidic or alkaline depending on the nature of the ions they contain.

Diagnostic Assessment:

- **Ask the students** to examine the lesson preparation image and attempt to answer the questions, as these questions serve as a diagnostic assessment to gauge the students' prior knowledge about the lesson and to uncover any misconceptions or incorrect concepts they may have.
- **Listen carefully** to the students' answers to these questions and ask them to explain the reasons for their answers.
- **Clarify to them** that the correct answers to these questions will be revealed through the explanation of this lesson.

Use Diverse Teaching Strategies:

You can use (K.W.L) strategies, discussion, cooperative learning, educational games and experiments and discovery.

- **At the beginning of the lesson**, use the (K.W.L) strategy (What do you know?) – (What do you want to know?) – (What have you learned?).
- **Draw a K.W.L table** on the board, reminding the students of this strategy.

What do you know? (K)	What do you want to know? (W)	What have you learned? (L)

- Before explaining the lesson:

Ask the students to write down the information they already have about chemical indicators in the first column (What do you know?). Then, have them write the new information they wish to learn about chemical indicators in the second column (What do you want to know?).

- After explaining the lesson:

Ask the students to write down the information they have gained about chemical indicators in the third column (What have you learned?).

Chemical Indicators

Preparation of lesson:

- **Pose the following questions to the students and discuss their responses:**

1. Imagine you are a chemistry scientist in a laboratory and you want to determine the type of substance in front of you. Is it an acid or an alkali? What do you do?
2. Can we identify all chemical substances, such as acid and alkali solutions, through taste or smell?

- **Explain to the students** that there is significant danger in using the senses of taste, smell, or touch to identify certain chemical substances, as there are corrosive acids and caustic alkalis, such as sulphuric acid and sodium hydroxide.
- So how can we distinguish between acidic, alkaline and neutral substances?
- If you add lemon juice to tea and notice a colour change, what do you think is happening? How can we use colour changes to understand the properties of substances?
- **Explain to the students** that in chemistry, we have powerful tools called chemical indicators that help us safely identify chemical substances.

Activity 1 Practical

- The aim of this activity is to differentiate between acids, alkalis and neutral substances by using litmus strip.
- **Used substances :** Strong acid such as hydrochloric acid – Weak acid such as acetic acid – Strong alkali such as sodium hydroxide solution – Distilled water – Red and blue litmus strips.
- **Ask the students** to dip a blue litmus strip in a strong acid such as hydrochloric acid and a weak acid such as acetic acid.
- **Ask the students** to dip a red litmus strip in sodium hydroxide solution.
- **Ask the students** to dip both red and blue litmus strips in distilled water.


Chemical Indicators

Adding concentrated sulphuric acid to the table sugar causes it to be charred (becomes black) (Figure 1), this indicates that it is dangerous, so it is completely forbidden in taste, smell or touch any chemical substance in laboratory without teacher's permission , because some acids are burning and some alkalis are caustic.

Figure (1)

• As we cannot identify chemicals like acids and alkalis solutions by tasting or smelling. So.

How can we differentiate between acidic substances, alkaline substances and neutral substances ?

Activity 1 Practical

Used substances :

- Strong acid such as hydrochloric acid.
- Weak acid such as acetic acid.
- Strong alkali such as sodium hydroxide solution.
- Distilled water.
- Blue and red litmus strips.

Figure (2) Litmus strip in hydrochloric acid

Figure (3) Litmus strip in acetic acid

Figure (4) Litmus strip in sodium hydroxide solution

Figure (5) Litmus strips in distilled water

① What is the change occurring in the colour of the litmus strip when it is dipped in the used solutions :

- In hydrochloric acid : .....
- In sodium hydroxide solution : .....
- In acetic acid : .....

LESSON THREE : Chemical indicators and salts 17

- **Ask the students the following questions :**

① **What is the change occuring** in the colour of litmus strip when it is dipped in the used solutions:

- In hydrochloric acid : The blue strip turns red.
- In sodium hydroxide solution : The red strip turns blue.
- In acetic acid : The blue strip turns red.

② **Does** the colour of the red or the blue litmus strips **change** in distilled water?
The colour of both the blue and red strips does not change.

③ **Why** can't litmus strip be used to differentiate between a strong acid and a weak acid?
Because it turns red in both cases.

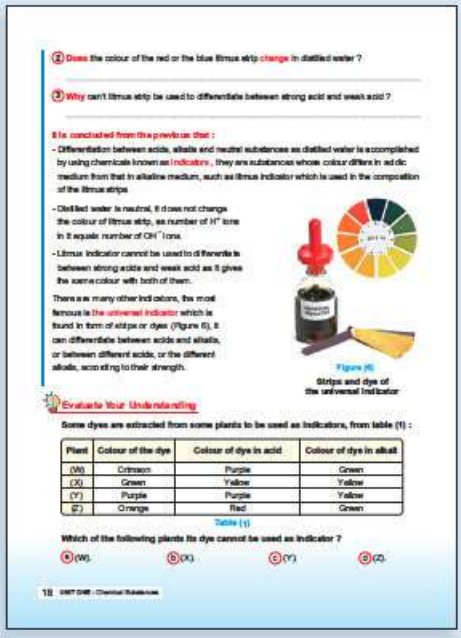
- **Explain to the students** that the concept of indicators refers to chemical substances that change colour in acidic medium compared to alkaline medium.
- **Inform the students** that litmus strip is made from litmus dye, which enables it to distinguish between acids and alkalis.
- **Clarify to the students** that distilled water is neutral and does not change the colour of litmus strip, as the number of hydrogen ions H^+ is equal to the number of hydroxide ions OH^-.
- **Explain to the students** that litmus strip is not suitable for distinguishing between strong acids and weak acids because it produces the same colour with both.

Dear Teacher:

- Universal indicator is a mixture of chemical indicators used to determine the pH level of a substance. It provides a range of different colours depending on the nature of the solution (acidic, alkaline, or neutral), which aids in accurately measuring pH

Method of Use :

- Add one or two drops of universal indicator solution to the sample.
- Compare the resulting colour with the attached standard colour chart to determine the pH value.
- If using universal indicator strip, dip the strip in the solution and then compare the colour with the chart.
- The universal indicator provides approximate results and is not as precise as pH meters.
- It is advisable to store it in a cool, dry place to maintain its effectiveness.


② Does the colour of the red or the blue litmus strip change in distilled water ?

③ Why can't litmus strip be used to differentiate between strong acid and weak acid ?

It is concluded from the previous that :

- Differentiation between acids, alkalis and neutral substances as distilled water is accomplished by using chemicals known as indicators , they are substances whose colour differs in acidic medium from that in alkaline medium, such as litmus indicator which is used in the composition of the litmus strips

- Distilled water is neutral, it does not change the colour of litmus strip, as number of H^+ ions in it equals number of OH^- ions.

- Litmus indicator cannot be used to differentiate between strong acids and weak acid as it gives the same colour with both of them.

There are many other indicators, the most famous is the universal indicator which is found in form of strips or dyes (Figure 6), it can differentiate between acids and alkalis, or between different acids, or the different alkalis, according to their strength.

Figure (6)
Strips and dye of the universal indicator

Evaluate Your Understanding

Some dyes are extracted from some plants to be used as indicators, from table (1) :

Plant	Colour of the dye	Colour of dye in acid	Colour of dye in alkali
(W)	Crimson	Purple	Green
(X)	Green	Yellow	Yellow
(Y)	Purple	Purple	Yellow
(Z)	Orange	Red	Green

Table (1)

Which of the following plants its dye cannot be used as indicator ?

ⓐ (W). ⓑ (X). ⓒ (Y). ⓓ (Z).

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Evaluate Your Understanding

- Ask the students to examine Table (1), which shows the results of using dyes from certain plants as indicators to distinguish between acids and alkalis and then answer the following question:

Which of the following plants its dye cannot be used as an indicator?

Plant dye (X).

Testing the Acidity and Basicity of the Gases

- **Pose the following reflective question to the students:**

  How can we test the acidity of gases?

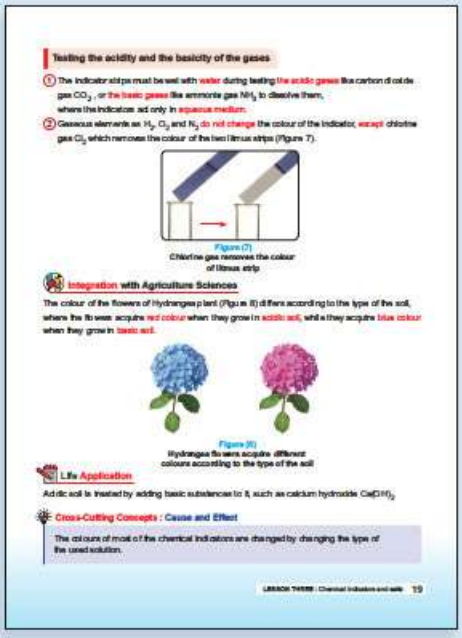
- **Collect the students' answers** without commenting on them until you have gathered a wide range of ideas.
- **Explain to the students that** when testing acidic gases such as carbon dioxide gas CO_2 or basic gases like ammonia gas NH_3, it is necessary to moisten the indicator strips with water to dissolve them, as indicators generally act only in an aqueous medium.
- **Clarify to the students that** gaseous elements such as N_2, O_2 and H_2 do not change the colour of the indicators, except for chlorine gas Cl_2, which removes the colour of the two litmus strips (Figure 7).

Integration with Agriculture Sciences

- **Explain to the students that** the colour of the flowers of the Hydrangea plant differs according to the type of soil (Figure 8), where:
- The flowers acquire red when they grow in acidic soil.
- The flowers acquire blue when they grow in basic soil.

Life Application

- Ask each student to imagine that they are trying to grow a plant in their garden, but it is not growing as expected despite their diligent care. This may seem puzzling, but the reason could lie in the soil itself. Soil is not merely a mixture of sand, clay and water; it possesses chemical characteristics that significantly affect plant growth. Among these characteristics, pH (acidity degree) is a crucial factor in determining the types of plants that can grow healthily.


Testing the acidity and the basicity of the gases

① The indicator strips must be wet with water during testing the acidic gases like carbon dioxide gas CO_2, or the basic gases like ammonia gas NH_3 to dissolve them, where the indicators act only in aqueous medium.

② Gaseous elements as H_2, O_2 and N_2 do not change the colour of the indicator, except chlorine gas Cl_2 which removes the colour of the two litmus strips (Figure 7).

Figure (7)
Chlorine gas removes the colour of litmus strip

Integration with Agriculture Sciences

The colour of the flowers of Hydrangea plant (Figure 8) differs according to the type of the soil, where the flowers acquire red colour when they grow in acidic soil, while they acquire blue colour when they grow in basic soil.

Figure (8)
Hydrangea flowers acquire different colours according to the type of the soil

Life Application

Acidic soil is treated by adding basic substances to it, such as calcium hydroxide $Ca(OH)_2$

Cross-Cutting Concepts : Cause and Effect

The colours of most of the chemical indicators are changed by changing the type of the used solution.

LESSON THREE : Chemical indicators and scale 19

- Explain to the students that acidic soil, which is characterized by a low pH, tends to be sour. This type of soil is commonly found in areas with heavy rainfall, where calcium and other alkaline minerals are leached away from the soil.
- Clarify to the students that treating acidic soil involves adjusting the pH level to suit the cultivated plants. Consequently, acidic soil is treated by adding basic substances to it, such as calcium hydroxide $Ca(OH)_2$

Cross-Cutting Concepts: Cause and Effect

- The concept of cause and effect is used to understand how events and phenomena are related to one another. Learning this concept helps students explain why things happen (the cause) and what results from this event or action (the effect).
- Apply the concept of cause and effect to the previous activity, illustrating that a change in the type of used solution (the cause) leads to a change in the colour of most chemical indicators (the effect).

Activity 2 Practical

- This activity aims to prepare a natural indicator from red cabbage (Figure 9).
- **Used tools:** Red cabbage leaves, boiling water, sieve, blender or knife and cutting board, ethyl alcohol, filter paper, various solutions for testing (such as orange juice, water, Baking soda solution).

Dear Teacher:

The natural indicator from red cabbage is an enjoyable and easy method to detect the pH level of various substances by using the anthocyanin pigment found in red cabbage leaves, which changes colour depending on the acidity or basicity of the medium.

- **Ask the students** to follow the steps of the activity in the student's book to prepare the red cabbage juice, which are:

① Slice $\frac{1}{4}$ of a red cabbage plant and chop the slices using a blender.

② Add 500 mL (half a litre) of boiling water to the contents in the blender.

③ Filter the mixture using a sieve.

④ Add 50 mL of ethyl alcohol to the filtrate.

⑤ Immerse a piece of paper into the filtrate until it colours then leave it to dry.

⑥ Cut the piece of coloured paper to make the indicator strips.

⑦ Use the strips of red cabbage indicator to identify the acidity, basicity, or neutrality of some household liquids, such as orange juice, water and baking soda solution.

- **Explain to the students** that the colour of the red cabbage indicator strip in:
  - **Orange juice:** the strip turns red.
  - **Water:** the colour of the strip remains unchanged.
  - **Baking soda solution:** the strip turns blue.
- **Scientific explanation:** The anthocyanin pigment in red cabbage interacts with the acidity degree of the solution, resulting in a colour change.

- **pH less than 7 (acidic):** the colour turns red or pink.
- **pH = 7 (neutral):** the colour remains purple.
- **pH greater than 7 (basic):** the colour turns green or blue.
- Adding ethyl alcohol to the indicator extracted from red cabbage is not essential, but it can be used in certain cases for specific purposes, **such as:**
- **Stability enhancement:** the alcohol helps preserve the indicator for a longer period, reducing bacterial or fungal growth in the solution.
- **Colour intensification:** the alcohol can help in extracting the anthocyanin pigment more efficiently from red cabbage.

Potential of Hydrogen pH

- **Ask the students** if they have ever wondered why some liquids taste sour, like lemon, while others, like water, have no taste? Or why soap reacts differently on our skin compared to vinegar? The secret behind these differences lies in a chemical property known as pH (potential of hydrogen).
- **Explain to the students** that pH is a scale used by scientists to determine the acidity or basicity of solutions. This scale ranges from 0 to 14 where numbers close to 0 indicate highly acidic substances, numbers close to 14 indicate highly basic substances and a value of 7 indicates neutrality, such as pure water.


Potential of Hydrogen pH

A profile of the scientist
Soren Sorensen

Figure (17)

Figure (18)
pH scale

Figure (19)
Reading of pH meter for HCl acid

Figure (20)
Reading of pH meter for NaOH solution

Figure (21)

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A profile of the Scientist: Soren Sorensen

- He was a Danish chemist born on 9 January 1868 and Died on 12 February 1939. He is considered a pioneer in the field of chemistry and is renowned for developing the pH scale in 1909, which is a scale used to differentiate between acidic or basic and neutral solutions.

Use Discussion Strategy

- **Ask the students** to observe (Figure 18), which illustrates the pH scale.
- **Pose the following questions to the students:**
  1. What is the pH value of neutral solutions and distilled water? It is 7
  2. What is the pH value of acids? less than 7
  3. What is the pH value of alkalis? greater than 7
- **Ask the students** which is stronger in acidity: an acid with pH of 1 or an acid with pH of 6 ? The acid with pH of 1
- **Explain to the students** that the strength of an acidic solution increases as the pH value approaches 0
- **Ask the students** which is stronger in alkalinity: an alkaline solution with pH of 8 or an alkaline solution with pH of 13? The solution with pH of 13
- **Explain to the students** that the strength of an alkaline solution increases as the pH value approaches 14
- **Clarify to the students** that pH values of solutions are measured accurately by using a pH meter device.
- **Ask the students to** observe (Figures 19 and 20), which demonstrate the use of a pH meter device.

Evaluate your understanding :

- **Ask the students** to examine Figure (22), which shows some pH values of some substances and then answer the following questions:

① **What** is the strongest alkaline substance ?
What is its pH? Oven cleaner, pH = 13

② **What** is the strongest acidic substance ?
What is its pH? Gastric acid, pH = 1

③ **Compare between** the acidity of grapes and tomatoes, with explanation.
The acidity of grapes is stronger than that of tomatoes because its pH value is lower.

④ **Compare between** the alkalinity of baking soda and ammonia solution, with explanation.
The alkalinity of ammonia solution is stronger than that of baking soda because its pH value is higher.

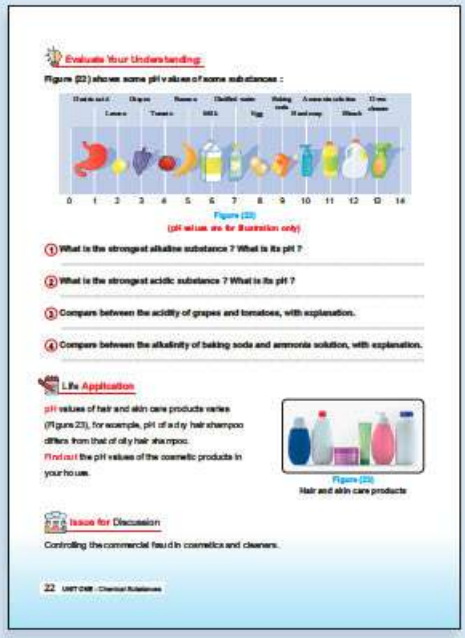
Evaluate Your Understanding

Figure (22) shows some pH values of some substances :

Figure (22)
(pH values are for illustration only)

① What is the strongest alkaline substance ? What is its pH ?

② What is the strongest acidic substance ? What is its pH ?

③ Compare between the acidity of grapes and tomatoes, with explanation.

④ Compare between the alkalinity of baking soda and ammonia solution, with explanation.

Life Application

pH values of hair and skin care products varies (Figure 23), for example, pH of a dry hair shampoo differs from that of oily hair shampoo.
Find out the pH values of the cosmetic products in your home.

Figure (23)
Hair and skin care products

Issue for Discussion

Controlling the commercial fraud in cosmetics and cleaners.

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Life Application

- **Explain to the students** the importance of knowing the pH values of skin care and hair care products used at home. Understanding the pH values of these products is essential for maintaining the health of skin and hair.
This importance stems from the direct impact of pH on the natural balance of our bodies.
- **Clarify to the students that:**

① Healthy skin has a protective layer called the "acid mantle," with a pH range of 4.5 to 5.5 Using products with an unsuitable pH (either highly alkaline or acidic) may damage this layer, making the skin susceptible to dryness and irritation.

② Oily skin may require products with a slightly lower pH to reduce excess oil.

③ Sensitive skin needs products close to neutral (pH = 7) to avoid irritation.

④ Hair and scalp have a natural pH ranging from 4 to 5

⑤ Shampoos with unsuitable pH values may cause dryness of hair or increased oiliness in the scalp.

Issue for Discussion

- **Discuss** the issue of commercial fraud with the students.
- **The aim of the discussion:** to raise students' awareness of the dangers of commercial fraud and its effects on society. To reinforce their moral values, such as honesty and integrity and to encourage critical thinking about how to combat this phenomenon.
- **Start by posing an open question:** "Have you ever bought a product that was not as you expected? How did you feel?"
- **Discuss with the students** the meaning of commercial fraud: "Commercial fraud is the provision of nongenuine or counterfeit products or services for the purpose of quick profit, without regard for quality or safety."
- **Ask the students** to provide examples from their daily lives.
- **Discuss with the students** the effects of commercial fraud, dividing the effects into three areas and discussing them:
  - **The effect on consumers:** loss of money, exposure to health risks, feelings of exploitation.
  - **The effect on society:** loss of trust among people, the spread of unethical behaviours, weakening of the local economy.
  - **The effect on original companies:** financial losses, decline in innovation and creativity.
- **Discuss with the students** the reasons for commercial fraud and ask them to consider the causes of this phenomenon.
- **Discuss with the students** the role of individuals and society in combating commercial fraud.
- **Emphasise to the students** the importance of honesty as a personal integrity and societal behaviour.

Salts

- **Explain to the students** that salts are not just the table salt we know, but rather they are chemical compounds that form the basis of many reactions in nature. They are produced as a result of the reaction between acids and alkalis and are found everywhere around us: in the seas, in the soil and even within our bodies.
- **Clarify to the students** that most salts are ionic compounds resulting from the reaction between acids and alkalis, consisting of the combination of a cation of an alkali with an anion of an acid.


Salts

Previously, you knew some types of chemical compounds like oxides, acids and alkalis, there is another type of compound is known as salts, most of them are ionic compounds produced from the reaction of the acids with the alkalis, it is formed by the combination of a cation of an alkali with an anion of an acid.

Activity 3 Conclude

Study the figures (24) : (27), to fill in the shown spaces by :
1. The name of each ion.
2. The molecular formula of the formed salt.

cation anion
Sodium nitrate
Figure (24)

cation anion
Calcium sulphate
Figure (25)

cation anions
Magnesium chloride
Figure (26)

cations anion
Ammonium carbonate
Figure (27)

It is concluded from the previous that :
- The molecule of the salt can be formed by the combination of :
  - Metal ion and nonmetal ion, except negative oxygen anion (O^{2-} oxide)
  - Ion of one element with ion of one atomic group, except hydroxide group (OH^-).
  - Ions of two atomic groups.
- When the same atomic group is repeated in the molecular formula of the compound, it is written between brackets, and the number of its repetitions below it.
- Naming of the salt begins with the name of the cation followed by the name of the anion.

LESSON THREE | Chemical indicators and salts 23

Activity 3 Conclude

- **Objective of the activity:** To conclude the components of a salt molecule.
- **Ask the students** to study the figures from (24) to (27) and fill in the blanks indicated on them with the appropriate information: the name of each ion and the molecular formula of the formed salt.
  1. Figure (24): Sodium cation, nitrate anion, $NaNO_3$
  2. Figure (25): Calcium cation, sulphate anion, $CaSO_4$
  3. Figure (26): Magnesium cation, chloride anions, $MgCl_2$
  4. Figure (27): Ammonium cations, carbonate anion, $(NH_4)_2CO_3$
- **Ask the students based on the previous examples, what is a salt molecule composed of ?**
  1. Figure (24): Sodium ion and nitrate group, $NaNO_3$
  2. Figure (25): Calcium ion and sulphate group, $CaSO_4$
  3. Figure (26): Magnesium ion and chloride ion, $MgCl_2$
  4. Figure (27): Carbonate group and ammonium group, $(NH_4)_2CO_3$
- **Explain to the students** that a salt molecule can be formed from the combination of:
  1. A metal ion and a nonmetal ion, except negative oxygen ion O^{2-}
  2. A single element ion and a polyatomic ion, except hydroxide group OH^-
  3. Two ions from polyatomic groups.
- **Ask the students** in figure (27) why the Ammonium group is written in brackets with the number 2 below it?
- **Clarify to the students** that when the same polyatomic group is repeated in the molecular formula of the compound, the group is written between brackets and number of its repetitions below it.
- **Explain to the students** that the naming of the salt begins with the name of the cation followed by the name of the anion.

Properties of Salts

Use the discovery learning strategy

- **Start the topic with the students** by conducting an exploratory activity.
- Bring different salts (zinc sulphate, sodium carbonate, copper sulphate).
- **Divide the students** into groups and give each group a sample, asking them to:
  1. Observe the colour and texture.
  2. Dissolve a small amount in water and note whether it dissolves completely.
  3. Measure the electrical conductivity of the solution (if equipment is available).
- **Ask the students:** What differences have you observed between the substances? How can these differences be explained based on the properties of salts?
- **Explain to the students** that salts differ from one another in terms of colour, solubility in water and the pH value of their solutions.
- **Ask the students** to observe (Figure 28) and explain that salts are solid substances, some of them are white in colour, such as zinc sulphate and sodium carbonate, while others are coloured, such as blue copper sulphate and green nickel chloride.
- **Explain to the students** that some salts soluble in water to form solutions, such as copper sulphate, nickel chloride and all sodium, potassium, ammonium and nitrate salts.
- **Explain to the students** that some salts are insolube or sparingly soluble in water, such as silver chloride, calcium sulphate and all carbonate salts, (except sodium, potassium and ammonium carbonates) (Figure 29).


Properties of Salts

- Salts are differ from each other in their colours, solubility in water and the pH of their solutions.
- Salts are solid substances, some of them are white in colour, such as zinc sulphate salt $ZnSO_4$, sodium carbonate salt Na_2CO_3 and some are coloured, such as the blue copper sulphate salt $CuSO_4$, and the green nickel chloride salt $NiCl_2$ (Figure 28).

Figure (28)
Solid salts

- Some salts are soluble in water, they form solutions, such as copper sulphate, nickel chloride and all sodium, potassium, ammonium and nitrate salts.
- Some of them are insoluble or sparingly soluble in water, such as silver chloride AgCl, calcium sulphate $CaSO_4$, and all carbonate salts (except sodium, potassium and ammonium carbonate salts) (Figure 29).

Figure (29)
Sodium carbonate dissolves in water, while calcium carbonate does not dissolve in water

Integration with Physics science

Salinity of the Dead Sea is the highest in the world, it is almost 10 times saltier than the Red sea, so it is not possible to drown in it (Figure 30), where the high percentage of salts found in water leads to increasing the density of this water.

Figure (30)
High salinity and density of Dead Sea water

Information and Communication Technology

Watch educational videos that demonstrate how to make soap which is considered a salt.

24 UNIT ONE : Chemical Substances

Integration with Physics science

Dear Teacher:

The Dead Sea is one of the saltiest bodies of water in the world, located in the Jordan Valley between Palestine and Jordan. It is a unique environment due to its high salinity, which is up to 10 times that of the Red Sea.

- **Ask the students:** Why do swimmers float easily on the surface of the Dead Sea without any effort?
- **Explain to the students** that the density of water depends on the amount of dissolved salts in it and due to the high concentration of salts in the Dead Sea, the water's density becomes much higher than that of the human body. This high density makes the Dead Sea one of the easiest places to float (Figure 30).

Information and Communication Technology

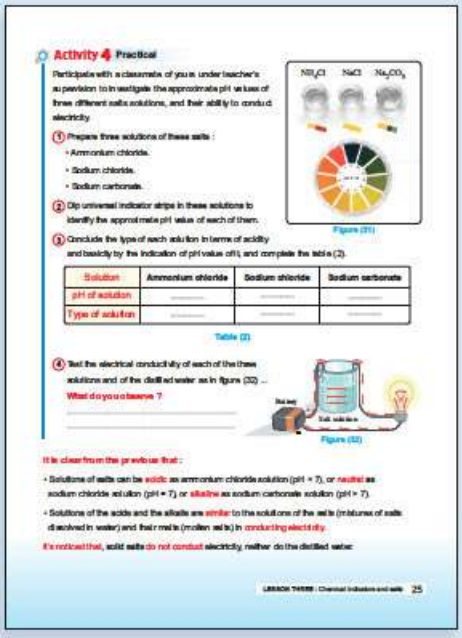
- **Ask the students** to watch educational videos that demonstrate how to make soap, which is considered a salt.

Activity 4 Practical

- The aim of this activity is to discover the properties of some salts.
- **Used tools :** Ammonium chloride solution, sodium chloride solution, sodium carbonate solution, universal indicator strips, electrical circuit.
- **Divide the students** into collaborative groups.
- **Ask the students** to investigate the approximate pH values of three different salt solutions using universal indicator strips (Figure 31).
- **Ask the students** to record their answers in Table (2).

Solution	Ammonium chloride	Sodium chloride	Sodium carbonate
pH of the solution	5	7	9
Type of solution	Acidic	Neutral	Alkaline

- **Ask the students** to discover the conductivity of the three salt solutions and distilled water as shown in (Figure 32).
- **Ask the students** to record their observations.
  The three solutions conduct electricity, while distilled water does not conduct electricity.
- **Explain to the students that salt solutions can be:**
  1. **Acidic**, such as ammonium chloride solution (pH < 7).
  2. **Neutral**, such as sodium chloride solution (pH = 7).
  3. **Alkaline**, such as sodium carbonate solution (pH > 7).
- **Clarify to the students** that acid and alkali solutions are similar to salt solutions and their melts forms (molten salts) in conducting electricity. Solid salts do not conduct electricity, neither do the distilled water.


Activity 4 Practical

Participate with a classmate of yours under teacher's supervision to investigate the approximate pH values of three different salts solutions, and their ability to conduct electricity.

① Prepare three solutions of these salts :
- Ammonium chloride.
- Sodium chloride.
- Sodium carbonate.

② Dip universal indicator strips in these solutions to identify the approximate pH value of each of them.

③ Conclude the type of each solution in terms of acidity and basicity by the indication of pH value of it, and complete the table (2).

Solution	Ammonium chloride	Sodium chloride	Sodium carbonate
pH of solution	.....	.....	.....
Type of solution	.....	.....	.....

Table (2)

④ Test the electrical conductivity of each of the three solutions and of the distilled water as in figure (32) ...

What do you observe ?

.....

.....

Figure (32)

It is clear from the previous that :

- Solutions of salts can be acidic as ammonium chloride solution (pH < 7), or neutral as sodium chloride solution (pH = 7), or alkaline as sodium carbonate solution (pH > 7).
- Solutions of the acids and the alkalis are similar to the solutions of the salts (mixtures of salts dissolved in water) and their melts (molten salts) in conducting electricity.

It's noticed that, solid salts do not conduct electricity, neither do the distilled water.

LESSON THREE : Chemical indicators and salts 25

Closure of the lesson:

- The teacher summarizes all the main ideas of the lesson five minutes before concluding.
- You may participate with the students in the lesson closure by asking them about the concepts covered in the lesson.

Answers of Evaluation Questions on Lesson Three

1 (1) (c)

(2) (b)

(3) (a)

(4) (d)

(5) (d)

(6) (b)

---

2 • **In case of tube (1):** Chlorine gas removes the colour of the two litmus strips.

• **In case of tube (2):** The blue litmus strip turns red.

---

3 (1) Acidic soil is treated by adding basic substances to it, such as calcium hydroxide $Ca(OH)_2$

(2) The flowers acquire red colour.

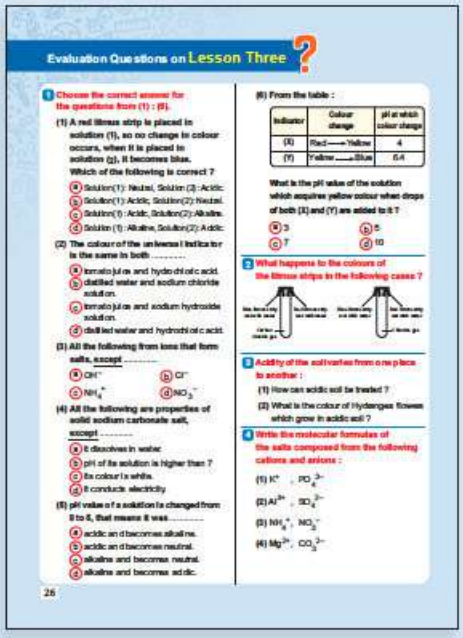
---

4 (1) K_3PO_4

(2) $Al_2(SO_4)_3$

(3) NH_4NO_3

(4) $MgCO_3$


Evaluation Questions on Lesson Three

1 Choose the correct answer for the questions from (1) : (6).

(1) A red litmus strip is placed in solution (1), so no change in colour occurs, when it is placed in solution (2), it becomes blue. Which of the following is correct ?
(a) Solution (1): Neutral, Solution (2): Acidic
(b) Solution (1): Acidic, Solution (2): Neutral
(c) Solution (1): Acidic, Solution (2): Alkaline.
(d) Solution (1): Alkaline, Solution (2): Acidic

(2) The colour of the universal indicator is the same in both .....
(a) tomato juice and hydrochloric acid.
(b) distilled water and sodium chloride solution.
(c) tomato juice and sodium hydroxide solution.
(d) distilled water and hydrochloric acid.

(3) All the following from ions that form salts, except .....
(a) OH^- (b) Cl^-
(c) NH_4^+ (d) NO_3^-

(4) All the following are properties of solid sodium carbonate salt, except .....
(a) It dissolves in water.
(b) pH of its solution is higher than 7
(c) Its colour is white.
(d) It conducts electricity.

(5) pH value of a solution is changed from 8 to 6, that means it was .....
(a) acidic an d becomes alkaline.
(b) acidic an d becomes neutral.
(c) alkaline and becomes neutral.
(d) alkaline and becomes acidic.

(6) From the table :

Indicator	Colour change	pH at which colour change
(X)	Red ⟶ Yellow	4
(Y)	Yellow ⟶ Blue	6.4

What is the pH value of the solution which acquires yellow colour when drops of both (X) and (Y) are added to it ?
(a) 3 (b) 5
(c) 7 (d) 10

2 What happens to the colours of the litmus strips in the following cases ?

3 Acidity of the soil varies from one place to another :
(1) How can acidic soil be treated ?
(2) What is the colour of Hydrangea flowers which grow in acidic soil ?

4 Write the molecular formulas of the salts composed from the following cations and anions :
(1) K^+ , PO_4^{3-}
(2) Al^{3+} , SO_4^{2-}
(3) NH_4^+ , NO_3^-
(4) Mg^{2+} , CO_3^{2-}

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Additional Learning Resources:

- Utilising digital learning resources such as the Egyptian Knowledge Bank, as well as educational videos and films available on websites.

Teaching Support Strategies for Inclusive Education
in Science

Unit One: Chemical Substances

Lesson One: Metals and Nonmetals

Inclusive Education Category	Support Strategies
Intellectual Disability and Slow Learning Hyperactivity and Attention Deficit Autism Spectrum	• Remind the student of the differences between the properties of matter (solid, liquid, gas) using real models or cards and images. • Present dimensional models and illustrated cards of metals first, explaining their key characteristics to the student through practical demonstrations or short videos. Then repeat the process for nonmetals, classifying the cards according to their type, and ask the student to reclassify them independently, providing appropriate feedback. • Use models or coloured magnetic pieces or coloured adhesive foam to clarify the concept of metallic bonding to the student through practical demonstrations, ensuring to use only two colours to represent (cations and the cloud of free electrons). • Use coloured clay to visually explain the concept of alloy formation to the student, and you may show simplified video clips illustrating how alloys are made. • Change the format of assessment questions to multiple choice or matching questions, or true/false questions.
Learning Difficulties	• Remind the student with learning difficulties of the properties of metals and nonmetals, and provide them with a brief comparison table of each property, along with dimensional models if possible, or cards and images. • Explain the concept of metallic bonding to the student through practical demonstrations using coloured models representing both cations and the cloud of free electrons, and illustrate the physical properties through diagrams and symbols indicating the relation between metallic bonding, the hardness of metals and melting points, using different colours. • Remind the student of the information included in the evaluation questions and evaluate them in reading the questions.
Hearing Impaired	• Write a list of the terms covered in the lesson (metal, nonmetal, metallic bond, alloys) and support it with visual hints or illustrations of their meanings. • Allow the hearing-impaired student to perform the KWL strategy (Know, Want to know, Learned) in collaboration with a classmate. • Use practical demonstrations with the hearing-impaired student to differentiate between the properties of metals and nonmetals. • Summarize the properties of metals and nonmetals for the hearing-impaired student in a table regarding electrical conductivity, malleability and luster, using visual hints for meaning. • Summarize the key and important information from the lesson in short phrases and write them on the board, guiding the hearing-impaired student to identify them in their book and monitor their progress. • Use colour coding for terms and important words expressed in the summarized phrases written on the board. • Present an illustrative diagram to the hearing-impaired student showing the relation between the number of valence electrons, the strength of metallic bonds and melting points, and explain it to them. • Share with the hearing-impaired student a story about the mixing of metals to make (swords) through illustrated cards or drawings representing the events. • Utilise illustrations and summary tables when answering evaluation questions.

Inclusive Education Category	Support Strategies
The Blind and the Visually Impaired	• Use tactile models made of metals for blind students to identify them (sodium, copper, zinc, silver). • The blind student's knowledge of colour and luster will be merely informational. • Present (Figure 9) as a tactile model so that the blind student can recognize the metallic bond in aluminum and the metallic bond in sodium. • Provide a dimensional representation of the bronze alloy structure.

Unit One: Chemical Substances

Lesson Two: Acids and Alkalis

Inclusive Education Category	Support Strategies
Intellectual Disability and Slow Learning Hyperactivity and Attention Deficit Autism Spectrum	• Write the segments that end the names of anions and the acids formed from them, as well as the segment that begins the naming of alkalis, on coloured cards and arrange the cards to form the correct molecular formula for the acids and alkalis. Repeat the words clearly and allow the student to repeat after you, providing appropriate feedback to ensure they can pronounce the names correctly. • Use a practical demonstration strategy to illustrate the properties of acids and alkalis, as well as the relations between alkalis, nonmetals and acids whenever possible.
Learning Difficulties	• Summarize the molecular formula for both acids and alkalis for the student in the form of mind maps, ensuring that the segments that end the names of anions and the acids formed from them, as well as the segment that begins the naming of alkalis, are coloured differently as described in Activity (1). • Summarize the properties of acids and alkalis for the student in a table on the board, using practical demonstrations or video clips to illustrate Activity (2) and Activity (3). • Summarize the relation between metals, alkalis, nonmetals, and acids for the student in a table on the board, using a diagram to illustrate the transformations that occur in metals when they burn, using arrows and numbers.
Hearing Impaired	• Provide a practical experiment for the hearing-impaired student that demonstrates the connection between the behaviour of acids and alkalis and ionization in water. • Summarize the ionization of acids and alkalis in water for the hearing-impaired student in an illustrative diagram. • Use animated videos to show how atomic groups form within chemical compounds. You may refer to websites such as (Khan Academy or YouTube). • Use plastic models or small balls to represent atoms and connect them loosely to represent chemical bonds, illustrating the partial structure of the group for the hearing-impaired student. • Prepare boards or screens displaying atomic groups with their chemical symbols in a large and clear manner, such as (hydroxide group OH^-, nitrate group NO_3^-, sulphate group SO_4^{2-}), ensuring each group is coloured differently for easier identification by the hearing-impaired student.
The Blind and the Visually Impaired	• When conducting laboratory experiments, consider safety and security factors for blind students. • The blind student's awareness of the (colour of the litmus strip) will be merely information that they need to be aware of.

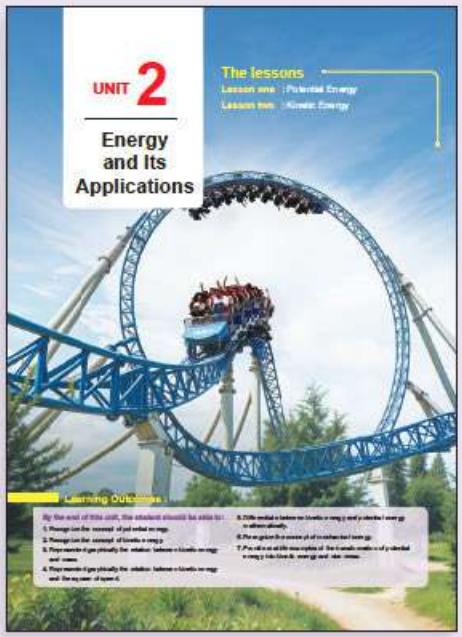
Inclusive Education Category	Support Strategies
Intellectual Disability and Slow Learning **Hyperactivity and Attention Deficit** **Autism Spectrum**	• Present the tools used in the lesson activities to the student, allowing them to explore these with their senses and distinguish between them in terms of shape and colour. Implement the activities practically, ensuring that each activity is broken down into short segments, and allow the student to mimic the steps while adhering to safety and security protocols during execution. • Explain the concept of salts to the student using models or diagrams to illustrate how they are formed through the reaction of acids with alkalis. • Summarize the properties of salts for the student in specific points due to their difficulty in inference.
Learning Difficulties	• Summarize the concept of chemical indicators for the student on the board in a short sentence, writing the names of the materials and tools used in the activities and linking them to their visual or real forms if possible, so the student can recognize them visually. • Summarize the results of Practical Activity (1) for the student in a mind map on the board. • Write a table on the board to compare the types of salts mentioned in the lesson in terms of (colour – solubility in water) and assist the student in reading the table and the names of the salts and their chemical symbols correctly.
Hearing Impaired	• Provide a list supported by visual hints or drawings for the new terms in the lesson (Chemical indicator-Litmus strip ....). • Use practical demonstrations with the hearing-impaired student to clarify the concept of chemical indicators. Present an infographic to the hearing-impaired student to illustrate the importance of the pH scale. Explain to the hearing-impaired student through practical experimentation that litmus strip only indicates whether the solution is acidic or not, without specifying strength. • Prepare a board or screen displaying the pH scale for the hearing-impaired student in a large and clear manner, using expressive body language to illustrate the colour coding in the drawing for both strong and weak acids. • Write important ideas and information from the lesson on the board directly in short, separate statements, ensuring each statement contains only one piece of information. • Summarize for the hearing-impaired student strong and weak acids in the form of equations as follows: (pH = 0 to 1 ⟶ Strong acid), (pH = 3 to 6 ⟶ Weak acid) using colour differentiation in writing the numbers and phrases.
The Blind and The Visually Impaired	• The blind student should learn that the colour of the litmus strip will be merely information that must be known. • Introduce the blind student to the specific values associated with each colour on the universal litmus strips for identifying pH values. • Present the shapes involved in Activity (3) in a dimensional format so that the blind student can distinguish between anions and cations in the four shapes. • In Figure (30), provide the blind student with an experiment to understand the concept of objects floating on the surface of the Dead Sea.

Unit Two: Energy and Its Applications

Introduction to the Unit

Energy is the basic upon which all natural phenomena and human activities rely. It plays a vital role in operating devices, transporting vehicles, powering factories and even in the biological processes within our bodies. Energy is a fundamental concept in the sciences, and its forms vary between kinetic, thermal, electrical, chemical, nuclear and others. Among its many forms, potential energy and kinetic energy stand out as two main types that reflect how energy is stored or used.

In this unit, we will explore the relation between potential energy and kinetic energy, and how energy can transform between these two forms in our daily lives. We will also learn about the applications of this transformation, such as the motion of falling objects, the operation of swings, or even the mechanisms of amusement park rides. Through this, we will understand how position and motion affect energy quantities and their significance in various physical systems.



Learning Outcomes

By the end of this unit, students will be able to:

1. Recognize the concept of potential energy.
2. Recoginze the concept of kinetic energy.
3. Represented graphically the relation between kinetic energy and mass.
4. Represented graphically the relation between kinetic energy and the square of speed.
5. Differentiate between kinetic energy and potential energy mathematically.
6. Recognize the concept of mechanical energy.
7. Provide real-life examples of the transformation of potential energy into kinetic energy and vice versa.

Unit Lessons and time period.

The unit includes two lessons:

- **Lesson One:** Potential Energy (Two periods).
- **Lesson Two:** Kinetic Energy (Two periods).

Activities and Educational Resources

The unit includes various activities and resources including:

- **Activities:** Discovery – Prediction – Inference – Deduction – process
- **Resources:** Images – Videos – Internet – Laboratory tools.

Teaching strategies

There are various active learning strategies, including:

Laboratory Experiments: A method that provides students with direct sensory practical experience by employing all senses in learning about the phenomenon being studied.

Cooperative Learning: An educational strategy where students are divided into small heterogeneous groups to achieve common goals, namely completing the required tasks with each member responsible for their own learning and that of their peers.

Discussion: An educational method that relies on dialogue between the teacher and the student or among students under the teacher's supervision, aimed at recalling old information or arriving at new information, based on prepared questions for this purpose.

Brainstorming:

- A method used to generate the largest number of ideas, regardless of their type or level, to address a topic in an environment characterised by freedom and safety in expressing ideas.

Concept Maps:

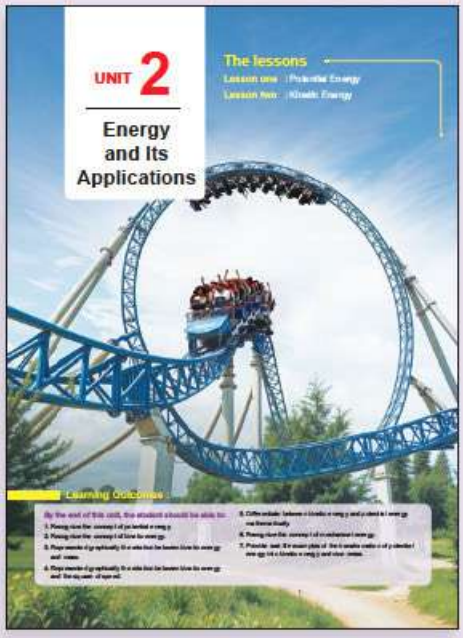
- These are diagrams that highlight the relation between concepts, placing lesser concepts under higher ones and linking them with words that clarify the relation between the concepts.

Similarities Strategy:

- This strategy focuses on linking unfamiliar concepts with familiar ones. It emphasises the interconnection of the cognitive structure and aims to ensure the retention of learning.

Educational Games Strategy:

- An educational activity governed by rules chosen by the teacher to achieve the objectives of a specific lesson, relying on the element of friendly competition among students, either individually or in groups. It should be noted that there is no single best method; rather, there is a method that is most suitable for a particular teaching situation.

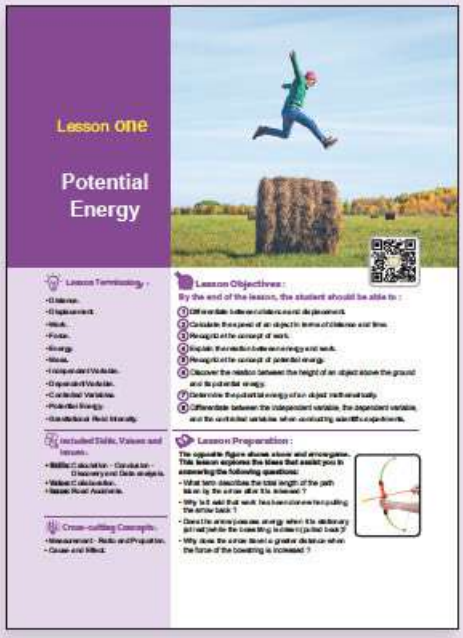


Assessment Methods:

There are various assessment methods in the unit including :

- **Diagnostic Assessment:** Pre-tests.
- **Formative Assessment:** Oral questions – assignments – research activities.
- **Summative Assessment:** End-of-unit tests.
- **Self-Assessment:** Evaluate your understanding.

Lesson One:
Potential Energy



Introduction

The first lesson of this unit addresses the topic of potential energy, which surrounds us everywhere and is responsible for many natural phenomena and daily applications.
In this lesson, we will explore the concept of potential energy and the factors that affect it. Through this lesson, students will acquire a range of new concepts, and the lesson aims to develop skills in discovery, inference, and deduction.

Lesson Objectives:

1. Differentiate between distance and displacement.
2. Calculate the speed of an object in terms of distance and time.
3. Recognize the concept of work.
4. Explain the relation between energy and work.
5. Recognize the concept of potential energy.
6. Discover the relation between the height of an object above the ground and its potential energy.
7. Determine the potential energy of an object mathematically.
8. Differentiate between the independent variable, the dependent variable and the controlled variables when conducting scientific experiments.

Teaching Aids and Learning Resources Used:

Data show – films – student book images – the internet – science laboratory.

Duration and place of Teaching:

Two periods (4 sessions) – classroom and multimedia lab – science laboratory.

Lesson Terminology :

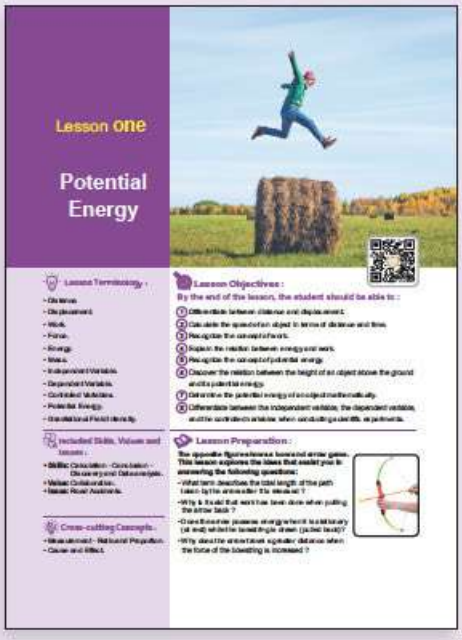
- Distance
- Displacement
- Work
- Force
- Energy
- Mass
- Independent Variable
- Dependent Variable
- Controlled Variables
- Potential Energy
- Gravitational Field Intensity

Misconceptions or Incorrect Concepts:

- **Some students believe** that potential energy means that an object always contains energy; however, potential energy is not always available, as it depends on the object's position or state relative to a specific force (such as gravity).
- **Some students believe** that potential energy depend only on the height of the object; however, it depends on several factors, such as mass, height relative to a reference point and the intensity of the gravitational field.
- **Some students believe** that a light object does not possess potential energy; however, every object with mass and height has potential energy, although it is lower for smaller mass objects compared to larger ones at the same height.

Diagnostic Assessment:

- **Ask the students** to examine the lesson preparation image and attempt to answer the questions, using these questions as a diagnostic assessment to gauge the student's prior knowledge about the lesson and to uncover any misconceptions they may have.
- **Listen carefully** to the students' answers to these questions and ask them to explain their reasons behind their responses.
- **Clarify to them** that the correct answers to these questions will be revealed through the explanation of this lesson.


Lesson one

Potential Energy

Use Diverse Teaching Strategies:

You can use K.W.L strategies, discussion, cooperative learning, and numbered heads.

- **At the beginning of the lesson**, use the K.W.L strategy (What do you know? – What do you want to know? – What have you learned?).
- **Draw a (K.W.L) table** on the board, reminding the students of this strategy:

What do you know? (K)	What do you want to know? (W)	What have you learned? (L)

Before explaining the lesson :

- Ask the students to write down the knowledge they already know about potential energy in the first column (What do you know?).
- Then, Have them write the new information they wish to learn about potential energy in the second column (What do you want to know?).

After Explaining the Lesson:

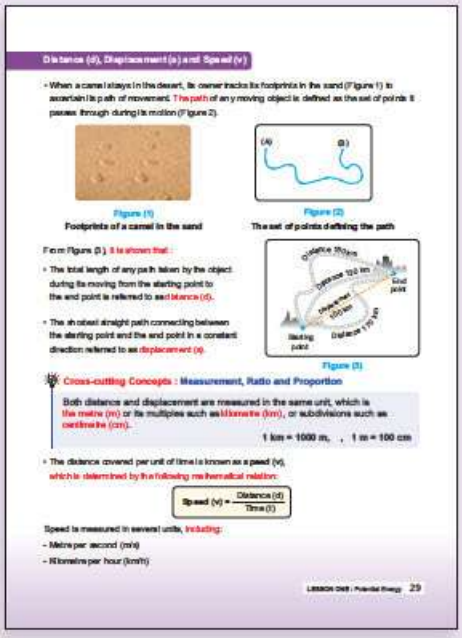
- Ask the students to write down the knowledge they have gained about potential energy in the third column (What have you learned?).

Preparing the Lesson:

- **Draw a simple circular path** on the board and ask the students to imagine a runner running around it. Then ask the students: "If the runner starts from a certain point and returns to it after completing a full lap, what distance has he covered? Is his final position different from his initial position?"
- **Ask the students another question:** "When your parent drives a car over a long distance, is the distance they have travelled always equal to the straight line between the starting point and the end point? How can we measure that?"
- **Encourage the students** to provide answers and open a discussion about the difference between the path in both cases.
- **Make the students** reflect on the difference between straight distance and the path they take.

Distance (d), Displacement (s), and Speed (v):

- **Explain to the students** that when a camel strays in the desert, its owner tracks its footprints in the sand (Figure 1) to determine its path of movement.
- **Mention to the students** that the path of any moving object is defined as the set of points that it passes through during its motion (Figure 2).
- **Clarify the difference** between distance and displacement; distance is the total length of any path taken by an object during its moving from the starting point to the end point, whereas displacement is the shortest straight path connecting between the starting point and the end point in a constant direction.
- **Provide an example** from the students' personal experiences and ask them: "Think about your journey from home to school: do you always take the shortest route, or do you sometimes take a longer route due to turns or traffic lights? How does the distance you travel differ from the displacement between home and school?"
- **Ask two students** to walk along different paths: one in a straight line and the other along a curved path, ensuring both end at the same point.
- **Ask the students:** "Which path represents the displacement? And which represents the distance?"
- **Ask the students examine** (Figure 3) in the student's book, which illustrates the path of an object from the starting point to the end point, and determine the values of **distance and displacement**.


Distance (d), Displacement (s) and Speed (v)

- When a camel strays in the desert, its owner tracks its footprints in the sand (Figure 1) to ascertain its path of movement. The path of any moving object is defined as the set of points it passes through during its motion (Figure 2).

Figure (1)
Footprints of a camel in the sand

Figure (2)
The set of points defining the path

From Figure (3), it is shown that:

- The total length of any path taken by the object during its moving from the starting point to the end point is referred to as distance (d).
- The shortest straight path connecting between the starting point and the end point in a constant direction referred to as displacement (s).

Figure (3)

Cross-cutting Concepts : Measurement, Ratio and Proportion

Both distance and displacement are measured in the same unit, which is the metre (m) or its multiples such as kilometre (km), or subdivisions such as centimetre (cm).

1 km = 1000 m, , 1 m = 100 cm

- The distance covered per unit of time is known as speed (v), which is determined by the following mathematical relation:

$$\text{Speed (v)} = \frac{\text{Distance (d)}}{\text{Time (t)}}$$

Speed is measured in several units, including:

- Metre per second (m/s)
- Kilometre per hour (km/h)

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Cross-cutting Concepts: Measurement, Ratio, and Proportion:

Dear Teacher:

- **It is essential to** understand various measurements of phenomena, in terms of size, time, and energy, and to recognize the impact of changes in size, ratio, or quantity on the structure or performance of the system, as well as to comprehend different sizes, ratios, energy rates, and the relative relations between quantities and their changes related to a specific phenomenon.
- Measurement, ratio, and proportion can be easily linked to units of distance measurement, as these concepts play an important role in determining the relations between actual distances and those measured in models or maps.
- **Encourage students** to convert real distances into different units (metres (m), kilometres (km), centimetres (cm)).
- **Show an image** or a short video representing a runner or a car moving between different points at varying speeds.
- **Ask:** "How do we measure speed? Is speed always constant?"
- **Mention to the students** the definition of speed (v), which is: the distance covered per unit of time.
- **Explain to the student** the law of measurement the speed and its units.

Mathematical Understanding:

- **Ask the students to** calculate the speed of an object that covers a distance of 8 m in a time of 2 s
- **Ask the students** to write down the law first, then substitute the given values, and finally perform the division.
- **Emphasise to the students** the importance of writing the unit of measurement (m/s).

Issue for Discussion

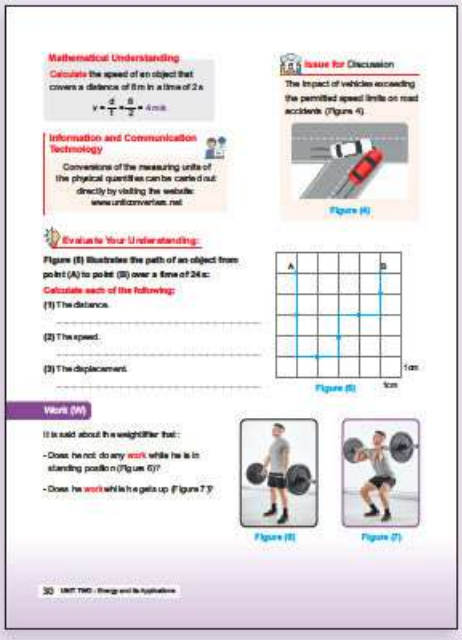
- Discussing the issue of "the impact of vehicles exceeding the permitted speed limits on road accidents" (Figure 4) serves as an opportunity to enhance their road safety awareness and connect scientific and social concepts with practical examples.
- **Start the discussion** by posing the following question to the students: "What do you know about the importance of adhering to speed limits on roads?" and what factors may lead to road accidents?
- **You may present statistics** on road accidents and their causes (such as excessive speed and using a mobile phone while driving).
- **Explain the relation** between speed and stopping distance and how increasing speed affects the length of the stopping distance and increases the likelihood of a collision.
- **Discuss with the students** the impacts of accidents on individuals and society (human and material losses) and why do some people exceed the speed limits?
- **Ask the students** the following question: what are the possible solutions could reduce accidents resulting from excessive speed?

Information and Communication Technology

- **Explain to the students that** technology has assisted us in performing conversions of measuring units of the physical quantities directly.
- **Ask the students** to visit the website:

www.unitconverters.net

and use it to convert units of distance and speed.



Mathematical Understanding

Calculate the speed of an object that covers a distance of 8 m in a time of 2 s

$v = \frac{d}{t} = \frac{8}{2} = 4$ m/s

Information and Communication Technology

Conversions of the measuring units of the physical quantities can be carried out directly by visiting the website: www.unitconverters.net

Issue for Discussion

The impact of vehicles exceeding the permitted speed limits on road accidents (Figure 4)

Figure (4)

Evaluate Your Understanding:

Figure (5) illustrates the path of an object from point (A) to point (B) over a time of 24 s:

Calculate each of the following:

(1) The distance.

(2) The speed.

(3) The displacement.

Figure (5)

Work (W)

It is said about the weightlifter that:

- Does he not do any work while he is in standing position (Figure 6)?
- Does he work while he gets up (Figure 7)?

Figure (6) Figure (7)

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Evaluate Your Understanding

- **Ask the students to** evaluate their understanding by calculating the distance, speed, and displacement of an object along its path as shown in (Figure 5) over a time of 24 s:

(1) The distance: $d = 4 + 2 + 2 + 2 = 12$ cm

(2) The speed: $v = \frac{d}{t} = \frac{12}{24} = 0.5$ cm/s

(3) The displacement: $s = AB = 4$ cm

Work (W)

- **Pose the following preliminary questions to the students:** Have you ever pushed a stationary car? Did you feel tired? If you tried to push a wall, would it move? Would you be doing work?
- **Explain to the students that** you may exert effort, but does that mean you have accomplished work?!
- **Ask the students to** observe Figures (6) and (7) in the student book, then ask them why it is said that a weightlifter does not do work while in a standing position (Figure 6), while he do work while he gets up (Figure 7)?

Activity 1 Conclude

The aim of this activity is to discover the concept of work.

- **Used Tools:** Table (1) in the student's book.
- Ask the students to study Table (1) and answer the following questions:

① **When** does a force do work?
When the direction of its effect is in the same direction of the motion.

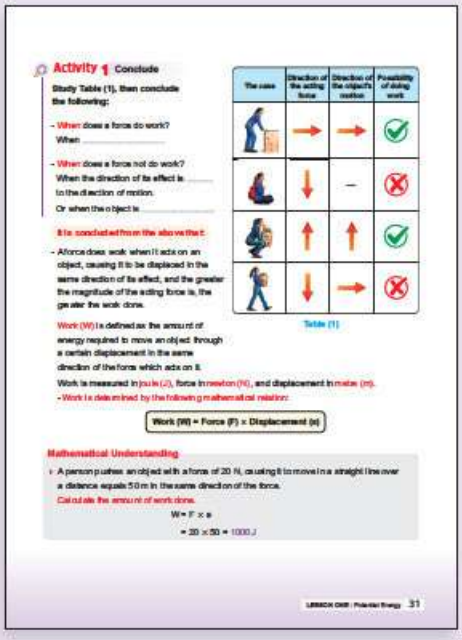
② **When** does a force not do work?
When the direction of its effect is perpendicular to the direction of motion or when the object is at rest.

- Explain to the students that work occurs when a force acts on an object, causing the object to move in the direction of the effect of that force over a certain distance.
- Clarify to the students that work is done when a force acts on an object, resulting in its displacement in the same direction of the effect of the force, and the greater the magnitude of acting force is, the greater the work done.
- Define work (W) to the students as the amount of energy required to move an object through a certain displacement in the same direction of the effect of the force which acts on it.
- Explain to the students that work is measured in joule (J), force in newton (N), and displacement in metre (m).
- Clarify to the students the mathematical relation used to determine the value of work:

Work (W) = Force (F) × Displacement (s)

Mathematical Understanding

- **Ask the students** to calculate the amount of work done when a person pushes an object with a force of 20 N, causing it to move in a straight line over a distance of 50 m in the same direction of the force.



- **Ask the students** to write the law first, then substitute the given values, and finally perform the calculation.
- **Emphasise to the students** the importance of writing the unit of measurement (joule J).

Analytical Thinking

- This activity aims to apply the work calculation law.

Use the numbered heads strategy.

- **Divide the students** into small groups (4-6). Each student takes a specific number, for example, (1, 2, 3, 4, ...) instead of their name.
- **Ask the students** to examine figures (8:11) and perform calculations to determine the numbers of the two robots that do the same amount of work.
- **Ask each student** to think about the answer individually, then have the students put their heads together to discuss and agree on an answer.
- **Select a number** and ask the students with that number from each group to present their answers.
- **Identify the group** that earned the most points in the lesson and award marks based on group performance.

① Robot 1:

$W = 20 \times 3 = 60$ J

② Robot 2:

$W = 30 \times 3 = 90$ J

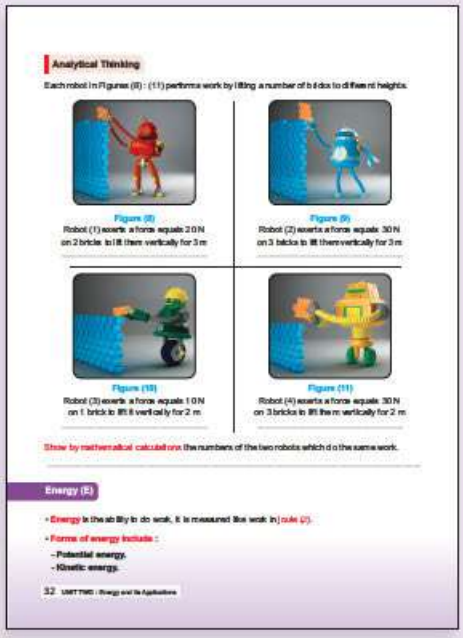
③ Robot 3:

$W = 10 \times 2 = 20$ J

④ Robot 4:

$W = 30 \times 2 = 60$ J

- **Explain to the students that** Robot (1) does the same amount of work as Robot (4).


Analytical Thinking

Each robot in Figures (8) : (11) performs work by lifting a number of bricks to different heights.

Figure (8)
Robot (1) exerts a force equals 20 N on 2 bricks to lift them vertically for 3 m

Figure (9)
Robot (2) exerts a force equals 30 N on 3 bricks to lift them vertically for 3 m

Figure (10)
Robot (3) exerts a force equals 10 N on 1 brick to lift it vertically for 2 m

Figure (11)
Robot (4) exerts a force equals 30 N on 3 bricks to lift them vertically for 2 m

Show by mathematical calculations the numbers of the two robots which do the same work.

Energy (E)

- Energy is the ability to do work, it is measured like work in joule (J).
- Forms of energy include :
  - Potential energy.
  - Kinetic energy.

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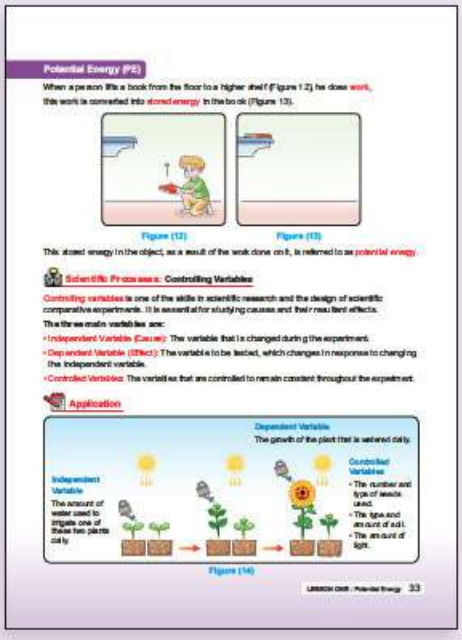
Energy (E)

- **Pose the following introductory questions to the students:** What makes a car move? How do electrical devices like a fan or a phone work? Have you noticed how we feel active after eating?
- **Clarify to the students** that all these examples depend on a common concept which is energy. Energy is the ability of an object to do work or cause a change, whether in motion, light, heat, or other forms.
- **Explain to the students** the concept of energy as the ability to do work, measured in joule (J).
- **Inform the students** that energy exists in multiple forms, including potential energy and kinetic energy.

Potential Energy (PE)

- **Explain to the students** that when a person lifts a book from the floor to a higher shelf (Figure 12), he does work that is converted into stored energy in the book (Figure 13). This stored energy in the object, as a result of the work done on it, is known as potential energy.


Potential Energy (PE)

When a person lifts a book from the floor to a higher shelf (Figure 12), he does work, this work is converted into stored energy in the box (Figure 13).

Figure (12) Figure (13)

This stored energy in the object, as a result of the work done on it, is referred to as potential energy.

Scientific Processes: Controlling Variables

Controlling variables is one of the skills in scientific research and the design of scientific comparative experiments. It is essential for studying causes and their resultant effects.

The three main variables are:

- Independent Variable (Cause): The variable that is changed during the experiment.
- Dependent Variable (Effect): The variable to be tested, which changes in response to changing the independent variable.
- Controlled Variables: The variables that are controlled to remain constant throughout the experiment.

Application

Dependent Variable
The growth of the plant that is watered daily.

Independent Variable
The amount of water used to irrigate one of these two plants daily.

Controlled Variables
- The number and type of seeds used.
- The type and amount of soil.
- The amount of light.

Figure (14)

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Scientific Processes: Controlling Variables

Dear Teacher :

- **Controlling Variables** is one of the essential skills in scientific research and the design of scientific comparative experiments. It is essential for studying causes and their resultant effects.
- **The three main variables are:**

- Independent Variable:

  This is the variable that is changed during the experiment.

- Dependent Variable:

  This is the variable that is tested and changes in response to change the independent variable.

- Controlled Variables:

  These are the variables that are controlled to remain constant throughout the experiment.

- **The aim of this process is for the student to be able to:**

1. Identify the variables that may affect a situation, event or experiment.
2. Differentiate between independent, dependent, and controlled variables in the situation or experiment and distinguish between them.
3. Distinguish between conditions that keep a certain factor constant and conditions that do not maintain one of the factors.
4. Conduct a test to determine the effect of one or more independent variables on a dependent variable.
5. Control the variables that are not part of the experimental hypothesis.

Application

- **Explain to the students** that (Figure 14) illustrates an experiment to study the effect of the amount of water on plant growth.
- **The experiment:** Two pots of the same size containing the same amount and type of soil, the same number and type of seeds used, and the same amount of light, are watered with different amounts of water.
- **Clarify to the students the types of variables in this experiment:**

1. **Independent Variable:** The amount of water used to irrigate one of the plants daily.
2. **Dependent Variable:** The growth of the plant that is watered daily.
3. **Controlled Variables:** The number and type of seeds used, the type and amount of soil and the amount of light.

What are the factors affecting the potential energy of the objects?

Activity 2 Discover

- This activity aims to explore the factors that affect the potential energy of 3 glass marbles.
- **Used tools :** A basin filled with fine sand – 3 glass marbles of different weights – a metric ruler.

Using cooperative learning strategy:

1. Divide the students in the class into equal-sized groups (4-6) with different levels.
2. Ask each group to choose a name for their group.
3. Ask each group to carry out the activity.
4. Assign a role to each student within the group.
5. Ask each group to present their observations and conclusions to the other groups and discuss them with one another.
6. Discuss the students about what they have discovered.
7. Correct any incorrect answers provided by the students.

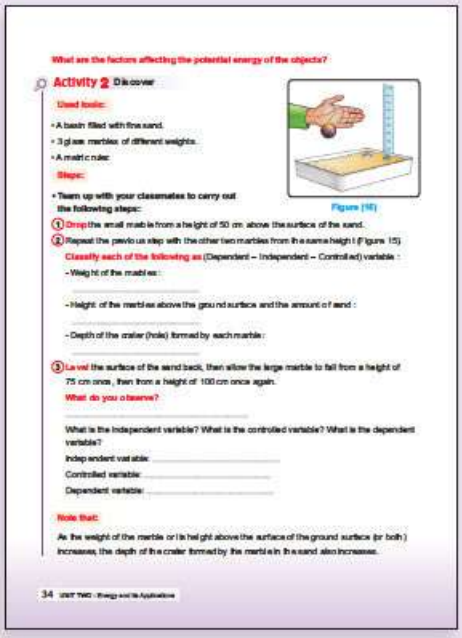
- **Ask the students to carry out the following steps:**
  1. Drop the small marble from a height of 50 cm above the surface of the sand.
  2. Repeat the previous step with the other two marbles from the same height (Figure 15).

Then ask the students to classify the following into (dependent, independent, controlled) variables :

- Weight of the marbles: Independent variable.
- Height of the marbles above the ground surface and the amount of sand: Controlled variables.
- Depth of the crater (hole) formed by each marble: Dependent variable.

3. Ask the students to level the surface of the sand back, then allow the large marble to fall from a height of 75 cm once and from 100 cm another time. What do you observe?

   The depth of the crater (hole) formed by the marble increases with the height from which it is dropped.


What are the factors affecting the potential energy of the objects?

Activity 2 Discover

Used tools:

- A basin filled with fine sand.
- 3 glass marbles of different weights.
- A metric ruler.

Steps:

- Team up with your classmates to carry out the following steps:

Figure (15)

1. Drop the small marble from a height of 50 cm above the surface of the sand.
2. Repeat the previous step with the other two marbles from the same height (Figure 15).

Classify each of the following as (Dependent – Independent – Controlled) variable :

- Weight of the marbles:
- Height of the marbles above the ground surface and the amount of sand :
- Depth of the crater (hole) formed by each marble:

3. Level the surface of the sand back, then allow the large marble to fall from a height of 75 cm once, then from a height of 100 cm once again.

What do you observe?

What is the independent variable? What is the controlled variable? What is the dependent variable?

Independent variable:
Controlled variable:
Dependent variable:

Note that:

As the weight of the marble or its height above the surface of the ground surface (or both) increases, the depth of the crater formed by the marble in the sand also increases.

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- **Ask the students** to identify what is the independent variable ? what is the controlled variable ? and what is the dependent variable ?

Independent variable: Height of the marble above the ground surface.

Controlled variables: Weight of the marble and amount of sand.

Dependent variable: Depth of the crater formed by the marble each time.

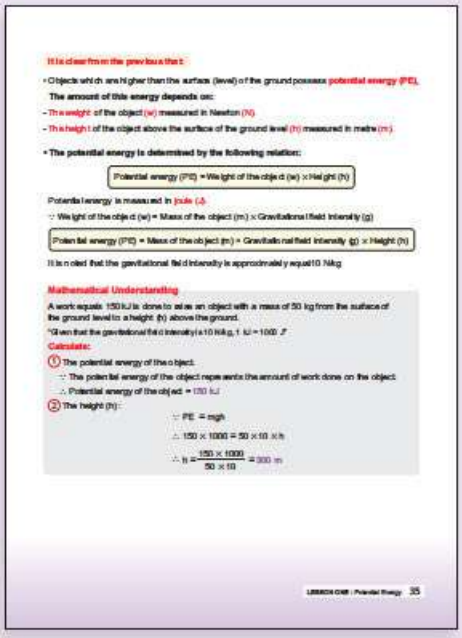
- **Explain to the students** that as the weight of the marble or its height above the ground surface or both, increase, the depth of the crater formed by the marble in the sand also increases.

- **Use an image** or a short video showing a dam or a person jumping from a height into water and ask them: "What is the relation between the height of an object and the energy it can generate?"
- **Allow the students** to reflect on this idea and deduce the importance of the object's position in storing energy.
- **Explain to the students** that elevated objects above the ground possess potential energy (PE), the amount of this energy depends on:

① The weight of the object (w), measured in Newton (N).

② The height of the object above the surface of ground level (h), measured in metre (m).

- **Clarify to the students** the mathematical relation for determining potential energy.



It is clear from the previous that:

• Objects which are higher than the surface (level) of the ground possess potential energy (PE).
The amount of this energy depends on:
- The weight of the object (w) measured in Newton (N).
- The height of the object above the surface of the ground level (h) measured in metre (m).

• The potential energy is determined by the following relation:

Potential energy (PE) = Weight of the object (w) × Height (h)

Potential energy is measured in joule (J).

∵ Weight of the object (w) = Mass of the object (m) × Gravitational field intensity (g)

Potential energy (PE) = Mass of the object (m) × Gravitational field intensity (g) × Height (h)

It is noted that the gravitational field intensity is approximately equal 10 N/kg.

Mathematical Understanding

A work equals 150 kJ is done to raise an object with a mass of 50 kg from the surface of the ground level to a height (h) above the ground.
*Given that the gravitational field intensity is 10 N/kg, 1 kJ = 1000 J.

Calculate:

① The potential energy of the object.
∵ The potential energy of the object represents the amount of work done on the object.
∴ Potential energy of the object = 150 kJ

② The height (h):
∵ PE = mgh
∴ 150 × 1000 = 50 × 10 × h
$\therefore h = \frac{150 \times 1000}{50 \times 10} = 300$ m

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Mathematical Understanding:

- **Ask the students** to calculate the potential energy of the object and the height (h) when 150 kJ of work is done to raise an object with a mass of 50 kg from the surface of the ground to a height (h) above the ground, Given that the gravitational field intensity is 10 N/kg and 1 kJ = 1000 J
- **Ask the students to** write the law first, then substitute the given values, and then perform the division.
- **Emphasise to the students** the importance of writing the units of measurement.

Evaluate your Understanding :

- Ask the students to examine Figure (16), which illustrates the path of a football that has been kicked by a player.
- Identify **which of the following** choices represents the potential energy of the ball at the three positions (X), (Y) and (Z) ?

• Choice : (d)

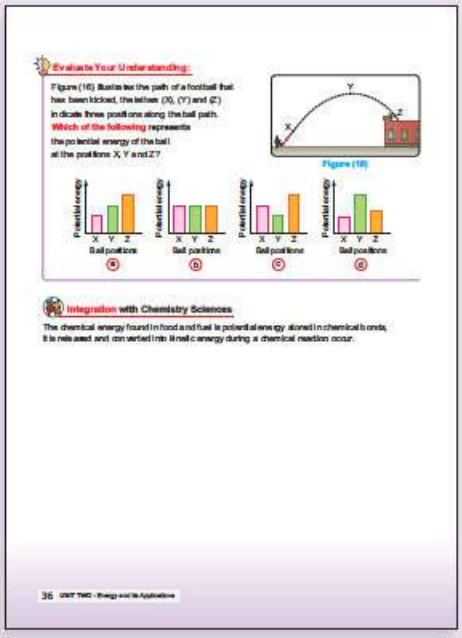
Evaluate Your Understanding:

Figure (16) illustrates the path of a football that has been kicked, the letters (X), (Y) and (Z) indicate three positions along the ball path.
Which of the following represents the potential energy of the ball at the positions X, Y and Z?

Figure (16)

Potential energy — X Y Z — Ball positions

(a) (b) (c) (d)

Integration with Chemistry Sciences

The chemical energy found in food and fuel is potential energy stored in chemical bonds, it is released and converted into kinetic energy during a chemical reaction occur.

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Integration with Chemistry Sciences

- **Pose the following question to the students**: Why do we need food? Because it contains stored energy that we use to perform activities.
- **Present the following analogy to the students:** "Food is like a battery; it contains stored energy waiting to be released to power our bodies."
- **Explain to the students** that chemical energy is a type of potential energy stored in the chemical bonds between atoms in the molecules of substances. When these bonds are broken or reformed during chemical reactions (such as digestion or combustion), energy is released and used to perform work or generate heat.
- **Ask the students** why the chemical energy found in food is considered potential energy. Because the chemical energy in food (such as carbohydrates, fats, and proteins) is not used directly; it remains stored in the chemical bonds until it is released and converted into kinetic energy during a chemical reaction. When a person consumes food, chemical reactions (such as digestion and cellular respiration) begin, where the stored chemical energy is transformed into kinetic energy (for muscles) or thermal energy (to regulate body temperature).
- **Provide the students** with a real-life example: When you eat a piece of bread, you store chemical energy. During physical activity, this energy is converted into kinetic energy to move the muscles.

Closure of the lesson :

- The teacher summarizes all the main ideas of the lesson five minutes before concluding.
- You can involve the students in closing the lesson by asking them about the concepts covered in the lesson.

Answers of Evaluation Questions on Lesson One

1

(1) (b) (2) (a)

(3) (d) (4) (d)

2

$$t = \frac{d}{v} = \frac{200}{40} = 5 \text{ s}$$

3

$$PE = w \times h$$

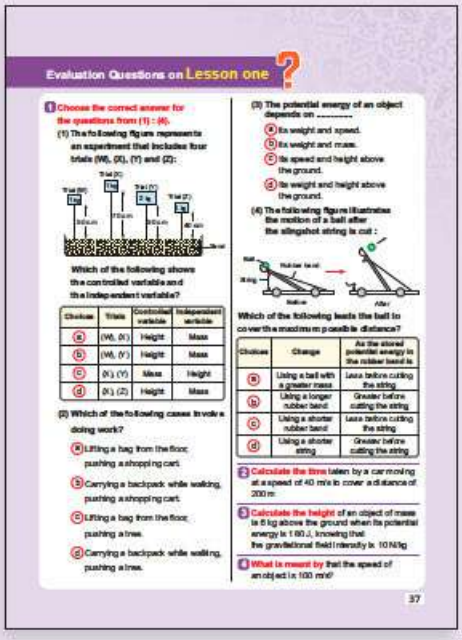
$$= m \times g \times h$$

$$180 = 6 \times 10 \times h$$

$$\therefore h = \frac{180}{6 \times 10} = 3 \text{ m}$$

4

This means that this object covers a distance of 100 m in 1 second.


Evaluation Questions on Lesson one

1 Choose the correct answer for the questions from (1) : (4).

(1) The following figure represents an experiment that includes four trials (W), (X), (Y) and (Z):

Trial (W) 6 kg, 200 cm; Trial (X) 6 kg, 200 cm; Trial (Y) 8 kg, 200 cm; Trial (Z) 8 kg, 40 cm

Which of the following shows the controlled variable and the independent variable?

Choices	Trials	Controlled variable	Independent variable
(a)	(W), (X)	Height	Mass
(b)	(W), (Y)	Height	Mass
(c)	(X), (Y)	Mass	Height
(d)	(X), (Z)	Height	Mass

(2) Which of the following cases involve doing work?

(a) Lifting a bag from the floor, pushing a shopping cart.

(b) Carrying a backpack while walking, pushing a shopping cart.

(c) Lifting a bag from the floor, pushing a tree.

(d) Carrying a backpack while walking, pushing a tree.

(3) The potential energy of an object depends on .....

(a) its weight and speed.

(b) its weight and mass.

(c) its speed and height above the ground.

(d) its weight and height above the ground.

(4) The following figure illustrates the motion of a ball after the slingshot string is cut :

Ball, Rubber band, String, Before, After

Which of the following leads the ball to cover the maximum possible distance?

Choices	Change	As the stored potential energy in the rubber band is
(a)	Using a ball with a greater mass	Less before cutting the string
(b)	Using a longer rubber band	Greater before cutting the string
(c)	Using a shorter rubber band	Less before cutting the string
(d)	Using a shorter string	Greater before cutting the string

2 Calculate the time taken by a car moving at a speed of 40 m/s to cover a distance of 200 m.

3 Calculate the height of an object of mass is 6 kg above the ground when its potential energy is 180 J, knowing that the gravitational field intensity is 10 N/kg

4 What is meant by that the speed of an object is 100 m/s?

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Additional Learning Resources:

- Utilise digital learning resources such as the Egyptian Knowledge Bank, as well as educational videos and documented films available on websites.

Lesson Two: Kinetic Energy

Introduction:

The second lesson of this unit addresses the topic of kinetic energy, the energy that objects possess due to their motion. It is one of the fundamental forms of energy in nature and is essential for understanding many phenomena around us today. Through this lesson, students will acquire a range of new concepts, and the lesson aims to develop skills in discovery, deduction, and inference.

Lesson Objectives:

1. Recognize the concept of kinetic energy.
2. Determine the kinetic energy of an object mathematically.
3. Analyze from given data the relation between kinetic energy and the mass of the moving object.
4. Analyze from given data the relation between kinetic energy and the square of the speed of a moving object.
5. Compare between potential energy and kinetic energy.
6. Deduce the relation between potential energy and kinetic energy.
7. Provide real-life examples of the transformation of potential energy into kinetic energy.

Teaching Aids and Learning Resources Used:

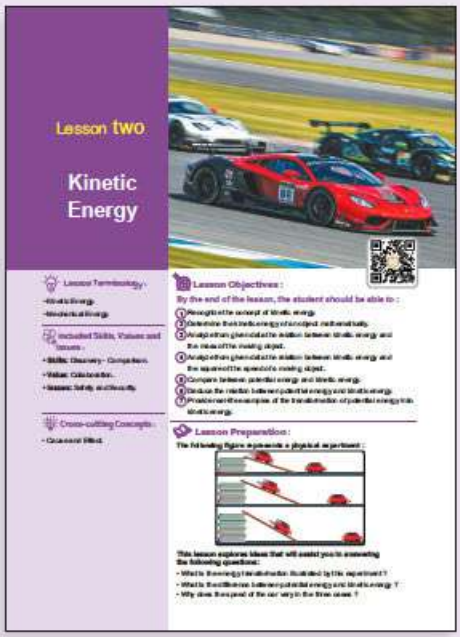
Data show – Films – Student book images – Internet – Science lab.

Duration and place of Teaching:

Two periods (4 sessions) – Classroom and media lab – Science laboratory.

Lesson Terminology :

- Kinetic Energy
- Mechanical Energy

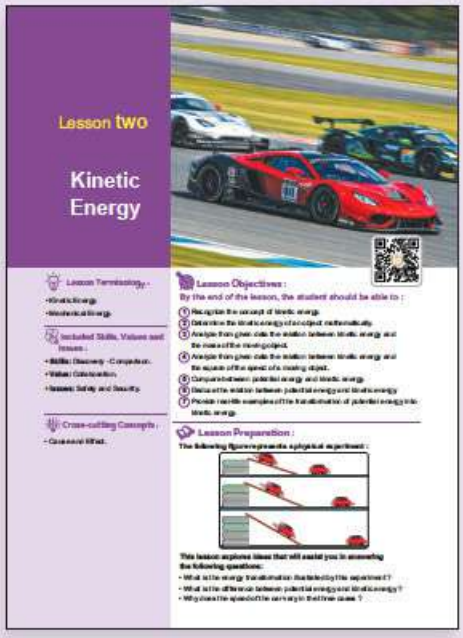


Misconceptions or Incorrect Concepts:

- **Some students think** that a moving object possesses the same amount of kinetic energy; however, kinetic energy depends on the mass of the object and its speed. Objects with greater mass or higher speeds have greater kinetic energy.
- **Some students think** that kinetic energy depends only on the speed of the object, but it actually depends on two factors: mass and the square of the speed. Even if the speed is low, a large mass can possess significant kinetic energy.
- **Some students think** that kinetic energy exists only in large objects, but any object in motion, regardless of its size, has kinetic energy. Even tiny particles like electrons have kinetic energy while they are moving.
- **Some students think** that objects moving at a constant speed do not have kinetic energy, but as long as an object is in motion, it has kinetic energy, even if its speed is constant.

Diagnostic Assessment:

- **Ask the students** to examine the lesson preparation image and attempt to answer the questions, as these questions serve as a diagnostic assessment to gauge their prior knowledge about the lesson and uncover any misconceptions they may have.
- **Listen carefully to the students' answers** to these questions and ask them to explain the reasons behind their answers.
- **Clarify to them that the correct answers** to these questions will be revealed through the explanation of this lesson.



Use Diverse Teaching Strategies:

You can use (K.W.L) strategies discussion, collaborative learning, and discovery learning.

- **At the beginning of the lesson**, use the (K.W.L) strategy (What do you know? – What do you want to know? – What have you learned?).
- **Draw a (K.W.L)** table on the board, reminding the students of this strategy:

What do you know? (K)	What do you want to know? (W)	What have you learned? (L)

Before explaining the lesson:

Ask the students to write down what they already know about kinetic energy in the first column (What do you know?). Then, have them write what new information they wish to learn about kinetic energy in the second column (What do you want to know?).

After explaining the lesson:

Ask the students to write down what they have learned about kinetic energy in the third column (What have you learned?).

Kinetic Energy (KE)

Preparing the lesson :

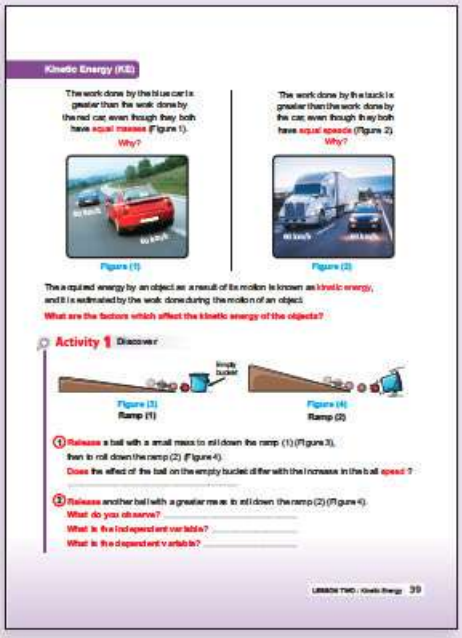
- Imagine you are playing football with your friends. When you kick the ball hard, it moves quickly towards the goal. But if you push it gently, it hardly moves. Why does this happen? What makes the ball move at different speeds? There is something common in all moving objects, whether it is a ball, a car, or even a flowing river; it is what is known as kinetic energy.
- **Ask the students** to observe Figure (1) in the student book, which shows that the work done by the blue car is greater than the work done by the red car, even though they both have equal masses. Why? Because as the speed of an object increases, its kinetic energy increases, and thus the work done increases.
- **Ask the students** to observe Figure (2) in the student book, which shows that the work done by the truck is greater than the work done by the car, even though both have equal speed. Why? Because as the mass of an object increases, its kinetic energy increases and thus the work done increases.
- **Explain to the students** that the acquired energy by an object due to its motion is referred to as kinetic energy, which is measured by the work done during the motion of an object.

What are the factors which affect the kinetic energy of the objects?

Activity 1 Discover

- **The aim of this activity is to explore the factors that affect the kinetic energy of objects.**
- **Used Tools :**

  Ramp (1) – Ramp (2) – Empty bucket – Small mass ball – Large mass ball.
- **Ask the students** to follow the steps of the activity and then answer the questions that follow:


Kinetic Energy (KE)

The work done by the blue car is greater than the work done by the red car, even though they both have equal masses (Figure 1). Why?

The work done by the truck is greater than the work done by the car, even though they both have equal speeds (Figure 2). Why?

Figure (1) Figure (2)

The acquired energy by an object as a result of its motion is known as kinetic energy, and it is estimated by the work done during the motion of an object.

What are the factors which affect the kinetic energy of the objects?

Activity 1 Discover

Figure (3) Ramp (1) Figure (4) Ramp (2)

1. Release a ball with a small mass to roll down the ramp (1) (Figure 3), then to roll down the ramp (2) (Figure 4).
   Does the effect of the ball on the empty bucket differ with the increase in the ball speed ?
2. Release another ball with a greater mass to roll down the ramp (2) (Figure 4).
   What do you observe?
   What is the independent variable?
   What is the dependent variable?

LESSON TWO : Kinetic Energy 39

1. Release a ball with small mass to roll down the ramp (1) Figure (3), and then to roll down the ramp (2) Figure (4).
   Does the effect of the ball on the empty bucket differ with the increase in ball speed? Yes.
2. Release another ball with a larger mass to roll down the ramp (2) Figure (4). **What do you observe?**

   The speed of the larger mass ball is greater than the speed of the smaller mass ball.

- **What is the independent variable?** The mass of the ball.
- **What is the dependent variable?** The kinetic energy of the ball.

- Explain to the students that the kinetic energy (KE) of any object depends on each of :
  - The mass of the object (m), measured in kilogram (kg).
  - The speed of the object (v), measured in metre per second (m/s).
- Clarify to the students the equation for calculating kinetic energy and its unit of measurement.

Mathematical Understanding:

- Ask the students to calculate the kinetic energy of a metal ball of mass 2 kg and moves with a speed of 3 m/s
- Instruct the students to first write down the law, then substitute the given values, and finally perform the division.
- Emphasise to the students the importance of including units of measurement.

Critical Thinking

- **Encourage the students to solve the following problem:**

  Two objects (X) and (Y), the mass of object (X) is double the mass of object (Y), and the speed of object (X) is half that of object (Y).

- **Is** the kinetic energy of object (X) equal to the kinetic energy of object (Y)? **with explanation.** No.
- **Explanation:**

Assuming that:

– The mass of object (X) = 4 kg

– The mass of object (Y) = 2 kg

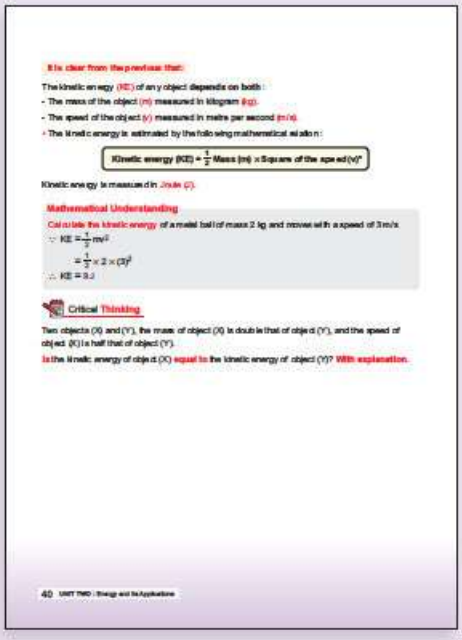
– The speed of object (X) = 2 m/s

– The speed of object (Y) = 4 m/s

KE of object (X) = $\frac{1}{2} \times 4 \times (2)^2 = 8$ J

KE of object (Y) = $\frac{1}{2} \times 2 \times (4)^2 = 16$ J

Therefore, the kinetic energy of object (X) is not equal to the kinetic energy of object (Y), because the kinetic energy of object (X) is equal to half the kinetic energy of object (Y).


It is clear from the previous that:

The kinetic energy (KE) of any object depends on both :
- The mass of the object (m) measured in kilogram (kg).
- The speed of the object (v) measured in metre per second (m/s).

The kinetic energy is estimated by the following mathematical relation :

Kinetic energy (KE) = $\frac{1}{2}$ Mass (m) × Square of the speed (v)²

Kinetic energy is measured in Joule (J).

Mathematical Understanding

Calculate the kinetic energy of a metal ball of mass 2 kg and moves with a speed of 3 m/s

∵ KE = $\frac{1}{2}$ mv²

= $\frac{1}{2} \times 2 \times (3)^2$

∴ KE = 9 J

Critical Thinking

Two objects (X) and (Y), the mass of object (X) is double that of object (Y), and the speed of object (X) is half that of object (Y).

Is the kinetic energy of object (X) equal to the kinetic energy of object (Y)? With explanation.

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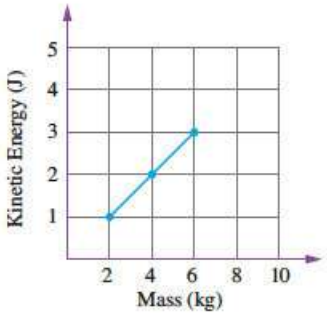
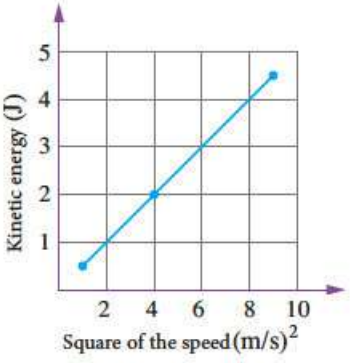
Activity 2 Discover

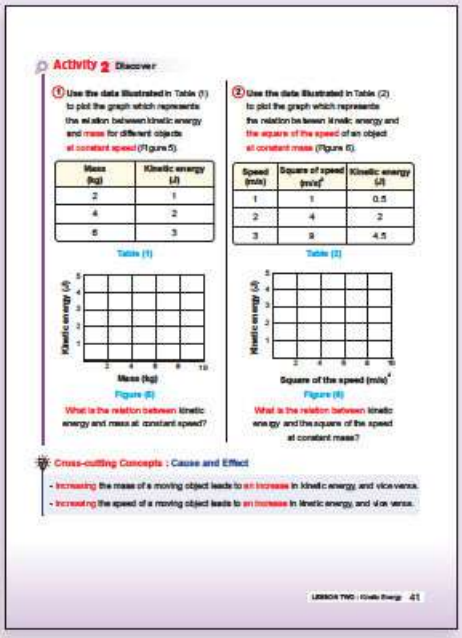
- **This activity aims to plot the graph and discover the relation between the variables.**
- **Used Tools:** tables in the student's book.
- **Ask the students** to use the data illustrated in Table (1) to plot the graph of kinetic energy and mass for different objects at constant speed, as shown in Figure (5).
- **Explain to the students** that mass is represented by the horizontal axis and kinetic energy is represented by the vertical axis.



- What is the relation between kinetic energy and mass at constant speed? As the mass of the object increases, the kinetic energy increases, and vice versa.
- Ask the students to use the data illustrated in Table (2) to plot the graph of kinetic energy and the square of the speed of an object at constant mass, as shown in Figure (6).
- Explain to the students that the square of the speed represents the horizontal axis and kinetic energy represents the vertical axis.



- What is the relation between kinetic energy and the square of speed at constant mass? As the speed of the object increases, the kinetic energy increases, and vice versa.



Cross-Cutting Concepts: Cause and Effect

- The concept of cause and effect is used to understand how events and phenomena are related to one another. Learning this concept helps students explain why things happen (the cause) and what results from this event or action (the effect).
- Apply the concept of cause and effect to the previous activity:

(1) Increasing the mass of the moving object (cause) leads to an increase in kinetic energy (effect), and vice versa.

(2) Increasing the speed of the moving object (cause) leads to an increase in kinetic energy (effect), and vice versa.

Scientific Skills: Comparison

Dear Teacher:

The skill of comparison is one of the fundamental skills that assists students in understanding concepts and acquiring knowledge in a more organized and effective manner.

The following are its importance keys :

- Enhancing deep understanding of concepts.
- Developing analytical and critical thinking.
- Improving organizational and classification skills.
- Enhancing written and oral expression skills.
- **Ask the students** to compare between potential energy (PE) and kinetic energy (KE) by completing Table (3):

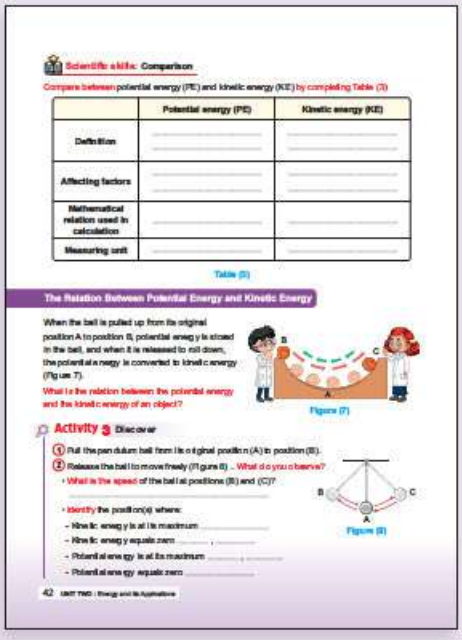
	Potential Energy (PE)	Kinetic Energy (KE)
Definition	The energy stored in an object as a result of work done on it.	The energy acquired by an object as a result of its motion.
Affecting Factors	• Weight of the object. • Height of the object above the ground surface.	• Mass of the object. • Speed of the object.
Mathematical Relation Used in Calculation	PE = w h	KE = $\frac{1}{2}mv^2$
Measuring Unit	Joule (J)	Joule (J)

The Relation Between Potential Energy and Kinetic Energy

- **Ask the students** to observe Figure (7) in the student's book and ask them:

① **What happens when the ball is pulled up from its original position (A) to position (B)?** Potential energy becomes stored in the ball.

② **What happens when the ball is allowed to fall from position (B)?** The potential energy begins to be converted into kinetic energy.


Scientific skills: Comparison

Compare between potential energy (PE) and kinetic energy (KE) by completing Table (3)

	Potential energy (PE)	Kinetic energy (KE)
Definition		
Affecting factors		
Mathematical relation used in calculation		
Measuring unit		

Table (3)

The Relation Between Potential Energy and Kinetic Energy

When the ball is pulled up from its original position A to position B, potential energy is stored in the ball, and when it is released to roll down, the potential energy is converted to kinetic energy (Figure 7).

What is the relation between the potential energy and the kinetic energy of an object?

Figure (7)

Activity 3 Discover

① Pull the pendulum ball from its original position (A) to position (B).

② Release the ball to move freely (Figure 8) .. What do you observe?

- What is the speed of the ball at positions (B) and (C)?
- Identify the position(s) where:
  - Kinetic energy is at its maximum
  - Kinetic energy equals zero
  - Potential energy is at its maximum
  - Potential energy equals zero

Figure (8)

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Activity 3 Discover

- **This activity aims to discover the relation between potential energy and kinetic energy.**
- **Used Tools:** A suspended pendulum, as shown in Figure (8).
- **Ask the students** to pull the pendulum ball from its original position (A) to position (B), then release the ball to move freely and record their observations.
- **Ask the students to answer the following questions:**

① **What is the speed** of the ball at positions (B) and (C)? Zero

② **Identify** the position(s) where:

- Kinetic energy is at its maximum (A)
- Kinetic energy equals zero (B), (C)
- Potential energy is at its maximum (B), (C)
- Potential energy equals zero (A)

- **Explain to the students** that when the pendulum ball is released after being pulled, it moves back and forth around position (A), in such a way that:

- Its speed decreases as it moves away from position (A) until it reaches zero at positions (B) and (C).
- Its speed is at its maximum while passing through position (A).

Ask the students to complete Table (4) with what happens to both potential energy and kinetic energy of a pendulum ball during its motion.

During the movement from	Potential Energy	Kinetic Energy
(B) ⟶ (A)	Decreases	Increases
(A) ⟶ (C)	Increases	Decreases
(C) ⟶ (A)	Decreases	Increases
(A) ⟶ (B)	Increases	Decreases

- **Pose the following questions** to the students based on the results of the previous activity:

① **When** is the potential energy of an object at its maximum?

- **Explain to the students that** the potential energy of an object is at its maximum at its highest point above its original position.

② **When** is the kinetic energy at its maximum?

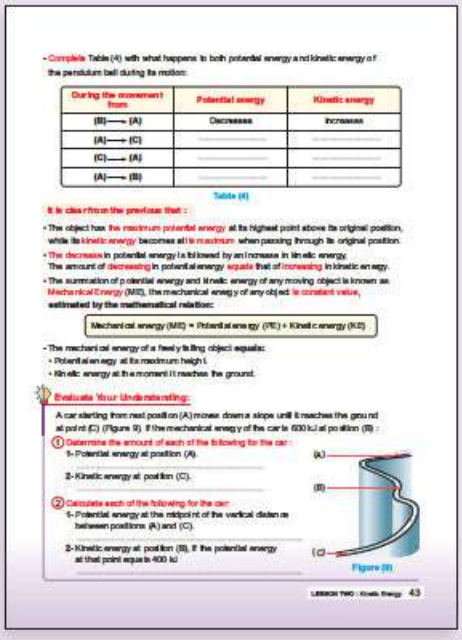
- **Explain to the students that** the kinetic energy is at its maximum when the object passes through its original position (rest position).
- **Ask the students what happens when potential energy decreases ?** Kinetic energy increases.
- **Clarify to the students** that a decrease in potential energy is followed by an increase in kinetic energy. The amount of decrease in potential energy equals to the amount of increase in kinetic energy.
- **Explain to the students** that the summation of potential energy and kinetic energy for any moving object is known as mechanical energy (ME).
- **Clarify to the students** that the mechanical energy of any object is a constant value, defined by the following mathematical relation:

Mechanical Energy (ME) = Potential Energy (PE) + Kinetic Energy (KE)

- **Ask the students** what is the mechanical energy for an object in free fall ?
- **Explain to the students** that the mechanical energy of an object in freely falling is equal to:

– Potential energy at its maximum height.

– Kinetic energy at the moment it reaches the ground.



- Complete Table (4) with what happens to both potential energy and kinetic energy of the pendulum ball during its motion:

During the movement from	Potential energy	Kinetic energy
(B) ⟶ (A)	Decreases	Increases
(A) ⟶ (C)		
(C) ⟶ (A)		
(A) ⟶ (B)		

Table (4)

It is clear from the previous that :

- The object has the maximum potential energy at its highest point above its original position, while its kinetic energy becomes at its maximum when passing through its original position.
- The decrease in potential energy is followed by an increase in kinetic energy. The amount of decreasing in potential energy equals that of increasing in kinetic energy.
- The summation of potential energy and kinetic energy of any moving object is known as Mechanical Energy (ME), the mechanical energy of any object is constant value, estimated by the mathematical relation:

Mechanical energy (ME) = Potential energy (PE) + Kinetic energy (KE)

- The mechanical energy of a freely falling object equals:
  - Potential energy at its maximum height.
  - Kinetic energy at the moment it reaches the ground.

Evaluate Your Understanding:

A car starting from rest position (A) moves down a slope until it reaches the ground at point (C) (Figure 9). If the mechanical energy of the car is 600 kJ at position (B) :

① Determine the amount of each of the following for the car :

1- Potential energy at position (A).

2- Kinetic energy at position (C).

② Calculate each of the following for the car:

1- Potential energy at the midpoint of the vertical distance between positions (A) and (C).

2- Kinetic energy at position (B), if the potential energy at that point equals 400 kJ.

Figure (9)

Evaluate Your Understanding

- To evaluate the students' understanding of the relation between potential energy and kinetic energy, ask them to answer the questions in Form (9), which illustrates a car starting from rest position (A) moves down a slope until it reaches the ground at point (C). If the mechanical energy of the car is 600 kJ at position (B):

① Ask the students to **determine**:

1. Potential energy at position (A): 600 kJ
2. Kinetic energy at position (C): zero

② Ask the students to **calculate** the following for the car:

1. Potential energy at the midpoint of the vertical distance between positions (A) and (C): 300 kJ
2. Kinetic energy at position (B) if the potential energy at that point is 400 kJ: 200 kJ

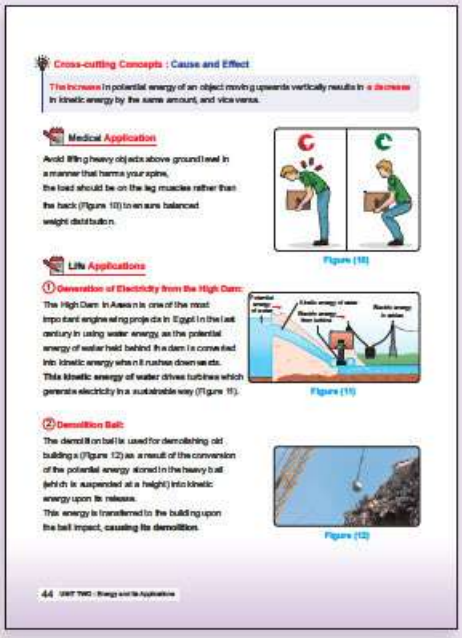
Cross-cutting Concepts: Cause and Effect:

- **The concept** of cause and effect is used to understand how events and phenomena are interconnected. Learning this concept helps students explain why things happen (the cause) and what results from that event or action (the effect).
- **Apply the concept** of cause and effect to the previous activity: the increase in potential energy of an object moving upwards vertically (the cause) results in a decrease in kinetic energy by the same amount (the effect), and vice versa.

Medical Application

- **Explain to students** that the correct method for lifting heavy objects from the ground depends on focusing on using the leg muscles to ensure the weight is distributed evenly, keeping the back straight, and bringing the load close to the body.
- **Demonstrate the steps for lifting a heavy object correctly and safely:**

1. Before attempting to lift the object, ensure that you are capable of lifting it safely.
2. Stand close to the object to reduce strain on your muscles.
3. Position your feet at an appropriate distance for balance (approximately shoulder-width apart).
4. Maintain a straight back and do not arch your back while bending.
5. Instead of bending at the waist, bend your knees and keep your back straight.
6. Assume a position similar to a squat so that the leg muscles bear the majority of the load, rather than the back muscles.
7. Use both hands to hold the object to ensure stability.
8. Push your body upwards using your leg muscles, not your back muscles.
9. Hold the object close to your chest, as this reduces stress on your back and shoulders.
10. When lowering the object, bend your knees again while keeping your back straight.


Cross-cutting Concepts : Cause and Effect

The increase in potential energy of an object moving upwards vertically results in a decrease in kinetic energy by the same amount, and vice versa.

Medical Application

Avoid lifting heavy objects above ground level in a manner that harms your spine, the load should be on the leg muscles rather than the back (Figure 10) to ensure balanced weight distribution.

Figure (10)

Life Applications

① Generation of Electricity from the High Dam:

The High Dam in Aswan is one of the most important engineering projects in Egypt in the last century in using water energy, as the potential energy of water held behind the dam is converted into kinetic energy when it rushes downwards. This kinetic energy of water drives turbines which generate electricity in a sustainable way (Figure 11).

Figure (11)

② Demolition Ball:

The demolition ball is used for demolishing old buildings (Figure 12) as a result of the conversion of the potential energy stored in the heavy ball (which is suspended at a height) into kinetic energy upon its release.
This energy is transferred to the building upon the ball impact, causing its demolition.

Figure (12)

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Life Applications

- **Explain to students** some real-life applications of potential energy and kinetic energy and how we benefit from them in our lives.

1. **Provide a practical example of potential and kinetic energy:** generating electricity from the High dam (Figure 11):

- Dams are among the most prominent practical applications that illustrate the relation between potential energy and kinetic energy, as the energy stored in water is converted into energy used to generate electricity.
- When water is stored behind the dam, it is at a significant height above ground level. Due to this height, the water gains potential energy and the higher the dam or the greater the amount of stored water, the more potential energy is stored.
- When the dam's gates are opened, the water flows downwards due to gravity.
  During the water's flow, potential energy is converted into kinetic energy.
- The rapidly flowing water is directed towards the turbines located in the dam.
  When the water drives the turbine blades, it moves them, converting kinetic energy into mechanical energy. The generators connected to the turbines convert this mechanical energy into electrical energy.

② **Provide another real-life example of potential and kinetic energy:**

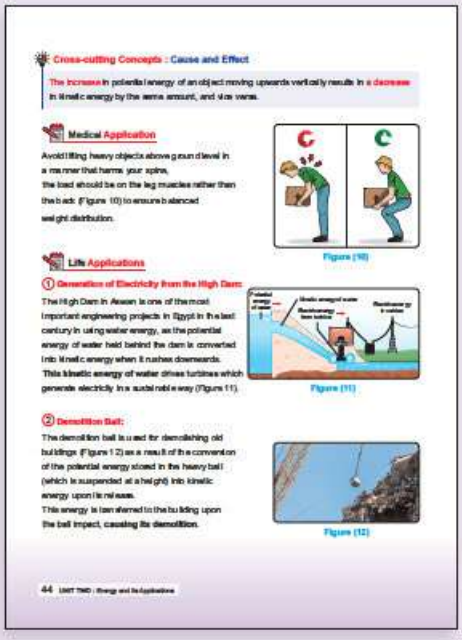
Demolition Ball (wrecking ball) (Figure 12):

- It is considered one of the practical applications that illustrate the relation between potential energy and kinetic energy, as a heavy ball is used, lifted by a crane, for demolishing old buildings and structures.
- When the demolition ball is lifted by the crane to a certain height, it gains potential energy due to its elevation above the ground. The greater the height of the ball or the greater its mass, the more potential energy is stored within it.
- When the ball is released to swing or fall towards the target:

  The potential energy that the ball acquired during the lift is converted into kinetic energy during the motion.
- Kinetic energy represents the ball's ability to affect and destroy the target upon impact.
- Upon colliding with walls or buildings, the kinetic energy is transformed into mechanical energy to demolish the structure.

closure of the Lesson:

- A skill in which the teacher summarizes all the main ideas of the lesson, concluding five minutes before the end.
- You may participate the students in the lesson closure by asking them about the concepts covered in the lesson.


Cross-cutting Concepts : Cause and Effect

The increase in potential energy of an object moving upwards vertically results in a decrease in kinetic energy by the same amount, and vice versa.

Medical Application

Avoid lifting heavy objects above ground level in a manner that harms your spine, the load should be on the leg muscles rather than the back (Figure 10) to ensure balanced weight distribution.

Figure (10)

Life Applications

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The High Dam in Aswan is one of the most important engineering projects in Egypt in the last century in using water energy, as the potential energy of water held behind the dam is converted into kinetic energy when it rushes downwards. This kinetic energy of water drives turbines which generate electricity in a sustainable way (Figure 11).

Figure (11)

② Demolition Ball:

The demolition ball is used for demolishing old buildings (Figure 12) as a result of the conversion of the potential energy stored in the heavy ball (which is suspended at a height) into kinetic energy upon its release.
This energy is then shared to the building upon the ball impact, causing its demolition.

Figure (12)

44 UNIT TWO : Energy and its Applications

Answers of Evaluation Questions on Lesson Two

1

(1) ⓐ **(2)** ⓓ

---

2 This means that the summation of the potential and kinetic energies of this object during its motion equals 200 J

3

(1) The kinetic energy of the object is decreased to half.

(2) The kinetic energy of the object increases to four times its value.

---

4 **(1)** ✗ **(2)** ✓ **(3)** ✓ **(4)** ✗

---

5 $KE = \frac{1}{2} \times m \times v^2$

$= \frac{1}{2} \times 12 \times 1 \times 1 = 6$ J

---

6 **(1)** **1-** Kinetic energy before falling = zero

2- Kinetic energy at the surface of the ground = Potential energy of the object before falling.

$\because PE = m \times g \times h$

$= 10 \times 10 \times 4 = 400$ J

$\therefore KE = 400$ J

(2) The mechanical energy of the object at the midpoint between the falling position and the ground = Potential energy of the object before falling = 400 J

---

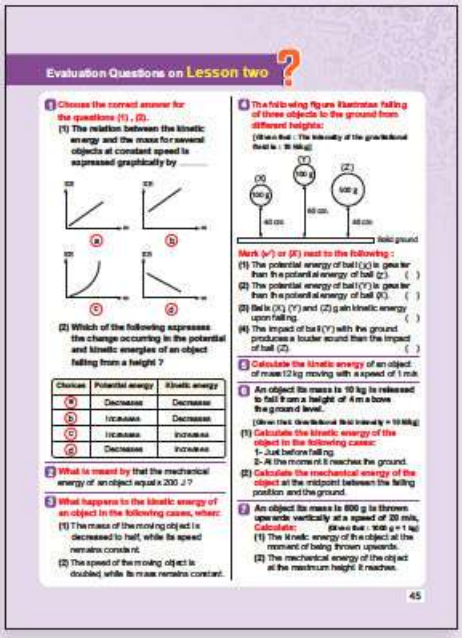
7 **(1)** $m = \frac{600}{1000} = 0.6$ kg

$KE = \frac{1}{2} \times m \times v^2$

$= \frac{1}{2} \times 0.6 \times 20 \times 20 = 120$ J

(2) The mechanical energy of the object at the maximum height it reaches = Kinetic energy at the moment it is thrown upwards

ME = KE = 120 J


Evaluation Questions on Lesson two

Additional Learning Resources:

Utilising digital learning resources such as the Egyptian Knowledge Bank, as well as educational videos and documentaries available on internet sites.

Unit Two: Energy and Its Applications

Lesson One: Potential Energy

Inclusive Education Category	Support Strategies
Intellectual Disability and Slow Learning Hyperactivity and Attention Deficit Autism Spectrum	• Write the new concepts related to the lesson (speed - distance - displacement - force - work - energy - mass) for the student in a mind map, using illustrated cards and different colours to write the symbols that represent each concept and the units of measurement used. • Use a practical demonstration strategy to assist the student in answering the application questions mentioned in the lesson. • Clarify to the student the information and conclusions related to activities (conclusion - discover - analytical thinking) through simple practical examples, as these skills may be challenging for the student.
Learning Difficulties	• Create a table on the board for the student that outlines the new concepts (speed - distance - displacement - force - work - energy - mass) and link each concept to its symbol and relevant law. • Write a table summarizing the units of measurement used for measuring each of (distance - displacement - speed - force - work - energy - mass), and remind the student of the methods for converting from one unit to another. • Write a mind map on the board illustrating the types of variables used in conducting scientific research (independent variable - dependent variable - controlled variables) along with the concept of each variable, and provide the student with simple examples from their environment. • Use a practical demonstration to clarify the relation between (independent variable - dependent variable - controlled variables) and allow the student to carry out the activity themselves, recording the resulting measurements and assisting them in interpreting the results. • Remind the student of the information related to the questions and allow them to share answers with their peers, providing appropriate assistance and feedback.

Inclusive Education Category	Support Strategies
Hearing Impaired	• Use simple and clear language with the hearing impaired to explain the difference between the concepts of distance and displacement. • Utilise object representation to clarify the concepts of distance and displacement. For example, place a toy car on the table and move the car along a winding path, using string to measure the distance and a ruler to measure the displacement. • Emphasise through object representation that measuring with string along a winding path equals distance, while measuring with a ruler in a straight line equals displacement. • Present the illustrative diagram of the concept of distance separately from the diagram of the concept of displacement, and do not present a single illustration for both concepts to avoid confusion in understanding. • Summarize the key concepts of distance and displacement in a two-column table on the board for the hearing impaired, and provide a graphical hint for the meaning of each, including scale, ratio, and proportion. (1 km = 1000 m / 1 m = 100 cm). Speed Law: $\left(\text{Speed} = \frac{\text{Distance}}{\text{Time}}\right)$, as well as units of speed measurement (metre/second) (kilometre/hour), should remain visible throughout the lesson and be highlighted during related activities. • Encourage the hearing impaired student to use a calculator and provide training on this. • Provide additional examples for the hearing impaired and guide them for further practice on solving problems. • Prepare a large and clear board or screen displaying the illustrative table (for the state and direction of the applied force, direction of the body's movement, and potential to do work), and explain it to the hearing impaired student. • Write the work law on the board throughout the explanation or during the related activities. • Encourage the hearing impaired student to use the calculator and provide training on this, giving more examples and guiding them for further practice on solving problems.
The Blind and the Visually Impaired	• Demonstrate to the blind student practically the meaning of footprints in the sand through hands-on practice in the schoolyard, allowing them to first identify their own footprints, then provide them with a raised drawing of a path on paper for them to recognise by touch. • Assist the blind student in actively engaging with the content of Table (1) in Activity (1) to understand force and its effect on movement through their body. • In Activity (2), allow the blind student to understand the depth of the hole after balls have fallen into it by placing their fingers in the resulting hole to recognise its depth and its relation to the weight of the balls and the height from which they fell. • The data included in the graphs shown in Figure (16) should be described to the blind student.

Inclusive Education Category	Support Strategies
Intellectual Disability and Slow Learning **Hyperactivity and Attention Deficit** **Autism Spectrum**	• Explain to the student Activity (1) (Discover) through practical application using available models and toy cars, and repeat the activity multiple times to ensure the student can recognize the changes occurring in each experiment. Allow them to imitate you. • Write the law of kinetic energy on cards and stick them on a board, assisting the student in understanding and reading the abbreviation of each term in the law, and help them rearrange the cards independently to write the formula correctly. • Explain to the student Activity (2) (Discover) and clarify the relation between kinetic energy, mass, and speed through illustrations and arrows indicating whether the relation is inverse or direct. Similarly, do this in Activity (3). • Write a comparison table between potential energy and kinetic energy clearly on the board, explain the table's content to the student, repeat the concepts, ask them to repeat after you, and assist them in reading the table independently.
Learning Difficulties	• Write the new concepts for the student on the board in a concise sentence, and help them read and copy it into their notebook. • Implement Activity (1) with the student through practical demonstration and ask them to state what they observe each time, assisting them in drawing conclusions. Then summarize the results of the application and record them on the board. Write the law of kinetic energy as illustrated in the mathematical relation mentioned in the lesson, and help the student read the summary and copy it into their notebook. • Carry out a similar activity to Activity (2) (Discover) with the student step by step, then assist them in carrying out the activity again independently, mimicking the previous activity, and help them identify the positions of the numbers on the graph to correctly depict the relation between the variables. • Write a comparison table between potential energy and kinetic energy on the board for the student, assist them in reading it multiple times, and then help them complete the table independently in their book based on their visual perception, providing appropriate assistance and feedback. • Conduct Activity (3) (Discover) with the student through practical demonstration, assisting them in drawing conclusions and recording them in their book. Provide them with the steps of the application and repeat them multiple times. • Summarize the relation between potential energy and kinetic energy for the student in the form of a diagram using arrows indicating increase or decrease. Then write the equation for mechanical energy clearly on the board and provide the student with practical examples for substitution in the equation, ensuring the use of small numbers.

Inclusive Education Category	Support Strategies
Hearing Impaired	• Make the hearing-impaired student observe a light ball and a heavy ball moving at the same speed, then ask them to note which one is harder to stop, and explain that the larger mass means greater kinetic energy. Push a toy car to slide slowly and then quickly in front of the hearing-impaired student, drawing their attention to how speed affects kinetic energy, and clarify that speed has a significant impact. Demonstrate through practical examples the relation between energy and speed, highlighting that energy depends on the square of speed. • Write the law for calculating kinetic energy on the board and explain it to the hearing-impaired student, ensuring it remains visible throughout the explanation or related activities. • Use simpler words to summarize definitions for the hearing-impaired student and write them on the board or on a worksheet, such as «Kinetic energy is the energy that an object has when it is moving. If its speed increases, its energy increases, and if its mass increases, its energy also increases.» • Use very straightforward problems and simple language free from relation like (half and double), but use (greater than and less than). • It is preferable to change the format of questions such as «What is the relation between kinetic energy and mass when...» to true or false statements. • Use practical demonstrations for the hearing-impaired student to explain the relation between potential energy and kinetic energy. Simplify the concept of the relation between potential energy and kinetic energy using direct language and separate summary statements, for example: «When an object is elevated, it has potential energy.» • «When the object moves downwards, potential energy is converted into kinetic energy.» • «The highet increases, the potential energy increases.» • «The speed increases, the kinetic energy increases.» • Ensure the hearing-impaired student understands the summary statements written on the board by demonstrating the practical example and pointing to each of the summary statements as they perform. • Use repetition to reinforce understanding.
The Blind and the Visually Impaired	• The practical activity included in the lesson preparation section should be performed with the blind student in the classroom using the available tools. • Describe the images in figures (1) and (2) to the blind student. • Allow the blind student to feel the slope with their hand to understand it through experience.

Unit Three: Environment and Genetics

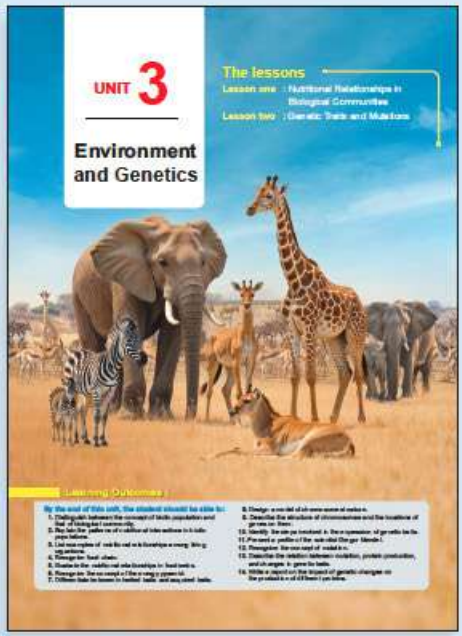
Introduction to the Unit

The nature around us is filled with diversity and change, and every living organism has a unique story that intertwines the effects of the environment it inhabits with the genetic information it carries. Life, as we see it today, is the result of millions of years of interaction between hidden and visible factors, between what we have inherited from our ancestors through genes and the challenges and opportunities presented by our surrounding environment. The traits carried by living organisms are not merely coincidences, they are a precise blend of the genetic code that preserves the history of generations and the environmental changes that test the ability of the organism to adapt and endure.

In this unit, we will explore how the environment and genetics interact to shape the features of life on Earth. We will learn about the role genes play in transmitting hereditary traits from one generation to the next, and how the environment contributes to the expression or modification of these traits. We will also discover how living organisms adapt to their surrounding conditions to ensure their survival.

Learning Outcomes

1. Distinguish between the concepts of biotic population and that of biological community.
2. Explain the patterns of nutritional interactions in biotic populations.
3. List examples of nutritional relationships among living organisms.
4. Recognize food chain.
5. Illustrate the nutritional relationships in food webs.
6. Recognize the concept of the energy pyramid.
7. Differentiate between inherited traits and acquired traits.
8. Design a model of chromosome structure.
9. Describe the structure of chromosomes and the locations of genes on them.
10. Determine the steps involved in the expression of genetic traits.
11. Present a profile of the scientist Gregor Mendel.
12. Recognize the concept of mutation.
13. Describe the relation between mutation, protein production, and changes in genetic traits.
14. Write a report on the impact of genetic changes on the production of different proteins.



Unit Lessons and Time Period

The unit includes 2 lessons:

- **Lesson One:** Nutritional Relationships in biological communities (Two periods)
- **Lesson Two:** Genetic traits and mutations. (Two periods).

Activities and Educational Resources

The activities and resources in this unit include:

- **Activities:** Discovery, prediction, conclude, deduction, practical work.
- **Resources:** Images, videos, the internet, laboratory tools.

Teaching Strategies

There are various and diverse active learning strategies, including:

Laboratory Experiments:

A method that provides students with direct hands-on sensory experience by employing all the senses in learning about the phenomenon being studied.

Cooperative Learning:

An educational strategy in which students are divided into small, heterogeneous groups to achieve common goals, namely completing the required tasks, with each member responsible for their own learning and that of their peers.

Discussion:

- An educational approach that relies on dialogue between the teacher and the student or amongst students themselves, under the teacher's supervision, with the aim of recalling previous information or arriving at new insights. This method is based on questions prepared for this purpose.

Brainstorming:

- A technique used to generate the maximum number of ideas, regardless of their type or level, to address a topic in an atmosphere of freedom and safety for expressing ideas.

Concept Maps:

- These are diagrammatic representations that highlight the relationships between concepts, arranging lesser concepts beneath higher ones and linking them with words that clarify their relationships.

Similarities Strategy:

- This strategy focuses on connecting unfamiliar concepts with familiar ones. It emphasises the interconnection of the cognitive structure and aims to ensure the retention of learning outcomes.

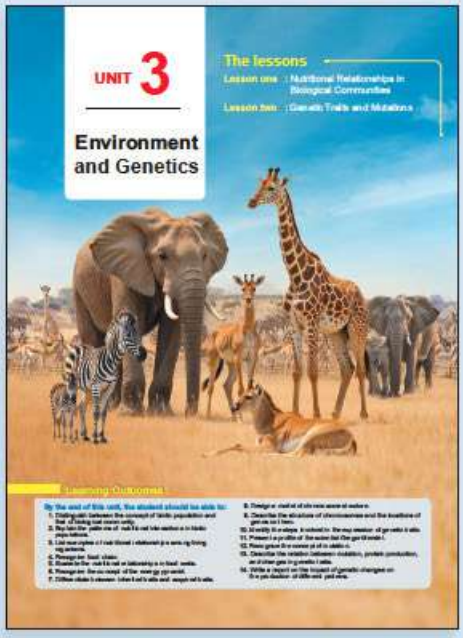
Educational Games:

- It should be noted that there is no one best method; rather, there is a more suitable method for a specific teaching situation.

Assessment Methods

The assessment methods in the unit are varied and include:

- **Diagnostic Assessment:** Pre-tests.
- **Formative Assessment:** Oral questions – assignments – research activities.
- **Summative Assessment:** End-of-unit tests.
- **Self-assessment:** Evaluate your understanding.



Lesson One: Nutritional Relationships in Biological Communities

Introduction: The first lesson of this unit addresses the topic of nutritional relationships in biological communities. At the center of every ecosystem, living organisms are intertwined in a complex web of nutritional relationships that ensure the continuation of life. Each living organism relies, in one way or another, on another organism to meet its energy and food needs. In this lesson, we will explore the concepts of food chains, food webs, and the various roles of living organisms as producers, consumers, and decomposers. We will illustrate how living organisms depend on one another and how any disruption in these relationships can lead to ecological disturbances that may affect entire biological communities. Through this lesson, students will acquire a set of new concepts, and the lesson aims to enhance skills in discovery, deduction, and inference.

Lesson Objectives:

1. Distinguish between the concepts of biotic population and that of biological community.
2. Illustrate patterns of nutritional interactions in biological communities.
3. List examples of nutritional relationships among living organisms.
4. Recognize the food chain.
5. Illustrate nutritional relationships in food webs.
6. Compare the patterns of nutritional relationships among living organisms across various biological systems.
7. Recognize the concept of the energy pyramid.

Teaching Aids and Learning Resources Used:

Data show – films – student book images – Internet – science laboratory.

Duration and Place of Teaching:

Two periods (4 Sessions) – classroom and media lab - science laboratory.

Lesson Terminology:

- Ecosystem
- Nutritional Relationships
- Commensalism
- Mutualism
- Competition
- Predation
- Food Chain
- Food Web

Misconceptions or Incorrect Concepts:

- **Some students believe** that food chains are always isolated; however, living organisms often participate in complex food webs that include multiple interlinked chains.
- **Some students think** that decomposers like bacteria and fungi are unimportant or merely a minor part of the food web, yet decomposers play a crucial role in recycling nutrients and breaking down organic matter to return it to the soil.
- **Some students believe** that plants require nutrition like animals and classify them as consumers, while plants are considered producers, as they make their own food through photosynthesis using solar energy.
- **Some students think** that predators always sit at the top of the food chain, yet predators can also fall prey to other predatory animals.

- **Some students believe** that human do not affect food webs or are disconnected from them; however, human are part of the food web and significantly impact it through hunting, agriculture, and pollution.

Diagnostic Assessment:

- **Ask students to examine** a preparation image for the lesson and attempt to answer questions, as these questions serve as a diagnostic assessment for students to gauge their prior knowledge of the lesson and reveal their misconceptions.
- **Listen carefully** to students' answers to these questions and ask them to explain their reasoning.
- **Clarify that** the correct answers to these questions will be explored through the explanation of this lesson.

Use Diverse Teaching Strategies:

You can use K.W.L, strategies, discussion, cooperative learning, role-playing and educational games.

- **At the beginning of the lesson**, use the K.W.L strategy (What do you know? – What do you want to know? – What have you learned?).
- **Draw a K.W.L table** on the board, reminding students of this strategy:

What do you know? (K)	What do you want to know? (W)	What have you learned? (L)

Before explaining the lesson:

Ask students to write down what they already know about nutritional relationships in biological communities in the first column (What do you know?). In the second column (What do you want to know?), ask them to write down the new information they wish to learn about nutritional relationships in biological communities.

After explaining the lesson:

Request students to write down what they have learned about nutritional relationships in biological communities in the third column (What have you learned?).

Preparing the Lesson:

- At the beginning of the lesson, ask the students the following question to spark their curiosity about the topic: What would happen if a specific type of living organism (each student chooses a living organism) disappeared from our environment?
- Discuss the students' answers.

The Ecosystem

- **Bring a picture or a short video clip** that shows a natural landscape (such as a forest, beach, or desert).
- **Ask the students** to observe the components present in the image (plants, animals, water, air, soil, etc.) and record their answers in two groups: Living organisms (plants, animals) and non-living components (soil, water, air).
- **Ask them:** Do you think these components affect each other? What happens if one component is removed from the picture?
- **Explain to the students** that the ecosystem consists of living organisms and non-living components such as water, air and soil, and that the ecosystem includes several levels of organization.
- **Divide the ecosystem for the students into four levels using simplified examples:**

① **Individual:** A single living organism (such as a tree, rabbit or gazelle) belonging to a specific species of living organism.

② **Biotic Population:** A group of individuals of the same species living in a particular place at the same time (**e.g.**, a group of gazelles).

③ **Biological Community:** The various biotic populations of different species that inhabit the same environment (gazelle, trees, birds).

④ **Ecosystem**: Any place that includes living organisms and non-living component (soil, water, air) and includes several levels of organization.

- **Ask the students** to draw a mind map representing the levels of the ecosystem.

Patterns of Nutritional Interactions Among Individuals of Biological communities

- **Ask the students:** What do living organisms need to survive? (Guide the discussion towards food and energy). Do all organisms obtain their food in the same way?
- **Discuss the students'** answers regarding the differences among living organisms.
- **Explain to the students** that each living organism relies, in one way or another, on another living organism to meet its energy and food needs.
- **Clarify to the students** that there is a variety of nutritional relationship patterns due to the diverse ways that living organisms obtain food.
- **Explain to the students** that there are relationships that result in harm to one of the individuals, such as predation, or both individuals together, such as competition, and other relationships where one individual benefits, such as mutualism, or both individuals benefit without harm to either, such as commensalism.


The Ecosystem

The ecosystem consists of living organisms and non-living (abiotic) components such as water, air and soil. The ecosystem includes several levels of organization (Figure 1).

Figure (1) Levels of the ecosystem

Organization begins at the individual level, which is the single living organism belonging to a specific species. The species is the fundamental unit in the classification of living organisms. A group of individuals of the same species that live in a particular place at the same time is known as a biotic population. The various populations of different species that inhabit the same environment form a biological community.

Patterns of Nutritional Interactions Among Individuals of Biological Communities

The patterns of nutritional (food) relationships vary with the variation of the methods by which the living organisms obtain their food. There are relationships that result in harm to one individual, such as predation, or both individuals such as competition, and other relationships in which one individual benefits such as commensalism, or both individuals benefit without causing harm to either of them such as mutualism.

1 Predation

Activity 1 Observe and Conclude

Observe the figures (2) : (4) which show predation of certain living organisms by other living organisms, and then answer the following questions :

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1 Predation

Activity 1 Observe and conclude

- This activity aims to discover the concept of the predation relationship.
- **Materials used**: images from the student's book.

Use the learning cycle strategy:

- Ask the students to contemplate the figures from (2: 4) that illustrate the predation of some living organisms on other living organisms, and then answer the following questions.

① **Identify** the living organisms in each nutritional relationship:

- The Predators: Lion, panther chameleon, Venus flytrap (Dionaea plant).
- The Preys: Zebra, insect, insect.

② **State** the beneficiary and the harmed organisms in these nutritional relationships:

- Beneficiary organisms: Lion, Panther chameleon, Venus flytrap (Dionaea plant).
- Harmed organisms: Zebra, insect, insect.
- **Explain to the students** the concept of the predation relationship, which results in harm to one of the individuals. The individual that benefits from the food relationship is called the predator, while the individual that is harmed or loses its life is called the prey.

2 Competition

- **Ask the students** what happens if there are many individuals competing for a single resource (such as water or food)? Discuss the students' answers which will lead towards the idea of competition.
- **Ask the students:** Do you think living organisms compete in nature? Why? Discuss the students' answers.
- **Explain to the students** that competition is a nutritional relationship that can take various forms and types, including the competition between two individuals of the same species for a food resource that exists in limited quantities, as shown in figure (5), which negatively affects their growth or survival.

3 Mutualism

- **Show a short video** about a clear mutualistic relationship (such as bees pollinating flowers while obtaining nectar).
- **Ask the students:** How does the bee benefit? By extracting nectar from the flowers. What does the plant benefit from? By transferring pollen grains on the bodies of bees from one flower to another for the process of floral reproduction as shown in figure (6).
- **Explain to the students** that mutualism is a nutritional relationship between two individuals where both benefit from each other without harm to either.

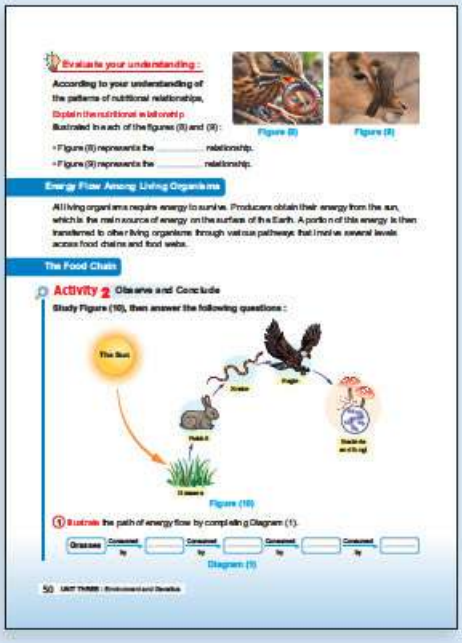
- **Divide the students** into groups and ask them to create a fictional relationship between two organisms, so that each benefits from the other.

4 Commensalism

- **Ask the students:** Can there be an interaction between two organisms where one is benefiting and the other is not harmed?
- **Inform the students that** there is a type of relationship between living organisms called commensalism, where one organism benefits while the other is unaffected.
- **Explain to the students** that commensalism is a nutritional relationship where one individual, known as the commensal, benefits, while the other individual, known as the host, does not receive any benefit nor suffers harm.
- **Give the students** examples of commensalism, including the food relationship between the oxpecker bird and Nile crocodiles, where the oxpecker bird benefits from feeding on leftover food that get trapped between the crocodile's teeth, while the crocodile neither benefits nor is harmed as shown in figure (7).

Evaluate Your Understanding

- **Ask the students** to evaluate their understanding by explaining the type of food relationship illustrated in figures (8) and (9).
- Figure (8) represents the predatory relationship.
- Figure (9) represents the commensal relationship.



Energy Flow Among Living Organisms

- **Present the students** with a short story illustrating energy transfer, for example: energy starts from the sun, which plants convert into food through photosynthesis. The rabbit eats the grass, and a portion of the energy stored in the plants is transferred to it. Subsequently, the fox feeds on the rabbit, and then its body decomposes by decomposers, returning energy to the soil.
- **Explain to the students that:**
- All living organisms require energy to survive.
- Producers obtain their energy from the sun, which is the main source of energy on the Earth's surface.
- Energy flows from producers to other living organisms in various pathways that include multiple levels through food chains and food webs.

The Food Chain

Activity 2 Observe and conclude

This activity aims to discover the concept of the food chain.

- **Materials used**: Images from the student's book.
- **Ask the students** to study figure (10), then answer the following questions:

(1) **Illustrate** the Path of energy flow by completing diagram (1):

② **What** is the producer? **And Why** is it described as autotrophic organism? The grasses, and it is described as autotrophic because it produces its own food through photosynthesises.

③ **Why** are the rabbit, snake and eagle classified as consumers?

- The rabbit is a consumer because it obtains energy by feeding on grasses.
- The snake is a consumer because it obtains energy by feeding on the rabbit.
- The eagle is a consumer because it obtains energy by feeding on the snake.

④ **Which** is (are) the consumer(s) that feed(s) on plants (herbivorous organisms or herbivores) and which feed(s) on meat (carnivorous organisms or carnivores)?

- Herbivores organisms: The rabbit.
- Carnivores organisms: The snake and the eagle.

⑤ **What** are the (primary, secondary, tertiary) consumer organisms?

- The rabbit is a primary (or first level) consumer as it feeds on producer.
- The snake is a secondary consumer, as it feeds on herbivores.
- The eagle is a tertiary consumer, as it feeds on carnivores.

⑥ **Why** are bacteria and fungi called decomposers? Because they break down organic substances found in the bodies of other organisms after their death into simpler substances that mix with the soil and become part of its components.

- **Explain to the students** the definition of a food chain, which is the path of energy transfer in the form of food as it moves from one living organism to another within the ecosystem.
- **Explain to the students** the definition of a trophic level, which is each stage in which energy is transferred in the food chain.

Use Discussion Strategy:

- **Pose the following questions to the students:**

1. How many levels are there in a food chain?

Explain to the students that any food chain, whether terrestrial, aquatic, or desert, consists of several trophic levels.

② What is the producer ? And why is it described as autotrophic organism?

③ Why are the rabbit, snake, and eagle classified as consumers?

- The rabbit is a consumer because it obtains energy by feeding on .....
- The snake is a consumer because it obtains ..... by feeding on .....
- The eagle is a consumer because it obtains ..... by feeding on .....

④ Which is (are) the consumer(s) that feed(s) on plants (herbivorous organisms or herbivores) and which feed(s) on meat (carnivorous organisms or carnivores)?

- Herbivorous organisms : .....
- Carnivorous organisms : .....

⑤ What are the (primary, secondary and tertiary) consumer organisms?

- ..... is a primary (or first level) consumer, as it feeds on .....
- ..... is a ..... consumer, as it feeds on .....
- ..... is a ..... consumer, as it feeds on .....

⑥ Why are bacteria and fungi called decomposers?

It is clear from the previous that:

- The path of energy transfer (flow) in the form of food as it moves from one organism to another within the ecosystem is known as a food chain.
- Each stage in which energy is transferred in the food chain is referred to as a trophic level.
- The food chain, whether terrestrial, aquatic or desert, are formed of many trophic levels, the first level is occupied by a producer, while the consumers occupy the higher levels (the second, the third ...), and end with a decomposer.
- The organisms which obtain their food from the dead bodies are known as the decomposers, as they break down (decompose) the organic substances found in the bodies of the other organisms after being dead to simpler substances which mix with the soil and become part of its components.

Life Application

Sustainable agriculture

The study of food chains is used in designing food systems that utilize living organisms to eliminate agricultural pests instead of using pesticides, a method known as biological control, such as the use of the dotted beetles (ladybugs) to feed on aphids insects, which are agricultural pests that harm vegetables and fruits (Figure 11).

Figure (11)

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2. **What organism** occupies the first level? A producer.
3. **What organisms** occupy the higher levels (second, third, ...)? A consumers.
4. **What is the organism** with which the food chain ends? It ends with a decomposer.
5. **Ask the students** why organisms that obtain their food from the remains of dead organisms are called decomposers? Because they decompose the organic substances found in the bodies of other organisms after their death into simpler substances that mix with the soil and become part of its composition.

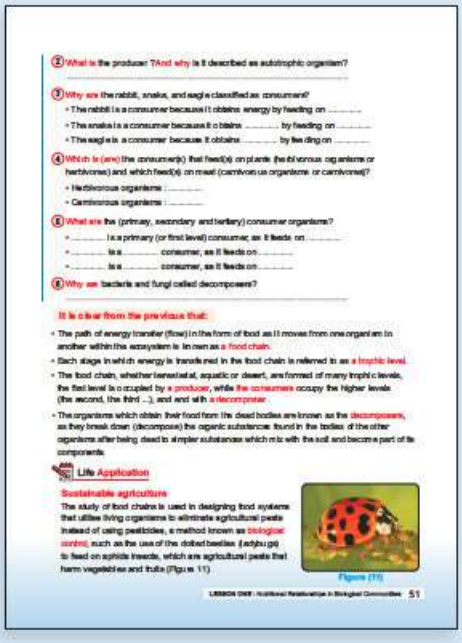
Use Role-Playing Strategy:

- **Ask the students** to stand in a line representing the food chain.
- **The first student** represents the sun. The second represents plants (producer organisms). The third represents herbivorous animals (primary consumer). The fourth represents carnivorous animals (secondary consumer). The last student represents the decomposer.
- **Use** a string to connect the students to illustrate how energy flows from the sun to the decomposer.

Life Application

- **Dear Teacher:**
- **Biological control is** a natural method for managing pests and diseases that affect agricultural crops or the environment, using beneficial living organisms instead of chemical pesticides. This method relies on the natural balance between living organisms and is considered a sustainable and environmentally friendly approach. The aim is to reduce the use of chemical pesticides to lessen environmental pollution and their harmful effects on human and animal health, while maintaining ecological balance by enhancing the role of beneficial organisms.
- **Types of Biological Control:**

1. **Biological predators:** For example, using dotted beetles (ladybugs) that feed on aphids insects, which are agricultural pests that affect vegetables and fruits (Figure 11).
2. **Parasites:** Certain types of wasps that lay their eggs inside harmful insects.
3. **Natural Pathogens:** Such as fungi and bacteria that cause diseases in harmful insects.
4. **Resistant plants:** Growing plant varieties that have natural resistance to pests.



(2) What is the producer ? And why is it described as autotrophic organism?

(3) Why are the rabbit, snake, and eagle classified as consumers?
- The rabbit is a consumer because it obtains energy by feeding on .....
- The snake is a consumer because it obtains ..... by feeding on .....
- The eagle is a consumer because it obtains ..... by feeding on .....

(4) Which is (are) the consumer(s) that feed(s) on plants (herbivorous organisms or herbivores) and which feed(s) on meat (carnivorous organisms or carnivores)?
- Herbivorous organisms : .....
- Carnivorous organisms : .....

(5) What are the (primary, secondary and tertiary) consumer organisms?
- ..... is a primary (or first level) consumer, as it feeds on .....
- ..... is a ..... consumer, as it feeds on .....
- ..... is a ..... consumer, as it feeds on .....

(6) Why are bacteria and fungi called decomposers?

It is clear from the previous that:

- The path of energy transfer (flow) in the form of food as it moves from one organism to another within this ecosystem is known as a food chain.
- Each stage in which energy is transferred in the food chain is referred to as a trophic level.
- The food chain, whether terrestrial, aquatic or desert, are formed of many trophic levels, the first level is occupied by a producer, while the consumers occupy the higher levels (the second, the third ...), and end with a decomposer.
- The organisms which obtain their food from the dead bodies are known as the decomposers, as they break down (decompose) the organic substances found in the bodies of the other organisms after being dead to simpler substances which mix with the soil and become part of its components.

Life Application

Sustainable agriculture

The study of food chains is used in designing food systems that utilize living organisms to eliminate agricultural pests instead of using pesticides, a method known as biological control, such as the use of the dotted beetles (ladybugs) to feed on aphids insects, which are agricultural pests that harm vegetables and fruits (Figure 11).

Figure (11)

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Ask the students the following questions:

1. **Have** you noticed that the teeth of animals differ depending on their type of food?
2. **Why does** a lion have sharp canines, while a horse has incisors?

- **Request that students** observe pictures of animals (such as a lion, horse) and human and ask them to note their teeth.
- **Explain** to the students the difference between incisors and canines: Incisors are the flat teeth located at the front of the mouth, used for cutting plants, while canines are the pointed teeth used for tearing prey.
- **Clarify to the students that:**

1. Herbivorous animals need incisors to cut plants (Figure 12).
2. Carnivorous animals need canines to tear prey (Figure 13).
3. Human has both types because they consume a varied food.

- **Pose the following question to the students:** What type of food does a bear eat?

It feeds on both plants and animals (meat) (Figures 14 and 15).

- **Explain to the students** that omnivorous animals are those that eat almost everything, such as human who consume fruits, vegetables and meats.
- **Clarify to the students** that eagles eat carrion and help clean the environment, as do hyenas (Figure 17), preventing the accumulation of carcasses in nature.
- **Explain to the students** that scavengers are animals that eat what remains of dead organisms.
- **What is the difference between a decomposers and a scavengers?**

Decomposers: Organisms that break down organic substances from the bodies of other organisms after they die into simpler substances that mix with the soil and become part of its composition.

Scavengers: Larger organisms (such as hyenas and eagles) that feed on the remains of dead organisms.


• Most herbivorous animals, such as the horse, are characterised by the presence of incisors for cutting plants (Figure 12), whereas most carnivorous animals, such as the lion, are distinguished by sharp canines for tearing prey (Figure 13).

Figure (12) Herbivore

Figure (13) Carnivore

Organisms that feed on :

- Both plants and animals are known as omnivores, such as the bear (Figures 14, 15), the raven, the mouse and the hedgehog.
- The remains of dead organisms are known as scavengers, such as: hyena (Figure 16), eagles (Figure 17), and cockroaches.

Figure (14)

Figure (15)

The bear is an omnivore

Figure (16) Hyena is a scavenger

Figure (17) Eagle is a scavenger

What is the difference between a decomposers and a scavengers ?

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Evaluate Your Understanding

- **Ask the students** to evaluate their understanding by illustrating some living organisms in an aquatic environment at the North Pole (Figure 18) and then answer the following questions:

① **Construct** a food chain from these living organisms:
Algae → copepod → Fish → Seal → Polar bear

② **Which** organism represents a secondary consumer? The fish.

Food Web

- **Pose the following question to the students:** What is the difference between a food chain and a food web? Allow the students to think and discuss their answers.

Use educational game strategies:

Food Chain Game:

- Distribute cards to the students containing names or pictures of different organisms (such as grass, rabbit, fox, eagle).
- Ask the students to arrange themselves in a simple food chain.
- After completing this, add other organisms (such as wheat, locust, mouse) and discuss how the chain can change into a web.
- Explain to the students that it is rare to find isolated food chains in ecosystems, as one organism can feed on multiple sources while this organism itself is a source of food for several other organisms at higher trophic levels.
- Clarify to the students that the interconnection and overlapping of multiple food chains lead to the formation of what is known as a food web.

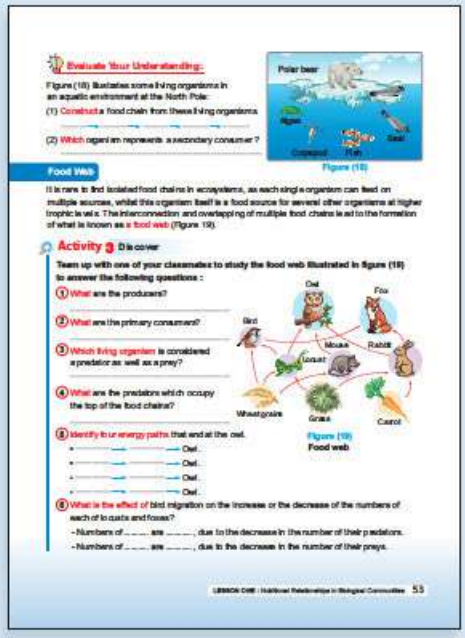
Activity 3 Discover

This activity aims to explore the food web.

- **Materials used:** Images from the student's book.
- **Ask the students** to study Figure (19), then answer the following questions:

① **What** are the producers? wheat grains, grass, carrot.

② **What** are the primary consumers? Bird, locust, mouse, rabbit.


Evaluate Your Understanding:
Figure (18) illustrates some living organisms in an aquatic environment at the North Pole:
(1) Construct a food chain from these living organisms.
(2) Which organism represents a secondary consumer ?
Polar bear
Algae
Copepod
Fish
Seal
Figure (18)
Food Web
It is rare to find isolated food chains in ecosystems, as each single organism can feed on multiple sources, whilst this organism itself is a food source for several other organisms at higher trophic levels. The interconnection and overlapping of multiple food chains lead to the formation of what is known as a food web (Figure 19).
Activity 3 Discover
Team up with one of your classmates to study the food web illustrated in figure (19) to answer the following questions :
① What are the producers?
② What are the primary consumers?
③ Which living organism is considered a predator as well as a prey?
④ What are the predators which occupy the top of the food chains?
⑤ Identify four energy paths that end at the owl.
• ..... → ..... → Owl.
• ..... → ..... → Owl.
• ..... → ..... → Owl.
• ..... → ..... → Owl.
⑥ What is the effect of bird migration on the increase or the decrease of the numbers of each of locusts and foxes?
- Numbers of ..... are ....., due to the decrease in the number of their predators.
- Numbers of ..... are ....., due to the decrease in the number of their preys.
Owl
Fox
Bird
Mouse
Rabbit
Locust
Wheat grains
Grass
Carrot
Figure (19)
Food web
53

③ **Which living organism** is considered a predator as well as a prey? The bird.

④ **What are the predators** which occupy the top of the food chains? The owl and the fox.

⑤ **Identify four energy paths that end at the owl:**

- Wheat grains → Locust → Owl.
- Wheat grains → Mouse → Owl.
- Carrot → Rabbit → Owl.
- Grass → Rabbit → Owl.

⑥ **What is the effect of** bird migration on the increase or the decrease of the numbers of both locusts and foxes?

- Numbers of locusts are increasing due to the decrease in the number of their predators.
- Numbers of foxes are decreasing due to the decrease in the number of their preys.

Cross-cutting Concepts: Cause and Effect

- The concept of cause and effect is used to understand how events and phenomena are interconnected. Learning this concept helps students explain why things happen (the cause) and what results from this event or action (the effect).
- Apply the concept of cause and effect to the previous activity:

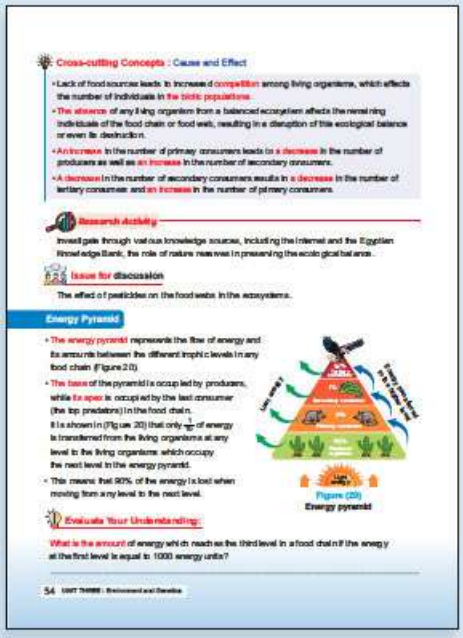
1. Lack of food resources (the cause) leads to increased competition among living organisms (the effect), which affects the number of individuals in the biotic populations.
2. The absence of any living organism from a balanced ecosystem (the cause) affects the remaining individuals of the food chain or food web, resulting in a disruption and possibly destroying this ecological balance (the effect).
3. An increase in the numbers of primary consumers (the cause) leads to a decrease in the numbers of producers and an increase in the numbers of secondary consumers (the effect).
4. A decrease in the numbers of secondary consumers (the cause) leads to a decrease in the numbers of tertiary consumers and an increase in the numbers of primary consumers (the effect).

Research activity

- Ask students to research various knowledge sources, including the internet and the Egyptian Knowledge Bank, about the role of reserves in maintaining ecological balance, such as providing a safe environment for rare and endangered plants and animals, and preserving living organisms that play vital roles in food chains and food webs, among others.

Issue for Discussion

- Discuss with students the effect of pesticides on the food webs in ecosystems.
- You may use the following questions to guide the discussion:
- **What** are pesticides, and why do farmers use them?
- **How** do you think pesticides that kill insects might affect other organisms in the environment?
- **What** is the impact of pesticides on target and non-target organisms?
- **How** do they affect ecological balance and biodiversity?


Cross-cutting Concepts : Cause and Effect

• Lack of food sources leads to increased competition among living organisms, which affects the number of individuals in the biotic populations.

• The absence of any living organism from a balanced ecosystem affects the remaining individuals of the food chain or food web, resulting in a disruption of this ecological balance or even its destruction.

• An increase in the number of primary consumers leads to a decrease in the number of producers as well as an increase in the number of secondary consumers.

• A decrease in the number of secondary consumers results in a decrease in the number of tertiary consumers and an increase in the number of primary consumers.

Research activity

Investigate through various knowledge sources, including the internet and the Egyptian Knowledge Bank, the role of nature reserves in preserving the ecological balance.

Issue for discussion

The effect of pesticides on the food webs in the ecosystems.

Energy Pyramid

• The energy pyramid represents the flow of energy and its amounts between the different trophic levels in any food chain (Figure 20).

• The base of the pyramid is occupied by producers, while its apex is occupied by the last consumer (the top predators) in the food chain.

It is shown in (Fig ure 20) that only $\frac{1}{10}$ of energy is transferred from the living organisms at any level in the living organisms which occupy the next level in the energy pyramid.

• This means that 90% of the energy is lost when moving from any level to the next level.

Figure (20)
Energy pyramid

Evaluate Your Understanding:

What is the amount of energy which reach as the third level in a food chain if the energy at the first level is equal to 1000 energy units?

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Energy Pyramid

- The energy pyramid is a model used to represent the amount of energy that transfers through different levels of the food chain or food web in an ecosystem. This pyramid illustrates how energy decreases as we move from one level to another in the food chain.
- **Ask students:** How does energy transfer from one living organism to another in the ecosystem? Or what energy do herbivorous animals obtain from plants?
- **Request students to** observe Figure (20), which displays the energy pyramid with different levels.
- **Ask students** which organisms occupy the base of the pyramid?

The producers.

- And which organisms occupy the apex of the pyramid?

The consumers.

- **Discuss with students** how energy is lost at each level in the food chain.
- **Explain to students** that only a fraction of the energy is transferred from organisms at any level to organisms at the next level in the energy pyramid, specifically that 90% of energy is lost when moving from one level to the next.

Evaluate Your Understanding

- **Ask students** to evaluate their understanding by calculating the amount of energy that reaches the third level in a food chain if the energy at the first level is equal to 1000 energy units.

∵ Each trophic level in the energy pyramid transfers $\frac{1}{10}$ from its energy to the next trophic level.

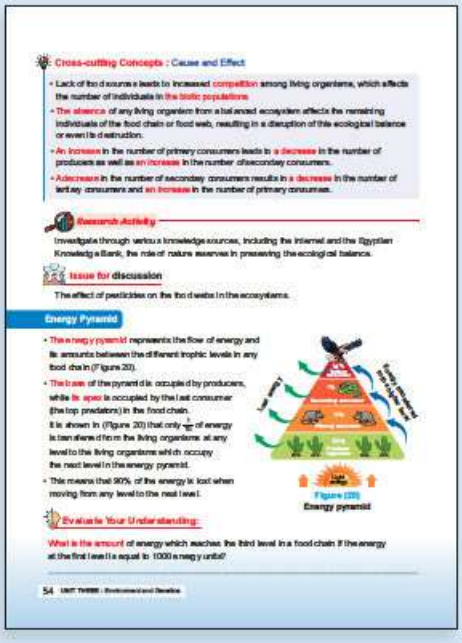
∴ The amount of energy that reaches the second trophic level

$= 1000 \times \frac{1}{10} = 100$ energy units.

- Therefore, the amount of energy that reaches the third trophic level $= 100 \times \frac{1}{10} =$ 10 energy units.

Closure of the Lesson:

- This is a skill in which the teacher summarises all the main ideas of the lesson before concluding it five minutes before the end.
- You may involve students in closing the lesson by asking them about the concepts covered in the lesson.



Cross-cutting Concepts : Cause and Effect

- Lack of food sources leads to increased competition among living organisms, which affects the number of individuals in the biotic populations.
- The absence of any living organism from a balanced ecosystem affects the remaining individuals of the food chain or food web, resulting in a disruption of this ecological balance or even its destruction.
- An increase in the number of primary consumers leads to a decrease in the number of producers as well as an increase in the number of secondary consumers.
- A decrease in the number of secondary consumers results in a decrease in the number of tertiary consumers and an increase in the number of primary consumers.

Research Activity

Investigate through various knowledge sources, including the Internet and the Egyptian Knowledge Bank, the role of nature reserves in preserving the ecological balance.

Issue for discussion

The effect of pesticides on the food webs in the ecosystems.

Energy Pyramid

- The energy pyramid represents the flow of energy and its amounts between the different trophic levels in any food chain (Figure 20).
- The base of the pyramid is occupied by producers, while its apex is occupied by the last consumer (the top predators) in the food chain.
  It is shown in (Figure 20) that only $\frac{1}{10}$ of energy is transferred from the living organisms at any level to the living organisms which occupy the next level in the energy pyramid.
- This means that 90% of the energy is lost when moving from any level to the next level.

Figure (20)
Energy pyramid

Evaluate Your Understanding:

What is the amount of energy which reaches the third level in a food chain if the energy at the first level is equal to 1000 energy units?

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Answers of Evaluation Questions on **Lesson One**

1

(1) (a) (2) (b) (3) (b) (4) (c) (5) (c)

2

(1) Because bees benefit by extracting nectar from flowers, while the plant benefits by transferring pollen grains on the bodies of bees from one flower to another, which promotes the floral reproduction.

(2) Because in this nutritional relationship, only one of the individuals (the plover bird) benefits by feeding on the leftover food that get trapped between the crocodile's teeth, while the other individual (the crocodile) neither benefits nor is harmed.

3 The number of snakes increases, thus, the number of earthworms decreases.

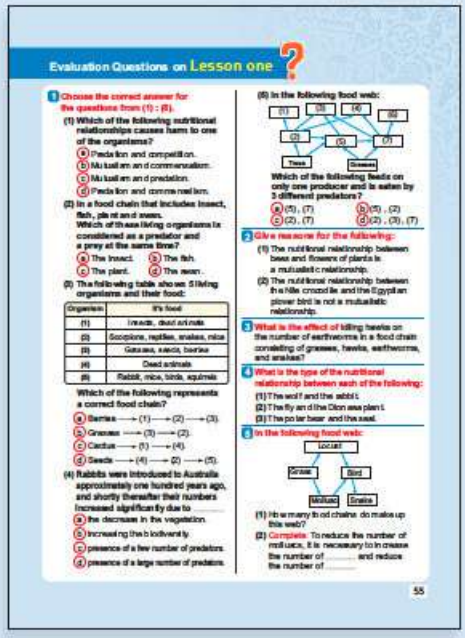
4

(1) : **(3)** Predation.

5

(1) 2

(2) Birds / Grass.


Evaluation Questions on Lesson one

1 Choose the correct answer for the questions from (1) : (5).

(1) Which of the following nutritional relationships causes harm to one of the organisms?
(a) Predation and competition.
(b) Mutualism and commensalism.
(c) Mutualism and predation.
(d) Predation and commensalism.

(2) In a food chain that includes insect, fish , plant and snake.
Which of these living organisms is considered as a predator and a prey at the same time?
(a) The insect. (b) The fish.
(c) The plant. (d) The swan.

(3) The following table shows 5 living organisms and their food:

Organism	It's food
(1)	Insects , dead animals
(2)	Scorpions , reptiles , snakes , mice
(3)	Grasses , seeds , berries
(4)	Dead animals
(5)	Rabbit , mice , birds , squirrels

Which of the following represents a correct food chain?
(a) Berries ⟶ (1) ⟶ (2) ⟶ (3).
(b) Grasses ⟶ (3) ⟶ (2).
(c) Cactus ⟶ (1) ⟶ (4).
(d) Seeds ⟶ (4) ⟶ (2) ⟶ (5).

(4) Rabbits were introduced to Australia approximately one hundred years ago, and shortly thereafter their numbers increased significantly due to .....
(a) the decrease in the vegetation.
(b) increasing their biodiversity.
(c) presence of a few number of predators.
(d) presence of a large number of predators.

(5) In the following food web:
(1) (3) (4) (6) (2) (5) (7) Trees Grasses
Which of the following feeds on only one producer and is eaten by 3 different predators?
(a) (5) , (7) (b) (5) , (2)
(c) (2) , (7) (d) (2) , (3) , (7)

2 Give reasons for the following:
(1) The nutritional relationship between bees and flowers of plants is a mutualistic relationship.
(2) The nutritional relationship between the Nile crocodile and the Egyptian plover bird is not a mutualistic relationship.

3 What is the effect of killing lizards on the number of earthworms in a food chain consisting of grasses, lizards, earthworms, and snakes?

4 What is the type of the nutritional relationship between each of the following:
(1) The wolf and the rabbit.
(2) The fly and the Dion sea plant.
(3) The polar bear and the seal.

5 In the following food web:
Locust Grass Bird Mollusc Snake
(1) How many food chains do make up this web?
(2) Complete: To reduce the number of molluscs, it is necessary to increase the number of ..... and reduce the number of .....

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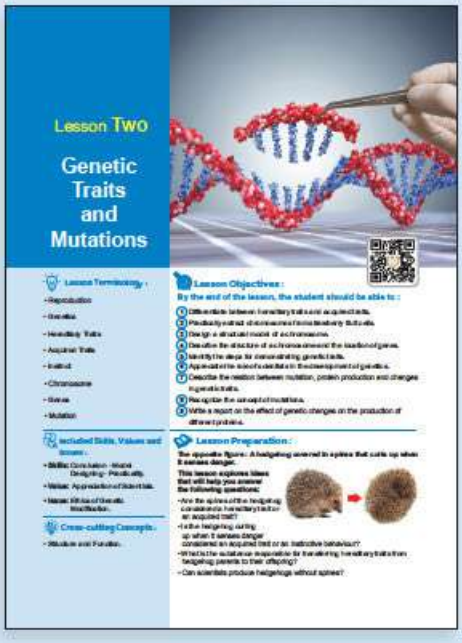
Additional Learning Resources:

- Utilise digital learning resources such as the Egyptian Knowledge Bank, as well as educational and documented videos and films available on internet sites.

Lesson Two: Genetic Traits and Mutations



Introduction:

Lesson two of this unit focuses on the topic of genetic traits and mutations. Genetic traits are one of the greatest wonders of living organisms; they determine our appearance, eye colour, body shape, and even our abilities and inclinations. These traits are passed from one generation to the next through tiny units called genes, which resemble secret codes stored within the cells of living beings. However, nature does not always follow the usual rules; sometimes, small changes occur in this genetic code, known as mutations. These mutations can be beneficial, harmful, or have no effect at all. Through this lesson, students will acquire a range of new concepts, and the lesson aims to develop skills in discovery, reasoning, and inference.

Lesson Objectives:

1. Differentiate between hereditary traits and acquired traits.
2. Practically extract chromosomes practically from strawberry fruit cells.
3. Design a structural model of a chromosome.
4. Describe the structure of a chromosome and the location of genes.
5. Identify the steps for demonstrating genetic traits.
6. Appreciate the role of scientists in the development of genetics.
7. Describe the relation between mutation, protein production, and changes in genetic traits.
8. Recognize the concept of mutations.
9. Write a report on the effect of genetic changes on the production of different proteins.

Teaching Aids and Learning Resources Used:

Data show – films – student book images – internet – science lab.

Duration and place of Teaching:

Two periods (4 sessions) – classroom and media lab – science lab.

Lesson Terminology:

- Reproduction
- Genetics
- Hereditary Traits
- Acquired Traits
- Instinct
- Chromosome
- Genes
- Mutation

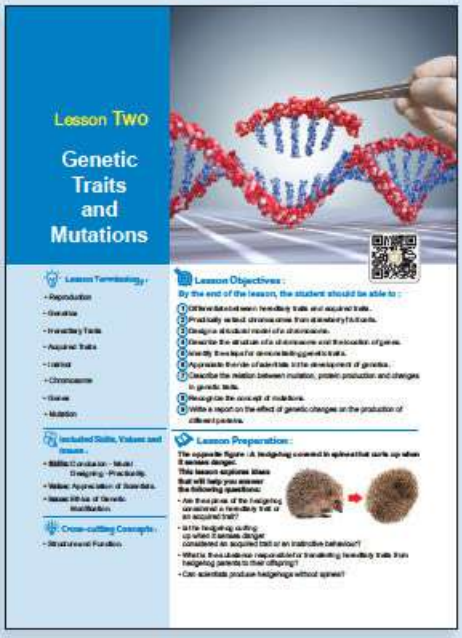
Misconceptions or Incorrect Concepts:

- **Some students believe** that genetic traits are inherited entirely from one parent (either the mother or the father) only; however, genetic traits are passed down from both parents as each parent carries two copies of the genes that combine to form traits in their offspring.
- **Some students think** that genetic traits are fixed and do not change, remaining the same without alteration; however, they can change due to mutations and long-term environmental influences.
- **Some students believe** that mutations are always harmful or lethal and cause diseases or catastrophic outcomes; however, mutations can be harmful, beneficial, or even neutral and are one of the reasons for biological diversity and evolution.

- **Some students believe** that mutations are always caused by human intervention, such as pollution or radiation. However, some mutations occur naturally as a result of random errors during DNA replication or due to natural factors such as ultraviolet radiation.

Diagnostic Assessment:

- **Ask students** to examine the lesson preparation image and attempt to answer the questions, as these questions serve as a diagnostic assessment to gauge their prior knowledge about the lesson and uncover any misconceptions or incorrect concepts they may have.
- **Listen carefully** to students' answers to these questions and ask them to explain the reasons behind their responses.
- Clarify that the correct answers to **these** questions will be revealed through the explanation of this lesson.



Use Diverse Teaching Strategies:

You can use K.W.L, strategies, discussion, cooperative learning, similarities, practical experiments and educational games.

- **At the beginning of the unit**, use the K.W.L strategy (What do you know?), (What do you want to know?), (What have you learned?).
- **Draw a K.W.L table** on the board, reminding students of this strategy:

What do you know? (K)	What do you want to know? (W)	What have you learned? (L)

- **Before explaining the lesson:** Ask students to write down the knowledge they already have about genetic traits and mutations in the first column (What do you know?). Then, they should write the new knowledge they wish to gain about genetic traits and mutations in the second column (What do you want to know?).
- **After explaining the lesson:** Ask students to write down the knowledge they have learned about genetic traits and mutations in the third column (What have you learned?).

Genetic (Hereditary) Traits and Acquired Traits

Preparing the lesson:

- **Ask the students** that the following motivational question: Have you ever noticed that you resemble one of your parents or siblings in the shape of your eyes, hair colour, or even your way of laughing? Why do you think this happens?
- **Give the students** a chance to respond and share examples from their lives.
- **Show the students** a family photo consisting of individuals who share some distinctive traits (such as eye colour or height); you can refer to Figure 1 in the student's book, and ask the students to identify the common traits among them.
- **Explain to the students** that the science which studies the transmission of hereditary traits from parents to offspring is called genetics.

Activity 1 Conclude

- **The aim of this activity is to** differentiate between genetic traits, acquired traits, and instinctive behaviours.
- **Tools used:** figures from the student's book.
- **Ask the students to** investigate the figures from (2 to 7), then clarify the trait or behaviour expressed by each figure, by writing the following letters below each figure:

1. **The letter (H):** traits likely to be transmitted from parents to offspring without learning.
2. **The letter (I):** behaviours and skills likely to be transmitted from parents to offspring without learning.
3. **The letter (A):** traits that one individual may acquire more than other individuals through learning or training.

- **Figure (2):** A squirrel breaks hazelnut shell (I).
- **Figure (3):** Coloured eyes (H).
- **Figure (4):** Strong muscles (A).
- **Figure (5):** The length of a giraffe's neck (H).
- **Figure (6):** A dolphin plays with a ball (A).
- **Figure (7):** A bat sleeps upside down (I).


Genetic (Hereditary) Traits and Acquired Traits

In the first term, you have learned that all living organisms perform a series of vital processes, including reproduction. All of them reproduce to produce new individuals (offspring) resembling their parents (Figure 1). The science that studies the transmission of genetic traits from parents to offspring is called genetics (Heredity).

Figure (1)

Activity 1 Conclude

Investigate the figures (2) : (7), then clarify the trait or behaviour expressed by each figure by writing:

- The letter (H) below the figures that represent traits that are likely to be transmitted from parents to offspring without learning.
- The letter (I) below the figures that represent behaviours and skills that are likely to be transmitted from parents to offspring without learning.
- The letter (A) below the figures that represent traits that one individual may acquire more than other individuals through learning or training.

Figure (2) A squirrel breaks hazelnut shell (.....)

Figure (3) Coloured eyes (.....)

Figure (4) Strong muscles (.....)

Figure (5) The length of giraffe's neck (.....)

Figure (6) A dolphin plays with a ball (.....)

Figure (7) A bat sleeps upside down (.....)

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Use Cooperative Learning Strategy:

- **Ask the students the following question:**

  Have you ever noticed the similarities between family members?

  Or have you thought about how human learn new skills, while some animals behave naturally without instruction?

- **Divide the students** into three main groups, with each group working on one of the following concepts: inherited traits, acquired traits, instinctive behaviours.
- **Assign tasks** to each group, and explain the required task clearly.
- **Provide them with educational materials** such as (images, short texts, or video clips), and the student book.
- **Ask them to answer guiding questions:**

(1) Inherited traits: What are they? How are they passed on? Examples of them.

(2) Acquired traits: How do they develop? What is the difference between them and inherited traits?

(3) Instinctive behaviours: What do they mean? And why do they not require teaching?

- Within each group, assign roles (leader, writer, presenter, researcher). Have the students discuss the concept, write their notes, and prepare a short presentation to explain the concept to the class.
- **Ask each group** to present what they have learned to the class in a creative way (drawing a diagram, writing a short story, acting out a simple scene, etc.). After each presentation, discuss with the students the remaining concepts to connect them together.
- **Explain to the students** that inherited traits are those that are passed from parents to offspring without learning and are inherited from generation to generation.
- **Provide the students** with examples of inherited traits such as human hair colour, the short legs of the Arctic fox, and the hard shell covering a turtle's body, and define such traits, then ask them for other examples from their experiences.
- **Explain to the students** that instinctive behaviours (instinct) are behaviours and skills that are transmitted from parents to offspring without learning.

- **Provide the students** with examples of instinctive behaviours such as a spider weaving its web to catch insects, and a chicken incubating its eggs. Then ask them for other examples from their experiences.
- **Explain to the students** that acquired traits are traits that are not inherited from parents but are acquired from the surrounding environment through learning or training and do not pass from one generation to another.
- **Provide the students** with examples of acquired traits such as a child learning to walk and learning languages, then ask them for other examples from their experiences.

Evaluate Your Understanding

- Ask the students to evaluate their understanding by classify the following into genetic traits, acquired traits, and instinctive behaviours:

(1) Reading and writing: Acquired traits.

(2) Facial freckles: Genetic traits.

(3) Curly hair: Genetic traits.

(4) The bird building its nest: Instinctive behaviours.

(5) Breastfeeding: Instinctive behaviours.

(6) The horse jumping over obstacles: Acquired traits.

Chromosomes and the Transmission of Genetic Traits

- **Ask the students** the following question: Have you ever wondered how traits such as eye colour or height are passed from parents to offspring? What carries these traits within the cells of our bodies?
- **Allow the students to** share their thoughts and observations, which will spark their curiosity to seek the answer.

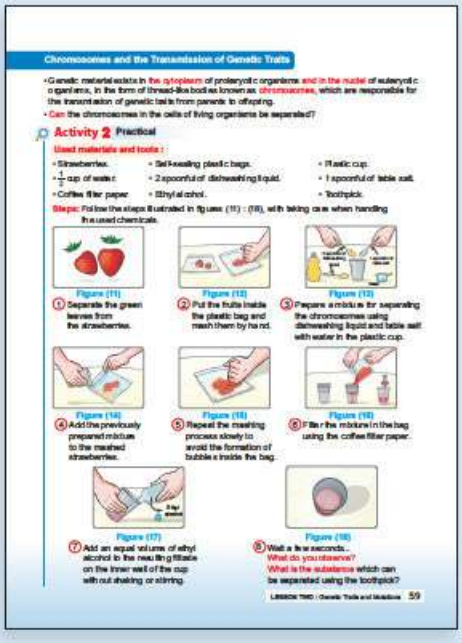
Use the Strategy of Similarities:

- **Compare chromosomes** within the cell to books in a large library.
- **Ask the students** to imagine that within each cell in our bodies, there is a massive library containing books. Each book contains specific instructions for building and operating the human body. These books are what we call chromosomes, and they carry the essential genetic information for life.
- **Present a microscopic** image of chromosomes or a diagram showing chromosomes within a cell.
- **Explain to the students** that genetic material exists in the cytoplasm of prokaryotic organisms and the nuclei of eukaryotic organisms, in the form of thread-like bodies known as chromosomes, which are responsible for transmitting genetic traits from parents to offspring.
- **Pose the following question** to the students: Can chromosomes found in the cells of living organisms be separated? Answer: Yes.

Activity 2 Practical

- The aim of this activity is to demonstrate how to extract genetic material (DNA) containing chromosomes from strawberry cells.
- **Used Materials and tools:**

Strawberries – self-sealing plastic bags – plastic cup – $\frac{1}{2}$ Cup of water – 2 spoonful of dishwashing liquid – 1 spoonful of table salt – Coffee filter paper – ethyl alcohol – toothpick.


Chromosomes and the Transmission of Genetic Traits

- Genetic material exists in the cytoplasm of prokaryotic organisms and in the nuclei of eukaryotic organisms, in the form of thread-like bodies known as chromosomes, which are responsible for the transmission of genetic traits from parents to offspring.
- Can the chromosomes in the cells of living organisms be separated?

Activity 2 Practical

Used materials and tools :

- Strawberries.
- Self-sealing plastic bags.
- Plastic cup.
- $\frac{1}{2}$ cup of water.
- 2 spoonful of dishwashing liquid.
- 1 spoonful of table salt.
- Coffee filter paper.
- Ethyl alcohol.
- Toothpick.

Steps: Follow the steps illustrated in figures (11) : (18), with taking care when handling the used chemicals.

Figure (11) ① Separate the green leaves from the strawberries.

Figure (12) ② Put the fruits inside the plastic bag and mash them by hand.

Figure (13) ③ Prepare a mixture for separating the chromosomes using dishwashing liquid and table salt with water in the plastic cup.

Figure (14) ④ Add the previously prepared mixture to the mashed strawberries.

Figure (15) ⑤ Repeat the mashing process slowly to avoid the formation of bubbles inside the bag.

Figure (16) ⑥ Filter the mixture in the bag using the coffee filter paper.

Figure (17) ⑦ Add an equal volume of ethyl alcohol to the resulting filtrate on the inner wall of the cup without shaking or stirring.

Figure (18) ⑧ Wait a few seconds... What do you observe? What is the substance which can be separated using the toothpick?

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- **Instruct the students** to follow the steps outlined in figures (11) to (18) in the student book, taking care when handling the chemicals used:

① Separate the green leaves from the strawberries.

② Place the fruit inside the plastic bag and mash them by hand.

③ Prepare a mixture for separating the chromosome using dishwashing liquid and table salt with water in the plastic cup.

④ Add the previously prepared mixture to the mashed strawberries.

⑤ Repeat the mashing slowly to avoid the formation of bubbles inside the bag.

⑥ Filter the mixture in the bag using the coffee filter paper.

⑦ Add an equal volume of ethyl alcohol to the resulting filtrate on the inner wall of the cup without shaking or stirring.

⑧ Wait a few seconds... What do you observe?

White threads that are separated on the surface of the filtrate.

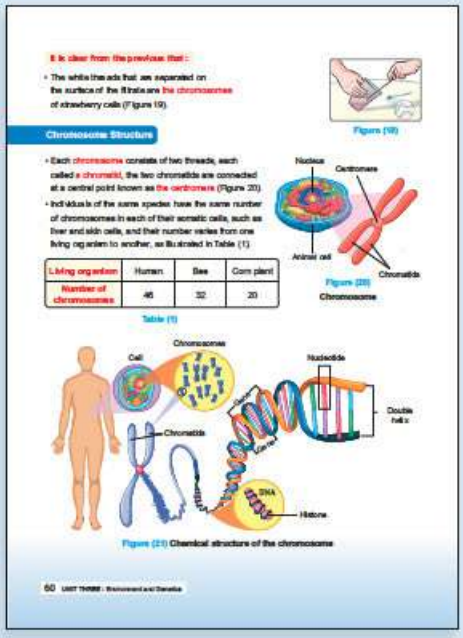
What is the substance which can be separated using the toothpick?

Chromosomes from strawberry cells.

- **Explain to the students** that the white threads that are separated on the surface of the filtrate are the chromosomes of strawberry cells (Figure 19).

Chromosome Structure

- **Explain to the students** that each chromosome consists of two threads, each called a chromatid, which are connected at a central point known as the centromere (Figure 20).
- **Explain to the students** that individuals of the same species agree in the number of chromosomes present in their somatic cells, such as liver and skin cells, while the number varies from one organism to another.
- **Ask the students to** read Table 1 and identify the number of chromosomes in various living organisms.
- **Explain to the students** that the number of chromosomes in human cells is 46, whereas it is (32) in bee cells and (20) in corn plant cells.
- **Ask the students to** examine (Figure 21), which illustrates the chemical structure of the chromosome.
- **Explain to the students** that the chromosome is chemically composed of nucleic acid (DNA) wrapped around a type of protein known as histones.
- **Explain to the students** that DNA is made up of small segments called genes, each of which consists of a sequence of smaller building units known as nucleotides, arranged as two strands twisted around each other, forming what is known as the double helix.
- **Explain to the students** that genes are responsible for the expression of the hereditary traits of the organism.
- **Explain to the students** that a single chromosome carries thousands or millions of genes, and the number of genes varies from one chromosome to another within the same individual's cells.

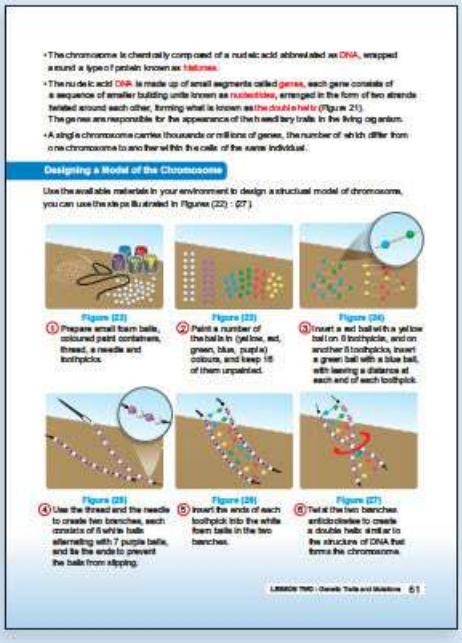


Designing a Model of the Chromosome

Dear Teacher :

The skill of developing and using models is one of the scientific and engineering practices emphasised by the Next Generation Science Standards (NGSS).

- **Model:** A model is an abstract representation of a phenomenon through three-dimensional particles, mathematical relationships, graphical representations, or computer simulations, thereby providing ideas on how the phenomenon occurs.
- Modelling can begin as students progress from tangible "images" or physical models (such as a toy car) to more abstract representations of related relationships in later grades, such as a diagram representing the forces acting on a specific object in the system.
- **Ask students to** design a tangible model of the chromosome structure using materials from their environment. For example, students could use small foam balls, coloured paint containers, string, a needle, and toothpicks. They can follow the steps and shapes from examples (22) to (27) in the student book.



• The chromosome is chemically composed of a nucleic acid abbreviated as DNA, wrapped around a type of protein known as histones.

• The nucleic acid DNA is made up of small segments called genes, each gene consists of a sequence of smaller building units known as nucleotides, arranged in the form of two strands twisted around each other, forming what is known as the double helix (Figure 21). The genes are responsible for the appearance of the hereditary traits in the living organism.

• A single chromosome carries thousands or millions of genes, the number of which differ from one chromosome to another within the cells of the same individual.

Designing a Model of the Chromosome

Use the available materials in your environment to design a structural model of chromosome, you can use the steps illustrated in Figures (22) : (27).

Figure (22)
① Prepare small foam balls, coloured paint containers, thread, a needle and toothpicks.

Figure (23)
② Paint a number of the balls in (yellow, red, green, blue, purple) colours, and keep 16 of them unpainted.

Figure (24)
③ Insert a red ball with a yellow ball on 8 toothpicks, and on another 8 toothpicks, insert a green ball with a blue ball, with leaving a distance at each end of each toothpick.

Figure (25)
④ Use the thread and the needle to create two branches, each consists of 8 white balls alternating with 7 purple balls, and tie the ends to prevent the balls from slipping.

Figure (26)
⑤ Insert the ends of each toothpick into the white foam balls in the two branches.

Figure (27)
⑥ Twist the two branches anticlockwise to create a double helix similar to the structure of DNA that forms the chromosome.

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A Profile of the Scientist Gregor Mendel:

- **Explain to students** the role of scientists in serving science and society by mentioning the contributions of Mendel, an Austrian scientist born in 1822, who is considered the founder of the science of genetics.
- **Explain to students** the efforts of this scientist, who conducted experiments over approximately eight years on 24,000 pea plants, leading to the conclusion that each hereditary trait is controlled by a pair of genetic factors, later known as genes. Without Mendel's efforts, scientific research would not have reached the remarkable advancements seen today in the field of genetic engineering.
- **Ask students** to use specialised websites to research Mendel's experiments.

The Role of Genes in Expression of Hereditary Traits

- **Explain to students** that genes are very small parts located within DNA, resembling programming codes that control our bodies.
- **Clarify that genes** are like the instructions written within our bodies, determining how we look and what our traits are.
- **Use the following analogy with students**: "Imagine genes as recipes that tell the chef (the body) how to prepare a specific dish (the traits)."
- **Explain to students** that each gene carries instructions for producing a specific protein. These proteins influence traits such as hair colour, eye colour, and even the shape of ear lobes.
- **Clarify to students** that we inherit genes from our parents: half from the mother and half from the father. Therefore, we find that traits are a mix from both.
- **Explain to students** that scientists Beadle and Tatum proposed the one gene-one enzyme hypothesis, which states that each gene produces a specific enzyme, which is responsible for a chemical reaction that leads to the formation of a protein that exhibits a specific hereditary trait.


A profile of the scientist

Gregor Mendel

An Austrian scientist born in 1822, he is considered the founder of the science of genetics. He conducted experiments over approximately eight years on 24,000 pea plants, after which he concluded that each hereditary trait is controlled by a pair of genetic factors, which were later became known as genes. Had it not been for Mendel's efforts, scientific research today would not have achieved such remarkable advancements in the field of genetic engineering.

Figure (28)

The Role of Genes in Expression of Hereditary Traits

Heredity traits are passed from parents to offspring through genes, with an individual inheriting half of their genetic material from the father and the other half from the mother. Scientists Beadle and Tatum, through their experiments, affirmed the one gene - one enzyme hypothesis, which states that each gene produces a specific enzyme, and this enzyme is responsible for occurrence of a chemical reaction that leads to the formation of a protein that expresses a specific hereditary trait.

Cross-cutting Concepts : Structure and Function

The difference in the arrangement of the nucleotides on DNA results in the difference of the genes present on a single chromosome, which in turn leads to the difference in the hereditary trait that each gene is responsible for expressing.

Mutations

Why do some cows appear huge compared to other cows (Figure 29)?

What are the reasons for a person being born with six fingers on one hand (Figure 30)?

Figure (29)

Figure (30)

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Cross-Cutting Concepts: Structure and Function

- The concept of structure and function illustrates the relationship between the structure of something and how it works and performs its function. For example, the difference in arrangement of nucleotides on DNA leads to the difference of the genes present on a single chromosome, which in turn leads to the differences in the hereditary trait that each gene is responsible for expressing.

Mutations

- **Ask students to** observe figures (29) and (30) and share their observations.
- **Question students why** some cows appear huge compared to others? What are the reasons for a person being born with six fingers on one hand?
- **Listen carefully to students'** answers and guide the discussion to conclude that small changes occurring in our bodies or in living organisms can lead to new traits. These changes are called mutations.

Use Educational Game Strategies:

- **Write a word** on the board, such as "wonder".
- **Ask the students to** change just one letter, which will change the meaning of the word (e.g., wonder → wander).
- **Provide another example** in which the change is in the arrangement of letters, such as: quite and quiet.
- Quite means completely.
- Quiet means calm.
- **Explain to the students** that mutations are similar to this small change that can lead to significant differences in traits.
- **Clarify to the students that** there can be a change in the nature of the gene, such as a change in the order of the nucleotides that make it up, which leads to a change in the hereditary trait for which this gene is responsible, and thus the emergence of a new trait that did not exist before; this is known as a mutation.
- **Divide mutations** into two types:

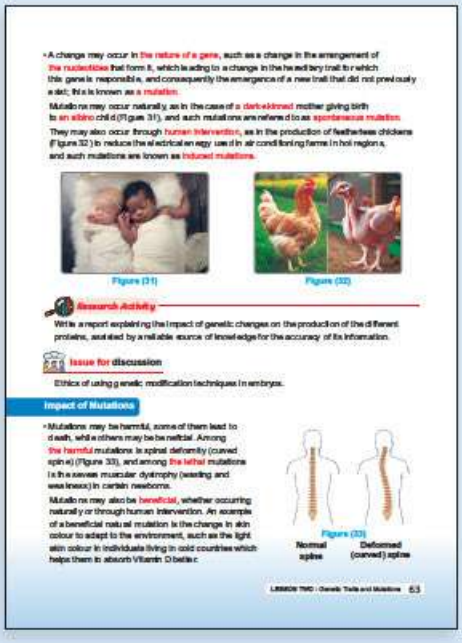
1. **Spontaneous mutations:** occur naturally, such as the birth of a dark-skinned mother to an albino child (Figure 31).
2. **Induced mutations:** occur with human intervention, such as producing featherless chickens (Figure 32) to reduce the electricity used for air conditioning in farms in hot regions.

Research activity

- **Ask the students** to write a report explaining the impact of genetic changes on the production of different proteins, assisted by a reliable source of knowledge.

Issue for Discussion

- **Discuss with the students** the issue of: the ethics of using genetic modification techniques on embryos; this discussion can be an engaging and beneficial topic for developing critical thinking skills among students.
- **Start the discussion** with the question: If you could modify the genes of an embryo to make it smarter or stronger, would you do it? Why or why not?


• A change may occur in the nature of a gene, such as a change in the arrangement of the nucleotides that form it, which leading to a change in the hereditary trait for which this gene is responsible, and consequently the emergence of a new trait that did not previously exist; this is known as a mutation.

Mutations may occur naturally, as in the case of a dark-skinned mother giving birth to an albino child (Figure 31), and such mutations are referred to as spontaneous mutation.

They may also occur through human intervention, as in the production of featherless chickens (Figure 32) to reduce the electrical energy used in air conditioning farms in hot regions, and such mutations are known as induced mutations.

Figure (31) Figure (32)

Research Activity

Write a report explaining the impact of genetic changes on the production of the different proteins, assisted by a reliable source of knowledge for the accuracy of its information.

Issue for discussion

Ethics of using genetic modification techniques in embryos.

Impact of Mutations

• Mutations may be harmful, some of them lead to death, while others may be beneficial. Among the harmful mutations is spinal deformity (curved spine) (Figure 33), and among the lethal mutations is the severe muscular dystrophy (wasting and weakness) in certain newborns.

Mutations may also be beneficial, whether occurring naturally or through human intervention. An example of a beneficial natural mutation is the change in skin colour to adapt to the environment, such as the light skin colour in individuals living in cold countries which helps them to absorb Vitamin D better.

Figure (33)
Normal spine Deformed (curved) spine

LESSON TWO : Genetic Traits and Mutations 63

- **Discuss with the students** the positive aspects (such as: curing genetic diseases, etc.) and the negative aspects (such as: discrimination against individuals based on their genetic traits, etc.).

Ethical Analysis of the Issue: Justice: Will this technology be available to everyone or will it become exclusive to the wealthy? Do parents have the right to choose their children's traits?

- **Ask each student** for their personal opinion at the end of the discussion. Encourage them to think rationally and respect the opinions of others.

Impact of Mutations

- **Ask the students** whether they believe mutations are harmful or beneficial.
- **Explain to the students** that mutations in human can be:

– **Harmful:** such as spinal deformities (Figure 33).

– **Lethal:** such as severe muscle dystrophy and weakness in some newborns.

– **Beneficial:** such as changes in skin colour to adapt to the environment, as seen in individuals with lighter skin living in cold countries to help them absorb vitamin D better.

- **Explain to the students** that all mutations introduced in plants are beneficial.
- **Provide examples of** introduced mutations in plants and discuss their importance, such as the production of seedless fruits (Figure 34).
- **Ask the students** if they find this mutation beneficial.
- **Clarify to the students** that creating a mutation to produce wheat plants resistant to wheat rust disease (Figure 35) is important for the country's economy as it increases production, reduces imports, and conserves foreign currency.

Integration with Agricultural Science

- **Explain to the students** that the production of cubic-shaped watermelons (Figure 36) is a result of innovative agricultural techniques used in some countries to achieve an unconventional appearance for watermelons. The process of growing cubic-shaped watermelons generally involves the use of boxes or square moulds to direct the growth and shape of the fruit. When the watermelon begins to grow and reaches a certain size (usually after 3-4 weeks of planting), it is placed in a square mould or a transparent box made of plastic or glass. The watermelons are arranged within this mould in a way that allows them to grow within the square boundaries.
- Explain to the students the reasons for this cultivation, which is that it can be stored more efficiently in limited spaces. It is sometimes produced for commercial purposes or to decorate special occasions due to its unique appearance.

Life Application

- **Dear Teacher:**
- A mutation that allows for lactose tolerance refers to the genetic change that enables some individuals to continue digesting lactose (the sugar found in milk) efficiently into adulthood. Typically, many people experience a deficiency of the enzyme lactase during childhood or adolescence, leading to difficulty in digesting lactose, a condition known as lactose intolerance. However, in some cases, a genetic mutation occurs that allows an individual to produce sufficient amounts of lactase even in later stages of life.


The mutations resulting in seedless fruits (Figure 34) or wheat plants resistant to wheat rust disease (Figure 35) they are all beneficial mutations induced by human.

Figure (34) Seedless lemon

Figure (35) Leaves of wheat plants infected with wheat rust

Integration with Agricultural Science

The production of cubic-shaped watermelons (Figure 36) to facilitate their transport is not resulting from a mutation, either, it is a agricultural technique whereby watermelons are placed in square molds during their growth, causing them to take the shape of the mold.

Figure (36) Cubic-shaped watermelon

Life Application

- The mutation of lactose tolerance, which allows lactose sugar found in milk and dairy products such as cheese and yogurt to be converted into simpler sugars that are easier for the body to absorb, is a natural mutation.
- Individuals who suffer from lactose intolerance feel crampy, nausea and other painful symptoms when drinking milk or eating dairy products. They can avoid milk and dairy products by using dairy alternatives, as illustrated in Figure (37), which do not cause these symptoms.

Butter → Olive oil
Milk → Soya milk
Coffee creamer → Almond milk
Milk chocolate → Dark chocolate

Figure (37) Dairy products alternatives

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- **Explain to the students** that there are individuals who do not fully digest lactose, the sugar found in milk and dairy products. This occurs due to a deficiency or absence of the lactase enzyme produced by the body in the small intestine. Lactase is responsible for breaking down lactose into simple sugars for absorption into the bloodstream.
- When individuals who are lactose intolerant consume milk or products containing lactose, they may suffer from : feel crampy, nausea and other painful symptoms.
- **Explain to the students** that they can avoid milk and its products by using alternatives such as olive oil, soya milk, almond milk, and dark chocolate.

Closure of the Lesson:

- The teacher should summarise all the main ideas of the lesson five minutes before concluding.
- You can involve the students in closing the lesson by asking them about the concepts covered in the lesson.

Answers of Evaluation Questions on Lesson Two

1

(1) Genetic / Acquired.

(2) Genes / Nucleotides.

(3) Enzyme / Protein.

2

(1) (c) **(2)** (b) **(3)** (a)

3

(1) Albino.

(2) The occurrence of a change in the nature of the gene responsible for expressing the trait of black skin, resulting in the emergence of a new trait (white skin), known as mutation.

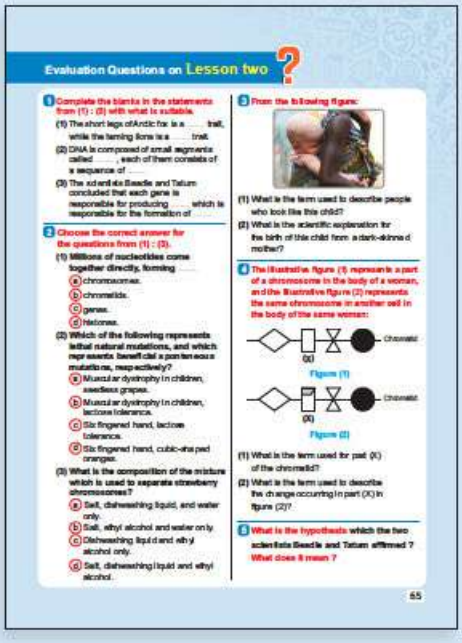
4

(1) Gene.

(2) Mutation.

5

- The One Gene – One Enzyme Hypothesis, states that each gene produces a specific enzyme responsible for the occurrence of a chemical reaction that leads to the formation of a protein that expresses a specific hereditary trait.


Evaluation Questions on Lesson two

1 Complete the blanks in the statements from (1) : (3) with what is suitable.
(1) The short legs of Ancon fox is a ..... trait, while the taming lions is a ..... trait.
(2) DNA is composed of small segments called ....., each of them consists of a sequence of .....
(3) The scientists Beadle and Tatum concluded that each gene is responsible for producing ..... which is responsible for the formation of .....

2 Choose the correct answer for the questions from (1) : (3).
(1) Millions of nucleotides come together directly, forming .....
(a) chromosomes. (b) chromatids. (c) genes. (d) histones.
(2) Which of the following represents lethal natural mutations, and which represents beneficial spontaneous mutations, respectively?
(a) Muscular dystrophy in children, seedless grapes.
(b) Muscular dystrophy in children, lactose tolerance.
(c) Six fingered hand, lactose tolerance.
(d) Six fingered hand, cubic-shaped oranges.
(3) What is the composition of the mixture which is used to separate strawberry chromosomes?
(a) Salt, dishwashing liquid, and water only.
(b) Salt, ethyl alcohol and water only.
(c) Dishwashing liquid and ethyl alcohol only.
(d) Salt, dishwashing liquid and ethyl alcohol.

3 From the following figure:
(1) What is the term used to describe people who look like this child?
(2) What is the scientific explanation for the birth of this child from a dark-skinned mother?

4 The illustrative figure (1) represents a part of a chromosome in the body of a woman, and the illustrative figure (2) represents the same chromosome in another cell in the body of the same woman:
Chromatid (X)
Figure (1)
Chromatid (X)
Figure (2)
(1) What is the term used for part (X) of the chromatid?
(2) What is the term used to describe the change occurring in part (X) in figure (2)?

5 What is the hypothesis which the two scientists Beadle and Tatum affirmed ? What does it mean ?

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Additional Learning Resources:

Utilising digital learning resources such as the Egyptian Knowledge Bank, as well as educational and documented videos and films available on internet sites.

Unit Three: Environment and Genetics

Lesson One: Nutritional Relationships in Biological Communities

Inclusive Education Group	Support Strategies
Intellectual Disability and Slow Learning Hyperactivity and Attention Deficit Autism Spectrum	• Clarify the new concepts related to the lesson for students by using concise sentences and presenting images and models of the types of animals included in the ecosystem, highlighting their differences in terms of food nature, shape, type, and classifying similar ones into groups to illustrate the concept of a «biotic population» practically. Then, gather the different species together to clarify the concept of a «biological community.» • Draw a mind map illustrating the types of nutritional relationships (predation, competition, commensalism, mutualism) on a board and enhance it with images or small models if possible, assisting students in reading and recognising the content of the map through their various senses. • Explain the concept of energy flow to students by presenting video clips or images, then summarize the concept in a diagram using cards and assist students in reading and correctly arranging the diagram. Then, replicate the previous arrangement to complete (Diagram 1) in their notebooks and provide appropriate feedback. • Present a set of cards that contain images and names of each of the (producers and consumers in their various forms) and classify them into groups according to their type, asking students to replicate your classification. Then, draw a concise mind map on the board illustrating the classification of living organisms. • Use illustrated cards to create a model of a food chain and connect the images using ribbons, ensuring each card is numbered to clarify the correct sequence. • Show students various images and video clips demonstrating the shape of teeth in herbivorous animals and carnivorous animals, then draw a mind map to classify animals according to their dietary nature into (herbivores, omnivores, carnivores, scavengers, decomposers), and give students adequate time to read the map and copy it into their notebooks.

Inclusive Education Group	Support Strategies
Learning Difficulties	• Create a mind map illustrating the concepts related to the lesson (ecosystem – biological community – biotic population) in concise sentences, highlighting the key term in each concept with a different colour and enhance the map with illustrations and images. • Write a concise table on the board to compare the types of food relationships (predation – competition – commensalism – mutualism) and utilise illustrative images and video clips if possible. • Draw a diagram that illustrates the flow of energy for the students on the board and supplement it with simple examples and some illustrative images, then allow the students to complete the diagram again in their writing based on their visual perception of the entire content and provide appropriate assistance. • Classify types of organisms into (producers and consumers) and consumers into (primary, secondary, tertiary, decomposers) for the student in a table on the board, providing examples for each type. • Write the concepts derived from the lesson (food chain - trophic level - biological control) on the board in concise sentences and present simple examples of different food chains with supporting images, assisting the student in reading correctly. • Write a brief comparison table between (herbivores, carnivores, scavengers, decomposers) including examples for each type in the table and help the student read the table and copy it into their notebook.
Hearing Impaired	• Present more examples through illustrated cards for both the biological community and biotic population, using coloured cards to distinguish between them; for example, red cards could represent the biological community and green cards for the biotic population. • Show explanatory videos that clarify the concepts of biological community and biotic Population. Use a colour-coding writing strategy in summarizing the content of the explanatory videos on the board. **Example:** - Biotic population = Organisms of the same species only. - Biological community = Organisms of different species sharing the environment. • Formulate the ecosystem in a simple equation on the board, for example: Ecosystem = Living organisms + Non-living environment + Interaction between them. • Display illustrated examples of both living and non-living organisms.
The Blind and Visually Impaired	• Describe the image related to the levels of the ecosystem for the visually impaired and the images included in figures (2), (3) and (4).

Lesson Two: Genetic Traits and Mutations

Inclusive Education Group	Support Strategies
Intellectual Disability and Slow Learning **Hyperactivity and Attention Deficit** **Autism Spectrum**	• Utilise some short video clips, cards, and images that illustrate the concept of genetic traits and the similarities between different organisms. Then, explain to the student the difference between (genetic traits - instinctive behaviours - acquired traits) using simple examples. Provide them with cards and classify them according to their type, asking them to mimic you and reclassify them with appropriate support. • Clarify the concept of chromosomes and their components (centromere - chromatid) using coloured modelling clay, repeating the concepts multiple times and allowing them to echo after you, providing suitable feedback. • Allow the student to collaborate with their peers in constructing a model of a chromosome and assign them a role suitable to their abilities. • Explain the concept of mutations to the student by presenting images that illustrate the differences, such as a hand with five fingers versus another hand with six fingers, and so on. • Draw an illustrative diagram for the student showing the types of mutations (harmful - lethal - beneficial) and present them with cards and video clips whenever possible.
Learning Difficulties	• Write a table on the board for the student to compare between (genetic traits, instinctive behaviours, acquired traits), providing examples for each type and using some illustrative images. • Present a model to the student as an example that illustrates the structure of chromosomes and the components of DNA (genes - nucleotides that form the double helix). Then assist them in designing a chromosome model that mimics the previous one, collaborating with their peers and providing suitable assistance and physical encouragement during the activity. • Draw a diagram using arrows and numbers to clarify the role of genes in expressing genetic traits. • Explain the concept of mutations and their types to the student through illustrative images and some simple examples, writing the concepts on the board in clear handwriting and assisting them in reading and copying them into their notebooks.

Inclusive Education Group	Support Strategies
Hearing Impaired	• Draw a comparison table with five columns to aid hearing-impaired students in understanding, with the first column for comparison aspects (How is it obtained? Can it be changed? Examples from human and examples from animals), the second column for (genetic traits), the third for (instinctive behaviours), the fourth for (acquired traits) and the fifth (a pictorial card or expressive drawing of the meaning). • Write a quick summary in short phrases on the board before beginning the exercises and activities related to the concepts of (genetic traits, instinctive behaviours, acquired traits). **Example:** - Genetic traits = inherited and do not change (e.g., eye colour). - Instinctive behaviours = automatic behaviour that does not require learning (e.g., a baby crying). - Acquired traits = learned from experience and environment (e.g., riding a bicycle). • Provide a simple summary in short, direct phrases about important information regarding chromosomes and the transmission of genetic traits.
The Blind and Visually Impaired	• Use manufactured tactile models to introduce the shape of a hedgehog to blind individuals, if possible. • Describe the images included in (Activity 1) from (Figure 2) to (Figure 7). • Provide a dimensional model illustrating the details of (Figures 20 and 21) allowing the blind individual to recognize the shape of the chromosome and its chemical composition, while considering the size ratios between the nucleus and the cell. • When designing a model of the chromosome as shown in Figures (22, 23, 24, 25, 26, 27) replace your use of colours with materials of different textures for the blind individuals; however, for partially sighted individuals, the preparation of the model will remain unchanged.

Unit Four: Natural Cycles

Introduction to the Unit

Nature is a theatre of life, where various components come together in harmony to keep the Earth a habitable place. Nature is a delicate system that operates through integrated cycles that maintain the balance of life, referred to as «the cycles of nature». These cycles are not merely physical or chemical processes; they are the foundation of life that makes our planet a unique place.

The cycles form the cornerstone of the continuity of life on Earth, such as the water cycle, the rock cycle, and others.

In this unit, we will explore how the water cycle and the rock cycle function, and you will gain a deeper understanding of the relationships between the components of the ecosystem and the importance of preserving it to ensure the sustainability of the planet.

Learning Outcomes

1. Recognize the multiple pathways of water during its cycle.
2. Analyze the processes to determine the states of water during its movement in its various pathways.
3. Recognize that physical and chemical changes in Earth substances and living organisms occur by the effect of the energy from the sun and the Earth interior.
4. Conclude that all processes on Earth occur as a result of the flow of energy and the cycling of matter within the Earth.
5. Explain the role of weathering, erosion, melting, crystallization and sedimentation in the formation of rocks.

Unit Lessons and Time Period

The unit includes 2 lessons:

Lesson One: The Water Cycle. (Two periods)

Lesson Two: The Rock Cycle. (Two periods)

Activities and Educational Resources

The unit includes various activities and resources including:

Activities: Discovery - Prediction - Conclusion - Induction - Practical work.

Resources: Images - Videos - Internet - Laboratory tools.

Teaching Strategies

There are various active learning strategies, including:

Laboratory Experiments:
A method that provides students with direct sensory practical experience by engaging all senses in learning about the phenomenon being studied.

Cooperative Learning:
An educational strategy in which students are divided into small, heterogeneous groups to achieve common goals, which involve completing required tasks, with each member responsible for their own learning and that of their peers.

Discussion:

A teaching method that relies on dialogue between the teacher and the student or among students. under the teacher's supervision, aimed at recalling prior knowledge or arriving at new information and it is based on questions prepared for this purpose.

Brainstorming:

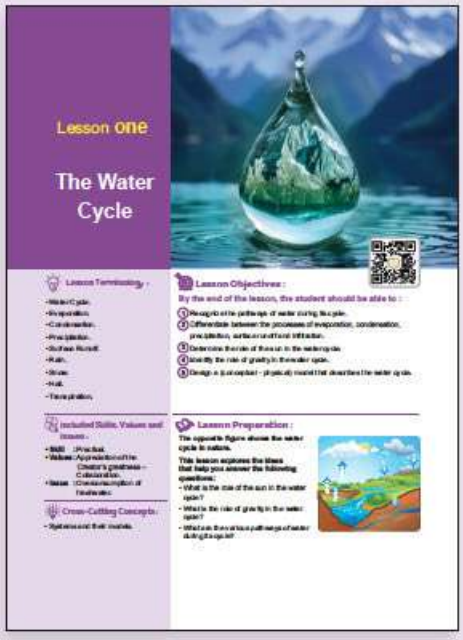
A method used to generate the maximum number of ideas, regardless of their type or level, to address a topic in an atmosphere of freedom and safety for expressing ideas.

Assessment methods

There are various assessment methods in the unit, including:

- **Diagnostic assessment:** Pre-tests.
- **Formative assessment:** Oral questions – Assignments – Research activities.
- **Summative assessment:** End-of unit tests.
- **Self-assessment:** Evaluate your understanding.

Lesson One: The Water Cycle



Background:

The first lesson of this unit addresses the topic of the water cycle. The water you drink today may have been part of a river hundreds of years ago or a raindrop on the peak of a mountain. This continuous movement is known as the «water cycle,» a remarkable journey in which water moves between the atmosphere, the earth, and bodies of water. This cycle includes key processes such as evaporation, condensation and precipitation, each playing a role in maintaining the balance of water on our planet. In this lesson we will explore how the water cycle works, why it is essential for the continuation of life, and how it relates to our daily lives. We will also examine the role of humans in this cycle and their impact on it. Through this lesson, students will acquire a range of new concepts, and the lesson aims to develop skills in discovery, reasoning, and inference.

Lesson Objectives:

1. Recognize the pathways of water during its cycle.
2. Differentiate between the processes of evaporation, condensation, precipitation, surface runoff and infiltration.
3. Determine the role of the sun in the water cycle.
4. Identify the role of gravity in the water cycle.
5. Design a (conceptual – physical) model that describes the water cycle.

Teaching Aids and Learning Resources Used:

Data show - Films - Student textbook - Internet - Science laboratory.

Duration and place of Teaching:

Two periods (4 sessions) - Classroom and media lab - Science laboratory.

Lesson Terminology:

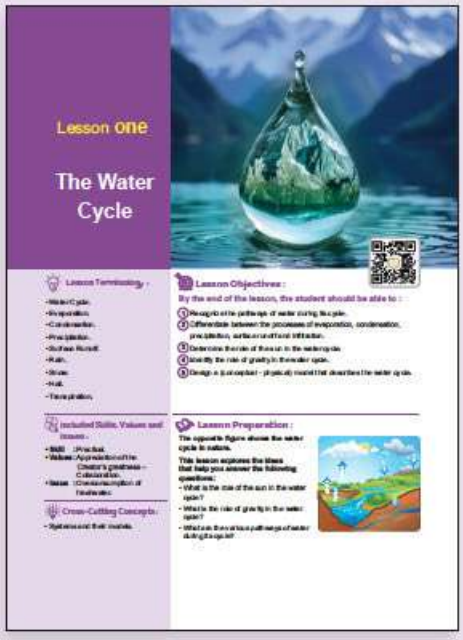
- Water Cycle
- Evaporation
- Condensation
- Precipitation
- Surface Runoff
- Rain
- Snow
- Hail
- Transpiration

Misconceptions or Incorrect Concepts:

- **Some students believe that** the water cycle only starts from the seas. However, the water cycle can begin from any water source, such as rivers, lakes, or even soil moisture and plants that lose water through evaporation and transpiration.
- **Some students think that** the water cycle is a simple process that occurs in a short time, but the water cycle is complex and can take years or even thousands of years for water to move between various components of the ecosystem, such as oceans, mountains and groundwater.
- **Some students believe that** human does not have a significant impact on the water cycle. However human activities such as deforestation, pollution, and excessive water consumption greatly affect the water cycle by altering evaporation and precipitation rates and contaminating water sources.
- **Some students think that** evaporation only occurs when water is boiling; however, evaporation can happen at any temperature as long as water molecules at the surface gain enough energy to turn into vapour.

Diagnostic Assessment:

- **Ask the students** to examine the lesson preparation image and attempt to answer the questions, as these questions serve as a diagnostic assessment to gauge their prior knowledge about the lesson and to reveal any misconceptions or incorrect concepts they may hold.
- **Listen carefully** to the students› answers to these questions and ask them to explain their reasoning.
- **Clarify** that the correct answers to these questions will be revealed through the explanation of this lesson.



Use diverse teaching strategies:

You can use K.W.L strategies, discussion, cooperative learning, brainstorming, Discovery.

- At the beginning of the lesson, use the K.W.L strategy (What do you know? – What do you want to know? – What have you learned?).
- **Draw a K.W.L table** on the board, reminding the students of this strategy:

What do you know? (K)	What do you want to know? (W)	What have you learned? (L)

- Before explaining the lesson:

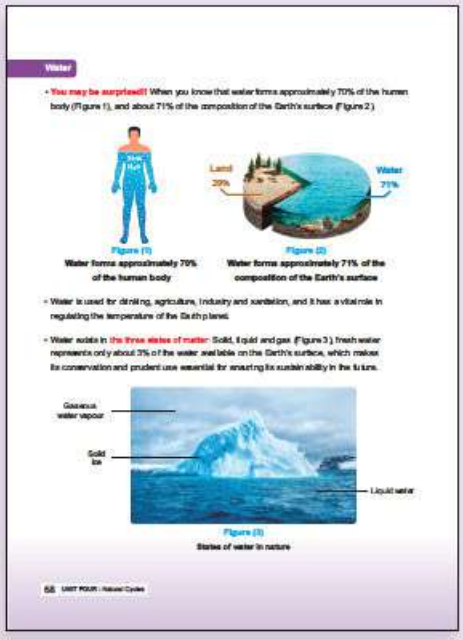
Ask the students to write down the knowledge they already possess about the water cycle in the first column (What do you know?). Then, have them write the new information they wish to learn about the water cycle in the second column (What do you want to know?).

– After explaining the lesson:

Ask the students to write down the knowledge they have gained about the water cycle in the third column (What have you learned?)

Lesson Preparation:

- **At the beginning of the lesson,** explain to the students that when we talk about life on Earth planet, water is the main element that supports all forms of life. Water makes up about 70% of your body weight. If you lose one percent of this water, you feel thirsty. If you lose 10% or more, you risk death. A human cannot survive more than three days without water.
- **Ask the students:** Did you know that the amount of water on our planet has not changed for millions of years? How does the amount of water remain consistently the same?
- **Discuss the students'** responses.
- **Explain to the students** that water represents about 71% of the Earth's surface composition (Figure 2).



Water

Use Brainstorming Strategy:

1. Generating Ideas:

Pose the following question to the students:

What would happen if water disappeared for one day?

In this step, students should mention as many answers as possible; accept all responses as there is no model answer, and do not dismiss or ignore any idea or response.

2. Filtering and Sorting:

Ask the students to group the answers and reconstruct them by removing repeated ideas and merging similar ones.

3. Critique and Evaluation:

Assess the students' responses at the end of the brainstorming session and conclude with them on the importance of water in our lives.

- **Show images** illustrating different uses of water (drinking, agriculture, industry, sanitation) and ask the students to identify and discuss them.
- **Explain to the students** that water plays a vital role in regulating the Earth's temperature.
- **Ask the students** to observe (Figure 3) in the student book and identify the states of water in nature.
- **Explain to the students** that water exists in three states of matter: solid, liquid and gas.
- **Clarify to the students** that fresh water represents only about 3% of the water available on the Earth's surface.
- **Ask the students** about their role in conserving fresh water.

How does water transfer from the Earth's surface to the atmospheric air?

Activity 1 Practical

- The aim of this activity is to discover the process of evaporation.
- **Used tools and materials**: Two cups of water - rubber band - cellophane paper - marker.
- **Ask the students** to pour equal amounts of water into the two cups as shown in (Figure 4).

1. **Ask the students** to use the marker to mark the water level in both cups, labelling one cup with the letter (A) and the other with the letter (B).
2. **Ask the students** to cover the opening of cup (B) with cellophane paper and secure it with the rubber band.
3. **Ask the students** to place the two cups in a sunny place for 5 to 6 hours.

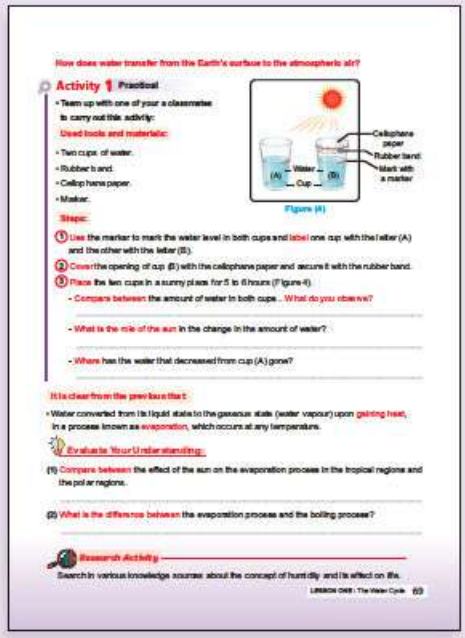
- **Ask the students to answer the following questions:**
  - **Compare between** the amount of water in both cups.

    The amount of water in cup (A) decreases, while the amount of water in cup (B) remains unchanged.
  - **What is the role of the sun** in the change in the amount of water?

    The energy derived from the heat of the sun caused the water to evaporate.
  - **Where** has the water that decreased from cup (A) gone?

    It converted to the atmospheric air in the form of water vapour.
  - **Ask the students** to deduce a definition of the process of evaporation.

    This is the conversion of water from its liquid state to a gaseous state (water vapour) upon gaining heat.
  - **Explain to the students** that the process of evaporation occurs at any temperature.


How does water transfer from the Earth's surface to the atmospheric air?

Activity 1 Practical

• Team up with one of your classmates to carry out this activity.

Used tools and materials:

• Two cups of water.
• Rubber band.
• Cellophane paper.
• Marker.

Figure (4)

Steps:

1. Use the marker to mark the water level in both cups and label one cup with the letter (A) and the other with the letter (B).
2. Cover the opening of cup (B) with the cellophane paper and secure it with the rubber band.
3. Place the two cups in a sunny place for 5 to 6 hours (Figure 4).

- Compare between the amount of water in both cups. What do you observe?
- What is the role of the sun in the change in the amount of water?
- Where has the water that decreased from cup (A) gone?

It is clear from the previous that:

• Water converted from its liquid state to the gaseous state (water vapour) upon gaining heat, in a process known as evaporation, which occurs at any temperature.

Evaluate Your Understanding:

(1) Compare between the effect of the sun on the evaporation process in the tropical regions and the polar regions.

(2) What is the difference between the evaporation process and the boiling process?

Research Activity

Search in various knowledge sources about the concept of humidity and its effect on life.

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Evaluate Your Understanding

- **Ask the students** to evaluate their understanding by answering the following questions:

1. **Compare between** the effect of the sun on the evaporation process in the tropical regions and the polar regions.

   The rate of evaporation in tropical regions is faster than in polar regions, as the sunlight rays are vertical in tropical regions, thus having a greater effect, while in polar regions, the sunlight rays are slanted, spreading their heat over a larger distance, resulting in a lesser effect.
2. **What is the difference between** the evaporation process and the boiling process?

   Evaporation occurs at any temperature, while boiling occurs at a certain temperature known as the boiling point (100°C).

Research Activity

- **Ask the students** to research in various knowledge sources, including the internet and the Egyptian Knowledge Bank, about the concept of humidity and its effect on life.

- **Ask the students** whether water vapour remains in the atmospheric air, or can it return to the Earth's surface once again?

Activity 2 Practical

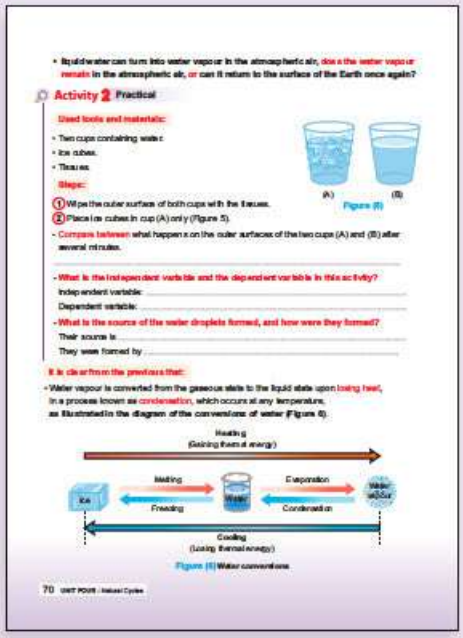
- The aim of this activity is to discover the process of condensation.
- **Used Tools and materials:** Two cups of water - Ice cubes - Tissues.

(1) **Ask the students** to wipe the outer surface of both cups with the tissues.

(2) **Ask the students** to place ice cubes in cup (A) only.

- **Ask the students to answer the following questions:**
  - **Compare between** what happens on the outer surfaces of the two cups (A) and (B) after several minutes.

    Water droplets are formed on the outer surface of cup (A) only.
  - **What** is the independent variable and the dependent variable in this activity?
    * Independent variable: Temperature of the water (ice cubes)
    * Dependent variable: Formation of water droplets on the surface of cup (A).
  - **What** is the source of the water droplets formed, and How were they formed?
    * Their source is water vapour present in the atmospheric air.
    * They were formed by: the condensation of water vapour in the atmospheric air when it comes into contact with the cold surface of the cup.
- **Explain to the students** that water vapour converts from a gaseous state to a liquid state upon losing heat, in a process known as condensation.
- **Clarify to the students** that condensation occurs at any temperature, not just at the freezing point of water.


• Liquid water can turn into water vapour in the atmospheric air, does the water vapour remain in the atmospheric air, or can it return to the surface of the Earth once again?

Activity 2 Practical

Used tools and materials:

• Two cups containing water.
• Ice cubes.
• Tissues.

Steps:

(1) Wipe the outer surface of both cups with the tissues.
(2) Place ice cubes in cup (A) only (Figure 5).
• Compare between what happens on the outer surfaces of the two cups (A) and (B) after several minutes.

(A) (B)

Figure (5)

• What is the independent variable and the dependent variable in this activity?
Independent variable: .....
Dependent variable: .....
• What is the source of the water droplets formed, and how were they formed?
Their source is .....
They were formed by .....

It is clear from the previous that:

• Water vapour is converted from the gaseous state to the liquid state upon losing heat, in a process known as condensation, which occurs at any temperature, as illustrated in the diagram of the conversions of water (Figure 6).

Figure (6) Water conversions

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- **Ask the students** to examine figure (6) in the student's book, which illustrates a diagram of the conversions of water.
- **Explain to the students** that water changes from one state to another by gaining or losing thermal energy, as follows:

(1) Water converts from a solid state (ice) to a liquid state when ice gains heat and begins to melt, in a process called **melting**.

(2) Water converts from a liquid state to a solid state (ice) when water loses heat and freezes at 0°C, in a process called **freezing**.

(3) Water converts from a liquid state to a gaseous state (water vapour) when the water is heated, causing it to evaporate into the atmospheric air, in a process called **evaporation**.

(4) Water converts from a gaseous state to a liquid state when water vapour in the atmospheric air cools and converts into small water droplets, in a process called **condensation**.

Evaluate Your Understanding

- **Ask the students** to evaluate their understanding by observing Figure (7) and then answering the question in the student's book. One of the students prepared the set up shown in figure (7) and noticed the formation of water droplets on the lower surface of the basin. **What** can be done to reduce the amount of water droplets formed?

Answer: (b)

- **Inquire from the students** where does the water in water bodies such as oceans, seas, rivers and lakes comes from ? **How** are they formed ? **and where** do they go afterwards?

Activity 3 Practical

- The aim of this activity is to discover the water cycle.
- **Used tools and materials :** Empty cup - Ice cubes - Hot water - Tissues - Rubber band - Cellophane Paper - Marker.

(1) **Ask the students** to pour hot water into the cup.

(2) **Ask the students** to wipe the mouth of the cup with tissues, then cover the mouth of the cup with cellophane paper and secure it with a rubber band.

(3) **Ask the students** to draw a line with the marker indicating the water level in the cup.

(4) **Ask the students** to place ice cubes on the surface of the cellophane paper as shown in Figure (8).

- **Request the students to answer the following questions related to the activity:**
  - **What is the importance of** the ice cubes in this activity?

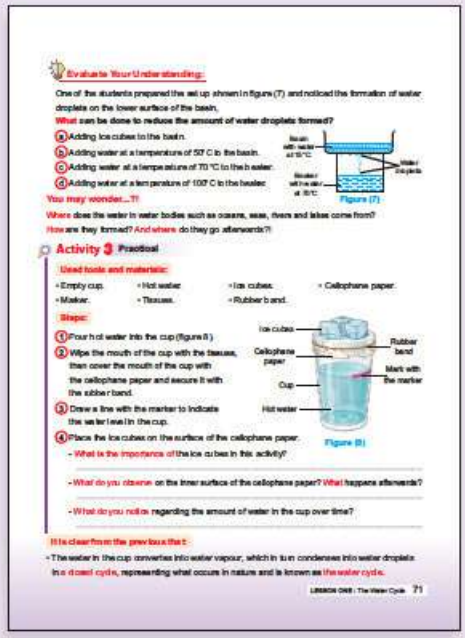
    They lower the temperature of the surface of the cellophane paper.

  - **What do you observe** on the inner surface of the cellophane paper? **What** happens afterwards?

    Water droplets form on the inner surface of the cellophane paper.

  - **What do you notice** regarding the amount of water in the cup over time?

    It remains constant.


Evaluate Your Understanding:

One of the students prepared the set up shown in figure (7) and noticed the formation of water droplets on the lower surface of the basin.

What can be done to reduce the amount of water droplets formed?

(a) Adding ice cubes to the basin.
(b) Adding water at a temperature of 50 °C to the basin.
(c) Adding water at a temperature of 70 °C to the beaker.
(d) Adding water at a temperature of 100 °C to the beaker.

Figure (7)

You may wonder...?!

Where does the water in water bodies such as oceans, seas, rivers and lakes come from?

How are they formed? And where do they go afterwards?!

Activity 3 Practical

Used tools and materials:

- Empty cup.
- Hot water.
- Ice cubes.
- Cellophane paper.
- Marker.
- Tissues.
- Rubber band.

Steps:

(1) Pour hot water into the cup (figure 8).
(2) Wipe the mouth of the cup with the tissues, then cover the mouth of the cup with the cellophane paper and secure it with the rubber band.
(3) Draw a line with the marker to indicate the water level in the cup.
(4) Place the ice cubes on the surface of the cellophane paper.

Ice cubes, Cellophane paper, Rubber band, Mark with the marker, Cup, Hot water

Figure (8)

- What is the importance of the ice cubes in this activity?
- What do you observe on the inner surface of the cellophane paper? What happens afterwards?
- What do you notice regarding the amount of water in the cup over time?

It is clear from the previous that:

- The water in the cup converts into water vapour, which in turn condenses into water droplets in a closed cycle, representing what occurs in nature and is known as the water cycle.

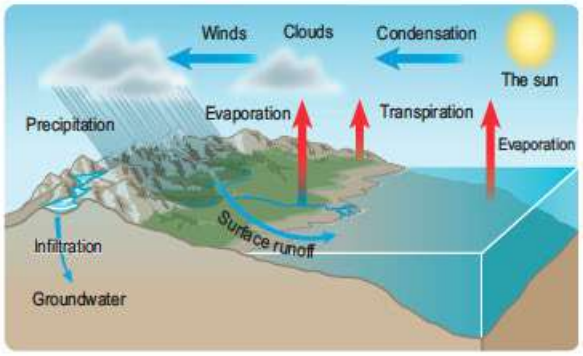
LESSON ONE : The Water Cycle 71

It is clear from the previous that:

- The water in the cup converts into water vapour, which in turn condenses into water droplets in **a closed cycle**, representing what occurs in nature and is known as **the water cycle**.

The Water Cycle in Nature

- **Ask the students**
  What are the sources of water in nature ?
- **Explain to the students** that the sources of water are numerous, including (the evaporation of water from large water bodies such as rivers, seas and oceans - the process of transpiration in plants - the evaporation of sweat).
- **Present the following image** to the students as an activity to explore the pathways of water in nature themselves.
- **Ask the students** to name each process in the water cycle using the following terms and write a description for each process (condensation - evaporation - precipitation - transpiration - surface runoff - infiltration).



(1) Evaporation process, which is the conversion of seawater from its liquid state to water vapour.

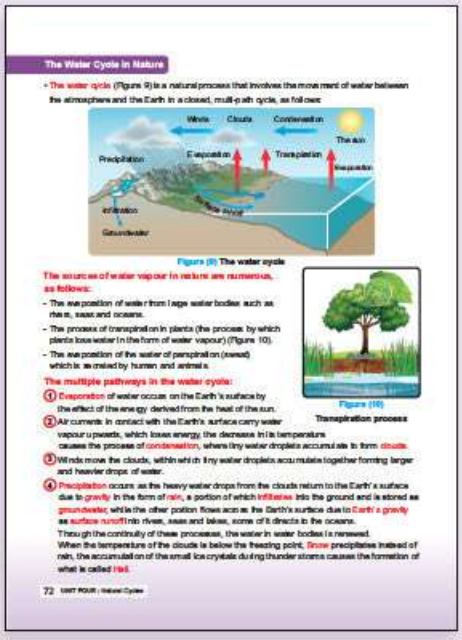
(2) Transpiration process, which is the loss of water by plants in the form of water vapour.

(3) Condensation process, which is the conversion of water vapour into tiny water droplets, leading to the formation of clouds.

(4) Precipitation process, which is the falling of water to the Earth's surface in the form of rain, snow, or hail due to the effect of Earth's gravity.

(5) Infiltration process, which is the infiltration of some water from the surface into the ground and its storage as groundwater.

(6) Surface runoff process, which is the flow of rainwater on the Earth's surface and into the seas and lakes due to the effect of Earth's gravity.


The Water Cycle in Nature

- The water cycle (Figure 9) is a natural process that involves the movement of water between the atmosphere and the Earth in a closed, multi-path cycle, as follows:

Winds Clouds Condensation
The sun
Precipitation
Evaporation
Transpiration
Evaporation
Surface runoff
Infiltration
Groundwater

Figure (9) The water cycle

The sources of water vapour in nature are numerous, as follows:

- The evaporation of water from large water bodies such as rivers, seas and oceans.
- The process of transpiration in plants (the process by which plants lose water in the form of water vapour) (Figure 10).
- The evaporation of the water of perspiration (sweat) which is excreted by human and animals.

Figure (10)
Transpiration process

The multiple pathways in the water cycle:

1. Evaporation of water occurs on the Earth's surface by the effect of the energy derived from the heat of the sun.
2. Air currents in contact with the Earth's surface carry water vapour upwards, which loses energy, the decrease in its temperature causes the process of condensation, where tiny water droplets accumulate to form clouds.
3. Winds move the clouds, within which tiny water droplets accumulate together forming larger and heavier drops of water.
4. Precipitation occurs as the heavy water drops from the clouds return to the Earth's surface due to gravity in the form of rain, a portion of which infiltrates into the ground and is stored as groundwater, while the other portion flows across the Earth's surface due to Earth's gravity as surface runoff into rivers, seas and lakes, some of it directs to the oceans.
Through the continuity of these processes, the water in water bodies is renewed.
When the temperature of the clouds is below the freezing point, Snow precipitates instead of rain, the accumulation of the small ice crystals during thunder storms causes the formation of what is called Hail.

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The Multiple Pathways in the Water Cycle:

- Explain to the students the pathways of water in the water cycle in nature, which are:

(1) **Pathway 1:** The process of evaporation, which occurs for water on the Earth's surface due to the effect of energy derived from the heat of the sun.

(2) **Pathway 2:** The process of condensation, which occurs when the air currents in contact with the Earth's surface carry water vapour upwards, losing energy, leading to a decrease in its temperature, and tiny water droplets accumulate together to form clouds. The winds move the clouds, within which tiny water droplets accumulate together to form larger and heavier droplets of water.

(3) **Pathway 3:** The process of precipitation, where heavy droplets of water from the clouds return to the Earth's surface due to gravity in the form of rain.

(4) **Pathway 4:** The process of infiltration, where part of the rainwater infiltrates into the ground and is stored as groundwater, while the other part flows on the Earth's surface due to Earth's gravity during the process of surface runoff into rivers, seas, and lakes, with some of it directs to the oceans. With the continuous occurrence of these processes, the water in water bodies is renewed.

It is concluded from the previous that :

- **The difference between snow and hail:** snow precipitates instead of rain when the temperature of the clouds is below freezing point, while hail occurs when small ice crystals accumulate during thunder storms.
- **Ask the students** the following question: What is the role of the sun and gravity in the water cycle?
- **Explain to the students** that the sun and gravity together maintain the continuity of the water cycle, as the sun causes the movement of water from the earth to the atmospheric air, while gravity works to return the water back to the earth again, thus maintaining the balance of the ecosystem.

Evaluate Your Understanding

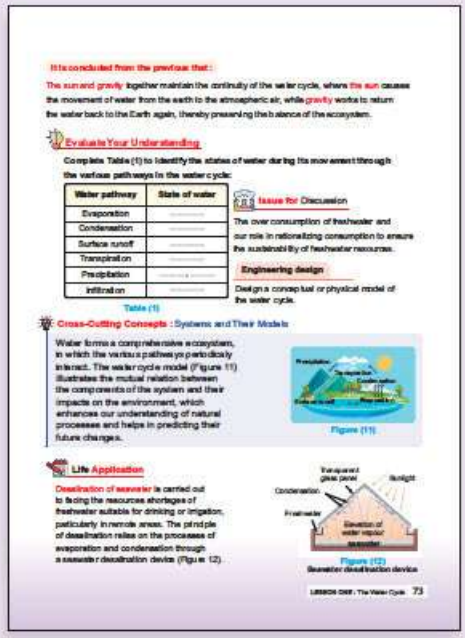
- **Ask the students** to evaluate their understanding by completing Table (1) to identify the states of water during its movement through the various pathways in the water cycle:

Water pathway	State of water
Evaporation	Vapour
Condensation	Liquid
Surface runoff	Liquid
Transpiration	Vapour
Precipitation	Liquid, Solid
Infiltration	Liquid

Cross-cutting concepts: Systems and Their Models

Dear Teacher:

- Defining a system and delineating its boundaries while constructing a clear model serves as a tool for understanding and testing ideas related to it and for its development. Understanding systems is crucial for comprehending phenomena and designing solutions to engineering problems. Identifying and modelling the system(s) helps students focus on the interactions of components within the system's boundaries. Moreover, the system model provides students with a tool for understanding and testing ideas in science and engineering.


It is concluded from the previous that :

The sun and gravity together maintain the continuity of the water cycle, where the sun causes the movement of water from the earth to the atmospheric air, while gravity works to return the water back to the Earth again, thereby preserving the balance of the ecosystem.

Evaluate Your Understanding

Complete Table (1) to identify the states of water during its movement through the various pathways in the water cycle:

Water pathway	State of water
Evaporation	.....
Condensation	.....
Surface runoff	.....
Transpiration	.....
Precipitation	.....
Infiltration	.....

Table (1)

Issue for Discussion

The over consumption of freshwater and our role in rationalizing consumption to ensure the sustainability of freshwater resources.

Engineering design

Design a conceptual or physical model of the water cycle.

Cross-Cutting Concepts : Systems and Their Models

Water forms a comprehensive ecosystem, in which the various pathways periodically interact. The water cycle model (Figure 11) illustrates the mutual relation between the components of the system and their impacts on the environment, which enhances our understanding of natural processes and helps in predicting their future changes.

Figure (11)

Life Application

Desalination of seawater is carried out to facing the resources shortages of freshwater suitable for drinking or irrigation, particularly in remote areas. The principle of desalination relies on the processes of evaporation and condensation through a seawater desalination device (Figure 12).

Figure (12)
Seawater desalination device

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- **Explain to the students** that water forms a comprehensive ecosystem in which the various pathways (evaporation, condensation, precipitation, surface runoff and infiltration) interact cyclically (periodically). The water cycle model (Figure 11) illustrates the interrelationships between the components of the system and their impacts on the environment, thereby enhancing our understanding of natural processes and aiding in predicting their future changes.

Life Application

- **Explain to the students** how to utilise the processes of water conversion in the desalination of seawater to face the shortage of fresh water resources suitable for drinking or irrigation, especially in remote areas.
- **Clarify to the students** that the desalination process relies on the processes of evaporation and condensation using a seawater desalination device (Figure 12).

Closure of the Lesson:

- A skill in which the teacher summarizes all the main ideas of the lesson before concluding it five minutes early.
- You may engage the students in closing the lesson by asking them about the concepts covered in the lesson.

Answers of Evaluation Questions on Lesson One

1 (1) (a) (2) (b) (3) (b)
(4) (d) (5) (b)

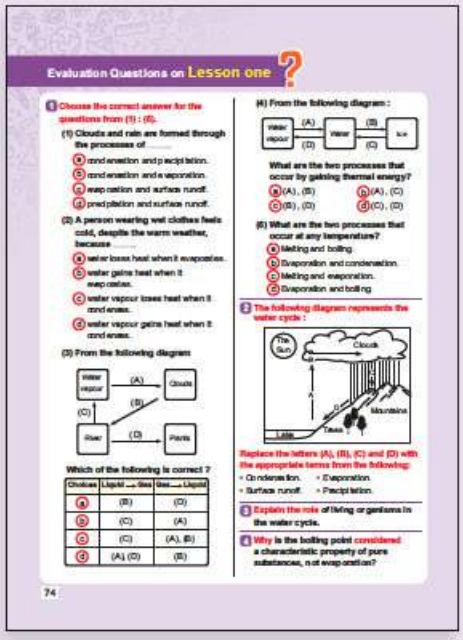
2

(A): Evaporation. **(B)**: Condensation.

(C): Precipitation. **(D)**: Surface runoff.

3 The plant is considered a source of water vapour through the transpiration process, while human and animals are considered a sources of water vapour through the evaporation of sweat.

4 Because boiling process occurs at a specific temperature, while evaporation process occurs at any temperature.


Evaluation Questions on Lesson one

1 Choose the correct answer for the questions from (1) : (5).

(1) Clouds and rain are formed through the processes of .....
(a) condensation and precipitation.
(b) condensation and evaporation.
(c) evaporation and surface runoff.
(d) precipitation and surface runoff.

(2) A person wearing wet clothes feels cold, despite the warm weather, because .....
(a) water loses heat when it evaporates.
(b) water gains heat when it evaporates.
(c) water vapour loses heat when it condenses.
(d) water vapour gains heat when it condenses.

(3) From the following diagram

Which of the following is correct ?

Choices	Liquid → Gas	Gas → Liquid
(a)	(B)	(D)
(b)	(C)	(A)
(c)	(C)	(A), (B)
(d)	(A), (D)	(B)

(4) From the following diagram :

What are the two processes that occur by gaining thermal energy?
(a) (A), (B) (b) (A), (C)
(c) (B), (D) (d) (C), (D)

(5) What are the two processes that occur at any temperature?
(a) Melting and boiling.
(b) Evaporation and condensation.
(c) Melting and evaporation.
(d) Evaporation and boiling.

2 The following diagram represents the water cycle :

Replace the letters (A), (B), (C) and (D) with the appropriate terms from the following:
• Condensation • Evaporation
• Surface runoff • Precipitation

3 Explain the role of living organisms in the water cycle.

4 Why is the boiling point considered a characteristic property of pure substances, not evaporation?

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Additional Learning Resources:

Utilising digital learning resources such as the Egyptian Knowledge Bank, as well as educational and documented videos and films available on websites.

Lesson Two: The Rock Cycle

Introduction:

- The second lesson of this unit covers the topic of the rock cycle. The rocks we see around us are not as static as they appear; rather, they are on a continuous journey, transforming from one type to another over time. Rocks are not merely rigid components of nature; they are a living testament to millions of years of geological changes, known as the rock cycle. Through this lesson, students will acquire a set of new concepts, and the lesson aims to develop skills in discovery, inference and deduction.

Lesson Objectives:

1. Recognize that rocks are composed of one or more minerals.
2. Understand the role of Earth processes in rock formation.
3. Differentiate between weathering and erosion.
4. Identify the types of the rocks.
5. Explain the transformation of the rocks from one type to another.
6. Design a (conceptual – physical) model that describes the rock cycle.
7. Recognize the role of Earth processes in the formation of fossil fuel.

Teaching Resources and Learning Materials Used:

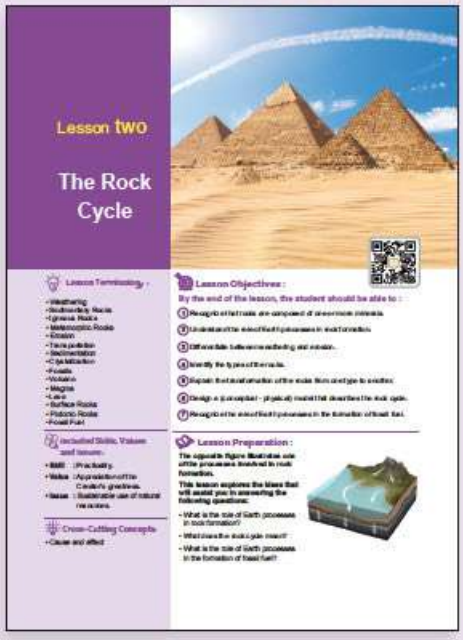
Data show - Films - Student textbook images - Internet - Science laboratory.

Duration and Place of Teaching:

Two periods (4 sessions) - Classroom and media lab - Science laboratory.

Lesson terminology:

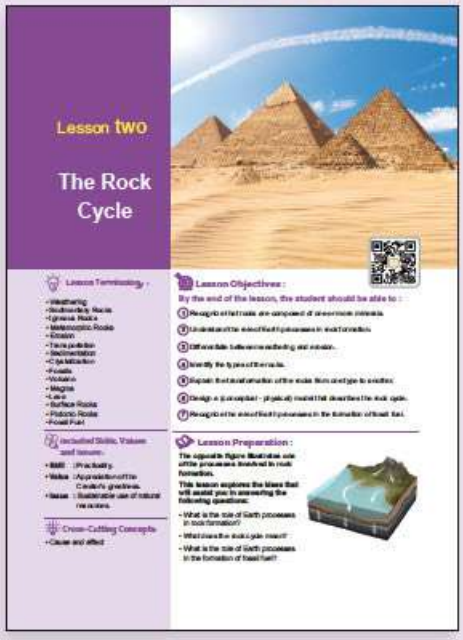
- Weathering
- Igneous Rocks
- Erosion
- Sedimentation
- Fossils
- Magma
- surface Rocks
- Fossil Fuel
- Sedimentary Rocks
- Metamorphic Rocks
- Transportation
- Crystallization
- Volcano
- Lava
- plutonic Rocks



Misconceptions or Incorrect Concepts:

- **Some students believe that** the rock cycle is linear, meaning that rocks always transform directly between the three types (igneous, sedimentary, and metamorphic) in a fixed order. However, it is a dynamic process where any type of rock can directly change into another type based on environmental conditions such as pressure, heat, or erosion.
- **Some students think that** the rock cycle occurs quickly and can be observed within a human lifetime, whereas the rock cycle is a process that takes millions of years and relies on slow geological conditions that occur over time.
- **Some students believe that** igneous rocks are formed solely from volcanic activity, but igneous rocks can also form from the solidification of molten material beneath the Earth's surface (plutonic igneous rocks) or from lava on the surface (surface igneous rocks).
- **Some students think that** all metamorphic rocks are either igneous or sedimentary rocks that have been subjected to heat and pressure, but metamorphic rocks can also arise from other metamorphic rocks that have undergone different conditions of pressure and heat.

- **Some students believe that** the rock cycle occurs in the same way in all areas of the Earth; however, the rock cycle varies based on geographical and geological factors in each region, such as volcanic activity, erosion or the presence of tectonic plates.



Diagnostic Assessment:

- **Ask students** to examine the lesson preparation image and attempt to answer the questions, as these questions serve as a diagnostic assessment to gauge their prior knowledge of the lesson and uncover any misconceptions they may have.
- **Listen carefully** to the students' answers to these questions and ask them to explain their reasoning.
- **Clarify that** the correct answers to these questions will be revealed through the explanation of this lesson.

Use diverse teaching strategies:

You can use K.W.L strategies - discussion - cooperative learning - discovery.

- At the beginning of the lesson, use the K.W.L strategy (What do you know?) - (What do you want to know?) - (What have you learned?).
- Draw a K.W.L table on the board, reminding students of this strategy.

What do you know? (K)	What do you want to know? (W)	What have you learned? (L)

- Before explaining the lesson:

Ask students to write down the knowledge they already have about the rock cycle in the first column (What do you know?). Then, ask them to write the new information they wish to learn about the rock cycle in the second column (What do you want to know?).

- After explaining the lesson:

Ask students to write down the knowledge they have gained about the rock cycle in the third column (What have you learned?).

Rocks

Lesson Preparation:

- **Ask the students the following stimulating questions:**
  1. **What** distinguishes one rock from another ? Do you think they have the same origin, or did they form in different ways?
  2. **Do you** believe that rocks are solid and unchanging forever? Or can they change over time? How does this happen?
- **Give the students** a chance to respond and encourage them to provide answers and guesses without correcting them immediately.
- **Explain to the students** that rocks are not just silent masses; they are in continuous motion over time within a natural cycle called the «rock cycle». Today, we will learn how rocks of different types are formed and what factors influence their formation.
- **Clarify to the students** that rocks are solid materials made up of one or more minerals.
- **Provide the students** with an example of granite, which consists of three types of minerals.
- **Ask the students** the following question:

  Where can rocks be found?

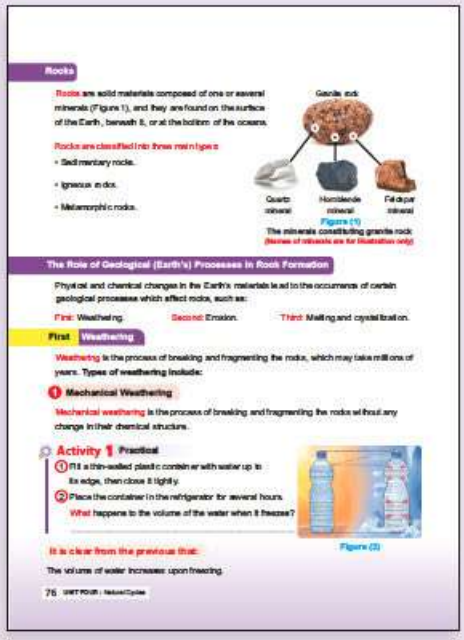
  Rocks can be found on the Earth's surface, beneath it, or at the bottom of the oceans.
- **Explain to the students** that rocks are classified into three main types: igneous rocks, sedimentary rocks, and metamorphic rocks.

The Role of Geological (Earth's) Processes in Rock Formation

- **Review with the students the difference between physical changes and chemical changes:**
  1. **Physical change:** a change in the state or shape of a substance without changing its chemical composition.
  2. **Chemical change:** a change that results in the formation of new materials with chemical compositions different from the original substances.
- **Explain to the students** that physical and chemical changes in Earth materials lead to geological processes affecting rocks.

First Weathering

- **Explain to the students** the concept of weathering, which is the process of breaking and fragmenting rocks. This process can take millions of years, and there are two types of weathering.


Rocks

Rocks are solid materials composed of one or several minerals (Figure 1), and they are found on the surface of the Earth, beneath it, or at the bottom of the oceans.

Rocks are classified into three main types:

- Sedimentary rocks.
- Igneous rocks.
- Metamorphic rocks.

Granite rock

Quartz mineral | Hornblende mineral | Feldspar mineral

Figure (1)

The minerals constituting granite rock

(Names of minerals are for illustration only)

The Role of Geological (Earth's) Processes in Rock Formation

Physical and chemical changes in the Earth's materials lead to the occurrence of certain geological processes which affect rocks, such as:

First: Weathering. Second: Erosion. Third: Melting and crystallization.

First Weathering

Weathering is the process of breaking and fragmenting the rocks, which may take millions of years. Types of weathering include:

1 Mechanical Weathering

Mechanical weathering is the process of breaking and fragmenting the rocks without any change in their chemical structure.

Activity 1 Practical

① Fill a thin-walled plastic container with water up to its edge, then close it tightly.

② Place the container in the refrigerator for several hours.

What happens to the volume of the water when it freezes?

Figure (2)

It is clear from the previous that:

The volume of water increases upon freezing.

76 UNIT FOUR : Natural Cycles

1 Mechanical Weathering

- **Explain to the students** the concept of mechanical weathering, which is the process of breaking and fragmenting rocks without any change in their chemical structure.

Activity 1 Practical

- The aim of this activity is to illustrate the concept of mechanical weathering.
- **Materials used:** a plastic container, a freezer, water.
- **Ask the students** to fill a thin-walled plastic container with water up to its edge, then close it tightly and place the container in the freezer for several hours.
- **Ask the students** what happens to the volume of water when it freezes?

  The volume of water increases when it freezes.
- **Explain to the students** that the volume of water increases upon freezing.
- **Dear teacher, you can conduct another activity:**

  ① **Bring** two transparent plastic cups and two equal-sized pieces of limestone.

  ② **Place** each piece of limestone in a plastic cup.

  ③ **Fill** both plastic cups with water.

4. **Place** one of the cups in the freezer and leave it overnight, while keeping the other cup outside the freezer.
5. The next day, take the cup out of the freezer and let it sit until the ice melts.
6. Examine the limestone in the two cups.
7. **Note:** You may observe that the expansion caused by freezing water can lead to cracking or breaking of some stones.

- **Ask the students** to observe Figure (3) and answer the following question: What happens to the rock when water freezes inside it?

  When water freezes in the cracks of the rock, the volume of the water increases, causing the rock to break.

- **Explain to the students** that one of the causes of mechanical weathering is the freezing of water.
- **Ask the students** to observe Figures (4 and 5) and describe each image.
- **Explain to the students** that the flow of water and the wind blowing lead to the fragmentation and breaking of rocks, and these are other causes of mechanical weathering.
- **Explain to the students** the processes of thermal expansion and contraction of the minerals that make up rocks:

1. Rocks are composed of a variety of minerals, and each mineral expands and contracts at different rates when exposed to changes in temperature.
2. In areas that experience significant temperature differences between day and night (such as deserts), rocks are exposed to continuous expansion and contraction; these differences lead to the cracking of rocks.

- **Ask the students** to observe Figures (6 to 8) and describe each image.
- **Dear teacher, you can conduct the following activity:**

1. Heat a rock using a heat source for a short period.
2. Quickly immerse it in cold water or place it in a cold environment.
3. Observe the appearance of cracks or listen for a slight cracking sound as a result of rapid thermal change.

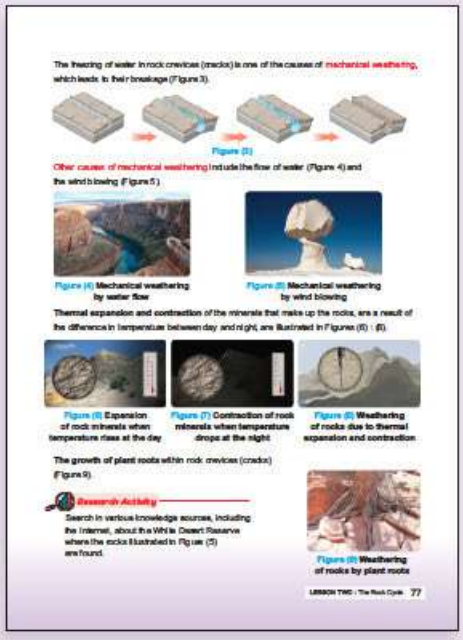

The freezing of water in rock crevices (cracks) is one of the causes of mechanical weathering, which leads to their breakage (Figure 3).

Figure (3)

Other causes of mechanical weathering include the flow of water (Figure 4) and the wind blowing (Figure 5).

Figure (4) Mechanical weathering by water flow

Figure (5) Mechanical weathering by wind blowing

Thermal expansion and contraction of the minerals that make up the rocks, are a result of the difference in temperature between day and night, are illustrated in Figures (6) : (8).

Figure (6) Expansion of rock minerals when temperature rises at the day

Figure (7) Contraction of rock minerals when temperature drops at the night

Figure (8) Weathering of rocks due to thermal expansion and contraction

The growth of plant roots within rock crevices (cracks) (Figure 9).

Research Activity

Search in various knowledge sources, including the Internet, about the White Desert Reserve where the rocks illustrated in Figure (5) are found.

Figure (9) Weathering of rocks by plant roots

LESSON TWO : The Rock Cycle 77

- **Explain to the students** that one of the causes of mechanical weathering is the growth of plant roots inside the cracks of rocks, where the roots penetrate the small cracks in the rock. As they continue to grow, the roots exert pressure on the walls of the cracks, leading to their expansion, and over time, this process can result in the breaking and fragmentation of the rocks.

Research Activity

- Ask the students to research from various knowledge sources, including the internet, about the White Desert Reserve, where the rock illustrated in Figure (5) are found.

2 Chemical Weathering

- **Review** the concept of mechanical weathering with the students.
- **Explain to the students** that there is another type of weathering known as chemical weathering, which is the process of breaking down and fragmenting rocks with a change in their chemical structure.

Activity 2 Practical

- The aim of this activity is to illustrate the concept of chemical weathering.
- **Materials used:** a piece of limestone - acid - a matchstick.
- **Ask the students** to follow the steps of the activity from the student book.
- **Instruct the students** to place a piece of limestone on a glass plate and add drops of acid to the piece of limestone. **And answer the following questions:**

① What do you observe? The rock gets corroded and gas bubbles evolve.

② What happens when a lit matchstick is brought close to the gas bubbles formed? The matchstick goes out.

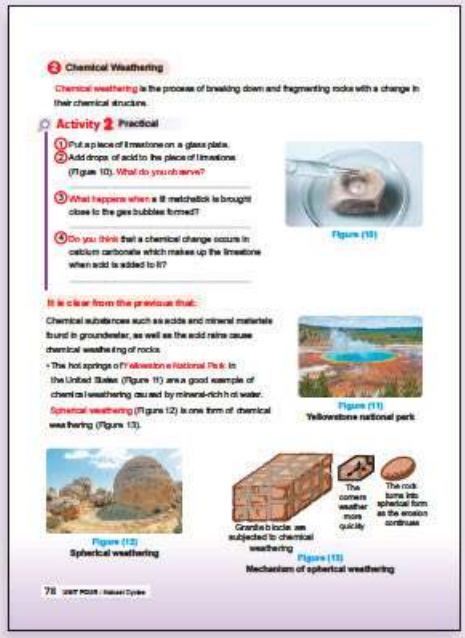
③ Do you think a chemical change occurs in calcium carbonate which makes up the limestone when acid is added to it? Yes, a chemical change occurs.

It is clear from the previous that:

- Chemical substances such as acids and mineral materials found in groundwater, as well as the acid rains cause chemical weathering of rocks.

Dear Teacher:

- Yellowstone National Park is one of the most famous and oldest natural reserves in the world. It is located in the United States, spanning three states. Established in 1872, it was the first national park in the world. Yellowstone is renowned for being situated over a massive active volcano known as the «Yellowstone Supervolcano» and contains many hot springs and geothermal features, such as the famous «Old Faithful» geyser, which regularly erupts water and steam into the air.


2 Chemical Weathering

Chemical weathering is the process of breaking down and fragmenting rocks with a change in their chemical structure.

Activity 2 Practical

① Put a piece of limestone on a glass plate.
② Add drops of acid to the piece of limestone. (Figure 10). What do you observe?

③ What happens when a lit matchstick is brought close to the gas bubbles formed?

④ Do you think that a chemical change occurs in calcium carbonate which makes up the limestone when acid is added to it?

Figure (10)

It is clear from the previous that:

Chemical substances such as acids and mineral materials found in groundwater, as well as the acid rains cause chemical weathering of rocks.

• The hot springs of Yellowstone National Park in the United States (Figure 11) are a good example of chemical weathering caused by mineral-rich hot water.

Spherical weathering (Figure 12) is one form of chemical weathering (Figure 13).

Figure (11)
Yellowstone national park

Figure (12)
Spherical weathering

Granite blocks are subjected to chemical weathering

The corners weather more quickly

The rock turns into spherical form as the erosion continues

Figure (13)
Mechanism of spherical weathering

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- **Explain to the students** that the springs in Yellowstone National Park in the United States are a good example of chemical weathering caused by mineral-rich hot water.
- **Ask the students** to observe figures (12, 13) and deduce how spherical weathering occurs:

① When granite blocks are subjected to chemical weathering.

② The corners weather more quickly.

③ The rock turns into spherical form as the erosion continues.

Evaluate Your Understanding

- **Ask the students** to evaluate their understanding by answering the question in the student's book. What do you expect to happen to the shape of ice cubes when placed in an open area? The ice melts, which is evident at the edges that take a curved shape.


Evaluate Your Understanding:
What do you expect to happen to the shape of ice cubes when placed in an open area?
Life Application
Calcium carbonate powder, resulting from the crushing of limestone rock, is used in making casts for individuals with bone fractures (Figure 14).
Figure (14)
Second Erosion
Why does the water coming from the Ethiopian Plateau appear brown?
How was the agricultural soil in Egypt formed over millions of years?
When rainfall occurs on the Ethiopian Plateau, a weathering process of the rocks takes place, followed by an erosion process, during which the rock fragments resulting from the weathering are transported away from the areas where they were originally found (Figure 15).
Weathering and erosion of rocks
Gravel
Sand
Silt
Clay
Rainfall
Sand
Silt
Clay
Medium flow
Clay
Silt
Slow flow
Clay
Gravel
Sand
Silt
Clay
Figure (15)
The processes of transportation and sedimentation
LESSON TWO : The Rock Cycle 79

Life Application

Dear Teacher:

- Casts are typically made from solid materials used to stabilise broken bones during the healing process. In traditional casts, (which contains calcium sulphate) is used. However, with technological advancements, other calcium compounds, such as calcium carbonate, are now used to provide strength and durability.
  The powdered calcium carbonate produced from crushed limestone is used to make the casts for individuals with bone fractures (Figure 14).

Second Erosion

Dear Teacher: You can conduct the following activity with the students:

1. **Place** a layer of sand at the bottom of a plastic basin to represent the bedrock.
2. **Add a** layer of gravel on top of the sand, followed by a layer of clay.
3. **Use a** source of water, such as a container or a small hose, to slowly pour water over the layers.
4. **Observe** how the smaller particles (such as clay) move quickly with the water flow, while the larger particles (such as gravel) settle at the bottom.
5. **Repeat** pouring water several times, adding new layers of sand, gravel, and clay each time.
6. **Notice** how sedimentary layers form on top of one another and how materials accumulate over time.
7. **Ask** the students to gently press on the layers using their hands or light pressing tools.
8. **Explain** to the students that this represents what happens in rivers or beaches where different materials are transported and deposited in separate layers. They are subjected to significant pressure from the weight of the accumulated layers above them, leading to the hardening of sediments and their transformation into sedimentary rocks over time.

- **Ask the students** why the water coming from the Ethiopian plateau appears brown ? This is due to the large amounts of clay and silt sediments and mineral elements that the water picks up as it flows from the mountains and plains to the rivers.
- **Ask the students** how was the agricultural soil in Egypt formed over millions of years ? It has formed as a result of the accumulation of silt sediments carried by the Nile River from elevated areas in Africa.
- **Explain to the students** that when rain falls on the Ethiopian plateau, weathering of rocks occurs, followed by erosion, which involves transporting the rock fragments produced by weathering away from their original places.
- **Ask the students** to observe (Figure 15), which illustrates the processes of transportation and sedimentation, and describe what happens: after rocks are broken down by weathering, sediments are transported by natural agents to new locations. When these agents lose their ability to transport these materials (such as when the water current or winds calm), the sediments settle in those locations and begin to accumulate over time.

- **Explain** to the students that rock fragments, known as sediments, are deposited in sedimentary environments.
- **Clarify** to the students that when sediments are compressed over the years into layers, a process of lithification occurs, transforming them into cohesive rocks known as sedimentary rocks (Figure 16).
- **Provide** examples of sedimentary rocks to the students: limestone, sandstone, and clay stone.
- **Explain** to the students the characteristics of sedimentary rocks: they are porous due to the spaces between the sediment particles that comprise them, and they contain fossils (Figure 17).
- **Inform** the students that erosion processes have beneficial effects, such as the formation of river deltas, but they also have detrimental (harmful) effects, such as coastal erosion due to action of sea waves.

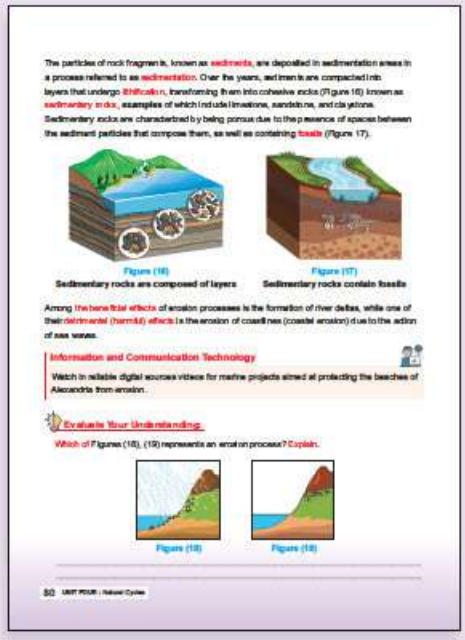
Information and Communication Technology

- **Ask the students** to explore reliable digital sources regarding marine projects aimed at protecting the beaches of Alexandria from erosion.

Evaluate Your Understanding

- **Ask** the students to evaluate their understanding by answering the question in the student book: **Which of** figures (18, 19) represents an erosion process? **Explain**.

Figure (18) illustrates a chemical weathering process of rocks due to rainfall, followed by the transportation of rock fragments away from their original places and their deposition in other areas.



The particles of rock fragments, known as sediments, are deposited in sedimentation areas in a process referred to as sedimentation. Over the years, sediments are compacted into layers that undergo lithification, transforming them into cohesive rocks (Figure 16) known as sedimentary rocks, examples of which include limestone, sandstone, and clay stone. Sedimentary rocks are characterised by being porous due to the presence of spaces between the sediment particles that compose them, as well as containing fossils (Figure 17).

Figure (16)
Sedimentary rocks are composed of layers

Figure (17)
Sedimentary rocks contain fossils

Among the beneficial effects of erosion processes is the formation of river deltas, while one of their detrimental (harmful) effects is the erosion of coastlines (coastal erosion) due to the action of sea waves.

Information and Communication Technology

Watch in reliable digital sources videos for marine projects aimed at protecting the beaches of Alexandria from erosion.

Evaluate Your Understanding

Which of Figures (18), (19) represents an erosion process? Explain.

Figure (18)

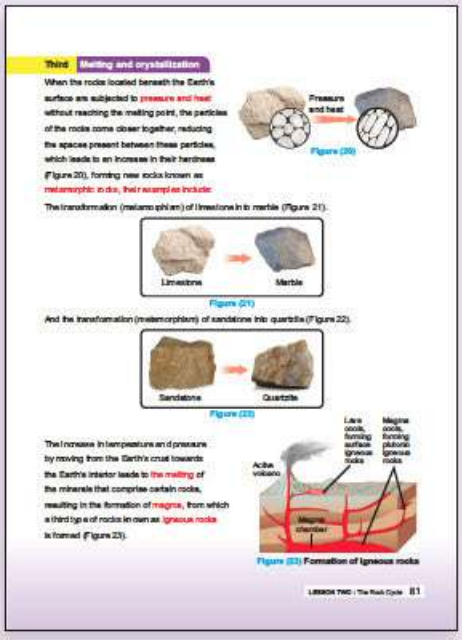
Figure (19)

Third Melting and Crystallization

Dear Teacher: You can conduct the following activity with the students:

1. **Cut a** number of red, orange, and yellow wax crayons and stack them on top of each other on a paper plate.
2. **Press** down first with your thumb and then with a hammer to «shape the wax».
3. **Heat** the plate in the microwave for 3 or 4 minutes.
4. **Remove** the plate and observe the colours swirling together.
5. **Allow** it to cool completely, just as magma cools when it flows to the Earth's surface.
6. **What do you observe:** The colours of the wax change and blend together, solidifying as the wax cools.
7. **Conclusion:** Solid rocks transform into a liquid state due to high temperatures. When they cool, they change from a liquid to a different solid state.

- **Explain to the students** that when rocks beneath the Earth's surface are subjected to pressure and heat without reaching their melting point, the mineral particles come closer together, reducing the spaces between them, which increases their hardness, forming new rocks known as metamorphic rocks.
- **Provide examples to the students** of metamorphic rocks, such as limestone transforming into marble, and sandstone turning into quartzite.
- **Explain to the students** the reason for this transformation, which is due to the exposure of limestone to heat and pressure, leading to the rearrangement of carbonate minerals in the limestone to form larger, more organized crystals, ultimately giving the substance the solid and shiny characteristics of marble.



Dear Teacher:

- **Explain to the students** that rock melting is the process of transforming rocks or solid minerals into a liquid state due to high temperatures. Melting occurs when rocks within the Earth's interior are subjected to extremely high heat that exceeds their melting point. This melting results in the formation of magma, the molten material that may erupt to the surface through volcanoes and is called lava, or remain beneath the Earth's crust.
- **Clarify to the students** that crystallization is the process of transforming magma or lava from a liquid state to a solid state as it cools. Crystallization occurs when magma cools either beneath the Earth's surface (known as plutonic cooling) or when it erupts to the surface as lava (known as surface cooling). The crystallization process results in the formation of igneous rocks.
- **Present to the students** (Figure 23), which illustrates the formation of igneous rocks. Ask them to identify the types of igneous rocks and the reasons for their formation.

- **Divide the students** into small groups and ask each group to draw a diagram illustrating the types of rocks.
- **Ask the students** to read the text in the student's book and record a comparison between surface igneous rocks and plutonic igneous rocks in the following table:

Points of comparison	Surface igneous rocks	Plutonic igneous rocks
Source	Lava	Magma
Location of solidification	Earth's surface	Earth's interior
Cooling duration	Cools quickly	Cools very slowly
Crystal size	Small crystals	Large crystals
Examples	Basalt, Pumice	Granite, Gabbro

Igneous rocks are classified into two types, depending on the location of their solidification. If magma emerges with the remaining volcanic products to the earth's surface, it loses a significant amount of the gases mixed with it, forming what is known as lava, which cools quickly to form rocks with small crystals known as surface igneous rocks, such as basalt (Figure 24) and pumice (Figure 25).

Figure (24) Basalt

Figure (25) Pumice

Basalt and pumice are surface igneous rocks

But, if magma overlaps between the cracks and layers of the earth's crust, it cools very slowly, forming rocks with large crystals known as plutonic igneous rocks, such as granite (Figure 26) and gabbro (Figure 27).

Figure (26) Granite

Figure (27) Gabbro

Granite and gabbro are plutonic igneous rocks

Integration with the Science of Construction

Issue for discussion

Rocks of all types are used in construction, as exemplified by the use of limestone in the construction of the Pyramids of Giza in Egypt (Figure 28) and marble in the construction of the Taj Mahal in India (Figure 29).

Sustainable use of natural resources

Figure (28) One of Giza Pyramids

Figure (29) Taj Mahal in India

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Integration with the Science of Construction

- **Explain to the students** the uses of rocks in our lives, as rocks are used in construction, such as limestone in construction of the Pyramids of Giza in Egypt (Figure 28) and marble in the construction of the Taj Mahal in India (Figure 29).

Issue for Discussion

Dear Teacher:

- Sustainable use of natural resources in a way that meets the needs of the current generation without compromising the ability of future generations to meet their own needs. It involves balancing consumption with the preservation of resources over the long term.
- **Discuss with the students** the uses of rocks in our lives, such as: construction (granite, marble), cement production (limestone), and minerals (such as copper and iron extracted from rocks).
- **You can discuss issues related to the use of rocks such as:**

1. **Unsustainable extraction:** Over-extraction of rocks can lead to a reduction in available resources in the future, making it difficult to meet the needs of upcoming generations.
2. **Landscape degradation:** Quarries and mines lead to changes in the shape of the land, destroying natural habitats for some living organisms.
3. **Limited resources:** Some types of rocks, such as marble and granite, are not found in large quantities and can be rare, making them susceptible to depletion as demand increases.

- **You can discuss strategies for achieving sustainable use of rocks such as:**

1. Using modern technologies like underground mining instead of open-pit mining to reduce environmental impact.
2. Recycling and using recycled materials in construction projects.
3. Exploring alternative materials for construction and industry that may be more sustainable, such as recycled plastics or concrete mixed with eco-friendly materials.

Cross-cutting concepts: Cause and Effect

- The concept of cause and effect is used to understand how events and phenomena are interconnected. Learning this concept helps students explain why things happen (the cause) and what results from this event or action (the effect).
- Apply the concept of cause and effect: Through various processes, such as weathering and erosion, extreme pressure and heat, melting and cooling (the cause), rocks transform from one type to another, forming what is known as the rock cycle (the effect).

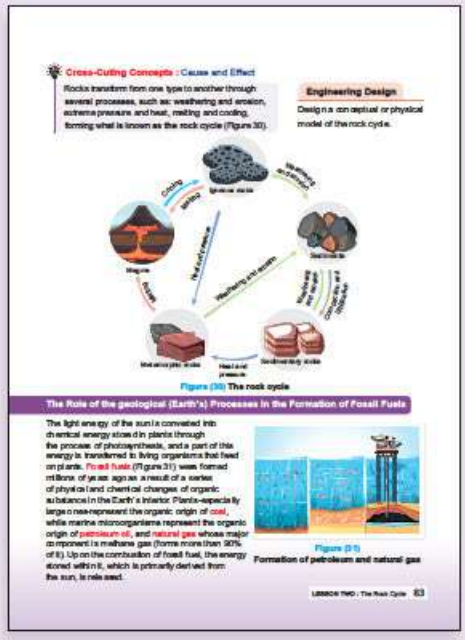
Engineering Design

- Ask students to design a conceptual or physical model of the rock cycle.

The Rock Cycle

- **Explain to students** that the rock cycle is a dynamic process that occurs over millions of years, where igneous, sedimentary, and metamorphic rocks change from one type to another through a series of natural processes such as weathering, sedimentation, melting, and crystallization, and pressure. This cycle illustrates how the Earth is in a constant state of change.
- **Ask students to** observe (Figure 30), which represents the rock cycle.
- **Summarize** the stages of the rock cycle for students:

1. **Igneous rocks:** Formed when lava cools on the Earth's surface or magma solidifies between cracks and layers of the Earth's crust.
2. **Sediments:** Resulting from the weathering and erosion of other rocks, sediments are transported to different locations by water or wind.
3. **Sedimentary rocks:** Formed when sediments accumulate over time, and under pressure and heat, these sediments compact to form sedimentary rocks.
4. **Metamorphic rocks:** Formed when igneous or sedimentary rocks are subjected to high temperatures or pressures without melting, leading to changes in their mineral composition.
5. **Magma:** Rocks in the Earth's interior melt due to high temperatures and pressure, forming magma, which flows to the Earth's surface and is called lava.



The Role of the geological (Earth's) Processes in the Formation of Fossil Fuels

- **Ask students** to read the text in the student's book and answer the following questions:

1. What happens in photosynthesis process? The sunlight energy is converted into chemical energy stored in plants.
2. How is the energy stored in plants transferred to living organisms? A part of this energy is transferred to living organisms that feed on plants.
3. What is the reason for the formation of fossil fuels in the Earth's interior? As a result of a series of physical and chemical changes of organic substances in the Earth's interior over millions of years.
4. What is the organic origin of coal? Plants, especially larger ones.
5. What is the organic origin of petroleum oil and natural gas? Marine microorganisms.

- **Explain to students** that methane gas constitutes over 90% of the components of natural gas, and when fossil fuels are burned, the stored energy released is primarily derived from the sun.

Closure of the Lesson:

- A skill in which the teacher summarizes all the main ideas of the lesson before concluding it five minutes early.
- You can involve students in closing the lesson by asking them about the concepts covered in the lesson.

Answers of Evaluation Questions on Lesson Two

1 (1) (a) (2) (c) (3) (b)
(4) (d) (5) (a)

2

(1) Weathering / Erosion.

(2) Surface / Plutonic.

(3) Coal / Petroleum oil.

3

(1) Igneous rocks.

(2) Sedimentary rocks.

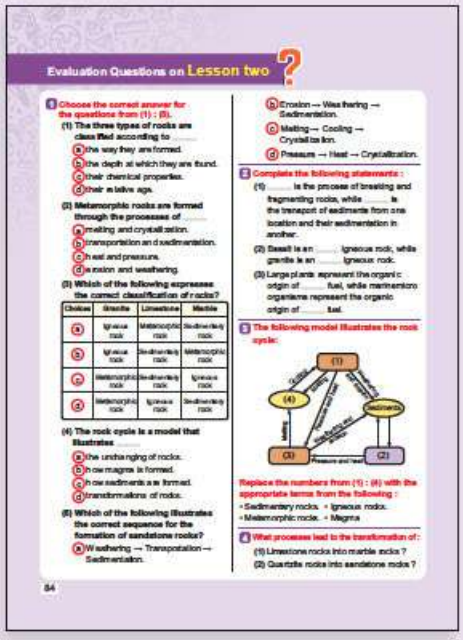
(3) Metamorphic rocks.

(4) Magma.

4

(1) High pressure and heat.

(2) Weathering, erosion and lithification.



Evaluation Questions on Lesson two

1 Choose the correct answer for the questions from (1) : (5).

(1) The three types of rocks are classified according to .....
(a) the way they are formed.
(b) the depth at which they are found.
(c) their chemical properties.
(d) their relative age.

(2) Metamorphic rocks are formed through the processes of .....
(a) melting and crystallization.
(b) transportation and sedimentation.
(c) heat and pressure.
(d) erosion and weathering.

(3) Which of the following expresses the correct classification of rocks?

Choices	Granite	Limestone	Marble
(a)	Igneous rock	Metamorphic rock	Sedimentary rock
(b)	Igneous rock	Sedimentary rock	Metamorphic rock
(c)	Metamorphic rock	Sedimentary rock	Igneous rock
(d)	Metamorphic rock	Igneous rock	Sedimentary rock

(4) The rock cycle is a model that illustrates .....
(a) the unchanging of rocks.
(b) how magma is formed.
(c) how sediments are formed.
(d) transformations of rocks.

(5) Which of the following illustrates the correct sequence for the formation of sandstone rocks?
(a) Weathering → Transportation → Sedimentation.
(b) Erosion → Weathering → Sedimentation.
(c) Melting → Cooling → Crystallization.
(d) Pressure → Heat → Crystallization.

2 Complete the following statements :

(1) ..... is the process of breaking and fragmenting rocks, while ..... is the transport of sediments from one location and their sedimentation in another.

(2) Basalt is an ..... igneous rock, while granite is an ..... igneous rock.

(3) Large plants represent the organic origin of ..... fuel, while marine micro organisms represent the organic origin of ..... fuel.

3 The following model illustrates the rock cycle:

Replace the numbers from (1) : (4) with the appropriate terms from the following :
• Sedimentary rocks. • Igneous rocks.
• Metamorphic rocks. • Magma

4 What processes lead to the transformation of :

(1) Limestone rocks into marble rocks ?

(2) Quartzite rocks into sandstone rocks ?

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- **Additional Learning Resources.**

Utilising digital learning resources such as the Egyptian Knowledge Bank, as well as educational and documented videos and films available on websites.

Methods of Supporting Teaching for Integration Groups
in Science

Unit Four: Natural Cycles

Lesson One: The Water Cycle

Integration Group	Support Methods
Intellectual Disability and Slow Learning Hyperactivity and Attention Deficit Autism Spectrum	• Use practical demonstrations to illustrate the three states of water (liquid water in a glass – a piece of ice – a cup of hot water from which steam rises) and allow the student to explore the different states of water using their senses, while ensuring safety by not allowing contact with hot water by hand. • identify the results using their senses, then summarise the conclusions from the experiments in simple bullet points. • Design a specific diagram for the student on the transformations of water using cut-outs of cardstock, foam, or illustrated cards to clarify the processes of evaporation, condensation, melting and freezing, while explaining each concept individually, then comparing between each of them. • Utilise some short videos that illustrate the water cycle in nature, then execute them with explanatory drawings on the board in a summarized manner.
Learning Difficulties	• Draw a simplified mind map illustrating the three states of water (liquid – solid – gas) and show them how to transition from one state to another using practical life examples. • Assist the student in engaging their peers in executing the practical activities and provide them with appropriate encouragement to observe the changes occurring during the implementation, then summarize the findings from the experiment in a simple sentence on the board and highlight key terms with different colours, helping them to read the sentence and copy it into their notebook. • Write a brief table comparing the following concepts (condensation – evaporation – melting – freezing – boiling) with the aid of some explanatory drawings.
Hearing Impaired	• Present a list of new concepts from the lesson (evaporation, condensation, melting process,...) supported by images or drawings to hint at the meaning.
The Blind and Visual Impaired	• Describe Figure (3) related to the states of water in nature, along with providing practical examples for the states of water.

Integration Category	Support Methods
Intellectual Disability and Slow Learning **Hyperactivity and Attention Deficit** **Autism Spectrum**	• Present a collection of cards that illustrate the various types of rocks, ensuring that each type is presented individually to facilitate the student's understanding of each type, then display them sequentially. • Utilise various explanatory videos and images to clarify the concepts of (Weathering – erosion – melting and crystallization). • Explain the concepts of (weathering – erosion – melting and crystallization) to the student through a practical demonstration strategy, repeating the steps for the student multiple times to aid in observing the changes that occur and summarize the conclusions in concise points. • Provide the student with samples of rock types according to what is available (real samples or images) and assist them in distinguishing the differences between them, then classify them according to their types, ensuring that each type is presented individually at the beginning to minimise the student's attention dispersion as much as possible. • Draw a concise explanatory diagram for the student summarising the cycle of fossil fuel formation and support the drawing with images and explanatory diagrams.
Learning Difficulties	• Create a mind map for the student on the board illustrating the types of rocks (sedimentary – igneous – metamorphic) along with displaying real samples if possible or presenting some images and video clips. • Create a table on the board comparing between the types of geological processes for rocks (weathering – erosion – melting and crystallization) and present some explanatory images and video clips to clarify them visually. • Provide a concise table comparing between both mechanical and chemical weathering processes, highlighting key terms in different colours to assist the student in reading the content of the table, then copy it into their notebook and utilise explanatory images to distinguish between each type from the others. • Summarize the concept of rock erosion for the student in a concise sentence, then clarify the concept of sedimentary rocks and their types, utilising images and explanatory diagrams. • Clarify the concepts of melting and crystallization to the student through practical demonstrations, then write a concise table on the board to compare between sedimentary rocks, metamorphic rocks, and igneous rocks and magma, providing examples for each type and presenting the student with real samples if possible or some cards and explanatory images. • Explain to the student how fossil fuels are formed through a concise diagram and utilise short explanatory videos if possible.
Hearing Impaired	• List the new concepts in the lesson (weathering – erosion – melting and crystallization) supported by images or symbols to hint at the meaning. • Provide a simple comparison between the four processes (weathering – erosion – melting and crystallization) to assist the hearing-impaired student in understanding. • Explain to the hearing-impaired student the explanatory diagrams (the process of transport and deposition, sedimentary rocks are composed of layers, sedimentary rocks contain fossils, sedimentary rocks are subjected to pressure and heat, etc.) using simplified language and direct body language to help them understand the objective in each of them. • Present explanatory videos if possible for (formation of igneous rocks, the rock cycle, natural gas formation) and provide a simple summary in short, direct phrases about important information in the video on the board.