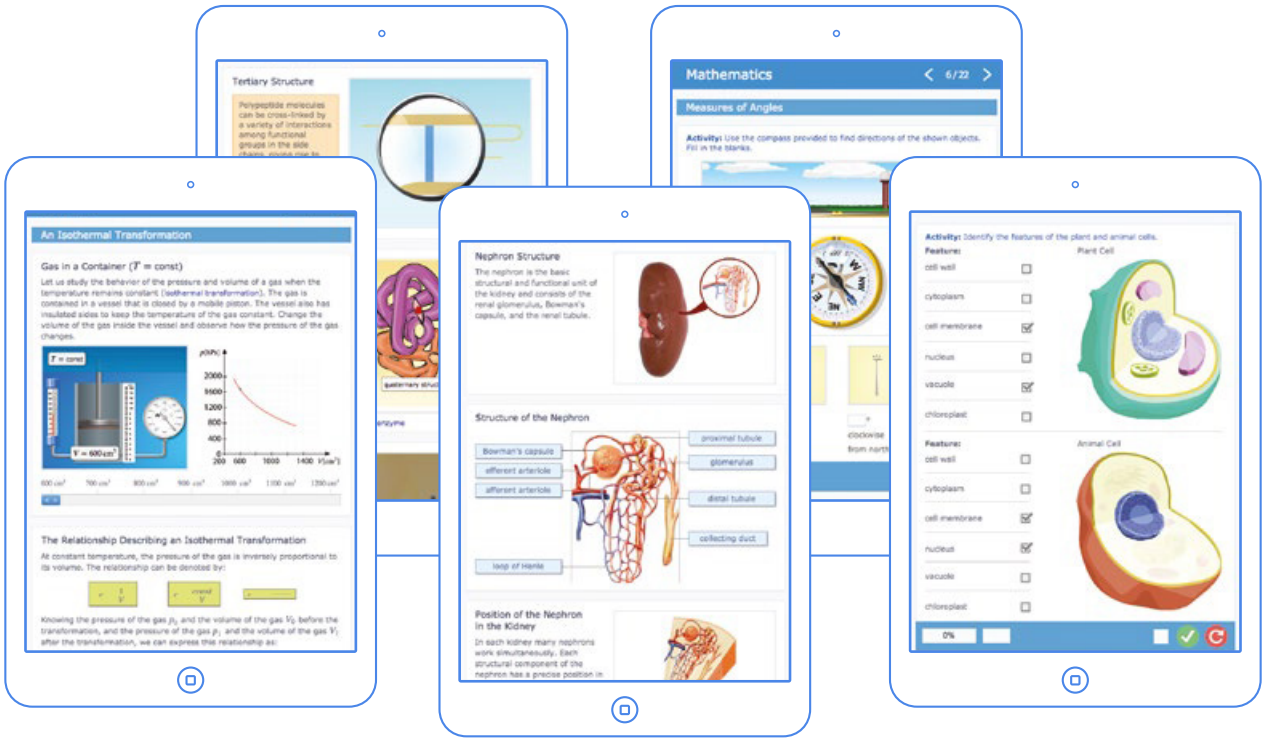

mCurriculum

Comprehensive K-12 eContent Package

Table of Contents

CHAPTER	LESSON	DESCRIPTION
I. Life Processes and Cell Functions	**Animal and Plant Cells**	This lesson explores the similarities and differences between animal and plant cells. Students will learn about the cell membrane, cytoplasm, and nucleus in both animal and plant cells. They will also explore the functions of chloroplasts and cell walls in plant cells and specialized animal cells. The lesson also details levels of organization, including the way animal and plant cells form tissues, tissues form organs, and organ systems form the complex levels of organization in the human body.
	Human Organ Systems	This lesson describes key functions of the human organ systems. Students will learn major organs that belong to each system and functions of specific organs.
	Life Processes	Description: This lesson details seven life processes required by living organisms: respiration, nutrition, excretion, growth, sensitivity, movement, and reproduction. Students learn how these life processes distinguish living things from non-living things.
	Specialized Cells	This lesson describes ways in which cells are specially adapted to their functions. Students will explore examples of specialized cells in both animals and plants. They will also learn some of the features of the red blood cell, cilia cell, sperm cell, and other specialized cells.
	Structure of Flowering Plants	This lesson describes the four main plant organs: the stem, leaves, roots, and flower. Students will learn that the male sex cells, called pollen grains, fertilize female sex cells, called ova. They will also learn ways in which seeds develop after fertilization and are dispersed by plants.
II. Humans as Organisms	**Absorption and Waste**	This lesson describes how the products of digestion are absorbed into the bloodstream and transported throughout the body. Students will learn the role of the kidneys in the removal of waste as well as the process of solid waste remove in humans.
	Adolescence	This lesson describes physical and emotional changes that occur during puberty. Students will learn some of the key changes take place in girls and boys during adolescence.
	Breathing	This lesson discusses the role of lung structure in gas exchange. Students will learn the role of the lungs and the structure of the lungs. They will also learn about the mechanism of breathing and the differences between inhaled and exhaled air.
	Development of the Fetus	This lesson describes the development of a baby from cell division to birth. Students will learn about implantation, the role of the placenta, the stages of development of the fetus, and the stages of birth.
	Digestion	This lesson outlines the principles of digestion, including the role of enzymes in breaking large molecules into smaller ones. Students will learn how food is used as fuel during respiration to maintain the body's activity and as a raw material for growth and repair. They will also learn how to describe the role of the main organs of the human digestive system.
	Drugs and Health	In this lesson, students will learn the main types of legal and illegal drugs. Students will review the dangers of the most commonly abused drugs, and consider how drug abuse can affect human health.
	Fighting Disease	This lesson describes how the growth and reproduction of bacteria and the replication of viruses can affect human health. Students will learn how the body's natural defenses can be enhanced by immunization and medications.

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	Human Reproduction	This lesson covers the male and female reproductive systems. Students will learn about the human sex organs, about the stages of the menstrual cycle, and about how fertilization takes place in humans.
	Human Respiration	This lesson describes the difference between the two types of respiration: aerobic respiration and anaerobic respiration. Students will learn how to summarize aerobic respiration and anaerobic respiration in word equations. They will also learn how substances involved in respiration are transported through the bloodstream and how energy is obtained from respiration.
	Nutrition	This lesson defines a balanced diet and provides examples of good sources of carbohydrates, proteins, fats, vitamins, minerals, and fiber. Students will learn the importance of each of these nutrients, as well as how vital water is to human health.
	Smoking	This lesson covers the effects of smoking on the human body. Students will learn about the chemicals found in cigarette smoke and the health problems associated with them. They will also learn how smoking affects a fetus.
	The Skeleton and Movement	This lesson describes the role of the skeleton and joints. Students will learn the principle of antagonistic muscle pairs and how movement is produced in the body.
III. Green Plants as Organisms	**Factors Affecting Photosynthesis**	This lesson explores factors that affect photosynthesis, including light, water, temperature, and carbon dioxide. Students will learn about the importance of these factors as well as how to test for them.
	Photosynthesis and Food Production	This lesson explains the important role of plants as food and as oxygen producers. Students will learn about photosynthesis, including what plants need for photosynthesis and how the process can be summed up in an equation.
	Plant Growth	This lesson details what plants need to be healthy, including the minerals nitrates, phosphates, and potassium. Students will learn the role of roots and root hairs in absorbing water and minerals from the soil. They will also learn how nutrients can be added to soil that lacks them.
	Respiration in Plants	In this lesson, students will learn the importance of the products of plant respiration and the key role of water in a plant's life processes. The lesson describes aerobic respiration in plants, including the word equation for plant respiration. It also describes how photosynthesis and respiration are related.
IV. Variation, Classification, and Inheritance	**Causes of Variation**	This lesson explores environmental and inherited causes of variation. Students will learn examples of human variation that can be attributed to genetic and to environmental factors. They will also learn the main causes of variation in plants.
	Classification	In this lesson, students will learn how to classify organisms into taxonomic groups. They will also learn examples of organisms from each taxonomic group.
	Inheritance	This lesson defines inherited characteristics and explains the role genes play in inheritance. Students will explore several examples of inherited characteristics, as well as the usefulness of selective and cross-breeding techniques.
	Variation	The lesson defines the term species, and explores the nature of variation between organisms. Students will learn about variation between species and within a species, including human variation. They will also learn the difference between continuous and discontinuous variation.

CHAPTER	LESSON	DESCRIPTION
V. Living Things in Their Environment	**Adaptation**	This lesson describes the ways in which organisms are adapted to survive in their different habitats. Students will explore specific examples of how plants and animals are adapted to daily and seasonal changes in their habitats.
	Food Chains	This lesson describes terminology and concepts associated with food chains. Students will learn how energy is transferred through food chains, how food chains can be quantified using pyramids of numbers, and how toxic substances can accumulate in food chains.
	Food Webs	This lesson builds on the Food Chain lesson by describing how several food chains can be combined to make a food web. Students will learn how to interpret a food web diagram, learn the terminology for food webs, and explore how changes in the population of a single organism in a food web can affect other organisms.
	Habitats	This lesson describes how a habitat supports a diversity of plants and animals. Students will explore the unique features and organisms of a variety of habitats. In the process, they will learn types of adaptations that help organisms survive in specific habitats.
	Survival	This lesson describes factors that affect the survival of organisms in an ecosystem. Students will learn about special adaptations and interactions organisms within ecosystems develop. They will also see how predator–prey relationships can influence the size of a population as well as the type of organisms that survive in a population.
	Sustainable Development	This lesson covers the topic of sustainable development. Students will see how human activities have caused some species to become endangered. Then they will then learn some of the ways in which living organisms and the environment can be protected. They will explore the principles of sustainable development and the value of low-energy homes.
VI. Grouping and Classifying Materials	**Compounds**	This lesson details how elements combine through chemical reactions to form compounds. Students will learn how compounds differ from elements and mixtures of substances. They will also learn the names and properties of some common compounds.
	Elements	This lesson describes the nature of elements. Students will learn that elements consist of atoms, which can be represented by symbols. They will also analyze how the periodic table organizes the elements.
	Mixtures	In this lesson, students will learn how mixtures are composed of parts that are not combined. They will learn the names and key properties of several mixtures. They will also learn how to distinguish mixtures from elements and compounds.
	Naming Compounds	This lesson details how compounds are represented by formulas. Students will learn how chemical reactions can be summarized using word equations. They will also learn how to use a formula to determine the number of atoms in a compound.
	Particle Theory	This lesson describes the particle theory of matter in basic terms. Students will learn to use particle theory to explain the properties of solids, liquids, and gases.
	Physical Changes	This lesson describes what is meant by the phrase, "changes of state." Students will learn how changes of state occur, and how they can be reversed. They will also learn how to explain gas pressure and diffusion.
	Properties of Metals	In this lesson, students will learn how to describe the appearance, state at room temperature, magnetic properties, and thermal and electric conductivities of metals. They will also learn other properties of metals, such as malleability and density.

CHAPTER	LESSON	DESCRIPTION
	Properties of Non-Metals	In this lesson students will learn how to describe the appearance, state at room temperature, magnetic properties, and thermal and electric conductivity of non-metals. They will also learn other properties of non-metals, such as strength and density.
	Separating Mixtures	This lesson explores several ways in which mixtures can be separated into their parts. Students will learn how distillation, filtration, evaporation, and chromatography can be used to separate different types of mixtures.
	Solids, Liquids, and Gases	This lesson explores the states of matter of solids, liquids, and gases. Students analyze the properties of each state, and learn how the particle theory explains the differences between the states. They also observe experiments to learn what happens when substances change from one state of matter to another.
VII. Changing Materials	**Chemical Reactions**	This lesson focuses on the roles of reactants and products in a chemical reaction. Students will learn that virtually all materials, including those in living systems, are formed by chemical reactions. They will also explore several different types of chemical reaction, and learn how some chemical reactions are useful to humans and others are harmful.
	Geological Changes	This lesson describes three ways in which the weathering of rock takes place: physical, chemical, and biological. Students will learn how the forces generated by expansion, contraction, and the freezing of water can cause weathering. They will also learn how gases dissolved in precipitation can break down rocks. Then they will see examples of how plants and animals can cause weathering, and learn the types of materials that make up soil.
	Physical Changes in Materials	This lesson describes how mass is conserved when physical changes take place. Students learn how a material's temperature changes as it is heated or cooled enough to melt, boil, condense, or freeze. Students will also learn what energy transfers occur during changes of state and how materials expand and contract as they change temperature.
	Rock Formation	In this lesson students will learn the processes by which igneous, sedimentary, and metamorphic rocks are formed. They will see how the mode of rock formation affects the texture and mineral content of the rock. They will also learn characteristics and examples of each type of rock. The lesson ends with a discussion of how rocks are commonly used for building and other purposes.
	Solutions	This lesson details what happens when one substance dissolves in another. Students will learn how solubility varies with temperature, what a saturated solution is, and the differences between the solubility of solutes in different solvents. They will also learn how solvents and solutes are used in everyday life.
	The Effects of Combustion	This lesson describes how fossil fuels form. Students will learn the effects of fossil fuels on the environment, including global warming and acid precipitation. They will also see how the amount of pollution from combustion can be reduced.
VIII. Patterns of Behavior	**Acid Reactions**	This lesson explains how acids react with metals, bases, and carbonates, and describes the products of these reactions. Students will also learn how acids can corrode metal and cause the chemical weathering of rocks.
	Acids and Bases	This lesson describes the properties of acids and bases. Students will learn how to use indicators and the pH scale to classify solutions as acidic, basic, or neutral. They will also learn everyday examples of acids and bases.
	Displacement Reactions	This lesson explains displacement reactions. Students will learn examples of displacement reactions between metals and solutions of a salt or another metal. They will also learn the order of metals in the reactivity series and how metals are extracted from their ores.

CHAPTER	LESSON	DESCRIPTION
	Neutralization	This lesson explains the process of neutralization. Students will learn how to make salts using a neutralization reaction and some everyday applications of neutralization.
	The Reactivity of Metals	This lesson describes the reactivity of metals with oxygen, water, and acids. Students will learn that substances are produced by these reactions. They will also learn how to name the products of these reactions.
IX. Electricity	**Electric Current**	This lesson explores how the current in a circuit depends on the number of cells and the number and nature of other components. Students will learn that current is not 'used up' by components. They will also see that the resistance of wires depends upon their material, length, and thickness.
	Electrical Circuits	This lesson begins by describing the source of static electricity. Then students learn how to measure current and voltage. They also explore how energy is transferred from batteries and other sources to the components in electric circuits. Students demonstrate their understanding by interpreting and drawing electric circuit diagrams.
	Electromagnets	This lesson describes how an electric current in a wire produces a magnetic field. Students will learn how electromagnets are constructed, and what factors affect their strength. They will also learn some uses of electromagnets, including electric bells, relay switches, and appliances.
	Magnets	In this lesson, students will learn what it means for an object to be magnetic. They will explore magnetic fields and how they affect magnetic materials. Students will also explore how magnets interact with each other.
	Series and Parallel Circuits	This lesson details how to design and construct series and parallel circuits. As students analyze and build circuits, they learn how current flows in different types of circuits and what causes a short circuit.
X. Forces and Motion	**Balanced and Unbalanced Forces**	In this lesson, students will learn how unbalanced forces change the speed or direction of motion of objects. They will also see that balanced forces do not cause a change in the motion of an object. Students will explore several examples of these balanced and unbalanced forces in action.
	Force and Rotation	This lesson shows how levers can make work easier. Students learn how forces cause objects to turn around the pivot of a lever. They then learn the three basic types of levers, how to draw force arrows on diagrams that show how levers work, and everyday examples of levers.
	Friction	This lesson describes how frictional forces such as air resistance affect motion. Students will learn how the balance between frictional forces affects the movement and direction of an object. They will explore the concepts using specific examples.
	Pressure	This lesson explores the concept of pressure. Students will learn the quantitative relationship between force, area, and pressure. They will then learn how to solve problems for force, area, or pressure. In addition, they will learn applications of increased and decreased pressure.
	Speed	This lesson describes how to determine the speed of a moving object. Students will learn how to use the triangular relationship between speed, distance, and time to solve problems. They will also learn units of speed and how to show speed data in graphical form.

CHAPTER	LESSON	DESCRIPTION
	Torque	This lesson introduces the principle of torque. Students will learn how to measure torque and balance torques. Advanced students will find opportunities for calculating torque.
	Weight	In this lesson, students will learn the difference between weight and mass. They will see how the weight of an object results from the gravitational attraction between the object and the Earth. Students will learn how to measure mass and weight. They will also explore how the weight of an object depends on its mass, the mass of the Earth, and how far the object is from the center of the Earth.
XI. Light and Sound	**Color**	This lesson describes how white light can be dispersed to give a range of colors. Students will learn how colored filters affect white light. They will also learn how to describe the appearance of colored objects in white light and other colors of light.
	Hearing	This lesson explains how sound travels and how sound is caused by vibration. Students will learn how sound causes the ear drum to vibrate and why different people have different audible ranges. They will also learn the effects of loud sounds on the ear.
	Light	In this lesson, students will learn that light traveling in a uniform medium moves in a straight line at a finite speed. They will observe the difference between opaque and transparent objects. They will also see what happens during eclipses of the sun and moon. They will learn the difference between the speed of light and sound, and consider how that difference affects our perception of events. They will also explore how we see objects.
	Reflection	This lesson helps students understand how mirrors work and how they are used. Students will learn what path light follows when it is reflected and how a periscope works. They will also learn to draw a reflection diagram, and describe how light is reflected off different types of surfaces.
	Refraction	This lesson explains that light travels at different speeds in different materials, depending on the density of the materials. Students will learn the principle of refraction: how a light ray bends when it passes from one medium to another. They will explore several examples of refraction and learn how to draw a refraction diagram.
	Sound	This lesson compares the ways in which sound and light travel, including their speeds. Students will learn how to explain the relationship between the loudness of a sound and the amplitude of the vibration causing it. They will also explain the relationship between the pitch of a sound and the frequency of vibration causing it.
XII. The Earth and Beyond	**Satellites**	This lesson focuses on satellites. Students will learn about the moon and other natural satellites of planets. Then they will explore artificial satellites and probes to learn about their various purposes and processes, including weather monitoring, communication and navigation, observation of the Earth, and observation of outer space.
	The Night Sky	This lesson explains why the sun and other stars are light sources. Students will learn how the planets and other bodies can be seen by reflected light in the night sky. They will also become familiar with some of the major constellations and the Horsehead Nebula.
	The Rotating Earth	This lesson describes how the movement of the Earth causes the apparent daily movement of the sun and stars. Students will learn how long it takes the Earth to orbit the sun. They will also explain the phenomena of the seasons.
	The Solar System	In this lesson students will learn how to describe the relative positions of the Earth, sun, and planets in the solar system. They will describe the movements of the planets around the sun and relate these to gravitational force. They will also learn to explain how the movement of the earth causes the apparent movement of other bodies.

CHAPTER	LESSON	DESCRIPTION
XIII. Energy Resources and Energy Transfer	**Energy Conservation**	This lesson explains what is meant by the conservation of energy. Students will learn how energy is always conserved, and how energy can be given out as useful energy and wasted energy.
	Energy Resources	This lesson covers different forms of energy resources. Students will learn how to describe a variety of energy resources, and classify them as renewable or non-renewable. They will also learn how to compare the strengths and weaknesses of different energy resources.
	Generating Electricity	This lesson describes how electricity is generated. Students will learn the differences between renewable and non-renewable energy sources in terms of electricity generation.
	Heat and Temperature	This lesson describes the difference between temperature and heat. Students will learn how differences in temperature can lead to the transfer of energy.
	The Sun's Energy	This lesson describes the sun's role as the ultimate source of most of the Earth's energy. Students will learn the sun's role in the formation of fossil fuels and explain how the sun's energy is transferred to renewable energy resources.
	Transfer of Energy	In this lesson, students will learn how energy can be transferred and stored. They will be able to describe how heat energy is transferred directly by radiation and indirectly by conduction, convection, and evaporation.

CHAPTER	LESSON	DESCRIPTION
I. Decimals, Integers, Factors, and Exponents	**Calculating with Decimals**	This lesson focuses on calculating with decimals. Students practice written calculations to add, subtract, and multiply decimals as well as to divide a decimal by both an integer and a decimal.
	Comparing and Ordering Decimals	This lesson focuses on comparing and ordering decimals. Students begin by identifying the greater or smaller decimal for length measurements. They then complete pairs of related inequality statements. Students then use number lines to compare, order, and plot both positive and negative decimals.
	Comparing Decimals	This lesson focuses on comparing and ordering decimals. Students name the place value of digits in both whole numbers and decimals. They also compare and order whole numbers and decimals, both with and without a number line.
	Converting Fractions to Repeating Decimals	This lesson focuses on converting fractions to repeating decimals. Students first convert fractions and mixed numbers to terminating decimals. They then work with writing fractions as non-terminating decimals and examine repeating periods of 1, 2, and more terms. Finally, students write some repeating decimals as fractions.
	Integers	This lesson introduces negative integers, using a number line. Students work with opposite integer pairs and practice adding and subtracting integers on a number line. They apply these skills in real-world applications such as finding water levels and bank balances.
	Multiplying and Dividing by 0.1 and 0.01	This lesson focuses on multiplying and dividing integers and decimals by 0.1 and 0.01. Students begin by reviewing powers of 10, including writing large and small numbers using powers of 10. They multiply and then divide integers by 0.1 and 0.01, followed by multiplying and dividing decimals by 0.1 and 0.01.
	Operations with Integers	This lesson focuses on adding, subtracting, multiplying, and dividing positive and negative integers. Students begin by adding integers on a number line. They then add larger 3- and 4-digit integers, and subtract negative integers by adding the opposite. Students then multiply and divide positive and negative integers and end the lesson by examining patterns for integer operations.
	Powers of Ten with Integer Exponents	This lesson focuses on powers of ten with integer exponents. Students translate between powers of ten written in exponential or decimal form and explore the meaning of a negative exponent of ten. They also multiply and divide powers of ten.
	Powers, Roots, and Scientific Notation	This lesson focuses on squares and square roots, and cubes and cube roots. Students use area to relate squares and square roots, and volume to relate cubes and cube roots. Students learn to recognize which numbers cannot be squared integers, and find cubes of negative integers. The lesson ends with an introduction to scientific notation.
	Prime Factorization, GCF, and LCM	This lesson focuses on finding the prime factorization for composite numbers, and using it to find the GCF, LCM, and LCD. Students begin by identifying prime and composite numbers. They find prime factorizations and write them in exponential form. Students then find the greatest common factor (GCF) and least common multiple (LCM) of two composite numbers. Students end the lesson by using the GCF to simplify fractions and to find the lowest common denominator (LCD) to write equivalent fractions.
	Prime Factorization, the GCF, and the LCD	This lesson focuses on prime factorization and the GCF and LCD. Students begin by distinguishing between prime and composite numbers. They then find the divisors and prime factorization of composite numbers. Next, they find the greatest common factor (GCF) of two or more numbers and the least common denominator (LCD) for two fractions. The lesson concludes by using factors to simplify fractions.

CHAPTER	LESSON	DESCRIPTION
	Rounding Decimals	This lesson focuses on rounding decimals. Student first round natural numbers before rounding decimals to the nearest integer and to the nearest tenth and hundredth place. They then write natural numbers in expanded form and as a sum of powers of 10. Students also write decimals in expanded form as a sum of negative powers of 10.
	Rounding Decimals and Accuracy	This lesson extends rounding decimals to any place value and examines the accuracy of rounding to different decimal places when compared to the actual value. Students first round decimals to a given number of decimal places. They then identify rounded numbers that are more and less accurate. Students end the lesson by identifying decimals that round to equivalent numbers.
	Rounding Numbers	This lesson focuses on rounding counting numbers and decimals. Students round numbers to the nearest ones, tens, hundreds, thousands, tenths, and hundredths place. Students conclude the lesson by examining the reasonableness of rounded numbers.
	Terminating and Repeating Decimals	This lesson focuses on terminating and repeating decimals. Students begin by using a calculator to convert fractions into decimals and identify if the decimals are terminating. Students then use long division to convert fractions and mixed numbers into terminating and then repeating decimals. They conclude the lesson by identifying whether a product of fractions is a terminating or repeating decimal.
	Triangular Numbers, Squares, and Square Roots	This lesson explores triangular numbers to introduce squares and square roots. Students begin with number patterns made of dots that form a square or a triangle to learn about perfect squares. Students then square integers and find the square roots of perfect square whole numbers.
II. Fractions, Ratios, Proportions, and Percents	**Adding and Subtracting Fractions**	This lesson focuses on adding and subtracting fractions or mixed numbers with unlike donominators. Students start by writing equivalent fractions using the least common denominator (LCD). They then add and subtract fractions, and extend their work to mixed numbers with unlike denominators. Finally, students solve real-world applications by adding and subtracting fractions or mixed numbers with unlike denominators.
	Applying Ratios and Proportions	This lesson focuses on applying ratios and proportions to solve real-world problems. Students first write ratios for recipe ingredients and for different currencies. They identify ratios of like and unlike units such as weight, time, length, and capacity, and find unit rates. Students also use cross multiplication to solve proportions and convert measurements.
	Exploring Fractions	The lesson explores the meaning of fractions including parts of a unit, as the quotient resulting from dividing two numbers, and as a place on a number line. Students practice the skills of identifying equivalent fractions on a number line and reducing fractions. Finally, students find equivalent fractions using a common denominator as preparation for adding fractions.
	Exploring Percent	This lesson relates percent to parts per hundred, and shows two methods for finding percent: rewriting a fraction so that the denominator is 100 or multiplying the fraction by 100%. Students find percent as a decimal by dividing the part by the whole and expressing the result as a percent. These skills are then applied to solve real-world problems.
	Fractions, Decimals, and Percents	This lesson focuses on fractions whose denominators are factors of 10, 100, or 1000. Students identify and rewrite equivalent fractions with a denominator that is a power of 10. They also order decimals and rewrite fractions and decimals as percents.

CHAPTER	LESSON	DESCRIPTION
	Multiplying and Dividing Integers by Fractions	This lesson focuses on multiplying and dividing integers by fractions or mixed numbers. Students start by multiplying fractions by integers in real-world context such as recipes. They then multiply mixed numbers by integers. Next, students relate division of integers by fractions to multiplication by the reciprocal of the fraction. They then divide both positive and negative integers by fractions, and then by mixed numbers.
	Operations Involving Fractions and Decimals	The lesson focuses on operations with fractions and decimals. Students add, subtract, multiply, and divide a fraction and a decimal. They then apply these skills to solve a real-world problem.
	Order of Operations	This lesson focuses on the order of operations. Students learn the order of operations systematically by extending the operations from addition and subtraction to include: multiplication, division, exponents, and finally parentheses. Students apply the order of operations to simplify number expressions that include natural numbers, decimals, and fractions.
	Percent Increase and Decrease	The lesson focuses on finding percent increase and percent decrease. Students apply the percent equation (percent times whole equals part) to various real-world problems including working with a percent greater than 100%. They find percent, sale price, discount, original price, and use these to find percent increase and decrease. Students also solve problems involving reading bar graphs and line graphs.
	Ratios and Proportions	This lesson focuses on ratios and proportions. Students write the ratio of two perimeters and of two parts of a line segment. They also write ratios for various mixtures. They end the lesson by finding three parts of a given number so that the parts are in specified ratios.
	Scale Drawings and Maps	This lesson explores scale drawings and maps. Students practice reading scale drawings and maps, and translate map distance into actual distance. They then make scale drawings and locate a position on a map from a description of actual distances. The lesson concludes with a comparison of two differently-sized copies of the same map.
	Solving Ratio and Proportion Applications	The lesson focuses on applying ratios and proportions to solve applications. Students begin by dividing a whole (such as a candy bar, amount of money, or group of people) into parts with given ratios. They then extend ratios to 3 and 4 terms, and use ratios to find percents. Next, students write and use proportions to solving real-world problems, including currency exchange.
III. Algebra: Expressions and Equations	**Exploring Quadratic Equations**	This lesson explores quadratic equations. Students begin by reviewing algebraic expressions, the commutative and associative properties, and the distributive property. They also review solving and checking simple linear equations. Students then practice evaluating expressions with exponents. Next, they look at quadratic equations that have no real roots and solve by inspection quadratic solutions with integer roots. The lesson ends by comparing a linear equation with a quadratic equation, and relating the quadratic equation as a representation of a quadratic function.
	Linear Equations and Their Graphs	The lesson examines linear equations in two variables and their graphs. Students begin by writing linear equations and learning the general form of the equation $y = ax + b$. Students see how a table of values for the two variables leads to graphing the equation as a straight line. They see the relationship between the coordinates of points on the graph of a straight line and the pairs of values that satisfy the equation of that line. Students also examine the equation and graph of horizontal and vertical lines. Finally, students identify equations of lines from their graphs.

CHAPTER	LESSON	DESCRIPTION
	Monomials and Combining Like Monomials	This lesson focuses on monomials and combining like term monomials. Students begin by identifying monomials and like monomial terms. They then combine like monomial terms and multiply monomials by integers. Students then work with the commutative property to add and multiply like monomials.
	Multiplying Linear Expressions	This lesson focuses on multiplying linear expressions or binomials. Students see several different methods to multiply two binomial expressions, including a mental method similar to FOIL. They also use area models for multiplying two binomials, similar to using algebra tiles. Students then solve quadratic equations (with a constant term of zero) by factoring out an x and setting each factor equal to zero. Students conclude the lesson by finding the Greatest Common Factor (GCF) of several numbers and of several algebraic expressions with exponents.
	Simplifying Algebraic Expressions	This lesson focuses on simplifying algebraic expressions. Students begin by factoring out the greatest common factor (GCF) in numeric and algebraic expressions. They then apply the Distributive Property to multiply algebraic expressions and combine like terms. Next, students add and subtract algebraic expressions. The lesson concludes with practice in identifying and combing like terms for algebraic expressions.
	Simplifying and Factoring Expressions	This lesson focuses on simplifying and factoring algebraic expressions. Students first identify and combine like terms for algebraic expressions with terms of that contain variables. They then identify and factor out the greatest common factor to rewrite a sum as the product of a common factor times an expression in parentheses. The lesson also applies the Multiplication Property of –1 to show the effect of removing or adding parentheses preceded by a negative sign.
	Solving Linear and Non-Linear Equations	This lesson focuses on solving linear and non-linear equations. Students begin by identifying equations as either linear or non-linear (quadratic or with the variable in the denominator), and determining whether they have no solution or more than one solution. Students apply several methods for solving equations with the variable on both sides, including one involving mental math and transposition. They then use two methods for solving linear equations that contain fractions. Students apply these skills to real-world problems.
	Solving Multi-Step Equations	This lesson focuses on writing and solving multi-step linear equations. Students first solve equations by collecting like terms and undoing the operations that have been done to the variable. Students solve equations that have the unknown on one side, and then with equations that have the variable on both sides. Finally, students solve equations with parentheses by apply the Distributive Property before simplifying and solving the equation as they have previously practiced. Students conclude the lesson by writing and solving multi-step equations to solve word problems.
	Substituting Values into Formulas	This lesson explores formulas and substituting values into formulas. Students apply a formula to find the area of convex polygons using the lattice points, or intersections. They apply the Pythagorean Theorem to find the hypotenuse of a right triangle, and use the results to find the perimeter of that triangle. Students also use formulas for the area of a triangle, and the perimeter and area of a rectangle.
	Using Formulas and Exploring Binomials	This lesson focuses on using formulas including formulas for binomials. Students first convert temperatures between Centigrade and Fahrenheit measurements using formulas. They then use a formula for the square of binomials such as (a + b) or (a – b) and a formula for the difference of two squares.
	Writing an Equation to Solve Word Problems	This lesson focuses on writing equations to solve word problems. Students translate the facts in real-world problems by selecting a variable, stating what it represents, and choosing an equation that describes the relationship in the problem. The many different types of applications use skills in solving equations, using proportions and ratio, using percents, and apply the GCF and LCM.

CHAPTER	LESSON	DESCRIPTION
	Writing and Evaluating Algebraic Expressions	This lesson focuses on algebraic expressions. Students translate word phrases into algebraic expressions and represent real-world problems with algebraic expressions. They write multiplication expressions without using a multiplication symbol, and evaluate algebraic expressions by substituting values for the variables.
	Writing and Solving Equations	This lesson focuses on writing and solving linear equations with variables on both sides of the equation. Students write and solve equations for a variety of real-world situations starting with one-step and two-step equations before applications with the variable on both sides of the equation. Students also check their solutions.
	Writing and Solving Simple Equations	This lesson focuses on writing and solving simple equations in one variable. Students begin by identifying and writing equations that represent a balanced scale. They then solve one-step addition and subtraction equations, and check their solution. Students then solve one-step multiplication and division equations. The lesson ends with students using equations to solve application problems.
IV. Algebraic Relationships: Functions and Sequences	**Finding Terms and Sums of Sequences**	This lesson focuses on finding terms and sums of sequences expressed in tables. Students find terms in arithmetic and geometric sequences and compare them. They then find the nth term of an arithmetic and a geometric sequence and proceed to find partial sums for geometric sequences related to investments and interest.
	Formulas for Arithmetic Sequences	This lesson focuses on using formulas for the general term of an arithmetic sequence. Students begin by a finding the nth term of an arithmetic sequence. Next, they find n for both increasing and decreasing arithmetic sequences when they are given the value of the nth term. Students end with identifying the formula for the nth term of an arithmetic sequence when they are given a number sequence.
	Functions	This lesson introduces functions with mapping diagrams, tables, and function rules. Students read and make mapping diagrams for a variety of real-world situations. They read functions represented in tables and identify and use function rules described in words. Students translate between function representations of mapping diagrams, tables, and word rules.
	Generating Sequences from Rules	This lesson focuses on using the nth term of a sequence to generate terms of a sequence and finding first- and second-difference sequences. Students write terms of sequences from pictorial and word descriptions and by using a given formula for the nth term, including formulas with quadratic rules and with variables in the denominator. Students conclude the lesson by finding the first- and the second-difference sequence for a sequence with a quadratic rule.
	Graphing Linear Functions	This lesson focuses on graphing linear functions of the form y = ax, y = ax + b, and y = a. Students first complete tables and plot ordered pairs to graph linear functions. They then find and plot a convenient pair of points to graph linear functions. Next, students graph constant functions of the form y = a. The lesson concludes with students identifying linear functions from their graphs and identifying the general function rule for their graphs
	Graphs of Linear Functions	This lesson focuses on graphs of linear functions of the form y = ax, where a is positive. Students translate among tables, graph, and equations of linear functions of the form y = ax. For example, students find the equation of a linear function from its graph, and identify equations given two points and its graph. Students also relate the steepness of slope of a linear function to the value of the coefficient a in y = ax.

CHAPTER	LESSON	DESCRIPTION
	Inverse Linear Functions	This lesson focuses on finding inverse functions and their graphs. Students begin by using inverse operations to isolate the variable and solve an equation. They then find the input of a function that gives a certain output. Next, they identify the inverse function (reversing the mapping) for various linear functions, as well as finding the inverse of the general linear equation y = ax + b by exchanging the variables and solving for y. They proceed to identify and graph linear functions and their inverses on the same coordinate grid.
	Line and Distance vs Time Graphs	This lesson examines line graphs and, in particular, Distance vs. Time graphs. Students begin by examining how the various possible relationships between two variables are expressed in line graphs. They then make a line graph and make and interpret Distance vs. Time graphs for real-world situations. The lesson concludes comparing Distance vs. Time line graphs.
	Rules and Graphs of Linear Functions	This lesson focuses on linear function rules and graphs. Students begin by reviewing the meaning of a function, and that a function can be represented by a table, a graph, a formula, or in words. They then explore the relationship between a function and the coordinates of the points on its graph. They examine the effect of changing the value of a in y = ax, and look at the slope of a road defined as the change in y divided by the change in x. They observe the changes in the graph of y = ax + b as the values of a and b change and see what happens to the y-intercept and the slope. They end by making an observation about parallel lines.
	Sequences	This lesson introduces arithmetic and geometric sequences. Students begin by observing the patterns for various arithmetic sequences and geometric sequences, relating each to its rule, or equation. They examine increasing and decreasing patterns for both arithmetic and geometric sequences. The lesson concludes with the Fibonacci sequence and the Collatz problem, which is a sequence that applies two different rules, one for even numbers and one for odd numbers.
	Sequences with Term Numbers	This lesson focuses on sequences with explicit term numbers. Students practice identifying term numbers and relating each to its matching term of a sequence. Students construct some basic sequences, extend sequences, and find non-sequential terms.
	Solving Applications with Linear Functions	This lesson focuses on linear functions and their graphs in real-world situations. Students begin by identifying graphs of linear functions and and relating the equation form y = mx + b with the slope and y-intercept. Students then solve a wide variety of real-world applications that involve the equation of a linear function, linear graphs, and particular x- and y-values of a function.
	The nth Term of an Arithmetic Sequence	This lesson focuses on the nth term of an arithmetic sequence. Given the gereral formula for an arithmetic sequence, students find the value for specified terms. They then identify the first five terms for a sequence given the general formula and given pictorial representations. Students conclude the lesson by finding the formula for a given arithmetic sequence.
	Working with Variables	The lesson examines letter variables in expressions, equations, formulas, and function rules. Students evaluate expressions for values of the variables, and solve equations for the variable. They then substitute values for variables in formulas, and rewrite formulas by solving them for one of their variables. The lesson concludes with substituting into a function rule to make a table.
	Writing Real-World Functions	This lesson focuses on writing linear functions for real-world situations. Students begin by using function notation to identify a function from a word description. Next, they write functions for equations. Students then identify the independent variable in a word description and exchange the dependent and independent variables to write a new function. Students conclude the lesson by relating a linear function rule to its graph, and reading information from a graph.

CHAPTER	LESSON	DESCRIPTION
V. Geometry	**Angles and Angles in Polygons**	This lesson focuses on acute, obtuse, and reflex angles, and the sum of the interior angles of polygons. Students begin by naming and visually estimating angle measures. They then compare angle measures and use multiples of 45˚ and 60˚ angles to build polygons. Students conclude the lesson by applying the sum of the interior angle measures of a quadrilateral and then the sum of angle measures of a polygon to find unknown angle measures.
	Angles Formed by Two Lines and a Transversal	This lesson focuses on the angles formed by a transversal intersecting two lines. Students name the various pairs of angles formed by a transversal including: corresponding angles, alternate angles, and interior and exterior angles. Student learn the angle measure relationships when the two lines are parallel and apply them find missing angle measures. Students conclude the lesson by examining the converse relationship, where knowing about a pair of angle measures implies that the lines forming the angles are indeed parallel.
	Angles in Triangles	This lesson focuses on angles in triangles. Students find missing angle measures for vertical, supplementary, corresponding, and alternate interior angles. They then apply the sum of the angle measures of a triangle to equilateral, isosceles, and right triangles. Next, students extend the sum of angle measures of a triangle to quadrilaterals. Lastly, they examine the measure of an exterior angle of a triangle.
	Angles in Triangles and Polygons	This lesson focuses on angle measures in triangles, quadrilaterals, and other polygons. Students begin by applying the sum of the angle measures in a triangle and in a quadrilateral to finding missing angle measures. They then apply the property that the largest angle lies opposite the largest side to find angle measures in triangles. Students also apply property about equilateral and right triangles as well as parallelograms and trapezoids to find missing angle measures. The lessons concludes with students finding the sum of the interior angle measures for various polygons.
	Circles and Inscribed Polygons	This lesson examines circles and inscribed polygons. Students first work with the vocabulary associated with circles including radius, chord, diameter, center, and minor and major circular arcs. They draw a square, hexagon, and triangle inscribed in a circle. Students conclude the lesson by finding the missing measures for various parts of figures that involve circles.
	Constructions Based on Angles	This lesson focuses on constructions made with a straightedge and compass that involve angle measures. Students begin by constructing a square and a rectangle. They then find the center of a given circle, bisect a given angle, and construct an angle congruent to a given angle. They conclude the lesson by constructing a rhombus given one side and an angle.
	Exploring Two-Dimensional Figures	This lesson explores two - dimensional or plane figures. Students name and identify polygons including squares, triangles, rhombuses, rectangles, trapezoids, and kites. They identify properties of specific polygons such as regular polygons and parallelograms. The lesson concludes by examining circles and ellipses.
	Identifying Congruent Triangles	This lesson focuses on congruent triangles. Students use properties of angles to find missing side lengths and angle measures in various figures such as isosceles and equilateral triangles. They then identify by observation pairs of congruent figures. Students then apply the SSS, SAS, and ASA theorems to identify congruent triangles.
	Interior and Exterior Angles in Polygons	This lesson focuses on angles in polygons. Students identify interior and exterior angles for triangles and other polygons. They then derive the formulas for the sums of the interior angles and the sum of the exterior angles of an n-sided polygon. Students conclude the lesson by matching descritpions of polygons with their names.

CHAPTER	LESSON	DESCRIPTION
	Lines, Angles, Circles, and Disks	This lesson focuses on lines, angles, circles, and disks. The lesson begins with the basic elements of geometry: lines, rays, and line segments. Students then study angles and classify them by their measure. They also use a protractor to measure and draw angles of various measures. Finally, students contrast circles with disks.
	Parallel Lines, Perpendicular Lines, and Angle Measures	This lesson focuses on parallel and perpendicular lines, and angle measures on a line and about a point. Students learn to identify and draw parallel and perpendicular lines. They then find the shortest distance between a line and a point. Students identify and apply straight angles, vertical angles, and angles around a point to find missing angle measures. Finally, students examine the sum of the angle measures in a triangle.
	Properties of Polygons	This lesson focuses on polygons and their properties. Students begin by classifying and drawing triangles by side length and angle measures. They examine whether it is possible to build a triangle of given side lengths. Next, students examine quadrilaterals including squares, rectangles, rhombuses, trapezoids, and kites. Students differentiate between regular and irregular polygons and recognize polygons with reflectional and rotational symmetry.
	Straightedge-and-Compass Constructions	This lesson is about constructions make using only a straightedge and compass. Students learn to construct an isosceles triangle, an equilateral triangle, the perpendicular bisector of a line segment, and a line perpendicular or parallel to a given line.
	Symmetry and Congruence	This lesson focuses on symmetry and congruence. Students examine line symmetry for two triangles on a coordinate grid, and draw the reflection of a triangle with respect to a given line of symmetry on plain paper. They examine point symmetry and identify pairs of figures symmetric with respect to a given point. Students conclude the lesson by drawing a polygon that is congruent to one that is given.
VI. Coordinate and Solid (3-D) Geometry	**Combining Transformations**	This lesson focuses on combined transformations. Students review transformations including translations, reflections, and rotations. They then examine equivalent transformations and proceed to combine reflections across parallel lines. They also combine point and line refelections, and reflections and rotations. Students conclude the lesson by apply these concepts to frieze patterns.
	Enlarging a Shape	This lesson focuses on enlargements of a shape. Students identify and use scale factors. They then enlarge a shape relative to a point called the center of enlargement. Students practice making enlargements on plain paper and a coordinate grid.
	Exploring Shapes Built from Cubes	The lesson explores building shapes from a given number of cubes. Students construct side and front views (or elevations) of various shapes built with cubes, as well as constructing the shape given various views. They also determine the number of cubes used to build a shape. They find the number of interior cubes for a large cube built of small ones by counting the cubes with no painted surfaces. Students end the lesson by building a shape with cubes from written directions.
	Faces and Edges of Polyhedrons	This lesson focuses on polyhedrons. Students begin with the definitions of face, vertex, and edge. They then work with nets, the parallel and perpendicular faces, and parallel and perpendicular edges for various prisms.
	Introducing Vectors	This lesson introduces vectors. Students begin by moving a point horizontally and vertically on a coordinate grid. They then use a line segment and arrowhead to represent a distance and direction on a coordinate grid. Next, students describe displacements on a coordinate grid using column vectors expressed in matrix notation. They conclude the lesson by adding vectors graphically to find the ending point of a mouse's journey.

CHAPTER	LESSON	DESCRIPTION
	Position and Coordinate Systems	This lesson uses real-world examples to introduce the location of points in a coordinate system. Students name points on a grid and locate the position of a named point in all four quadrants of the coordinate plane, including points described with fractions and decimals.
	Prisms	This lesson focuses on prisms. Students match three-dimensional, or space figures, to complete a cube, and examine how a box is deconstructed to make its net. They rotate space figures to match a given view, and experiment with different nets for cubes. Students sort shapes into prisms and non-prisms, and match a solid with its net. They conclude the lesson by drawing a 3-D figure in a 2-D representation using graph paper.
	The Cartesian Coordinate System	This lesson explores the Cartesian coordinate system. Students begin by naming the location of points with an ordered pair and plotting points. They see and apply the formula for finding the midpoint of a segment using the coordinates of its two endpoints. Students also learn the equation of a vertical and horizontal lines, and how its corresponding inequality is graphed as a shaded region. The lesson concludes with identifying graphs of the intersection of a horizontal and vertical inequalities.
	Three-Dimensional Figures	This lesson introduces three-dimensional figures including cubes, right rectangular prisms, and pyramids, and discusses faces, edges, and vertices for these figures. Students draw various figures on isometric graph paper. They also use front, side, and top views to identify and draw figures, as well as nets for different space figures, such as prisms, pyramids, and cylinders. The lesson ends with traces of a space figure--the two-dimensional figures that represent the various faces of the three-dimensional figure.
	Transformations	This lesson focuses on transformations of points and figures including reflections rotations, translations, and combined transformations. Students begin with mirror symmetry and identifying lines of symmetry. They then reflect points and figures, and play a symmetry game. Next, students rotate points and figures about a center of rotation in a grid. Finally, they perform translations of points and combine multiple transformations.
	Transformations of Figures	This lesson focuses on transformations of 2-D figures including translations, reflections, and rotatations. Students first transform polygons using translations and reflections. They then transform 2-D figures using rotations about a point, and see that a single transformation can sometimes replace two or more transformations. Students then identify equivalent and combined transformations. They conclude the lesson by enlarging a polygon using a scale factor and a center point.
	Using Technology to Draw Shapes	This lesson is about using technology to draw and change shapes. Students use a computer drawing program called LOGO to draw various shapes. Students then use a graphing calculator to specify the coordinates of the points of a figure. They use this method to translate polygons on a grid by adding to the coordinates in the list. They can also enlarge a figure by multiplying the coordinates.
VII. Perimeter, Area, and Volume	**Areas of Polygons**	This lesson focuses on the area of polygons. Students reviews finding the area of rectangles and extends this to finding the area of any parallelogram. They then draw parallelograms and find the side lengths given information about the area. Next, students find the area of irregular figures that can be divided into parallelograms. They then solve triangle area problems and calculate the areas of various polygons including trapezoids.
	Circles: Circumference, Diameter, and Pi	This lesson focuses on circles and the number pi. Student finds the perimeter of squares and regular hexagons both inscribed in and circumscribed about a circle. They then use the radius and diameter to show that the circumference of a circle is a little more than 3 times the diameter, thus deriving an approximate value of pi. They then find that the ratio of circumference to diameter is always approximately 3.14. Students use an approximate value for pi (3.14) to calculate various measures for circles. They then solve real-world problems involving the distance traveled by a wheel and the perimeter of a slice of cake.

CHAPTER	LESSON	DESCRIPTION
	Circular Areas	This lesson focuses on finding the area of complex circular figures. Students begin by finding the area of a square both inscribed in and circumscribed about a circle to introduce the formula for the area of a circle. They then apply the formula, using approximate values for pi, to find the areas of various figures involving circles. Students then find exact values for areas of complex circular figures.
	Converting Metric Units of Area and Volume	This lesson focuses on area and volume, including metric conversions of area and volume. Student begin by finding areas of various polygons and converting between metric units of area. Students then find the volume of right rectangular prisms and convert between metric units of volume. The lessons ends with applications of these skills to solving real-world problems involving volume, rates, and ratios.
	Distance on Speed vs Time Graphs	This lesson focuses on finding distance from a Speed vs Time graph. Students first learn that distance can be represented as the area of a rectangle on a Speed vs Time graph. Students then examine variations on the Speed vs Time graph including holding each variable constant. In the last activity, students graph points for an inverse variation curve of a constant distance.
	Finding Surface Area and Volume	This lesson focuses on finding the surface area and volume of cubes and right rectangular prisms. Students find these measures in both the metric system and the customary system of measurement. They then solve real-world surface area and volume problems.
	Measuring Length and Area	This lesson focuses on measurements of length and area in both the customary and metric systems. Students begin by converting lengths within and between each measurement system. They then estimate lengths in each measurement system, and calculate and estimate areas.
	Metric Units of Length and Area	This lesson focuses on the metric units of length. Students first explore historical units of length. They then estimate metric lengths, identify appropriate units of length, and convert lengths within the metric system. The lesson also provides activities on identifying and converting metric units of area.
	Perimeter and Area	This lesson focuses on perimeter and area. Students find the perimeter of squares and other rectangles, and solve problems involving perimeters. They then find the areas of irregular figures, and of squares and rectangles.
	Solving Geometric Word Problems	This lesson focuses on solving geometric word problems. Students apply the vocabulary and properties of geometric figures to solve challenging geometric word problems involving length, area, and volume. The lesson carefully steps students through the thought processes and calculations involved in solving these multistep application problems.
	Surface Area	This lesson focuses on surface area. Students are introduced to surface area with the painting of walls. They then learn to calculate the surface area of cubes and rectangular solids by using nets and adding the area of each face of a solid. Students solve real-world applications involving surface area and end by finding the area of irregular solids.
	Surface Area and Volume of Prisms	The lesson focuses on the surface area and volume of prisms. Students begin by identifying prisms and right prisms. They then define regular prisms and use the formula for the volume of a right rectangular prism. Students also apply the formula for the surface area of a right prism, using information about its net.
	Using the Coordinate Plane to Solve Problems	This lesson explores using the coordinate plane to solve word problems. Students begin the lesson by finding the area of a triangle drawn on a coordinate grid. Then they compare the perimeters and then the areas of rectangles on a coordinate grid. Students then draw a line graph to show the distance, rate, and time relationship of a hiking trip, both uphill and downhill

CHAPTER	LESSON	DESCRIPTION
VIII. Analyzing and Displaying Data	**Comparing Two Sets of Data**	This lesson focuses on comparing two sets of data using measures of central tendency and range. Students begin by comparing means in a double bar graph, and finding measures of central tendency for two groups of students from bar graphs. They also compare the two sets of data using the range. Students draw a double bar graph and compare the mean and range for two sets of data.
	Displaying Data with Graphs	This lesson focuses on graphical representations of data. Students begin by distinguishing between frequency tables and relative frequency tables, and between quantitative and qualitative data. Students then use data in frequency tables to make bar graphs, circle graphs, line graphs, and scatter plots.
	Frequency and Relative Frequency	This lesson focuses on frequency and relative frequency. Students first record data in lists. They then organize the data by grouping it into frequency tables. Next, students use a frequency table to find the relative frequency as a fraction and use the results to answer questions and draw conclusions.
	Mean, Median, Mode, and Range	This lesson focuses on finding the mean, median, mode, and range for a set of data. Students begin by creating frequency charts for real-world applications. They then find the arithmetic mean, median, mode, and range, for given sets of data.
	Measures of Central Tendency	This lesson focuses on measures of central tendency. Students find the median and mode for real-world applications, reading from a table of results from several throws of a number cube, and from a bar graph of temperatures. They then find the mode, arithmetic mean, and median for other real-world applications.
	More on Mean, Median, Mode, and Range	This lesson focuses on finding the mean, median, mode, and range and using them to compare two sets of data. Students read data presented in circle and bar graphs, tables, and lists, and use the data to find the median, mean, mode, and range. They then compare these measures of central tendency and range for two sets of real-world data.
	Organizing Data	This lesson focuses on organizing data into tables. Students record given data in lists, and order the data into tables. They find frequency of results from tables, bar graphs, and circle graphs. Students also perform basic analysis of the data including finding relative frequency.
	Reading Graphs and Misleading Graphs	The lesson focuses on reading graphs and misleading graphs. Students examine how data can be visually represented with bar graphs, tables, pictograms, circle graphs, and line graphs. They then study how a bar graph can be misleading, and make an accurate bar graph. Students conclude the lesson by reading data from various line graphs.
	Reading Tables and Graphs	This lesson focuses on reading tables and graphs. Students read tables, diagrams, and graphs to answer questions about the real-world data, including identifying which questions cannot be answered by the given data. The lesson then presents an example of the process of gathering data, ordering it, and organizing the data into a meaningful format.
	Scatter Plots and Lines of Best Fit	This lesson focuses on scatter plots and lines of best fit. Students begin by making a line graph to examine data over time. They then identify scatter plots as having positive, negative, and no correlation. They work with lines of best fit, or trend lines, and study cautions about their use when making predictions. Student conclude the lesson by drawing a line of best fit using the mean values of the variables as one point, and estimating an appropriate line through this point.
	Secondary Data	This lesson contrasts primary data (that you collect) and secondary data (collected by other sources), and shows advantages and disadvantages associated with each kind of data. Students classify various sources of data, and evaluate the reliability of these sources. The lesson concludes with examples of combining secondary data from different sources.

CHAPTER	LESSON	DESCRIPTION
	Visualizing and Organizing Data	This lesson focuses on interpreting data presented in tables and graphs. Students examine tables and bar graphs to answer questions, make new tables by regrouping the data, and make graphs. Students also read and make double bar graphs and double line graphs.
	Working with Surveys and Survey Data	This lesson focuses on surveys and survey data. It begins with a problem, and then shows the process of finding the answer, including planning survey questions, collecting data, and drawing conclusions. Students work with four kinds of survey questions, and apply the process presented to a real-world situation.
IX. Probability	**Experimental and Theoretical Probability**	The lesson shows the meaning of relative frequency (or experimental probability) compared to the theoretical probability. Students calculate the experimental probability given various experimental results. They also recognize the differences between experiments with random outcomes and those that are not random. Student use relative frequency to estimate outcomes.
	Foundations of Probability	This lesson introduces probability. Students begin by identifying when a game can be won or lost. They then identify certain and impossible events. Students learn to identify equally likely events and find all the possible outcomes for various events. Finally, student find the favorable outcomes for an event and briefly touch upon the probability of an event.
	Probability of Events and Their Complements	This lesson explores the probability of events and their complements. Students begin by recording the outcome of two simple events using an ordered pair of numbers. They identify the sample space of all possible outcomes for various random experiments using this notation. Students explore sampling with and without replacement, and identify sets of favorable outcomes and their complement, or opposite.
	Probability of Simple Events	This lesson focuses on the probability of simple events. Students find probabilities for various events that involve random devices, such as number cubes, playing cards, and spinners. They are introduced to selecting items without replacement and find probabilities for these events.
	Probability With and Without Replacements	This lesson investigates sampling with and without replacement to find probabilities. Students use the definition of probability to find the probability of a given outcome in various real-world situations including games with number cubes. They find probabilities for events involving selecting items with replacement and without replacement. Students conclude the lesson with an informal introduction to the fundamental counting principle.
	The Language of Probability	This lesson focuses on the language associated with probability. Students examine various examples to clarify an event, an event whose outcome is certain, an outcome that is impossible, a random experiment, and the sample space.
X. Problem Solving	**Money Math Using Euros**	This lesson focuses on money calculations that a visitor to Europe might make. Student use euros to calculate and compare the cost of items by addition, subtraction, and multiplication. Students also calculate earnings in euros for various pay rates.
	Solving Distance, Rate, and Time Problems	This lesson focuses on solving distance, rate, and time word problems. Students begin by finding the rate needed to travel a certain distance in a specific amount of time. They then solve problems to find the distance traveled for a known rate and time. Finally, students find the time required for a trip of known speed and time.
	Solving Problems Step by Step	The lesson focuses on problem solving. Student first replace key words with mathematical symbols, and then factor and compare whole numbers. Throughout the lesson students solve real-world applications involving distance, rate, and time, as well as finding percent increase and decrease.

CHAPTER	LESSON	DESCRIPTION
	Solving Word Problems	This lesson focuses on solving word problems that ask 'how many' or 'how much.' Student practice solving a variety of real-world problems that include multiplication, divisibility, percents, and counting principles. Students conclude by solving multistep problems.
	Using Visual Aids to Solve Problems	This lesson focuses on solving visual problems involving geometric figures and graphs. Students begin by dividing squares and circles into equal parts. They then solve word problems involving circles. Students then read bar graphs and make and interpret line graphs.
	Work, Rate, and Divisibility Problems	This lesson focuses on multistep problems involving rate, time, and amount of work completed. Students solve many real-world problem that involve multiple operations, including filling a container, finding distance and portions, and a calendar problem.
XI. Mental, Written, and Calculator Computations	**Doing Arithmetic Using Written Skills**	The lesson focuses on written methods for arithmetic computations with natural numbers. Students see the intermediate steps for extensive addition, subtraction, multiplication and division problems. The apply the 'pencil and paper' methods to solve real-world applications.
	Fractions, Decimals, and Percents with Mental Math	This lesson focuses on mental math computations with fractions, decimals, and percents. Students begin by reviewing multiplication facts. They then mentally add or subtract fractions with numerators of one. Students then combine fractions with the same denominator or the same numerator. They conclude the lesson by applying mental math strategies to real-world problems involving decimals and percent.
	Solving Applied Problems with a Calculator	This lesson focuses on real-world applications that are solved using a calculator. Studetns first solve problems involving percents, percents of numbers, and percent increase. Students then use a calculator with parentheses to solve cost, mixture, and volume problems.
	Solving Arithmetic Problems with a Calculator	This lesson shows how to use a calculator to solve real-world problems. Applications involving adding, subtracting, multiplying, and dividing natural numbers and decimals. For example, students find the costs associated with various travel situations.
	Solving Arithmetic Problems with Writing	This lesson focuses on written calculations. Students begin with some practice in mental math and then extend calculations with counting numbers to adding, subtracting, multiplying, and dividing whole numbers greater than 100, as well as to decimals.
	Using a Calculator with Parentheses	This lesson focuses on using calculators . Students examine how to use a calculator to solve real-world applications for money and distance problems. They also work rounding answers to various decimal places and use the parentheses and square root keys.

CHAPTER	LESSON	DESCRIPTION
I. Numbers (1)	**Integers**	At the end of this activity, students should be able to: understand and use negative integers, order integers, use basic operations on integers, round large integers to the nearest given power of 10.
	Divisibility	At the end of this activity, students should be able to: understand the division of integers, know the notions of the quotient and the remainder, and how to use them, know how to recognize prime, composite numbers and relatively prime numbers , know how to find the highest common factor of two integers, know how to find the least common multiple of two integers.
	Prime Factorization	At the end of this activity, students should be able to decompose a positive integer into prime factors and use prime factor decomposition to determine the greatest common factor and the least common multiple of two positive integers
	Fractions	At the end of this activity, students should be able to recognize and name fractions, reduce a fraction to lowest terms, compare fractions and find a fraction of a number.
	Operations on Fractions	At the end of this activity, students should be able to: multiply fractions, add and subtract fractions, divide fractions, use the notion of the reciprocal of a rational number, use the properties of operations on rational numbers.
	Decimals	At the end of this activity, students should be able to: apply arithmetic operations to decimals, round decimals to a given number of significant figures or decimal places.
	Decimals and Fractions	At the end of this activity, students should be able to: recognize terminating, recurring and non-recurring decimals, convert terminating and recurring decimals to fractions, convert a fraction to a decimal.
	General Division	At the end of this activity, students should be able to: divide any two rational numbers, use long division with decimals.
	Powers and Roots	At the end of this activity, students should be able to: represent multiplication as a power, understand and use square and cube roots and apply properties of exponents in calculations (for integer indices).
	Scientific Notation	At the end of this activity, students should be able to: represent a number in scientific notation, use scientific notation in computations.
	Use of a Calculator	At the end of this activity, students should be able to perform arithmetic operations, apply the division algorithm, find the prime factorization of a natural number, approximate certain irrational numbers and better understand the standard form.
II. Geometry and Transformations	**Triangles**	At the end of this activity, students should be able to: recognize adjacent, supplementary, vertical, alternate, corresponding, straight and full angles, calculate the measures of the above angles, given one or two of them, use the theorem on the angle sum of a triangle, define an exterior angle in a triangle and compute it, calculate angles in a triangle, given two of its angles, one of its angles etc.
	Congruence of Triangles	At the end of this activity, students should be able to recognize congruent figures and understand and use congruence conditions for triangles: SAS, ASA, SSS.

CHAPTER	LESSON	DESCRIPTION
	Quadrilaterals and Their Properties	At the end of this activity, students should be able to understand and be able to precisely describe types of quadrilaterals, know and be able to apply the theorem on the angle sum in a quadrilateral and understand what the exterior angle of a quadrilateral is.
	Polygons and Regular Polygons	At the end of this activity, students should be able to: understand what irregular and regular polygons are, calculate the number of diagonals in a polygon, calculate the sum of the angles in a polygon, calculate the sum of the exterior angles of a convex polygon, calculate the central angle in a regular polygon, calculate the interior and the exterior angles of a regular polygon, draw regular n-gons.
	Coordinates	At the end of this activity, students should be able to place numbers in their correct places on the number line, understand the coordinates of points on the plane, place points with given coordinates in the correct places on the plane, find equations of horizontal and vertical lines on the plane, understand what the coordinates of a point in 3-dimensional space mean and find equations of planes parallel to the planes x = 0, y = 0 and z = 0.
	Symmetry	At the end of this activity, students should be able to find images of figures under reflection, find coordinates of figures under reflection in the axes, find coordinates of figures under reflection in the line x = a and the line y = b, find coordinates of figures under reflection in the line x = y and the line y = −x, find images of figures under symmetry and find coordinates of figures under symmetry with respect to the origin.
	Translations, Reflections, Rotations	At the end of this activity, students should be able to draw images of figures under translations, rotations and reflections, find a vector of a translation given in the coordinate system, know and use properties of translations, know and use properties of rotations and know and use properties of reflections.
	Dilations	At the end of this activity, students should be able to draw images of figures under enlargement with respect to a given point and using a given scale, find the centre point of an enlargement, find the scale of an enlargement, know and use properties of enlargements, know how the area of a given figure is changed after enlargement and know how the volume of a given solid is changed after enlargement.
	Similarity	At the end of this activity, students should be able to recognize similar figures, know when two polygons are similar, know when two triangles are similar (SSS, AA, SAS) and know the ratio of the areas of two similar figures.
	Similarity - Solving Problems	At the end of this activity, students should be able to: use similarity of triangles in solving problems, recognize proportions when an angle is cut by two parallel lines, find line segments on the arms of an angle cut by two parallel lines.
III. Algebraic Expressions	**Algebraic Expressions**	At the end of this activity, students should be able to: form algebraic expressions, calculate their values, simplify like terms, simplify algebraic expressions, name algebraic expressions.
	Using the Distributive Property	At the end of this activity, students should be able to: multiply out brackets of the form a(b + c), multiply out brackets of the form a(b + c + d), multiply out brackets of the form (a + b)(c + d), multiply out brackets of the form (a + b)(c + d)(e + f), deal with the negative sign in expressions.
	Special Products	At the end of this activity, students should be able to: use special formulas for squaring binomials, use the formula for the difference of squares, recognise and use the formulas in different calculations.

CHAPTER	LESSON	DESCRIPTION
	Factoring by Grouping	At the end of this activity, students should be able to: reverse the process of multiplying out the brackets, factorise an expression by taking out the common factor, factorise an expression by grouping.
	Factoring by Other Methods	At the end of this activity, students should be able to: factorize binomials by using the difference of squares, factorize trinomials by algebraic manipulation.
	More Factoring	At the end of this activity, students should be able to: factorise trinomials by algebraic manipulation.
IV. Algebraic Fractions	**Solving Equations Involving Algebraic Fractions**	At the end of this activity, students should be able to simplify algebraic fractions, operate on algebraic fractions and solve simple rational equations.
	Solving a Formula for a Specified Variable	At the end of this activity, students should be able to: rearrange different formulas, make a variable the subject of the formula.
V. Reasoning	**Mathematical Statements**	At the end of this activity, students should be able to: recognise mathematical statements in the form of a theorem, recognise the assumption and the claim of a theorem, understand the role of a proof and of a counterexample in mathematical reasoning, construct counterexamples to simple false statements.
	Deductive Reasoning	At the end of this activity, students should be able to: use short deductions to build a proof, verify deductions.
	Understanding the Theorem	At the end of this activity, students should be able to: recognize the difference between a proof and a demonstration, construct a proof based on a demonstration.
	Problem Solving	At the end of this activity, students should be able to: discover a property upon observation and trials, find a (short) proof of a given simple property, recognize incorrect steps in reasoning.
	Problem Assumptions	At the end of this activity, students should be able to: understand the significance of theorem assumptions, check the necessity of assumptions.
VI. Sets	**Sets**	At the end of this activity, students should be able to: understand the notion of a set, identify particular sets (either by a list of elements or by a formula), perform operations on sets: sum, intersection and difference, apply the operations to solve simple problems.
VII. Handling Data	**Problem Specification**	At the end of this activity, students should be able to: identify variables and cases, distinguish different types of data, design experiments.
	Sampling	At the end of this activity, students should be able to: construct a good questionnaire, identify a source of bias in the data, choose an appropriate sampling method, draw the sampling units using different sampling methods.
	Representing Data	At the end of this activity, students should be able to: draw dot plots, identify categorical, ordinal, discrete and continuous variables, construct stemplots and back-to-back stemplots, join the stems in a stemplot, construct frequency tables, describe class intervals in a frequency table, draw histograms, read the frequencies from a histogram, draw frequency polygons and frequency density polygons, calculate frequency density and frequency density histograms.

CHAPTER	LESSON	DESCRIPTION
	Measures of Central Tendency - the Arithmetic Mean	At the end of this activity, students should be able to: understand the mean as an indicator of fair allocation, understand the mean as the 'balancing point' of a data set, calculate the arithmetic mean for raw data, calculate the weighted mean, calculate the arithmetic mean for data in frequency tables, calculate the arithmetic mean for scaled data, calculate the arithmetic mean for combinations of sets of data.
	Measures of Central Tendency - the Mode, the Median	At the end of this activity, students should be able to find the mode of raw data, find the mode of grouped data, check multimodality of data, find the median of raw data, find the median in a stemplot, understand the difference between arithmetic mean and median and find the median in transformed data.
	Measures of Variability (1)	At the end of this activity, students should be able to: use different measures of data variability, calculate the standard deviation and variance.
	Measures of Variability (2)	At the end of this activity, students should be able to construct the five-number summary and draw a box plot- detect an outlier in data.
	Cumulative Frequency Curve	At the end of this activity, students should be able to: draw the cumulative frequency curve (polygon), draw the cumulative percentage frequency curve (polygon). -estimate the median and the quartiles for grouped data.
	Skewness	At the end of this activity, students should be able to investigate skewness of data and calculate different measures of skewness.
	Case Study (1)	At the end of this activity, students should be able to apply the measures of central tendency in real-life situations.
	Case Study (2)	At the end of this activity, students should be able to apply statistical tools to real-life data.
VIII. Geometry - Pythagorean Theorem	**Pythagorean Theorem**	At the end of this activity, students should be able to: understand and use the Pythagorean formula for right triangles, calculate the unknown side in a right triangle, apply the Pythagorean theorem to real-world problems, recognise Pythagorean triples - use the converse of the Pythagorean theorem to recognise right triangles.
	Application of the Pythagorean Theorem in 2-D	At the end of this activity, students should be able to: find the diagonal of a square, find the height of an equilateral triangle, find the area of an equilateral triangle, find the area of a square, given the diagonal, use the Pythagorean theorem to solve real-world problems, find the radii of inscribed and circumscribed circles about an equilateral triangle, find the distance between two points in a coordinate system.
	Application of the Pythagorean Theorem in 3-D	At the end of this activity, students should be able to find the diagonals of cubes and cuboids, use the Pythagorean theorem to calculate segments in solids and find the distance between points in the 3-dimensional coordinate system.
	Compass-and-Straightedge Constructions (1)	At the end of this activity, students should be able to construct a perpendicular bisector of a segment, construct a perpendicular to a given line through a point on the line, construct a perpendicular to a given line through a point off the line, construct a line parallel to a given line, construct the bisector of an angle and use the basic constructions to construct more complex configurations.
	Compass-and-Straightedge Constructions (2)	At the end of this activity, students should be able to solve simple problems related to loci and constructions, construct an equilateral triangle, a square, a regular pentagon, a regular hexagon, a regular octagon and decagon and construct some simple loci.

CHAPTER	LESSON	DESCRIPTION
IX. The Circle	**The Circle**	At the end of this activity, students should be able to: recognise parts of a circle: centre, radius, circumference, arc, chord, diameter, sector, segment, calculate the length of an arc, calculate the area of a sector, relate the area of a segment to the area of a sector and of a triangle, understand the notion of tangent and construct a tangent at a given point, understand the notion of a common tangent.
	Circle Theorems	At the end of this activity, students should be able to: solve problems using properties of tangents, solve problems using chord bisection by a perpendicular radius.
	Inscribed and Central Angles	At the end of this activity, students should be able to: recognize inscribed and central angles, explain the relation between inscribed and central angles on the same arc, calculate the area of a sector, recognize cyclic quadrilaterals.
	Equation of a Circle	At the end of this activity, students should be able to: write the equation of a circle with centre at the origin and at an arbitrary point, determine the centre and the radius of a circle, solve problems involving the equation of the circle.
	Mutual Position of Two Circles	At the end of this activity, students should be able to: recognise the mutual position of two circles, find the mutual position of two circles in the coordinate system, solve problems involving circles.
	Mutual Position of a Line and a Circle	At the end of this activity, students should be able to: recognise the mutual position of a circle and a line, write an equation of a tangent in simple cases.
	Circles Inscribed and Circumscribed	At the end of this activity, students should be able to: understand the notions of inscribed and circumscribed circles, construct a circle inscribed into a triangle or quadrilateral, construct a circle circumscribed about a triangle or quadrilateral, recognise quadrilaterals that have an incircle, recognise cyclic quadrilaterals.
	Solving Problems Involving Circles	At the end of this activity, students should be able to: solve various problems involving the circle and inscribed and central angles.
X. Percentages	**Solving Problems Involving Percentages**	At the end of this activity, students should be able to: find the scale factor of increase and decrease, find percentage change, find the value after consecutive percentage changes, find the percentage profit.
	Repeated Percentage Change	At the end of this activity, students should be able to: find the amount when percentage change is repeated, find the population, given the rate, find the price, given the inflation rate, find the accumulated amount, given the rate, find the equivalent rate and effective rate.
	Percentages	At the end of this activity, students should be able to: change a fraction into a percentage and vice versa, find the percentage of a value, express one number as a percentage of another, find the value, given a percentage of a number.
XI. Sequences	**Looking for the Pattern**	At the end of this activity, students should be able to: recognize patterns in number sequences, name the next term in a given simple sequence.
	Finding the nth Term of a Sequence	At the end of this activity, students should be able to: find term-to-term or position-to-term definition for a given sequence, find the nth term of a sequence given by term-to-term or position-to-term definition.

CHAPTER	LESSON	DESCRIPTION

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	Classical Concepts of Probability (1)	At the end of this activity, students should be able to: understand the notion of relative frequency, understand the notion of probability,use probability measures in simple situations.
	Classical Concepts of Probability (2)	At the end of this activity, students should be able to: distinguish experimental and subjective probability, understand classical probability, find classical probabilities in different probabilistic situations.
	The Set of Possible Outcomes	At the end of this activity, students should be able to: represent the possibility space in many several ways, choose equally likely elementary events, write up the outcomes of a compound experiment using a tree diagram and a possibility space diagram.
	Mutually Exclusive Events	At the end of this activity, students should be able to: recognize mutually exclusive events, use the sum formula for mutually exclusive events.
	Independent Events (1)	At the end of this activity, students should be able to: recognise independent events.
	Independent Events (2)	At the end of this activity, students should be able to: find the probability of two independent events occurring simultaneously, use the multiplication rule for independent events.
	Solving Probability Problems	At the end of this activity, students should be able to: use various methods to solve probabilistic problems.
XV. Graphs of Different Functions	**A Function and Its Graph**	At the end of this activity, students should be able to: plot the graph of a simple function, understand how the graph of a function is constructed.
	Equation of a Line	At the end of this activity, students should be able to: plot the graph of a line, find the gradient of a given straight line, find the gradient of a line perpendicular or parallel to a given straight line, read properties of a line from its general equation.
	Linear Functions	At the end of this activity, students should be able to: recognise linear functions, understand the role of coefficients of a linear function, construct the graph of a given linear function.
	Quadratic Functions (1)	At the end of this activity, students should be able to: recognise the graph of a quadratic function as a parabola, read properties of a quadratic function from its graph.
	Quadratic Functions (2)	At the end of this activity, students should be able to: sketch the graph of a given quadratic function, read properties of a quadratic function from its graph.
	Other Functions	At the end of this activity, students should be able to: recognise the graph of a reciprocal function, recognise the graph of the function y=x^3, construct and understand the graph of the function y=a^x for integer x and fixed positive integer a.
	Graphs and Real-World Situations	At the end of this activity, students should be able to: understand the behaviour of a function knowing its graph, read basic properties of a function from its graph, predict 'future values' of a function knowing part of its graph.
XVI. Measurement on the Plane and in Space	**Measuring (1)**	At the end of this activity, students should be able to use measures in daily use, use measurements to estimate length, angle and weight and understand and interpret approximate values of measures.

CHAPTER	LESSON	DESCRIPTION
	Measuring (2)	At the end of this activity, students should be able to use measures in daily use, use measurements to estimate length, angle, mass and speed and understand and interpret approximate values of measures.
	Areas of Plane Shapes (1)	At the end of this activity, students should be able to find the areas of polygons and other shapes made of triangles on the plane.
	Areas of Plane Shapes (2)	At the end of this activity, students should be able to find the area of shapes bounded by straight lines and arcs on the plane.
	Volume and Surface Area of Prisms	At the end of this activity, students should be able to understand the notion of volume, calculate the volume and the surface area of a given prism and apply the formula for the volume of a prism in real-world situations.
	Volume and Surface Area of Pyramids	At the end of this activity, students should be able to understand the notion of volume, calculate the volume and the surface area of a given pyramid and apply the formula for the volume of a pyramid in real life.
	Volume and Surface Area of Cylinders and Spheres	At the end of this activity, students should be able to calculate the volume and the surface area of cylinders and spheres, understand how the formulas for volume and surface area of a sphere were established and apply the formulas for volume and surface area of cylinders and spheres in real-life situations.
	Volume and Surface Area of Cones	At the end of this activity, students should be able to calculate the volume and the surface area of cones and frustums, construct a model of a cone and a frustum.
	Volumes of Similar Solids	At the end of this activity, students should be able to recognize similar solids and prove similarity and find the volume of a solid similar to a given solid.
XVII. Solving Equations	**Solving Linear Equations**	At the end of this activity, students should be able to understand the notion of a linear equation and solve linear equations in one variable.
	Solving Systems of Linear Equations Graphically	At the end of this activity, students should be able to mark the solution set of an equation on the plane, solve linear equations in two variables and solve simultaneous linear equations in two variables graphically.
	Solving Systems of Linear Equations Graphically and Algebraically	At the end of this activity, students should be able to solve simultaneous linear equations in two variables using graphical and algebraic methods.
	Solving Problems Involving Systems of Linear Equations	At the end of this activity, students should be able to use simultaneous linear equations to solve problems.
	Solving Quadratic Equations	At the end of this activity, students should be able to understand the notion of a quadratic equation, be able to solve quadratic equations.
	The Quadratic Formula	At the end of this activity, students should be able to understand the notion of the discriminant of a quadratic equation, find the number of real solutions of a quadratic equation without solving it and solve a quadratic equation by using the quadratic formula.

CHAPTER	LESSON	DESCRIPTION
	Solving Problems Involving Quadratic Equations (1)	At the end of this activity, students should be able to apply the quadratic formula in various situations and solve mathematical problems involving quadratic equations.
	Solving Problems Involving Quadratic Equations (2)	At the end of this activity, students should be able to apply the quadratic formula in different situations and solve real-life problems involving quadratic equations.
	Solving Polynomial Equations	At the end of this activity, students should be able to recognise polynomial equations, understand the notion of a solution of an arbitrary equation and understand the notion of an approximate solution of an equation.
	Approximating Solutions of Polynomial Equations	At the end of this activity, students should be able to find approximate solutions of equations, understand the bisection method and approximate roots of an equation up to a given accuracy.
XVIII. Inequalities	**Linear Inequalities**	At the end of this activity, students should be able to: understand the notion of inequality, solve linear inequalities in one variable, mark the solution set of an inequality on the number line.
	Systems of Linear Inequalities	At the end of this activity, students should be able to solve simultaneous linear inequalities in one variable, solve linear inequalities in two variables, solve simultaneous linear inequalities in two variables and mark the solution set on the plane.
XIX. Numbers (2)	**Powers, Roots and Rational Exponents**	At the end of this activity, students should be able to understand and calculate the nth root of a positive number, understand fractional indices and use index laws.
	Irrational Numbers	At the end of this activity, students should be able to understand and recognize irrational numbers, simplify expressions containing irrational numbers, rationalize denominators and approximate irrational numbers.
XX. Vectors	**Vectors**	At the end of this activity, students should be able to understand the notion of a vector.
	Operations on Vectors	At the end of this activity, students should be able to: add and subtract vectors graphically.
	Scalar Multiple	At the end of this activity, students should be able to know how to change the magnitude of a vector using a scalar multiple.
	Applications of Vectors	At the end of this activity, students should be able to understand applications of vectors in science problems and use vectors in simple science problems.
XXI. Correlation and Regression	**Sampling Techniques**	At the end of this activity, students should be able to: use simple, systematic and stratified sampling methods in choosing a random sample from a population.
	Regression Line	At the end of this activity, students should be able to find the line of best fit for a given set of data and estimate a future value.
	Correlation	At the end of this activity, students should be able to understand correlation as a measure of the relationship between two variables, recognize positive, negative and zero correlation, use Pearson's correlation coefficient to measure the strength of linear correlation and use Spearman's rank coefficient to measure correlation between two sets of data.
	Analyzing and Comparing Sets of Data	At the end of this activity, students should be able to: compare two sets of data using measures of central tendency, dispersion of data and compare two sets of data using diagrams.

CHAPTER	LESSON	DESCRIPTION
	Using Probability to Analyze Random Events	At the end of this activity, students should be able to: simulate a random sample for the given frequency, calculate the expectation of a population (population mean), and the population variance, calculate the expectation and variance of the sample mean.
XXII. Trigonometry (2)	**Trigonometric Equations (1)**	At the end of this activity, students should be able to solve simple trigonometric equations.
	Trigonometric Equations (2)	At the end of this activity, students should be able to solve simple trigonometric equations.
	The Sine Formula for the Area of a Triangle	At the end of this activity, students should be able to: use the sine formula for the area of a triangle in various problems.
	Solving Problems Involving Trigonometric Equations	At the end of this activity, students should be able to: solve real-life problems involving trigonometric equations.
	Pythagorean Theorem and Trigonometry in 3-D	At the end of this activity, students should be able to recognise the angles of elevation and depression, find the angle between the line and the plane, and the angle between two planes, apply the Pythagorean theorem and trigonometric ratios to find the volume and surface area of solids, apply the Pythagorean theorem and trigonometric ratios to find the measures of some angles in solids.
XXIII. Transformations of Graphs	**Transforming Graphs of Various Functions**	At the end of this activity, students should be able to: sketch a graph of a function given by a simple equation (linear or quadratic) involving absolute value, sketch the graph of a function $y = \|f(x)\|$ or $y = f(\|x\|)$, knowing the graph of the function $y = f(x)$.
	Transforming Graphs of Trigonometric Functions (1)	At the end of this activity, students should be able to: calculate the periods of modified trigonometric functions, sketch graphs of trigonometric functions with modified periods.
	Transforming Graphs of Trigonometric Functions (2)	At the end of this activity, students should be able to: draw graphs of trigonometric functions with modified period, amplitude and position, model periodic phenomena using trigonometric functions.
	Using Graphs (1)	At the end of this activity, students should be able to: solve equations graphically, solve systems of equations graphically.
	Using Graphs (2)	At the end of this activity, students should be able to: solve an inequality graphically, solve systems of inequalities graphically.
	Graphs of Simple Loci	At the end of this activity, students should be able to: construct graphs of simple loci, derive Cartesian equations of simple loci, find the intersection points of a circle and a straight line graphically and algebraically.
	Area Under a Curve	At the end of this activity, students should be able to: understand the relationship between distance and the velocity–time graph, approximate the area under a curve by rectangles, apply the trapezium rule to approximate the area under a curve.
	Tangents to Graphs	At the end of this activity, students should be able to: understand the notion of a tangent to a curve at a point, write the equation of a tangent from a graph, understand the notion of the gradient of a line, find a gradient of a line from a graph, find the equation of a tangent to a circle, estimate the gradient of a curve at a point.

CHAPTER	LESSON	DESCRIPTION
I. The Cell – the Basic Unit of Living Organisms	**Structure of Plant and Animal Cells**	At the end of this activity, students should be able to describe the basic organization of the cell and compare and contrast animal and plant cells.
	Microscopes and the Size of Cells	At the end of this activity, students should be able to describe a light microscope, describe the concept of electron microscope design, compare and contrast light and electron microscopes, define the basic units of measurement applicable to microscopic studies and prepare samples for examination under a light microscope.
	Chemical Composition of Cells	At the end of this activity, students should be able to have a basic understanding of the chemical composition of a cell, know the structure and function of proteins, lipids and carbohydrates, and be able to define the role that each of the molecules plays in the metabolic processes within a cell and a multicellular organism.
	The Nucleus as a Store of Genetic Material	At the end of this activity, students should be able to describe the structure of chromosomes, define haploid and diploid sets of chromosomes, define homologous chromosomes, and define changes in the amount of genetic material during cell cycle.
	Cell Division	At the end of this activity, students should be able to describe and compare mitosis and meiosis and define the importance of mitosis and meiosis.
	Cell Specialization	At the end of this activity, students should be able to define the levels of organization existing in the living world and associate the components of the cell with their function in particular cells.
	Transport Across Membranes	At the end of this activity, students should be able to define diffusion, osmosis and active transport, compare and contrast diffusion, osmosis and active transport, describe examples of diffusion, osmosis and active transport in animals and plants, and discuss the significance of each kind of transport in living organisms.
	Metabolic Transformations in a Cell	At the end of this activity, students should be able to define metabolism, explain the differences between anabolic and catabolic reactions, explain the role of ATP, define the role of enzymes, explain the term "active site" and present a diagram of a reaction with an enzyme, explain the terms "cofactor" and "inhibitor" and their influence on the progress of enzymatic reactions, and demonstrate the influence of temperature on the rate of enzymatic reactions.
	Plant Tissues	At the end of this activity, students should be able to distinguish meristems from true tissues, define the functions and distribution of meristems in plants, and define the structure and functions of true primary and true secondary tissues.
	Animal Tissues	At the end of this activity, students should be able to describe the features of the cells constituting basic animal tissues and define the functions of the main animal tissues.
II. The Diversity of Living Organisms	**Classification of Organisms**	At the end of this activity, students should be able to recognize the need for organizing information about species, understand the principles of classification of species according to their specific features, and understand the reasons for the differences between systems of classification of living creatures.
	Prokaryotes, Protists and Fungi	At the end of this activity, students should be able to name the basic features of prokaryotes and eukaryotes, name the basic features of protists and differentiate between the basic groups of protists, and name the basic features of fungi and lichens.

CHAPTER	LESSON	DESCRIPTION
	Plants	At the end of this activity, students should be able to name the basic characteristics of plants, distinguish the basic groups of plants, recognize how plants adapt to terrestrial conditions, and recognize the diversity of plant forms.
	Invertebrates	At the end of this activity, students should be able to recognize the variety of adaptations among the groups of invertebrates, indicate the features that are characteristic for each group of invertebrates, assign animals to a specific group of invertebrates, recognize similarities in structure and function in selected representatives of the groups of invertebrates, and recognize the differences in structure and function in selected representatives of the groups of invertebrates.
	Reproduction in Invertebrates	At the end of this activity, students should be able to describe the diversity of reproductive methods and adaptations in invertebrates and describe the similarities and the differences in the structure and function of the reproductive organs and systems of selected examples from given classes of invertebrates.
	Vertebrates	At the end of this activity, students should be able to describe the variety of adaptations among the classes of vertebrates, indicate the features of selected animals that are characteristic of the class of invertebrates to which they belong, and describe the similarities and differences in structure and function of selected examples of the classes of vertebrates.
	Reproduction in Vertebrates	At the end of this activity, students should be able to recognize the different reproductive adaptations among classes of vertebrates, recognize the differences in the structure and function of the egg among classes of vertebrates, recognize the adaptations that enable the embryos of reptiles, birds and mammals to become independent from the aquatic environment, recognize how parents participate in the postembryonic development of their offspring, especially in birds and mammals, and recognize the similarities between representatives of classes of vertebrates in regard to the development of the embryo inside the mother's body.
	Viruses	At the end of this activity, students should be able to describe the basic characteristics of viruses, describe the main differences between viruses and cell organisms, describe the structure of a virus, name the stages and events in the viral multiplication cycle, recognize human diseases caused by viruses, and understand how viruses affect a host cell.
III. Circulation	**Blood**	At the end of this activity, students should be able to describe the structure of blood, describe the chemical composition of plasma, describe the structure and function of blood cells, explain the process of blood clotting, and explain how the transport of respiratory gases occurs.
	Blood Vessels	At the end of this activity, students should be able to describe the structure of arteries, veins and capillaries, define the functions of arteries, veins and capillaries, and explain how components are exchanged between blood and tissue fluid.
	Blood Groups and the Rh Factor	At the end of this activity, students should be able to determine human blood groups, explain what Rh factor is, present the possibility of transfusion in the ABO and Rh systems, explain what serological incompatibility involves, and give examples of medical application of blood.
	The Circulatory System	At the end of this activity, students should be able to define the location of the heart in the human organism, describe cardiac muscle tissue, discuss the structure of the heart, describe the cardiac cycle, explain the importance of the coronary circulation, describe the pulmonary circulation, and describe the systemic circulation.

CHAPTER	LESSON	DESCRIPTION
	Effects of Physical Effort on the Functioning of the Circulatory System	At the end of this activity, students should be able to the influence of physical effort on blood, vessels and the heart, and the response of blood vessels and the heart to physical effort the most common ways of prevention of cardiovascular diseases.
	Risk Factors for Heart Attack	At the end of this activity, students should be able to define the process of atherosclerosis, arterial hypertension, and the related cardiovascular diseases, describe the most common ways of preventing cardiovascular diseases, and describe cardiopulmonary resuscitation.
IV. Nutrition	**Nutrients**	At the end of this activity, students should be able to describe the importance of the organic constituents of food: proteins, fats, carbohydrates, vitamins and fibre, describe the importance of water and mineral ions, indicate the sources of nutrients, explain the factors affecting nutritional requirements, describe the effects of nutrient deficiencies, and give examples of the use of preservatives and colourings in foods.
	The Human Digestive System	At the end of this activity, students should be able to present the structure of the human alimentary canal, show the relationship between the structure and functions of each section of the alimentary canal and explain the structural and functional connection between the liver and pancreas and the alimentary canal.
	Digestion	At the end of this activity, students should be able to define digestion, explain how digestive enzymes work, describe the digestion of carbohydrates, proteins, fats, define the site of the absorption of digestion products, describe the role of bile in lipids digestion, and define the role of symbiotic bacteria in vitamins production.
	Absorption	At the end of this activity, students should be able to describe the adaptations of the intestine for the absorption of the products of digestion, describe the absorption of the products of protein, carbohydrate and lipid digestion, indicate the association between the circulatory system and alimentary canal, describe the role of the liver in the regulation of glucose levels, and describe the role of the liver in detoxification.
V. Respiration	**Cellular Respiration and Energy Production**	At the end of this activity, students should be able to know the structure of the respiratory system, know the course of gas exchange in the lungs. explain that respiration involves the release of energy from organic compounds, differentiate between the two types of respiration: aerobic and anaerobic, indicate the type of respiration that releases the most energy, explain the circumstances in which anaerobic respiration occurs in human beings, and explain the meaning of the term "oxygen debt".
	The Respiratory System	At the end of this activity, students should be able to describe the structure of the respiratory system, explain the mechanism of breathing, compare the composition of inhaled and exhaled air, explain what is involved in gas exchange in the lungs, and name the adaptations of the lungs to gas exchange.
VI. Nervous System	**The Nervous System as a Receptor of Environmental Stimuli**	At the end of this activity, students should be able to specify the main types of stimuli received by the nervous system, describe a neurone and the basic types of neurons, define the basic elements of the nervous system involved in producing the appropriate response to a stimulus, characterize the structure and function of a synapse, and define a neurotransmitter.
	Nervous System	At the end of this activity, students should be able to name the parts of the nervous system and their structures, describe the basic functions of particular parts of the nervous system, define the terms "nerve centre" and "nerve", and name the most important structures protecting the nervous system.

CHAPTER	LESSON	DESCRIPTION
	The Peripheral Nervous System	At the end of this activity, students should be able to describe the hierarchy in the peripheral nervous system (PNS), define and describe the divisions of the autonomic nervous system (ANS), and explain the opposing (antagonistic) actions within the PNS, its motor system and the ANS.
	Reflex Responses of the Nervous System	At the end of this activity, students should be able to differentiate between voluntary and involuntary responses, define conditioned and unconditioned reflexes, and describe Pavlov's experiments.
	Sensory Organs	At the end of this activity, students should be able to describe the three types of receptors, define the role of receptors in the body, and describe the structure and function of the organs of taste and smell.
	The Eye and the Ear	At the end of this activity, students should be able to know the tissue structure, know the mechanisms of the generation of nerve impulses and the principles of their operation, know the structure and function of receptors in the nervous system, describe the structure of the eye and ear the sensory organs of hearing and balance, and define the functions of the eye and ear.
VII. Hormones	**Hormones and Endocrine Glands**	At the end of this activity, students should be able to define a hormone, name the endocrine glands and define their location in the human organism, name the hormones released by certain glands, present examples of hormone activity in the human organism, explain what is involved in the regulation of hormone secretion, and define the dominant role of the pituitary gland in the endocrine system.
	Hormonal Regulation of Metabolic Processes	At the end of this activity, students should be able to explain how blood sugar level is regulated, describe the action of adrenaline, present the action of growth hormone, and explain the role of thyroid hormones.
	Sex Hormones	At the end of this activity, students should be able to define the effects of sex hormones on the development of the secondary sex characteristics, explain how hormones regulate the menstrual cycle, and give examples of the applications of hormones.
VIII. Human Locomotion System	**Skeletal Muscles**	At the end of this activity, students should be able to describe the external structure of skeletal muscles, describe the structure of the skeletal muscle cell, explain the terms: muscle fiber, myofibril, myofilament, sarcomere and neuromuscular junction, explain the sliding filament theory, and explain the antagonistic activity of muscles.
	The Skeletal System	At the end of this activity, students should be able to explain what is involved in the process of bone remodelling, describe the morphological structure of a long bone, name the components of the axial and appendicular skeletons, define joint, explain its role and name its main components, and name the functions of the human skeletal system.
IX. Homeostasis	**Homeostasis**	At the end of this activity, students should be able to explain the terms relating to the internal environment of the organism and homeostasis, explain the roles of the nervous and endocrine systems in homeostasis and the interdependence of these systems, explain the mechanisms of negative and positive feedback, and present an example of a homeostatic mechanism (regulation of glucose concentration in the blood).
	The Role of the Kidneys	At the end of this activity, students should be able to define excretion, discuss the structure of the nephron, describe the stages of urine formation – glomerular filtration, and tubular secretion, explain the role of ADH in the regulation of water excretion, and explain how an artificial kidney works and the importance of kidney transplantation to people with renal failure.

CHAPTER	LESSON	DESCRIPTION
	Thermoregulation	At the end of this activity, students should be able to distinguish between endothermic and exothermic organisms, define homoiothermy, explain the importance of homoiothermy for the human organism, describe the basic methods used by the organism thermoregulation process, present elements of the thermoregulatory system and indicate the role of the nervous system in thermoregulation, and present the mechanism of negative feedback in thermoregulation.
X. Human Reproduction	**Development of the Human Embryo**	At the end of this activity, students should be able to explain how fertilization occurs, name the initial stages of embryo development: cleavage and gastrulation, define the role of the placenta, describe the gradual development of the embryo and fetus, and present the stages of labor.
	The Reproductive System	At the end of this activity, students should be able to present the structure of the male reproductive system, define the functions of specific organs of the male reproductive system, present the structure of the female reproductive system, define the functions of specific organs of the female reproductive system, describe spermatogenesis, present the structure of sperm cells, describe oogenesis, and present the structure of egg cells.
XI. Health and Diseases	**The Human Immune System**	At the end of this activity, students should be able to define antigen, antibody, immunity, specific and non-specific immunity, cellular and humoral immunity, name the components of the immune system, describe the role of phagocytes and lymphocytes in the immune response, and describe an inflammatory response – characterize primary and secondary immune responses.
	Vaccinations	At the end of this activity, students should be able to define the terms "epidemic" and "pandemic", give examples of epidemic chains and methods of breaking them, describe the significance of the discoveries by Jenner and Pasteur in the development of vaccinations, explain how active immunity is produced by vaccination, state the difference between preventive vaccination and therapeutic vaccination, explain the significance of vaccinations in the fight against infectious diseases, and justify the need for the administration of preventive vaccinations.
	Bacterial Diseases	At the end of this activity, students should be able to describe the most important concepts of medical microbiology, describe how people become infected with the Mycobacterium tuberculosis Salmonella typhi, Vibrio cholerae, Yersinia pestis and Treponema pallidum, describe the most important risks associated with the diseases caused by these bacteria, present the most important methods for avoiding infections with these bacteria, and give reasons for the introduction of public health regulations in order to combat infectious diseases.
	Viral Diseases	At the end of this activity, students should be able to name several viral diseases (influenza, poliomyelitis, rubella, measles, mumps, chickenpox), explain why one person can contract influenza several times, explain why bird flu viruses are so dangerous to human beings, briefly describe the characteristics of childhood diseases (rubella, measles, mumps, chickenpox) and their complications, describe the possible complications of viral hepatitis B and C, and describe the role of vaccinations in the prevention of viral diseases, including poliomyelitis.
	Human Immunodeficiency Virus (HIV)	At the end of this activity, students should be able to explain the abbreviations HIV and AIDS, describe the structure of HIV, describe the life cycle of HIV, explain how HIV affects the functioning of the immune system, describe the process of HIV infection, give examples of high-risk behaviors, explain how HIV can be easily destroyed by means of common disinfectants and high temperature, and comprehend that people infected with HIV can lead a normal life in society.
	Antiseptics and Antibiotics	At the end of this activity, students should be able to give the definitions of antibiotics, antiseptics, antisepsis, describe the action of penicillin, and describe the idea and importance of antibiotic resistance in bacteria.

CHAPTER	LESSON	DESCRIPTION
	Parasitic Diseases	At the end of this activity, students should be able to explain what parasitism involves, present the life cycles of selected human parasites, explain the pathological effect of parasites, and present ways to prevent parasitic infections.
	Effects of Drugs, Cigarettes and Alcohol	At the end of this activity, students should be able to define dependence and present its examples, describe the effects of basic drug types on the nervous system, define addiction, give examples of addictions, describe the effects of cigarettes on the organism and name diseases caused by smoking, and describe the effects of alcohol on the organism and name diseases caused by drinking.
XII. Plant Nutrition	**Photosynthesis**	At the end of this activity, students should be able to write the equation for photosynthesis, describe the course of the light phase and the dark phase of photosynthesis, describe how temperature, light and carbon dioxide levels affect the rate of photosynthesis, describe the relationship between photosynthesis and respiration, and explain the importance of photosynthesis.
	Mineral Nutrition in Plants	At the end of this activity, students should be able to define macro-elements, trace elements and ultra-trace elements, describe the importance of macro-elements for optimum plant growth and development, and present the importance of inorganic fertilizers.
	Crop Production	At the end of this activity, students should be able to explain how soil pH affects the growth of plants, name the types of fertilizers, name the methods for combating weeds, describe methods for protecting plants from diseases, present the advantages of greenhouses for plant cultivation, and describe the principle of hydroponic cultivation.
	Carnivorous Plants	At the end of this activity, students should be able to define the significance of carnivorousness, describe how plants capture animals, give named examples of carnivorous plants, and indicate the distribution of selected carnivorous plants.
XIII. Plant Reproduction	**Plant Reproduction**	At the end of this activity, students should be able to describe the mode of reproduction in spore-bearing plants, compare the life cycles of mosses and ferns, describe the life cycle of gymnosperms, and describe the reproductive organs and life cycle of angiosperms.
	Seed Germination and Plant Growth	At the end of this activity, students should be able to describe the structural components of a seed and their roles, describe the chemical composition of different seeds, describe the process of germination, and define the environmental factors necessary for germination.
XIV. Transport in Plants and Plant Movements	**Water Transport in Plants**	At the end of this activity, students should be able to discuss the structure of xylem, describe the mechanisms of water transport in plants, define transpiration, its types and importance, describe the modes of intake and transport of inorganic ions, and define water balance in plants.
	Transport and Accumulation of Organic Substances in Plants	At the end of this activity, students should be able to discuss the structure of phloem and indicate its location in a plant, name the organic compounds produced during photosynthesis and stored in plants, describe the transport of organic compounds from the leaves to other plant organs, and name examples of storage organs in plants.
	Responsiveness and Plant Movements	At the end of this activity, students should be able to define tropisms, nastic movements and taxis, present examples of plant movements, and explain mechanisms of tropisms and nastic movements.

CHAPTER	LESSON	DESCRIPTION
XV. Variation in Organisms	**Variation of Organisms**	At the end of this activity, students should be able to explain what the nature of variation consists in, distinguish between genetic and environmental variation, define phenotype, describe the differences between continuous and discontinuous variation, and present examples of both types of variation;
	Reproduction and Variation	At the end of this activity, students should be able to define a clone, explain why simple and mitotic divisions lead to the formation of clones, explain how genetic recombination occurs during meiosis, and explain the significance of genetic variation within a species.
	Mutations as a Source of Variation in Organisms	At the end of this activity, students should be able to define mutation, present the significance of mutations in somatic and reproductive cells, and define mutagens and present examples.
XVI. Heredity	**Heredity According to Mendel**	At the end of this activity, students should be able to define genotype, phenotype, gene, allele, discuss Mendel's first and second laws, and use a Punnett square.
	The Principles of Sex Inheritance in Humans	At the end of this activity, students should be able to discuss sex inheritance, define sex-linked and sex-influenced traits, name the disorders related to abnormalities in the number of sex chromosomes, and define karyotype and describe the human karyotype.
	The Chromosomal Theory of Inheritance	At the end of this activity, students should be able to discuss chromosomal inheritance and define linked genes – construct a chromosome map.
	Genetic Diseases	At the end of this activity, students should be able to define mutation and discuss the causes of selected genetic diseases – construct a pedigree chart.
	Inheritance of Blood Groups in Humans	At the end of this activity, students should be able to discuss the systems of blood grouping and describe the principles of blood group inheritance.
	Nucleic Acids	At the end of this activity, students should be able to discuss the structures of DNA and RNA and describe the structure and function of mRNA, tRNA and rRNA.
	The Gene as a Structural and Functional Unit of DNA	At the end of this activity, students should be able to discuss the processes of transcription and translation and describe the regulation of transcription.
	Mutations as Changes in DNA	At the end of this activity, students should be able to define point mutations and divide them into different categories, differentiate between point mutations and chromosomal aberrations, present examples of the effects of mutations and the methods by which the organism protects itself against them, and describe the mutation occurring in the case of sickle-cell disease and its effects.
XVII. Evolution	**The Origin of Life on Earth**	At the end of this activity, students should be able to recognize the organic compounds that may arise in an abiotic environment, describe an experiment to confirm the synthesis of organic compounds in an abiotic environment, list the characteristics that distinguish living organisms from inanimate matter, and describe the differences between the environmental conditions prevailing on Earth 4 billion years ago and now.
	Charles Darwin and the Theory of Evolution	At the end of this activity, students should be able to explain the consequences of the discovery of evolution and its mechanisms, explain how Darwin formulated his theory, and explain the significance of Darwin's scientific discoveries.
	Laws of Evolution and Speciation	At the end of this activity, students should be able to describe the basic mechanisms and principles of evolution and describe the process of species formation.

CHAPTER	LESSON	DESCRIPTION
	The History of Life on Earth	At the end of this activity, students should be able to the evolution of living organisms occurred in changing conditions, usually different from those of the present day, present-day groups of organisms have been evolving for hundreds of millions of years, and present-day species have developed over several millions of years.
	Human Evolution	At the end of this activity, students should be able to: indicate the major events in human evolution – indicate the most important achievements of human evolution – understand that human evolution from pre-human forms was a long and complex process – understand that the course of human evolution from pre-human forms has not been fully clarified to date – understand that the present evolution of the Homo sapiens is a cultural evolution.
XVIII. How We Combat Microorganisms and How We Use Them	**Bacterial Growth**	At the end of this activity, students should be able to explain the concept of doubling time, indicate the factors affecting bacterial growth, define bacterial colony and explain how to estimate the number of bacteria in a culture on the basis of the number of colonies, present a bacterial growth curve for a batch culture, and explain the principles of the chemostat.
	Protecting Food from Spoilage	At the end of this activity, students should be able to describe Pasteur's experiment to show the presence of bacteria in the air, name the factors that cause food spoilage, explain what pasteurization involves and give examples of pasteurized products, define sterilization and describe the methods of food sterilization, and present some traditional methods for inhibiting the development of bacteria in food.
	Biotechnology Past and Present	At the end of this activity, students should be able to define biotechnology and present examples of past and present biotechnological processes, explain the significance of fermentation as a key biological process in biotechnology, present the main stages in the production of beer, yogurt and hard cheeses, explain the importance of pasteurization in these processes, present generic names of the microorganisms taking part in these processes, describe single-celled protein and the substrates used in its production, and describe the structure of a biofermenter and the differences between batch and continuous cultures.
	Industrial Uses of Bacteria	At the end of this activity, students should be able to explain the principle of the biological treatment of municipal wastewater, explain how wastewater is purified by the activated sludge method and the biofiltration method, define eutrophication and explain the biological method for the removal of nitrogen and phosphorus compounds, explain how biogas is produced, discuss the role of enzymes in biological washing powders, and present the main stages of the industrial production of enzymes.
XIX. Genetic Engineering	**Genetic Engineering and its Applications in Biotechnology**	At the end of this activity, students should be able to: explain the artificial recombination of DNA – demonstrate the significance of restriction enzymes in manipulating DNA – explain the term "vector", give examples and describe its properties from the perspective of genetic engineering – demonstrate the stages of obtaining the product of a given gene in the bacterial cell – give examples of biologically active proteins obtained by genetic engineering techniques – explain the basics of the polymerase chain reaction (PCR).
	Other Applications of Genetic Engineering	At the end of this activity, students should be able to: explain what the Southern blot technique involves – present the principles of operation of genetic probes and examples of their application – explain the term "genetic fingerprint" – explain the goal of the Human Genome Project.
	Genetic Modification of Organisms	At the end of this activity, students should be able to: explain what selection involves – give examples of methods for the modification of crops – explain the terms genetically modified organisms, gene therapy, reproductive cloning and therapeutic cloning – describe the principal stages of organism cloning – give examples of the ethical problems arising from genetic modification of organisms.

CHAPTER	LESSON	DESCRIPTION
XX. Living Organisms and Their Environment	**The Individual and the Population**	At the end of this activity, students should be able to define species, individual and population, population size, range and density, reproduction rate and death rate, interpret a survivorship curve, and distinguish between abiotic and biotic factors.
	Competition and Predation	At the end of this activity, students should be able to use the term competition, recognize the various results of competition, recognize the variety of relationships possible between competing species, use the term predation, recognize the various results of predation, and recognize the variety of predator-prey relationships.
	Symbiosis	At the end of this activity, students should be able to use the term "symbiosis" correctly, recognize the different types of symbiotic associations, differentiate between the types of symbiotic associations, and recognize the effects of symbiosis and their significance.
	Life on Land	At the end of this activity, students should be able to notice the many adaptations to terrestrial life and identify the features that enable plants and animals to use the resources of the terrestrial environment.
	Life in Water	At the end of this activity, students should be able to recognize the many adaptations necessary for life in water, identify features that enable animals to use the resources of the aquatic environment, and recognize the similarities and differences in the adaptations of fish and whales to life in water.
	Adaptations of Organisms to the Environment	At the end of this activity, students should be able to describe the dynamic influence of environmental factors on adaptation, describe the range of adaptations and their categories, understand the causes of similar adaptations in unrelated groups of organisms, understand the significance of energy-saving adaptations, and understand the adaptational significance of gathering and processing information.
	Different Modes of Feeding in Mammals	At the end of this activity, students should be able to recognize the relationships between environmental factors and feeding-related adaptations in mammals, recognize the reasons for the development of different feeding-related adaptations in mammals, recognize the effects of different feeding-related adaptations in mammals, and understand the value of feeding-related adaptations in mammals.
	Humans and the Environment	At the end of this activity, students should be able to describe the nature, range and uniqueness of the adaptations of humans to the environment, describe the relationship between the level of human existence and the state of natural resources, describe the effects of human activities on the natural environment, understand the dependency of humans on environmental resources and factors, understand that macroeconomic plans and calculations should take into consideration the effects of human activities on nature, and understand the necessity to minimize the negative effects of human activities on nature.
	Environmental Pollution	At the end of this activity, students should be able to understand the relationship between the introduction of substances, energy and species into the environment by man and the changes that they cause in the environment, understand the adverse effects of pollution on the standard of living of humankind, understand the adverse effects of pollution on all the components of the natural environment and the relationships that exist in it, understand the dependency of humankind on environmental resources and factors, understand why it is necessary to include the effects of human activity on nature in macroeconomic planning and accounting, and understand why it is necessary to minimise the adverse effects of human activity on the environment.

CHAPTER	LESSON	DESCRIPTION
	The Greenhouse Effect and the Ozone Hole	At the end of this activity, students should be able to describe how human activities cause global changes in the natural environment, describe the dependency of humans on environmental resources and factors, explain the necessity of taking into account the effects of human activities on the natural environment in macroeconomic plans and calculations, describe the necessity to minimize the adverse effects of humans on the natural environment, and explain the difficulties in assessing the proportional effects of human activities and natural processes on the natural environment.
	Conservation of Natural Resources	At the end of this activity, students should be able to determine the range and pace of changes in the natural environment caused by humans, describe the importance of the conservation of natural resources for the continued existence of the natural environment and humankind, describe the measures for nature conservation, understand the relationship between the quality of human life and the degree of conservation of natural resources, understand the principle behind the conservation of natural resources by the protection of entire ecosystems, and understand the need for long-term planning in the exploitation and economical use of natural resources.
XXI. The Flow of Energy and Matter, Information Exchange	**Ecosystem**	At the end of this activity, students should be able to use the concepts of: ecosystem, biocenosis, biotope, recognize the abundance of connections between species inhabiting an ecosystem and their connections with the abiotic environment, and recognize the mechanisms functioning within an ecosystem.
	Food Chains	At the end of this activity, students should be able to use the terms: food chain, trophic level and food web, notice the abundance of potential interdependencies between species inhabiting one ecosystem, and notice the abundance of pathways of energy flow and matter circulation in an ecosystem.
	Information in Nature	At the end of this activity, students should be able to describe the different types of information about the environment that are vital for life, describe the modes of communication between individuals of the same species and different species, understand the significance of information about the environment for the survival and development of individuals (populations, species), understand the significance of communication for the survival and development of an individual (population, species), and understand the significance of genetic information in nature.
	Biogeochemical Cycles	At the end of this activity, students should be able to understand the inter-relationships between the elements of the ecosystem that take part in the natural cycles of matter.

CHAPTER	LESSON	DESCRIPTION
I. Forces	**Forces**	At the end of this activity, students should be able to know: what a force is, – the unit of force, – how to represent a force by means of a vector, – how to calculate the resultant of forces which are acting along the same line, – when we encounter forces in equilibrium.
	Addition of Forces	At the end of this activity, students should be able to: – determine the resultant of any two forces. – calculate the maximum and the minimum magnitude of the resultant of two forces. – resolve a force into two component forces.
	Force Measurement	At the end of this activity, students should be able to: – describe which property of a spring is applied in force gauges. – explain the difference between weight and mass.
	Torque	At the end of this activity, students should be able to: describe a force arm, calculate torque, indentify the unit of torque, find the equilibrium of torques.
	Equilibrium	At the end of this activity, students should be able to: – give an example to explain how to find a centre of gravity. – give the conditions necessary for a body to remain in equilibrium. – give examples to show the difference between stable, unstable, and neutral equilibrium.
	Levers and Pulleys	At the end of this activity, students should be able to: – explain how a class one lever operates. – explain how a class two lever works. – explain how a stationary pulley and a moving pulley operate. – give examples of how levers and pulleys are used.
II. Motion	**Displacement, Distance, and Velocity**	At the end of this activity, students should be able to: – explain how to describe the position of a body and define a frame of reference. – give definitions for path of motion, distance, and displacement. – calculate speed and velocity, and determine the differences and similarities between the concepts. – give examples of units of speed; note this differs form above (speed). – describe average and instantaneous velocities and give examples of each. – graphically determine the vector of resultant velocity.
	Acceleration	At the end of this activity, students should be able to: specify the types of motion, – calculate acceleration, – calculate the speed when the acceleration or the acceleration–time relationship is given.
	Graphs of Motion	At the end of this activity, students should be able to: graph changes over time for distance and speed for uniform motion, calculate the speed of a body given a distance-time graph, calculate distance given a speed-time graph.
	Accelerating Motion	At the end of this activity, students should be able to: – derive acceleration and distance from a speed-time graph, – describe how the speed changes in uniformly variable motion and represent it on a graph, – describe the changes in distance traveled by an accelerating body that had an initial speed equal to zero, – plot a distance-time graph for uniformly variable motion.
	Curvilinear Motion	At the end of this activity, students should be able to: – explain the concepts of period and frequency and name their units. – calculate speed in a circular motion when the radius of the circle and the period or frequency of rotation are given. – draw a velocity vector at any point of the path in a curvilinear motion. – calculate the speed of a body during horizontal projection.
III. Forces and Motion	**Force and Acceleration**	At the end of this activity, students should be able to: explain how the acceleration of a body is affected by the force exerted on the body and the mass of the body, state Newton's second law of motion, explain the difference between mass and weight, calculate force on the basis of Newton's second law.

CHAPTER	LESSON	DESCRIPTION
	Momentum	At the end of this activity, students should be able to: give examples to explain the principle of conservation of momentum, differentiate between elastic and inelastic collisions, explain the relationship between force, the time for which it is applied, and change in momentum, describe the concept of momentum.
	Inertia	At the end of this activity, students should be able to: describe inertia and explain why Newton's first law of motion is called the principle of inertia, give examples to explain that a force is required to change the speed and direction of a moving body, state and explain Newton's first law of motion.
	Friction	At the end of this activity, students should be able to: give examples of static friction and kinetic friction, – explain what static friction and maximum static friction depend on, – describe kinetic friction and explain what quantities its magnitude depends on, – explain the relationship between friction, initial movement, and stopping.
	Air Resistance	At the end of this activity, students should be able to: describe the factors that air resistance depends on, explain the difference between free fall in a vacuum and free fall in air.
	The Force of Reaction	At the end of this activity, students should be able to: give examples of action and reaction force pairs, explain Newton's third law of motion, explain why the forces of action and reaction cannot be in balance.
IV. Energy	**Work**	At the end of this activity, students should be able to: explain the concept of work, – calculate the work done by a force acting over a given distance, – explain when a force performs no work.
	Potential Energy	At the end of this activity, students should be able to: give the definition of potential energy and elastic potential energy, calculate the magnitude of the potential energy, understand that energy can be transferred between bodies and that it can change from one form to another.
	Kinetic Energy	At the end of this activity, students should be able to: give the definition of potential energy and elastic potential energy, calculate the magnitude of the potential energy, understand that energy can be transferred between bodies and that it can change from one form to another.
	Energy Conversions	At the end of this activity, students should know: the concept of internal energy, – the concept of mechanical energy, – that an increase in temperature corresponds to an increase in internal energy, – that energy can be transferred between bodies and can change into a different form of energy, – the principle of conservation of energy.
	Power	At the end of this activity, students should be able to: understand the concept of power, – name the units of power, – calculate the value of power.
	Efficiency	At the end of this activity, students should be able to: understand the concept of 'energy losses', calculate the efficiency of the energy conversion process, calculate the efficiency of a device.
V. Gravitation	**Gravitation**	At the end of this activity, students should be able to: define the gravitational force, state the law of gravitation, explain the relationship between the force of gravity and weight, explain the difference between weight and mass.

CHAPTER	LESSON	DESCRIPTION
	Free Fall	At the end of this activity, students should be able to: state the type of motion represented by free fall, explain how the distance traveled by a freely falling body changes in subsequent equal time periods, calculate the speed of a falling body at any time, calculate the distance traveled by a falling body, explain the differences and the similarities between falling bodies on the Earth and on the Moon, describe the concept of weightlessness.
	Space Flights	At the end of this activity, students should be able to: predict the trajectories of objects launched from the Earth, – explain the meaning of escape velocities for the Sun and the Earth, – state how a rocket is provided with a required velocity, – describe the states of weightlessness and overload.
	Satellites	At the end of this activity, students should be able to: describe the conditions required to place a satellite in a specific orbit, explain the quantitative relationships between a satellite's velocity, orbital period, and the radius of a satellite's orbit, give examples of the application of satellites, explain which type of satellite is known as a geostationary satellite.
VI. Matter	**Gases, Liquids and Solids**	At the end of this activity, students should be able to: explain the concept of the state of matter, explain the concepts of a crystal, a monocrystal, a polycrystal, an amorphous body, and allotropy, describe the three common states of matter found on Earth.
	Properties of Matter	At the end of this activity, students should be able to: explain the concept of elasticity, plasticity, and brittleness, understand the concept of wetting, surface tension, and diffusion, calculate the extension of a body by applying Hooke's law.
	Density	At the end of this activity, students should be able to: explain the concepts of density and specific gravity, – explain how to calculate the density of solids and liquids, – calculate density, volume, or mass when the other two quantities are given.
	Temperature	At the end of this activity, students should be able to: explain the concepts of heat and temperature, understand the temperature scales Celsius, Fahrenheit, and Kelvin, convert the temperature from one scale into another.
	Thermal Expansion	At the end of this activity, students should be able to: explain the concepts of linear expansion and volume expansion, understand that the extension of a body depends on the increase in temperature and the initial length, calculate the extension of a body due to heating, describe the anomalous expansion of water.
	Expansion of Gases	At the end of this activity, students should be able to: explain the phenomenon of thermal expansion of gases, give examples of the effects of gas expansion, use the relationship V/T = const to calculate an increase in the volume of a gas due to an increase in its temperature.
VII. Pressure	**Pressure**	At the end of this activity, students should be able to: give definitions of pressure and strength, calculate pressure, area, or force when the other quantities are given.
	Pressure of a Liquid	At the end of this activity, students should be able to: explain the concept of pressure and thrust, state Pascal's principle, calculate hydrostatic pressure.
	Air Pressure	At the end of this activity, students should be able to: explain the relationship between pressure and altitude, – explain the concepts of negative pressure and positive pressure, – calculate the load of the atmosphere on a given surface.

CHAPTER	LESSON	DESCRIPTION
	Gas Laws	At the end of this activity, students should be able to: describe gas transformations and the relationship between volume, pressure, and temperature, calculate volume, pressure, or temperature when the two other parameters are given, describe the practical application of gas laws.
	Buoyant Force	At the end of this activity, students should be able to: understand the concept of buoyant force, describe what the buoyant force depends on, state Archimedes' principle, calculate the buoyant force when the density of a liquid and the volume of an object are given.
	Floating Bodies	At the end of this activity, students should be able to: state the conditions under which bodies can float in liquids and gases, calculate the part of a homogenous body which is submerged below the surface of a liquid, explain why bodies of a particular shape that are made of a substance denser than a liquid can still float in the liquid, explain the differences in the movements of a ship and a submarine.
VIII. Heat	**Specific Heat**	At the end of this activity, students should be able to: explain the concept of specific heat, determine the specific heat of a substance, calculate the amount of the heat absorbed or emitted by a body.
	Thermal Transfer	At the end of this activity, students should be able to: explain the concept of heat conduction, convection, and radiation, calculate the heat penetrating through a partition due to the mechanisms of conduction.
	Melting and Freezing	At the end of this activity, students should be able to: explain the concept of the melting point of a substance, explain the concept of the heat of fusion, determine the heat of fusion of a substance, calculate the amount of heat absorbed and emitted during melting or freezing.
	Evaporation and Condensation	At the end of this activity, students should be able to: state and differentiate between the concepts of evaporation and boiling, explain the concept of the heat of vaporization, determine the heat of vaporization of a substance, explain the relationship between the boiling point of water and pressure
	Sources of Heat	At the end of this activity, students should be able to understand: the concept of the heat of combustion, – the concept of a heat engine, – how to calculate the heat obtained due to combustion, – the concept of a heat pump.
	Efficiency and Economy	At the end of this activity, students should be able to: explain the reasons for heat loss and the methods for limiting the phenomenon, explain the consequences of the balance (or lack of balance) between the heat provided and the heat lost.
IX. Electrostatics	**Charging Objects**	At the end of this activity, students should be able to: explain the concepts of electron, proton, electric charge, and elementary charge, state the methods used to charge objects, describe the interaction of charged bodies, explain the effect of grounding.
	Conductors and Insulators	At the end of this activity, students should be able to: describe the concepts of an insulator and a conductor, – explain the concepts of electric field and field lines, – explain the concept of voltage, – state the relationship between voltage and the flow of charge across a conductor.
	Capacitors	At the end of this activity, students should be able to: explain the concepts of capacitor and capacitance, describe the structure of a capacitor, calculate the charge of a capacitor of known capacitance and voltage, state the uses of a capacitor.

CHAPTER	LESSON	DESCRIPTION
	Application of Static Electricity and the Threats It Poses	At the end of this activity, students should be able to: explain the concept of a spark discharge, describe the mechanism of discharging, state the reasons for and the results of atmospheric discharges, explain the threats posed by static electricity, describe how a photocopier operates.
X. Direct Current	**Cells and Batteries**	At the end of this activity, students should be able to: describe a cell and an electrode, describe the structure of a cell, explain the difference between a capacitor and a cell, describe the operation of a battery and an accumulator.
	Electric Current	At the end of this activity, students should be able to: explain the concept of electric current, – apply the relationship between charge, current and time, – explain how current flows, – describe the differences in the flow of current through solids and liquids.
	Ohm's Law	At the end of this activity, students should be able to: know how to study the relationship between current and voltage, be able to calculate resistance and know the unit of resistance, be able to calculate resistance, given the graph I(U), know Ohm's Law.
	Direct Current Circuit	At the end of this activity, students should be able to: explain the concept of total resistance, differentiate between series and parallel connections, state Kirchhoff's law, calculate the voltage and the current in simple electrical circuits.
	Variable Resistors and Nonlinear Resistors	At the end of this activity, students should be able to: explain the concepts of a resistance wire and a thermistor, – describe the way in which a resistor of variable resistance works, – state how a change in resistance affects the current flowing through a circuit, – describe the relationship between the resistance and the dimensions of a conductor, – describe the qualitative relationship between resistance and temperature for different materials.
	Work and Power of Current	At the end of this activity, students should be able to: explain the concept of work and power of a current, calculate the work and power of a current, describe the work done by a current, explain the concept of the power and efficiency of an electrical device, describe energy transformation in an electrical circuit.
XI. Magnetism	**Magnetic Field**	At the end of this activity, students should be able to: give examples of the application of magnets – present methods to demonstrate the presence of magnetic fields – describe the shape of a magnetic field around a bar magnet – explain the concept of magnetic flux density and name its unit – describe the shape of the magnetic field around the Earth.
	Electromagnets	At the end of this activity, students should be able to: describe a magnetic field around a rectilinear conductor, a circular loop and a coil – give examples of the application of electromagnets.
	Electromagnetic Force	At the end of this activity, students should be able to: describe an electromagnetic force – determine the direction of operation of an electromagnetic force – explain how the position of the conductor in relation to the magnetic field lines affects the magnitude of the electromagnetic force – state the relationship between the magnitude of the magnetic force and the flux density, the length of the conductor, and the strength of the field – describe the interaction of current-carrying conductors placed close together.
	Electric Motor	At the end of this activity, students should be able to: describe the structure of an electric motor – name the basic elements of a motor and explain their function – give some examples of the application of electric motors.

CHAPTER	LESSON	DESCRIPTION
	CRT and an Oscilloscope	At the end of this activity, students should be able to: describe the movement of a charged particle in an electric and a magnetic field, determine the direction of the Lorentz force, describe the key elements of an oscilloscope and a cathode ray tube (CRT).
XII. Alternating Current	**Electromagnetic Induction**	At the end of this activity, students should be able to: explain the phenomenon of electromagnetic induction, – give an example to explain Lenz's Law, – describe eddy currents, – explain the phenomena of mutual induction and self-induction, – give examples of the application of induction.
	Alternating Current and a Generator	At the end of this activity, students should be able to: explain the concept of heat conduction, convection, and radiation – calculate the heat penetrating through a partition due to the mechanisms of conduction.
	Transformer	At the end of this activity, students should be able to: describe the structure and the application of a transformer, – explain the concept of turns ratio, – explain how the number of turns in the primary and secondary coils affects the magnitude of the voltage and current in the secondary coil, – describe the operation of a car ignition system.
	Transfer of Electrical Energy	At the end of this activity, students should be able to: describe the concept of power demand – explain how electricity is transmitted – explain the significance of transformers in the transfer of electric energy – describe the elements of the National Grid system.
	Current in a Household	At the end of this activity, students should be able to: name the parts of a household electric mains system – describe the characteristics of the type of connection used in a household mains system – explain the concepts of overload and short-circuit – describe the methods of protection against overload and short-circuit – name the conductors that form a household circuit and state the colours with which they are marked.
	Electric Energy and Methods of Energy Saving	At the end of this activity, students should be able to: describe the work parameters of an electrical appliance, – calculate the energy absorbed by a given device when its power and working time are given, and estimate the cost of the energy, – read and interpret the data displayed by an electricity meter, – determine the power of a device given the readings of the electricity meter, – interpret the information on the energy consumption label of a given device.
XIII. Electronics	**Diode**	At the end of this activity, students should be able to: explain how substances can be divided into conductors, insulators and semiconductors – describe the doping of semiconductors – explain the difference between n-type and p-type semiconductors – describe a p-n junction – state the properties of a semiconductor diode.
	Power Supply Units and Rectifiers	At the end of this activity, students should be able to: explain the rectifying operation of a diode – state the basic methods of rectifying an alternating current – describe the general structure of a DC power supply.
	Light and Current	At the end of this activity, students should be able to: describe a light-dependent resistor and give examples of its application – describe an LED diode and give examples of its application – recognise the symbols for LDR and LED – connect an LED diode in forward bias – describe the structure of digital and alphanumeric display devices.
	Transistor	At the end of this activity, students should be able to explain the operation and application of a transistor, describe the ways in which a transistor may be open or closed, use the concept of a voltage divider to explain how to control the opening and closing of a transistor, give examples of a transistor switch and provide a short description of its operation, and describe the amplifying property of a transistor and give examples of the application of this feature.

CHAPTER	LESSON	DESCRIPTION
	Logic Gates	At the end of this activity, students should be able to: describe the operation of NOT, AND, OR, NAND, and NOR logic gates and prepare truth tables for them – explain the operation of a flip-flop.
	Digital Systems	At the end of this activity, students should be able to: describe analogue and digital signals, – explain the methods of encoding signals – give examples which demonstrate the conversion of an analogue signal into a digital one – describe different methods of recording and transferring signals.
XIV. Oscillations and Mechanical Waves	**Oscillations**	At the end of this activity, students should be able to: explain the concepts of: amplitude, period, frequency, and phase of oscillation – describe harmonic oscillations – explain the movement of a pendulum – state the relationship between the period of oscillation of a pendulum and its length – explain the addition of oscillations in two mutually perpendicular directions.
	Resonance	At the end of this activity, students should be able to: describe the conversion of energy during oscillation – explain the concepts of free, damped and forced oscillations – describe the phenomenon of resonance – give examples of the threats related to resonance.
	Mechanical Waves	At the end of this activity, students should be able to: explain how waves carry energy, explain the concept of a mechanical wave, wavelength, frequency and amplitude, calculate the wavelength (of a specific frequency) in a specific medium when the velocity of wave propagation in this medium is given, describe the behaviour of a wave when it passes from one medium to another.
	Reflection and Refraction of Waves	At the end of this activity, students should be able to: explain the phenomena of wave reflection and wave refraction, – explain the concepts of the angle of incidence and the angle of refraction of a wave, – state the Laws of Reflection and Refraction of a Wave, – explain the phenomena of wave absorption and wave dispersion.
	Seismic Waves	At the end of this activity, students should be able to: explain the nature of seismic waves, define body seismic waves and surface seismic waves, describe the propagation of seismic waves inside the Earth, and describe a tsunami.
	Diffraction and Interference of Mechanical Waves	At the end of this activity, students should be able to: define diffraction and interference – explain the phenomenon of wave diffraction – describe a standing wave.
XV. Sounds	**Sound**	At the end of this activity, students should be able to: define an acoustic wave, – calculate the wavelength of an acoustic wave given its speed and frequency, – explain why the speed of sound depends on the medium in which it propagates and understand why, when the medium is air, it also depends on the temperature, – describe the phenomena of echo, reverberation, and acoustic resonance, – describe the wavefront of an object moving at supersonic speed.
	Infrasound and Ultrasound	At the end of this activity, students should be able to: describe the structure and the functioning of the human ear, – list the properties of infrasound and ultrasound, – state the audibility range of the human ear, – describe the functioning of an ultrasound scanner, – give examples of the application of ultrasound.
	Interference of Sound Waves	At the end of this activity, students should be able to: describe the oscillations of a string, – explain the theory of fundamental frequency and harmonic frequencies, – explain the concept of the sound spectrum, – describe and explain the phenomenon of beats.

CHAPTER	LESSON	DESCRIPTION
	Sounds in Music	At the end of this activity, students should be able to: explain the structure of a musical scale – define an octave, perfect pitch, timbre – describe the principle of construction of stringed and wind instruments.
	Sound Intensity	At the end of this activity, students should be able to: state the definition of sound intensity, – define a decibel, – give examples of the problems caused by noise and the methods of protection against them.
	Doppler Effect	At the end of this activity, students should be able to: know on what the Doppler effect depends in the case of acoustic waves – be able to predict the frequency of the perceived sound in relation to the frequency of emitted sound in a given situation – realise that the Doppler effect also occurs with other types of waves.
XVI. Electromagnetic Waves	**Electromagnetic Waves**	At the end of this activity, students should be able to: define an electromagnetic wave – explain why light is an electromagnetic wave – state the relationship between wavelength and wave frequency – give the approximate speed of an electromagnetic wave in a vacuum – realise that the speed of light is the fastest rate of information transfer.
	Laser	At the end of this activity, students should be able to: define: monochromaticity and coherence – state the difference between laser light and light emitted by other sources – give examples of laser applications.
	Diffraction and Interference	At the end of this activity, students should be able to: recognise and describe the phenomena of the diffraction and interference of light, – describe interference fringes, – explain the theory of the interference of light which has passed through a diffraction grating.
	The Ranges of Electromagnetic Waves	At the end of this activity, students should be able to: state the ranges of electromagnetic waves, – give examples of the different properties of waves from particular ranges, – give examples of the application of waves from different ranges.
	Threats Related to Electromagnetic Waves	At the end of this activity, students should be able to: understand how radiation absorption rate is related to wavelength and the type of material, – know the application of microwaves, – understand the concept of greenhouse effect and its causes, – understand the concept of ozone hole, – understand the concept of ionisation.
	Application of Waves for Communication	At the end of this activity, students should be able to: explain the concepts of AM and FM modulation – give examples of the application of electromagnetic waves in communication
XVII. Light	**Reflection of Light**	At the end of this activity, students should be able to: explain the concept of a ray of light – give examples and describe the formation of umbra and penumbra – state the Law of Reflection – explain how an image is formed in a mirror – explain what happens to a ray when it has been reflected at two or three mirrors which are perpendicular to each other.
	Spherical Mirrors	At the end of this activity, students should be able to: explain the theory of concave and convex spherical mirrors – define principal focus and virtual focus – describe the properties of images formed by spherical mirrors – produce appropriate drawings.
	Refraction of Light	At the end of this activity, students should be able to: describe how speed, wavelength and frequency of light change when light passes from one medium to another – explain Fermat's principle – calculate the refractive index – give examples to explain the Law of Refraction – describe the passage of light through a transparent plate – list the conditions for total internal refraction and give examples of its application.

CHAPTER	LESSON	DESCRIPTION
	A Lens	At the end of this activity, students should be able to: identify different types of lenses, – describe the properties of images formed by lenses and draw ray diagrams to show how those images form, – calculate the enlargement and the optical power of a lens.
	Optical Instruments	At the end of this activity, students should be able to: explain the concepts of visual angle, and optimum viewing distance – describe the operation of a magnifying glass, a microscope, a camera, refracting telescope, binoculars, and a reflecting telescope.
	The Eye	At the end of this activity, students should be able to: describe the structure of the eye and explain the functions of its particular elements – define short-sightedness and long-sightedness and explain how these defects can be corrected with glasses.
	Colors	At the end of this activity, students should be able to: name the colors found in white light.– explain the processes of light mixing and paint mixing to obtain a desired color, provide a short description of color blindness and explain the significance of cones for color perception, describe the Purkinje effect.
XVIII. Nuclear Physics	**Structure of an Atom**	At the end of this activity, students should be able to: give short descriptions of models of the atom according to Thomson and Rutherford – name the components of the nucleus and determine their charges – describe spectrum analysis – state Bohr's postulates – calculate the radius of the n-th orbit in an atom of hydrogen, given the radius of the first orbit – calculate the energy (in electronvolts) of an electron located in the n-th orbit and the energy emitted or absorbed when the electron moves from one orbit to another – explain the symbolic notation of a nucleus – give the definition of an isotope.
	Nuclear Radiation	At the end of this activity, students should be able to: describe nuclear radiation, – provide characteristics of α, β and γ radiation, – describe β+ radiation, – explain the concept of a radioactive series.
	Decay Law	At the end of this activity, students should be able to: explain the concept of half-life – describe the decay of radioactive isotopes – explain the concept of radioactivity, state its unit and state the factors that determine its value.
	Effect of Radiation on Live Organisms	At the end of this activity, students should be able to describe the operation of a scintillation counter, a Geiger-Müller counter, and a Wilson cloud chamber, explain the concepts of absorbed dose and dose equivalent and state the units of the two quantities, name the main sources of radiation in the surrounding environment and give examples of the effects of radiation.
	Application of Radioactivity	At the end of this activity, students should be able to: describe the tracer method – explain the concepts of: isotope therapy, radiocarbon dating, rock dating, and isotope sterilisation – give examples of the application of nuclear radiation in industry.
	Nuclear Fission	At the end of this activity, students should be able to: explain the concepts of mass defect and binding energy – describe the reaction of fission – explain the concepts: fissile material, chain reaction, avalanche reaction, critical mass – state the main effects of an atomic explosion.
	Nuclear Energy	At the end of this activity, students should be able to: state the conditions that need to be satisfied for a fusion reaction to occur – describe the structure and operation of a nuclear reactor – explain the advantages and disadvantages of nuclear power engineering in comparison with conventional power engineering.

CHAPTER	LESSON	DESCRIPTION
	Nuclear Fusion	At the end of this activity, students should be able to: explain thermonuclear fusion – describe a proton cycle – describe the construction of an H-bomb – explain the methods of conducting a controlled fusion reaction.
XIX. Earth and the Universe	**The Solar System**	At the end of this activity, students should be able to: name and provide a short description of the main components of the Solar System, – describe Kepler's Laws.
	The Moon	At the end of this activity, students should be able to: describe the movement of the Moon around the Earth – explain the lunar phases – describe the structure of the Moon.
	Eclipses	At the end of this activity, students should be able to: describe a lunar eclipse and a solar eclipse, – name the different types of eclipses, – describe the course of an eclipse.
	The Structure and the Evolution of Stars	At the end of this activity, students should be able to: describe the structure of the Sun, – explain the method of division of stars into spectral classes, – describe an H-R diagram, – discuss the basic stages in the evolution of stars dependent on their initial mass.
	Galaxies	At the end of this activity, students should be able to: explain the structure of the Galaxy, – describe the characteristics of star clusters, – describe the classification of galaxies.
	The Universe	At the end of this activity, students should be able to: describe the methods of observation of the Universe, – state Hubble's Law, – explain the concept of CMB radiation, – provide a short characteristic of the Big Bang concept and describe the cosmological models.

CHAPTER	LESSON	DESCRIPTION
I. States of Matter	**Basic Properties of Matter**	At the end of this activity, students should be able to: explain what matter is and describe its structure, specify the state of matter for various substances, define density, measure or calculate the volume of solids and liquids, calculate the density of a substance given its mass and volume, name the basic properties of solids, liquids and gases and discuss the differences between them.
	Gases	At the end of this activity, students should be able to: describe the structure of gases – name the characteristic properties of gases and describe them using the concept of particles (occupying a space of any shape, mixing, compressibility, expansibility, pressure) – explain what influences the pressure of a gas – describe the relationship between the size of gas particles and the density of the gas.
	Liquids	At the end of this activity, students should be able to: represent the structure of liquids and describe their characteristic properties using the particle concept – explain the importance of the ability of liquids to change shape – explain the purpose of a hydrometer – calculate the density of a liquid after measuring its volume and mass.
	Solids	At the end of this activity, students should be able to: illustrate the structure of solids and describe their characteristic properties using the concept of particles – determine the hardness of a solid body on the basis of its behaviour in relation to Mohs' hardness scale for minerals – describe the differences in the structure of matter in its different physicalstates (distance between particles, forces of attraction, energy of particles, mobility of particles).
	Changes of State	At the end of this activity, students should be able to: give definitions of individual changes of state and the temperatures at which they occur – describe the progress of a change of state using the concept of particles – give examples of changes of state that occur in nature and in everyday life.
	Physical Changes Accompaying Heating and Cooling	At the End of This Activity, Students Should Be Able to: draw the heating curve and cooling curve for a substance and describe them in detail – show the changes in volume and density undergone by most substances during heating or cooling – explain the concept of thermal expansion of bodies and what causes it – describe the changes in the volume and density of water in the three basic states of matter, and explain why ice has a lower density than liquid water – give examples of how the knowledge of thermal expansion of bodies is applied.
	Diffusion and Dissolving	At the end of this activity, students should be able to: describe the phenomenon of diffusion – demonstrate the process of diffusion between substances in different states of matter – name the factors that affect the rate of diffusion and explain the relationship between them – indicate examples of diffusion in the immediate surroundings – describe the process of dissolution and define the terms solvent, solute and solution – name the factors that affect the process of dissolution and describe their effect.
	Gas Laws. Part I	At the end of this activity, students should be able to: name the units used to express gas temperatures and pressures – discuss the relationship between the pressure, temperature and volume of gas – quote Boyle's law and Charles's law – solve calculation problems requiring a knowledge of the gas laws: Boyle's law and Charles's law.
	Gas Laws. Part II	At the end of this activity, students should be able to: discuss the relationship between the volume of a gas and its temperature – quote Gay-Lussac's law – do calculations requiring the application of Gay-Lussac's law – define isobaric, isochoric and isothermal changes and name the gas laws that govern these changes – write the equation describing the relationship among pressure, volume and temperature of a gas – transform the equation of state according to the problem to be solved.

CHAPTER	LESSON	DESCRIPTION
II. Elements, Compounds and Mixtures	**Elements**	At the end of this activity, students should be able to: discuss the different types of matter – explain the difference between a pure substance and a mixture – discuss the different types of pure substance – write the symbols of the most important elements – discuss the properties of metals and nonmetals – name the properties of metals that make them different from nonmetals – the properties of metalloids.
	Chemical Compounds	At the end of this activity, students should be able to: define a chemical compound – define a molecule – define a molecular formula – indicate the difference between a molecular formula and an empirical formula – determine the empirical formula based on the percentage composition of a compound – demonstrate, using an example, that the properties of a chemical compound are different from those of the elements that compose it.
	Mixtures	At the end of this activity, students should be able to: discuss the different types of mixture – establish whether a mixture is homogeneous or heterogeneous – define a solution – say what decantation and sedimentation involve – say what centrifugation and evaporation involve – say what crystallisation involves – say what chromatography involves – discuss the uses of chromatography.
III. Atomic Structure	**Early Atomic Theories**	At the end of this activity, students should be able to: give the main postulates of Dalton's atomic theory – discuss the atomic model proposed by Dalton – discuss the atomic model proposed by Thomson – discuss and interpret the experiment using gold foil – discuss the Rutherford model of the atom – discuss the component particles of the atom (electron, proton, neutron).
	The Structure of the Atom	At the end of this activity, students should be able to: say what information can be obtained from the atomic number – determine the number of protons and the total number of electrons in an atom on the basis of the atomic number – determine the composition of atomic nuclei, given the atomic number and the mass number – explain the term isotope – discuss the similarities and differences between hydrogen isotopes – calculate the percentage abundance of a given isotope.
	Relative Atomic Mass	At the end of this activity, students should be able to: give a definition of atomic mass unit – explain the terms atomic mass and molecular mass – find atomic masses of elements in the periodic table – calculate the atomic mass of an element taking into account its isotopic composition – calculate the isotopic composition of an element on the basis of its atomic mass – explain why it is useful to know the atomic masses of elements.
	Continuous and Line Spectra	At the end of this activity, students should be able to: explain the phenomenon of light – describe and interpret an experiment involving the passing of white light through a prism – discuss the electromagnetic spectrum – describe the atomic spectrum of hydrogen – describe atomic spectra of other elements – discuss the application of flame tests.
	The Bohr Model of the Atom	At the end of this activity, students should be able to: discuss the Bohr model of the atom – define atomic energy levels – discuss the ground state and excited states of the hydrogen atom – explain the formation of the spectral lines in the atomic spectrum of hydrogen – discuss the process of ionization.
	The Electron Configuration of an Atom	At the end of this activity, students should be able to: state the arrangement of electrons in the individual subshells of an atom – write the electron configuration of an atom, knowing its atomic number – give the principles of the classification of elements in the periodic table – determine which group and period a given element belongs to on the basis of its electron configuration – determine the electron configuration of an element knowing its position in the periodic table – describe the formation of positive and negative ions.

CHAPTER	LESSON	DESCRIPTION
IV. Bonding	**Ionic Bonding. Part I**	At the end of this activity, students should be able to: explain how ionic compounds are formed using the example of sodium chloride – describe the structure of sodium chloride in the solid state – compare the properties of sodium, chlorine and sodium chloride – solve simple problems concerning ionic bond formation.
	Ionic Bonding. Part II	At the end of this activity, students should be able to: discuss the nature of ionic bonds – predict the type of ion formed by Group 1 and 2 metals and the more important Group 16 and 17 nonmetals – describe the structure of an ionic crystal lattice – name the characteristic properties of ionic compounds and explain how they arise.
	Covalent Bonding. Part I	At the end of this activity, students should be able to: discuss the formation of covalent bonds – indicate which elements form covalent bonds – explain the terms: Lewis dot-and-cross diagrams, structural formula and molecular formula – name the non-metals that occur in nature in the form of diatomic molecules – illustrate simple diatomic molecules using molecular formulae, structural formulae and Lewis diagrams – explain how multiple bonds are formed.
	Covalent Bonding. Part II	At the end of this activity, students should be able to: give the definition of valence – write down the formula for a molecule, knowing the valences or ionic charges – give examples of diatomic and polyatomic molecules – know that carbon atoms can form single, double or triple bonds with one another.
	Simple and Giant Molecular Solids	At the end of this activity, students should be able to: describe the structure of the crystal lattice of covalent compounds – define the terms simple molecular solid and giant molecular solid – give some examples of simple and giant molecular solids – describe the properties of elements and compounds forming simple molecular solids and giant molecular solid crystals – explain why certain giant molecular solids conduct electricity, and give examples of such solids.
	Allotropes	At the end of this activity, students should be able to: explain the phenomenon of allotropy – give examples of elements that occur in different allotropic forms – describe the allotropic forms of carbon, oxygen and sulphur – describe the physical properties of diamond and graphite – give examples of the uses of graphite and diamond – discuss the role of ozone in nature.
	Metallic Bonding	At the end of this activity, students should be able to: identify metals – describe the characteristic physical properties of metals – describe the position of metals in the periodic table and recall their electron configurations – describe the nature of metallic bonding based on the 'electron sea' model – explain how the properties of metals arise from their inner structure.
	Alloys	At the end of this activity, students should be able to: define alloys – give examples of iron, aluminium, copper and tin alloys – describe some uses of steel, brass, bronze and Duralumin – explain why alloys have different properties from pure metals.
V. Representing Chemical Reactions	**Chemical and Physical Change**	At the end of this activity, students should be able to: explain what a physical change and a chemical change involve – give examples of physical changes and chemical changes – discuss the methods for representing a chemical change – define the terms: reactant and product and identify them in a chemical equation.
	Chemical Equations	At the end of this activity, students should be able to: describe how the number of molecules and the number of atoms in a molecule are indicated – write down a simple chemical reaction using symbols for elements and formulae for compounds – balance simple chemical equations using stoichiometric coefficients – explain how the physical states of reactants are indicated in chemical equations – give the definition of a stoichiometric coefficient.

CHAPTER	LESSON	DESCRIPTION
	Reaction Types	At the end of this activity, students should be able to: explain the following reaction types: combination, decomposition, displacement, precipitation, neutralisation, oxidation reaction and reduction reaction, exothermic reaction, endothermic reaction, reversible reaction and irreversible reaction – name the type of reaction, given a chemical equation.
VI. Quantitative Aspects of Chemical Reactions	**Atomic and Molecular Mass**	At the end of this activity, students should be able to quote the law of conservation of mass and explain it on the basis of the particularity of matter, explain the terms: atomic mass and molecular mass, read the atomic masses of elements from the periodic table, calculate the molecular masses of chemical compounds, obtain information about the quantitative composition of chemical compounds from their molecular formulae, and use the different ways of representing the composition of substances.
	The Mole	At the end of this activity, students should be able to: the unit of quantity of matter – the mole – Avogadro's number – the molar mass – calculating the number of moles – interpreting molecular formulae in terms of moles – empirical formulae – calculating the percentage composition of a chemical compound.
	Using the Mole Concept	At the end of this activity, students should be able to: write a chemical equation using the molar interpretation – solve simple problems using the mole concept – calculate the mass of products or reactants in a chemical reaction – calculate the volumes of gaseous products – solve simple problems using the concept of molarity – calculate the molarity of an acid or base using acid-base titration.
VII. Acids, Bases and Salts	**Properties of Acids**	At the end of this activity, students should be able to: explain the properties of acids – name a few uses of acids – describe the structure of acids – give the definition of dissociation and understand this process – describe the dissociation of weak and strong acids.
	Properties of Bases	At the end of this activity, students should be able to: give the definition of a hydroxide – describe the properties of bases – describe the uses of bases – determine the structure of bases – give a definition of dissociation – define the terms 'strong' and 'weak' bases and describe their behaviour in water.
	Indicators and pH	At the end of this activity, students should be able to: state the purpose of indicators – determine the pH of a solution using an indicator – determine the acidity or alkalinity of a solution using the pH scale – indicate the colours corresponding to alkaline, neutral and acidic solutions on the pH scale – identify strong and weak acids and strong and weak alkalis on the basis of the pH value of their solutions – discuss the applications of pH measurements.
	Neutralisation Reactions	At the end of this activity, students should be able to: explain what neutralization involves and how it is carried out – determine the molecular formula of a salt – name salts – balance equations for neutralization reactions – discuss the practical applications of neutralisation reactions.
	Salts	At the end of this activity, students should be able to: give examples of salts occurring in nature – give examples of some uses of salts – discuss the dissociation of salts and specify the types of ion present in a solution of a salt – describe the reaction between a metal and an acid at the macroscopic and microscopic levels – discuss precipitation reactions, using appropriate examples – classify some common salts as soluble or insoluble – describe the thermal decomposition of carbonates.
	Reactions of Acids and Bases	At the end of this activity, students should be able to: discuss reactions between nonmetal oxides and water – discuss reactions between bases and nonmetal oxides – discuss reactions between acids and metal oxides – discuss reactions between carbonates or hydrogencarbonates and acids – discuss reactions between acids and a solution of ammonia.

CHAPTER	LESSON	DESCRIPTION
	Acid-Base Titration	At the end of this activity, students should be able to: describe the principles of titration and how it is carried out – discuss the aims of titration – calculate the mass of a solute – determine the concentration of a solution by titration – calculate the mass of solute in a titrated sample.
VIII. Water and Water Solutions	**Properties of Water**	At the end of this activity, students should be able to: describe the structure of the water molecule – explain the process of formation of hydrogen bonds – describe the process of dissolution of ionic compounds (electrolytic dissociation) – list methods for detecting the presence of water – explain what distilled water is – discuss the effect of the presence of other substances in water on water's freezing and boiling points.
	Solubility in Water	At the end of this activity, students should be able to: define the terms: saturated solution, solubility, crystallisation, solubility curve – describe the dissolution of gases, liquids and solids in water and discuss the effect of various physical factors on this process – use a solubility curve to find the number of grams of a solute that will be dissolved at a specific temperature and perform simple calculations using the data obtained from this graph.
	Natural Waters	At the end of this activity, students should be able to: explain what hard water is, the causes and types of water hardness – describe the methods for eliminating temporary and permanent hardness from water – name the main water pollutants and the sources of this pollution – describe methods for removing water pollution caused by petroleum and petroleum products – name the main processes carried out during water treatment – describe the main steps in wastewater purification.
	Colloids. Washing in Water	At the end of this activity, students should be able to: explain what colloids are – name the properties that distinguish colloids from other types of mixture (true solutions and suspensions) – list the types of colloid and give examples of them – explain what emulsifying agents are and what coagulation involves – explain how soap and detergents remove dirt – describe the behaviour of soap and detergents in hard water.
IX. The Periodic Table and Chemical Properties of the Elements	**The Periodic Table**	At the end of this activity, students should be able to: give the criteria for the classification of the elements in the periodic table – state the group in which a given element occurs on the basis of the number of its valence electrons, and vice versa – state the period in which a given element occurs on the basis of the number of electron shells, and vice versa – determine whether a given element is a metal, a metalloid or a nonmetal from its position in the periodic table – give examples of similarities in the properties of elements within a given main group – give examples of periodic changes in the properties of elements that occur in the same period.
	Noble Gases	At the end of this activity, students should be able to: write the electron configuration of the first three elements of Group 18 – describe the trends in the melting points, boiling points and densities in Group 18 – state the relationship between their atomic structure and the properties of the noble gases – account for the chemical inertness of the noble gases – give an example of a compound of a noble gas – give examples of the uses of the noble gases.
	Alkali Metals	At the end of this activity, students should be able to: describe the electron configuration of the alkali metals – describe the trends in the melting points and the boiling points of Group 1 elements – describe the trends in the density of Group 1 elements – explain the relationship between the atomic structure and the properties of the alkali metals – describe the trends in the reactivity of the alkali metals – describe the trends in the atomic radii of the Group 1 metals.

CHAPTER	LESSON	DESCRIPTION
	Reactions of Alkali Metals	At the end of this activity, students should be able to: describe the electron configuration of alkali metals – write equations for the reactions of alkali metals with water, the halogens and oxygen – know the relationship between the structure of the halides of alkali metals and their properties – know the relationship between the structure of the oxides of alkali metals and their properties – describe the uses of alkali metal compounds.
	Alkaline Earth Metals. Group 2	At the end of this activity, students should be able to: describe the electron configuration of Group 2 metals – write equations for the reactions of the alkaline earth metals with water and oxygen – describe the relationship between the structure of the Group 2 elements and their chemical and physical properties – compare the reactivity of the metals of Groups 1 and 2 of the periodic table.
	Halogens. Group 17	At the end of this activity, students should be able to: represent the electron configuration of the elements of Group 17 – explain the formation of halogen molecules – compare the solubility of halogens in water and in hexane and give reasons for the differences – describe the trends in the melting points and boiling points in Group 17 – describe the relationship between the atomic structure and the physical properties of the elements – mention the uses of halogens and their compounds.
	Reactions of the Halogens	At the end of this activity, students should be able to: account for the high reactivity of the halogens – describe the trend in the reactivity with increasing atomic number of the halogens within the group – explain why chlorine is more reactive than bromine – write equations for reactions of halogens with metals and hydrogen – account for the acidic character of hydrogen halides – mention the most important properties and applications of hydrochloric acid – predict whether a molecule of a given halogen will react with a simple ion of another halogen.
	Transition Elements	At the end of this activity, students should be able to: describe the position of the transition elements in the periodic table – give examples of transition elements – describe the basic physical properties of transition elements – name the properties that are characteristic of transition elements – give examples of transition elements used as catalysts.
X. Reactivity of Metals	**The Reactivity Series**	At the end of this activity, students should be able to: explain what the reactivity series of metals is and what can be predicted from it – determine the reactivity of a metal from its position in the reactivity series – describe how metals react with hydrochloric acid, cold water, steam and oxygen – state which metals displace hydrogen from acids on the basis of the reactivity series – explain what noble metals are and what chemical properties they have in common.
	Reactions Involving Metals	At the end of this activity, students should be able to: use the reactivity series to predict the direction of displacement of metals by other metals from solutions of their salts – know that metal ores occur in the Earth's crust – know how metals are extracted from their ores – know that the method for the extraction of a particular metal from its ore depends on the reactivity of this metal – explain what the process of corrosion involves – name the factors that influence the rate of corrosion of iron – explain how to prevent corrosion.
	Electrochemical Cells	At the end of this activity, students should be able to: define a voltaic cell; - explain the structure and the principles of a voltaic cell – give an example of a chemical reaction that occurs in a cell – write equations for half-reactions in a voltaic cell – discuss the principles of a fuel cell – discuss the practical applications of voltaic cells and fuel cells.

CHAPTER	LESSON	DESCRIPTION
XI. Electrolysis	Conductivity of Electrolytes	At the end of this activity, students should be able to: know why some substances conduct an electric current in the molten state or in aqueous solutions – know what electrolytes are – explain how to distinguish between an electrolyte and a non-electrolyte – give examples of electrical conductors – determine which ions are present in a molten salt – specify which ions are present in a solution of an electrolyte.
	Electrolysis	At the end of this activity, students should be able to: say what electrolysis is and how it is carried out describe the apparatus for carrying out electrolysis identify the cathode and anode in an operating electrolyzer determine the products of electrolysis of typical molten salts and typical aqueous solutions write equations for the electrode reactions that occur during the electrolysis of typical solutions.
	Applications of Electrolysis and Calculations Connected with Electrolysis	At the end of this activity, students should be able to: describe how the electrolysis of brine proceeds , explain what electroplating involves, name the uses of electrolysis, calculate the quantity of product prepared by an electrolysis, calculate the time during which electric current must be applied to yield a given amount of a product by electrolysis.
XII. Organic Chemistry	Alkanes	At the end of this activity, students should be able to: indicate which compounds are classed as organic compounds, on the basis of their chemical formulae, explain the terms: hydrocarbons, saturated hydrocarbons, alkanes and homologous series, give the names and formulae of the individual members of the homologous series of alkanes containing from 1 to 10 carbon atoms.
	Isomerism of Alkanes	At the end of this activity, students should be able to: define the terms isomerism and isomers, explain what alkyl groups are and give the names of alkyl groups corresponding to individual members of the homologous series of alkanes, name simple isomers of straight chain alkanes that have one substituent or several substituents of the same type, and isomers that have different substituents, explain why straight chain alkanes are characterised by higher boiling and melting points than their branched isomers.
	Alkenes	At the end of this activity, students should be able to: explain the term unsaturated hydrocarbons or alkenes, give the names and formulae of simple alkenes and isomers that differ in the position of the double bond, describe the addition reactions of bromine and hydrogen to alkenes, discuss the rules of nomenclature for brominated derivatives of alkenes.
	Alcohols	At the end of this activity, students should be able to: explain what alcohols are, give names and formulae for common monohydric alcohols, describe the methods for obtaining ethanol, and discuss its uses, describe the reaction between ethanol and sodium, and the dehydration reaction, give examples of dihydric and trihydric alcohols.
	Carboxylic Acids	At the end of this activity, students should be able to: explain what carboxylic acids and esters are, give the names and formulae of common carboxylic acids, discuss the chemical properties of carboxylic acids (acidity of aqueous solutions), write down the reactions of ethanoic or methanoic acid with magnesium, copper(II) oxide and carbonates, give examples of higher fatty acids, discuss the structure of soaps, write down the reaction for esterification and specify the conditions under which it proceeds.
XIII. Chemical Reactions	Endothermic and Exothermic Reactions	At the end of this activity, students should be able to: describe the phenomenon of energy transfer in a chemical reaction, define exothermic and endothermic reactions, identify exothermic and endothermic reactions, draw energy diagrams, do simple calculations associated with energy transfer during a chemical reaction.
	Reversible Reactions and Chemical Equilibrium	At the end of this activity, students should be able to: know what irreversible and reversible processes are, give examples of reversible and irreversible processes, explain the state of dynamic equilibrium, know what factors affect equilibrium, apply Le Chatelier's principle in reversible reactions

CHAPTER	LESSON	DESCRIPTION
	Reaction Rate	At the end of this activity, students should be able to: define reaction rate as the change of concentration of reactants or products with time, give examples of fast and slow reactions, draw a graph showing changes of concentration with time, find reaction rates from given experimental data, describe the basic methods for the determination of reaction rates, describe the economic importance of reaction rates.
	Factors Affecting Reaction Rate	At the end of this activity, students should be able to: explain the collision theory give the factors affecting chemical reaction rates propose methods for increasing a reaction rate define a catalyst.
	Catalysts	At the end of this activity, students should be able to: define catalysts, explain the concept of activation energy, explain the mechanism of catalyst action, give examples of applications of catalysts, identify the benefits of using catalysts in industry.
	Enzymes – Biological Catalysts	At the end of this activity, students should be able to: explain how to significantly increase the reaction rate, define enzymes and give examples of them, describe the action of enzymes and their importance in everyday life, explain the process of fermentation, define biotechnological process, give an example of biotechnological process.
XIV. Useful Products From Organic Sources	**Fossil Fuels and Crude Oil**	At the end of this activity, students should be able to: understand the role of fossil fuels, know the origin of fossil fuels, know the location of the main deposits of fossil fuels in the world, understand the fractional distillation process.
	Cracking and Combustion of Hydrocarbons	At the end of this activity, students should be able to: know and understand the cracking process, understand what octane rating means, know the products from the complete and the incomplete combustion of hydrocarbons.
	Polymers	At the end of this activity, students should be able to: define the terms - monomer, polymer, polymerization, describe the structures of polymers and classify them according to the structure of macromolecules, define a copolymer, indicate everyday objects that are made of plastic, mention the basic properties of polymers, explain the terms thermoplastics and thermosetting plastics, describe the uses of at least three different polymers.
	Environmental Impact of Oil Products	At the end of this activity, students should be able to: know how to identify the products from the complete combustion of hydrocarbons, understand the origin of unwanted industry-related effects in the atmosphere, know what we could do to combat the greenhouse effect, acid rains, increasing amounts of plastic litter, understand the difference between total and incomplete combustion of hydrocarbons.
XV. Useful Products from Rocks	**Metals from Metal Ores**	At the end of this activity, students should be able to: mention the most important chemical elements which make up the Earth's crust, give the names of minerals that contain iron, aluminum, titanium and copper and write their chemical formulas, predict, on the basis of the reactivity series of the metals, whether a given metal can displace another metal from its compounds, discuss the methods for metal extraction from ores.
	Iron	At the end of this activity, students should be able to: describe the method for the extraction of iron in a blast furnace, explain the production process for steel, describe the corrosion of iron and steel, describe methods for the protection of iron and steel against corrosion.
	Aluminum	At the end of this activity, students should be able to: name the ores of aluminum, describe the process of extracting aluminum from bauxite, using aluminum as an example, discuss the phenomenon of passivation, mention the most important uses of aluminum, explain how aluminum is recycled and indicate the benefits of this process.

CHAPTER	LESSON	DESCRIPTION
	Copper and Titanium	At the end of this activity, students should be able to: name the minerals that contain copper and titanium, discuss methods for the extraction and refining of copper, describe the method for the extraction of titanium, explain why titanium and copper do not corrode, state the uses of copper and titanium.
	Industrial Uses of Limestone	At the end of this activity, students should be able to: name the types of rock that contain calcium carbonate, describe the reactions that occur in limestone in the presence of carbon dioxide and water, explain what quicklime and slaked lime are and how they are prepared, explain the terms mortar, cement, concrete and glass, describe the methods of preparation and applications of these materials.
	Sulfur and Sulfuric(VI) Acid	At the end of this activity, students should be able to: name the principal minerals that contain sulfur, discuss the properties of sulfur, describe the methods for the extraction and the combustion reactions of sulfur, discuss the process for manufacturing and the hygroscopic properties of sulfuric(VI) acid, discuss the uses of sulfur and sulfuric(VI) acid, describe the effect of sulfur dioxide on living organisms and on the process of corrosion.
XVI. Useful Products from Air	**Air**	At the end of this activity, students should be able to: name the constituents of clean air, name the pollutants of air, their sources and environmental impact, explain the terms 'acid rain' and 'smog', discuss the preparation of oxygen and nitrogen from air, describe the properties of oxygen and its applications.
	Ammonia and Nitric Acid	At the end of this activity, students should be able to: describe the properties of nitrogen, and its uses, describe the properties of ammonia and the method for its synthesis on an industrial scale, describe the properties of nitric(V) acid and the steps in its preparation from ammonia, give the definition of reaction yield and be able to use it in simple calculations.
	Fertilizers	At the end of this activity, students should be able to: discuss the structure of soil, name the basic elements essential for plants and discuss their effect on plants, give natural and artificial sources of these elements, describe the processes for preparing basic artificial fertilizers containing nitrogen, phosphorus and potassium, describe the effect of fertilizers on water basins or reservoirs, and ways of preventing the pollution of surface water with fertilizers.
XVII. Food and Drugs	**Carbohydrates**	At the end of this activity, students should be able to: give the definitions of carbohydrates, mono-, di- and polysaccharides, describe the structures of glucose, fructose, sucrose, starch, cellulose and glycogen, describe the properties of these compounds and give reactions for their identification, discuss the importance of carbohydrates in the diet.
	Proteins	At the end of this activity, students should be able to: describe what amino acids, polypeptides and proteins are, discuss the spatial structure of proteins, explain the phenomenon of denaturation and name the factors that cause it, describe the color reactions used for the detection of proteins.
	Fats	At the end of this activity, students should be able to: describe the structure of a fat molecule, classify fats according to their physical state, origin and structure, describe the reactions of saponification and the hardening of oils, give the uses of fats.
	Food and Drugs	At the end of this activity, students should be able to: explain what vitamins are and classify them as water-soluble or fat-soluble, mention some sources of vitamins, discuss methods for protecting food against the adverse effect of bacteria and oxygen, explain the terms: avitaminosis, hypervitaminosis, antivitamin, functional food, antibiotics.

CHAPTER	LESSON	DESCRIPTION
XVIII. Chemistry and the Earth	The Structure of the Earth	At the end of this activity, students should be able to: define the relative positions of the Earth, Moon and Sun in the Universe, name the layers of the Earth, describe the properties of the main layers within the Earth, compare the abundance of elements in the Earth's crust and in the whole of the Earth, specify the sources of information used to determine the structure of the inner part of the Earth, describe how density, pressure and temperature vary with depth from the surface, specify the position of the magnetic poles of the Earth.
	Tectonic Plates	At the end of this activity, students should be able to: say what tectonic plates are and describe their properties, explain why tectonic plates shift, explain what happens in places where the edges of tectonic plates meet, describe what divergent, convergent and transform boundaries are, give evidence for the expansion of the ocean floor, present the evidence for the changes in the Earth's magnetic field in the past, say how continents move, give the evidence for continental drift.
	Tectonic Movements, Earthquakes and Volcanoes	At the end of this activity, students should be able to: explain how volcanoes form, explain why earthquakes occur and describe where they occur most often, show the location of volcanoes on the Earth, using a map with the tectonic plates marked on it, show the location of seismic zones on the Earth, using a map with the tectonic plates marked on it, describe the effect of the processes involving tectonic plates on the formation of volcanoes and earthquakes, describe the applications of the Richter scale.
	Igneous Rocks	At the end of this activity, students should be able to: explain what minerals are, what rocks are composed of and what is the difference between a rock and a mineral, explain which chemical compounds are the principal components of magma, explain how igneous rocks are formed and classify them according to the form of their crystals, distinguish between intrusive and extrusive rocks, give examples of the most common igneous rocks and explain the differences between them, list the characteristic properties of igneous rocks, know the applications of igneous rocks.
	Sedimentary Rocks. Part I	At the end of this activity, students should be able to: explain what weathering is and list the factors that influence this process, name and describe the types of rock weathering, give examples of physical, chemical and biological weathering, explain what erosion involves and give examples of different forms of erosion, name the ways in which weathered rocks are transported, discuss rock transportation by water, wind and glaciers, explain the origin of sediments on sea and ocean floors.
	Sedimentary Rocks. Part II	At the end of this activity, students should be able to: explain how sedimentary rocks were formed, account for the order in which rock layers are arranged, explain how fossils were formed, determine the age of rock layers on the basis of the fossils found in them, give examples of the most common sedimentary rocks and explain the differences between them, name the characteristic properties of sedimentary rocks, describe the principal component of limestone rocks.
	Metamorphic Rocks and Circulation of Rock Material	At the end of this activity, students should be able to: explain how metamorphic rocks are formed, give examples of the most common metamorphic rocks, mention the characteristic properties of metamorphic rocks, discuss the 'rock cycle', recognize the basic types of rock on the basis of their characteristic properties.
	The Atmosphere	At the end of this activity, students should be able to: explain how the Earth's atmosphere evolved before reaching its present composition, describe the approximate percentage composition of the atmosphere at present, discuss the structure of the atmosphere, describe the process of formation of radicals by the break-up of a covalent bond, explain how chlorine radicals can deplete the ozone layer, explain the effect of the ozone-hole expansion on human health, explain how the ozone layer is formed, describe the causes of the greenhouse effect, and what impact it could have on the living conditions on Earth.

CHAPTER	LESSON	DESCRIPTION
	Oceans	At the end of this activity, students should be able to: explain how the oceans were formed, explain the origin of salts in the oceans, list the characteristic properties of sea water, list the most abundant ions in sea water, discuss the concentration of salts in oceans, discuss salinity balance, discuss the role of the oceans in maintaining the composition of the atmosphere, discuss the economic importance of the oceans.
XIX. Laboratory Techniques and Analytical Tests	**Handling Liquids**	At the end of this activity, students should be able to: explain the purpose of a graduated cylinder, pipette and burette and describe how they are used, describe how to transfer a liquid from a bottle to a beaker, carry out a temperature measurement and determination of the pH and odour of a liquid, determine the age of rock layers on the basis of the fossils found in them, heat a liquid in a test-tube in a safe way.
	Handling Solids. Heating	At the end of this activity, students should be able to: describe how solids are stored, give guidelines on how to correctly transfer solids from containers, and how to weigh and crush solids, explain what decantation, filtration and evaporation involve and why these techniques are used, discuss the structure of the Bunsen burner and its safe use.
	Gases: Handling and Laboratory Tests	At the end of this activity, students should be able to: describe the set-up used for collecting gases, prepare equipment for measuring the volume of gases evolved from various chemical reactions, describe methods for obtaining oxygen, hydrogen and carbon dioxide in a chemistry lab and for the identification of these gases, discuss how to use indicator paper when investigating gases.
	Testing for Ions	At the end of this activity, students should be able to: explain what a flame test involves, give the flame colors characteristic of lithium, sodium, potassium, barium, calcium, copper and lead, and be able to distinguish between these metals on the basis of their flame colours, describe simple methods for detecting ammonium, carbonate, sulfate(VI), sulfate(IV) and halide ions.
XX. Safety in the Chemical Laboratory	**Safety in the Chemical Laboratory**	At the end of this activity, students should be able to: recognise the types of hazardous substance on the basis of the hazard symbols, read the hazards involved in contact with a given substance and the guidelines for handling on the basis of the R and S symbols, specify appropriate personal protective equipment, discuss the principles for the safe conduct of experiments, describe the procedure in an emergency.

CHAPTER	LESSON	DESCRIPTION
I. Numbers (1)	**Surds**	At the end of this activity, students should be able to: - understand and use surds. - use basic operations on surds. - simplify expressions with surds. - rationalise a denominator containing surds in fractions.
II. Quadratic Functions	**Quadratic Functions, Graphs**	At the end of this activity, students should be able to sketch the graph of a quadratic function and represent a quadratic function in the general and factorized forms.
	Factoring Quadratic Functions	At the end of this activity, students should be able to write a quadratic function in factor form with integer coefficients and rational x-intercepts, find the vertex of a quadratic function written in factor form, write a quadratic function in vertex form by completing the square and write a quadratic function in vertex form by calculating the determinant of the function
	Quadratic Equations	At the end of this activity, students should be able to solve a quadratic equation using different methods and estimate the roots of a quadratic equation.
	Linear-Quadratic Systems of Equations	At the end of this activity, students should be able to solve one quadratic–one linear systems of equations, find graphical solutions of simultaneous equations and find equations of given graphs.
	Linear-Quadratic Systems of Inequalities	At the end of this activity, students should be able to solve a system of one quadratic–one linear inequality with one unknown, find the union and intersection of sets of numbers satisfying different inequalities, check if the solution of an inequality includes another set of solutions, find the graphic solution of an inequality with two unknowns and find the graphic solution of a system of one quadratic–one linear inequality with two unknowns.
	Quadratic Inequalities	At the end of this activity, students should be able to: solve quadratic inequalities in the vertex form, solve quadratic inequalities by the test-point method, solve quadratic inequalities by the sign graph method, combine inequalities equations.
III. Polynomials	**Writing Polynomials**	At the end of this activity, students should be able to recognize polynomials, determine the degree and coefficients of a polynomial and calculate the value of a polynomial.
	Addition, Subtraction, and Multiplication of Polynomials	At the end of this activity, students should be able to add, subtract and multiply polynomials, find values of the sum, difference and product of polynomials and understand and use the relationship between the degrees of two polynomials and the degrees of their sum, difference and product.
	Division of Polynomials	At the end of this activity, students should be able to perform algebraic operations fluently and add, subtract and multiply polynomials.
	The Factor and Remainder Theorems	At the end of this activity, students should be able to use the factor theorem, use the remainder theorem and do synthetic division of polynomials.
	Factorization of Polynomials	At the end of this activity, students should be able to decompose a simple polynomial into factors with smaller degree, using various methods.
	Factorization and Roots of Polynomials	At the end of this activity, students should be able to find roots of polynomials using factorisation, find rational roots of polynomials with rational coefficients and solve simple polynomial equations and inequalities.

CHAPTER	LESSON	DESCRIPTION
IV. Graphs of Polynomials	**Sketching Graphs**	At the end of this activity, students should be able to estimate the end behavior of a polynomial function, find crucial points for the graph of a polynomial and sketch a rough graph of a polynomial.
	Graphical Solution of Equations (1)	At the end of this activity, students should be able to use graphical methods to solve simple equations and use graphical methods to check algebraic solutions of equations.
	Graphical Solution of Equations (2)	At the end of this activity, students should be able to use graphical methods to solve equations and systems of equations and use graphical methods to check algebraic solutions of equations.
	Graphical Solution of Inequalities (1)	At the end of this activity, students should be able to understand the notion of half-planes, know how to define a half-plane using an inequality and know how to find graphically the solution of an inequality in two variables.
	Graphical Solution of Inequalities (2)	At the end of this activity, students should be able to understand the notion of inequality in two variables as well as find the graphical solution of an inequality in two variables.
	Translations and Graphs	At the end of this activity, students should be able to understand the effect of a translation on a graph of a polynomial as well as understand the effect of a translation on the equation behind the graph.
V. Coordinate Geometry (1)	**Equation of a Straight Line**	At the end of this activity, students should be able to define different positions of a straight line in the coordinate system, read out the gradient and the y-intercept from the formula and the graph, write the equation of a line passing through two points and change one form of the equation of a line to another.
	Parallel and Perpendicular Lines	At the end of this activity, students should be able to recognize parallel lines by comparing their gradients and recognize perpendicular lines by multiplying out their gradients.
	Coordinate Geometry of a Circle	At the end of this activity, students should be able to place the circumference of the circle given by the equation (x − x0)2 + (y − y0)2 = r2 in the coordinate system, place the disc (x − x0)2 + (y − y0)2 ? r2 or (x − x0)2 + (y − y0)2< r2 in the coordinate system, represent the equation of the circle x2 + y2 − 2ax − 2by + c = 0 in the form (x − x0)2 + (y − y0)2= r2 and find the equation of a circle with three points given.
	The Tangent	At the end of this activity, students should be able to understand the notion of a tangent to a circle and a curve and know how to find the equation of the tangent to a given circle at a given point.
	The Normal	At the end of this activity, students should be able to understand the notion of a normal to a curve and know how to find the equation of the normal to a given simple curve at a given point.
	Intersection points (1)	At the end of this activity, students should be able to find the coordinates of intersection points of a straight line and other figures given by equations.
	Intersection points (2)	At the end of this activity, students should be able to find the coordinates of intersection points of two figures given by equations.

CHAPTER	LESSON	DESCRIPTION
VI. Differentiation (1)	**The Derivative**	At the end of this activity, students should be able to understand the notion of tangent and gradient of a curve, understand what the derivative function is, understand differentiation, recognise a non-differentiable function by its graph and visualise the graph of the derivative knowing the function.
	Differentiation of Simple Functions	At the end of this activity, students should be able to find the derivatives of simple functions y = x^n for any natural n, find th e derivative at a given point from the definition using the graph and recognise graphs of derivatives of simple functions.
	Differentiation of Polynomials	At the end of this activity, students should be able to differentiate functions of the form y = xn for n natural, differentiate a sum of monomials, differentiate a polynomial and sketch the graph of the derivative of a polynomial, knowing the function.
	Finding Slopes, Tangents, and Normals	At the end of this activity, students should be able to use differentiation to find gradients of a curve, find the equation of the tangent to the graph of a polynomial at a given point, find the equation of the normal to the graph of a polynomial at a given point and solve problems by using a tangent to a curve.
	Monotonicity	At the end of this activity, students should be able to recognise increasing and decreasing functions, understand the connection between the sign of the derivative and monotonicity of a function, find intervals of monotonicity and relate the graph of the function to the graph of the derivative.
	Local Extrema, Stationary Points, Critical Points	At the end of this activity, students should be able to understand the notion of local maximum and minimum, understand the notion of stationary point and critical point, use the derivative to find stationary points and find the global maximum and minimum of a function.
	Finding Local Extrema	At the end of this activity, students should be able to find local extrema at points of differentiability, find local extrema at points of non-differentiability and find local extrema in some more complex cases.
	Finding Maximum and Minimum Values	At the end of this activity, students should be able to find maximum and minimum values of a function in both closed and open intervals, if it exists.
	Second-Order Derivatives	At the end of this activity, students should be able to find the second-order derivative of a polynomial, use the second-order derivative to find and classify extrema and decide on extrema when the second derivative is zero.
VII. Integration (1)	**The Anti-Derivative**	At the end of this activity, students should be able to understand the notion of anti-derivative, understand the inverse of differentiation and calculate the integral of xn for natural n.
	Integrating	At the end of this activity, students should be able to understand and use simple laws of integration and integrate polynomials.
	The Definite Integral	At the end of this activity, students should be able to understand the definite integral, evaluate the definite integral of a polynomial and use simple laws of definite integration.
	Area Under the Curve	At the end of this activity, students should be able to use the definite integral to calculate areas delimited by function graphs and straight lines.

CHAPTER	LESSON	DESCRIPTION
VIII. Numbers (2)	**Laws of Indices – Rational Exponents**	At the end of this activity, students should be able to understand and use roots of any order, use powers of any rational exponent and apply laws of indices in calculations.
IX. Graph Transformations	**Transformations of Graphs (1)**	At the end of this activity, students should be able to find the graph of the functions y = f(x) + a and y = f(x + a), given the graph of y = f(x) (a – constant).
	Transformations of Graphs (2)	At the end of this activity, students should be able to: find the graphs of the functions y = a f(x) and y = f(ax), if the graph of y = f(x) is given (a – constant) – find the graph of the function y = a f(bx + c), if the graph of y = f(x) is given (a, b, c – constant values).
X. Sequences and Series	**Sequences**	At the end of this activity, students should be able to find the nth term of a sequence, find the formula for the nth term of a sequence in easy cases, understand the definition of terms depending on previous terms in a sequence and recognize increasing and decreasing sequences.
	Arithmetic Sequence	At the end of this activity, students should be able to define, recognise and use arithmetic sequences.
	Arithmetic Series	At the end of this activity, students should be able to: calculate the sum of the first n terms of a given arithmetic sequence, use the rule for the sum to n of positive integers.
	Geometric Sequence	At the end of this activity, students should be able to define, recognise and use geometric sequences as well as calculate the sum of the first n terms of a given geometric sequence.
	Geometric Series	At the end of this activity, students should be able to find the sum of the first n terms of a given geometric sequence and find the sum of an infinite convergent geometric series.
	Infinite Convergent Geometric Series	At the end of this activity, students should be able to recognise convergent geometric series and calculate the sum of a given convergent geometric series.
	The Binomial Expansion	At the end of this activity, students should be able to: formulate the binomial theorem, perform calculations of the form 1.99^n or positive integer n, know some properties of Pascal's Triangle.
	Binomial Series	At the end of this activity, students should be able to expand (1 + x)^n for rational n and |x|< 1 and use the expansion to calculate approximate values of rational powers and roots.
	Expansion of Rational Functions	At the end of this activity, students should be able to expand a rational function into a series in xn for natural n and apply the series expansion of a rational function to find approximations of its value for a given x.
XI. Trigonometry (1)	**General Angles**	At the end of this activity, students should be able to find the distance covered in a given number of revolutions and understand the notion of general angle as rotation.
	General Angles, Angle Measures	At the end of this activity, students should be able to find the distance traveled during a given number of revolutions, understand the notion of general angle as rotation and convert radian measure to degrees and vice versa.

CHAPTER	LESSON	DESCRIPTION
	Basic Trigonometric Functions	At the end of this activity, students should be able to understand and use the trigonometric functions of a general angle, be able to calculate the trigonometric functions of an angle, given the value of one of the functions, understand the basic trigonometric identities, know how to prove simple trigonometric identities and know how to use some reduction formulas.
	Graphs of Trigonometric Functions	At the end of this activity, students should be able to sketch graphs of trigonometric functions, understand the relation between the formula and the transformation of a graph and apply trigonometric functions in real-world situations.
	Simple Trigonometric Equations	At the end of this activity, students should be able to solve trigonometric equations of the form sinx = a, cosx = a and tanx = a, solve equations of the form psinx = qcosx and solve real-world problems involving equations.
	Solving Simple Trigonometric Equations	At the end of this activity, students should be able to solve equations of the form sin(f(x)) = a, where f is a linear function, solve equations of the form cos(f(x)) = a, where f is a linear function, solve equations by introducing a new variable and solve real world problems involving solving equations.
	The Area of a Triangle	At the end of this activity, students should be able to find the area of a triangle using the formula Area = (a*b*sin a)/2, find the area of a polygon and apply the relation between the area of a triangle and the radius of the inscribed circle.
	The Sine Rule	At the end of this activity, students should be able to find the sides of a triangle using the sine rule, find the angles of a triangle using the sine rule, understand the ambiguous case of the sine rule and apply the sine rule in real world problems.
	The Cosine Rule	At the end of this activity, students should be able to find the missing sides of a triangle using the cosine rule, find the angle of a triangle using the cosine rule and apply the cosine rule in real-world problems (bearings).
	Measuring the Circle	At the end of this activity, students should be able to find the length of an arc, find the area of a sector of a circle, find the area of a segment of a circle and apply the formulas for the length of an arc and the area of a sector in more complex problems.
XII. Exponents and Logarithms	**Exponential Functions**	At the end of this activity, students should be able to draw an exponential function, use properties of exponential functions, apply an exponential function in easy examples and match a transformed graph with a formula.
	Logarithms	At the end of this activity, students should be able to understand the notion of logarithms, change exponential form to logarithmic form, evaluate basic logarithms, apply laws of logarithms, change the base of a logarithm and rewrite logarithms as a single logarithm.
	Basic Exponential Equations	At the end of this activity, students should be able to solve basic exponential equations, use logarithms to solve exponential equations and apply appropriate techniques to solve real-world problems modelled by exponential equations.
	Exponential Inequalities	At the end of this activity, students should be able to solve basic exponential inequalities and use logarithms to solve exponential inequalities.
	The Natural Exponential Function	At the end of this activity, students should be able to recognize an exponential function with the base e, apply an exponential function f(x) = e^x in real-world situations and transform and apply an exponential function f(x) = e^x.

CHAPTER	LESSON	DESCRIPTION
	The Natural Logarithmic Function	At the end of this activity, students should be able to recognise the natural logarithmic function, state the domain and asymptote of a logarithmic function, find inverses of exponential and logarithmic functions and use the logarithmic function in solving problems.
	Exponential Growth and Decay	At the end of this activity, students should be able to model exponential growth, understand the logistic curve model of population growth, understand the process of radioactive decay and use the exponential curve in modelling real-world situations.
XIII. Differentiation (2)	**Derivatives of Powers with Rational Exponents**	At the end of this activity, students should be able to find the derivative of a power with a negative integer exponent, find the derivative of a root and find the derivative of a power with a rational exponent.
XIV. Integration (2)	**Integrals of Powers with Rational Exponent**	At the end of this activity, students should be able to understand and be able to use anti-derivatives and integrals, be able to use simple laws of integration and be able to calculate the indefinite integral of a polynomial.
	Approximation of the Area Under a Curve	At the end of this activity, students should be able to approximate a definite integral using the trapezium rule and approximate the area under a function graph using the trapezium rule.
XV. Functions	**Functions – Basic Notions**	At the end of this activity, students should be able to understand functional dependence, model simple phenomena using right functions, identify the domain of a function and understand the range, represent a simple function in various ways and understand and sketch the graph of a function.
	Composition of Functions	At the end of this activity, students should be able to understand composition of functions, calculate the value of a composite function for a given argument, find the formula for a composite function and identify the domain of a composite function.
	Inverse Functions	At the end of this activity, students should be able to state the existence of an inverse function and define it for a given function (simple cases) and sketch the graph of the inverse function, given the graph of the original function.
	The Absolute Value Function	At the end of this activity, students should be able to - understand the various meanings of the absolute value, understand how to use the absolute value in computations .- understand how to solve simple equalities and inequalities involving the absolute value.
	Transformation of Graphs	At the end of this activity, students should be able to fit the graph of a function to given data by altering the scale on the x or y-axis and by translating the graph along the x or y-axis and find an algebraic representation for the function modified to fit the required graph.
XVI. Trigonometry (2)	**Inverse Trigonometric Functions**	At the end of this activity, students should be able to graph inverses of basic trigonometric functions, list the properties of inverse functions and find an angle, given its trigonometric function.
	Other Trigonometric Functions	At the end of this activity, students should be able to sketch the graphs of the reciprocals of basic trigonometric functions, list the properties of reciprocal functions and graph simple transformations of reciprocal functions.
	Identities For Trigonometric Functions	At the end of this activity, students should be able to understand trigonometric identities introduced in the lesson, use the trigonometric identities to find unknown values of trigonometric functions and use trigonometric identities to prove simple new identities.

CHAPTER	LESSON	DESCRIPTION
	Trigonometric Functions of the Sum and Difference of Angles (1)	At the end of this activity, students should be able to understand the proof for the sine and cosine of the sum and difference of angles, prove trigonometric identities involving sum and difference formulas and use sum and difference formulas to find exact values of trigonometric functions.
	Trigonometric Functions of the Sum and Difference of Angles (2)	At the end of this activity, students should be able to understand the proof for the sum and difference of a linear combination of the sine and cosine, factorise the sum and difference of a linear combination of the sine and cosine and use the sum and difference formulas to solve problems.
	Double-Angle Formulas	At the end of this activity, students should be able to understand the proofs for double-angle formulas, use double-angle formulas to solve problems, rewrite sinA, cosA and tanA in terms of tan and use double-angle formulas to prove trigonometric identities.
XVII. Differentiation (3)	**Derivatives of Exponential and Logarithmic Functions**	At the end of this activity, students should be able to: find the derivative of the natural exponential function, find the derivative of the natural logarithmic function, find the derivative of linear combination of these functions.
	Derivatives of Trigonometric Functions	At the end of this activity, students should be able to find the derivatives of the sine and cosine functions, find the derivatives of the tangent and cotangent functions and find the derivative of a linear combination of trigonometric functions.
	Differentiation Rules (1)	At the end of this activity, students should be able to differentiate the sum and difference of two or more functions, differentiate the product of two functions and differentiate the quotient of two functions.
	Differentiation Rules (2)	At the end of this activity, students should be able to differentiate composite functions.
XVIII. Integration (3)	**Integration of Selected Functions**	At the end of this activity, students should be able to integrate the exponential function, integrate the function x^−1 and integrate the sine and cosine functions.
	Integration Methods (1)	At the end of this activity, students should be able to integrate by substitution and integrate by parts.
	Integration Methods (2)	At the end of this activity, students should be able to calculate the definite integral by substitution and calculate the definite integral by parts.
	Volumes of Revolution	At the end of this activity, students should be able to recognise a solid of revolution, find the volume of a solid of revolution and use the formula for the volume of a cone, the frustum of a cone, a sphere and a one-base segment of a sphere.
XIX. Numerical Methods	**Zeros of a Function**	At the end of this activity, students should be able to find the number of zeros of a function, find intervals with zeros of a function and approximate zeros of a function.
	Approximate Solution of Equations	At the end of this activity, students should be able to use the secant method to find an approximate solution of an equation and use Newton's method to find an approximate solution of an equation.
	Numerical Integration – Mid-Ordinate Rule	At the end of this activity, students should be able to approximate the area under a curve using the mid-ordinate method.

CHAPTER	LESSON	DESCRIPTION
	Numerical Integration – Simpson's Rule	At the end of this activity, students should be able to use Simpson's rule to find the definite integral of a given function.
XX. Rational Functions	**Rational Expressions**	At the end of this activity, students should be able to recognize rational expressions and simplify rational expressions.
	Rational Functions	At the end of this activity, students should be able to recognize rational functions, define the domain of a rational function, find asymptotes of a rational function and recognize graphs of simple rational functions.
	Algebraic Division	At the end of this activity, students should be able to divide one polynomial by another, with a remainder and use the algorithm of polynomial division in various situations.
	Partial Fractions	At the end of this activity, students should be able to recognise partial fractions and decompose a rational expression into partial fractions.
XXI. Coordinate Geometry (2)	**Equations of Curves**	At the end of this activity, students should be able to sketch a curve, given its equation, understand the relationship between an equation and a curve in the coordinate system and recognise a basic curve from its equation.
	Parametric Equations of Curves	At the end of this activity, students should be able to understand parametric equations of curves and find parametric equations of simple common curves
XXII. Differentiation and Integration	**Differential Equations**	At the end of this activity, students should be able to understand the notion of a differential equation, understand the notion of the solution of a differential equation, understand the notion of initial conditions, solve simple differential equations by inspection and solve the simplest differential equations.
	Equations with Separable Variables	At the end of this activity, students should be able to solve linear homogeneous differential equations, solve differential equations with separable variables and find particular solutions of simple differential equations.
	Implicit Differentiation	At the end of this activity, students should be able to: understand the notion of an implicit function, understand the notion of the derivative of an implicit function, differentiate implicit functions.
	Parametric Differentiation	At the end of this activity, students should be able to understand the notion of a parametrically defined function, understand the notion of the derivative of a parametrically defined function and differentiate parametrically defined functions
	Tangents and Normals for Implicitly or Parametrically Defined Curves	At the end of this activity, students should be able to understand the notion of a tangent and a normal to a curve, find the equation of the tangent to a given curve at a given point and find the equation of the normal to a given curve at a given point.
	Integration Using Partial Fractions	At the end of this activity, students should be able to integrate rational functions.
XXIII. Vectors	**Vectors**	At the end of this lesson you should be able to recognize quantities that can be represented by vectors, represent a given vector on the plane or in space in the form of a pair or a trio of numbers and find the magnitude of a given vector on the plane or in space.

CHAPTER	LESSON	DESCRIPTION
	Algebraic Operations on Vectors	At the end of this activity, students should be able to perform vector addition, perform multiplication of a vector by a scalar and apply algebraic operations on vectors to geometry.
	Position Vectors	At the end of this activity, students should be able to understand and use the notion of a position vector, describe the location of points, using vectors and use position vectors to express the basic geometric properties of points and segments in the coordinate system.
	Vector Equations of Lines in 2-D	At the end of this activity, students should be able to represent a line on the plane by its vector equation and transform the vector equation of a straight line into Cartesian form and vice versa.
	Vector Equations of Lines in 3-D	At the end of this activity, students should be able to present a line in space in the form of a vector equation, transform the vector equation of a straight line in 3-D to the Cartesian form and find the intersection points of two lines given in the form of vector equations.
	The Scalar Product (1)	At the end of this activity, students should be able to understand the notion of the scalar product of two vectors and find the scalar product of two vectors in 2-D or 3-D.
	The Scalar Product (2)	At the end of this activity, students should be able to use the scalar product to solve geometrical problems.
	Perpendicular Distance from a Point to a Line	At the end of this activity, students should be able to find the perpendicular distance from a point to a line.

CHAPTER	LESSON	DESCRIPTION
I. Chapter Title	**Lesson Title**	Description
II. Chemistry of Organisms	**Chemical Elements of the Cell**	At the end of this activity, students should be able to define biogenic elements and present their basic role in the formation of organic compounds, explain the meanings of the terms 'macro-elements', 'trace elements' and 'ultra-trace elements' and present examples of the biological significance of these elements, and discuss the most important properties of water (from a biological point of view) and their significance in the world of living organisms.
	Carbohydrates: their Structure, Properties, Occurrence, and Importance	At the end of this activity, students should be able to define carbohydrates, monosaccharides, disaccharides and polysaccharides and give examples of carbohydrates representing these classes, describe the occurrence and functions of the most important carbohydrates, describe the characteristic properties of monosaccharides, disaccharides, storage polysaccharides and structural polysaccharide and explain the reactions of hydrolysis and condensation of carbohydrates and their importance.
	Lipids: Structure, Properties, Occurence, and Importance	At the end of this activity, students should be able to describe the structure of lipids and their major groups, describe the structure of fatty acids and their significance as metabolic fuel and structural components of different groups of lipids, - describe the structure of a triacylglycerol molecule and the role of triacylglycerols in living organisms, understand the bipolar character of the structure of phospholipid molecules and its biological significance and describe the importance of cholesterol as a component of cell membranes and a substrate for the synthesis of steroid hormones and vitamin D3.
	Proteins	At the end of this activity, students should be able to present the general structure of amino acids, describe the formation of a peptide bond, describe four levels of organization of protein molecules and explain how they are formed and explain the significance of the primary structure of protein in the configuration of proteins.
	Biochemical Tests, Chromatography, Electrophoresis, and Separation of Tissues	At the end of this activity, students should be able to know how to detect sugars, reducing sugars, polysaccharides, fats and proteins in biological material, define electrophoresis and describe the components of an electrophoresis unit and the principles of electrophoretic separation, define chromatography and describe the components of a paper chromatography unit and explain the concept of relative front and its application in chromatography.
III. Basics of Cytology	**Morphology of Prokaryotic and Eukaryotic Cells as Seen under the Light Microscope**	At the end of this activity, students should be able to describe the differences in the structure of eukaryotic and prokaryotic cells, describe the similarities and differences between eukaryotic cells, determine the size of objects using the light microscope, determine the number of cells using the light microscope and explain how the transport of respiratory gases is organized.
	Current Techniques in Cytology	At the end of this activity, students should be able to describe the principles of light and electron microscopy and centrifugation and give examples of specific areas of biological research in which the above techniques can be applied.
	Cell Ultrastructures	At the end of this activity, students should be able to describe the structure and functions of the nucleus, cytoplasm and cytosol, define the structure and functions of rough endoplasmic reticulum (RER), SER (smooth endoplasmic reticulum), ribosomes, the Golgi body and the cytoskeleton, describe the structure and role of cell wall and membrane, define the structure and function of the mitochondrion, chloroplast and vacuole and describe the structure of the cell and the basic roles of cellular organelles.
	Specialization of Cells	At the end of this activity, students should be able to define the features of stem cells, explain determination and differentiation of cells and tissues of cells and tissues and name the basic characteristics of such cells and name and discuss examples of differentiated cells in animals and plants.

CHAPTER	LESSON	DESCRIPTION
	Transport Across Membranes	At the end of this activity, students should be able to describe, compare and contrast the processes of osmosis and diffusion, know the principles of Fick's first law, explain the importance of passive and active transport and cytosis and explain the following terms: "isotonic", "hypotonic" and "hypertonic", "water potential", "osmotic potential" and "osmotic pressure".
	Cell Division – Mitosis	At the end of this activity, students should be able to describe the process of mitosis, describe the cell cycle, describe changes in chromosome structure during the cell cycle and mitosis and explain the importance of mitosis.
	Cell Division – Meiosis	At the end of this activity, students should be able to describe the process of meiosis, describe changes in chromosome structure during the cell cycle and meiosis, explain the importance of meiosis and explain the differences between mitosis and meiosis.
IV. Taxonomy	**Taxonomy**	At the end of this activity, students should be able to prepare a simple classification of species based on their characteristics, understand the reasons for the differences between the various systems of classification of living organisms, explain the cardiac cycle, know the principles of classification of species based on their phenotypical characteristics and the properties of their genome and understand the importance of the degree of kinship and phylogeny in the classification of species.
	Prokaryotes – Simple Organisms with No Nucleus	At the end of this activity, students should be able to name the basic characteristics of prokaryotes, name the basic differences between Archaea and Eubacteria, name the basic differences between Gram-positive and Gram-negative bacteria and recognise the basic types of bacteria.
	Protista	At the end of this activity, students should be able to describe the basic characteristics of eukaryotes and protests, name the basic differences between protists and tissue organisms, differentiate between the groups of protests, list the diverse modes of adaptation to environmental conditions developed by protests and list the diverse modes of reproduction in protists.
	Fungi	At the end of this activity, students should be able to describe the basic features of fungi and differentiate between the basic phyla of fungi, recognise the different types of adaptations to the environment in fungi, recognise the similarities in the methods of reproduction in fungi and describe the significance of fungi in nature.
	Plants	At the end of this activity, students should be able to indicate the basic features of plants, distinguish the basic groups of plants, recognise the diversity of plant forms and recognise the similarities and differences in the life cycles of bryophytes, pteridophytes and seed plants.
	Animals – the Invertebrates	At the end of this activity, students should be able to recognise the variety of adaptations in the invertebrate groups, indicate, using selected examples, the characteristic features of each invertebrate group, assign animals to a specific invertebrate group and recognise the structural and functional similarities and differences in selected examples of the invertebrate groups.
	Animals – the Vertebrates	At the end of this activity, students should be able to recognize the multitude of adaptations of particular vertebrate groups, indicate the characteristic features of vertebrate groups using examples, place particular animals into the correct vertebrate groups and recognize the similarities in structure and function in selected examples of vertebrate groups.

CHAPTER	LESSON	DESCRIPTION
V. Metabolism	**Enzymes as Biocatalysts**	At the end of this activity, students should be able to present the components of enzymes, explain the catalytic activity of enzymes, and how reaction rate depends on substrate and enzyme concentrations, explain the substrate specificity of enzymes and the difference between "the lock-and-key" and "induced fit" hypotheses, present the effects of temperature and pH on enzyme activity, present the mechanisms of competitive and non-competitive inhibition of enzyme activity and present the principles of enzyme classification and name the main classes of enzymes.
	Industrial Uses of Enzymes	At the end of this activity, students should be able to present examples of industrial uses of enzymes, produce a diagram of the production of an enzymatic protein and explain the characteristics of enzymes that make them useful in technology.
	Uses of Enzymes in Medical Laboratories	At the end of this activity, students should be able to explain why enzymatic methods are better than chemical methods in determining the substances found in body fluids, present an enzymatic method for determining glucose concentration, explain how a biosensor operates, present several uses of the ELISA technique and explain how it functions, as well as explain how determining the quantity of certain enzymes in the blood is helpful in diagnosing organ damage and present examples of enzymes used to diagnose diseases.
	Metabolic Transformations	At the end of this activity, students should be able to define metabolism, describe the characteristics of catabolism and anabolism, define exergonic and endergonic reactiong, indicate the sites in a cell where the most important metabolic transformations take place, describe the role of ATP in cellular metabolism, define phosphorylation, present its types and where they occur in a cell and explain the role of coenzyme A in cellular metabolism.
	Autotrophic Nutrition and Photosynthesis	At the end of this activity, students should be able to define autotrophic and heterotrophic nutrition, name photo-autotrophs and chemo-autotrophs, explain photosynthesis and chemosynthesis and define the role of pigments in photosynthesis.
	Biochemistry of Photosynthesis	At the end of this activity, students should be able to present the structure of chloroplasts, differentiate between light-dependent and light-independent reactions, define the sites in the chloroplast at which particular reactions occur, explain the light-dependent phase, name three phases of the Calvin cycle and name the products of photosynthesis.
	Factors Affecting Photosynthesis	At the end of this activity, students should be able to know how light, water, temperature and carbon dioxide levels affect photosynthesis and describe how to test for the four factors listed above.
	Cell Respiration	At the end of this activity, students should be able to explain the concept of cell respiration, present the role of ATP in metabolic processes, define the respiratory quotient, discuss the electron transport chain, explain what glycolysis involves and where it occurs, present the major stages of glycolysis, explain the Krebs cycle and explain the process of fermentation and its significance in nature and the human economy.
	Aerobic Respiration	At the end of this activity, students should be able to explain the concept of cell respiration, present the role of ATP in metabolic processes, define the respiratory quotient, discuss the electron transport chain, explain what glycolysis involves and where it occurs, present the major stages of glycolysis and explain the Krebs cycle.
VI. Nervous Coordination	**Excitability of Neurons**	At the end of this activity, students should be able to describe the structure of a neurone, define two functional states of a neurone, describe the conduction of a nerve impulse along an axon and explain the relationship between the speed of conduction, the presence of a myelin sheath and axon diameter.

CHAPTER	LESSON	DESCRIPTION
	Transmission of Nerve Impulses from Cell to Cell – Synapses	At the end of this activity, students should be able to describe the function and structure of a chemical synapse, define excitatory synapse and inhibitory synapse and describe the conduction of a nerve impulse along an axon.
	Structure of the Human Nervous System	At the end of this activity, students should be able to classify the nervous system, define excitatory and inhibitory synapses, describe the structure of the brain, spinal cord and nerves, and explain the relationship between the central and peripheral nervous systems on the basis of their structure and functions.
	Involuntary Functioning of the Nervous System	At the end of this activity, students should be able to define and describe the basic characteristics of a reflex arc and give examples of the functioning of monosynaptic and polysynaptic reflexes.
	Autonomic Nervous System	At the end of this activity, students should be able to define and describe the parts of the ANS, show the location of particular types of neurone in the ANS, define and describe the functions of the antagonistic divisions of the ANS, explain, with examples, the antagonistic effects of the ANS on the body, describe the function and effects of acetylcholine and noradrenaline in the ANS and describe the 'fight-or-flight' reaction and the nervous and endocrine systems responsible for this.
	Receptors	At the end of this activity, students should be able to define and describe the basic characteristics of receptors (specificity, threshold) and describe the process of sensory transduction (receptor and action potentials);- describe the functioning of the receptors of touch, pressure, hearing, balance and pain.
	The Eye	At the end of this activity, students should be able to define and describe the structure and function of the eye, describe the process of impulse generation and transduction in the eye and give examples of good habits while reading or writing.
	Animal Behavior as a Form of Adaptation to the Environment	At the end of this activity, students should be able to: understand the adaptational role of behavior, understand the role of genetic information in passing on behavior patterns, understand the role of experience in the modification of an individual's behavior, differentiate between the various forms of behavior, and understand the association between the evolution of the animal nervous system and the development of controlled behavior.
VII. Food Ingestion and Digestion	**Heterotrophic Nutrition**	At the end of this activity, students should be able to: define heterotrophic nutrition, define digestion, present the types of digestion, present examples of heterotrophic organisms, describe saprotrophic nutrition using fungi as an example, explain how nutritional requirements in animals change at different stages of development.
	Nutrients	At the end of this activity, students should be able to: define the role of proteins, lipids, carbohydrates, vitamins and mineral compounds in human nutrition and name foods that are the source of essential chemical compounds vital nutrients.
	Nutritional Requirements	At the end of this activity, students should be able to define basal metabolic rate and the conditions under which it should be calculated, name the factors affecting the basal and active metabolic rates, define the role of carbohydrates and fats in meeting daily energy requirements, define complete and incomplete proteins and give examples of products containing such proteins, and explain what a vegetarian diet involves and present its advantages and disadvantages.
	The Human Digestive System	At the end of this activity, students should be able to describe the structure of the alimentary system, define the significance of the glands that empty into the alimentary canal, define digestion, and explain how digestive enzymes work.

CHAPTER	LESSON	DESCRIPTION
	The Processes of Food Digestion	At the end of this activity, students should be able to describe the digestion of carbohydrates, proteins, fats and nucleic acids and describe the nervous and hormonal regulation of the secretion of digestive juices.
	Absorption of Digestion Products	At the end of this activity, students should be able to present the histology of the wall of the alimentary canal, define the site of the absorption of digestion products, and define the mode of absorption of digestion products.
	Digestion of Cellulose	At the end of this activity, students should be able to name the symbiotic organisms of the digestive system, define the role of symbionts in cellulose digestion, present the structure of the ruminant stomach, and describe the function of the ruminant stomach.
VIII. Internal Transport	**Transport of Substances in Animals**	At the end of this activity, students should be able to explain the reasons for the development of the circulatory system in animals, describe the structure of blood, describe the structure and function of blood vessels, describe the adaptation of erythrocytes to oxygen transportation, and explain the significance of tissue fluid and the lymphatic system.
	Structure and Functions of the Heart	At the end of this activity, students should be able to outline the structure of the circulatory system in mammals, describe the structure of the heart, using a model or an illustration, explain the cardiac cycle, describe the regulation of heart rate by the nervous and endocrine systems and describe the effect of physical activity on blood flow through the organs during the resting state and during physical effort.
	Transport of Substances in Plants	At the end of this activity, students should be able to describe the morphology of vascular tissues – the xylem and phloem, demonstrate the adaptation of a root for the absorption of water and dissolved mineral salts, describe the pathway of water transport in root cells, determine the factors that cause flow of water in vessels, and explain how transport takes place in phloem.
	Transpiration	At the end of this activity, students should be able to define transpiration, describe the types of transpiration, describe the pathway of water transport in root cells, describe the effects of environmental factors on transpiration, and present the adaptations of plants for survival in dry conditions.
IX. Respiratory Gas Exchange	**Respiratory Surfaces**	At the end of this activity, students should be able to: present the factors that affect the diffusion of gases across respiratory surfaces, present the main types of respiratory organs in animals, explain the functioning of gills in fish, present the anatomical features that enable gas exchange on land, using plants and insects as examples, discuss gas exchange in relation to water evaporation from the body surface, and present the main structural features and the principles of lung ventilation in land vertebrates.
	Transport of Respiratory Gases	At the end of this activity, students should be able to explain the role of respiratory pigments in the transport of oxygen by body fluids, present the structure of hemoglobin A, describe the oxygen dissociation curve for hemoglobin, explain the physiological importance of the Bohr effect and the role of BPG in the transport of oxygen by hemoglobin, explain the association between the high oxygen affinity of fetal myoglobin and hemoglobin and their functions, and describe carbon dioxide transport and the role of hemoglobin in this process.
	Physiology of the Human Respiratory System	At the end of this activity, students should be able to describe the anatomy of the respiratory system, explain the functions of the parts of the respiratory system, describe the histological structure of the lung and alveoli, explain the mechanisms of pulmonary ventilation, and give examples of the organism's adaptations to low levels of oxygen.

CHAPTER	LESSON	DESCRIPTION
X. Physiology of Muscles	**Physiology of Muscle Contractions**	At the end of this activity, students should be able to describe the macroscopic and microscopic structure of skeletal muscle, describe the principles of the sliding filament theory of contraction and compare and contrast slow (red) and fast (white) muscle fibres.
	Chemistry of Muscle Contraction	At the end of this activity, students should be able to describe the molecular basis of the sliding theory of contraction, describe the transmission of a stimulus from a nerve to a sarcomere and explain the principles of aerobic and anaerobic metabolism in skeletal muscles.
XI. Reproduction	**Physiology of the Human Reproductive System**	At the end of this activity, students should be able to describe the structure of the male and female reproductive systems, differentiate between the tissues of the testes and ovaries, describe the process of spermatogenesis in the testes and oogenesis in the ovaries and describe the structure of sperm and egg cells.
	Fertilization	At the end of this activity, students should be able to explain what hormonal regulation of the menstrual cycle involves, describe the fusion of the egg and sperm cells and describe the development of the blastocyst and its implantation in the uterine wall.
	Development of the Human Embryo	At the end of this activity, students should be able to explain how fertilization occurs, name the initial stages of embryo development: cleavage and gastrulation, define the role of the placenta, describe the gradual development of the embryo and fetus and present the stages of labour.
	Birth Control in Humans and Animals	At the end of this activity, students should be able to explain how hormones regulate female fertility, describe the oestrous cycle in farm animals, list the methods for increasing the reproductive capacity of farm animals and describe the influence of bovine somatotropin on the lactation of farm animals.
	Growth and Development of the Organism	At the end of this activity, students should be able to define growth and development, name the various types of growth of organisms, interpret growth curves, describe the changes that take place in the female during puberty, describe the changes that take place in the male during puberty and explain the role of hormones in the growth and development of the organism.
	The Aging Process	At the end of this activity, students should be able to describe the age-related changes in the nervous system, describe the age-related changes in the sensory systems, describe age-related changes in the respiratory and circulatory systems, explain how aging affects BMR, describe the regression of tissues with reference to bony and cartilaginous tissues, and describe the hormonal changes during menopause.
	Sexual Reproduction in Plants	At the end of this activity, students should be able to describe the flower structure in angiosperms, describe the development of a pollen grain and embryo sac, define pollination, present mechanisms for protection against self-pollination, explain what double fertilization involves, and describe the formation of a seed and a fruit.
XII. Homeostasis	**The Concept of Homeostasis**	At the end of this activity, students should be able to: define the internal environment of the human organism, define homeostasis, name the homeostatic mechanisms, describe the mechanisms of negative and positive feedback, and give examples of the processes regulated by negative and positive feedback.

CHAPTER	LESSON	DESCRIPTION
	Hormonal Regulation	At the end of this activity, students should be able to define a hormone, name the main human endocrine glands and the principal hormones secreted by these glands, present the difference in the effects of three groups of hormones on cells, present the relationship between the hypothalamus, pituitary and the glands controlled by the pituitary, present the physiological action of selected hormones, describe the hormonal regulation of calcium ion concentration in extracellular fluid and describe the role of hormones in the metamorphosis of insects.
	Thermoregulation	At the end of this activity, students should be able to define homeothermy and the mechanisms of heat exchange between organisms and their environment, present the relationship between the metabolic rate and the temperature of the environment in ectotherms and endotherms, explain the concept of thermogenesis and its regulation, name the elements of the thermoregulatory system, describe the reactions that take place in the thermoregulatory system in response to an increase or decrease n the temperature of the environment and define hypothermia, hyperthermia and fever.
	Regulation of Glucose Level in the Blood	At the end of this activity, students should be able to: explain the dangers resulting from excessively high or low glucose levels in the blood, present the effects of insulin and glucagon on glucose metabolism, and present the most important metabolic disorders in diabetes.
	The Liver as a Homeostatic Organ	At the end of this activity, students should be able to describe the general structure of the liver, its location and vascularization, name the major functions of the liver, describe the transformations of carbohydrates, proteins and fats that occur in the liver, and name the major components of bile and discuss the role of bile in metabolism of fats.
	Role of the Kidneys in Regulating Water-Electrolyte Balance – Part 1	At the end of this activity, students should be able to present the types of nitrogenous waste compounds produced by the catabolism of nitrogenous compounds in different animals according to their environment, define filtration, reabsorption and secretion, describe the function of the renal tubule and the filtration in the glomerulus, describe the structures of the human excretory system and the structure of the nephron, and explain the mechanism of reabsorption in the proximal tubule of the nephron.
	Role of the Kidneys in Regulating Water-Electrolyte Balance – Part 2	At the end of this activity, students should be able to describe the structure of the loop of Henle and its role in the concentration of urine, explain the principles of the counter-current multiplier system and counter-current exchange, explain the role of ADH and aldosterone in the regulation of the volume and solute concentration of body fluids, explain the role of the kidneys in the regulation of blood pH, describe the regulation of water balance in humans, and describe the composition of urine and the urination reflex.
	Regulation of Water Loss in Desert Animals	At the end of this activity, students should be able to recognize the different adaptations of animals to life in a water-deficient environment, understand the basic mechanisms that limit water loss in desert animals, and understand the basic principles of water management in desert animals.
XIII. Human Health	**Characteristics of a Healthy Organism**	At the end of this activity, students should be able to define lifestyle and health, describe a balanced diet, specify the characteristics of anorexia and bulimia and describe the dangers of smoking.
	The Concept of Disease	At the end of this activity, students should be able to define disease, describe different types of diseases and characterise diseases caused by environmental factors.
	Bacterial Diseases	At the end of this activity, students should be able to present examples of the mechanism of bacterial virulence, explain Koch's principles name the routes of transmission of salmonellosis, tuberculosis and cholera, and describe basic antiseptic procedures and the treatment of bacterial infections.

CHAPTER	LESSON	DESCRIPTION
	Parasitic Diseases	At the end of this activity, students should be able to present examples of the mechanisms of parasite pathogenicity, discuss the routes of infection and means of preventing parasitic diseases and discuss the life cycles of Plasmodium, Ascaris, and Schistosoma.
	AIDS – an Example of a Viral Disease	At the end of this activity, students should be able to: define HIV and AIDS, discuss the life cycle of the virus, and present preventive measures against HIV infection.
	Human Immunity	At the end of this activity, students should be able to: describe the events that occur during an immune response, define antigens and antibodies, name the types of immune cells and describe their function, compare and contrast innate and acquired responses, describe and define the importance of immune memory and describe passive and active immunization with examples.
	Coronary Heart Disease	At the end of this activity, students should be able to: describe the processes involved in atherosclerosis, coronary heart disease and myocardial infarction, define coronary heart disease and ischaemia, and describe the measures for preventing coronary heart disease and briefly describe the methods of treatment.
	Cancer	At the end of this activity, students should be able to: define malignant and benign neoplasms, name and discuss the stages of neoplasm development, discuss the factors responsible for neoplasms and give examples of preventive measures we can take to reduce the risk of developing cancer, and discuss anti-neoplasm mechanisms existing in the organism and methods of cancer treatment.
	Actions of Different Groups of Medicines	At the end of this activity, students should be able to discuss the action of antibiotics and beta-blockers, and name the methods for obtaining monoclonal antibodies and give examples of their use as drugs.
XIV. Genetic Information	**DNA – the Carrier of Genetic Material**	At the end of this activity, students should be able to demonstrate that DNA is the carrier of genetic material located in the cell nucleus, present the chemical and spatial structure of DNA and define replication, explain the semi-conservative nature of replication and describe the process of replication.
	Organization of DNA in Chromosomes	At the end of this activity, students should be able to present the levels of DNA organization from double helix to metaphase chromosome, explain the role of histones in the spatial structure of DNA, present the morphology of metaphase chromosome, define homologous chromosomes, autosomes and heterosomes, describe a karyotype and the principles of its preparation and explain the terms locus, allele, homozygote and heterozygote.
	Cloning of Organisms	At the end of this activity, students should be able to define a clone and explain what cloning involves, describe the methods of plant cloning, including micropropagation, describe the stages in the cloning of an animal organism and explain the concepts of reproductive cloning and therapeutic cloning.
	Genetic Code and Protein Synthesis	At the end of this activity, students should be able to describe the structure of RNA, its types and the site of location in the cell, explain the connection between DNA and proteins, and explain the notion of translation and describe its course.
	Mutations	At the end of this activity, students should be able to define a mutation, describe the types of gene mutations and their possible consequences, describe the effects of certain physical and chemical mutagens on DNA, and explain the role of suppressor genes and oncogenes in the development of neoplasms.

CHAPTER	LESSON	DESCRIPTION
	Chromosomal Mutations	At the end of this activity, students should be able to define a chromosomal aberration and present the types of chromosomal mutations and present examples of the chromosomal aberrations that most often occur in humans.
XV. Genetic Engineering	**Genetic Engineering Techniques**	At the end of this activity, students should be able to define genetic engineering, discuss the basic techniques of genetic engineering and indicate applications of genetic engineering.
	Medical Applications of Genetic Engineering	At the end of this activity, students should be able to explain the role of genetic engineering in medicine, discuss the basic genetic engineering techniques used in medicine and indicate the applications of genetic engineering in forensic medicine and diagnostics.
	Transgenic Organisms	At the end of this activity, students should be able to define a transgenic organism, describe the process of creating a transgenic organisms and give examples of genetic modifications.
XVI. Genetics According to Mendel	**Inheritance of a Single Trait**	At the end of this activity, students should be able to present the importance of Mendel's research for genetics, explain Mendel's law of dominance, discuss Mendel's first law of segregation, define homozygote, heterozygote, phenotype and genotype, apply modern knowledge to explain Mendel's first law, construct a Punnett square and present the mechanism of inheritance of Huntington's chorea and cystic fibrosis.
	Inheritance of Two or More Traits	At the end of this activity, students should be able to explain the term co-dominance, give examples of co-dominance (inheritance of blood groups and sickle-cell anaemia), demonstrate the functioning of multiple alleles, explain the term epistasis, draw a genetic diagram for a dihybrid cross and quote Mendel's second law.
	Inheritance of Sex	At the end of this activity, students should be able to explain the term sex chromosomes, present the mechanism of inheritance of sex hormones in human, define linked traits, present the mechanism of inheritance of linked traits, present the mechanism of inheritance of sex-linked illnesses: haemophilia and colour blindness, present the mechanism of inheritance of sex-linked traits and explain the cause of baldness.
XVII. Variation in Organisms	**The Nature of Variation**	At the end of this activity, students should be able to explain what individual variation involves, describe the basic types of distribution of trait variation, differentiate between discontinuous variation and continuous variation of traits, understand the biological significance of trait variation and understand the reasons for the vast range of possible combinations of traits and the uniqueness of individual traits.
	Factors Influencing Variation	At the end of this activity, students should be able to name the main factors influencing variation of traits, differentiate between inherited variation and non-inherited variation, explain the relationship between phenotypic traits, genotype (the genetic record of traits) and the modifying effects of environmental factors, explain the biological significance of variation and explain the reasons for the vast range of possible combinations of traits and the uniqueness of an individual's traits.
	Elements of Population Genetics	At the end of this activity, students should be able to indicate the main factors that affect the frequency of traits in populations, understand the association between the factors that affect a population and evolution and explain the reasons for the vast range of possible trait combinations and the uniqueness of individual traits.
	Speciation – the Formation of Species	At the end of this activity, students should be able to indicate the main factors that affect the formation of species, understand the association between factors that affect a population and the process of speciation and understand the processes of reproductive isolation that determine the identity of a species.

CHAPTER	LESSON	DESCRIPTION
	Different Modes of Speciation	At the end of this activity, students should be able to indicate the main factors that influence the formation of species, understand the range of factors that affect speciation in a population and understand the factors that lead to reproductive isolation and determine the formation of species.
XVIII. Population	**Features of Populations**	At the end of this activity, students should be able to name the main features of populations, recognize the changeability of population features and understand the reasons for the vast range of possible trait combinations and the uniqueness of population traits.
	Biodiversity	At the end of this activity, students should be able to recognize the significance of biodiversity for the existence of nature and humankind, recognize that human activities can damage biodiversity, understand the association between the quality of human life and the degree of biodiversity, understand the principle of conserving biodiversity by the protection of entire ecosystems and understand the need to protect endangered species.
	The Ecosystem – an Organized and Functional Unit of the Natural Environment	At the end of this activity, students should be able to recognize the ecosystem as an organized and functional unit, recognize the multiplicity of interactions that constitute an ecosystem, understand why ecosystems need to be self-maintaining and understand why it is necessary to preserve entire ecosystems in order to maintain the balance of nature.
	Energy Flow and the Circulation of Matter	At the end of this activity, students should be able to recognize the complex associations between the species in a single ecosystem, recognize the multiplicity of pathways of energy flow and matter circulation in an ecosystem, understand the one-way nature of energy flow through the environment and the cyclical nature of the flow of matter through the environment and understand how the balance of matter and energy in the natural environment can be interpreted in economic terms.
	Ecological Succession	At the end of this activity, students should be able to recognize changes in ecosystems over time, recognize the multiplicity of interactions that make up the process of succession, assess the effects of human activities on the course of succession in different ecosystems and understand the causes of changes that take place in ecosystems over time.
	Effects of Human Activity on Ecosystems	At the end of this activity, students should be able to recognize the effects of human actions on nature as an organized and functional system, recognize the extent of changes induced by humans in ecosystems, understand the association between the quality of human life and the degree of the conservation of nature as an organized and functional system, understand the need for long-term planning and careful management of the exploitation and transformation of ecosystems and understand the need for ecosystem conservation and for the restoration of ecosystems destroyed by human actions.
	Agriculture – the Conservation of Biodiversity	At the end of this activity, students should be able to recognize the effects of agriculture on environmental resources and the natural environment, understand the relationship between agriculture and environmental resources and factors, understand why macroeconomic plans and calculations should take into account the effects of agriculture on the natural environment, understand the need to conserve biodiversity by agriculture and forestry practice and understand the principle of conserving biodiversity by the protection of entire ecosystems.

CHAPTER	LESSON	DESCRIPTION
I. Statics	Forces	At the end of this activity, students should be able to: recognise forces as a measurement of the interaction between bodies, describe the basic characteristics of a force vector, specify different types of forces, differentiate between the effects of the action of forces.
	Addition of Forces	At the end of this activity, students should be able to: add and resolve forces, determine graphically the resultant force and the component forces, calculate the magnitudes of the resultant forces and the component forces in right-angled triangles.
	Torque	At the end of this activity, students should be able to: know that the moment of a force indicates the ability of a force to rotate a body, be able to calculate the moment of a force, be able to add moments of forces, know how levers operate.
	Equilibrium	At the end of this activity, students should be able to: understand the concept of a rigid solid, determine the centre of gravity of a solid, explain the different types of equilibrium.
	Forces and Moments of Forces in Constructions	At the end of this activity, students should be able to: explain the difference between elements of a construction which are extended and those which are compressed, use ropes to substitute some of the elements in constructions, give examples of solutions that are applied in constructions.
II. Kinematics	Uniform Motion	At the end of this activity, students should be able to: understand that motion is relative, understand the concept of position, speed and average speed, read and construct graphs of position, calculate speed, given change in position and time, convert speed units.
	Accelerating Motion	At the end of this activity, students should be able to: understand the concept of uniform accelerating motion and non-uniformly accelerating motion, read and construct graphs of speed, calculate acceleration from a graph of speed in uniformly accelerating motion, understand the concept of free fall.
	Distance in Accelerating Motion	At the end of this activity, students should be able to: calculate any quantity in accelerating motion, interpret graphs of position in uniformly varying motion, calculate the distance covered by a body moving with uniformly varying motion, explain the equation of motion for uniformly accelerating motion.
	Description of Motion in Terms of Vectors	At the end of this activity, students should be able to: describe velocity and acceleration as vector quantities, describe the concept of position vector increment and velocity vector increment, understand the relationship between the direction of the acceleration vector and the shape of the path of motion.
	Circular Motion	At the end of this activity, students should be able to: describe circular motion at constant speed, understand the concepts: period, frequency, angular speed, and centripetal acceleration, calculate centripetal acceleration, calculate angular speed when you are given the period, frequency, or speed and radius.
	Projectile Motions	At the end of this activity, students should be able to: describe horizontal projectile motion and projectile motion at an angle, calculate basic parameters of projectile motion.
III. Dynamics	The First and the Third Law of Motion	At the end of this activity, students should be able to understand that forces always occur in pairs, understand and apply the First and the Third Laws of Motion, understand the concept of inertial and non-inertial systems and understand the concept of inertia.

CHAPTER	LESSON	DESCRIPTION
	Momentum	At the end of this activity, students should be able to apply the principle of conservation of momentum, use the principle of conservation of momentum to explain how a reaction engine works and explain the relationship between force impulse and change in momentum.
	Newton's Second Law of Motion	At the end of this activity, students should be able to understand Newton's Second Law of Motion and describe the relationship between the principle of conservation of momentum and Newton's Second Law of Motion.
	Forces in Curvilinear Motions	At the end of this activity, students should be able to understand the relationship between the behaviour of a body and the direction of the force exerted on it, understand the concepts of centripetal force and centrifugal force and describe the relationship between the curvature of a path and the magnitude of centripetal force.
	Friction	At the end of this activity, students should be able to describe when friction occurs, explain the concepts of static friction, kinetic friction ad rolling friction, explain on what the force of friction depends, calculate the coefficient of friction from the relationship between friction and the normal contact force and calculate the coefficient of friction by measuring the angle of inclination.
	Air Drag	At the end of this activity, students should be able to understand drag, explain how drag is affected by the velocity of a moving body, its cross-sectional area and the density of the medium and explain the concept of terminal velocity.
IV. Energy	**Work and Energy**	At the end of this activity, students should be able to: calculate the work done, and the change in potential and kinetic energy, give examples of situations when work is not performed.
	Potential Energy and Kinetic Energy	At the end of this activity, students should be able to: explain what mechanical energy is, apply the principle of conservation of mechanical energy in practice.
	Internal Energy	At the end of this activity, students should be able to: define internal energy, explain that temperature is a measure of changes in the internal energy, calculate the efficiency of an appliance.
	Power	At the end of this activity, students should be able to: understand the concept of power, calculate it and name its units.
	Collisions	At the end of this activity, students should be able to: distinguish between elastic and inelastic collisions, give examples demonstrating the conservation of momentum during collisions and showing that during elastic collisions the total kinetic energy of the bodies does not change, differentiate between head-on and oblique collisions.
	Simple machines	At the end of this activity, students should be able to: describe the operation of simple machines such as levers, pulleys, and inclined planes, and state the benefits of their application, explain why the application of simple machines does not decrease the amount of work that needs to be done.
V. Rotational Motion	**Angular Velocity and Angular Acceleration**	At the end of this activity, students should be able to give the definition of a radian, convert radians into degrees and vice versa, describe how to calculate angular velocity, explain the relationship between angular velocity and linear velocity, describe how to represent an angular velocity vector, explain how to calculate angular acceleration and state the relationship between angular acceleration and linear acceleration.

CHAPTER	LESSON	DESCRIPTION
	Newton's Second Law for Rotational Motion	At the end of this activity, students should be able to describe a force arm, calculate the moment of a force, and give a specific example, explain the concept of the moment of inertia and describe Newton's First and Second Law for rotational motion.
	Angular Momentum	At the end of this activity, students should be able to describe the concept of angular momentum, explain the relationship between angular momentum and change in angular momentum and provide examples to explain the principle of conservation of angular momentum.
	Energy of Rotational Motion	At the end of this activity, students should be able to explain the concepts of kinetic energy of rotational motion, describe how to calculate the total kinetic energy of a body moving simultaneously in rotational and translational motion and apply the principle of conservation of energy using the concept of kinetic energy of rotational motion.
VI. Gravitational Field	**Gravitational Force**	At the end of this activity, students should be able to: understand that any two bodies attract one another due to gravitation, calculate the magnitude of the gravitational force in a specific case, understand how the gravitational field is represented, distinguish between a central field and a uniform field.
	Gravitational Acceleration	At the end of this activity, students should be able to: understand that the gravitational acceleration on the surface of the Earth is not constant, explain the relationship between gravitational acceleration and distance from the surface of the Earth, state the difference between the mass and the weight of a body, determine the gravitational acceleration for a system of a few celestial bodies.
	Potential Energy	At the end of this activity, students should be able to: explain the relationship between the potential energy of the gravitational field and the distance from the Earth, state how to calculate changes in potential energy both close to and far from the surface of the Earth, describe the relationship between the changes in potential energy in a gravitational field, determine the potential energy of a system composed of several bodies.
	Potential	At the end of this activity, students should be able to: explain the concept of potential, describe how potential depends on the distance from Earth, calculate the potential of a system of bodies, explain the concept of equipotential surfaces.
	Satellites	At the end of this activity, students should be able to: understand how a satellite revolves around the Earth without propulsion, calculate the radius of the orbit of a satellite, given its period of revolution around the Earth, and calculate its period from the radius of its orbit, calculate speed of a satellite in an orbit, give a few examples of the application of satellites.
VII. Matter	**Density**	At the end of this activity, students should be able to explain the concept of density, describe how to determine the density of solids and liquids and explain the relationship between density and the molecular structure of matter.
	Stresses	At the end of this activity, students should be able to get to know the concept of stress, the concept of compression, tension and torsion and the relationship between the properties of materials and their microscopic structure.
	Hooke's Law	At the end of this activity, students should be able to explain the calculation for strain and stress, describe a strain-stress graph, formulate Hooke's Law, give an explanation of Young's modulus, define ultimate strength and calculate elastic potential energy.

CHAPTER	LESSON	DESCRIPTION
	Temperature	At the end of this activity, students should be able to describe the Celsius, Fahrenheit and Kelvin scales of temperature, explain how to measure temperature, describe the relationship between the temperature and the velocity of molecules and explain the thermal expansion of various substances.
	Heat Transfer	At the end of this activity, students should be able to explain heat transfer by conduction, convection, and radiation, explain thermal conductivity and calculate the heat flux in heat transfer by conduction between layers of different thicknesses and different thermal conductivities.
	The States of Matter	At the end of this activity, students should be able to describe the states of matter of a substance, name the phase transitions between the states of matter, understand the concept of latent heat of vaporization and latent heat of fusion and explain how temperature is related to pressure.
VIII. Mechanics of Fluids	**Hydrostatic Pressure**	At the end of this activity, students should be able to: calculate the pressure exerted by solid bodies and by liquids, give examples to explain how a liquid exerts pressure in all directions, give examples to explain the hydrostatic paradox, give examples of the application of combined vessels.
	Atmospheric Pressure	At the end of this activity, students should be able to: state the definition of pressure, understand the concepts of high pressure, low pressure, vacuum, describe the devices that are used for measuring pressure, explain how atmospheric pressure changes with altitude.
	Pascal's Law	At the end of this activity, students should be able to: state Pascal's law, explain the operation of a hydraulic press and other devices that apply Pascal's law, describe the phenomenon of water hammer.
	Archimedes' Principle	At the end of this activity, students should be able to: measure upthrust, calculate upthrust, state Archimedes' Principle, name the conditions that need to be met for a body to float, explain what the depth of immersion of a floating body depends on.
	Bernoulli's Principle	At the end of this activity, students should be able to: how the principle of continuity and Bernoulli's Principle are applied in the mechanics of fluids, how to calculate the magnitudes of pressure/velocity for selected simple cases of flow, how a lift is generated on the wing of a plane or a bird.
	Movement of Bodies in Liquids	At the end of this activity, students should be able to: explain the difference between laminar flow and turbulent flow, explain the concept of kinematic viscosity and dynamic viscosity of a fluid, explain the concept of Reynolds number, explain Stokes' Law, explain how the type of flow affects the drag of a body.
IX. Gas Laws	**Gas Transformations**	At the end of this activity, students should be able to: define and use the gas equation of state, prove that the gas laws which refer to isoprocesses constitute specific cases of the gas equation of state, describe how an ideal gas differs from a real one.
	The Ideal Gas Equation	At the end of this activity, students should be able to: define and use the gas equation of state, prove that the gas laws which refer to isoprocesses constitute specific cases of the gas equation of state, describe how an ideal gas differs from a real one.

CHAPTER	LESSON	DESCRIPTION
	Kinetic Theory of Gases	At the end of this activity, students should be able to: explain the Maxwell velocity distribution of gas molecules, describe the concept of mean velocity, root-mean-square velocity and probability, state the relationship between the mean kinetic energy of gas molecules and the temperature, state the relationship between gas pressure and pressure and root-mean-square velocity, explain the basics of the kinetic theory of gases.
	Molar Specific Heat of a Gas	At the end of this activity, students should be able to: explain the concept of molar specific heat at constant volume, explain the concept of molar specific heat at constant pressure, state the theoretical assumptions for calculating the molar specific heat of gases from the kinetic theory of gases, explain the discrepancy between the values of the specific molar heat obtained in an experiment and those obtained from theoretical calculations, explain the principle of equipartition of energy.
	Adiabatic Transition	At the end of this activity, students should be able to: explain the significance of thermal insulation, describe an adiabatic transition, state the adiabatic equation, describe the difference between an adiabatic transition and an isothermal transition, name some examples of natural phenomena and technical processes in which we encounter an adiabatic transition.
X. Thermodynamics	**The First Law of Thermodynamics**	At the end of this activity, students should be able to: state The First Law of Thermodynamics, calculate the work done in the gas transitions mentioned above, explain the significance of The First Law of Thermodynamics, describe the consequences of The First Law of Thermodynamics.
	Heat Engine	At the end of this activity, students should be able to: explain how a heat engine operates, describe the operation of an internal-combustion engine, know the difference between reversible and irreversible processes, calculate the efficiency of an ideal heat engine, state some practical applications of heat engines.
	Specific Heat	At the end of this activity, students should be able to: explain the principle of heat balance, explain the zeroth law of thermodynamics, calculate the heat needed to heat up or cool down a given mass of a substance to a given temperature, explain the concept of specific heat capacity, describe the methods of the measurement of the specific heat capacity of liquids and solids.
	Sources of Heat	At the end of this activity, students should be able to: explain the reaction of combustion, name the alternative sources of energy and the methods of their application.
	The Second Law of Thermodynamics	At the end of this activity, students should be able to: state the reasons for entropy increase in an isolated system, explain the physical interpretation of entropy, state the significance of the Second Law of Thermodynamics, explain the consequences of the Second Law of Thermodynamics.
XI. Electrostatics	**Coulomb's Law**	At the end of this activity, students should be able to: name the ways of charging bodies and explain what they involve, give an example to explain the law of conservation of charge, give the unit of electric charge, explain what an elementary charge is, state Coulomb's Law.
	Electric field	At the end of this activity, students should be able to: explain the concept of electric field strength, explain what the electric field lines represent, describe the movement of an electric charge in a homogeneous electric field.

CHAPTER	LESSON	DESCRIPTION
	Potential	At the end of this activity, students should be able to: explain the concepts of electric field potential and equipotential surfaces, explain why the potential of a homogeneous field changes linearly with distance.– state the formula for the potential in a field due to a point charge, describe the relationship between potential and electric field strength in the form of a gradient, explain the concept of potential energy of a charge in an electric field.
	Capacitance	At the end of this activity, students should be able to: define capacitance, explain how a capacitor works, explain the meaning of dielectric, describe the changes in the electric field inside a capacitor and the capacitance of the capacitor when a dielectric is placed in between the plates.
	Capacitors	At the end of this activity, students should be able to: explain why the capacitance of a capacitor depends on its dimensions and the distance between its plates – describe the phenomenon of capacitor leakage, state the formula for the energy of a capacitor, state the formula for the capacitance of capacitors connected in series, state the formula for the capacitance of capacitors connected in parallel.
XII. Direct Current	**Electric Current**	At the end of this activity, students should be able to: draw a scheme for an electric circuit containing the basic elements, explain the concept of the flow of electrons, calculate current, explain the flow of current through a conductor from a microscopic point of view, explain what an ammeter is, what it is used for and how it is operated, give examples demonstrating Kirchhoff's First Law, define direct current.
	Electrical Resistance	At the end of this activity, students should be able to: state Ohm's Law, explain what the resistance of a conductor depends on, calculate the resistance of a conductor of specified dimensions and resistivity, describe the relationship between the resistance of metals and their temperature, explain the phenomenon of superconductivity.
	Resistors	At the end of this activity, students should be able to: recognise connection in series and connection in parallel, calculate the combined resistance of a system of resistors, name the characteristic features of connection in series and connection in parallel.
	Electromotive Force	At the end of this activity, students should be able to: explain the structure of a cell and name its elements, describe the EMF and the internal resistance of a cell and state the formulae for calculating the magnitudes of the two quantities, state Ohm's Law for a whole circuit, explain the concept of fault current, describe the method of connecting cells.
	Work and Power of Electric Current	At the end of this activity, students should be able to: calculate the work done by a current, estimate the cost of work of a device of a given power, determine the power of a given electrical device using an electric energy meter, explain when overloading occurs and how we can protect household electrical wiring against its effects.
XIII. Magnetism	**Magnetic Field**	At the end of this activity, students should be able to: explain the concepts of: magnetic field, flux density and uniform field, understand the difference in behaviour of various materials placed in a magnetic field, give a graphical representation of the magnetic field of the Earth and describe it.
	The Magnetic Field Around Current-Carrying Wires	At the end of this activity, students should be able to: describe magnetic field around current-carrying wires, calculate the magnitude of magnetic flux density in simple cases, describe how an electromagnet operates.
	Electromagnetic Force	At the end of this activity, students should be able to: give the definition of electromagnetic force, state Fleming's left-hand rule, explain on what and in what way the magnitude of the electromagnetic force depends, calculate the magnitude of the electromagnetic force.

CHAPTER	LESSON	DESCRIPTION
	Application of Electromagnetic Forces	At the end of this activity, students should be able to: describe a commutator, a rotor, and brushes, explain the operation of an electric engine, calculate the moment of a couple of electromagnetic forces exerted on a frame.
	The Movement of a Charge in a Magnetic Field	At the end of this activity, students should be able to: describe the movement of a charge in a magnetic field, calculate the magnitude of Lorentz force, give and describe examples of the application of Lorentz force.
XIV. Alternating Current	**Phenomenon of Electromagnetic Induction**	At the end of this activity, students should be able to: describe the phenomenon of induction, calculate the induced EMF, calculate the magnitude of flux, describe the origin of eddy currents.
	Generator and Alternating Current	At the end of this activity, students should be able to: understand the concept of flux density, calculate the EMF value of a rotating frame, calculate the work and power of an alternating current, understand how a generator operates, describe an alternating current, give the definition of r.m.s. voltage and r.m.s. current, give the definition of inductance, ohmic resistance and reactance.
	Transformer	At the end of this activity, students should be able to: describe how a transformer operates, explain the concepts of primary coil and secondary coil, calculate the voltage across a transformer when the number of coil turns and the input voltage is given, explain how an induction coil operates, calculate the efficiency of a transformer, explain the concept of eddy currents.
	Transmission of Electrical Energy	At the end of this activity, students should be able to: explain why high-voltage overhead lines are constructed, describe the way in which a transformer transfers energy, calculate power losses in a transmission line.
	Current in a Household	At the end of this activity, students should be able to: state the advantages and disadvantages of batteries and mains as power supplies, describe the structure of a household electric mains, explain why circuit breakers are used, state the purpose of the third wire in a cable of certain devices, describe how a residual current circuit breaker is used, explain how three-phase current is separated for use in different apartments.
XV. Electronics	**Electronics**	At the end of this activity, students should be able to explain the concepts of semiconductor, doped conductor, p–n junction, diode, explain how a diode operates and explain how to use diodes to convert alternating current into direct current.
	Light and Current	At the end of this activity, students should be able to explain the concepts of a light-dependent resistor, photocell, light-emitting diode, semiconductor laser, describe an internal photoelectric effect, explain the abbreviations LDR, LED and give examples of the application of light emission and absorption by a p-n junction.
	Transistors and Gates	At the end of this activity, students should be able to explain the concept of a transistor, describe the operation of a bipolar junction transistor and a field-effect transistor, explain how to amplify an electric signal using a transistor and construct logic gates using transistors.
	Digital Systems	At the end of this activity, students should be able to explain the concepts of both an analogue and a digital signal, describe the digital storage of sound and state the advantages of digital signals over analogue ones.
XVI. Harmonic Motion	**Oscillations**	At the end of this activity, students should be able to describe harmonic oscillations and state the equation for displacement, velocity and acceleration in simple harmonic motion.

CHAPTER	LESSON	DESCRIPTION
	Pendulum	At the end of this activity, students should be able to explain the theory of the simple gravity pendulum and the physical pendulum, describe the movement of a simple pendulum, state the changes in the force which cause a pendulum to oscillate, explain on what quantities the period of a simple and a physical pendulum depend, determine the gravitational acceleration given the T(L) measurement for a ball pendulum and describe the concept of a Foucault pendulum.
	Energy of Oscillations	At the end of this activity, students should be able to plot a graph of energy as a function of time and position and plot a graph representing the changes in amplitude and the displacement of damped oscillations.
	Resonance	At the end of this activity, students should be able to describe free, damped and forced oscillations and explain the phenomenon of resonance and also give examples.
XVII. Mechanical Waves	**Mechanical Waves**	At the end of this activity, students should be able to: to characterise electromagnetic waves by comparing their properties with those of mechanical waves, to name the particular ranges of electromagnetic waves, to provide a short description of the ranges of electromagnetic waves by discussing various examples of their applications.
	Reflection and Refraction of Waves	At the end of this activity, students should be able to: explain the movement of a wave reflected at a fixed and at a free end of a string, describe the movement of a wave along a string made of segments of different density, state Huygens' principle, describe the reflection and the refraction of waves in two-dimensional areas, explain the concepts of echo and reverberation.
	Diffraction and Interference of Mechanical Waves	At the end of this activity, students should be able to: the concept of diffraction, the concept of interference, the concept of stationary waves, where stationary waves occur in musical instruments, the concept of beats.
	Oscillations of a String	At the end of this activity, students should be able to: state the formula for the velocity of a wave in a string, state the formula for harmonic frequencies, explain the concept of resonance.
	The Intensity of a Wave	At the end of this activity, students should be able to: the shape of spherical, circular and plane waves, the meaning of the intensity of a wave, how intensity and amplitude of a circular wave and a spherical wave change with the distance from the source, what change in sound intensity is described by 1 bel = 10 dB.
	The Doppler Effect	At the end of this activity, students should be able to: explain the Doppler effect, decide whether in a given situation the frequency of the perceived wave is higher or lower than the frequency of the emitted wave, give examples of the practical application of the Doppler effect, state the definition of a shock wave.
XVIII. Electromagnetic Waves	**Electromagnetic Waves**	At the end of this activity, students should be able to characterise electromagnetic waves by comparing their properties with those of mechanical waves, name the particular ranges of electromagnetic waves and provide a short description of the ranges of electromagnetic waves by discussing various examples of their applications.
	Diffraction and Interference	At the end of this activity, students should be able to state Huygens' Principle, describe the phenomena of wave interference and wave diffraction, describe Young's experiment, explain the type of image that can be obtained when monochromatic light passes through a diffraction grating and also the type obtained when white light is used and explain the idea of light wavelength measurement with a diffraction grating.

CHAPTER	LESSON	DESCRIPTION
	Polarization	At the end of this activity, students should be able to describe a polarised wave and explain the difference between complete and partial polarisation, describe polarisation by reflection and by refraction and give examples of the application of the polarisation of light.
	Application of Waves for Communication	At the end of this activity, students should be able to describe the Hertz's experiment, state the range of radio waves and describe their propagation in the atmosphere of the Earth and provide the basic information on the operation of mobile telephony, television broadcasting, satellite television, and satellite telephony.
	Signal Encoding	At the end of this activity, students should be able to describe amplitude modulation and frequency modulation as well as explain the idea of digital encoding and give examples of digital encoding of both sound and images.
XIX. Optics	**Reflection and Refraction of Light**	At the end of this activity, students should be able to: describe the phenomenon of total internal reflection, state Huygens' Principle, calculate the refractive index, explain how an image is produced in a mirror, state Snell's Law.
	Spherical Mirrors	At the end of this activity, students should be able to: explain the principles of image formation in spherical mirrors, define focal point and focal length, calculate the distance and the size of an image when the size and location of the object and the parameters of the mirror are given, describe how an image is formed by a mirror, explain how to calculate the magnification of an image, use the mirror equation.
	Lenses	At the end of this activity, students should be able to: explain the principle of the formation of images by lenses, define focal point and focal length, calculate the image distance and the size of an image when the size of the object and its distance are given, define the power of a lens, determine the focal point given the shape of a lens and its refractive index, calculate the magnification, use the lens formula.
	Optical Instruments	At the end of this activity, students should be able to: state the principle of operation of a magnifying glass, a refracting telescope, and a microscope, calculate the magnification of a refracting telescope, a microscope and a magnifying glass, explain the concept of a prism and its applications, explain how light diffraction limits the resolving power of some optical devices.
	An Eye	At the end of this activity, students should be able to: explain how images are formed in the eye, explain the concept of accommodation, long-sightedness and short-sightedness, explain how the sight defects of long-sighted and short-sighted people can be corrected, state the definition of colour blindness, explain how a moving picture is formed.
XX. Atomic Physics	**Radiation of Objects**	At the end of this activity, students should be able to define a black body, state the Stefan-Boltzmann Law and state Wien's Law.
	External Photoelectric Effect	At the end of this activity, students should be able to describe the photoelectric effect, calculate the threshold wavelength, determine the work function and apply experimental measurement to determine Planck's constant.
	Emission and Absorption Spectra	At the end of this activity, students should be able to: state Planck's postulates, understand the formation of emission and absorption spectra of gases, understand the difference between spontaneous and stimulated emission, explain the operation of a laser.
	Electron Energy Levels in an Atom	At the end of this activity, students should be able to describe the atomic models of Thomson, Rutherford and Bohr, explain how emission and absorption are related to changes in atomic energy levels and describe the band model of a solid body.

CHAPTER	LESSON	DESCRIPTION
	X-Rays	At the end of this activity, students should be able to define X-radiation, state the reasons for the occurrence of X-radiation, give examples of practical applications of X-radiation, explain the causes for the detrimental effect of X-radiation on live organisms and describe the application of X-rays in the analysis of crystal structure.
	Waves of Matter	At the end of this activity, students should be able to explain the de Broglie hypothesis, state the formula for wavelength related to a material particle and describe the operation of an electron microscope.
XXI. Nuclear Physics	**The structure of Atomic Nucleus**	At the end of this activity, students should be able to: define an atomic nucleus, a nucleon, a neutron, and an isotope.– explain the concepts of atomic mass and atomic mass unit.– explain the concepts of mass number and atomic number, describe the composition of a nucleus of any isotope.– state the forces which are present in a nucleus.
	Nuclear Radiation	At the end of this activity, students should be able to: describe the phenomenon of radiation, describe alpha and beta radiation, describe a radioactive series, specify the reasons why nuclear radiation is so harmful.
	Decay Law	At the end of this activity, students should be able to: describe the decay of radioactive elements, explain the concepts of: half-life, decay constant, mean lifetime; and describe the relationship between them, state the formula for exponential law of decay, explain the concept of the activity, name its units, and state on what its magnitude depends, understand the radiocarbon method and scintigraphic examination.
	Stability of the Nuclei	At the end of this activity, students should be able to: explain the concept of binding energy and mass defect, describe the table of isotopes, explain why certain nuclei are characterised by higher stability and others by lower stability, explain where unstable isotopes which are heavier than lead are found in nature.
	Nuclear Fusion	At the end of this activity, students should be able to: describe a particular reaction of nuclear fusion, calculate the energy released during a reaction, given the masses of the substrates and the products, explain the operation of the Sun as a thermonuclear reactor, describe the operation of a hydrogen bomb.
	Nuclear Fission	At the end of this activity, students should be able to: describe a nuclear fission reaction, calculate the energy released during a reaction given the mass of the substrates and the products, explain the meaning of critical mass, describe the operation of a nuclear reactor, explain the operation of an atomic bomb.
	Elementary Particles	At the end of this activity, students should be able to: describe a lepton, baryon, boson and a fermion, explain the concept of particle-antiparticle, state what is meant by antimatter, explain the concept of a quark, and the fact that nucleons are made of quarks.
XXII. Astrophysics	**The Solar System**	At the end of this activity, students should be able to: explain the concept of the astronomical unit, state the relationship between the size of the Sun and the planets and give the distances between them, name the elements of the Solar System and provide a short description of each of them.
	Classification of Stars	At the end of this activity, students should be able to: recognise a few of the best-known constellations, explain the concept of stellar parallax, define the parsec and the light year, explain the difference between apparent magnitude and absolute magnitude, describe the radiation emitted by stars and explain how it can be used to estimate the surface temperature of a star, name the spectral classes of stars, describe an H-R diagram.

CHAPTER	LESSON	DESCRIPTION
	Evolution of Stars	At the end of this activity, students should be able to: describe the basic stages in the evolution of stars in relation to their initial masses, given an H-R diagram, indicate the position of: the main sequence, white and red dwarves, red and blue giants, describe the fate of the Sun, explain the origin of heavy elements.
	Galaxies	At the end of this activity, students should be able to: explain what is the Milky Way, describe the structure of the Galaxy, name the different types of galaxies, describe the position of the Earth and the Sun in the Universe, state Hubble's Law, state the basic observations that indicate that the Universe is expanding, describe the different cosmological models: close, open and flat.
XXIII. Theory of Relativity	**The Speed of Light**	At the end of this activity, students should be able to: explain how Roemer proved that the speed of light was finite in value, describe the measurement of speed as conducted by Fizeau, explain the concept of relative motion, define inertial and non-inertial frames, state Einstein's postulates.
	Time and Distance	At the end of this activity, students should be able to: describe the relativity of simultaneity, time dilation and length contraction, calculate time dilation and length contraction, describe the twin paradox and the barn-pole paradox.
	Mass, Energy and Momentum	At the end of this activity, students should be able to: describe the changes in mass and momentum of an object with increasing velocity, calculate the rest energy of an object, calculate the total and the kinetic energy of an object, state the relativistic relationship between momentum and energy, calculate the mass defect and the related energy in nuclear reactions.
	General Theory of Relativity	At the end of this activity, students should be able to: explain the equivalence principle, describe the effects resulting from the general theory of relativity including the deflection of light, the precession of the orbits of planets, the slowing of time and the curvature of space.

CHAPTER	LESSON	DESCRIPTION
I. Atomic Structure	**The Structure of the Atom**	At the end of this activity, students should be able to describe the inner structure of the atom, define and use atomic number and mass number, compare the properties of subatomic particles, describe isotopes, explain how a mass spectrometer works, use the mass spectra of elements to determine the abundance of isotopes and define relative atomic mass and relative molecular mass.
	Development of Atomic Theory and Radioactivity	At the end of this activity, students should be able to give the main postulates of early atomic theories, describe how subatomic particles were discovered, explain how the modern atomic model was developed, explain the phenomenon of radioactivity, discuss the characteristics and origin of alpha, beta and gamma radiation, predict the process of radioactive decay and indicate the main uses of radioactive isotopes.
	Atomic Spectra	At the end of this activity, students should be able to describe light as a particular kind of electromagnetic radiation, explain the wave–like and particle–like nature of light, explain the relationships among wavelength, frequency and energy of radiation, explain the difference between continuous and line spectra, describe Bohr's model of the atom and explain the origin of spectral lines using Bohr's model.
	Electron Configuration of Atoms	At the end of this activity, students should be able to define the four quantum numbers, describe the structure of energy levels in a many–electron atom, define s, p and d orbitals, and describe their shapes, describe the rules for assigning electrons to subshells, deduce the electron configuration of an atom from its atomic number and describe the position of the element in the periodic table based on its electron configuration.
II. Bonding	**Types of Bonding**	At the end of this activity, students should be able to explain how elements form ions, explain the concept of the electrical charge of metal ions, and explain how the basic types of chemical bond are formed: ionic (electrovalent), covalent, multiple covalent, dative (coordinate) and metallic bonds.
	Electronegativity and Polarity	At the end of this activity, students should be able to define the concept of electronegativity, explain the electronegativity scale, describe how electronegativity changes across the periodic table, explain how the electronegativities of two elements affect the type of bonding between them and describe the variation of chemical bonding in the halides of the third period elements and the second group elements.
	Molecular Shapes	At the end of this activity, students should be able to outline the basis for determining molecular shapes using the VSEPR theory and determine the shape of simple molecules, including those containing lone electron pairs.
	Valence Bond Theory and Hybridization	At the end of this activity, students should be able to interpret covalent bonds as overlapping of atomic orbitals, define the bond, describe the main types of hybridisation, explain shapes of molecules using the concept of hybridisation of atomic orbitals and explain the formation of multiple bonds.
III. Phases and Phase Changes	**States of Matter**	At the end of this activity, students should be able to: describe the macroscopic properties of gases, liquids and solids, explain the properties of gases, liquids and solids in terms of the kinetic theory, describe the fourth state of matter, plasma.
	Phase Changes	At the end of this activity, students should be able to define a phase and a phase change, describe and analyze cooling and heating curves, explain phase changes in terms of the kinetic theory, define melting and boiling points, describe melting and freezing processes in terms of dynamic equilibrium, explain the process of vaporization and the existence of vapor pressure, tell the difference between vaporization and boiling, explain why boiling point depends on external pressure as well as describe sublimation and deposition.

CHAPTER	LESSON	DESCRIPTION
	Gas Laws	At the end of this activity, students should be able to describe the properties of an ideal gas, state Boyle's law, Charles's law and Avogadro's law and use them in calculations, use the ideal gas law to calculate the density of a gas and the relative molecular mass of a volatile compound and explain under what conditions real gases behave as ideal and how very low temperatures and extremely high pressures affect their behavior.
	Intermolecular Forces	At the end of this activity, students should be able to decide whether a molecule is polar or nonpolar, describe dipole–dipole interactions, describe London (dispersion) forces between induced dipoles, describe hydrogen bonding and explain the effect of intermolecular interactions on the physical properties of the substance.
	Structure of Solids	At the end of this activity, students should be able to describe the structure and properties of metallic crystals, ionic crystals, molecular crystals, macromolecular crystals and amorphous solids and identify the type of structure of a solid based on its properties.
IV. Stoichiometric Calculations	**The Mole**	At the end of this activity, students should be able to define the unit of quantity of matter, the mole, define Avogadro's number, define molar mass, calculate the number of moles in a given mass, calculate the mass given the number of moles, define the molar volume of gases and calculate volumes of gas reactants.
	Chemical Equations	At the end of this activity, students should be able to define a chemical equation and describe what it consists of, explain the difference between a stoichiometric subscript and a stoichiometric coefficient, explain how to balance chemical equations, determine stoichiometric coefficients in chemical reactions, obtain information about the qualitative and quantitative composition of a chemical compound from its molecular formula, calculate reacting masses on the basis of chemical equations and explain the concept of the limiting reactant.
	Practical Importance of the Mole	At the end of this activity, students should be able to determine the empirical formula of a chemical compound, determine the molecular formula given the empirical formula and molar mass, determine the composition of a mixture and calculate reaction yields.
	Concentration	At the end of this activity, students should be able to determine if mixture is homogeneous or heterogeneous, define saturated and unsaturated solutions and explain how to recognize the colloid solution, calculate molarity and do calculations involving molarity, calculate the concentration of ions in a solution, prepare a solution of given molarity, calculate the molarity of a solution after dilution and calculate the molarity of a solution after mixing two solutions of the same substance, explain what titration is and determine the molarity of a solution using titration and do calculations of reactant and product quantities for reactions occurring in solution and calculate the mass percent concentration.
V. Periodic Table	**The Periodic Table of the Elements**	At the end of this activity, students should be able to state the criteria for classifying the elements in the periodic table, state the group to which a given element belongs on the basis of its number of valence electrons, and vice versa, state the period to which a given element belongs on the basis of its number of electron shells, and vice versa, state the block to which a given element belongs, s, p, d or f, on the basis of its electron configuration and give the electron configuration of an element on the basis of its position in the periodic table, and vice versa.
	The Trends in the Properties of the Elements in Period 3	At the end of this activity, students should be able to know how atomic radius, ionisation energy, electronegativity, conductivity, melting point and boiling point vary across Period 3 and be able to explain what factors affect these properties.

CHAPTER	LESSON	DESCRIPTION
	Periodic Trends in the Chemical Properties of Elements	At the end of this activity, students should be able to understand how the electronegativity of elements influences the properties of their compounds, understand how the oxides of Period 3 elements form, and what their structure and their properties are, understand how the elements of Period 3 behave in the presence of water, understand how the chlorides of Period 3 elements form and what their structure is and understand the chemical properties of the chlorides of Period 3 elements.
	s-Block Elements	At the end of this activity, students should be able to write out the electron configurations of the elements in the s–block, describe the changes in the atomic radii of the s–block elements within groups and periods, describe the changes in the ionic radii of the s–block elements within groups and periods, describe the trend in the melting points of the elements in groups 1 and 2 and describe the relationship between atomic structure and the physical properties of elements.
	Chemical Properties of s-Block Elements	At the end of this activity, students should be able to describe the changes in reactivity of s–block metals within groups and periods, know what type of bonding occurs in compounds made by the s–block metals with other elements, know the reactions between the Group 1 and 2 metals and water, know the solubility of the Group 1 and 2 metal hydroxides and sulphates, know the reactions of the Group 1 and 2 metals with oxygen, know the stability of the Group 1 and 2 metal carbonates and know about the unique properties of beryllium.
	Elements of Group 17	At the end of this activity, students should be able to write the electron configuration of Group 17 elements, describe the trends in the size of atomic and ionic radii in elements of Group 17, state the direction of changes in the melting point and the boiling point in Group 17, discuss the relationship between the atomic structure and the physical properties of elements, describe the trends in the reactivity of halogens, explain why chlorine is more reactive than bromine and state whether a reaction occurs between a molecule of a particular halogen and a simple ion of another halogen.
	Reactions of Halogens	At the end of this activity, students should be able to: describe the reactions between halogens and metals, determine the water solubility of halides, describe the reactions between silver halides and ammonia solution, define photosensitive substances, explain why silver bromide forms a negative image on photographic films, describe other uses of the halogens and their compounds, describe the reactions between the halogens and concentrated sulphuric acid.
VI. Transition Metals	**Electron Configuration and Periodic Trends of Transition Elements**	At the end of this activity, students should be able to give a general description of d–block elements, relate the properties of transition metals to their electron configurations, indicate whether a certain transition metal atom or ion is paramagnetic or not, discuss general periodic trends in the d–block and explain the reactivity of transition metals in terms of standard reduction potentials.
	Oxidation States of Transition Elements	At the end of this activity, students should be able to: explain why transition elements exist in many oxidation states in their compounds, give the most common oxidation states for the 4th Period transition elements, explain the use of manganate(VII) and dichromate(VI) in redox titrations.
	Transition Metal Complexes	At the end of this activity, students should be able to describe the structure of complex ions and determine the co–ordination number of the central ion, classify ligands as uni– or multitendate, determine the charge of a complex ion, explain why transition metal complexes are usually colored, and say what affects their color, describe the reactions of complex ions in terms of ligand exchange, give examples of redox reactions promoted by changing the ligands, describe the uses of transition metal complexes, including in analytical tests and explain the biological importance of transition metal complexes.

CHAPTER	LESSON	DESCRIPTION
VII. Oxidation and Reduction	**Oxidation State**	At the end of this activity, students should be able to describe what oxidation–reduction reactions involve, calculate oxidation states, recognise redox equations, give the systematic names of inorganic compounds and polyatomic ions, specifying their oxidation states, discuss the oxidative–reductive properties of the s–block metals, discuss the oxidative–reductive properties of the elements of Group 17 and describe the oxidation states of the p–block elements in their commonest chemical compounds.
	Redox Reactions	At the end of this activity, students should be able to write a redox reaction in the form of half–equations, balance redox reactions occurring in acidic solution, using the method of half–equations, balance redox reactions occurring in alkaline solution, using the method of half–equations, know how to recognize the oxidizing agent (reducing agent) in an aqueous solution and determine the concentration of a solution using redox titration.
	Extraction of Metals, Part I	At the end of this activity, students should be able to explain and define a mineral and an ore, explain the general methods for extracting metals from their ores, explain the importance of iron to man, describe the operation of a blast furnace and discuss the chemical processes occurring during the extraction of iron and explain the basic oxygen process for making steel.
	Extraction of Metals, Part II	At the end of this activity, students should be able to describe the process of electrolysis and discuss its products, describe the general properties, uses and extraction methods for aluminium, titanium and copper and discuss economic aspects of metal extraction and recycling.
VIII. Electrochemistry	**Voltaic Cells**	At the end of this activity, students should be able to describe the structure of a voltaic cell, discuss the principles of voltaic cells, explain what emf is, use the conventional notation for cell descriptions and write the half–cell reactions and discuss the practical applications of voltaic cells.
	Standard Electrochemical Potential	At the end of this activity, students should be able to: describe the structure of a standard hydrogen electrode, calculate the emf of a cell, determine the relative oxidising and reducing ability of a chemical species on the basis of its standard reduction potential, identify an equation for a spontaneous reaction, discuss the practical applications of the calomel half–cell.
	Electrochemical Series	At the end of this activity, students should be able to estimate the oxidizing and reducing properties of chemical elements on the basis of their position in the electrochemical series, use the electrochemical series to predict the direction of displacement of metals from solutions of their salts by other metals, use the electrochemical series to identify metals that will displace hydrogen from acids, estimate the oxidizing and reducing properties of chemical species from their position in the electrochemical series, estimate the feasibility of a redox reaction using the position of the reactants in the electrochemical series and predict whether a particular substance can be used for the oxidation of another substance under standard conditions.
IX. Thermodynamics	**Enthalpy Change and Calorimetry**	At the end of this activity, students should be able to: explain what energy is and classify the various forms of energy, distinguish between a system and its surroundings, describe the energetic effects that accompany chemical and physical changes, classify reactions as exothermic or endothermic, explain the concept of enthalpy change, write and interpret thermochemical equations, define specific heat capacity and use this quantity in calculations, explain the concept of calorimetry, determine enthalpy changes from calorimetric data.
	Standard Enthalpy Change and Hess's Law	At the end of this activity, students should be able to define standard conditions, standard state and standard enthalpy change, define and use in calculations standard enthalpies of combustion and standard enthalpies of formation, explain Hess's law and use it in determining enthalpy changes and use standard enthalpies of combustion and standard enthalpies of formation in determining the standard enthalpy change of a reaction.

CHAPTER	LESSON	DESCRIPTION
	Born–Haber Cycle	At the end of this activity, students should be able to describe the formation of an ionic compound as a series of steps, explain every step in the formation of an ionic compound and the enthalpy changes involved: enthalpy of atomisation, ionisation enthalpy, electron affinity and lattice formation enthalpy, describe a Born–Haber cycle as an energy diagram linking the enthalpy of formation to the enthalpy changes of atomisation, ionisation and crystal lattice formation and use a Born–Haber cycle to calculate enthalpy changes and to predict the stability of an ionic compound.
	Enthalpy Changes in the Solution Process	At the end of this activity, students should be able to explain the properties of water in terms of the structure of the water molecule, describe the process of dissolving an ionic solid, define enthalpy of hydration and discuss the factors that affect its value, define enthalpy of solution, derive the value of enthalpy of solution from lattice formation enthalpy and enthalpy of hydration and describe how enthalpy of solution can be measured experimentally.
	Mean Bond Enthalpies	At the end of this activity, students should be able to define mean bond enthalpies, use mean bond enthalpies to predict enthalpy changes, describe the limitations in the use of mean bond enthalpies in thermochemical calculations and explain why for certain compounds the predicted values of enthalpy changes do not agree with the experimental values.
	Entropy	At the end of this activity, students should be able to use the laws of probability to explain the spontaneity of chemical and physical changes, explain the concept of entropy as a measure of disorder at the molecular level, discuss the entropy changes caused by chemical and physical processes, use standard entropy values to calculate standard entropy changes for reactions, explain how the entropy change of a system is affected by temperature, phase change or the stoichiometry of gaseous reactions, use enthalpy change and temperature to determine the enthalpy change for the surroundings and use a calculated total entropy change to predict whether a reaction is spontaneous or not.
	Free Energy	At the end of this activity, students should be able to define free energy change and use it to determine whether a reaction is feasible or not, discuss the effect of ?H° and ?S° values on free energy change, explain why most exothermic processes are spontaneous but only certain endothermic processes are spontaneous, discuss how lattice formation enthalpy, enthalpy of hydration and entropy change affect the solubility of ionic compounds in water, correlate the feasibility of a reaction with the temperature and explain dynamic equilibrium in terms of free energy change.
X. Reaction Kinetics	**Reaction Rate**	At the end of this activity, students should be able to explain the importance of the speed at which a chemical reaction occurs, define reaction rate as the change in concentration of a reactant or product over time, discuss reaction rates qualitatively using graphs and describe experimental methods for studying reaction rates: gas volume, gas pressure, mass, conductance, colorimetric, titrimetric.
	Collision Theory	At the end of this activity, students should be able to describe a chemical reaction at the microscopic level as a collision of reactant molecules, discuss the factors that govern the effectiveness of collisions, explain the course of a reaction in terms of activation energy and an activated complex, use energy diagrams to show the course of a reaction, define a reaction mechanism and give examples of chemical reactions that do not require collisions between molecules to occur.
	Effect of Concentration on the Reaction Rate	At the end of this activity, students should be able to explain how concentration affects reaction rates, discuss the effect of concentration in terms of the collision theory, explain the effect of pressure on the rate of reactions taking place in the gas phase, define the rate equation, rate constant and order of reaction, determine a rate equation from the relative rates at various concentrations of reactants, use rate equations for predicting relative and actual reaction rates and explain why the contact area affects the rate of heterogeneous reactions.

CHAPTER	LESSON	DESCRIPTION
	Effect of Concentration on the Reaction Rate	At the end of this activity, students should be able to explain what zero–order, first–order and second–order reactions are, explain how to express the rate equation for a first–order reaction using natural logarithms, explain how the half–life is related to the rate constant for first–order reactions and use graphical methods in kinetics.
	Effect of Temperature and Catalysts on the Reaction Rate	At the end of this activity, students should be able to explain how and why reaction rates depend on temperature, describe the distribution of molecular energies in gases and liquids, discuss why controlling the temperature of chemical reactions is important, define a catalyst and inhibitors, explain how catalysts work, using the activation energy concept, describe the catalytic activity of metals and elicit information about reaction rates from potential energy diagrams and the Maxwell–Boltzmann distribution curve.
	Catalysts and Enzymes	At the end of this activity, students should be able to indicate the differences between heterogeneous and homogeneous catalysis, describe the course of a reaction in the presence of a solid catalyst, explain the concept of autocatalysis and active complex theory, describe the mechanism of catalyst action, give examples of the uses of catalysts and how enzymes work.
XI. Chemical Equilibria	**Chemical Equilibrium and Equilibrium Constant**	At the end of this activity, students should be able to explain the difference between reversible and irreversible reactions, explain the dynamic character of chemical equilibrium, write equilibrium constant expressions using the appropriate reaction equations, determine the units of Kc, discuss the relationship between the magnitude of Kc and the position of chemical equilibrium and determine Kc for a reaction, knowing the equilibrium concentration of one of the reagents.
	Factors Affecting the Chemical Equilibrium	At the end of this activity, students should be able to use the reaction quotient to determine whether a given system is in chemical equilibrium, define Le Chatelier's principle, predict how the addition or removal of reactants or products will affect an equilibrium, describe, in terms of disturbed chemical equilibrium, the formation of stalagmites and stalactites, tooth decay, and the harmful effects of acid rain on trees, explain how temperature changes affect chemical equilibrium, predict the direction of a net reaction induced by a temperature change and explain why catalysts do not affect the position of equilibrium.
	Chemical Equilibrium in a Gas Phase	At the end of this activity, students should be able to explain why pressure affects reactions involving gases, convert between different units of pressure, explain how pressure changes affect chemical equilibria, define partial pressure and molar fraction, write the expression for Kp of a reaction, use the Kp constant in calculations of partial pressures at equilibrium, explain the importance of reaction conditions for industrial processes and discuss the factors that affect the outcome of the Haber process.
XII. Acids, Bases, and Salts	**Dissociation of Acids, Bases, and Salts**	At the end of this activity, students should be able to define strong and weak electrolytes and non–electrolytes, explain why solutions of electrolytes conduct electricity, define acids, bases and salts and describe their general properties, explain the dissociation of acids, bases and salts, describe the neutralisation reaction, discuss the solubility of salts and describe the precipitation process.
	Brønsted–Lowry Theory of Acids and Bases	At the end of this activity, students should be able to define acids and bases in terms of the Bronsted–Lowry theory, identify pairs of conjugated acids–bases in aqueous and non–aqueous media, describe the autoionisation of water, define the ionic product of water Kw, distinguish among neutral, acidic and alkaline solutions and calculate concentrations of ions using the ionic product equation.
	pH as the Universal Acidity Measure	At the end of this activity, students should be able to use logarithms in calculations, define pH of a solution, explain the relationship between pH and the concentrations of hydrogen and hydroxide ions, describe the pH scale, determine the pH of strong acids and bases and deduce the pH of the solution resulting from mixing an acid and a base.

CHAPTER	LESSON	DESCRIPTION
	Weak Acids and Weak Bases	At the end of this activity, students should be able to describe the dissociation of weak acids and bases, define the acid and base dissociation constants, compare the strengths of acids and bases using dissociation constants, explain the changes in subsequent dissociation constants for di– and triprotic acids, perform pH calculations for solutions of weak acids and bases and explain pKa and pKb values and use them to predict the strengths of acids and bases.
	Salts in Water Solution	At the end of this activity, students should be able to describe the dissociation of conjugate acids and bases, explain the hydrolysis of salts and describe the relation of Ka and Kb in conjugate acid–base pairs, decide whether the pH of a salt solution has a neutral, acidic or alkaline value and calculate the pH of solutions of the salts of weak acids and strong bases and of the salts of strong acids and weak bases.
	Buffers	At the end of this activity, students should be able to define acidic and alkaline buffers, describe quantitatively how buffers work, calculate the pH of a buffer solution, calculate the pH changes resulting from the addition of strong acids/bases to buffer solutions, determine the pH range of a buffer based on Ka and Kb constants and calculate the amounts of acid/base and salt required to prepare a buffer solution of specified pH.
	Acid-Base Titration	At the end of this activity, students should be able to define titration as the volumetric analytical technique, describe how to perform an acid–base titration, derive the unknown amount of acid/base from the results of an acid–base titration and explain the importance of standardisation of titrant solutions.
	Titration Curves	At the end of this activity, students should be able to describe how the pH of a solution changes upon gradual addition of the titrant, describe the characteristics of pH curves for strong acid-strong base, weak acid-strong base and weak base-strong acid titrations, explain how indicators work, choose the appropriate indicator for a given titration, discuss qualitatively pH curves with two equivalence points and indicate the limitations of acid-base titrations.
XIII. Reaction of Metal Ions in Water Solution	**Acid-Base Reactions of Metal Ions**	At the end of this activity, students should be able to define acids and bases in terms of the Lewis theory, describe the formation of aqua ions in water solution, explain the acidity (hydrolysis) reaction of hexaaqua–metal ions, define the products of the reactions of metal aqua ions with alkalis, ammonia and carbonates, explain the term amphoteric hydroxides and use the reactions of aqua complexes for the identification of metal ions.
	Ligand Exchange Reactions	At the end of this activity, students should be able to describe the stability of a complex in terms of formation constant, explain the reaction of aqua ions with ammonia and describe the structure of the resulting ammine complexes, describe metal complexes of chloride ions, explain why the complexes with multidentate ligands (chelating agents) are usually more stable than those with unidentate ligands and explain why the formation of complex ions affects the solubility of ionic compounds.
XIV. Hydrocarbons	**Petroleum As the Source of Hydrocarbons**	At the end of this activity, students should be able to understand the origin of fossil fuels, recognise the importance of crude oil, know the location of the principal deposits of crude oil in the world, understand the fractional distillation process, know the basic products from fractional distillation of crude oil and their uses, understand the terms 'cracking' and 'reforming' and be able to perform calculations involving the concepts of density and mass percentage.
	Hydrocarbons As Fuel	At the end of this activity, students should be able to understand the importance of energy in modern society, understand the difference between total and incomplete combustion of hydrocarbons, be able to work with graphs and calculations concerning hydrocarbon oxidation, understand the term 'energetic value' of a fuel and how to evaluate it and know how catalytic converters work.

CHAPTER	LESSON	DESCRIPTION
	Alkanes and Cycloalkanes	At the end of this activity, students should be able to be able to explain the unique properties of the element carbon, understand the terms 'homologous series' and 'isomers', know the basic structural features of alkanes and cycloalkanes, know how to name alkanes, alkyl groups and cycloalkanes according to the IUPAC rules and know how to draw structural formulas for alkanes and cycloalkanes and know the basic physical properties of alkanes and understand the influence of intermolecular forces on the physical properties of alkanes.
	Chemistry of Alkanes and Cycloalkanes	At the end of this activity, students should be able to understand why alkanes and cycloalkanes are chemically inert, understand the energy profile for the combustion of alkanes, know the conditions leading to homolytic fission of the C-C bond, understand the mechanism of free-radical substitution, know about the influence of the type of halogen on substitution in alkanes as well as know the basic methods for alkane and cycloalkane synthesis.
	Alkenes	At the end of this activity, students should be able to provide the names and structures of the first members of a homologous series of alkenes, state and explain the physical properties of alkenes, recall and explain the types of isomerism exhibited by alkenes and give examples and systematic names of compounds belonging to the series of alkadienes and cycloalkenes.
	Alkene Reactions	At the end of this activity, students should be able to understand the concept of electrophilic addition, understand why alkenes undergo electrophilic addition, be able to write molecular and structural equations for reactions involving alkenes, understand why addition reactions yield mixtures of isomeric alkanes, and predict their proportion in the mixture and understand the importance of addition polymerisation and be able to give examples of this type of reaction.
	Haloalkanes	At the end of this activity, students should be able to define the term 'functional group', build models of, construct formulae for, and correctly name haloalkanes, give examples of isomers of haloalkanes, describe the physical properties of haloalkanes, describe the methods of preparation of haloalkanes and write appropriate reaction equations, give examples of the uses of haloalkanes and discuss the environmental impact of haloalkanes.
	Reactions of Haloalkanes	At the end of this activity, students should be able to describe the properties of the C-X bond, write equations for the reactions of haloalkanes with bases, ammonia and the cyanide ion, explain the mechanism of SN1 and SN2 nucleophilic substitution reactions, give examples of elimination reactions in haloalkanes and write relevant equations and give examples of the applications of haloalkanes in organic synthesis.
	Alcohols	At the end of this activity, students should be able to describe the structure of alcohol molecule, name alcohols and draw their structural formulae, explain the phenomenon of isomerism in alcohols, explain the concept of primary, secondary and tertiary alcohols, describe the physical properties of ethanol and describe and explain the changes in the boiling points and solubility of alcohols with increasing molecular size.
	Ethanol	At the end of this activity, students should be able to investigate the physical properties of ethanol, describe the methods for obtaining ethanol, explain the most important applications of ethanol and assess the effects of alcohol on the human organism.
	Reactions of Alcohols	At the end of this activity, students should be able to describe the acidic properties of the -OH group in alcohols, describe and give examples of the elimination reactions of alcohols, the reactions between alcohols and inorganic acids, and reactions involving alcohol oxidation, explain how to distinguish primary, secondary and tertiary alcohols and explain the concept of monohydric and polyhydric alcohols.

CHAPTER	LESSON	DESCRIPTION
XV. Compounds with the Carbonyl Group	**Aldehydes and Ketones**	At the end of this activity, students should be able to define the carbonyl group, an aldehyde and a ketone and name examples of carbonyl compounds, explain the effect of the presence of a carbonyl group on the physical properties of aldehydes and ketones, design reactions for obtaining simple aldehydes and ketones and describe the occurrence of aldehydes and ketones in nature and give examples of the applications of them.
	Reactions of Aldehydes and Ketones	At the end of this activity, students should be able to define a nucleophilic addition reaction and discuss its mechanism, write equations for the addition reactions of hydrogen cyanide and hydrogensulphite, and name the products, write equations for the reduction of aldehydes and ketones with various reducing agents and name the products of these reactions, explain the differences between the behaviour of aldehydes and ketones during oxidation and describe the practical importance of these reactions, write equations for the oxidation of aldehydes and ketones using known oxidising agents and define Tollens', Fehling's and Brady's reagents and name the reactions used for identification of carbonyl compounds.
	Carboxylic Acids	At the end of this activity, students should be able to describe the general structure of carboxylic acids, name carboxylic acids according to the IUPAC rules, explain how the physical properties of carboxylic acids are a result of the structure of the carboxyl group, explain the acidic properties of carboxylic acids and discuss how the structure of an acid affects its acidic strength, describe the properties of the salts of carboxylic acids and the typical reactions of carboxylic acids, describe preparative methods for carboxylic acids and indicate the natural sources of carboxylic acids.
	Functional Derivatives of Carboxylic Acids	At the end of this activity, students should be able to describe the general structure of functional derivatives of carboxylic acids, explain nucleophilic acyl substitution reactions, describe the structure, properties, reactions and preparation of acyl chlorides, acid anhydrides, esters, amides and nitriles and explain acylation reactions.
XVI. Aromatic Compounds	**Benzene**	At the end of this activity, students should be able to describe the inconsistencies arising from the representation of the structure of benzene using C=C double bonds, explain the structure of benzene in the light of modern knowledge, understand the concepts of delocalisation and resonance and be able to take them into account when writing the structure of an organic compound, determine the resonance stabilisation energy for arenes, describe the names and structures of some polycyclic aromatic hydrocarbons and alkyl derivatives of benzene and explain the aromaticity criteria for organic compounds.
	Electrophilic Substitution	At the end of this activity, students should be able to define an electrophilic substitution reaction of the aromatic ring and describe its mechanism, write down the reaction of benzene nitration and name its products, give examples of the uses of nitro compounds, explain the Friedel-Crafts alkylation and acylation reactions of the benzene ring and design synthesis reactions for simple alkyl and acyl derivatives of benzene.
XVII. Organic Compounds of Nitrogen	**Structure and Properties of Amines**	At the end of this activity, students should be able to describe amines as functional derivatives of ammonia, name and classify amines as primary, secondary or tertiary, explain the physical properties of amines as related to their structure, explain the properties of amines as bases and discuss their strength as bases, explain the effect of a benzene ring on the strength of aromatic amines as bases and describe the structure, properties and uses of quaternary ammonium salts.
	Reactions and Preparation of Amines and Amides	At the end of this activity, students should be able to describe the alkylation of ammonia and amines, explain how primary, secondary and tertiary amides are formed by the acylation of amines, discuss the physical and acid-base properties of amides, describe the hydrolysis and reduction of amides and describe the main general preparative routes to aliphatic and aromatic amines and use them to plan syntheses.

CHAPTER	LESSON	DESCRIPTION
	Amino Acids	At the end of this activity, students should be able to explain the structure of amino acids and zwitterions, describe the structural features of amino acids found in proteins, explain the optical isomerism of amino acids, discuss physical properties in terms of zwitterions, explain and use the concept of isoelectric point and describe the general structure of peptides.
XVIII. Biologically Important Chemical Compounds	**Fats and Sugars**	At the end of this activity, students should be able to describe the structures and physical properties of animal and vegetable fats, describe the hydrolysis of fats and the addition reactions of unsaturated fats, explain the role of fats in our diet, explain the washing properties of soaps in terms of their molecular structure, describe the structure and physical properties of sugars and explain the reactions of sugars as reactions of the carbonyl and hydroxyl groups, describe the general structure and biological function of polysaccharides and explain the nutritional importance of sugars.
	Proteins and Nucleic Acids	At the end of this activity, students should be able to describe the primary, secondary, tertiary and quaternary structures of proteins, explain the nature of the interactions that give proteins a three-dimensional shape, explain the relationship between the shape of a protein molecule and its biological function, describe the denaturation of proteins, name the main building blocks of nucleic acids, explain the structure of DNA and how two strands are bonded together and explain why the two strands of DNA are complementary.
XIX. Polymers	**Polymer Types and Addition Polymers**	At the end of this activity, students should be able to classify polymers and describe their basic types: straight-chain, cross-linked, thermoplastic, thermosetting, elastomers, explain the mechanism of the addition reaction leading to polymerisation, using the example of polyethene, describe the properties of the most common addition polymers as: polypropene, PVC, polystyrene and Teflon and explain how plasticisers work.
	Condensation Polymers	At the end of this activity, students should be able to explain condensation polymerisation reactions, describe condensation polymers: polyesters and polyamides and their uses, describe composites and explain the negative environmental impact of polymers.
XX. General Topics in Organic Chemistry	**Organic Molecules**	At the end of this activity, students should be able to explain why carbon has a unique ability to form so many compounds, describe the importance of carbon compounds to life on Earth, discuss the differences between organic and inorganic chemistry, describe the general types of carbon-carbon bond, explain how bonding affects the shape of organic molecules, derive the empirical formula of an organic compound from experimental data and define and use empirical, molecular and general formulae as well as various types of structural formula.
	Naming Organic Compounds	At the end of this activity, students should be able to classify organic compounds as aliphatic, alicyclic or aromatic, define a homologous series of compounds, explain the general approach to naming organic compounds recommended by the IUPAC, identify and name parent hydrocarbons for organic molecules, build a name for an organic compound using the names of the parent hydrocarbon, alkyl groups and functional groups, apply the IUPAC rules in naming organic compounds and draw the structure of a molecule using its IUPAC name.
	Isomerism	At the end of this activity, students should be able to explain the general types of isomerism: structural isomerism (chain, positional, functional group) and stereoisomerism (geometric, optical), identify the type of isomerism in simple organic molecules, indicate the differences in physical and chemical properties of enantiomers and explain the construction and use of a polarimeter.
	Organic Reactions	At the end of this activity, students should be able to describe homolytic and heterolytic fission of a covalent bond, explain free-radical chain reactions, discuss the stability of free radicals, define electrophiles and nucleophiles, describe the formation of carbocations and discuss their stability, explain the mechanisms of: electrophilic addition, electrophilic substitution, nucleophilic substitution (SN1 and SN2) , nucleophilic elimination (E1 and E2), nucleophilic addition and nucleophilic addition-elimination and describe the most common oxidants and reductants used in organic syntheses, and give examples of specific uses of these reagents.

CHAPTER	LESSON	DESCRIPTION
	Analytical Tests in Organic Chemistry	At the end of this activity, students should be able to explain what information can be obtained from combustion tests, use the results of elementary analysis in the determination of empirical formulae, describe the chemical tests for alkenes, haloalkanes (including identification of the halogen), aldehydes, ketones, alcohols (including 1°, 2° and 3° alcohols), carboxylic acids, esters, acid anhydrides, acyl chlorides, amines and amino acids and use the information from analytical tests to identify organic compounds.
XXI. Spectrometric Techniques	**Infrared Spectroscopy, Part I**	At the end of this activity, students should be able to use information from chemical tests to determine the structure of an organic compound, describe electromagnetic radiation in terms of wavelength, frequency, energy of photons and wave number, explain the general concept of spectroscopy, define the infra-red region used in spectroscopy, explain why organic compounds absorb infra-red radiation, state the relationship between the frequency of bond vibration and the frequency of absorbed radiation, discuss the factors affecting the frequency of bond vibration and the modes of bond vibration and describe recording of an infra-red spectrum, construction of the spectrometer and sample handling.
	Infrared Spectroscopy, Part II	At the end of this activity, students should be able to use a correlation chart for infra-red spectra, indicate the most typical absorptions found in the spectra of alkanes, alkenes, alkynes, aromatic hydrocarbons, alcohols, amines, haloalkanes, aldehydes and ketones, carboxylic acids and their derivatives (esters, amides, nitriles), identify the presence and absence of functional groups using infra-red spectra, predict the infra-red absorption regions for molecules of known structure and describe the uses and limitations of infra-red spectroscopy.
	Mass Spectrometry, Part I	At the end of this activity, students should be able to: discuss the behaviour of charged particles in electric and magnetic fields, relate the deflection of a charged particle in a magnetic field to the mass and charge of the particle and the strength of the magnetic field, describe how a mass spectrometer works, explain what a mass spectrum is, explain the terms: base peak, molecular ion, fragmentation ion, relative abundance, discuss mass spectra of the elements in terms of the natural abundance of isotopes, explain the general features of mass spectra of organic compounds.
	Mass Spectrometry, Part II	At the end of this activity, students should be able to: use mass spectra to determine the relative molecular mass of a compound, discuss the stability of fragmentation ions, predict the most probable fragmentation patterns, recognise the spectra of chlorine– and bromine–containing compounds and use mass spectra for the identification of organic compounds.
	Nuclear Magnetic Resonance (NMR) Spectroscopy, Part I	At the end of this activity, students should be able to: explain how atomic nuclei behave in an external magnetic field, depending upon whether they posses nuclear spin or not, explain why a magnetic field causes the energy levels of nuclei possessing nuclear spin to split, explain the nuclear absorption of electromagnetic radiation by nuclei placed in a magnetic field, describe the construction and operation of an NMR spectrometer and how an NMR spectrum is recorded, explain the term 'chemical shift' and discuss why hydrogen atoms in organic molecules may produce more than one NMR absorption signal, explain why TMS has been chosen as a standard in NMR spectroscopy, identify equivalent and non–equivalent 1H atoms in the molecule, predict the number of absorption signals in low–resolution proton NMR spectra, as well as their relative intensity.
	Nuclear Magnetic Resonance (NMR) Spectroscopy, Part II	At the end of this activity, students should be able to: explain the coupling effect , predict the number of components in proton NMR multiplets, given the structural formula of a compound, draw conclusions about a molecular structure from the coupling pattern, state and use the n + 1 rule and describe the main types of multiplet: singlet, doublet, triplet, quartet, explain the types of coupling with non–equivalent 1H atoms, explain why there is no coupling with hydrogen atoms bonded to oxygen or nitrogen, use a chemical–shift correlation chart to obtain information about molecular structure and determine the structure of organic molecules using information provided by proton NMR spectra: the number and intensity of absorption signals, the coupling pattern and chemical shifts.

CHAPTER	LESSON	DESCRIPTION
	Determination of Molecular Structure	At the end of this activity, students should be able to: lculate and use the hydrogen deficiency index, use spectral and analytical data to draw conclusions about the structures of organic compounds.
	Absorption of Visible Light, Colorimetry	At the end of this activity, students should be able to: explain how the absorption of light produces colour, explain the origin of the colours of the inorganic compounds of s, p and d–block metals, as well as of organic compounds, describe how absorption spectra are recorded, explain the concept of colorimetry, define and use the Beer–Lambert law.
XXII. Environmental Pollution by Chemical Products	**Pollution of Air**	At the end of this activity, students should be able to describe the composition of air and the structure of the atmosphere, explain how the contemporary atmosphere evolved, explain the carbon cycle and discuss how it is disturbed by human activities, explain why the increasing concentration of atmospheric CO2 contributes to global warming, and what the probable results of a prolonged greenhouse effect would be, indicate the sources of sulphur dioxide and nitrogen oxides, explain the phenomenon of acid rain, describe the formation of photochemical smog and explain how CFCs disrupt the ozone layer.
	Pollution of Water	At the end of this activity, students should be able to explain the composition and properties of natural water: oxygen content, pH, hardness, content of ionic compounds, explain the toxic properties of heavy metals, give examples of poisoning by heavy-metal ions contained in water, discuss the positive and negative effects of using pesticides, explain the eutrophication of water by excess phosphate and describe the purification of tap water and the treatment of sewage.
	Pollution of Land	At the end of this activity, students should be able to explain the composition and disposal of solid commercial and domestic waste, discuss the benefits of and problems with the recycling of plastic, paper, glass and metals, indicate the sources of dioxins and explain the environmental impact of using nuclear energy for the production of electricity.