mVuli ACADEMY

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mCirruculum Statistics

	No. of Digital Lessons		No. of ePages	Films & Animations	Simulations Games & 3D objects	Illustrations	Photos & Slideshows
Upper Primary	Mathematics	127	1 099	700	473	876	69
	Science	80	635	489	210	1 288	313
Lower Secondary	Mathematics	136	1 320	897	609	320	103
	Physics	111	970	746	352	874	528
	Biology	101	903	413	144	655	1 171
	Chemistry	99	821	1 058	175	525	1 118
Upper Secondary	Mathematics	112	1 077	675	470	419	204
	Physics	119	1 055	928	393	902	465
	Biology	99	977	487	107	699	615
	Chemistry	100	889	1 354	303	1 176	304
	TOTAL	**1 084**	**9 746**	**7 747**	**3 236**	**7 674**	**4 891**

CONTENTS OF THIS SECONDARY PHYSICS PACKAGE

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.

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	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.

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	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. 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. 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.