وزارة التعليم

رؤية عمان ٢٠٤٠

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Physics Curriculum Framework

Grades 9-10 Bilingual Program

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وزارة التعليم
المديرية العامة للمؤسسات التعليمية الخاصة

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Introduction

Science plays a major role in the evolution of knowledge. It empowers us to use creative and independent approaches to problem solving. It arouses our natural curiosity and enables us to meet diverse and ever-expanding challenges. It enhances our ability to inquire, seek answers, research, and interpret data. These skills lead to the construction of theories and laws that help us to explain natural phenomena and exercise control over our environment. Science is, thus, an integral component of a balanced education.

This curriculum focuses on the content essential for preparing students to be engaged and productive citizens. A good foundation in the sciences will help citizens to respond to the challenges of a rapidly changing world using the scientific approach. It addresses, in addition to a specific knowledge base, the development of related skills and attitudes. Critical thinking, enquiry and reasoning are emphasized to ensure that students develop the ability to work creatively, think analytically and solve problems. The curriculum also ensures that students become aware of their moral, social, and ethical responsibilities, as well as the benefits intrinsic to the practical application of scientific knowledge to careers in the scientific field. Teaching these standards requires teaching methods that are varied and experiential. Effective lessons will be concerted and incorporated with: Practical work and the science standards, the place of information and communications technology in the science standards, teaching about science, technology and society, the mathematical requirements of the science standards.

The overall aims of science standards are that students should:

1. develop and sustain an interest in science and its applications.
2. have a sound and systematic knowledge of important scientific facts, concepts, and principles, and possess the skills needed to apply these in new and changing situations in a range of personal, domestic, industrial and environmental contexts.
3. recognise the importance of the application of scientific knowledge in the modern world and be aware of the moral, ethical, social, and environmental implications.
4. develop relevant attitudes, such as a concern for accuracy and precision, objectivity, integrity, enquiry, initiative, and inventiveness.
5. develop an understanding of the scientific skills that are essential for both further study and everyday life.
6. plan, design and perform experiments to test theories and hypotheses.
7. be proficient in the use of a range of scientific methods and techniques and in handling apparatus.
8. develop the ability to work independently and collaboratively with others when necessary.
9. integrate Information and Communication Technology (ICT) tools and skills.

Important Skills:

The Physics Curriculum aims to enable students to achieve academic success in science while equipping them with the skills needed to develop scientific thinking. It prepares them to pursue further studies and to participate effectively in a knowledge-based society, regardless of their future academic or career pathways.

- Scientific enquiry skills: Scientific enquiry, which ensures the development of scientific skills, intellectual and practical, should be integrated in the learning of the scientific content across all the science branches. Scientific enquiry skills include the following:

1. Carry out the practical experiments to develop the practical skills which will be mentioned in detail below.
2. Find secondary information sources such as the resources available in the public libraries and on the Internet and use these after validation and making sure of the suitability of the subject.
3. Apply Scientific knowledge and procedures to the situations of real Life.
4. Recognise the importance of cooperative teamwork, put work plans, distribute responsibilities and regulate and set specific targets for work.

- Know how scientists are working:

1. Realize that with science we can bring great benefits to humanity, also if it is abused can cause serious damage to the environment.
2. know how scientists are carrying out their work, such as environmental monitoring and control of industrial processes.
3. Know how scientists publish and present their ideas and results in order to encourage debate and development.
4. know that science could lead to the emergence of ethical considerations and discuss them.
5. know that there are many questions and considerations that cannot be answered by science.
6. trace the historical development of some key scientific models and know what contributions scientists presented in this development.

- Processing and delivery of information

1. present qualitative and quantitative data using a variety of methods, such as descriptive texts, graphics, images, tables, and maps with the use of technology methods and computer when it is appropriate, then analyse and explain these data to extract conclusions from them.
2. use mathematical relationships routinely to calculate the quantities.
3. do calculations based on data taken from the graphs and distinguish between independent and dependent variables.
4. handle data and write reports about the results.
5. use symbolic equations to represent chemical reactions and simple physical relationships.
6. use the appropriate methods to deliver scientific information.

- ICT application:

This curriculum provides students with a wide range of opportunities to use ICT in their study of science in order to play a full part in modern society, students need to be confident and effective users of ICT. Opportunities for ICT include:

1. gathering reliable information from electronic resources.
2. using spreadsheets and other software to process data.
3. using animations and simulations to visualize scientific ideas.
4. using software to present ideas and information on paper and on screen.

Skills and abilities to be assessed:

Students' learning is assessed based on the assessment objectives outlined in the Student Assessment Handbook for Science (Grades 5–10) for Private Schools, issued by the Directorate General of Educational Assessment. The handbook is circulated through the official correspondence system and is also available on the Educational Portal (www.moe.gov.om). It should be consulted when planning and implementing assessment practices in science subjects at this level (Grades 5-10).

Physics Syllabus for Grades 9-10

Physics is a science that is concerned with systems, laws, models, principles and theories that explain the physical behavior of our world and the universe. Physics is an enquiry-based discipline that involves practical and investigative skills as well as scientific knowledge and is regarded as a fundamental scientific discipline because all advances in technology can be traced either directly or indirectly to physical laws and theories. This syllabus emphasizes the application of scientific concepts and principles. Such an approach is intended to develop those long-term transferable skills of ethical conduct, teamwork, problem solving, critical thinking, innovation and communication. The syllabus will assist students in developing positive values and attitudes towards the physical components of the environment and will also provide a sound foundation for those who wish to pursue further studies in science.

Aims: Physics syllabus enables students to:

1. develop their knowledge and understanding of physics.
2. develop and apply their knowledge and understanding of the scientific process.
3. develop their understanding of the relationships between hypotheses, evidence, theories, and explanations.
4. develop and apply their observational, practical, modeling, enquiry and problem-solving skills, and their understanding in laboratory, field, and other learning environments.
5. develop their skills in reporting and presenting information clearly and logically in different formats.
6. develop their skills in communication, mathematics, and the use of technology in scientific contexts.
7. appreciate the contributions of some of the outstanding regional and international scientists to the development of Physics.
8. develop the ability to evaluate information critically, identify patterns, cause and effect, stability, and change, and evaluate ideas.

How to use this syllabus

This syllabus is arranged according to the following manner:

- Objectives:

Indicate the scope of the content, including practical work which will be examined as well. However, practical work should not necessarily be limited to these objectives.

The numbering key follows the format [Unit – Topic – Learning Objective] e.g., Unit 2. (2. Forces); Topic 1 (2.1 Effects of forces); and 1) is the first learning objective 2.1.1 Know that forces may produce changes in the size, shape, and motion of un object. The suffix (s) indicates a skill objective.

- Practical experiments and activities:

Show some examples of active Learning activities and do not represent Full -scale activities that can be done. It is recommended that **all** the suggested laboratory-related activities, such as conducting experiments, must be done. Other activities like making field trips, using simulations and viewing audio-visual materials, can be done also. Consider the sufficient time to carry out practical experiments determined in this syllabus and training students in practical skills related to them. The teachers should benefit from the student textbooks, teacher's resources, practical workbooks and the interactive digital resources that are recommended by MOE in the approved books list or affiliated with the approved series.

Guided learning time

This syllabus is designed based on learners having about 42 lessons in semester 1 and 48 lessons in semester 2 (each lesson is 40 minutes) for science. The actual amount of teaching time may vary according to your context.

Grade 9 (Bilingual) Physics - Semester 1			
Subtopics	**Learning Objectives**		**Practical activities**
Unit 1: Measurements and motion			
1.1 Length and time	1.1.1	Name the SI units of mass, time and length	Determine the volume of regular and irregular objects
	1.1.2(s)	Use the rules and measuring cylinders to find a length or a volume	
	1.1.3(s)	Use the clocks and devices, both analogue and digital, for measuring an interval of time	
1.2 Mass and Weight	1.2.1	Define the mass of a body	Use of Newton meter
	1.2.2	State that weight is a gravitational force	
	1.2.3	Distinguish between mass and weight	
	1.2.4	Use the equation W = mg	
1.3 Density	1.3.1	Define density	Determine density by displacement method
	1.3.2	Use the equation ρ = m/V	
	1.3.3(s)	Design an experiment to determine the density of a liquid, a regularly shaped solid and of an irregularly shaped solid which sinks in a liquid (volume by displacement) and make the necessary calculation	
1.4 Scalars and vectors	1.4.1	Demonstrate the difference between scalars and vectors and give common examples	
	1.4.2(s)	Determine graphically the resultant of two vectors in straight lines (same and different directions)	
	1.4.3	Determine graphically the resultant of two vectors using the method of triangle	
1.5 Motion	1.5.1	Define speed as the distance travelled per unit time	Demonstrate the speed and acceleration of moving trolley down a slope
	1.5.2	Recall and use the equation $v = \frac{s}{t}$	
	1.5.3	Define velocity as speed in a given direction	
	1.5.4(s)	Interpret a (distance-time) graph for objects at rest, moving with constant speed and moving with changing speed	

Grade 9 (Bilingual) Physics - Semester 1			
Subtopics	**Learning Objectives**		**Practical activities**
	1.5.5(s)	Calculate speed from the gradient of (distance-time) graph	
	1.5.6	Define acceleration as change in velocity per unit time	
	1.5.7	Calculate acceleration using the equation $a = \frac{\Delta v}{\Delta t}$	
	1.5.8(s)	Calculate acceleration from the gradient of a (speed-time) graph	
	1.5.9	Define deceleration as a negative acceleration and use this in calculations	
	1.5.10(s)	Interpret a (speed-time) graph for objects moving with speed velocity and moving with changing speed (acceleration or deceleration)	
Unit 2: Forces			
2.1 Effects of forces	2.1.1	Know that forces may produce changes in the size, shape, and motion of an object	Determine the spring constant
	2.1.2	Know that drag forces in liquids and gases (also known as air resistance) are forms of friction	
	2.1.3	Find the resultant of two or more forces acting along the same line	
	2.1.4	Describe the effect of the resultant force on the state of the motion of a body (either remaining at rest or continue moving with steady or changing velocity)	
	2.1.5	Recall and use the equation F=am and know that the force and the acceleration are in the same direction	
	2.1.6	Name the SI unit of force	
	2.1.7	Describe Hooke's law (the expression F=kx where k is the spring constant)	
	2.1.8	Describe the experimental procedure associated for Hooke's law	
	2.1.9(s)	Draw and interpret extension-load graphs	

Grade 9 (Bilingual) Physics - Semester 1			
Subtopics	**Learning Objectives**		**Practical activities**
2.2 Turning effect of force	2.2.1	Define the moment of a force and give everyday examples	Find the mass of an unknown object using moments
	2.2.2	Understand that increasing force or distance from the pivot increases the moment of a force	
	2.2.3	Calculate moment using the product force × perpendicular distance from the pivot	
	2.2.4	State the principle of moments to the balancing of a beam about a pivot	
	2.2.5(s)	Perform an experiment (involving vertical forces) to show that there is no net moment on a body in equilibrium	

Grade 9 (Bilingual) Physics - Semester 2			
Subtopics	**Learning Objectives**		**Practical activities**
Unit 3: Work and energy			
3.1 Work	3.1.1	Demonstrate the concept of work using equation (W= force × distance in the direction of the force)	
	3.1.2	Solve problem using the equation (W=F× d)	
3.2 Energy	3.2.1	State Energy as the capacity of doing work	Conservation of Kinetic Energy and Potential Energy using trolley, runway, and hanger
	3.2.2	State that energy may be stored as kinetic, gravitational potential, chemical, elastic strain), nuclear, electrostatic and internal (thermal)	
	3.2.3	Define the kinetic energy	
	3.2.4	Calculate the kinetic energy (KE) using the expression $\left(KE = \frac{1}{2}mv^2\right)$	
	3.2.5	Define the gravitational potential energy	
	3.2.6	Calculate gravitational potential energy (PE) using the expression (PE= mgh)	
	3.2.7	State the principle of the conservation of energy	
	3.2.8	State that mechanical energy (E) is the sum of kinetic energy (KE) and gravitational potential energy (PE)	
	3.2.9(s)	Apply the principle of the conservation of energy to mechanical system (Δ KE = - ΔPE)	
	3.2.10	Describe the transformation of energy	
	3.2.11(s)	Relate the mechanical work done (W) to the transformed energy (ΔE) using the expression (W= Fd =ΔE)	
	3.2.12	Understanding the concept of efficiency of energy transfer	
	3.2.13(s)	Use the equation $\left(efficiency = \frac{useful\ energy\ output}{total\ energy\ input} \times 100\%\right)$	
	3.2.14	Define the power as the work done per unit time	
	3.2.15	Use the equation (P=ΔE/t) in simple systems	
	3.2.16	Use the equation $\left(efficiency = \frac{useful\ power\ output}{total\ power\ \ input} \times 100\%\right)$	

Grade 9 (Bilingual) Physics - Semester 2			
Subtopics	**Learning Objectives**		**Practical activities**
Unit 4: Thermal Physics			
4.1 Kinetic particle model of matter	4.1.1	State the properties of solids, liquids and gases	
	4.1.2	Know the terms of the changes in state between solids, liquids and gases (gas to solid and solid to gas transfers are not required)	
	4.1.3	Describe qualitatively the particle structure of solids, liquids and gases in terms of the arrangement, separation and motion of the molecule's particles, and represent these states using simple particle diagram	
	4.1.4	Know that the forces and distances between particles (atoms, molecules, ions and electrons) and the motion of the particles affects the properties of solids, liquids and gases	
	4.1.5	Describe the relationship between the motion of particles and temperature, including the idea that there is a lowest possible temperature (-273ºC), known as absolute zero, where the particles have least kinetic energy	
	4.1.6	Describe qualitatively the pressure of a gas in terms of the motion of its particles	
	4.1.7	Describe the pressure and the changes in pressure of a gas in terms of the forces exerted by particles colliding with surfaces, creating a force per unit area	
	4.1.8	Describe Brownian motion	
	4.1.9	Describe that random motion of particles in a suspension as evidence for the kinetic particle model of matter	
	4.1.10	Relate qualitatively the change in temperature of a gas to change in pressure applied on it at constant volume	
	4.1.11	Relate change in volume of a gas to change in pressure applied on it at constant temperature (Boyle's law)	
	4.1.12	Use the equation PV=constant for a fixed mass of a gas at constant temperature, including the graphical representation of this relationship	
	4.1.13	Convert temperatures between kelvin and degrees Celsius using the equation T (in K) = θ (in °C) + 273	

Grade 9 (Bilingual) Physics - Semester 2			
Subtopics	**Learning Objectives**		**Practical activities**
4.2 Thermal properties and temperature	4.2.1	Describe qualitatively the thermal expansion of solids, liquids, and gases at constant pressure	Determine the Specific Heat Capacity of Solids and Liquids
	4.2.2	Explain, in terms of the motion and arrangement of molecules, the relative order of the magnitude of the expansion of solids, liquids and gases	
	4.2.3	Explain some of the everyday applications and consequences of thermal expansion	
	4.2.4	Relate a rise in the temperature of a body to an increase in its internal energy	
	4.2.5	Describe an increase in temperature of an object in terms of an increase in the average kinetic energies of all of the particles in the object	
	4.2.6	Define the specific heat capacity of a body as the energy required per unit mass per unit temperature increase	
	4.2.7	Use the equation: $\Delta E = mc\Delta\theta$	
	4.2.8(s)	Describe and perform experiment to measure the specific heat capacity of a substance	
	4.2.9	Describe melting and boiling in terms of energy input without a change in temperature	
	4.2.10	Distinguish between boiling and evaporation	
	4.2.11	Know the melting and boiling temperatures for water at standard atmospheric pressure	
	4.2.12	Describe condensation and solidification in terms of particles	
	4.2.13	Describe evaporation in terms of the escape of more-energetic molecules from the surface of a liquid	
	4.2.14	Understand that temperature, surface area and draught over a surface influence evaporation	
	4.2.15	Relate evaporation to the consequent cooling of the liquid	
	4.2.16	Explain the cooling of an object in contact with an evaporating liquid	
4.3 Transfer of thermal	4.3.1	Demonstrate the properties of good and bad thermal conductors (thermal insulator)	1.Compare the conductivity between metals and non-metals
	4.3.2	Explain conduction in solids including lattice vibration and transfer by electrons	
	4.3.3	Recognise convection as an important method of thermal transfer in fluids	
	4.3.4	Relate convection in fluids and gases to density changes	

Grade 9 (Bilingual) Physics - Semester 2			
Subtopics	**Learning Objectives**		**Practical activities**
energy	4.3.5(s)	Perform an experiments to illustrate convection	2.Demonstrate convection experimentally 3. Properties of good and bad emitters and absorbers
	4.3.6	Recognise that thermal radiation is infrared radiation and that all objects emit this radiation	
	4.3.7	Recognise that thermal energy transfer by radiation does not require a medium	
	4.3.8	Describe the effect of surface colour (black or white) and texture (dull or shiny) on the emission, absorption and reflection of radiation	
	4.3.9(s)	Describe and perform experiments to show the properties of good and bad emitters and good and bad absorbers of infra-red radiation	
	4.3.10	Understand that the amount of radiation emitted depends on the surface temperature and surface area of a body	
	4.3.11	Explain everyday applications and consequences of conduction, convection, and radiation	

Grade 10 (Bilingual) Physics - Semester 1			
Subtopics	**Learning Objectives**		**Practical activities**
Unit 1: Magnetism and Electricity			
1.1 Magnetism	1.1.1	Describe the forces between magnetic poles, and between magnets and magnetic materials, including the use of the terms north pole (N pole), south pole (S pole), attraction and repulsion, magnetised and unmagnetised	Drawing magnetic field lines around bar magnets
	1.1.2	Describe induced magnetism	
	1.1.3	State the differences between the properties of temporary magnets (made of soft iron) and the properties of permanent magnets (made of steel)	
	1.1.4	Distinguish between magnetic and non-magnetic materials	
	1.1.5(s)	Draw the pattern and the direction of magnetic field lines around a bar magnet	
	1.1.6	State that the direction of the magnetic field at a point is the direction of the force on the N pole of a magnet at that point	
	1.1.7(s)	Perform an experiment to identify the pattern of magnetic field lines, including the direction	
	1.1.7	Explain that magnetic forces are due to interactions between magnetic fields	
1.2 Static electricity	1.2.1	Recall that there are positive and negative charges	Determine the electrostatic charge using electroscope
	1.2.2	State that unlike charges attract and that like charges repel	
	1.2.3	Describe simple experiments for the production and detection of electrostatic charges	
	1.2.4	State that charging a body involves the addition or removal of electrons	
	1.2.5	Distinguish between electrical conductors and insulators and give typical examples	
	1.2.6	State that charge is measured in coulombs	
	1.2.7	Describe the structure and the uses of electroscope	
	1.2.8	Explain that charging of solids by friction involves only a transfer of negative charge (electrons)	
	1.2.9	Define earthing	
	1.2.10	Define an electric field as a region in which an electric charge experiences a force	

Grade 10 (Bilingual) Physics - Semester 1			
Subtopics	**Learning Objectives**		**Practical activities**
	1.2.11	State that the direction of an electric field at a point is the direction of the force on a positive charge at that point	
	1.2.12	Describe simple field patterns, including the field around a point charge, the field around a charged conducting sphere and the field between two parallel plates	
1.3 current	1.3.1	State that current is related to the flow of charge	Measure current in simple circuits
	1.3.2	Distinguish between the direction of flow of electrons and conventional current	
	1.3.3(s)	Describe the use of ammeters (analogue and digital) with different ranges	
	1.3.4	Use the equation I = Q / t	
	1.3.5	Name the unit of current	
	1.3.6	Distinguish between direct current (d.c) and alternating current (a. c)	
1.4 Potential difference and electromotive force	1.4.1	Define the potential difference (p.d.) across a circuit component	Measure P.d in simple circuits
	1.4.2	State that the potential difference (p.d.) across a circuit component is measured in volts	
	1.4.3	Recall that 1 V is equivalent to 1 J / C	
	1.4.4	State that the e.m.f. of an energy supplied by a source in driving charge round a complete circuit and is measured in volts	
	1.4.5	Describe the use of voltmeters (analogue and digital) with different ranges	
1.5 Resistance	1.5.1	State that resistance = p.d. / current	Determine the resistance using a V vs. I graph
	1.5.2	Recall and use the equation for resistance $R = \frac{V}{I}$	
	1.5.3	Name the unit of resistance	
	1.5.4(s)	Describe and perform experiment to determine resistance using a voltmeter and an ammeter and do the appropriate calculations	
	1.5.5(s)	Explain the current-voltage graph for an ohmic resistor and a filament lamp	

Grade 10 (Bilingual) Physics - Semester 1			
Subtopics	**Learning Objectives**		**Practical activities**
	1.5.6	Relate (without calculation) the resistance of a wire to its length and cross sectional area.	
1.6 Electrical energy and power	1.6.1	Define the electric power as the rate at which energy transformed (power=energy transformed/time)	
	1.6.2	Use the equations P = IV and E = IVt	
	1.6.3	State the Unit of power	
1.7 Electrical circuits	1.7.1	Draw circuit diagrams containing sources, switches, resistors (fixed and variable), heaters, thermistors, light-dependent resistors, lamps, ammeters, voltmeters, magnetising coils, transformers, fuses, relays and diodes	Determine the properties of circuits (series and parallel)
	1.7.2	Recall that the current at every point in a series circuit is the same	
	1.7.3	Use the fact that the sum of the p.d.s across the components in a series circuit is equal to the total p.d. across the supply	
	1.7.4	Calculate the combined (total) resistance of two resistors in series	
	1.7.5(s)	Design an experiment to calculate the effective resistance of two resistors in series	
	1.7.6	Use the fact that the current from the source is the sum of the currents in the separate branches of a parallel circuit	
	1.7.7	State that, for a parallel circuit, the current from the source is larger than the current in each branch	
	1.7.8	Recall that p.d across each component in parallel circuit is the same	
	1.7.9	State that the combined resistance of two resistors in parallel is less than that of either resistor by itself	
	1.7.10	Calculate the combined resistance of two resistors in parallel	
	1.7.11(s)	Design an experiment to calculate the combined resistance of two resistors in parallel	
	1.7.12	State the advantages of connecting lamps in parallel in a lighting circuit	

Grade 10 (Bilingual) Physics - Semester 1			
Subtopics	**Learning Objectives**		**Practical activities**
	1.7.13	State the hazards of: – damaged insulation – overheating of cables – damp conditions	
	1.7.14	Explain fuses and circuit breakers	
	1.7.15	Explain the benefits of earthing metal cases	
1.8 Electromagnetic effects	1.8.1	Know that a conductor moving across a magnetic field or a changing magnetic field linking with a conductor can induce an e.m.f. in the conductor	Electromagnetic induction experiment
	1.8.2(s)	Demonstrate electromagnetic induction with an experiment	
	1.8.3	State the factors affecting the magnitude of an induced e.m.f.	
	1.8.4	Explain the structure of a rotating-coil generator with slip rings	
	1.8.5	Describe the working principle of generator	
	1.8.6	Sketch a graph of voltage output against time for a simple a.c. generator	
	1.8.7	Describe the pattern and direction of the magnetic field due to currents in straight wires and in solenoids	
	1.8.8	Recognise that a current-carrying coil in a magnetic field may experience a turning effect	
	1.8.9	Describe the operation of an electric motor, including the action of a split-ring commutator and brushes	
	1.8.10	Describe the basic transformer with a soft-iron core	
	1.8.11	Describe the principle of operation of a transformer	
	1.8.12	Understand the terms step-up and step-down	
	1.8.13	Use the equation (Vp / Vs) = (Np / Ns)	

Grade 10 (Bilingual) Physics - Semester 2			
Subtopics	**Learning Objectives**		**Practical activities**
Unit 2: Waves			
2.1 General wave properties	2.1.1	Understand that waves transfer energy without transferring matter	Study the wave properties using the ripple tank
	2.2.2(s)	Describe what is meant by wave motion as illustrated by vibrations in ropes and springs, and by experiments using water waves	
	2.1.3	Distinguish between transverse and longitudinal waves	
	2.1.4	Use the term wave front	
	2.1.5	Give the meaning of speed, frequency, wavelength and amplitude	
	2.1.6	Use the equation $v = f\lambda$	
	2.1.7	Describe how waves can undergo: – reflection at a plane surface – refraction due to a change of speed	
	2.1.8	Demonstrate reflection and refraction in water waves	
	2.1.9	Describe how waves can undergo: – diffraction through a narrow gap – diffraction at an edge	
	2.1.10	Demonstrate diffraction in water waves	
	2.1.11	Describe how wavelength and gap size affect diffraction through a gap	
	2.1.12	Describe how wavelength affects diffraction at an edge	

Grade 10 (Bilingual) Physics - Semester 2				
Subtopics		**Learning Objectives**		**Practical activities**
2.2 Light	2.2.1 Reflection of light	2.2.1.1	State the properties of light: – straight lines – transfers energy – travel through empty space – has a speed of 300,000km/s	Verify the law of reflection
		2.2.1.2	Describe the formation of an optical image with its characteristics by a plane mirror	
		2.2.1.3	Demonstrate law of reflection by plane mirrors	
		2.2.1.4(s)	Draw ray diagram for reflection by plane mirrors	
		2.2.1.5	Define: incident ray, reflected ray, normal, angle of incidence and angle of reflection	
		2.2.1.6	Use the law angle of incidence = angle of reflection	
	2.2.2 Refraction of light	2.2.2.1(s)	Demonstration law of the refraction of light by rectangular glass block	
		2.2.2.2	Use the terminology for the angle of incidence i and angle of refraction r	
		2.2.2.3	Use the equation sin i / sin r = n	
		2.2.2.4	Define refractive index in terms of angle of incidence and angle of refraction	
		2.2.2.5	Define refractive index n in terms of speed (n=speed of light in air/speed of light in medium)	
		2.2.2.6	Describe total internal reflection	
		2.2.2.7	Give the meaning of critical angle	
		2.2.2.8	Use n = 1 / sin c, where c is the critical angle	
		2.2.2.9	Explain the action of optical fibers in medicine and communications technology	
		2.2.2.10	Describe the dispersion of light from glass prism including the seven colours of the spectrum in their correct order	
		2.2.2.11	Describe a single frequency light means monochromatic	

Grade 10 (Bilingual) Physics - Semester 2				
Subtopics		**Learning Objectives**		**Practical activities**
	2.2.3 Thin lenses	2.2.3.1	Distinguish between converging and diverging lenses in term of: – shape – light pass	Describe the nature of an image formed by converging lens experimentally (one position is enough)
		2.2.3.2	Use the terms principal focus and focal length	
		2.2.3.3	Draw and use ray diagrams for the formation of a real image by a converging lens	
		2.2.3.4	Describe the nature of an image using the terms enlarged/same size/diminished, upright/inverted and real image/ virtual image	
		2.2.3.5(s)	Draw and use ray diagrams for the formation of a virtual image by a diverging lens	
2.3 Electromagnetic spectrum		2.3.1	Describe the main features of the electromagnetic spectrum in order of wavelength and frequency	
		2.3.2	State that the speed of electromagnetic waves in a vacuum is 3.0×10^8 m / s and is approximately the same in air	
		2.3.3	State applications of each region in electromagnetic spectrum	
		2.3.4	Understand the safety issues regarding microwaves and X-rays	
2.4 Sound		2.4.1	Describe the production of sound by vibrating sources	
		2.4.2	Describe the longitudinal nature of sound waves and compression and rarefaction	
		2.4.3	State that the approximate range of audible frequencies for a healthy human ear is 20 Hz to 20 000 Hz	
		2.4.4	Know that a medium is needed to transmit sound waves	
		2.4.5	Know that the speed of sound in air is approximately 330–350 m/s	
		2.4.6	Describe an echo as the reflection of sound waves	
		2.4.7	Use the equations: speed=distance travelled/ time taken, speed=frequency × wavelength	
		2.4.8	Relate the loudness and pitch of sound waves to amplitude and frequency	
		2.4.9	Define ultrasound as sound with a frequency higher than 20 kHz	
		2.4.10	Know that, in general, sound travels faster in solids than in liquids and faster in liquids than in gases.	

Grade 10 (Bilingual) Physics - Semester 2			
Subtopics	**Learning Objectives**		**Practical activities**
Unit 3: Atomic physics			
3.1 Atomic model	3.1.1	Describe the structure of an atom in terms of a positive nucleus and negative electrons	
	3.1.2	Describe the composition of the nucleus in terms of protons and neutrons	
	3.1.3	State the features of protons, neutrons and electrons (charge, mass)	
	3.1.4	Use the term atomic number (proton number) Z	
	3.1.5	Use the term mass number (nucleon number) A	
	3.1.6	Use the term nuclide and the notation $^{A}X_{z}$	
	3.1.7	Explain the term isotope	
3.2 Radioactivity	3.2.1	Define background radiation	
	3.2.2	Identify α, β and γ-emissions by: – their nature – their relative ionising effects – their relative penetrating abilities –their deflection in electric fields and in magnetic fields (β+ are not included)	
	3.2.3	Give examples of practical applications of α, β and γ-emissions	
	3.2.4	Know that ionising nuclear radiation can be measured using a detector connected to a counter	
	3.2.5	Define radioactive decay	
	3.2.6	State that during α- or β-decay the nucleus changes to that of a different element	
	3.2.7	Calculate half-life from data or decay curves	
	3.2.8	Describe the effects of ionising radiations on living things	
	3.2.9	Describe how radioactive materials are handled, used and stored in a safe way	

Yearly plan

Semester 1 (GRADE 9)	Semester 2 (GRADE 9)	Semester 1 (GRADE 10)	Semester 2 (GRADE 10)
1. Measurements and motion 1.1 Length and time 1.2 Mass and weight 1.3 Density 1.4 Scalars and vectors 1.5 Motion 2. Forces 2.1 Effects of forces 2.2 Turning effect of force	3. Work and energy 3.1 Work 3.2 Energy 4. Thermal physics 4.1 Kinetic particle model of matter 4.2 Thermal properties and temperature 4.3 transfer of thermal energy	1.Magnetism and Electricity 1.1 Magnetism 1.2 Static electricity 1.3 Current 1.4 Potential difference and electromotive force 1.5 Resistance 1.6 Electrical energy and power 1.7 Electrical circuits 1.8 Electromagnetic effects	2. Waves 2.1 General wave properties 2.2 Light 2.3 Electromagnetic spectrum 2.4 Sound 3. Atomic physics 3.1 Atomic model 3.2 Radioactivity

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