L-Università ta' Malta

MATSEC
Examinations Board

SEC 45 Syllabus

Core Science

2025

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Introduction

This syllabus is based on the curriculum principles outlined in *The National Curriculum Framework for All* (NCF) which was translated into law in 2012 and designed using the *Learning Outcomes Framework* that identify what students should know and be able to achieve by the end of their compulsory education.

As a learning outcomes-based syllabus, it addresses the holistic development of all learners and advocates a quality education for all as part of a coherent strategy for lifelong learning. It ensures that all children can obtain the necessary skills and attitudes to be future active citizens and to succeed at work and in society irrespective of socio-economic, cultural, racial, ethnic, religious, gender and sexual status. This syllabus provides equitable opportunities for all learners to achieve educational outcomes at the end of their schooling which will enable them to participate in lifelong and adult learning, reduce the high incidence of early school leaving and ensure that all learners attain key twenty-first century competences.

This programme also embeds learning outcomes related to cross-curricular themes, namely digital literacy; diversity; entrepreneurship creativity and innovation; sustainable development; learning to learn and cooperative learning and literacy. In this way students will be fully equipped with the skills, knowledge, attitudes and values needed to further learning, work, life and citizenship.

What is Core Science?

Core Science is the intellectual and practical activity encompassing the systematic study of the structure and behaviour of the physical and natural world through observation and experiment. It incorporates several elements of various scientific disciplines and organizes knowledge in the form of testable explanations and predictions about the Earth and beyond.

What does a study of Core Science entail?

Candidates studying Core Science will be presented with an integrated, rather than a compartmentalized, approach towards the various branches of science.

Experimental work is central to the teaching programme of Core Science. An investigative approach to teaching the subject highlights the study of key concepts of science in real-world contexts. Course work carried out throughout the programme is essential for candidates taking the examination to acquire direct experience of the laboratory.

This subject gives students the opportunity to learn about the applications of Science to everyday situations and to help them develop higher order thinking skills. An investigative approach to teaching is suggested and while factual knowledge and subject content are important, reasonable time should be devoted for the development of the learners' reasoning in contrast to the recall of facts.

The examination paper will test the knowledge and understanding of scientific facts and principles and the ability to apply these to everyday situations as well as to solve theoretical and practical problems both qualitatively and quantitatively.

Coursework has been allotted 30% of the final grade to reflect a wider range of skills and attitudes towards Science.

How is Core Science related to candidates' lives, to Malta, and/or to the world?

Core Science is important because it influences most aspects of everyday life, including food, energy, medicine, transportation, leisure activities and environmental issues. Science improves human life at every level from the individual level to global issues. Everyday applications of scientific knowledge are multiple and diverse.

The aspirational programme learning outcomes for this subject are:

At the end of the programme, I can:

- understand that Science is dynamic and continuously evolving and that its principles and theories may change;
- acquire a knowledge of basic scientific concepts, understand the scientific principles and patterns and be aware of the importance of adopting the scientific method of investigation;
- develop experimental and investigative competences and the relevant practical skills whilst having due regard to correct and safe laboratory practice;
- develop abilities to:
    - form hypotheses and design experiments to test these hypotheses;
    - organize, interpret and evaluate information in order to draw conclusions, make decisions and / or solve problems;
    - communicate scientific knowledge and findings in appropriate ways.
- understand news, articles, etc. presented in the media involving science;
- use science in decision making on both every day and socio-scientific issues;
- appreciate the contribution of science to society in relation to economic, ethical and social implications.

List of Learning Outcomes

At the end of the programme, I can:

LO 1. Explain the composition and behaviour of matter.
LO 2. Explain the properties and behaviour of water and aqueous solutions.
LO 3. Describe and explain the motion of objects.
LO 4. Explain mechanisms involved for the body to achieve homeostasis.
LO 5. Explain sexual reproduction and inheritance in humans.
LO 6. Discuss sustainable processes after having considered the different forms of energies, sources of renewable and non-renewable energies, energy transfers and their efficiencies.
LO 7. Describe the properties and uses of various electrical components around us.
LO 8. Describe the different types of waves and how they travel.
LO 9. Explain how the different components of a balanced diet are used by the human body.
LO 10. Link the effects of lifestyle choices to the breathing and circulatory systems.
LO 11. Link the effects of lifestyle choices to physical and mental wellbeing.
LO 12. Use the appropriate scientific techniques to analyse evidence which has been collected from the scene-of-crime.
LO 13. Use the appropriate procedure to separate chemicals and identify an unknown substance.
LO 14. Show an understanding of Ecology, Conservation and Fieldwork.
LO 15. Explain how green plants are at the basis of all food chains and make energy available to all consumers.
LO 16. At the end of the programme, I can demonstrate an understanding of how science works and is communicated.

List of Subject Foci

1. Air
2. Water
3. Transport
4. Communication
5. Energy
6. Fit and Healthy
7. Forensic Science
8. Life on Earth

Programme Level Descriptors

This syllabus sets out the content and assessment arrangements for the award of Secondary Education Certificate in Biology at Level 1, 2 or 3. First teaching of this programme begins in September 2022. First award certificates will be issued in 2025.

The following levels refer to the qualification levels that can be obtained by candidates sitting for SEC examinations. These are generic statements that describe the depth and complexity of each level of study required to achieve an award at Level 1, 2 or 3 in Biology. (Level 1 being the lowest and level 3 the highest).

Level 1: At the end of the programme the candidate will have obtained basic knowledge, skills and competences in the subject such as basic repetitive communication skills and the ability to follow basic, simple instructions to complete tasks. Support is embedded within the task.

Level 2: At the end of the programme the candidate will have obtained good knowledge, skills and competence in the subject such as the interpretation of given information and ideas. The candidate will have developed the ability to carry out complex tasks. Limited support may be embedded within the task.

Level 3: At the end of the programme the candidate will autonomously apply knowledge and skills to a variety of complex tasks. Candidates will utilise critical thinking skills to analyse, evaluate and reflect upon their own work and that of others. Problem solving tasks may be part of the assessment process.

Learning Outcomes and Assessment Criteria

Subject Focus:	**Air**
Learning Outcome 1: **Paper I and Paper II**	**At the end of the programme, I can explain the composition and behaviour of matter.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
	1.2a Label the structure of an atom in terms of protons, neutrons and electrons.	1.3a Describe the structure of an atom in terms of protons, neutrons and the distribution of electrons in shells. *Including the mass and charge of the proton, neutron and electron.*
1.1b Describe air as mixture of gases. *List the components of air and their corresponding percentages.*	1.2b Illustrate the carbon cycle.	1.3b Explain the human impact on the carbon cycle. • *Deforestation, urbanisation, burning of fossil fuels.*
	1.2c Name various pollutants present in the atmosphere. *These are to include:* • *oxides of nitrogen;* • *oxides of sulfur;* • *particulate matter;* • *ozone in the lower atmosphere.*	1.3c Describe the causes and the effects of the various atmospheric pollutants on ecosystems and/or biodiversity. • *Acid rain;* • *Particulates;* • *Allergies;* • *Depletion of ozone layer;* • *Deforestation, Urbanisation;* • *Burning of fossil fuels;* • *Global warming;* • *Greenhouse effect;* • *Climate change;* • *Carbon footprint.*

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
	1.2d Compare the properties of the three states of matter.	1.3d Describe the kinetic theory of matter qualitatively.
1.1e Recall that density of a substance depends on its mass and volume.	1.2e Explain density as the mass per unit volume. *Simple calculations involving ρ=m/V.*	1.3e Investigate the density of an unknown material through measurements of mass and volume.
	1.2f Apply the concept of density to buoyancy. *E.g. ice and water and oil and water.*	
	1.2g Outline the parameters by which a gas can be described. • pressure; • volume; • temperature.	1.3g Explain the relationship between one parameter and another whilst keeping the third parameter constant: the three gas laws.
1.1h Distinguish between elements and compounds.	1.2h Describe valency, as the number of bonds that an atom is able to establish.	1.3h Explain bonding as the quest to become more stable: full outer shell or octet.
1.1i Distinguish between gases which are monoatomic and others which are diatomic. *(H_2, N_2, O_2, F_2, Cl_2, Br_2 and I_2)*	1.1i Distinguish between ionic and covalent bonding.	1.3i Illustrate covalent (*single, double and triple bonds)* and ionic bonding. *Using dot and cross diagrams.*
1.1j Identify physical and chemical changes.	1.2j Distinguish between physical and chemical changes.	1.3j Investigate different types of chemical changes. *These should include:* *Fast and slow reactions, endothermic and exothermic reactions, evolution of gases, colour change, precipitation and decomposition.*

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
1.1k Represent chemical changes by word equations. *Include combustion and decomposition.*	1.2k Represent chemical changes by balanced chemical equations. *Limited to chemical changes covered in this programme.*	1.3k Represent balanced chemical equations including the state symbols. *(s) - solid* *(l) - liquid* *(g) - gas* *(aq) - aqueous*
1.1l Recall definitions of oxidation and reduction. *In terms of oxygen and hydrogen, in terms of gain/loss of electrons.*	1.2l Distinguish between oxidation and reduction: in terms of oxygen and hydrogen, in terms of gain/loss of electrons.	1.3l Describe oxidation and reduction in terms of oxidation numbers; oxidising/reducing agent.
	1.2m Identify that the 'mole' is a quantity: the Avogadro constant.	1.3m Explain the meaning of the relative molecular mass (rmm) from relative atomic masses (ram) and that the relative atomic/molecular mass in grammes contains one mole.

Subject Focus:	Water
Learning Outcome 2: Paper I and Paper II	**At the end of this programme, I can explain the properties and behaviour of water and aqueous solutions.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
2.1a Distinguish between solvent, solute and solution.	2.2a Describe the concepts of solubility (the maximum amount of solute that can dissolve in a certain amount of solution at a certain temperature); saturation; the effects of temperature, stirring, size of solute particles.	2.3a Distinguish between solubility of ionic compounds and covalent compounds.
2.1b Recall the units in which volume can be measured in, mainly cm^3, mL, dm^3, L.	2.2b Conversion of units: cm^3 to dm^3 and vice versa; mL to L and vice versa.	
	2.2c Recall that there are different measures of concentration: grammes per dm^3; moles per dm^3; ppm; ppb; % by vol v/v.	2.3c Explain different measures of concentration: grammes per dm^3; moles per dm^3; ppm; ppb; % by vol v/v. *Simple calculations.*
2.1d Recognise that water is the basis of life on Earth.	2.2d List the importance of water for life. • *medium for chemical reactions to occur;* • *transport;* • *support;* • *reproduction;* • *cooling agent.*	2.3d Use the physical properties of water to explain its importance in living organisms.
2.1e Recall water as the most abundant molecule in cells.	2.2e Name ways in which living organisms gain and lose water. • *intake of food and drink;* • *absorbed by plant's roots;* • *evaporation (including sweating, exhaled air and transpiration);* • *urine and faeces.*	

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
2.1f Draw labelled diagrams of the main features of animal and plant cells. *Features are to include the cell membrane, cell wall, cytoplasm, cell vacuole, nucleus, chloroplast and mitochondria.*	2.2f Describe the functions of the different components of animal and plant cells.	
2.1g Use a microscope to observe prepared slides of animal and plant origin.	2.2g Interpret the cell structure features of prepared animal and plant slides.	2.3g Prepare a slide with plant tissue material.
2.1h Define diffusion.	2.2h Explain the factors that affect the rates of diffusion. *To include:* • *temperature;* • *surface area to volume ratio;* • *concentration gradient;* • *diffusion distance;* • *mass of the particle;* • *medium.*	2.3h Apply the principles of diffusion to the human body and ecosystems. *Examples can include:* • *respiratory system;* • *digestive system;* • *long distance transport of air and water pollutants.* *Students should be able to investigate the rates of diffusion of gases such as diffusion of ammonia and hydrogen chloride in a tube.*
2.1i Recall the meaning of osmosis. *Refer to semi-permeable membranes.*	2.2i Describe the process of osmosis and the role of semi-permeable membranes.	2.3i Explain the process of osmosis, and the role of semi-permeable membranes – the concept of water potential.
	2.2j Perform an investigation to observe the effects of osmosis on plant cells. *A guided investigation to determine the effects of different solution concentrations on plant cells.*	2.3j Carry out an investigation to observe the effects of osmosis on plant cells. *Students are expected to design, perform and analyse investigations to determine the effects of different solution concentrations on plant cells.*
2.1k Use indicators and the pH scale to distinguish between acidic, alkaline and neutral solutions. *Using litmus, universal indicator and pH probes.*	2.2k Classify a substance as acidic, alkaline or neutral.	

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
2.1l Identify common safety symbols.	2.2l Distinguish between dilute and concentrated acids and alkalis (amount of substance).	2.3l Explain the difference between strong and weak acids / alkalis (degree of ionisation).
2.1m Describe everyday life applications of neutralisation reactions.	2.2m Identify that acids form hydrogen ions when they dissolve in water and solutions of alkalis contain hydroxide ions.	2.3m Recognise that aqueous neutralisation reactions can be generalised to hydrogen ions reacting with hydroxide ions to form water.
2.1n Identify acidic and alkaline household substances.	2.2n Explain that chlorine is used to kill microorganisms in water supplies and as a bleach.	
	2.2o Distinguish between soft and hard water; soaps and detergents.	2.3o Investigate the effect of different levels of water hardness on soap.
	2.2p Distinguish between biological and non-biological washing detergents.	2.3p Explain the environmental impact of biological and non-biological detergents.
2.1q Distinguish between slow and fast reactions.	2.2q Describe the factors that affect speed of reactions: temperature; surface area; catalysts.	2.3q Explain the factors that affect rates of reactions: temperature, surface area; reaction profile, activation energy, catalysts.
		2.3r Investigate factors that affect rates of reactions such as: temperature, surface area and catalysts.

Subject Focus:	Transport
Learning Outcome 3: Paper I and Paper II	**At the end of the programme, I can describe and explain the motion of objects.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
3.1a Recall the meaning of the terms: scalar quantities (magnitude/size only) and vector quantities (magnitude/size and direction).		3.3a Explain the difference between scalar and vector quantities. *To include: speed / velocity, distance (length) / displacement, mass / weight, temperature, acceleration, work, pressure, density.*
3.1b Identify forces as a push or a pull and as a vector quantity represented by an arrow.	3.2b Calculate the resultant force by addition and subtraction of forces. *Limited to parallel forces only.*	
		3.3c Distinguish between mass and weight.
		3.3d Explain weight as a force due to the 'pull' of gravity. *The concept of acceleration due to gravity.*
	3.2e Calculate the weight of an object given its mass and the value of the gravitational field strength (expressed in N/kg) and state its direction. *W=mg*	
3.1f Define friction and air resistance.	3.2f Describe instances where friction and air resistance are useful.	3.3f Investigate factors affecting friction and/or air resistance.

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
	3.2g Explain Newton's first law: a body continues in its state of rest and of uniform motion in a straight line unless compelled by an external force.	3.3g Apply the principles implied by Newton's First law in everyday examples.
3.1h Identify which section(s) in a distance-time graph indicate(s): i. a state of rest; ii. constant speed.		3.3h Sketch a distance-time graph to represent different sections of a journey: i. at rest; ii. constant speed.
	3.2i Determine the speed from a distance-time graph.	3.3i Determine the average speed from a distance-time graph.
3.1j Identify which section(s) in a velocity-time graph indicate(s) an object: i. at rest; ii. moving with constant velocity; iii. moving with a constant acceleration.		3.3j Sketch a velocity-time graph to represent different sections of a journey: i. constant velocity; ii. constant acceleration/ deceleration.
3.1k Identify acceleration and deceleration from a velocity-time graph.		3.3k Relate a negative gradient from a velocity-time graphs to deceleration.
	3.2l Calculate acceleration from a velocity-time graph. *No calculation of deceleration is required.*	3.3l Determine the displacement and the acceleration/deceleration from a velocity-time graph using a graphical method.
	3.2m Use the equations of rectilinear motion $v=u+at$, $s=ut+1/2at^2$, $v^2=u^2+2as$, $s=(u+v)t/2$ to solve problems.	
3.1n Define momentum.	3.2n Solve calculations involving: momentum = mv.	

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
	3.2o Describe the effect of momentum; elastic collisions, law of conservation of momentum; rate of change.	3.3o Solve calculations involving, the law of conservation of momentum. *Limited to inelastic collisions between two bodies i.e. body A colliding with body B and moving with a common velocity.*
	3.2p Solve calculations involving Newton's second law: F = ma. *Link to W=mg.*	
	3.2q Describe Newton's second law: the rate of change of momentum is proportional to the force acting upon it.	
3.1r State Newton's third law.	3.2r Describe examples illustrating Newton's third law.	
	3.2s Describe stopping distance of a vehicle (refer to safe speeds) as the sum of the reaction time (thinking distance) and the distance it travels under the braking force.	3.3s Explain factors that affect braking and reaction time; 'safe' speeds (including simple calculations); use of safety features such as safety belts, airbags, crumple zones.

Subject Focus:	Communication
Learning Outcome 4: **Paper I only**	**At the end of the programme, I can explain mechanisms involved for the body to achieve homeostasis.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
4.1a Define homeostasis as the maintenance of a constant internal state by organisms.		
4.1b State that the body needs a constant internal environment.		4.3b Explain the role of homeostasis as the maintenance of a constant internal state by organisms. *Limited to the maintenance of a constant blood glucose level.*
4.1c List examples of stimuli. *(light, heat, temperature, pressure, chemical)*	4.2c Define the term stimulus.	
4.1d Recall that the nervous system is made up of the Central Nervous System (CNS) and Peripheral Nervous System (PNS).	4.2d Explain how all responses follow the pathway; Stimulus → receptor → coordinator → effector → response.	4.3d Describe examples of effectors. • *muscles contracting;* • *glands secreting hormones;* *pupil dilating.*
	4.2e Describe the neurone as a specialised cell.	
	4.2f Identify the three types of neurones. • *sensory;* • *relay;* • *motor.*	

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
4.1g Identify the position of the main endocrine glands in the human body. • *thyroid;* • *pancreas;* • *adrenals;* • *ovaries;* • *testis;* • *pituitary.*		
4.1h Name hormones produced by the pancreas, adrenals and gonads. • *insulin and glucagon;* • *adrenaline;* • *oestrogen and progesterone;* • *testosterone;* *(Follicle Stimulating Hormone FSH and Luteinising Hormone, LH will be mentioned in LO below).*	4.2h Describe hormones as proteins produced by an endocrine gland, carried by the bloodstream and having its effect on a target organ.	4.3h Explain the function of each hormone mentioned.
	4.2i Explain how blood glucose level changes during the day. *E.g. before and after meals/exercise.*	4.3i Interpret data from graphs that show the effect of insulin in blood glucose levels in both people with diabetes and people without diabetes.
	4.2j Associate excessive carbohydrate intake in diet to diabetes.	4.3j Explain how Type 1 and Type 2 diabetes are controlled. *These are to include a healthy lifestyle with a diet low in carbohydrate, physical activity and medication.* *Detail of negative feedback mechanisms is not required.*

Subject Focus:	Communication
Learning Outcome 5: Paper I only	**At the end of the programme, I can explain sexual reproduction and inheritance in humans.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
5.1a Define puberty.	5.2a List at least three secondary sexual characteristics occurring during puberty in males and in females.	5.3a Identify the hormones which bring about changes associated with secondary sexual characteristics.
5.1b Identify structures of the male and female reproductive system.	5.2b Explain the roles of the structures of the male and female reproductive systems.	5.3b Describe differences in structure and number between male and female gametes.
	5.2c Explain that ovulation starts at puberty and that it is the release of an egg from the ovary approximately every 28 days.	
	5.2d Explain the stages of the menstrual cycle; menstruation, growth of lining in the uterus, ovulation and maintenance of the lining.	5.3d Describe the roles of the hormones Follicle stimulating hormone (FSH), Luteinising hormone (LH), oestrogen and progesterone, in the control of the menstrual cycle.
		5.3e Interpret data from graphs showing hormone levels during the menstrual cycle.
5.1f State when and where fertilisation occurs.		
5.1g Identify where the foetus develops.	5.2g Describe the sequence of events that lead to birth including. *These are to include:* *Copulation, fertilisation, implantation, development of the placenta and amniotic sac, growth of embryo, enlargement and contractions of the uterus.*	5.3g Explain the importance of progesterone during pregnancy.

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
	5.2h Identify hcG (human chorionic gonadotropin) as the hormone detected in pregnancy test.	
5.1i Identify that babies are born either through the vaginal canal or by caesarean.		
5.1j Give the definition of a contraceptive.		
5.1k Identify Fertility Awareness methods, Hormonal-based methods and Barrier methods of birth control. *Fertility awareness methods as exemplified by the thermal and the mucus (Billing's) method. Hormonal based methods as exemplified by the contraceptive pill and Barrier methods as exemplified by the use of the condom.*	5.2k Assess methods of birth control in terms of increasing effectiveness of preventing conception as well as preventing sexually transmissible infections.	
5.1l List examples of bacterial and viral STIs from: • HIV/AIDS; • Chlamydia; • Human Papillomavirus and genital warts; • Gonorrhoea; • Herpes; • Syphilis.	5.2l Outline the aims of the GU (Genito-Urinary) clinic. *On the basis of absolute confidentiality, the clinic offers:* • *diagnosis and treatment of STIs;* • *counselling and testing for HIV.*	5.3l Outline the symptoms and respective methods of transmission of bacterial and viral STIs. *Limited to: one bacterial and viral STI.*
5.1m Identify that the nucleus of a cell contains genetic material.	5.2m Recognise that genetic material is organised into chromosomes on which genes are located.	

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
	5.2n Describe the DNA molecule as two strands coiled to form a double helix, the strands being linked by a series of complementary base pairs (A with T and C with G). *Refer to a gene being made up of a sequence of bases that code for a particular protein.*	
5.1o State that there are 23 pairs of chromosomes in each nucleus.	5.2o Describe the last pair of chromosomes as determining gender. • *XX in a female;* • *XY in a male.*	5.3o Use the punnett square to show sex determination in humans.
5.1p Define mutation.	5.2p Identify examples of mutagens. • *These may include: UV radiation, X rays, nuclear radiation and chemicals.*	
5.1q List one example of genetic engineering.	5.2q Briefly describe examples of genetic engineering including: • cloning; • genetically modified organisms (GMOs) such as pesticide-resistant plants, golden rice and glow-in-the dark cats.	5.3q Explain some of the possible benefits and risks, including practical and ethical considerations, of using gene technology in modern agriculture and medicine.

Subject Focus:	Energy
Learning Outcome 6: **Paper I and Paper II**	**At the end of the programme, I can discuss sustainable processes after having considered the different forms of energies, sources of renewable and non-renewable energies, energy transfers and their efficiencies.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
6.1a Distinguish between renewable and non-renewable sources of energy. *Renewable sources are / can be replenished as they are used. Examples include solar, wind, biomass, biofuel, hydroelectricity, tidal.* *Non-renewable sources examples coal, crude oil, natural gas, nuclear fuel.*	6.2a Describe the advantages and disadvantages of different types of renewable and non-renewable sources of energy.	6.3a Discuss what the most sustainable forms of electricity generation in Malta are.
	6.2b Identify examples of how fossil fuel consumption can be reduced.	
6.1c Identify different forms of energy and the unit of measurement. *The different forms of energy are to include:* • *kinetic / movement;* • *thermal / heat;* • *electrical;* • *light;* • *sound;* • *chemical;* • *gravitational potential;* • *elastic potential;* • *nuclear.* *Energy is measured in Joules(J)/kiloJoules (kJ).*	6.2c Discuss the principle of conservation of energy by interpreting Sankey diagrams.	6.3c Construct energy Sankey diagrams.

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
	6.2d Calculate energy efficiency by using the formula: Efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$	
6.1e Demonstrate how the direction of heat flow depends on temperature difference.	6.2e Describe heating as an energy transfer due to a temperature difference (from a high temperature to a lower temperature).	
6.1f Identify factors that may affect the rate of heat energy transfer between an object/body and its surroundings.	6.2f Demonstrate the relationship between differences in rate of heat energy transfer and temperature between an object/body and its surroundings. *These can include:* • *comparing heat transfer in different surface areas;* • *comparing heat loss and gain in different coloured substances;* • *comparing heat losses in the presence of absence of a lid;* • *comparing heat losses through different types and thickness of lagging.*	6.3f Analyse the results obtained of an investigation where the relationship between differences in rate of heat energy transfer and temperature between an object/body and its surroundings were explored. *These can include:* • *comparing heat transfer in different surface areas;* • *comparing heat loss and gain in different coloured substances;* • *comparing heat losses in the presence of absence of a lid;* • *comparing heat losses through different types and thickness of lagging.*
		6.3g Explore how unwanted energy transfers can be reduced by making buildings and devices more energy efficient. *Aspects may include:* • *double glazing;* • *size and position of windows;* • *insulation;* • *lubrication of machines.*

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
6.1h Distinguish between different conductors and insulators of heat.	6.2h Compare the rate of heat conduction in different materials.	6.3h Apply the effects of thermal insulation to everyday activities.
6.1i Compare the energy content of food from different food labels.	6.2i Relate the temperature changes shown when burning different foods to the amount of energy present in food.	6.3i Carry out a fair investigation to calculate the energy released by different foods using the equation: $Q = mc\Delta\theta$. *The increase in temperature of a system depends on the mass of the substance heated, the type of material and the energy input.* *Q= quantity of energy, m=mass of substance heated in kg, c= specific heat capacity in J/kg degree Celsius and Δ θ= change in temperature*
6.1j Define carbon footprint.	6.2j List ways of reducing the carbon footprint.	6.3j Explain ways of reducing the carbon footprint.
6.1k Describe sustainable practices and the 5R's as the basis of environmental and waste management. *Refuse, reduce, recycle, repurpose and reuse.*	6.2k Identify the basic principles in carrying out a Life Cycle Assessment (LCA) of a material or product. *LCAs are carried out to assess the environmental impact of the materials and energy needed for different products in the following stages:* • *Extraction and Processing of raw materials* • *Manufacturing and packaging* • *Lifetime use and operation* • *Disposal at the end of its useful life* • *Transport and distribution at each stage.*	6.3k Evaluate data from a life cycle assessment of a material or product. • *Allocating numerical values to pollutant effects requires value judgements as LCAs are not a purely objective process.* • *Selective or abbreviated LCAs can be devised to evaluate a product but these can be misused to reach pre-determined conclusions, such as when supporting claims for advertising purposes.*

Subject Focus:	Energy
Learning Outcome 7: Paper I and Paper II	**At the end of the programme, I can describe the properties and uses of various electrical components around us.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
7.1a Recall that when an electric current passes through a component (or device), energy is transferred from the power supply to the component and/or to the environment.	7.2a Discuss how the main energy transformations in a power station result in the production of electricity.	
	7.2b Define power (measured in watts, W) of an appliance or device as a measure of the rate at which it transfers energy.	
	7.2c Calculate the amount of energy transferred in a process, in joules and in kilowatt hours. *Energy transferred = power × time* *(Joules, J) (Watts, W) (seconds, s)*	7.3c Apply the equation for Power to solve problems including use of subject of the formula. *power = voltage × current* *(watts, W) (volts, V) (amperes, A)*
7.1d List methods that reduce electrical energy usage in a personal context.	7.2d Outline methods that reduce electrical energy usage in a national context. *Relate electrical energy usage to specific actions outlined in the United Nations Sustainable Development Goals (SDGs) Process.* *Reference to SDG 7: Ensure access to affordable, reliable, sustainable and modern energy for all.* *Candidates are not expected to recite the specific targets outlined in the SDGs.*	7.3d Calculate the cost of energy supplied by electricity given the power, the time and the cost per kilowatt hour. *(kilowatt hours, kWh) (kilowatts, kW) (hours, h)*
7.1e Distinguish between series and parallel circuits. *Differences in uses of series and parallel circuits are to be tackled.* *Real life and pictorial circuits should be used.*		

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
7.1f Construct electric circuits using basic electrical components and symbols to represent electrical circuits using wire, battery, bulb/lamp and a switch.	7.2f Construct electric circuits using basic electrical components and symbols to represent electrical circuits using fuse, cell, ammeter, voltmeter and fixed resistor.	7.3f Construct electric circuits using basic electrical components and symbols to represent electrical circuits using diodes (including LEDs), resistors and variable resistors (including LDRs).
7.1g Draw the direction of flow of conventional current.		
7.1h Define current as the rate of flow of charge.	7.2h Explain that for charge to flow, a source of potential difference and a closed circuit are needed.	
		7.3i Explain why an ideal ammeter has negligible resistance.
	7.2j Use an ammeter to test that a current has the same value at any point in a single closed loop.	7.3j Apply the relationship between quantity of charge, current and time. *Q = I t; charge flow, Q, in coulombs, C, current, I, in amperes, A (amp is acceptable for ampere), time, t, in seconds, s*
		7.3k Explain why an ideal voltmeter has an infinitely high resistance.
	7.2l Explain that current (I) depends on both resistance (R) and potential difference (V). *Include the units in which these are measured.*	7.3l Investigate the relationship between I, R and V. *Students are required to interpret a graphical representation.* *Students are required to use V=IR to calculate the current, potential difference (voltage) and resistance in direct current (DC) series circuits.*

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
		7.3m Define Ohm's law - current is directly proportional to the voltage across a resistance if the temperature remains constant.
	7.2n Use the equations for total resistance for two resistors connected in series: $R_{total} = R_1 + R_2$	7.3n Use the equations for total resistance for two resistors connected in parallel: $R_{total} = 1/R_1 + 1/R_2$
	7.2o Explain that when two resistors are in series, the net resistance is increased, whereas with two resistors in parallel the net resistance is decreased.	
7.1p Distinguish between electrical conductors and insulators. *Practical uses of conductors and insulators are to be related to their use and issues of safety.*	7.2p Design a circuit that tests for electrical conductors and insulators.	
7.1q Name sources of alternating and direct current.	7.2q Distinguish between direct current DC and alternating current AC.	7.3q Explain the difference between direct and alternating current. *Each type of current could be recognized using the display of a cathode ray oscilloscope.* *Include that the domestic supply in the Malta is AC, at 50Hz and about 240 volts.*
7.1r Name the colours of the insulation covering of each wire. *Live wire – brown.* *Neutral wire – blue.* *Earth wire – green and yellow stripes.*		

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
7.1s Identify the live, neutral and earth wires from their position in a standard three pin plug.	7.2s Explain the differences in function between the live, neutral and earth mains wires, and the potential differences between these wires. *Include that a live wire may be dangerous even when a switch in a mains circuit is open, and explain the dangers of providing any connection between the live wire and earth.*	
7.1t Demonstrate how a fuse works.	7.2t Explain why fuses have various ratings.	7.3t Solve problems to identify the appropriate fuse rating.
7.1u Identify the earth wire and the circuit breaker in a house.	7.2u Explain the function of the earth wire and/or the circuit breaker in a household circuit.	7.3u Conduct research about the electrical safety features in a house. *Including earthing and circuit breakers.*
7.1v Identify household appliances that are double insulated.	7.2v Explain why double insulated appliances do not need an earth wire while appliances with a metal case need to be earthed.	
		7.3w Explain how in the national grid, electrical power is transferred at high voltage from power stations to each locality at a lower voltage. *Include how this system is an efficient way to transfer energy. Step-up transformers are used to increase the voltage from the power station to the transmission cables then step-down transformers are used to decrease the voltage to a much lower value for domestic use.*

Subject Focus:	Energy
Learning Outcome 8: Paper I and Paper II	**At the end of the programme, I can describe the different types of waves and how they travel.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
8.1a Describe what is meant by wave motion as shown by vibrations in ropes, springs, tuning forks and water waves.		
8.1b State that waves are caused by vibrations and that they carry energy as they travel, without carrying matter.		
8.1c Recognise a transverse and a longitudinal wave.	8.2c Differentiate between transverse and longitudinal waves. *Include examples of transverse waves such as water waves and light waves. Sound waves as examples of longitudinal waves.*	
8.1d Define amplitude, frequency and wavelength of a wave. *Include units: amplitude in metres, frequency in hertz and wavelength in metres.*	8.2d Relate the period of a wave to its frequency. *Include units of period in seconds.*	
8.1e Describe the relationship between speed, wavelength and frequency of a wave.	8.2e Use wave speed equation in calculations: $v = f \lambda$ *Include units: velocity in m/s.*	
	8.2f State the laws of reflection.	

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
	8.2g Use ray diagrams to illustrate reflection. *Including the normal, the incident ray, the reflected ray, angle of incidence and angle of reflection.*	8.3g Illustrate, with the use of ray diagrams, the path taken by a ray of light when reflected off more than one reflecting surface, as in the periscope.
	8.2h Describe the properties of an image formed in a plane mirror. *Including virtual, upright, laterally inverted as far behind the mirror as the object is in front.*	8.3h Investigate the laws of reflection using a ray box, mirror on a plane paper.
	8.2h Describe how sound waves are produced.	8.3i Investigate that sound waves require a medium and travel at different speeds depending on the medium. *To include that sound waves cannot travel through a vacuum.*
8.1j Recognise the frequency range which can be heard by an average person.	8.2j Describe sound echoes, ultrasound, and echolocation as examples of reflection.	8.3j Solve simple calculations regarding echoes using the equation: speed = distance / time v=d/t
8.1k Recognise the decibel (dB) as a measure of sound level.	8.2k Identify decibel levels which can cause harmful effects to the ear.	
8.1l List ways in which the ears can be protected from damage.		
	8.2m Describe what happens to a wave when it crosses the boundary between different mediums - refraction.	8.3m Explain how waves travel at different speed in different media. *Construct ray diagrams to illustrate the refraction of a wave at a boundary between two media.*

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
	8.2n Describe the patterns of reflection and refraction of plane waves in a ripple tank.	8.3n Investigate plane wave patterns of reflection and refraction in a ripple tank. *These are to include:* *reflectors placed at different angles; varying depths of water.*
8.1o List the different ranges of electromagnetic spectrum. *Radio, microwave, infrared, visible (red to violet), ultraviolet, X-rays and gamma rays, that these range from long to short wavelengths, from low to high frequencies, and from low to high energies.*	8.2o Identify the range and uses of wavelengths within the electromagnetic spectrum which can be detected by humans.	
8.1p Recognise that white light is made up of the 7 colours of the visible spectrum.	8.2p Describe the dispersion of white light into its constituent colours.	
8.1q List the uses of infrared radiation, microwaves and radio waves.	8.2q Describe why these types of electromagnetic radiation are hazardous.	8.3q Discuss whether mobile phones are safe to use.
8.1r Recall that radio waves have different frequencies bands.	8.2r Describe the role of satellites in communication; weather, Earth observation, Military and Navigation.	
		8.3s Investigate the critical angle of a semi-circular glass block.
8.1t Recall that optical fibres are used for communication.	8.2t Compare optical fibre communication to microwaves and radio waves. *To include that optical fibres carry more information and are more secure.*	8.3t Explain how light travels through an optic fibre in terms of critical angle and total internal reflection.

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
8.1u Compare similarities and differences between ultraviolet and visible light.	8.2u Describe the beneficial and harmful effects of ultraviolet radiation. *To include beneficial effects such as the role that UV-A, plays in formation of Vitamin D by the skin, and harmful effects on skin such as sunburn, premature aging, skin cancer, cataracts in our eyes.*	
	8.2v Describe why safety precautions are necessary to avoid harm from, x-rays and gamma rays.	8.3v Describe how X-rays are used in medical imaging and how gamma rays are used in radiotherapy, sterilising medical equipment and radioactive tracers.

Subject Focus:	Fit and Healthy
Learning Outcome 9: Paper I and Paper II	**At the end of the programme, I can explain how the different components of a balanced diet are used by the human body.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
9.1a Recall the basic food components of a balanced diet and some examples of foods that provide them. *To include water, carbohydrates, proteins, lipids (fats and oils), vitamins, minerals and fibre.*	9.2a Explain the importance of the basic food components to the human body. • *water: transport, constituent of blood, urine, tears, sweat;* • *carbohydrate: used by the body during respiration;* • *protein: used to build and repair body tissues, build hormones and enzymes;* • *lipids: used as a source and store of energy, provide insulation;* • *vitamins (fat-soluble and water-soluble): assist in enzyme action and are essential for cell reactions;* • *minerals: calcium for proper bone development to prevent osteoporosis and iron for haemoglobin to prevent anaemia;* • *fibre: maintaining a healthy colon; prevent bowel cancer, cleans digestive system, cleans digestive system, adds bulk to diet, together with water prevents constipation.*	9.3a Evaluate how the building blocks of the different food components vary from each other. *This should include comparison of the chemical elements present and building blocks of carbohydrates, proteins, and lipids:* • *Polysaccharides such as starch are insoluble. They are built from simple sugars such as glucose which are water soluble and can be absorbed. The main function of carbohydrates is to provide energy.* • *Proteins are long chained molecules of amino acids. Cells use amino acids to synthesise new proteins for growth and repair.* • *Lipids are built from fatty acids and glycerol. Their main function is the storage of energy, insulation and formation of cell membranes.*
	9.2b Perform food tests by following instructions. • *test for starch using iodine;* • *test for lipids using translucent stain test and cloudy emulsion test;* • *test for protein – biuret;* • *test for glucose - Benedict's solution.*	9.3b Interpret the results of food tests carried out on various foods.

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
9.1c Define the term balanced diet**.** *In terms of the healthy eating plate which is accompanied by water and physical activity.*	9.2c Identify the changes needed to a person's diet in order to maintain a balanced diet if there are changes in age and physical activity.	9.3c Explain the changes to a person's diet according to age and physical activity.
9.1d Identify the different components of the human digestive system. *Mouth, oesophagus (gullet), stomach, small intestine, liver, pancreas, large intestine, rectum, anus.*	9.2d Describe the function of the different components of the digestive system.	9.3d Explain the function of the following: • teeth; • salivary glands; • gastric juices; • bile; • pancreatic juices; • enzymes. *Only the terms carbohydrase, lipase and protease are to be used. Specific names of enzymes are not required.*

Subject Focus:	Fit and Healthy
Learning Outcome 10: Paper I and Paper II	**At the end of the programme, I can link the effects of lifestyle choices to the breathing and circulatory systems.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
10.1a Identify the main components of the human circulatory system. ● *the heart;* ● *arteries, veins and capillaries;* ● *blood (red blood cells, white blood cells, platelets and plasma).*	10.2a Describe the functions of the different components of the circulatory system.	10.3a Explain the double circulation of blood in the human heart.
10.1b Identify the main parts of the thorax. *Ribs, intercostal muscles, diaphragm, trachea, bronchi, bronchioles, alveoli, pleural membranes.*	10.2b Describe the function of the following features: ● rings of cartilage; ● ciliated cells and mucus producing cells; ● alveoli.	10.3b Associate the structural features with the characteristics of the gas exchange surface. *Features are to include:* ● *large surface area to volume ratio;* ● *moist surface;* ● *rich supply of blood;* ● *ventilation;* ● *thin epithelium.*
10.1c Recall the test for Carbon Dioxide using lime water.	10.2c Compare the composition of inhaled and exhaled air with respect to: ● nitrogen; ● oxygen; ● carbon dioxide; ● water vapour; ● temperature.	10.3c Explain the role of the rib cage, intercostal muscles and diaphragm during ventilation. *Make a reference to the maintenance of a constant internal pressure whilst there are changes in the thoracic volume.*
10.1d Define that respiration is the breakdown of food to obtain energy and that it occurs in the mitochondria.	10.2d List the ways that organisms use the energy produced during respiration. *These are to include carrying out body functions such as growth, movement, maintaining a constant body temperature etc.*	

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
10.1e Distinguish between the terms aerobic and anaerobic respiration by making reference to the presence or absence of oxygen.	10.2e Explain the differences between aerobic and anaerobic respiration in humans. *To include the:* • *the products produced;* • *word equations;* • *amounts of energy produced.*	10.3e Write the chemical equation that summarises aerobic respiration in humans.
10.1f Measure the effects of physical activity on the breathing and circulatory system. *Compare the pulse rate and breathing rates.*	10.2f Interpret the effect of physical activity on the heartbeat.	10.3f Discuss the role of diet, exercise and lifestyle on the risk of developing heart disease.
10.1g List the negative effects of some lifestyle choices that affect our health. *These are to include:* • *bad eating habits;* • *obesity as a risk factor for Type 2 diabetes* • *lack of exercise;* • *smoking;* • *misuse of medicine;* • *excess alcohol consumption;* • *carcinogens and radiation as risk factors in cancer.*	10.2g Describe the negative effects of some lifestyle choices that affect our health.	
	10.2h Identify some health conditions related to breathing and circulatory systems. • *asthma;* • *chest infections;* • *emphysema;* • *blocked blood vessels;* • *cardiac failure.*	
	10.2i Identify effects of direct and passive smoking on health. • *short term effects;* • *long term effects;* • *pregnant women.*	10.3i Explain the effects of the main ingredients in cigarette smoke on health. • *tar;* • *nicotine;* • *carbon monoxide.*

Subject Focus:	Fit and Healthy
Learning Outcome 11: Paper I only	At the end of the programme, I can link the effects of lifestyle choices to physical and mental wellbeing.

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
11.1a Define health as a state of both physical and mental wellbeing.	11.2a Identify ways of maintaining a healthy body. *These are to include:* • *a well-balanced diet;* • *regular exercise;* • *reducing stress;* • *rest;* • *seeking medical help for mental and physical difficulties.*	11.3a Discuss how different types of diseases interact to cause health problems. *Examples but not limited to:* • *problems with the immune system might make a person suffer from an infectious (communicable) disease;* • *specific viral infections may lead to the development of cancer;* • *stress, anxiety and depression may lead to non-infectious (non-communicable) diseases.*
11.1b Link infectious diseases to microorganisms called pathogens. • *one example of a bacterial disease;* • *one example of a viral disease;* • *one example of a fungal disease.*		
11.1c List methods of pathogen transmission: • air; • water; • food; • contact (body fluids); • animals.	11.2c Describe natural ways how the human body fights infections. *These are to include:* • *skin, mucus and cilia in respiratory tract, tears, acid in stomach prevent entry of pathogens;* • *role of white blood cells and antibodies.*	11.3c Discuss the use of medicine in preventing and fighting infections. *These are to include the use of antimicrobials such as:* • *use of antiseptics and disinfectants;* • *antibiotics;* • *antivirals;* • *antifungal;* • *vaccines.* *The emergence of resistant pathogens is to be discussed.*
11.1d Relate personal hygiene, abstinence and barriers (gloves and condoms) to preventing pathogen transmission.		

Subject Focus:	Forensic Science
Learning Outcome 12: Paper I and Paper II	**At the end of the programme, I can use the appropriate scientific techniques to analyse evidence which has been collected from the scene-of-crime.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
12.1a Identify some forensic investigations which may be used to solve problems. *Some examples are:* • *making simple observations;* • *preservation of data;* • *lifting of fingerprints;* • *footprints and other impressions;* • *bite marks;* • *hair and blood samples;* • *analysing paints and chemicals.*	12.2a Analyse single observations from a crime scene. *Some examples are:* • *comparing of fingerprints;* • *chromatography results;* • *comparing cotton fibres.*	12.3a Analyse various evidence, information and data from a crime scene. *Process a variety of data such as:* • *comparing fingerprints;* • *use of light microscope to compare cotton fibres or pollen grains;* • *blood splatter;* • *blood groups;* • *marks/impressions.*
	12.2b Link patterns of evidence towards possible conclusions. *Comparing different evidence collected from the crime-of-scene and establishing links to a possible suspect*.	12.3b Interpret how the forensic techniques and evidence collected could be used in an investigation.
12.1c Identify the four types of human teeth and their separate function.	12.2c Analyse bite marks through simple observations. *Identify missing teeth, space between teeth, etc.*	
12.1d Identify the main components of blood. *Blood (red blood cells, white blood cells, platelets and plasma).Cross reference to be made with same assessment in Fit and Healthy.*	12.2d Link results from blood analysis towards possible conclusions.	

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
	12.2e Explain how DNA evidence can be used to solve crimes.	
12.1f Identify simple safety precautions when dealing with body fluids.		

Subject Focus:	Forensic Science
Learning Outcome 13: Paper I and Paper II	**At the end of the programme, I can use the appropriate procedure to separate chemicals and identify an unknown substance.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
	13.2a Perform chromatography test as a way of separating colours.	13.3a Interpret results of a chromatography test.
13.1b Identify soluble and insoluble substances.	13.2b Distinguish between the terms soluble, insoluble, solute, solvent, solution and saturated.	
	13.2c Identify factors that affect solubility.	13.3c Explain the factors that affect solubility.
13.1d Carry out simple filtration experiments.	13.2d Identify the residue and the filtrate.	
13.1e Identify evaporation as a way of separating a soluble chemical from its solvent.	13.2e Carry out evaporation of salt water solution.	13.3e Explain how salt is produced in salt pans with reference to evaporation.
13.1f Identify simple distillation as a way of separating a solution and collecting the solvent.	13.2f Describe practical examples of simple and fractional distillation.	13.3f Explain the procedure of simple and fractional distillation.
13.1g Describe the procedure to carry out a flame test.	13.2g Identify the metal from the observed flame colour of the following cations: • Li^+ is crimson red • Na^+ is orange-yellow • K^+ is lilac • Ca^{2+} is brick-red • Cu^{2+} is blue-green • Ba^{2+} is apple-green	

Subject Focus:	Life on Earth
Learning Outcome 14: **Paper I and Paper II**	**At the end of the programme, I can show an understanding of Ecology, Conservation and Fieldwork.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
14.1a Define the terms habitat and environment.	14.2a Distinguish between population and community.	14.3a Describe an ecosystem in terms of interactions between organisms and their environment.
14.1b Define abiotic and biotic factors.	14.2b Describe the biotic and abiotic components in a named local ecosystem.	14.3b Discuss that abiotic and biotic factors limit population size distribution in a named local ecosystem.
14.1c Define biodiversity as the variety of life.	14.2c List the major threats to biodiversity.	
14.1d Identify examples of aquatic and terrestrial ecosystems. *Examples may include:* • *freshwater;* • *marine;* • *rocky coast;* • *cliff;* • *garigue;* • *woodland;* • *sand dunes;* • *steppe;* • *maquis;* • *agricultural land.*	14.2d Identify different biotic and abiotic components of the following ecosystems: • marine; • garigue; • woodland.	14.3d Evaluate how the balance of ecosystems can be altered. *Factors to include are:* • *seasonal changes;* • *natural disasters,* • *human impact such as urbanisation and agricultural practices- organic farming, introduction of new species, overuse of pesticides, fertilisers, over consumption of water table.*
14.1e Define the term biome.	14.2e Identify rainforests, desert and arctic tundra as biomes.	

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
14.1f Recall terms and meanings related to conservation and sustainability. *Terms are to include:* • *Endangered;* • *Extinct;* • *Special areas of conservation (SAC);* • *Outside development zone (ODZ).* *Students are expected to know two examples of each term.*	14.2f Describe issues related to conservation and sustainability. *Students are expected to know two examples of local organisations involved with conservation and sustainability.* *Issues are to include two named examples of each of the following:* • *alien / introduced species;* • *endemic species;* • *indigenous species.*	14.3f Evaluate the importance of the conservation of habitats and species in the Maltese Islands and the wider world. *The evaluation should include the importance of this topic with respect to the impact on the environment, economy, and the tourism sector in the Maltese Islands.*
14.1g Measure simple abiotic factors during a fieldwork study. *Factors studied are to be determined by the habitat investigated. These include:* • *temperature of air / water / soil;* • *wind speed and direction;* • *pH of water / soil;* • *light intensity.*	14.2g Identify positive and negative human impact on the habitat studied.	14.3g Analyse how the different biotic and abiotic factors investigated in the fieldwork study are interrelated.
14.1h Outline different fieldwork sampling methods. *These are to include the use of:* • *quadrats;* • *line / belt transects.*	14.2h Present collected data from a fieldwork session by the use of quadrats and line / belt transects.	14.3h Analyse results obtained from different sampling methods.

Subject Focus:	Life on Earth
Learning Outcome 15: **Paper I and Paper II**	**At the end of the programme, I can explain how green plants are at the basis of all food chains and make energy available to all consumers.**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
15.1a Construct food chains from local and foreign ecosystems to understand how organisms are related to each other via feeding relationships.	15.2a Interpret food webs. • *Identification of producers, consumers, herbivores, carnivores and omnivores.* • *Plants are producers because they make food which provides energy and biomass for other organisms.*	15.3a Predict the populations of different organisms in a food web when different biotic and abiotic factors are changed.
	15.2b Represent the relationship between producers and different levels of consumers as pyramids of energy.	15.3b Infer why not all the energy is transferred from one trophic level to another.
15.1c Identify that the process of photosynthesis enables plants to build up food.	15.2c Explain, using a word equation, that plants can convert simple inorganic substances to organic substances using light energy. *Use of terms carbon dioxide, water, chlorophyll, light energy, glucose and oxygen.*	
	15.2d Describe what happens to the glucose and oxygen produced during photosynthesis.	
15.1e State that abiotic factors may limit the rate of photosynthesis.	15.2e Explain how the maximum rate of photosynthesis is influenced by a number of factors. *Light intensity, carbon dioxide and temperature provide a limit to the plant's ability to photosynthesize.*	15.3e Interpret graphs about the effect of temperature, light intensity and carbon dioxide concentration on the rate of photosynthesis. *The term limiting factor is to be included.*

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
15.1f Perform the test for starch in plants.	15.2f Interpret the test for starch in plants.	15.3f Investigate how the presence/absence of light, carbon dioxide or chlorophyll affect photosynthesis. *Familiarity with test for oxygen production is needed.*

Learning Outcome 16:	**At the end of the programme, I can demonstrate an understanding of how science works and is communicated. (*To be implemented in combination with School Based Assessment.*)**

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
16.1a State that scientific knowledge changes with new evidence / observations / experiments.	16.2a Distinguish between a fact, a hypothesis, a theory and a law.	16.3a Discuss briefly the meaning of science in terms of its healthy scepticism, aimed objectivity, and the value of physical (observable / measurable) evidence.
16.1b Discuss the importance of fair (objective) testing in science.		16.3b Evaluate an experiment in terms of its objectivity.
16.1c Identify variables in an experiment.		16.3c Identify dependent and independent variables.
16.1d Follow health and safety regulations.	16.2d Identify potential procedural, physical, biological and chemical hazards.	16.3d Evaluate health and safety aspects during practical work.
16.1e Follow a written experimental procedure with guidance.	16.2e Follow a written experimental procedure with limited guidance.	16.3e Follow a written experimental procedure with minimal guidance.
16.1f Record observations / measurements in a pre-designed format.	16.2f Record observations / measurements appropriately.	16.3f Determine which observations / measurements are to be measured for an experiment.
	16.2g Write an appropriate laboratory report for practical work.	
16.1h Label diagrams.	16.2h Draw labelled diagrams of given apparatus.	16.3h Draw labelled diagrams of apparatus used during experiments.

Assessment Criteria (LEVEL 1)	Assessment Criteria (LEVEL 2)	Assessment Criteria (LEVEL 3)
16.1i Read values from simple graphical representations.	16.2i Interpret graphical representations containing single data set.	16.3i Interpret multiple data sets plotted on the same axes.
16.1j Plot a single data set on a given axis.	16.2j Plot a single data set.	16.3j Plot multiple data sets on the same axes.
	16.2k Sketch a graph for a given situation.	16.3k Sketch graphs to represent situations on existing plotted graphs.
16.1l Draw conclusions from practical work, with guidance.	16.2l Draw conclusions from practical work.	16.3l Evaluate an experimental procedure and results by suggesting improvements.
	16.2m Plan an experiment to solve a given problem, with guidance.	16.3m Plan an experiment to solve a given problem, with minimal guidance.
	16.2n Carry out an experiment to solve a given problem with supervision.	16.3n Carry out an experiment to solve a given problem without supervision.

Scheme of Assessment

School candidates

The assessment consists of Paper I and Paper II. Paper I consists of unmoderated school-based assessment (SBA) that is to be set and assessed by the school. Paper II consists of a controlled assessment that will take place at the end of the three-year programme.

School-based assessment (SBA): is any type of assessment of a candidate made by the school relevant to the respective SEC syllabus contributing to the final level awarded in the subject.

Controlled assessment: is comprised of a two-hour written exam set at the end of the programme and differentiated between two tiers:

a. Levels 1 and 2;
b. Levels 2 and 3.

Candidates are to satisfy the examiner in Paper I and Paper II to obtain a level higher than 1.

Paper I - School Based Assessment (30% of the total mark).

The school-based assessment shall be marked out of 100 each year (9, 10 and 11). The assessment for each year will contribute to 10% of the overall mark and will be reported to MATSEC by the school in Year 11. Therefore, each year will equally contribute to the final mark of the school-based assessment. The school-based assessment shall reflect the MATSEC syllabus covered in Year 9, Year 10 and Year 11.

School-based assessment can be pegged at either of two categories:

- SBA at categories 1-2 must identify assessment criteria from these two levels. It is suggested that ACs are weighted at a ratio of 40% at Level 1 and 60% at Level 2.
- SBA at categories 1-2-3 must identify assessment criteria from each of Levels 1, 2, and 3. It is suggested that ACs are weighted at a ratio of 30% at each of Levels 1 and 2, and 40% at Level 3.

The mark for SBA at level categories 1-2 presented for a qualification at level categories 2-3 will be calculated to 60% of the original mark. The mark stands in all other cases.

Part II: Controlled Assessment (70% of the total mark)

Written Examination (100 marks; 2 hours)

Learning outcomes with assessment criteria in the psychomotor domain can be assessed by asking questions in pen-and-paper format seeking understanding of the activity.

Controlled Assessment will:

- cover all the learning outcomes of the syllabus at the appropriate levels;
- consist of three obligatory sections, as follows:
    - **Section A** (40 marks): 6 – 8 short questions
    - **Section B** (15 marks): One structured question based on a given passage
    - **Section C** (45 marks): 3 long structured questions
- be marked out of 100 and all questions in each section are compulsory - answers are to be written on the examination paper provided.

Private Candidates

Private candidates will not be expected to carry out any school-based assessment as school candidates. Instead, private candidates need to sit for another Controlled paper as an alternative to the school-based assessment. Private candidates will be assessed through the means of **TWO** Controlled papers, one of which is common with school candidates.

Paper I – Controlled Assessment - Private Candidates Only (30% of the total mark)

Written Examination (100 marks; 2 hours)

Paper I for private candidates shall be a controlled assessment assessing levels 1, 2 and 3 as described in the respective syllabus and set and marked by MATSEC. It shall mainly focus on the learning outcomes marked in the respective syllabi as suggested for school-based assessment.

Learning outcomes with assessment criteria in the psychomotor domain can be assessed by asking questions in pen-and-paper format seeking understanding of the activity.

Controlled Assessment will:

- consist of a two-hour paper including four obligatory sections, as follows:
- have no sections, but consist of 8 – 10 structured questions of graded difficulty which are compulsory and are set as follows:
    - 30% from LOs 1, 2, 12 and 13
    - 35% from LOs 3, 6, 7 and 8
    - 35% from LOs 9, 10, 14 and 15
- be marked out of 100 and all questions in each section are compulsory - answers are to be written on the examination paper provided.

Paper II – Controlled Assessment (70% of the total mark).

Paper II is common with school candidates.

Appendices

The information found in the following appendices will be given in ALL Controlled Papers (1 & 2).

Appendix 1: Useful information

- Standard temperature and pressure (stp): 0 °C and 1 atm
- The molar volume for gases at stp = 22.4 dm^3
- A Periodic Table which includes the symbol, the name, the atomic number and the relative atomic mass of each element, is printed on the back of all Controlled Papers booklet.
- When necessary, take g, acceleration due to gravity, as 10 m/s^2.

Appendix 2: Useful equations

$\rho = \frac{m}{V}$	$v = f\lambda$	$Q = m\ c\ \Delta\theta$	
$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$	Unbalanced force = ma	W = m g	momentum = m v
v = u + a t	$s = u\ t + \frac{1}{2}\ a\ t^2$	$v^2 = u^2 + 2\ a\ s$	$s = (u + v)\frac{t}{2}$
Q = I t	V = I R	P = I V	E = P t
$R_{total} = R_1 + R_2$	$\frac{1}{R_{total}} = \frac{1}{R_1} + \frac{1}{R_2}$	Efficiency = $\frac{\text{useful output energy transfer}}{\text{total input energy transfer}}$	
Area of a triangle = $\frac{1}{2}$ b h	Area of a trapezium = $\frac{1}{2}$ (a + b) h	Area of a circle = π r^2	

Appendix 3: List of polyatomic ions and their charges Rt

List of polyatomic ions and their charges	
Name	**Formula**
Ammonium	NH_4^+
Nitrate	NO_3^-
Sulfate	SO_4^{2-}
Carbonate	CO_3^{2-}
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-

PERIODIC TABLE OF THE ELEMENTS

1	2											3	4	5	6	7	0
							1 **H** Hydrogen 1										4 **He** Helium 2
7 **Li** Lithium 3	9 **Be** Beryllium 4											11 **B** Boron 5	12 **C** Carbon 6	14 **N** Nitrogen 7	16 **O** Oxygen 8	19 **F** Fluorine 9	20 **Ne** Neon 10
23 **Na** Sodium 11	24 **Mg** Magnesium 12											27 **Al** Aluminium 13	28 **Si** Silicon 14	31 **P** Phosphorus 15	32 **S** Sulfur 16	35.5 **Cl** Chlorine 17	40 **Ar** Argon 18
39 **K** Potassium 19	40 **Ca** Calcium 20	45 **Sc** Scandium 21	48 **Ti** Titanium 22	51 **V** Vanadium 23	52 **Cr** Chromium 24	55 **Mn** Manganese 25	56 **Fe** Iron 26	59 **Co** Cobalt 27	59 **Ni** Nickel 28	63.5 **Cu** Copper 29	65 **Zn** Zinc 30	70 **Ga** Gallium 31	73 **Ge** Germanium 32	75 **As** Arsenic 33	79 **Se** Selenium 34	80 **Br** Bromine 35	84 **Kr** Krypton 36
85 **Rb** Rubidium 37	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	99 **Tc** Technetium 43	101 **Ru** Ruthenium 44	103 **Rh** Rhodium 45	106 **Pd** Palladium 46	108 **Ag** Silver 47	112 **Cd** Cadmium 48	115 **In** Indium 49	119 **Sn** Tin 50	122 **Sb** Antimony 51	128 **Te** Tellurium 52	127 **I** Iodine 53	131 **Xe** Xenon 54
133 **Cs** Caesium 55	137 **Ba** Barium 56	139 **La** Lanthanum 57	178 **Hf** Hafnium 72	181 **Ta** Tantalum 73	184 **W** Tungsten 74	186 **Re** Rhenium 75	190 **Os** Osmium 76	192 **Ir** Iridium 77	195 **Pt** Platinum 78	197 **Au** Gold 79	201 **Hg** Mercury 80	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	210 **Po** Polonium 84	210 **At** Astatine 85	222 **Rn** Radon 86

Key: a **X** Y b — *relative atomic mass* ***SYMBOL*** ***Name*** *atomic number*