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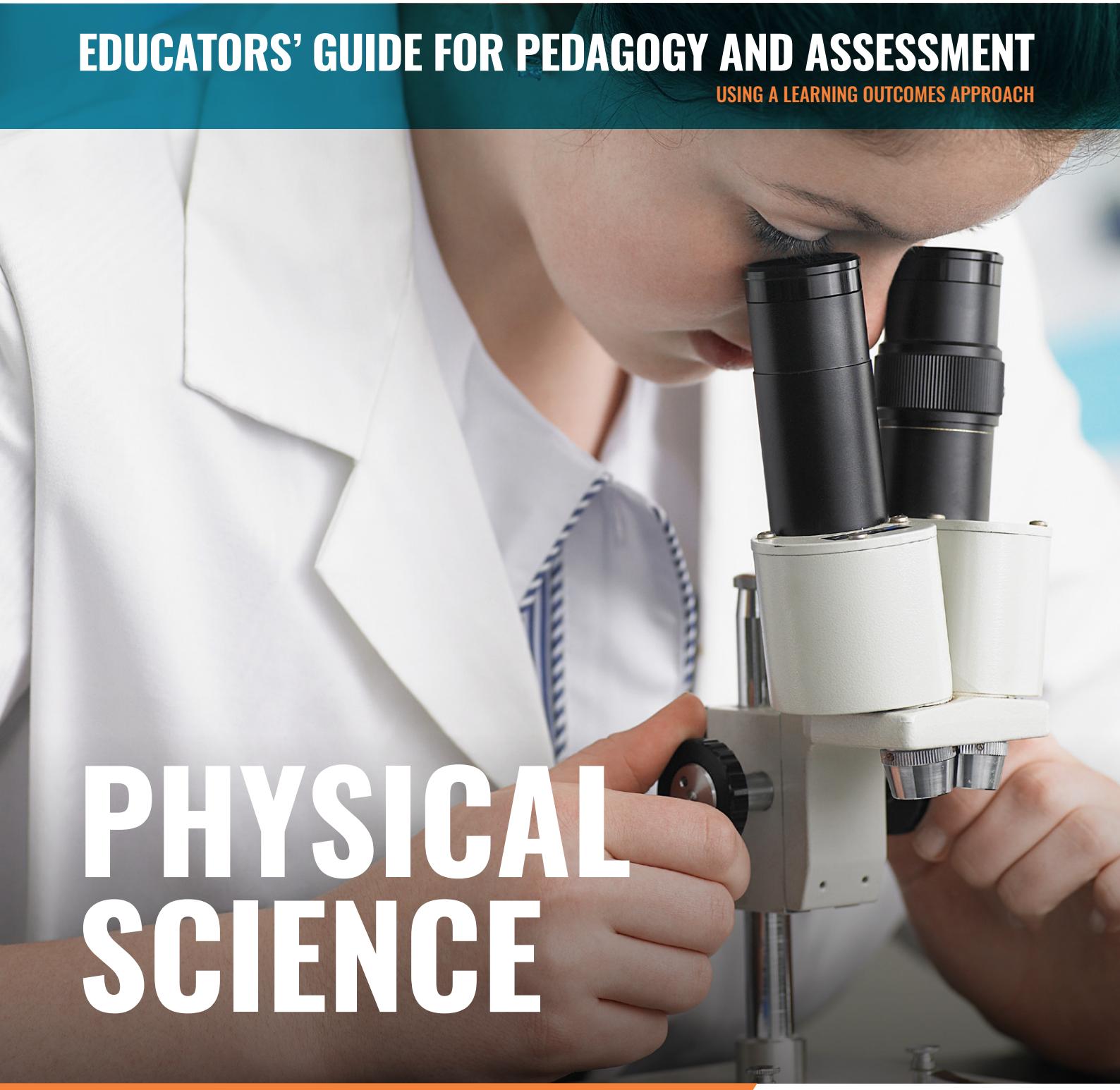
EDUCATORS' GUIDE FOR PEDAGOGY AND ASSESSMENT

USING A LEARNING OUTCOMES APPROACH



PHYSICAL SCIENCE

LEVELS 8 9 10

Learning Outcomes Framework

Learning Outcomes Framework

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Introduction

Following the endorsement of the National Curriculum Framework (NCF) in 2012, an ambitious plan was launched with the aim of putting theory into practice. Built upon the National Minimum Curriculum (2000), it addressed the gaps in Malta's learning processes where emphasis shifted from teaching the subject to teaching the learner.

The National Minimum Curriculum framework took important policy-related documents issued by the European Commission into consideration. These included the *Key Competences for Lifelong learning – A European Reference Framework* (included in the annex of the Recommendations; 2006/962/EC); the *Strategic Framework for European Cooperation in Education and Training* (ET 2020; 2009) and *Europe 2020 – A Strategy for Smart Sustainable and Inclusive Growth* (COM (2010) 2020) which is the follow up to the *Lisbon Strategy for Growth and Jobs (Memo 06/478/12 Dec 2006).*

Against the background of Malta's historical development and on the basis of the curriculum and EU documentation the NCF seeks to provide strategic direction by rationalising the necessary changes and their implications for area/subject content, pedagogies and assessment. The NCF was presented within a lifelong learning perspective and celebrates diversity by catering for all learners at each stage of their education. It aims to introduce more equity and decentralisation in the national system. The NCF seeks to present a seamless curriculum which reflects smooth transitions, building and extending on the firm foundations in early childhood education. In essence, the NCF aims to provide a quality education for all learners, reducing the percentage of early school leavers and encouraging their enrolment in further and higher education.

The NCF proposed a Learning Outcomes Framework (LOF) as the keystone for learning and assessment throughout the years of compulsory schooling. The aim of the Learning Outcomes Framework is to free schools and learners from centrally-imposed knowledge-centric syllabi and to give them the freedom to develop programmes that fulfil the framework of knowledge, attitudes and skills-based outcomes that are considered national education entitlement of all learners in Malta. The LOF is thus intended to eventually lead to more curricular autonomy of colleges and schools so as to better address the learning needs of their learners.

A number of other local policy documents published in recent months have also contributed to the need of a learning outcomes-based approach in today's educational structures. In particular, the *Framework for the Education Strategy for Malta 2014 – 2024* (2014), *A National Literacy Strategy for All in Malta and Gozo 2014 – 2019* (2014), *A Strategic Plan for Early School Leaving in Malta 2014* (2014), *Education for All: Special Needs and Inclusive Education in Malta* (2014), *Malta National Lifelong Learning Strategy 2020* (2015) and *Respect for All Framework* (2015) all point toward the need to provide 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 competences in literacy, numeracy, science and technology.

The ESF 1.228 Project – *Design of Learning Outcomes Framework, Associated Learning and Assessment Programmes and Related Training* is intended to deliver this Learning Outcomes Framework approach to the educators and all relevant stakeholders within compulsory schooling. It addresses the holistic development of all learners and advocates a quality education for all as part of a coherent strategy for lifelong learning which aims to ensure that all children have the opportunity to 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.

The LOF will allow for flexibility in teaching and learning programmes in order to address specific needs and to build upon strengths within the context of the learning communities in different colleges and schools. This concept of flexibility is promoted throughout the entire framework. While acknowledging that out-of-school factors such as poverty and social exclusion affect learner achievement, the LOF seeks to improve learners' learning experiences by encouraging creativity, critical literacy, entrepreneurship and innovation at all levels. This will allow learners to reach their potential by connecting what they have learnt to their individual contexts. Consequently, this will help learners develop a positive attitude towards learning and a greater appreciation of its usefulness.

The move from a prescriptive content-based curriculum towards a learning outcomes approach will impact all programmes in schools and all external examinations and assessment at the end of compulsory education in Malta.

The LOF was also designed to meet the four broad education goals outlined in the *Education Strategy for Malta 2014 – 2024* (Ministry for Education and Employment, 2014), namely to:

- reduce the gaps in educational outcomes between boys and girls and between students attending different schools, decrease the number of low achievers, raise the bar in literacy, numeracy and science and technology competence and increase student achievement.
- support educational achievement of children at-risk-of-poverty and from low socio-economic status and reduce the relatively high incidence of early school-leavers.
- increase participation in lifelong learning and adult learning.
- raise levels of learner retainment and attainment in further, vocational and tertiary education and training.

The Learning and Assessment Programmes (LAPs) which were drawn up for each subject will ensure that the focus is on the learner. As such, learning activities will be geared to stimulate creativity and imagination; enable learners to make correct value judgements when editing/correcting their own work; develop learners' investigative and constructive skills by making use of different media and promote receptive skills (listening and reading) which lead to productive skills (speaking and writing). LAPs are also intended to create an atmosphere where learners develop their own problem solving skills and their ability to think and reason logically; reflect on outcomes and consequences and explore possible alternatives and apply interesting and realistic contexts that are personally meaningful to them.

With the use of LAPs, teachers will be encouraged to create situations and resources which are intrinsically interesting, culturally embedded and cognitively engaging and enable learners to connect the various types of information that they have acquired.

THE LEARNING AND ASSESSMENT PROGRAMME FOR PHYSICAL SCIENCE

This document, which is aimed at policy makers, educators and educators in the classroom, presents the Learning and Assessment Programme (LAP) for Physical Science.

The LAP comprises:

- **The Learning Outcomes Framework (LOF)** - this encompasses a set of subject learning outcomes (SLOs) that set out what a learner is expected to know, understand or be able to do as a result of a process of learning. These learning outcomes are designed to be used in a range of delivery contexts and taught using different methods. They state the end result rather than describe the learning process or the learning activities.
- **Notes on Pedagogy and Assessment** - the learning outcomes are written in a way that informs pedagogy and, in conjunction with the assessment strategies related to each outcome, set a clear assessment expectation. This document sets down good practice teaching and assessment guidelines which educators may wish to take on board and adapt to meet the needs of their learners.

This document has been collaboratively developed by the Outlook Coop Learning Outcomes Framework Joint Venture comprising Outlook Coop as the lead partner, East Coast Education Ltd. and the University College London Institute of Education together with the Directorate for Quality and Standards in Education (DQSE). Mr Barry Smith (Joint Venture Technical Director), Mr Godfrey Kenely (Joint Venture Contract Director), Dr Michelle Attard Tonna (Head of Project) and Mr Gaetano Bugeja (Project Leader) directed the project experts.

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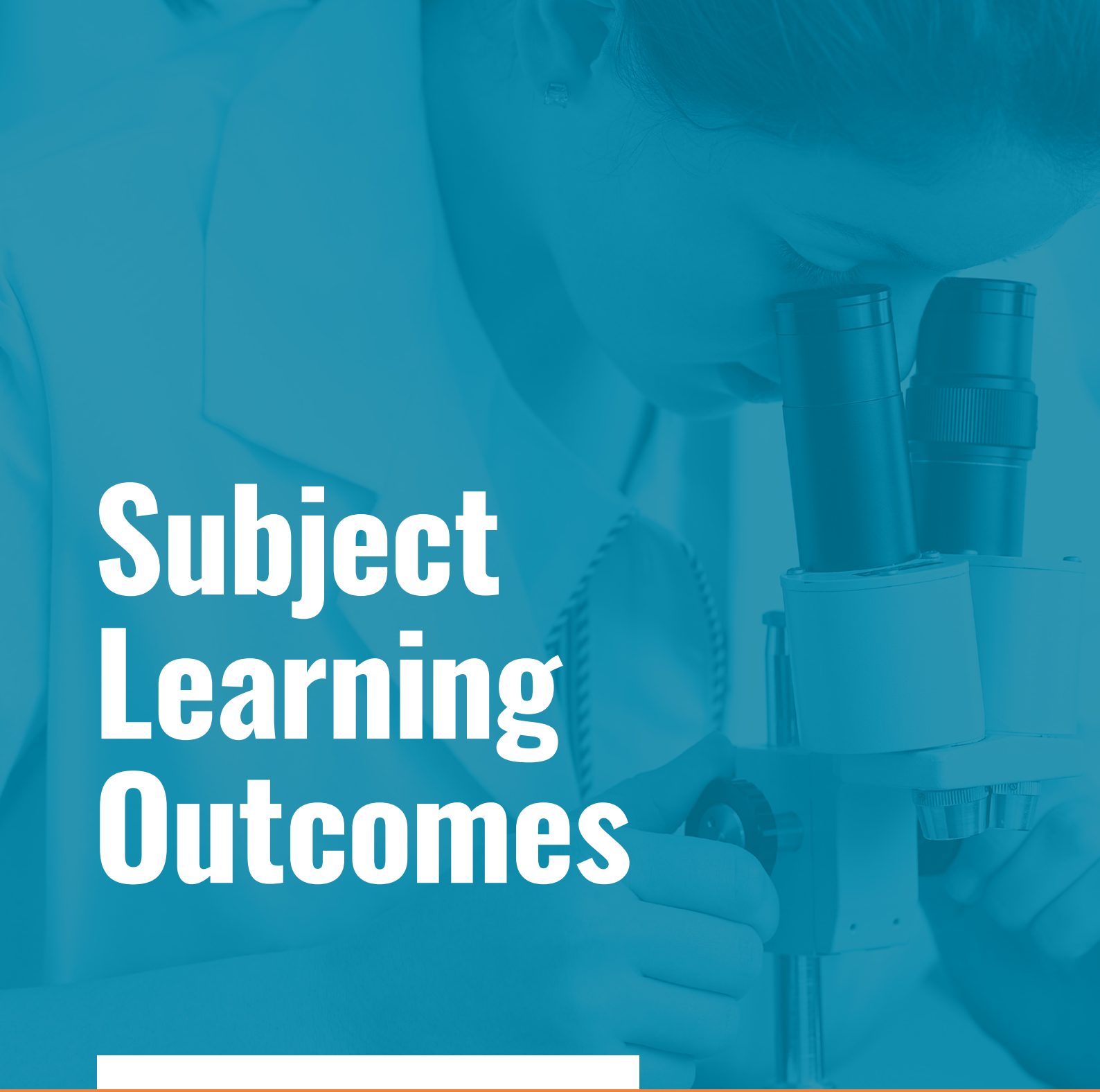


Subject Learning Outcomes

PHYSICAL SCIENCE

LEVELS 8 9 10

The Subject Learning Outcomes (SLOs) for Physical Science span from Attainment Level 8 to Attainment Level 10.

Within the Learning Outcomes Framework, Level 10 is viewed as the 'gifted and talented' level. Outcomes within this level sit at the upper end of the ability spectrum and extend learners further.

The core concept is *better* rather than *more.* At Level 10 learners demonstrate a deeper understanding and wider application of Level 9 content which marks the end of compulsory schooling. Level 10 outcomes may draw on three main areas:

- increased sophistication of understanding of the Level 9 content
- greater learning autonomy in developing understanding and skills
- increased application and problem solving.

It should be noted that each Attainment Level can be extended further and suggestions for this will be included in the Pedagogy and Assessment section of the document.

LEVEL 8

Subject Focus: Energy, Forces and motion

1. I can explain how the Periodic Table is made up of elements that differ in the number of protons and their atomic mass.
2. I can identify different symbols, of elements in the Periodic Table, usually referred to in physics.
3. I can use textbooks and the internet to research the development of the Periodic Table from John Newlads in 1863 and Dmitri Mendeleev in 1869, to modern day additions.
4. I can explain how the same element can bond to form a molecule *e.g. oxygen.*
5. I can explain how different elements can bond to form compounds.
6. I can explain that mixtures are made up of elements, compounds and/or molecules that are not all chemically bonded together.
7. I can describe the particle arrangements in solids, liquids and gases and how this gives rise to their respective properties.
8. I can model the molecular structure of solids, liquids and gases and use kinetic theory to describe how changes of state *e.g. melting and boiling, condensing and freezing* occur.
   CREATIVE LEARNING
9. I can discuss how changes of state of matter relate to the addition or removal of energy to/from the atoms or molecules of the material.
10. I can describe the motion of particles in solids, liquids and gases in relation to temperature and how this relates to their internal energy.
    PLANNING AND REFLECTION
11. I can discuss the different scales used for temperature and the relationship between them *e.g. Celsius and Kelvin from a historical perspective.*
12. I can model, through various means, how hotter objects expand due to an increase in the kinetic energy of the particles as a result of the transfer of energy.
13. I can explain how the increase in the kinetic energy of the particles of a gas, increases the pressure of a gas, which explains how hot air balloons are filled.
14. I can describe how hot fluids are less dense than cold fluids and am able to apply this principle to relevant situations.
15. I can explain how the expansion of liquids due to changes in temperature of the liquid is the principle behind liquid thermometers.
16. I can recognise and construct heating and cooling curves for different substances, including the different states of matter and correctly identify the melting and boiling points.

17. I can use models and analogies to demonstrate how heat is transferred by conduction in solids.
18. I can use the movement of free electrons to explain thermal and electrical conduction in materials.
19. I can explain how humans sweat to cool themselves down by evaporation of the sweat from the skin's surface.
20. I can describe evaporation and condensation in terms of heat transfer.
    EXPRESSIVE LANGUAGE
21. I can relate the evaporation rate to the kinetic energy of the liquid particles.
22. I can describe how convection is a method of heat transfer in fluids.
23. I can perform and describe a simple demonstration that shows convection currents in fluids.
24. I can explain how particles diffuse/spread from high concentration to low concentration.
25. I can use ideas of diffusion to describe how gaseous exchange occurs in a plant leaf during photosynthesis.
26. I can explain Brownian motion as the random motion of particles in fluids.
27. I can research how Robert Brown made his discovery of Brownian motion, using pollen grains and how Albert Einstein developed his idea in the early 20th Century.
28. I can investigate how density of a material is found, by using the mass and volume of an object.
    PRACTICAL
29. I can solve simple problems to find the density of materials using the relationship: density=mass/volume.
30. I can investigate how and why, objects float and sink in water and relate this to the density of an object in comparism to the density of water.
    PRACTICAL
31. I can investigate ways of limiting energy costs at home and at school.
    LEARNING TO BE
32. I can describe how heat can be transferred from hot objects by thermal radiation and that this is known as Infra red radiation which is a part of the electromagnetic spectrum.
33. I can investigate how the colour and type of surface affect the absorption and emission of heat.
    PRACTICAL
34. I can explain that all hot objects emit heat that is transferred to the local environment and describe this as wasted energy since it is dispersed and difficult to retrieve.
35. I can explain and give examples of energy transfers in terms of inputs, usefulness and wasted outputs.
    READING AND UNDERSTANDING
36. I can represent energy transfers graphically by using Sankey diagrams.
    MANAGING LEARNING
37. I can use Sankey diagrams to represent energy transfers.
    MANAGING LEARNING
38. I can use Sankey diagrams to determine the efficiency of household appliances using the equation: efficiency=useful output energy/total input energy.
39. I can research how and why people in different countries use various methods of heating and cooling in their homes.
    SELF AWARENESS
40. I can investigate ways of generating energy *such as waste to energy and energy recovery* as in *e.g. RO plants*.
    LEARNING TO BE
41. I can use the internet and textbooks to research the best methods of insulation and energy efficiency and formulate an information leaflet to help the Maltese make an informed choice about how to insulate their homes.
42. I can design, in theory and in practice, an experiment to find the specific heat capacity of various metals *such as copper, brass and aluminium*.
    CREATIVE LEARNING
43. I can solve problems to calculate the specific heat capacity using: E=mxcxdT.
44. I can explain Newton's Third Law of Motion.
45. I can describe how forces act in interaction pairs.
46. I can identify the forces acting between two objects.
47. I can represent the magnitude and direction of forces using lines and arrows.

48. I can calculate the resultant force of two or more forces acting either along a straight line or in a perpendicular line.
49. I can explain friction as a resistive force and investigate which factors affect friction between two surfaces in contact.
    COGNITIVE
50. I can explain why and how scientists need to ensure that only one variable is changed in an investigation, to generate a meaningful result.
51. I can design an experiment, in theory and in practice, to calculate the speed of a body, from measurements of distance and time.
    MANAGING LEARNING
52. I can plot a distance time graph using the correct axes for an object travelling at a constant speed.
53. I can construct a distance time graph for a body undergoing a described journey.
54. I can find the gradient of a distance time graph, to find the constant speed of an object.
55. I can differentiate between scalar and vector quantities.
56. I can calculate the total distance travelled using a velocity time graph, by calculating the total area under the graph.
57. I can find the constant acceleration of an object by calculating the gradient of a velocity time graph.
58. I can use the relationship: acceleration=change in velocity/change in time.
59. I can undertake an investigation using textbooks and online resources to explain the effect of balanced and unbalanced forces on the motion of objects.
    PLANNING AND REFLECTION
60. I can use the internet to compare the performance in terms of speed and range of electrical vehicles compared to conventional petrol/diesel engine cars.
61. I can explain the importance of finding alternative fuel sources due to the limited life of fossil fuels and how their combustion causes damage to the atmosphere.
62. I can compare renewable and non-renewable energy sources.
    LEARNING TO DO
63. I can critically evaluate and interpret scientific claims about energy sources and their impact on the environment.
    SELF AWARENESS
64. I can give a reasoned explanation about the most sustainable forms of energy generation suitable for Malta.
    LEARNING TO LIVE TOGETHER
65. I can research how increased carbon emissions affect the atmosphere and climate and how in the long term this may lead to rising sea levels due to the melting of the polar ice caps.

Subject Focus: Electricity and electromagnetism

1. I can demonstrate static electricity by rubbing strips of perspex or polythene with a cloth and then using the charged strips to make small pieces of paper move.
2. I can explain how static electricity involves the movement of negative charges or electrons, between two materials to leave one postively charged and one negatively charged.
3. I can describe the hazards of static electricity *e.g. when refuelling vehicles or when working with delicate electronic circuitry.*
    COGNITIVE LEARNING
4. I can research how static electricity is used in industry for spray painting and the removal of harmful pollutants in chimneys.
5. I can explain how positively and negatively charged ions depend on the numbers of electrons compared to the number of protons in an atom.
6. I can investigate what materials are conductors or insulators, using a simple circuit with a cell and a lamp.
    PERSONAL

7. I can explain that conductors contain more free electrons that flow when placed in a circuit with a power supply, when compared to other materials. I can explain the difference between the direction of the flow of charges and the direction of the conventional flow of current.
8. I can build a simple circuit with a power supply, bulb and ammeter to measure the current.
9. I can explain how current is related to the rate of flow of charge, past a point in circuit.
10. I can use the relationship: Q=It, to solve problems relating to charge, current and time.
11. I can use the correct circuit symbols to draw circuit diagrams of simple circuits.
12. I can demonstrate how a larger voltage on a variable power supply relates to a larger current or flow of electrons, in a circuit.
13. I can explain how the work done by a power supply is transferred into other forms of energy in components in a circuit when a current flows.
14. I can use the relationship: E=V/Q, to solve problems based on energy, voltage, or potential difference and charge.
15. I can design and build a simple circuit with a power supply, lamp, resistor, ammeter, voltmeter and switch.
16. I can use an analogy to model how charge flows in a circuit.
17. I can discuss how the rate of energy transfer in an electrical component is related to the voltage across the component and the current flowing through it.
18. I can use the relationship: P=IV, to solve problems concerning two variables.
19. I can use and manipultae the relationships: V=E/Q, P=IV and Q=Ixt, to show that: E=Pxt.
20. I can design and carry out an experiment to measure the resistance of a fixed resistor using current and voltage measurements.
21. I can adjust the potential difference across a fixed resistor to collect voltage and current measurements.
22. I can plot a straight line graph using voltage and current data for a fixed resistor.
23. I can use the current voltage graph for an ohmic conductor to find the resistance of the conductor.
24. I can describe how the collisions between free charges and ions in a conductor is the cause of resistance.
25. I can use Ohm's Law: V=IR, to solve problems when given two variables.
26. I can use resistors connected in series in a circuit to demonstrate how the total resistance increases in the circuit.
27. I can use an analogy to model how resistors in series increase the total resistance, since more work is done to move the charges through all the resistors in series.
28. I can use resistors connected in parallel in a circuit, to demonstrate how the total resistance decreases in the circuit.
29. I can explain how there are more pathways for charges to flow in a parallel arrangement of resistors when the resistance decreases.
30. I can demonstrate what happens to the current and voltage in a circuit when cells are arranged in series.
31. I can compare and contrast the properties of AC and DC currents and use an oscilloscope to demonstrate the difference.
    MANAGING LEARNING
32. I can interpret V-I graphs for different components *e.g. fixed resistor, light bulb, thermistor* to describe the resistance of the components and how it varies with voltage.
    MANAGING LEARNING
33. I can explain and model how houses, schools and work places can be electrically wired.
    SELF AWARENESS
34. I can research information about how to make homes, schools and workplaces more energy efficient. I can use this to write a letter to my school to suggest methods to increase energy efficiency in the school building.
    LEARNING TO LIVE TOGETHER
35. I can explain correct electrical safety measures used at home.
    LEARNING TO KNOW
36. I can describe the safety features used in electrical appliances including fuses, trip switches and residual current circuit breakers (RCCB).

37. I can explain how electricity companies generate regular bills for electricity used at home, by measuring the amount of electrical units used.
38. I can explain what the term kilowatt hour (kWh) means.
39. I can calculate the cost of using electricity using the equation: cost=Number of units used x cost per unit.
     MANAGING LEARNING
40. I can demonstrate the effects of the magnetic field around a current carrying conductor, using plotting compasses.
41. I can make my own magnets using iron nails and a permanent magnet.
     PRACTICAL
42. I can explain how a compass works in terms of the Earth's magnetic field.
     INTERPERSONAL

Subject Focus: Radiation for communication and health

1. I can identify the component radiations which make up the electromagnetic spectrum.
2. I can represent the wavelegths and frequencies of electromagnetic radiation in standard form.
3. I can research in textbooks and online, to be able to describe how different types of electromagnetic radiation are used for communication.
     READING AND UNDERSTANADING
4. I can use appropriate equipment and plan an investigation to measure the critical angle when modelling total internal reflection.
5. I can explain how light and infra red radiation may be used in fibre optic communications.
6. I can explain the benefits of fibre optics in broadband communications compared to older dial up connections.
7. I can compare and contrast the features of a model of the human eye and a camera.
8. I can research how the technology for cameras has progressed since the late nineteenth century to today *e.g. the availability of many mobile technologies containing CCD cameras.*
9. I can explain how the absorption of microwaves by the water in foods, forms the basis of operation for the microwave oven and how the increase in energy is transferred through the food by conduction.
10. I can describe how microwave ovens are designed to absorb stray microwaves to protect the users.
11. I can discuss how radiowaves and microwaves are used for long distance and global communications.
12. I can explain that microwaves are used to communicate with satellites since they are not absorbed by the earth's atmosphere.
13. I can model how the ionosphere acts as a mirror for radio waves to enable their use in global communications.
14. I can use data from scientific studies to investigate the claims made by opposing groups about the use of microwave radiation in mobile phones and formulate an argument, for or against, the use of microwaves.
15. I can compare the features of analogue and digital signals.
16. I can research how signals are transmitted in analogue and digital formats.
17. I can discuss the benefits of digital signals, how they are stored and how they form sounds and images.
18. I can demonstrate, how the intensity of a signal decreases the further away a receiver is from the trasmitting source.
19. I can describe how the earth's atmosphere transmits some electromagnetic radiation from the Sun through to the earth's surface.
20. I can use scientific data related to the levels of carbon dioxide to formulate an argument about global warming.
21. I can argue, for or against, the use of carbon fuels in relation to their benefits and harmful effects.

Subject Focus: Earth and the Universe

1. I can describe how the earth is one of the 8 planets in our solar system.
2. I can use textbooks and the internet to find information *e.g. size, mass, size of acceleration due to gravity* about all the planets in our solar system.
3. I can model the structure of the earth *e.g. core, mantle and crust* using different materials *e.g. modelling clay.*
4. I can use textbooks and the internet to explain that the map of the world has not always looked as it currently does.
5. I can use Wegener's theory of continental drift to show what the map of the world might have looked like at different stages in the earth's history.
6. I can explain how similar fossils and rock layers, as well as the shape of continents, are evidence of Wegener's theory of continental drift.
7. I can predict what might happen to the map of the earth in the future based on continental drift and forecasts of changing sea levels.
8. I can explain that sea floors spread at the rate of a few centimetres per year and how this is related to convection processes moving the mantle, due to the heat from the Earth's core.
9. I can describe how geologic features *such as mountains and volcanoes are usually found on the edge of tectonic plates*.
10. I can discuss how earthquakes are caused by the movement of tectonic plates relative to one another.
11. I can use the internet to investigate how scientists use data from seismic events to explore the structure of the earth.
12. I can use information from news sites and other internet sites to discuss how tsunamis are caused by seismic events *such as earthquakes happening in open seas*.
13. I can model the mechanical waves produced by earthquakes using a slinky.
14. I can use appropriate computer software to demonstrate the features of P (primary) waves and S (secondary) waves that are produced by earthquakes.
15. I can describe that P waves can travel through liquids and solids, but S waves can only travel through solids.
16. I can use the internet to investigate how the islands of Malta were formed.
17. I can model and describe how the sun, earth and moon move, in relation to one another and how this is the cause of solar and lunar eclipses on the Earth.
18. I can use the model of the sun, earth and moon to demonstrate the phases of the moon.
19. I can explain how the tides are caused due to the gravitational pull of the moon.
20. I can discover how Isaac Newton was the first person to explain how the moon caused the tides.
21. I can explain how waves are due to the heating effects of the sun and convectional currents that cause wind.
22. I can investigate using different methods how the particles of water waves move up and down and use this to explain how waves are a transfer of energy that does not cause matter to be transferred.
23. I can interpret diagrams of waves in terms of their amplitude, wavelength and frequency.
24. I can use the wave equation: wavespeed=wavelength x frequency.
25. I can recall that the speed of light is 300,000km/s which is equivalent to 3x10^8 m/s in standard form.
26. I can use a calculator to determine wavelengths and frequencies of different electromagnetic radiations concerning one variable *e.g. wavelength or frequency.*

LEVEL 9

Subject Focus: Energy, Forces and motion

1. I can write an article on how Galileo discovered that all objects fall with the same acceleration.
2. I can describe how all objects require an unblanced force to accelerate or decelerate.
3. I can use the equation: F=ma, to explain Newton's Second Law.
4. I can express momentum as the product of mass and velocity.
5. I can explain Newton's Second Law in terms of the rate of change of how the momentum of an object is proportional to the force applied to the object.
6. I can investigate that the time of impact affects the force of impact, using Newton's Second Law and I can apply it to practical situations.

   COGNITIVE LEARNING
7. Using: F=ma and Accelaration=change in velocity/change in time, I can derive Newton's Second Law in terms of momentum.
8. I can work out calculations using the law of conservation of linear momentum.

   COGNITIVE
9. I can distinguish between the mass and weight of an object.
10. I can use the relationship: W=mg, to solve mathematical problems concerning two variables.
11. I can describe how a force works when moving an object.
12. I can use the relationship: W=Fs, to solve problems concerning two variables.
13. I can describe how the work done by a force on a moving object, can increase the object's velocity, thus increasing the object's kinetic energy, E_k.
14. I can use the equation: E_k=1/2mv2, to solve problems related to kinetic energy.
15. I can rearrange the equation: E_k=1/2mv2, to make m or v the subject of the formula.
16. I can explain that the work done by a force on an object increases the height of the object above the ground and the object's gravitational potential energy E_p increases.
17. I can use the expression E_p=mgh to solve problems about GPE.
18. I can describe qualitatively how KE and GPE of a system can interchange and that the total energy is the sum of the KE and GPE.
19. I can give an example of energy interchange within a system to demonstrate conservation of energy.
20. I can use an idealised computer simulation of a pendulum to show the relationship between the period and the length of a pendulum.
21. I can use the equations for KE and GPE together, for calculations relating to falling objects.
22. I can plan an inquiry into the energy transfers in falling objects by measurements using data loggers.

    PLANNING AND REFLECTION
23. I can investigate how the surface area of a parachute affects the speed at which an object falls to the ground.
24. I can explain that the fastest speed a skydiver can reach is called the terminal velocity and that at this velocity the forces acting on the skydiver are balanced.
25. I can use the term terminal velocity, to describe this as the fastest speed cars can travel at when the forces acting on the car are balanced and there is no resultant force on the car.

26. I can distinguish between braking distance and thinking distance.
27. I can use ideas about stopping distance to understand how crash investigators are able to collect data about the speeds of cars involved in an accidents.
28. I can use equations for linear motion, to determine instantaneous velocities, acceleration, distances and time of travel, for objects that have a constant acceleration.
29. I can investigate how a helical spring extends or compresses when subjected to an increasing force.
     PRACTICAL
30. I can explain how the suspension of a car works and model this using different springs.
31. I can describe Hooke's Law in relation to the force exerted on a material and the extension of the material.
32. I can identify different types of material *e.g. brittle, ductile, polymeric* from stress strain graphs.
33. I can describe a moment as the turning effect of a force.
34. I can use the relationship: moment=force x perpendicular distance from pivot, for calculations concerning two variables.
35. I can use the Principle of Moments to find an unknown weight or distance in an everyday life application involving systems in equilibrium, up to two pivots only.
     COGNITIVE LEARNING
36. I can investigate how pressure exerted on a surface is determined by the weight of the body and the area of surface it covers.
     PRACTICAL
37. I can use the relationship: Pressure=Force/Area, to calculate problems concerning two variables.
38. I can discuss how the pressure on an object underwater and objects in different fluids change, depending on the density of the fluid and the depth of the object beneath the surface of a fluid.
     LEARNING TO KNOW
39. I can investigate and discuss how hydraulic machines rely on pressure to be able to lift heavy loads.
     PRACTICAL
40. I can use the relevant equation to calculate the pressure on a submarine at various depths in the Mediteranean Sea. I can investigate how submarines are designed to ensure they maintain structural integrity whilst in deep water.
41. I can elicit from relevant textbooks and the internet how mercury barometers can be used to measure atmospheric pressure.
42. I can discuss how, when a balloon is squeezed, the volume of the balloon decreases but the pressure inside the balloon increases.
43. I can research Boyle's Law which states: the pressure of a gas x the volume of a gas is a constant, as long as the temperature remains constant.
44. I can use a manometer to demonstrate Boyle's Law.
45. I can use Boyle's Law to solve problems concerning two variables.
46. I can identify Boyle's Law from a graph and describe the relationship between volume and pressure as being inversely proportional.
47. I can explain how an aerosol canister contains liquid that turns to vapour due to the change in temperature when the fluid is released from the canister and how the vapour now has a larger volume.
48. I can use Charles' Law to explain how, at constant pressure, the volume of a gas is directly proportional to the absolute temperature of the gas in Kelvin.

Subject Focus: Electricity and electromagnetism

1. I can demonstrate the relationship between voltage and resistance in a simple series circuit with one fixed resistor and a variable resistor.
2. I can explain that changing the resistance of a variable resistor changes the potential difference across the variable resistor.
3. I can use a thermistor to design and build a simple circuit that detects changes in temperature.
4. I can use a LDR to design a simple circuit to detect changes in light intensity.
5. I can explain how the potential difference across the power supply in a series circuit is equal to the sum of potential differences across the components.
6. I can explain how the current in a series circuit is the same at all points in the circuit.
7. I can explain how the potential difference accross the power supply in a parallel circuit, is the same as the potential difference across each component connected in parallel with the power supply.
8. I can explain how the current in a parallel circuit is divided between the branches in the circuit.
9. I can explain that the total current in a parallel circuit is equal to the sum of the current in the branches.
10. I can describe how the current is larger in the branch with the least resistance in a parallel circuit.
11. I can compare the properties of permanent magnets and electromagnets.
12. I can investigate the shapes of magnetic fields around different types of magnets and electromagnets.
    PRACTICAL
13. I can investigate how to change the strength of the magnetic field around an electromagnet and describe its practical use.
    COGNITIVE LEARNING
14. I can demonstrate that a current carrying conductor will experience a force in the presence of a magnetic field.
15. I can use Fleming's Left Hand Rule for a current carrying conductor in a magnetic field.
16. I can build a model DC motor using a power supply, a coil of wire, a split ring commutator and a permanent magnet.
17. I can explain that when a magnet is moved in relation to a coil of wire, a voltage is induced across the ends of the coil.
18. I can research how power stations, wind turbines and hydroelectric power stations generate electricity by using turbines that rotate coils in permanent magnetic fields.
19. I can describe how transformers can only be used with alternating current.
20. I can describe why transformers are required to adjust voltages to reduce energy losses, when electrical energy is distributed from power stations to consumers.
21. I can research and explain how electromagnetic induction is used in mobile phone chargers to charge phones without the need for cables.
    EXPRESSIVE LANGUAGE
22. I can solve calculation problems involving the number of primary and secondary turns and the primary and secondary voltages of tranformers using the expression: V1/V2=N1/N2, where V stands for Voltage and N stands for number of turns.
23. I can induce an emf across the ends of a coil of wire using a magnet. I can use Faraday's law of electromagnetic induction and explain how the emf induced in a coil depends on the rate of change of the magnetic flux and the number of turns of the coil.
24. I can research how DC motors are used in computing drives, vehicles and domestic appliances.

Subject Focus: Radiation for communication and health

1. I can explain in simple terms the absorption and ionising properties of alpha, beta and gamma radiation and discuss the health hazards to humans.
2. I can design an experiment to investigate the claims of sun cream and sun block manufacturers in the ability of sun creams to block out UV radiation.
3. I can compare SPF ratings to investigate manufacturer's claims about the extent to which they block out UV rays.
4. I can discuss how the ozone layer in the Earth protects us from harmful UV rays from the sun.
5. I can research using the internet and textbooks, how medical workers are protected from the harmful effects of X-Rays and Gamma rays by the use of absorbers.
6. I can discuss how over exposure to ionising radiation can lead to cancer.
7. I can describe how some radioactive materials may be used in medicine for treatment of cancer *e.g. gamma rays* and as tracers to help radiographers see inside a patient's body.
8. I can explain how nuclear radiation is emitted from the nucleus of an atom and that this is a random and spontaneous process.
9. I can describe the properties of the three types of radiation: alpha, beta and gamma.

    EXPRESSIVE LANGUAGE
10. I can relate the properties of the three types of radiation to practical applications.
11. I can explain what happens to the atomic number and mass number of a nucleus during radioactive decay and use this to identify the new isotopes formed.
12. I can describe how to detect radiation using speacialised equipment *such as a Geiger Muller tube*.

     MANAGING LEARNING
13. I can interpret measurement of activity from different radioactive sources as recorded from appropriate equipment *e.g. a Geiger Muller tube and counter*.
14. I can use the nuclear model of the atom to describe the location of protons, neutrons and electrons.
15. I can discuss the properties of the sub-atomic particles in an atom in relation to charge and mass.
16. I can interpret graphs of radioactive decay to determine the half-life and calculate the fraction of the original isotope left after a period of time.
17. I can design a model of half-life using coins, dice, Skittles to demonstrate exponential decay.
18. I can research the process of nuclear fission and its uses in nuclear power stations, including the hazards involved.

     LEARNING TO KNOW
19. I can list and discuss the advantages and problems of using nuclear power to generate electricity.

     LEARNING TO DO
20. I can describe the uses of some radioactive isotopes *e.g. Carbon 14* to date historical artefacts.

     SOCIAL CHANGE
21. I can discuss how it is possible for radiation workers to minimise exposure to nuclear radiation by wearing protective clothing and using badges that are designed to measure exposure.
22. I can research the experiments of Rutherford on the scattering of alpha particles by a thin gold foil.

Subject Focus: Earth and the Universe

1. I can research and write an essay about popular, previously held views about the model of our solar system and how this has changed over time *e.g. from Ptolomy and his geocentric model, to Copernicus and his heliocentric model*.
   SOCIAL LEARNING
2. I can discuss how Galileo's investigations and findings against the geocentric model put him in conflict with the beliefs of the Catholic Church at the time and use this as an example of how scientists can use their investigations and findings to challenge commonly held views.
3. I can build a simple telescope using a metre ruler and two convex lenses and make simple measurements of magnification using the equation: magnification=focal length of objective lens/focal length of eyepiece lens.
4. I can measure the focal length of convex lenses and give practical uses for this type of lens.
5. I can use ray diagrams to prove the law of reflection.
6. I can use a prism and other transparent objects to demonstrate refraction.
7. I can calculate the refractive index of transparent media using the ratio of the speed of light in a vacuum, to the speed of light in a medium.
8. I can describe how refraction in a dense medium affects the speed and wavelength of the light source but not its frequency.
9. I can demonstrate and describe how waves can be diffracted when travelling through gaps, similar in magnitude, to the wavelength of the wave.
10. I can demonstrate and describe how spectra may be formed by using prisms.
11. I can research about the red shift and use the information gathered, to be able to explain the theory of the expansion of the universe.
12. I can explain how red shift is evidence for the Big Bang Theory in the creation of the universe.
13. I can use the internet to research how astronomers obtain data on the universe, using different methods.
14. I can discuss the advantages and disadvantages of using orbiting telescopes as opposed to terrestrial telescopes.
15. I can research the life cycle of a star to present the different possible outcomes for different sized stars.
16. I can research how developments in Physics in the 20th Century, led scientists to describe how nuclear fusion of hydrogen is the process that sustains a star through the main stage of its life cycle.
17. I can correctly use the terms protostar, red giant and white dwarf when describing the lifecycle of our Sun.
18. I can present in graphical form the eventual fate of different stars based on their size, including why our Sun will become a black dwarf and why Supergiant stars *e.g. Antares* will go Supernova.
19. I can investigate how astronomers measure astronomical distances in light years, to determine the size of galaxies and the distances between them.
20. I can discuss how our Sun is one of billions of stars in the Milky Way, which is one of billions of galaxies in the universe.
21. I can explain that when we look at the stars at night we are looking back in time due to the finite speed of light and the distances between stars, galaxies and the earth.

LEVEL 10

Subject Focus: Energy, Forces and motion

1. I can discover how modern construction techniques allow for innovative ways to increase the energy efficiency of buildings.
    INTERPERSONAL
2. I can investigate and discuss how air conditioning units operate, to keep rooms and buildings cool, by transferring heat from hot to cool areas.
    LEARNING TO BE
3. I can use the manufacturer's information and specifications from the internet and the equations for electrical energy, power and the cost of electricity to evaluate the cost effectiveness of AC units.
    READING AND UNDERSTANDING
4. I can identify and explain the greenhouse effect and use it to explain global warming.
    LEARNING TO DO
5. I can research about best overseas practices in energy efficiency.
    SOCIAL CHANGE
6. I can research how different people from different cultures, use different construction techniques.
    COMMUNICATING FOR DIVERSITY
7. I can describe how modern construction techniques allow for innovative ways to increase energy efficiency in buildings.
    PRACTICAL
8. I can design an investigation into how different materials extend, when an external force is applied to one end and when the force is removed.
    PRACTICAL
9. I can plot a force vs extension graph, find where the elastic limit of different materials is and use this to decide what materials would be good for use in various circumstances *e.g. the construction of a suspension bridge.*
10. I can research and apply ways of incorporating stability in the design of modern vehicles.
     INFORMATION MANAGEMENT
11. I can investigate what materials could be used in the construction of submarines to allow for further exploration in deep seas and oceans.
12. I can discover how divers safely return to the surface by monitoring the size of gas bubbles as they rise up whilst underwater.
13. I can research Galileo's use of pendulums to successfully argue against the Aristotlean view that heavier objects fall to the earth faster than less heavy objects.
14. I can qualitatively relate distance, time and velocity time graphs.
     CREATIVE LEARNING
15. I can investigate the factors that affect circular motion including mass, velocity and the radius of the circle traced by the motion.
16. I can discuss the rotational energy of windmills in relation to the energy transfer from the kinetic energy of the air, how modern turbines use this to generate energy and comment on how wind turbines could be made to work more efficiently.
17. I can investigate methods of reducing damage to passengers in terms of force, momentum and time.
     PRACTICAL
18. I can form a reasoned argument about the sustainable growth of developing nations and their right to sustain their own development.
     SELF AWARENESS
19. I can evaluate local and global methods of transport, their relative impact on the environment and recommend the most sustaniable methods.
     LEARNING TO BE

Subject Focus: Electricity and electromagnetism

1. I can investigate electric fields and their effects on positive and negative charges.
2. I can research and present the history of electricity from its discovery, to modern day usage.
    INFORMATION MANAGEMENT
3. I can evaluate the use of LEDs, using equations for electrical energy and power, as a replacement for other forms of lighting in vehicles, streetlights, etc. in terms of cost and sustainability.
    LEARNING TO DO
4. I can compare methods of analog and digital electrical measurements and determine their accuracy.
    MANAGING LEARNING
5. I can discuss and evaluate the advantages, disadvantages, use of electric vehicles and develop arguments, for or against their use, compared to conventional petrol/diesel vehicles.
    INTERPERSONAL
6. I can discuss the similarities and differences between voltage and emf.
7. I can design and build my own AC generator.
    CREATIVE LEARNING
8. I can research how magnets are used in science from their use in the Large Hadron Collider and compare my conclusions on their use to their use in bullet trains and other hover vehicles.
    PERSONAL LEARNING
9. I can use a small neodymium magnet and copper pipe to demonstrate Lenz's Law.
10. I can investigate the effects of Lenz's Law in cars and other machines with DC Motors.
11. I can discuss the reasons why a constant, reliable electricity supply is necessary for our modern lifestyle, even in remote locations in the world.
     LEARNING TO KNOW
12. I can describe how semiconductors differ from ordinary conductors and where and why they are used.
     LISTENING AND SPEAKING
13. I can critically evaluate the benefits of using energy efficient appliances in the home in relation to cost, payback time and the impact on the environment.
     LEARNING TO BE

Subject Focus: Radiation for communication and health

1. I can critically analyse data about lifestyle, skin cancer and its prevention in Malta and around the world.
    READING AND UNDERSTANDING
2. I can compare and contrast the benefits and concerns of nuclear fusion and fission for the production of energy.
    COGNITIVE LEARNING
3. I can critically evaluate information from the internet to formulate arguments on the use of nuclear energy.
    LEARNING TO LIVE TOGETHER
4. I can discuss the effectiveness and potential use of nuclear fusion in the production of energy for the future.
    COMMUNICATING FOR DIVERSITY

Subject Focus: Earth and the Universe

1. I can discuss the possibilities of life on other planets and the conditions needed to sustain it.
    LEARNING TO DO
2. I can model the concept of red shift to explain how the universe is expanding.
    CREATIVE LEARNING
3. I can research and present the possibilites of humans living on other planets.
    LISTENING AND SPEAKING
4. I can discuss the Big Bang Theory.
5. I can research evidence for the existence of black holes and describe them as a singularity in space with a large gravitational pull, enough to prevent light escaping.
    DIGITAL MEDIA

6. I can research how telescopes are constructed and why they are constructed with mirrors and not objective lenses.
7. I can research using the internet and textbooks, how Edwin Hubble observed the red shift of galaxies to estimate the age of the universe.
8. I can investigate how scientists use data from seismic events to try to predict the occurence of earthquakes and volcanic eruptions in the future.
9. I can research current debates about the start of the universe *e.g. what came before the universe, multiverse theories.*
10. I can research about astronauts living on the International Space station and how they sustain themselves living in orbit around the earth.
     LEARNING TO BE
11. I can investigate how interference of waves is used in technology *e.g. by using noise reduction headphones*.
     COGNITIVE
12. I can discuss various scientific views regarding the fate of the universe.
     COMMUNICATING FOR DIVERSITY
13. I can research information about the red shift and use the information to explain the theory of the expansion of the universe.
14. I can critically evaluate the social, ethical and economic reasons, for and against, space exploration.
     SELF AWARENESS
15. I can research how scientists measure the speed of light.

Pedagogy

A. PEDAGOGY AND GOOD PRACTICE LEARNING

Educators need to keep up-to-date with the latest pedagogical strategies and concepts in order to be able to better understand and respond to learners' needs. Europe's *Education and Training 2020* strategy puts special emphasis on the teachers' role in the lives of their learners. Teachers play a crucial role in guiding their learners towards their goals and shaping their perceptions (European Commission, 2015).

Physical Science is concerned with the study of inanimate matter, energy and the physical properties of the Universe. This includes the study of matter and its interactions, from the very small atomic level to the massive interactions of galaxies in the universe. Physical Science includes themes from material science, earth science and astronomy, with the main focus being Physics.

The document *A Vision for Science Education in Malta* refers to the Physical Science subject as a means of 'providing more detailed explanations and applications of the physical and chemical concepts and principles in everyday life. It will mainly deal with matter, energy and the interactions between them on a microscopic scale, and with the formation and evolution of the Earth, the Solar System and the Universe on the macroscopic scale' (Ministry of Education, Employment and the Family, 2011:13).

Similarly, Encyclopaedia Britannica describes the Physical Science subject as 'the systematic study of the inorganic world, as distinct from the study of the organic world, which is the province of biological science. Physical science is ordinarily thought of as consisting of four broad areas: astronomy, physics, chemistry, and the Earth sciences' (Physical Science, Encyclopaedia Britannica, 2014).

Physical Science plays an increasingly important role in our everyday lives due to the influence of the subject on scientific and technological development, which underpins our country's economic growth and the social wellbeing of our community. Competence in this subject is instrumental in helping our country meet its social, economic and industrial targets since progress is directly linked to innovation and research, both of which are an integral part of Physical Science.

The study of Physical Science will contribute towards the holistic development of learners by:

- giving them the ability to work in scientific ways or to apply scientific principles which have proved effective in understanding and dealing with the natural and physical world.
- stimulating their curiosity, deepening their interest in the natural and physical world in which they live, and guiding them to reflect on the Universe.
- developing useful skills and attitudes that will prepare learners for various situations in life, such as self-employment and entrepreneurial ventures.
- enhancing understanding that the technological applications of Physical Science should be used responsibly in the promotion of social, human, environmental and economic development, both locally and globally.
- illustrating the development of scientific ideas within a historical context and relating better with the efforts undertaken by great scientists in their endeavour to move science forward as they discover something new.

Above all, the Physical Science subject, like all sciences, 'seeks to develop the scientific literacy of all learners, enabling them to make informed decisions as they strive to improve their quality of life and to understand the changing contexts. Besides imparting knowledge, science education also develops skills and ways of thinking that are important for decision-making and problem solving using an evidence-based approach. It also needs to provide a strong foundation for learners who wish to pursue a career in science and other science-related careers that require them to focus on science at post-secondary and tertiary levels' (Ministry for Education, Employment and the Family, 2011: 10).

The content addressed through the learning outcomes should be a means of achieving the purpose of the course of study and its learning outcomes rather than taking priority over everything else. As practical work is expected to be an integral part of the course of study, this work should provide opportunities for inquiry and investigations that provoke thinking and discussion rather than experiments to just confirm and prove theoretical issues. Learners should be given the opportunity to design, conduct and evaluate investigations both individually and collaboratively.

It is envisaged that the Physical Science course should aim to:

- engage learners with science and scientific phenomena, urging learners to think and participate in a dialogic and interactive type of classroom talk (Mortimer and Scott, 2003).
- provide learners with course content that enables them to acquire a rich knowledge base consisting of the four broad areas of the natural sciences (physics, chemistry, earth science and astronomy). However, topics should be more physics-based and learners should be able to clearly see the interrelation of these subjects and understand how they are an extension of physics.
- help learners become aware of the fact that understanding, investigating, communicating, linking and applying science is crucial to education.
- enhance learners' investigative skills relating to physical and chemical phenomena: classifying, communicating, measuring and designing an investigation; drawing and evaluating conclusions; formulating models; hypothesising, identifying and controlling variables; inferring, observing and comparing, interpreting, predicting, reflecting on problems and solving them.
- prepare learners for lifelong learning, employment, citizenship, holistic development, socio-economic development and environmental management. Learners who choose to study Physical Science as a subject, including those with barriers to learning, can have improved access to professional career paths related to applied science courses and vocational career paths.
- develop communication skills by giving learners opportunities to read scientific texts, to write reports, paragraphs and short essays that could be used to assess learners' learning with understanding.
- highlight links between Physical Science, our local environment and our world – links that are crucial to our learners' holistic understanding of the subject. Designing a context-based Physical Science curriculum that invokes the Maltese context is essential. The curriculum designed should give space and emphasise the local scenario.
- actively reflect IBL pedagogical practices based on the 5E instructional models.
- use a diagnostic teaching strategy that ensures that learning starts from what the learners know.
- develop an understanding that the learning of a scientific concept is an ongoing process that evolves with time.
- motivate all learners.
- provide clear ways of assessment that are both formative and summative in nature.
- allow space for learners to think about their own learning, and to record skills and concepts which they have learnt. This can help boost creativity and innovation and develop further interest in pursuing science careers.

The subject is offered as an option when learners are in transition from Year 8 to Year 9. At Year 7 and Year 8 learners would have been exposed to some of the subject foci covered in Core Science, which is offered during the aforementioned years. The LAP intends to develop learners' practical skills in Physics and an understanding of how Physics works through an investigative approach. It aspires to connect the applications of Physics to technological and environmental issues and to develop learners' understanding through a historical context within which scientific ideas were developed, possibly leading the way to further development and innovation. It also intends to encourage a positive attitude towards science in general and towards the environment and to create enthusiasm about Physics leading to further studies in the area. Levels 7, 8 and 9 should be dealt with interchangeably in the last three years of compulsory schooling.

It is envisaged that Physical Science should aim to engage learners with scientific phenomena using a constructivist pedagogy (Scaife, 2000).
This pedagogy can be characterised by these descriptors:

- A diagnostic teaching strategy that ensures that **learning starts from the learners' prior knowledge** (Ausubel, 1978).
- A classroom scenario that encourages/prompts the teacher to **actively engage the learner to think and participate individually and in group work** (Adey, 1999).
- A **dialogic and interactive type of classroom talk** that commits the teacher to attentive listening to learners and to making use of learners' contributions during teaching (Mortimer and Scott, 2003).

It also implies a pedagogy that promotes inquiry-based learning (Rocard, 2007). This demands an integrated and deep understanding of how to teach science and how scientific knowledge is structured. When put into practice, this would involve the use of the 5E model (Bybee et al., 2006). This instructional model is used significantly in science teaching and provides a good structure for developing a sound pedagogy.

All the above is in line with the *Vision for Science Education* which states that '[i]n inquiry-based learning learners are actively engaged in investigations and involved in working out meanings and explanations in groups – through the social construction of knowledge. Thus learners understand not only scientific knowledge, but also what it means to do science' (Ministry of Education, Employment and the Family, 2011: 13).

The teaching of science should develop scientific thinking and an understanding of higher order concepts, principles and theories in a holistic manner. Ethical, economic, social and moral issues contribute to a deeper understanding of science and its links to everyday life. This dimension helps learners to integrate knowledge from different learning areas and understand that science does not have a solution to all problem situations.

Subject Focus	Pedagogy and Assessment
Energy, forces and motion	• Use group work and role-playing to understand the concept of the kinetic theory. • Learners investigate energy efficiency and the use of renewable energy in other countries. • Assign a task discussing the different materials for building used around the world depending on the weather. Ideally mention sustainable use of such resources and whether people and resources are being exploited. • Learners investigate how the pressure in liquids and gases are used in real life situations *e.g. dams, ships etc.*
Electricity and electromagnetism	• Learners discuss the best way to produce electricity depending on the country and the energy resources available. • Actively involve learners in monitoring energy consumption at home/at school/ in the community and suggest possible ways of decreasing energy consumption based on factual data. • Learners discuss the implications involved in the production of electricity and issues associated with its generation. • Learners discuss proper ways of disposing of batteries and their impact on the environment. They could also discuss the benefits (economic, environmental) of using rechargeable batteries. • Learners build a model of a DC motor and discuss the advantages and disadvantages of using AC or DC motors in electric cars or other means of transportation. Issues that can be dealt with might include charging, battery life, performance, efficiency, environmental impact, etc.
Radiation for communication and health	• Using role play and group work, learners visualise the concept of polarisation. • Discuss case studies where, for example, low-lying cities have used large mirrors to reflect light onto PV panels to generate electricity. There are also possible linkages to solar collectors, solar cookers, solar farms and solar water heaters. • Set a group project or role-play to show the difference between fission and fusion. • Learners discuss advantages and disadvantages of generating electricity from nuclear energy from the local/national/global perspective. For example, in Malta we do not have nuclear power stations. However, the prevailing north-westerly (mistral) wind blows air from the southern part of France (where there are nuclear power stations). An explosion or nuclear leak would still impact Malta and the local habitat.
Earth and the Universe	• Investigate how certain paradigms and world views have led to our current situation on Earth and critically and creatively outline outcomes that these might have on life on other planets.

Physical Science should be complementary to subjects such as Material Science, Environmental Studies and Mathematics. A link between these subjects is inevitable. Such a link can be made stronger by emphasising, within these complementary subjects, how scientific theory guides technological innovation, which in return makes way for further development of theoretical and practical innovations.

Learning to Learn Strategies

The following are examples of the strategies which form part of the 'learning to learn process', one of the eight competencies featured in the document *European Reference Framework Key Competencies for Lifelong Learning* (European Commission, 2007):

- Pedagogical discussions between learners where, on a voluntary basis, learners explain how they carried out a specific task and how they managed to overcome the difficulties encountered, resulting in an exchange of strategies and techniques in a cooperative environment.
- Teaching learners to make use of punctuation marks, pictures, additional information outside the text, such as accompanying explanation of difficult keywords and identification of keywords during reading/ comprehension tasks.
- Teaching and guiding on the different stages of essay writing and the different tools and methods which could be adopted during each stage.

The Subject Learning Outcomes (SLOs) have been written in a way which helps educators to adopt engaging, enterprising and active learning approaches in a variety of contexts to promote and enable learner-centric teaching and learning strategies. Curriculum planners at all stages should regularly consider the opportunities presented by the SLOs to develop active learning throughout the levels in the Learning Outcomes Framework. Planning should be responsive to, as well as encourage participation by, the learner who can and should influence and contribute to the process.

To support curriculum planning and to ensure that all learners have access to an active, enterprising learning environment, a coherent approach to planning learning, teaching and assessment and to sharing information about progress and achievements is needed. In undertaking this type of curriculum planning, it is important not to see the SLOs as limiting factors containing the learning potential of learners and preventing any deviation of learning beyond that contained within the SLOs. This view fails to take into account the scope and flexibility provided by the learning outcomes approach. How, where and when the outcomes are taught and learned is at the discretion of the educator. The SLOs are there to demystify the assessment process by setting out straightforward learning expectations. In doing so, assessment is bound to evidencing the meeting of these same expectations.

Once the learning expectations are set educators can begin to introduce the flexibility in curriculum design and delivery that has been difficult to do up to this point. The learning outcomes approach allows educators to lean towards learner-centric teaching and learning strategies. This will mean knowing the many ways in which learners are different from one another, which of the many ways of learning are significant to the learning at hand and how to deal with this variance in ways that are supportive of the individual learners and allow them to progress. Section C: Reaching different learners within each level offers guidance on how this can be done.

B. EMBEDDING THE DELIVERY OF THE CROSS CURRICULAR THEMES

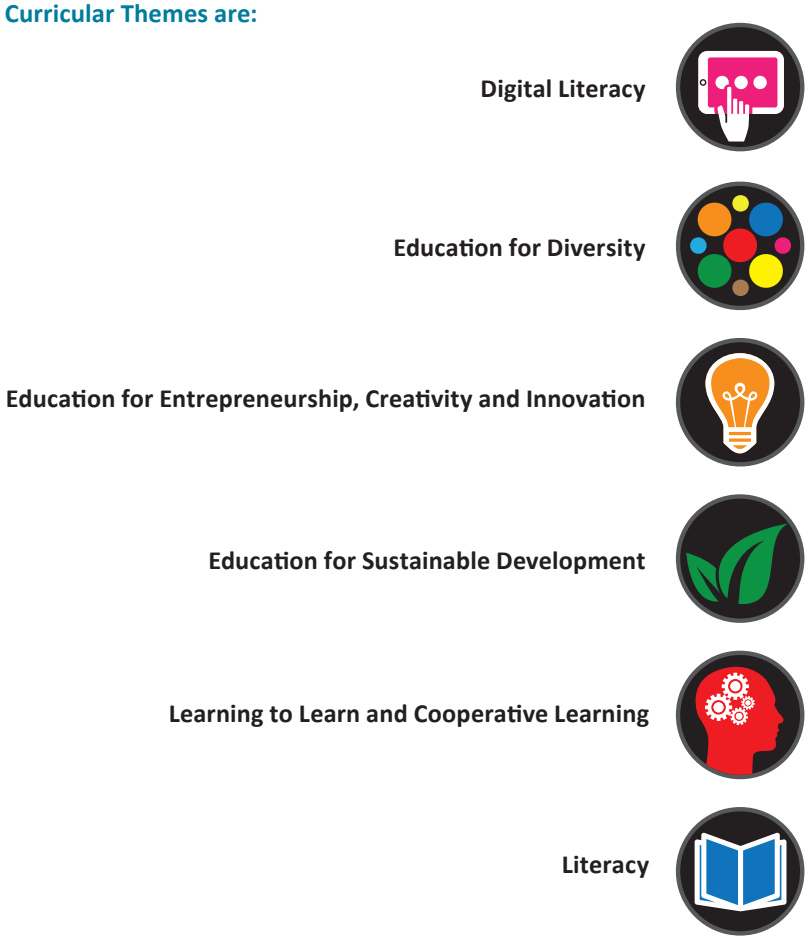
Across Europe there has been a shift from an exclusively subject-based approach to a more cross curricular, thematic, inter-disciplinary and collaborative approach that reflects real life situations and encourages transfer of skills from one learning area to another. Through a cross curricular approach, many curricular areas have been given a higher profile and a number of transversal competences have enhanced their status (European Commission, 2012). The CCTs connect the subjects by highlighting common learning objectives which are also reflected at in the school ethos (Ministry for Education and Employment, 2012: 31, 39).

The Cross Curricular Themes (CCTs) have been introduced in the LOF to ensure that all learners, as they progress through the levels, come into continual contact with the types of knowledge, skills and understanding needed to participate actively, prosper and contribute to Maltese society.

The embedding of the CCTs in the Subject Learning Outcomes offers access to a new learning identity that goes beyond the subject; learners will value the CCT learning when they see that it is an integral part of the Learning Outcomes Framework and that it is vital in helping them become holistic learners.

Each CCT is presented as a set of additional learning outcomes that young people need to encounter and develop a knowledge and understanding of as they progress through the Learning Outcomes Framework.

The Cross Curricular Themes are:



The Cross Curricular Themes can be found in the Appendix
and online at http://www.schoolslearningoutcomes.edu.mt/en/category/cross-curricular-themes

The CCTs need to be embedded within the learner's learning journey and experiences, the main point being that the CCT knowledge and understanding needs to be learned, consolidated and secured within a context. The context is important in order to add meaning and purpose and to reinforce the usefulness of the CCT. There is no one effective way of organising the embedded learning of the CCTs. However, directly linking a CCT outcome to an appropriate practical task within an SLO and then ensuring that there is an opportunity for CCT support at the time the practical task is undertaken is a particularly effective way of embedding a CCT.

Embedding is not just about interlinking different curricula. Mapping where the CCT content might fit in with SLOs or Subject Foci is only a starting point. The educator needs to establish how the CCT content adds value to the SLOs being taught and how something greater than just the sum of the different parts can be achieved. In essence, the CCT learning adds value in the establishment of key transferable knowledge, skills and understanding by starting with meaningful 'situated' engagements with the learning.

Embedding as a process

There are three main ways to approach the delivery of the knowledge, skills and understanding addressed in the CCTs in the learning process. These are:

- through delivery of and the learning associated with the SLOs
- by choosing particular teaching methods and strategies over others to deliver the SLOs.
- undertaking specifically constructed cross curricular or whole school activities.

This process implies an important shift in the way teachers approach the teaching of the subject content in the classroom. Integrating the cross curricular learning outcomes in the teaching of separate subjects requires teachers to step outside their traditional boundaries and work in close collaboration with one another to develop their approach to the CCTs and to exchange information about the learning development of specific learners in relation to the CCTs (European Commission, 2012:25).

Delivering CCTs through the SLOs

The first approach to the delivery of CCT content is by integrating the CCT learning with that of particular SLOs. The framework provides guidance on the best opportunities to do this. Where a particular SLO presents a good opportunity to address learning related to a Cross Curricular Theme a CCT icon appears after the SLO. This indicates that the SLO:

- creates a naturally occurring opportunity to begin to look at learning and skills development associated with a particular aspect of a CCT.
- can be enhanced or enriched by introducing a particular aspect of one of the CCTs.

To guide the educator to the specific learning outcomes of the CCT that are most relevant, the CCT icon which is attached to the SLO in question also includes a heading to identify which particular aspect of the CCT is the 'best fit', i.e. the part of the CCT content that is most closely linked to the knowledge, understanding and/or skills addressed within the SLO.

Although only one CCT has been identified this does not necessarily mean that other CCTs are not relevant. The identification of a particular theme merely suggests that the educator may find the one identified to be the most relevant, most appropriate or easiest to embed at that particular point, allowing the educator to teach the subject and the CCT in an integrated way.

Examples of this type of embedding in Physical Science include:

- I can model the molecular structure of solids, liquids and gases and use kinetic theory to describe how changes of state (melting and boiling, condensing and freezing) occur.
   CREATIVE LEARNING

  Taken from Level 8, Subject Focus: Energy, forces and motion

- I can critically evaluate the benefits of using energy-efficient appliances at home in relation to cost and payback time and the impact on the environment.
   LEARNING TO BE

  Taken from Level 10, Subject Focus: Electricity and electromagnetism

- I can describe the uses of some radioactive isotopes, *for example Carbon 14*, to date historical artefacts.
   SOCIAL CHANGE

  Taken from Level 9, Subject Focus: Radiation for communication and health

Example: Finding opportunities to address CCT learning in Physical Science SLOs

- **I can critically evaluate the benefits of using energy-efficient appliances at home in relation to cost and payback time and the impact on the environment.**
  LEARNING TO BE

Taken from Level 10, Subject Focus: Electricity and electromagnetism

The SLO offers an opportunity to look at the more close-to-home decisions that can be made in order to manage energy as a cost. In doing so it offers an opportunity to reflect on the actions and decisions of the individual in relation to the sustainability of a wider system. This type of SLO actually helps enhance the understanding associated with the CCT outcome rather than the other way round. The SLO helps provide a theoretical and practical understanding of how to be critically aware and, as a result, the ability to reflect on the choices made and their potential consequences.

The CCT outcomes that are particularly pertinent are:

- I am a critically reflective person and am able to evaluate decisions, choices and actions.
- I am responsible for my actions and capable of anticipating, adapting to and facing change.
- I can reflect upon the consequences of my actions on present and future generations.
- I am sensitive to divergent disciplines and perspectives, cultures and minority groups, including indigenous knowledge and world views, without prejudices and preconceptions.
- I am able to creatively and innovatively take considered action and challenge assumptions underlying unsustainable practice.

Addressing CCTs through use of particular teaching methods and strategies

CCTs can be used to inform the creation of Physical Science Departmental policies and strategies, for example by deliberately structuring learning to maximise the use of digital technologies. At the Departmental level, the following CCTs may be particularly suitable to help inform the pedagogy choices and delivery styles selected to maximise the flexibility introduced by the LOF::

Learning to Learn and Cooperative Learning

Digital Literacy

Education for Diversity

Educators may find that the following CCTs have a role to play in the choice of topics to stimulate interest and debate:

Education for Sustainable Development

Education for Entrepreneurship, Creativity and Innovation.

It will become evident that some of the CCTs are naturally suited to particular learning and teaching styles. Section C *Reaching different learners within each level* provides guidance on how particular CCTs can equip learners to thrive in particular learning environments. Deliberately choosing particular teaching strategies involving active and/or experiential learning and problem solving approaches where a certain degree of learner autonomy as well as team work is required will help frame learning in ways conducive to the introduction of the Digital Literacy and Learning to Learn and Cooperative Learning CCTs.

For example, the Learning to Learn and Cooperative Learning CCT comprises a category of learning outcomes on Personal Learning and, by addressing the learning related to this category of the CCT, learners will be developing the learning skills to bring to any task where a degree of autonomy and self-management is required. Similarly, the Social Learning category within the same CCT can help learners develop a framework of skills, attitudes and behaviours that will help them make the most of group or team work and other social learning strategies.

The Digital Learning CCT will help learners develop the competencies related to managing learning, sourcing, manipulating, communicating and presenting information. Having these types of learning skills embedded in the learning before they are most heavily used or required will help the learner approach the tasks with greater confidence in both the process of learning about SLOs and in demonstrating achievement of the outcomes themselves.

Addressing CCTs through cross curricular or whole-school activities

All the CCTs can be used as whole-school strategies for creating a high quality learning environment that values all learners and sets high expectations for all. Schools may see the benefit in having whole-school policies on the advancement of:

- Literacy
- Digital Literacy
- Education for Diversity
- Education for Sustainable Development

These types of CCTs can be used to help inform whole-school policies as well as add real value to the learning within the classroom. However, other CCTs may be used to form the basis of whole Year Group activities, or wider all-learner school initiatives around environmental issues. For example:

- The Education for Sustainable Development CCT could be used to form the basis of whole-school extra-curricular activities related to the Eko-Skola type of initiatives or low energy use initiatives. Fundraising activities to help with a school pursuit of renewable energy sources might bring together learning from this CCT with that of the Education for Entrepreneurship, Creativity and Innovation CCT.
- The Education for Entrepreneurship, Creativity and Innovation CCT could be used to underpin the learning and experiences associated with activities ranging from a ‘learner-owned’ tuck shop to a school event or whole-school initiatives about the world of work.

C. REACHING DIFFERENT LEARNERS WITHIN EACH LEVEL

One of the benefits of working within a Learning Outcomes Framework (and at the same time one of the challenges) is the ability to allow learners to progress at their own speed and to be able to adapt the teaching methodology and curriculum to meet their learning needs. The SLOs clearly show where the learning 'finish line' is at each level for each learner but educators need to acknowledge and plan for those learners who will reach this point quicker than some and also for those who may need more time and more scaffolding to be able to get to the standard required.

The Subject Foci are not rigid or restrictive and do not have to be delivered in a particular sequence or as discrete content areas taken in isolation. Subject Foci can be overlapped and blended into larger (or smaller) learning programmes. Educators may prefer to approach the learning contexts in a different order depending on the situation, or to deliver aspects of the learning through preferred topics.

Diversity of learners

The NCF embraces diversity and requires that this be promoted through an inclusive environment.

The NCF addresses the needs of:

- gifted and talented learners for whom the process of learning needs to be sufficiently challenging to engage and motivate them to develop their talents.
- learners with special educational needs for whom the curriculum should be written in a way that allows the teachers to appreciate how every student can access the same curriculum in every learning area and allows for the assessment of a continuum of ability.
- learners with severe disabilities for whom the curriculum should offer an education based on a continuum of abilities expressed in terms of developmental phases.
- learners from disadvantaged social backgrounds for whom the school, in collaboration with key local and institutional stakeholders in the community, needs to up-skill and support families and the local community to provide an environment that is educationally rich and stable.
- learners from diverse social, cultural and linguistic backgrounds including children of refugees and asylum seekers for whom the curriculum should include access to an educational programme which is embedded within an emotionally and psychologically supportive environment that respects their individual circumstances.

A National Curriculum Framework for All, Ministry for Education and Employment (2012:41)

All classrooms, even where setting is used, will comprise a range of abilities. This is because learners will have different strengths and limitations and will develop at different rates. To define a 'mixed ability' class simply as a group of learners with a range of abilities is overly simplistic. What about the range of learning styles and preferences, interest levels and home backgrounds, which all impact on the learning experience? Each learner will show strengths at different times depending on the topic being studied and the learning style being used. When they are outside their learning comfort zone they will perform less well. It is unrealistic to expect any group of learners, whatever their ability, to progress through a body of work at exactly the same pace. Two thirds of learners in a classroom will be working outside their learning style unless the task is varied.

One of the most effective ways to ensure that different learners are reached within each level and throughout the LOF is to teach learners to think for themselves. Some of the CCTs provide the toolkit of knowledge and skills for learners to be able to become more effective, resilient, resourceful and autonomous learners.

Progression and differentiation in learning

The principles of diversity and inclusion which underpin the NCF imply that at all stages learners of all aptitudes and competences should experience success, challenge, and the necessary support to sustain their effort. They need flexible learning programmes providing diverse learning experiences that cater for a wide spectrum of learners and allow for different rates of progression as children and young people work through their school years. Different approaches are needed to address different learning needs. With the focus increasingly on the learner, and with more mixed-ability classes in schools, differentiated approaches are becoming more important and teachers need to adopt strategies that build on children's and young people's previous learning and help them progress.

A National Curriculum Framework for All, Ministry for Education and Employment (2012:40)

Strategies for teaching a mixed ability class

The teacher in the classroom must start by making a connection with each learner in their classes on a personal level by knowing and using their names and getting to know what interests them. Incorporating areas of interest into the learning can be a good way to engage learners. Similarly, using this type of knowledge when setting homework or individual class work can be a useful motivator and may help keep learners engaged.

Personal Learning:

- I can identify the support and resources I need to learn.
- I am aware of my preferred way to learn and can use this to plan my own learning.
- I manage goals and time efficiently in learning.
- I feel competent in managing my own learning.
- I am open to feedback from others and am able to consider it.
- I reorganise myself by explicitly changing my assumptions over time.
- I am able to follow my own interests as this helps me to reflect on 'who I am'.
- I am pleased when I succeed at difficult tasks.

Taken from the Learning to Learn and Cooperative Learning CCT

Ways to empower learners and make them more able to thrive within the LOF

Create a dynamic learning environment by:

- managing the classroom and creating opportunities for learners to work individually, in pairs and in groups.
- changing the layout of the classroom to match the learning taking place.
- providing a choice of differentiated activities, allowing learners to select their level of engagement and challenge. This will help with the 'ownership' suggestion listed further down.
- using carefully selected and differentiated resource banks.
- presenting different ways to learn the same thing.

Engage learners by:

- creating a sense of learner ownership of the learning process by, for example, allowing learners to choose their own project.
- allowing learners to demonstrate their understanding in different ways, for example through self-selected means, be it a visual representation, an oral presentation or physical demonstration.
- building in the higher order thinking skills using Bloom's taxonomy (at all levels) and working with the SLOs to keep learning tasks interesting, providing useful stretch and challenges as SLOs are given added dimensions or are approached from different directions. This can be done by giving learners problem-solving tasks with the opportunity to transfer and apply their knowledge to a new context.

Turn learners into resilient learners by:

- at an early stage introducing the learners to the key learning strategies encompassed by the Learning to Learn and Cooperative Learning CCT.
- discussing the learning objective in each lesson with learners, making them aware of what they are expected to achieve by the end of the lesson. The SLOs (written in the first person) are directed at the learner.
- making learners aware of different learning styles; teaching learners techniques for learning new content using visual, auditory and kinaesthetic modes of learning and varying teaching strategies to cater for visual, auditory and kinaesthetic learners.
- teaching learners how to be less dependent on the teacher. For example, how do they get themselves 'unstuck' if they are stuck?

Use group work to:

- allow for reinforcement and extension (by using flexible groups).
- encourage learners to engage in Social Learning and to appreciate diverse viewpoints and personalities; build confidence in discussing their views with others; collaborate with other learners as part of their learning; seek out guidance and support from other learners; talk with others about learning; listen to others talk about learning and discuss various subjects and learning strategies with peers (by using mixed ability groups).

Gardner (1981) states: 'I don't care what intelligence people have. I care whether they can do things we value in our culture. What good is it to know if you have an IQ of 90 or 130… if in the end you can't do anything?' Gifted and talented children should get the chance to develop their full potential. Therefore activities should be aimed for gifted science learners in the areas where they show strength. These are likely to be in higher level thinking, creativity, independence in learning, group work and inquiry.

More assessment tools need to be used in the knowledge that learners will perform better when one tool is used over another, thus hopefully indicating where learning has happened. In choosing assessment procedures, educators should keep this in mind. In this way learners' ideas can be probed and the possibility of starting the teaching from the point where learners are becomes more realistic, so that assessment results can make more sense.

An inclusive approach to teaching and curriculum planning needs to be ensured. While the school will want to create an ethos of achievement for all learners, valuing a broad range of talents, abilities and achievements, the teacher will need to work out what that means in their classroom. At a basic level this starts with promoting success and self-esteem by taking action to remove barriers to learning, thus making sure that all learners in all groups thrive in the classroom. Teachers can overtly promote understanding and a positive appreciation of the diversity of individuals in their class and use the Diversity CCT as a catalyst for this approach extending it to include the learner directly.

Values- based education

Education is as much about building character as it is about equipping students with specific skills The way forward for the implementation of the framework is through values-based education. Values-based education refers to any explicit and/or implicit school-based activity which promotes student understanding and knowledge of values and which develops the skills and dispositions of students so they can enact particular values as individuals and as members of the wider community. It ensures that those leaving school should have qualities of self confidence, high self esteem, optimism and commitment to personal fulfilment as a foundation for their potential life roles as family, community and employees. Furthermore they should have the capacity to exercise judgement and responsibility in matters of ethical and social judgements.

Adapted from *Respect for All Framework,* Ministry for Education and Employment (2014:10)

Schools should have a vibrant and progressive culture, promoting well-being and respect, with ambition and achievement for all learners as its focus. This type of approach needs to be taken in each classroom. A great school is a caring school that supports every single person, irrespective of background or learning need. Such schools work in an atmosphere of unconditional positive regard. They work tirelessly to promote healthy and productive attitudes to learning, to life and to work. Developing an ethos of achievement and ambition defines the aspirational nature of successful schools, making the connection between expectation and success - success which covers all aspects of developing skills for life, for work and for learning - a hallmark of excellence.

From the perspective of the classroom, an inclusive approach addresses learners' needs through a variety of approaches including: early intervention strategies and a curriculum and approaches to learning and teaching which are designed to match the needs of all learners. Educators should have high expectations of their learners because they need to be encouraged to have high aspirations and goals for themselves. It is imperative that educators ensure that their learners know where they are in relation to their learning and how they can improve. Learners should be praised regularly, selectively and effectively to keep motivated.

As learners progress within the levels and between levels they should be encouraged to reflect on, take increasing ownership of and assume more responsibility for their own learning. Educators should start to introduce techniques to allow learners to make increasingly greater use of self-assessment to identify their strengths and development needs from the evidence of their efforts and act on feedback given from peers as well as educators in order to plan their next steps.

D. TEACHING DIFFERENT LEVELS WITHIN ONE YEAR GROUP

There will be learners within each class that need more time to be able to achieve the learning needed to demonstrate achievement of the SLOs. As learners progress through their learning journey they may move to a new year and start a new level but still have areas of unsecured learning from the previous level. The first important factor here is clarity of information on progress following this learner that makes it clear to their new teacher what support or additional work they may need to ensure that they can progress on to the new level.

Section C *Reaching different learners within each level* referred to the use of a range of strategies designed to respond to the different learning preferences of each learner. Where learners are entering the class in need of support to secure some aspects of the previous level it is important that:

- there is clear information about where the areas in need of support are.
- it is clear how these areas relate to progression and achievement in the new level.
- there are a range of strategies and learning devices available to match the learning style to the learner preference to assist with early progression.
- conversation with the learner about areas in need of support or reinforcement remains positive, learner-affirming and constructive.

One of the benefits of the LOF structure is that Levels 7 and 8 are delivered across two-year curriculum windows allowing time to develop learning programmes and deploy a range of learning methods to help learners progress and achieve.

There are a few models to consider when looking at introducing a measure of stretch for learners able to achieve SLOs well within the delivery time associated with the level. Educators may want to consider:

- exploring the SLOs in a broader and/or deeper way, perhaps looking to transfer or apply learning associated with the SLOs in new contexts.
- using more exacting or challenging texts.
- adding stretch by setting more challenging or complex tasks which exposes the learner to more challenging texts and vocabulary or introduces new Subject Foci or new areas of existing Subject Foci, remembering that the SLOs do not set a ceiling on the learning.
- looking at opportunities offered by the CCTs as sources of inspiration for introducing new areas of content to provide additional curriculum content that both enhances the subject learning experience and looks at CCT content in perhaps different or more challenging ways.

One other key source of material related to provision of additional challenge or stretch is the Subject Foci and SLOs from the level above. While it may not always be appropriate to begin to address these directly, educators may want to look at the contextual learning or preparation work that serves as a good introduction to learning at the next level. The focus here is on looking at the bridges between the learning in each level and how the learner can begin to access this learning. In this type of approach, as with the other areas of extension work, it will be important to keep a proper record of achievement to be able to inform teaching staff working with the learners when they move formally to the next level.

Although the above suggestions will help educators address the challenges of differentiation, it is nevertheless acknowledged that it is hard to implement differentiated instruction in a heterogeneous classroom, especially if educators are not supported or they do not know what they are differentiating – the curriculum or the instructional methods used to deliver it. It is hence important to give teachers clear guidance and support on what they need to do to differentiate instruction and be responsive to the needs of each learner by taking into account what they are teaching and who they are teaching. Time should also be factored in for teachers to assess their learners' needs, interest and readiness levels and to plan and design appropriate activities for each learner. These concerns can be addressed through effective professional development that strongly encourages teachers to apply their skills and which provides coaching throughout the process of using differentiation as a teaching approach.

E. TEACHING ONE LEVEL ACROSS TWO YEAR GROUPS

Within the LOF, Levels 7 and 8 have an added additional layer of challenge in curriculum planning and design in that both levels run across two different years. For example, Level 8 SLOs sit across Years 9 and 10. This means that educators need to consider how they might want to structure the delivery programmes needed to achieve the SLOs that will allow learning to take place in a meaningful and coherent way across two years that capitalises on any progression opportunities within the level. However, this wider window to reach the standard of a level also helps deal with some of the challenges discussed in the previous chapter.

When looking at the content shaped by the SLOs within a level, educators may be able to identify SLOs that are considered to be prerequisites for others in the same level and structure the curriculum accordingly. Some Subject Foci may naturally be delivered before others or educators may look to design and implement a curriculum that has more of a spiral curriculum progression feel to it. Educators may even feel that there are different ways to work with the Subject Foci, wrapping them up and addressing the SLOs by creating new subject areas incorporating the Subject Foci.

There are at least three obvious potential approaches that educators may wish to consider:

- Developing a period of ground work or preparation style learning before proceeding on to the curriculum directly associated with the SLOs.
- Developing a developmental approach across the existing SLOs where some suitable Subject Foci and corresponding SLOs are addressed before others with these supporting the learning of the SLOs to be covered in the second year.
- Developing a curriculum and learning programme approach that exhibits a mixture of the above two approaches.

There are also the more ambitious approaches where the Subject Foci and SLOs are absorbed into a more locally designed approach that may meet the strengths and interests of the staff and learners in a better way. Educators have the freedom to decide if there is a more integrated way to deliver and learn the subject. The LOF allows educators this measure of control and innovation to the benefit of their learners. Whichever the method selected, curriculum planning, resource selection and the selection of teaching strategies will all be important.

Assessment

A. METHODOLOGIES THAT WILL ENSURE FIT FOR PURPOSE ASSESSMENT

Assessment should be well-designed, personalised and timely in order to guide the teaching and learning process. A mixture between assessment for learning, assessment as learning and assessment of learning is critical to the achievement of the learning outcomes designed for this subject.

Assessment for learning or ongoing assessment is the process of seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go and how best to get there (Western and Northern Canadian Protocol for Collaboration in Education, 2006). It involves formal and informal assessment activities as part of learning and to inform the planning of future learning. This should be achieved through:

- practical work and investigations that lend themselves to measure learner learning.
- pair or group work tasks.
- project work assessing learners' performance in different aspects of learning, such as knowing, reasoning, applying and communicating what they have learnt.
- 'profile of achievement' constructed as they progress throughout the years.
- inclusion of all learners.

Assessment as learning focusses on learners and emphasizes assessment as a process of metacognition (knowledge of one's own thought processes) for learners. For learners to be actively engaged in creating their own understanding, they must learn to be critical assessors who make sense of information, relate it to prior knowledge, and use it for new learning (Western and Northern Canadian Protocol for Collaboration in Education, 2006).This should derive from:

- well designed activities clearly stating learning goals to encourage growth and actively engaging learners.
- exploration experiences that provide learners with a common base of activities within which concepts (i.e., misconceptions), processes, and skills are identified and conceptual change is facilitated (Bybee et al., 2006).
- the explanation phase that focuses learners' attention on a particular aspect of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills, or behaviours (Bybee et al., 2006).
- challenges that extend learners' conceptual understanding and skills.

Assessment of learning or summative assessment refers to strategies designed to confirm what learners know, demonstrate whether or not they have met the learning outcomes or the goals of their individualised programmes, or certify proficiency and make decisions about the learners' future programmes or placements. Assessment of learning is the assessment that becomes public and results in statements or symbols about how well learners are learning. It often contributes to pivotal decisions that will affect learners' futures (Western and Northern Canadian Protocol for Collaboration in Education, 2006). The effectiveness of assessment of learning for grading or ranking depends on the validity and reliability of activities. This should include:

- assessment tasks that simulate real world problems and situations;
- valid, reliable, authentic worksheets/tests with clear marking criteria; and
- end of year exams.

Assessment

Assessment is an integral part of the learning and teaching process, providing students and their parents with continuous, timely and qualitative feedback about their children's progress, giving teachers' information about their practice and providing schools and colleges with information about their curriculum planning, learning and teaching.

Assessment *for* learning (assessment for formative purposes) is a process carried out as learning is taking place. Learners and their teachers use the outcomes to find what learners know and are able to do in relation to learning.

Assessment *of* learning (assessment for summative purposes) is carried out at the end of a unit, mid-year or at the end of the year.

Assessment *as* learning (ongoing assessment) is the use of ongoing self-assessment by learners in order to monitor their own learning.

In subjects that are taught as modules, assessment of learning will take place at the end of a module. Information and judgments about learning are pulled together in a summary form for purposes of reporting to parents and sharing information with other teachers in the next class or school. If learners are fully aware of what is expected of them (the learning intentions) and the success criteria against which their learning will be evaluated, they will develop the self-evaluation skills which will help them become self-directed learners.

Well-designed and appropriately implemented, classroom assessment processes can:

- support learners to use self-assessment to gauge their learning, identify their strengths, their learning needs and their next steps.
- encourage learners to support one another's learning through peer assessment.
- help teachers to understand children's learning better, use evidence to monitor learners' progress, reflect on their practice and adapt or match their teaching to their learners' needs.
- help teachers plan for the learning of individuals and groups and ensure that all children receive appropriate attention.
- support parents to share their children's learning experiences, interpret assessment information and follow their children's educational development.
- promote the reporting on individual progress and achievement in an incremental manner.

Colleges and schools are required to develop an assessment policy. The policy should seek to address the quantity and quality of assessment practices as well as reporting to parents and other stakeholders.

Adapted from *A National Curriculum Framework for All*, Ministry for Education and Employment (2012:41-42) and *Assessments as learning,* Lam (2015:1)

Learners and others involved in their learning need timely, accurate feedback about what they have learned and how much and how well they have learned it. This helps to identify what they need to do next and who can help them build up their knowledge, understanding and skills. A learner's progress should be assessed in ways and at times appropriate to their learning needs. Judgements made about this learning should be based on evidence from a broad range of sources, both in and out of school and by reference to a learner's progress over time and across a range of activities.

By planning for ongoing assessment opportunities and periodic testing, particularly where learners use their skills in an integrated way, educators will allow learners to demonstrate, over time, *how much* and *how well* they have learned.

A balance of ongoing and periodic assessment opportunities will require learners to demonstrate a body of learning built up over time and to apply their knowledge and skills in different contexts. Mixing a range of learner controlled formative assessment opportunities will allow the learners themselves gauge how they are progressing against individual or grouped SLOs.

Educators should look to gather a range of quality pieces of evidence to show progression in learning from both ongoing formative assessment opportunities and periodic, summative assessments. So apart from using the 'final' test, learners can be assessed as they work in the classroom. Classroom activities should be organised by the teacher who is expected to see the importance of putting emphasis on discussion, inquiry, drawings, analogy use for explanations and discussion, as well as mental representation ideas. These activities can all be used to assess reasoning and understanding.

The amount and range of evidence related to ability to reason and understand should be sufficient to build up a profile of the learner's achievement but also be proportionate and manageable. Learners should be involved in the selection of evidence. The evidence should show that the learner has understood a significant body of knowledge, has responded consistently well to challenging learning experiences and has been able to apply what they have learnt in new and unfamiliar contexts.

Learning, teaching and assessment should be designed in ways that reflect how different learners progress in order to motivate and encourage them in their learning. To support this, all learners should be involved in planning and reflecting on their own learning through formative assessment, self- and peer evaluation and personal learning planning. Once learners are given the chance to interact with their peers and receive constant feedback from their educator, they are ultimately guided to make decisions on how to improve their Physical Science knowledge and skills. The learners are thus given the chance to play an active role in self-assessment which encourages them to seek out personal goals for learning Physical Science. These types of assessments can be planned at particular points, such as the end of a thematic unit, whereby the learners can judge and review their own performance by means of a grid which states the intended learning outcomes vis-à-vis the level at which they have been attained.

Physical Science educators will need to have a clear understanding of how their own learners are progressing in relation to others in their school and in other schools in Malta, against the outcomes and experiences at different levels. Regular, planned opportunities for dialogue are to be facilitated by Education Officers to help educators reach a shared and consistent interpretation of meaning as they apply the SLOs.

The learner does not have to be secure in every outcome at one level in order to move onto the next. When appropriate, the learner should have the opportunity to engage in learning experiences at the next level. Educators should plan to give learners experience of all the outcomes, but should take a holistic view. When learners have had a deep learning experience at one level, they should move on to the next.

Educators must ensure that their view of what a learner has achieved is supported by sound evidence. Their evaluation of this evidence must be consistent with the evaluations of colleagues in their own or another department

or centre. Centres should plan together and use their professional judgement in coming to a shared understanding of what it means to achieve a level. Emerging national guidance will support this process. Moderation is particularly important at times of transition from one level to the next and in transitions between Middle and Secondary Years.

The delivery of the learning associated with the CCTs and the associated assessment is the responsibility of all educators.

Improving the quality of teaching and learning also implies fostering a culture which ensures the transparency of quality assessment outcomes and having in place approaches, structures and roles played by internal and external school evaluation systems.

> *Quality assurance in education can be understood as policies, procedures, and practices that are designed to achieve, maintain or enhance quality in specific areas, and that rely on an evaluation process … [that is] a general process of systematic and critical analysis of a defined subject that includes the collection of relevant data and leads to judgements and/or recommendations for improvement. The evaluation can focus on various subjects: schools, school heads, teachers and other educational staff, programmes, local authorities, or the performance of the whole education system.*
>
> *Assuring Quality in Education: Policies and Approaches to School Evaluation in Europe,* European Commission (2015a:13)

Schools will need to begin to develop new quality assurance procedures, while enhancing existing ones, to support the introduction of the LOF and to secure its successful implementation in classrooms. This will need to be part of a whole-school implementation and quality strategy that could include opportunities for:

- Senior Management Teams taking an active interest in teacher CPD, monitoring teacher confidence levels and learner progress, e.g. sampling learners' work and leading whole-school self-evaluations.
- Heads of Schools creating shared preparation and planning time to help facilitate collaborative working.
- standards and expectations sharing through displaying learners' work aligned to levels to show progression, for example in work displayed on a 'learning wall'.
- staff engaging children and young people in discussions about progress and target-setting as part of planning to meet their learning needs.
- development of whole-school approaches to learning and assessment of CCTs.
- clear reporting strategies for feedback on progress within the school and outside the school, e.g. parents and guardians.

In Science Departments (in addition to the activities listed above), educators will need to be engaged in:

- regular departmental meetings to plan learning, teaching and assessment in a coherent way, with colleagues sharing effective strategies which they see as improving learning and achievement of learners.
- collaborative planning with other teachers, peer review and discussion of standards and expectations when teaching learners at the same level.
- cross-marking end of topic tests, periodic assessments and other internal assessments by marking learner work from other classes or groups, educators can engage in professional dialogue about the nature of the assessment, its fitness for purpose and the learner results.
- design of assessment materials, marking schemes and reporting strategies in collaboration with other teachers within the department or with appropriate staff in neighbouring schools.
- adopting strategies to avoid pre-judging outcomes, for example marking learners' work without knowing who the learner is.
- professional dialogue around learners' work that has been pre-marked to help reach an agreed view on quality and standards.
- Communities of Practice to share and/or strengthen their professional practice, focusing on sufficiency in assessment, consistency in interpreting SLOs, reporting progress to learners, parents and guardians and other teachers.

The Directorate for Quality and Standards in Education (DQSE) will ensure that:

- Education Officers carry out quality assurance visits to validate accuracy of each school's self-evaluation evidence and sample quality and consistency of the learning, teaching and assessment.
- staff members collate and analyse a range of local and national data to be used as the basis of discussion with Heads of Schools, Deputies and Faculty Heads/Principals to inform planning for improvement of learners' achievements.
- where good practice is identified, Education Officers, School Management Teams and other key personnel organise good practice events for staff across schools within the authority to disseminate good practice.

It is here being acknowledged that any feedback coming from schools, including that yielded from assessment, should reflect the wider objectives of education. Moreover, Quality Assurance conclusions will not automatically impact on the performance of schools. Schools need more than information on their performance – they also need guidance on how to improve and support, while attempting such improvement. The ultimate aim of quality assurance procedures should be to provide schools with an appropriate, coherent and comprehensive evaluation strategy which has a positive impact on the school leadership team and on the quality of teaching and learning.

B. INCLUSIVE ASSESSMENT METHODOLOGIES

To help allow vibrant and diverse classrooms to thrive and demonstrate their learning potential educators need to ensure that assessment in the classroom is fair and inclusive, allowing every learner to show what they have achieved and how well they are progressing. Educators can ensure that assessment meets all learners' needs by providing each learner with appropriate support, employing a range of assessment methods and options and, in doing so, affording all learners the best chance of success. This will mean using performance and assessment information from a variety of sources to monitor progress and to inform what needs to happen next in the learning journey.

Educators need to be aware of, and work to, the relevant legislative frameworks that support learners experiencing barriers to learning. Barriers may exist as a result of family circumstances, disability or health needs and social or emotional factors. Where these circumstances occur, learners are entitled to have their additional support needs recognised and supported at the earliest possible stage – by the school, educational authorities and / or the state. Assessment strategies will be effective when educators use a range of assessment approaches flexibly to identify strengths, learning and support needs for vulnerable, disengaged and hard-to-reach learners in their classrooms.

Supporting vulnerable learners
Supporting vulnerable learners may mean using planning tools such as personal learning plans or multi-agency coordinated support plans. Educators need to place the learner at the centre to ensure each learner with additional or diverse learning needs can achieve positive and sustained educational outcomes.

While schools need to consider which approaches will be most effective in helping to remove barriers to learning resulting from social and emotional circumstances including, for example, challenging behaviour, educators need to consider how these whole-school policies translate into action in the classroom.

Assessment planning and the resulting approaches taken (and instruments and methods used) need to ensure that all learners have an equal opportunity to demonstrate what they have learned and what they can do. Educators also need to consider what 'reasonable adjustments' to assessment approaches for disabled learners may look like in assessing ability. This may involve using appropriate assistive technologies. Given that good assessment practice is a key feature of teaching and learning, approaches used to help assess an individual learner's progress need to be as far as possible consistent with those used in the learning itself.

The principle of the continuum of achievement should be such that it allows a learner to follow the best pathway that will allow him or her to reach the maximum of his or her potential - irrespective of whether the student is a high flyer, has average abilities, basic abilities and/or has a disability. In this regard the NCF sought to establish a framework that ensures that, as far as possible, no student becomes a casualty of an education system that is unable to identify those learners who require encouragement and guidance. Equally importantly, the NCF allows for the introduction of different pathways that will truly allow a learner to develop his or her abilities in the manner best suited for him or her.

Adapted from *A National Curriculum Framework for All*, Ministry for Education and Employment (2012:5)

C. RELIABLE AND VALID WAYS OF ASSESSMENT

Assessment will involve planning high quality interactions with learners and will be based on thoughtful and probing questions drawn from the SLOs and designed to ascertain the extent to which the outcomes have been achieved. Learners will be clear about the kind and quality of work required to achieve success in the SLOs. The methods of assessment used need to reflect the nature of what is being assessed.

In the periods between formal assessment interventions individual learners should be encouraged to ask for and should be given timely feedback about the quality of their work that they can understand, reflect on and ask questions about. Educators should strive to encourage the learner's active engagement in discussion about their work and progress, and suggest the steps they can take to improve their performance.

Educators should seek to empower learners to develop the skills to evaluate their own and each other's work against the SLOs, encouraging them to develop an appreciation of their own learning needs, how well they are progressing towards achieving the standard exemplified by the SLOs and the types of action they need to take to improve their progress.

The SLOs have been written in a way that is designed to ensure that the learning expectation is clear. They also act like an anchor for any and all related assessment activity by defining the learning that is in scope for assessment activity and by omission being clear about what is not in scope. This makes the assessment process and assessment expectations more transparent for the learner. At times SLOs involve an additional layer of detail delivered through the use of exemplification to illustrate the nature of the challenge within the SLO or through a clear statement of what must be included as a minimum in addressing the learning associated with the SLO.

Where there is exemplification, the example given is designed to be indicative of the degree of difficulty or challenge expected to be reached in the SLO. The example adds a further layer of detail and clarity so the educator knows the standard the learner should be looking to achieve.

What the assessment should really be trying to establish is whether the learners have reached the standard of the SLO. Can they do what the SLO says they can do? Can they demonstrate the ability to do what the SLO claims for them and can they do it routinely, confidently and comfortably? Here the educator's professional judgement and the professional agreement on what constitutes achievement is important.

The assessment standard is not necessarily what is stated in the SLO. The standard is the shared and consistently applied interpretation of what acceptable learner performance in response to the SLO looks like. In order to reach this judgement, educators will need to work within the subject teaching community to agree what achievement looks like at each of the levels (e.g. Level 8), at the level of the Subject Foci within a level and at the level of an SLO where this is not immediately apparent and there is scope for ambiguity or interpretation.

Assessment within the LOFs will need to be subject to robust quality assurance procedures that are designed to instil confidence in teachers' assessment judgements and assure parents, guardians and other stakeholders that all learners will receive appropriate recognition for their achievements in line with the agreed national standards and that learners are making the appropriate progress in line with expectations.

Where assessment is for high stakes qualifications and external certification, particular safeguards are required to guarantee fairness to all young people and to provide assurance to parents and guardians, MCAST, the University of Malta and employers that the system is robust. To that end MATSEC will produce clear assessment plans for Level 9 and 10 assessment, detailing the balance between high-stakes external assessment and internal assessment procedures and quality assurance.

As learners approach points of transition (for example, across Levels) it is important to have rigorous and robust assessment and related quality assurance procedures in place in order to ensure that there is a reliable system for sharing information about progress and achievements. Again, MATSEC and/or DQSE will be responsible for producing the guidance documentation detailing the policy and procedures for any transition assessment arrangements involving high-stakes or external assessment.

Working the room: Measuring the impact of the teaching

This whole-class assessment technique can be used with Level 8 and 9 learners. Challenge stations are set up around the room, a sufficient number to split the class into groups of 3-5 with a different challenge presented to each group. The challenges should be related to what has recently been taught in class and should be based on two or three distinct learning outcomes. The groups should be balanced out evenly in terms of ability, with the addition of the elements of time and reward to keep motivation up and maintain the competitive spirit. The assessment of the activity will provide a good idea of how the whole class has understood what has been taught.

Adapted from *Designing Effective Activity Centers for Diverse Learners: A Guide for Teachers at All Grade Levels and for all Subject Areas,* Hilberg, Chang and Epaloose (2003)

D. ASSESSING CROSS CURRICULAR THEMES

The embedded CCTs within the SLOs are for guidance purposes only. As already indicated, the teacher may have better ideas of where, when and how to embed particular aspects of the CCTs.

The CCT icon in embedded SLOs is followed by a sub-heading from the CCT. This indicates the particular area of content that seems most appropriate for embedding within the delivery of the SLO.

The guidance about CCTs also describes how CCTs can be addressed through the choice of pedagogy or delivery style, classroom activity or approach to learning. Some may also be addressed through the introduction of whole-school or year group, curriculum enrichment activities or the adoption of particular sets of behaviours within the school community. The flexibility and freedom to decide upon and select which methods, opportunities and aspects of the CCTs are addressed when, where and how is entirely a subjective one. The aim is to ensure that the learners, through the course of their learning journey through the LOF, come into contact with the key learning associated with all the CCTs in significant and meaningful ways. The role of the CCTs is to yield resilient, adaptable, empowered young people with the robust, transferable skills the country needs to remain caring, inclusive, competitive and productive. This needs to be kept in mind when looking at the overall implementation and embedding of CCTs in the curricula.

This open and flexible approach to where, when and how CCTs are addressed is a challenge when it comes to trying to prescribe assessment approaches. While the lack of uniformity and consistency of when, where and how to embed CCTs in the LOF and in each subject area is attractive from a flexible delivery viewpoint, it represents a challenge in assessment from a standardisation standpoint.

The guidance around assessment of CCTs is simply to ensure that:

- the impact of the embedding strategy adopted at the classroom, departmental and school level is known and understood in terms of what has been learned.
- there is communication between schools, tutors and class teachers about the progress learners have made in coverage and acquisition of the CCT content.
- learners engage with each of the six CCTs with sufficient frequency, meaning and depth to allow them to achieve the key competencies they cover and to benefit from the new learning and skills each CCT introduces.

In each subject, educators may find it most beneficial to work with peers to determine the best-fit CCT opportunities, creating a support community to share development of resources and to help agree a consistent approach to teaching and assessment expectations when it comes to embedding the CCTs. Within this support community one can attempt to:

- agree which teaching approaches lend themselves to particular CCTs.
- share ideas and resource development.
- develop project-based approaches to SLO delivery that are enhanced by CCT inclusion.
- standardise assessment expectations around CCTs.

E. REPORTING PROGRESS

Learner and Parent/Guardian Reporting

Reporting on learning and progress should offer learners, parents, guardians and teachers insight into what learning expectations have been set, how the learner is progressing in relation to these learning expectations and how the learner can do what needs to be done to ensure continued progress and improvement as they go forward with their learning. Reporting should always be constructive, insightful and able to be used to stimulate meaningful discussion between the teacher, learner and their parent or guardian. It should, at the same time, be reflective, looking back at achievement, and forward-looking, focusing on improvement.

The LOF offers local flexibility for schools to decide how best to report information on learner progress, achievements and next steps within a clear set of national expectations. How frequent and what form such reporting takes are also decisions to be taken at the school and college level.

National expectations for reporting

Reporting will provide the learner, their parents or guardians with information on progress and achievement in each subject that includes:

- constructive, insightful and clear feedback throughout the learning experience.
- feedback on the learner's particular strengths, areas for development and completed achievements.
- feedback on the different curriculum areas.
- the particular support the learner is receiving to help them progress.
- attitude of the learner to learning.
- how home can play an active part in supporting the learning process.
- an opportunity to capture the learner's voice.
- an opportunity for parents/guardians to respond directly to the reporting feedback.

It is important that the reporting structure used is manageable for teachers.

Reporting is based upon the assessment of progress and there is a balance to be struck between how often assessment of progress is made and how often this progress is recorded and communicated to the learner and the parent/guardian. The reporting needs of the two groups are different:

- Learners should be receiving feedback on progress on an ongoing basis as a routine part of the learning and assessment process. The use of formative assessment (often called Assessment for Learning) should be a routine part of any assessment strategy. This makes this type of reporting frequent and continual.
- Parents and guardians need to be kept informed of their child's progress at key points in the learning journey where there needs to be feedback given around achievement and a discussion instigated between home and school about how further progress and improvement can be made. This makes this reporting much less frequent but recurring. At the very least, achievement of a level should be reported every time a level is achieved.

Reporting process
It is important to set up a process by which learners can take some ownership of what is reported. Educators should consider working with learners to determine which evidence should be drawn upon to summarise learning and progress for the purposes of reporting. This will invite reflection and dialogue about their learning and will be a useful opportunity to help the learner engage more deeply and meaningfully in discussion about their own learning. This type of dialogue will not restrict or impinge upon educators' professional judgements but will offer them some insight into the learner point of view and may help deepen their understanding of the impact of their own learning strategies.

The LOF offers the ability to report progress within the subject at different levels of detail. Each subject is broken down into levels, containing Subject Foci and each Subject Focus is further broken down into SLOs. With the SLOs making the outcomes of learning explicit, it will be important to establish what the learner, parent/guardian needs to know about progress against the SLOs and what can feasibly be shared, how often and when. Educators will first need to separate out internal reporting needs to chart a learner's progress, so that this can be shared with other teachers as they progress in other subjects, to benchmark progress more widely. Different audiences will need different details about learner progress.

The school and the relevant department need to set the policy on how they intend to report.

Internal Reporting

In order to maximise the opportunities that the LOF brings in terms of flexibility and freedom to help learners progress towards the learning expectations, the teacher will need to have a detailed appreciation of what the learner has already achieved and just how they relate to the learning expectations that the teacher is responsible for teaching. The teacher who comes next will also expect an appraisal of learner performance. It will be important to establish, through discussion with colleagues, how best to manage this internal communication and reporting in order to ensure a balance between what is helpful and insightful in assisting with the transition process and what is unwieldy, onerous and unmanageable.

It is important to remember that the detail that can be created around individual performance does not necessitate or promote an individualised teaching programme for each learner. Instead it is there to be used to facilitate a more responsive approach to curriculum design and more appropriate selection of teaching strategies and resource selection within the class.

As learners progress through the LOF, moving from level to level, year to year and class to class they will progress at different rates. This represents a challenge if learning is to remain fluid and continuous and progression is to be uninterrupted. That said, the Subject Foci and SLOs allow teachers to profile progress and achievement and to communicate that progress in a regular manner, indicating where the learner sits in relation to the overall expectations of a level, even indicating where there is some achievement beyond the level. The school is given the flexibility to decide how best it wants to communicate learner progress within the school and between those responsible for their learning and progression. Within the subject teaching team it will be important to identify an approach that is functional and clear within the subject and will ultimately maximise the Learning Outcome Framework's ability to chart progress in detail and in a personalised, learner-centric way.

A simple Achieved/Not Yet Achieved is clear feedback, yet it does not convey how close or far from being able to demonstrate achievement of the SLO the learner is. Educators may find it useful to come up with a convention that does more than just use a binary method of reporting achievement. Communicating more information about how a learner is relating to a particular level helps instigate discussion of where there may be particular learning challenges or where a learner has only started the learning associated with particular Learning Outcomes.

Evidence informing reporting should be drawn from a range of sources, including formal and informal assessment interventions, and educators should apply their professional judgement to a sufficient and robust body of evidence that allows them to report with confidence about progress made against a significant body of learning. Formal summative assessment interventions need to be subject to collaborative design and development and feature a measure of quality assurance and moderation to ensure what is reported is benchmarked against a wider understanding of the national standard.

How it is done elsewhere

The Scottish *Curriculum for Excellence* frames progression in relation to the learning expectations as developing, consolidating or having secured the learning objectives. These are not rigid categories but signposts indicating where the learner sits in relation to the expectations.

Typically, a learner who has started to engage in the work of a new level or area and starting to make progress in an increasing number of outcomes is at the Developing stage.

Once the learner has achieved a measure of breadth across the Subject Foci; can apply the learning in familiar situations; is beginning to show increased confidence by engaging in more challenging learning; and is starting to transfer their learning to less familiar contexts, they are engaged in a process of Consolidation.

Once significant achievement across the Subject Foci and outcomes has been recorded and there has been consistent success in meeting the level of challenge within the outcomes; learners are engaged in more challenging work; and are confidently transferring their learning and applying it in new and unfamiliar situations, their position in relation to expectations is viewed as Secure.

Adapted from *Building the Curriculum 5, A Framework for Assessment: Reporting,*
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Appendix

Digital Literacy

Digital literacy has become essential for learning and life. Besides cutting across various disciplines it must now be considered as being a discipline of its own such as music, art, science and literature. Digital literacy education seeks to equip learners with the competencies (knowledge, skills and attitudes) in the use of digital technology needed to access learning opportunities, to pursue their chosen careers and leisure interests and to contribute to society as active citizens. It also aims to provide them with knowledge of the principles underpinning these technologies and a critical understanding of the implications of digital technology for individuals and societies.

Digitally literate learners learn to become independent, confident and discerning users of technology. Subsequently they acquire and develop critical and analytical attitudes to appropriately choose the right digital tools according to specific needs.

Digital literacy includes five categories of digital competencies, namely: Information Management, Communication and Collaboration, Digital Media, Using Digital Tools for Learning, Management of the Internet.

The competence in information management enables learners with the means to access, evaluate and analyse and hence make an informed choice from a range of available data and information sources. Competencies relating to Communication and Collaboration empower learners to learn to communicate, collaborate and network with others. Competencies in Digital Media enable learners to analyse messages mediated by digital media and to express themselves creatively across a range of digital media.

Digital literacy also involves competence in using digital tools in various media and in different modes of learning (autonomous, collaborative, exploratory, designing). Digitally literate learners will learn to be responsible and competent in managing the internet, keeping themselves safe and secure online, making informed choices over privacy, taking responsibility for their actions, respecting intellectual property, abiding by the terms and conditions of systems they use and respecting the rights and feelings of others. In teaching digital literacy, teachers should look for authentic, meaningful and socially inclusive learning opportunities which allow learners to apply and develop their skills, knowledge and understanding across the curriculum. Digitally literate learners should be able to undertake challenging creative projects, both individually and collaboratively comprising aspects from different competence categories.

Theme Learning Outcomes:

Information Management

- I am able to identify and articulate my information needs.
- I can find, select, use and combine information from a range of sources.
- I can safely and critically navigate between online sources and select information effectively
- I can navigate between online sources and select information effectively.
- I can create personal information strategies.

Communication

- I can communicate through a variety of digital devices and applications.
- I can adapt my communication modes and strategies according to the people I am communicating with.
- I can use different digital tools to share knowledge, content and resources.
- I can help others to share knowledge, content and resources.
- I know how to quote other people's work and to integrate new information into an existing body of knowledge.
- I can engage with on-line learning communities effectively.
- I can use digital technologies to participate in online citizenship.

Collaboration

- I can use technologies and media to work in teams and collaborate in learning.
- I can collaborate with others and co-construct and co-create resources, knowledge and learning.
- I can function well in digitally mediated Communities of Practice

Use of Digital Media

- I can review, revise and evaluate information presented in a range of digital media.
- I understand both how and why messages in digital media are constructed and for what purposes.
- I can examine how individuals interpret messages in digital media differently.
- I understand how values and points of view are included or excluded and how digital media can influence beliefs and behaviours.
- I understand the ethical / legal issues surrounding the access and use of digital media, including copyright, ownership, licensing and use of proprietary content or software.
- I can work creatively across a range of digital media and multiple systems to present information effectively to a given audience.
- I can edit and improve content that I had already created or that others have created, respecting and acknowledging the rights of the original author.
- I can express myself through digital media and technologies.

Managing Learning

- I can use various tools to manage my own learning.
- I can use various tools and approaches to collaborate with others in learning.
- I can use various tools to explore ideas, theories, relationships and procedures.
- I can use various tools to learn by designing digital objects.
- I can use various tools and approaches to reflect on learning.
- I can use various tools and approaches to evaluate what I have learnt.
- I can build and assess e-portfolios.
- I can work on multiple eLearning management systems and platforms.

Managing Internet Use

- I understand how the internet and the world wide web work and can use them for communication and collaboration.
- I am aware of and abide by the principles of netiquette.
- I know what constitutes plagiarism.
- I can protect my devices from online risks and threats.
- I can protect myself and others from possible online dangers (e.g. cyber bullying) by following appropriate privacy and confidentiality procedures.
- I am able to consider the social, cultural, religious and ethical implications of digital technology and can confidently communicate, share information, access and distribute content without infringing upon other peoples' intellectual property.
- I am aware of cultural diversity online.
- I can develop active strategies to discover inappropriate behaviour.
- I can create, adapt and manage one or multiple digital identities.
- I can protect my e-reputation.
- I can manage the data that I produce through several online accounts and applications to avoid health risks related with the use of technology in terms of threats to physical and psychological well-being.
- I recognise Cloud Computing as a converging technology on which I can work and save my material.

Education for Diversity

The National Curriculum Framework (NCF) acknowledges Malta's cultural diversity and values the history and traditions of its people. It acknowledges and respects individual differences of gender, colour, ethnic and social origin, language, religion or belief, political or any other opinion, membership of a national minority, birth, ableism, age or sexual orientation and geographical location. A curriculum that acknowledges the fact that diversity is a feature of Maltese society, as it is of nations across Europe and the world, that can contribute to national prosperity and social cohesion.

As a member state within the United Nations, Malta is a signatory to international human rights instruments including the Universal Declaration of Human Rights (1948), the European Convention for the Protection of Human Rights and Fundamental Freedoms (1950), the International Covenant on Civil and Political Rights (1966), the International Covenenant on Economic, Social and Cultural Rights (1966) and the UN Convention on the Rights of the Child (1989). As a member of the European Union, Malta is legally bound by the EU Charter of Fundamental Rights.

These instruments set out international standards and commit Malta's government and people to democracy and to acknowledging that citizens and other residents have, and should enjoy, human rights without discrimination.

Consequently the NCF aims to help children acknowledge social justice and solidarity as key values in the development of the Maltese society and encourage young people to uphold fundamental democratic values and promote social justice.

Education for Diversity promotes an inclusive educational culture and challenges various educational processes such as decision making within schools, languages of instruction, methodologies used, learner interaction and learning resources. Education for Diversity ensures the inclusion of multiple perspectives and voices within the learning environment, provides spaces for learning about the languages, histories, traditions and cultures of non-dominant groups in a society, encourages team work and cooperative learning in multicultural, multi-ethnic and other diverse contexts, combines traditional and local knowledge and know-how with advanced science and technology and values the practice of multilingualism. In doing so, it encourages an understanding of global issues and the need for living together with different cultures and values.

Theme Learning Outcomes:

Self Awareness

- I am a person committed to democracy and understand that this means ensuring people of different views and cultures have their say and work together for a better society.
- I have a principled and ethical approach to life.
- I am committed to social justice and a democratic and inclusive society.
- I reserve judgement so that it may be made on a fair and rational basis.
- I strive to strike a balance between my rights and duties and those of others.

Social Change

- I uphold fundamental democratic values and work to promote social justice.
- I respect the different religious and humanist convictions, morals and beliefs that inform people's conceptions of right and wrong.
- I recognise unfairness, injustice and preferential treatment in daily life situations including racist, sexist and homophobic language and behaviour.
- I challenge expressions of prejudice and intolerance towards minorities such as racist, sexist and homophobic names, anecdotes and comments.
- I claim my rights and act on my duties knowing that my fellow learners and teachers have equal entitlement to their rights.
- I appreciate that the notion of 'identity' is complex and changing and limited as a concept in capturing who I am and that the idea of 'identities' is a more powerful way of understanding who I am and who others are.
- I attend and respond to my teachers and fellow learners and accept that they may have different points of view.

Communicating for Diversity

- I communicate with, work with and respect all of my fellow learners, teachers and adult helpers.
- I communicate with people who are different to understand how we are the same and to understand myself better.
- I strive to communicate effectively with others in a constructive, supportive and self-determined way.
- I can use effective language to challenge injustices and inequalities.
- I approach differences of opinion and conflicts of interest through dialogue, non-violent communication and consensus; where this fails, I am willing and able to use mediation.

Education for Entrepreneurship, Creativity and Innovation

While entrepreneurship, creativity and innovation can potentially be seen as being discrete attributes, it is perhaps more strategic to consider them as mutually reinforcing features of a more cohesive and singular aim: to ensure that the future citizens of Malta have the wherewithal to contribute to the sustainable prosperity of the nation in an increasingly competitive global economic and social contexts. The goals include the four main competence areas of personal and interpersonal skills, practical and cognitive skills. This more strategic vision reinforces the need for an approach to Entrepreneurship, Innovation and Creativity that permeates all aspects of the curriculum, while being clearly signposted to ensure that learners' entitlements are being met and that learning and teaching in relation to these themes can be quality assured.

The overall goals of entrepreneurship education are to give learners the attitudes, knowledge and capacity to act in an entrepreneurial way and to acquire the skills that will promote their lifelong employability in a rapidly changing commercial, economic and social environment. This includes becoming entrepreneurial citizens in other spheres beyond industry or employability. These goals require the development of the 'soft' generic personal and interpersonal skills fundamental to becoming entrepreneurial, as well as the fostering of the more discrete entrepreneurial knowledge and understanding required to pursue entrepreneurial endeavours and to possess an entrepreneurial mindset which is both creative and innovative.

Creativity is generally recognised as both an innate yet often under-developed quality in young people, as well as a practical skill that helps to unlock an entrepreneurial disposition. It is a skill that can be taught and that everyone can aspire to. It involves opening up young peoples' thinking processes in ways that help them to look at familiar things with a fresh eye, to identify and frame a problem and to generate solutions whilst using their imagination, knowledge and skills to explore new possibilities rather than established approaches.

The ability to be innovative and the confidence to look for innovative responses to opportunities or problems encountered is best nurtured in a safe, supportive environment where this type of approach is encouraged, recognised and rewarded. Such a pedagogy requires allowing learners time to reflect on a situation and tap their resources and imagination to develop plans and solutions. It also requires time for implementation of new processes and the application of new ideas. Teaching and learning for innovation might even include space to 'learn from failure'.

Theme Learning Outcomes:

Personal

- I can work effectively on my own.
- I am resilient and can perservere.
- I understand the importance of nurturing a positive self-image, self-esteem and self confidence.
- I recognise the importance of integrity and ethical values.

Interpersonal

- I know how to communicate my proposed strategies to others effectively.
- I am able to contribute to a team.
- I am able to take the lead.

Cognitive

- I am able to solve problems imaginatively and laterally.
- I am able to think critically.
- I am able to consider different perspectives.
- I can recognise that entrepreneurship and innovation should be underpinned by ethics and values relating to social justice and sustainability.

Practical

- I can turn creative ideas into action.
- I have a basic set of research skills.
- I am able to audit my own skills and interests in order to consider future academic and vocational career choices.
- I appreciate the importance that creativity and entrepreneurship have played in the development and progress of human society.

Education for Sustainable Development

Education for Sustainable Development (ESD) helps learners to develop the necessary competences (knowledge, skills, values, attitudes and behaviour) that enable them to become sustainable citizens. ESD empowers individuals to actively participate in decision making processes which are compatible with living within the environmental limits of our planet in a just, diverse, equitable and peaceful society.

ESD seeks to ensure that learners:

- Develop a sense of identity and belonging to their local, national, regional and global community.
- Are empowered to adopt their roles and responsibilities within a globally interdependent world.
- Understand and are empowered to address the real causes and consequences of unsustainable behaviour within the context of an interdependent and globalised world.
- Develop a future-oriented perspective that highlights the significance of their decisions, choices and actions on the quality of life of present and future generations.
- Are exposed to diverse learning environments using a broad array of educational experiences.
- Develop a holistic concept of the environment involving natural, social, economic, physical and cultural perspectives.
- Value and respect social, cultural and ecological diversity.
- Are committed to action to bring about change.

ESD should be achieved through a whole-school approach that involves the reorientation not only of the curriculum, but also of the school culture, the school campus management, the school community and the wider local community in line with sustainable development.

Learners should experience ESD through transformative pedagogies that facilitate ESD teaching and learning experiences that promote the acquisition of the knowledge, skills, values, attitudes and behaviours necessary to become active global citizens.

ESD should be a lifelong learning process involving a blend of learner-centred processes, such as participatory/ collaborative learning; problem-based learning; inter-disciplinary learning; multi-stakeholder social learning; critical and systemic thinking-based learning; action learning; learning outside the classroom; experiential learning; reflective evaluation and using relevant real-world contexts.

Theme Learning Outcomes:

Learning to Know

- I can explain how the natural, social, cultural and economic systems work and are interrelated.
- I can describe my role as a citizen within the local, national, regional and global context.
- I can recognise the relationship between understanding others and the wellbeing of all in the present and the future.
- I can identify the root causes of inequality and injustice and actions that lead to a better quality of life, equity, solidarity and environmental sustainability.
- I can justify the importance of identifying problems, reflecting critically, thinking creatively and having a wider vision in order to plan for the future and become an effective agent of change.
- I can recognise the importance of lifelong learning and use such learning experiences to approach new challenges and be in a better position to take informed decisions and evaluate their consequences.

Learning to Do

- I can communicate my ideas and present my opinions in thoughtful and informed discussions and decision making processes.
- I can critically assess processes of change in society and envision a more equitable and sustainable world.
- I can identify priorities and evaluate potential consequences of different decisions and actions.
- I am able to collaborate with people having different perspectives on dilemmas, issues, tensions and conflicts from different disciplines/places/cultures/generations.
- I can use the natural, social and built environment that surrounds me, as a context and source of learning.
- I can involve myself and others in real-world issues to bring about a positive difference.

Learning to Be

- I am a critically reflective person and am able to evaluate decisions, choices and actions.
- I am responsible for my actions and capable of anticipating, adapting to and facing change.
- I can reflect upon the consequences of my actions on present and future generations.
- I am sensitive to divergent disciplines and perspectives, cultures and minority groups, including indigenous knowledge and worldviews without prejudices and preconceptions.
- I am motivated to make a positive contribution to other people and their social and natural environment, locally and globally.
- I am able to creatively and innovatively take considered action and challenge assumptions underlying unsustainable practice.

Learning to Live Together

- I can live in harmony with myself, others and the natural world at a range of levels from the local to the global.
- I respect and value diversity and challenge social injustice.
- I have a future-oriented perspective for how I live my life as a citizen of the world.
- I actively engage myself with different groups across generations, cultures, places and disciplines.
- I can actively participate in processes and encourage negotiations for alternative sustainable futures.
- I will help others clarify diverse worldviews through dialogue and recognize that alternative frameworks exist.
- I will challenge unsustainable practices across educational systems, including at the institutional level.

Learning to Learn & Cooperative Learning

The aims of Learning to Learn are for learners to:

- Focus on learning processes as well as final performances.
- Hold a rich conception of learning and based on a personal conviction to manage own learning.
- Acquire a wide range of strategies for learning.
- Develop strategies to plan, monitor and review their own learning.
- Become competent in self-assessment.

Theme Learning Outcomes:

Social Learning

- I can appreciate diverse viewpoints and personalities.
- I am confident in discussing my views with others.
- I can follow the ideas of others and comment on their views.
- I can follow group discussions and collaboration and summarise what is being said or done.
- I collaborate with other learners as part of my learning.
- I learn by designing products with others.
- I seek out and am open for guidance and support from peers and adults.
- I am able to talk with others about learning.
- I listen to others talk about learning.
- I can discuss various subjects and learning strategies with peers.
- I can debate and support my argument without being judgemental while still empathising with others.
- I can learn about my needs to make the right choices.

Personal Learning

- I can identify the support and resources I need to learn.
- I am aware of my preferred way to learn and can use this to plan my own learning.
- I manage goals and time efficiently in learning.
- I feel competent in managing my own learning.
- I am open to feedback from others and am able to consider it for my personal improvement.
- I reorganise myself by explicitly changing my assumptions over time.
- I am able to follow my own interests as this helps me to reflect on ‘who I am’.
- I am pleased when I succeed at difficult tasks.
- I believe that effort can lead to success.
- I reflect on my mistakes and learn from them.

Cognitive Learning

- I am able to remember by recalling, recognising and locating information.
- I am able to link new information to my existing knowledge.
- I am able to analyse information that I come across.
- I evaluate knowledge in terms of my learning objectives and my preferred way of learning.
- I am able to solve problems on my own and in collaboration with others.
- I am able to assess myself as this helps me to understand what I know and who I am.
- I assess myself to analyse and further develop my ideas.

- I assess my peers to compare what I know to what others know, gaining knowledge of what mental models others hold of a particular concept and how these mental models can evolve for understanding to happen.
- I am able to focus on the main subject and summarise important points.
- I am able to apply my knowledge and understanding in differing contexts.
- I can manage my own learning to improve important skills including literacy and numeracy skills.
- I understand that learning involves different processes.

Creative Learning

- I take initiative in designing new products.
- I am able to think about new ways of making good use of objects.
- I am able to use my imagination and creativity.
- I prefer to move on to challenging tasks rather than stay on easy ones.
- I am able to face new, challenging experiences and learn from them.
- I learn by exploring events, life experiences and the physical environment.
- I am able to engage in unplanned spontaneous play.
- I am able to engage in planned, purposeful play.
- I understand that I can improve and learn and that if I am stuck I can think upon my difficulties, solve my problems and move forward.

Literacy

One of the most important aspects of literacy in Malta is the implication that a literate person is fluent in both Maltese and English. An essential factor to ensure that Malta remains a bilingual country is making sure that its learners develop equal competences in reading, writing, speaking, listening and comprehending in both official languages from the early years, preferably from kindergarten. Another is ensuring that learners develop the skill to switch easily from Maltese to English (or vice versa) depending on the situational need. Achieving bilingual literacy in our education means that all our young people feel comfortable and confident using both languages.

Literacy development will require a whole-school approach that is clearly reflected in school policies where there is a conscious effort in which a community for literacy is promoted throughout the curriculum. Literacy for learning is an intrinsic part of school life and every subject domain can serve as a context whereby literacy skills development could be enhanced. Furthermore, schools should strive for a literacy rich environment using technology as a platform.

The relevance of reading aloud and presenting ideas to an audience and the opportunities for contextualised language and play acting (drama) should be clearly identified as components of spoken literacy across the curriculum. Stressing the importance of oracy is key to encouraging active learning cultures and communities.

With regard to reading, the fun and interactive aspect of reading is very important; the purpose of reading should initially be for fun/interest and communication. The value of entertainment in reading, which is closely linked to attitude and disposition to language, is crucial especially in the Early and Junior Years. Critical and creative thinking, where the learner increasingly takes control of texts in different domains and gains awareness, will follow.

Theme Learning Outcomes:

Listening and speaking

- I can converse in a range of situations, both formal and informal, matching register and language to the situation and audience.
- I can listen to and understand spoken text well and respond or apply the information appropriately with comments and/or questions.
- I can use langauge to present my thinking logically and clearly and can talk to engage an audience while analysing and evaluation through an open-ended approach.
- I can use spoken language to share my ideas in a collaborative way, appreciating the social elements of conversation such as waiting for my turn and listening to what others have to say.

Expressive language

- I can use expressive language to develop my own thinking, using words to explore, clarify and confirm ideas.
- I can use expressive language to develop my thinking and the thinking of others by contributing to the explorative talk of my peers and the dialogic talk of my teachers.
- I can use expressive language to organise and rehearse ideas, arguments and language structures in order to synthesise and evaluate before writing and while editing.

Reading and understanding

- I can decode print effectively and successfully establish multisensory linking and phonemic awareness between grapheme and phoneme.
- I can read text in a fluent manner and understand what is written, gain knowledge and enjoy the process.
- I can select real, virtual and multimedia texts to entertain and inform me, constructing meaning from text, using words and visual or audio information to confirm, complement or change what I already know while discarding the superfluous.
- I can approach texts purposefully: I am aware of what I hope to gain from them and am able to use retrieval devices, cross references and links to follow themes or ideas through various means including texts accessed via technology.
- I can select appropriate texts for my purposes, taking account of implied readership and provenance as well as subject matter and format.
- I can identify and follow the different reading conventions of my academic subjects, regarding the place and purpose of reading texts in learning and in questioning or accepting the authority of these texts.

Writing

- I can draw on what I have read, what I have done and what I have felt at home, at school and at play to inform my writing.
- I can convey my thoughts powerfully and eloquently through speech and text.
- I can select the appropriate language, register, genre and medium for the texts I write.
- I can use writing in both manuscript (handwritten form) as well as digital form in order to inform, to persuade and to entertain other people.
- I can use writing to consider ideas and to reflect on and consolidate my own thinking and learning. I can follow the writing conventions of the genres and subjects I am studying.

Accuracy

- I can write accurately using language conventions and rules such as those established by Standard English / Kunsill Nazzjonali tal-Ilsien Malti / l-Akkademja tal-Malti.
- I can use my knowledge of morphology as well as my phonological awareness and visual memory to attempt to spell unfamiliar words and recognise correct spelling.
- I can use a range of punctuation marks to make my meaning clear to a reader.

Planning and reflection

- I can plan my written work and think what I want to communicate before I start to write.
- I can understand the need for drafting; I can edit and proofread my work and allow sufficient time in which to complete a piece of work.
- I can reflect about my writing and think about how I learn best.

Learning Outcomes Framework

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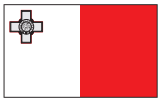

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