

Science refers both to a way of acquiring knowledge through observation and experimentation and to the organised body of knowledge of the physical and natural world acquired through the scientific method. The scientific method includes a set of logical and analytical procedures for experimentation and investigation, observation, collection and recording of data and evidence. The evidence gathered is subsequently used to develop hypotheses or explanations before these can be formally embodied as scientific knowledge and principles.

Science in the curriculum for basic education enhances students' curiosity, but also helps to develop an inquisitive mind through questioning and investigating. Learning science allows students to embrace the scientific method and procedures in decision-making and problem-solving. The learning of science is also seen as essential in the development of students' logical, critical, and creative thinking skills. Furthermore, learning science and working according to the scientific method encourage learners to develop a sense of rigour, integrity, and cooperative skills which are important for the advancement and development of our country.

Science is, today, acknowledged as a subject of lifelong utility to students, whether or not they would later embrace science-related careers. Learning science will provide students with the fundamentals for understanding the natural world and its phenomena and the innumerable applications of science to daily life issues and problems. It will also help them to adapt and live sustainably in a modern and technologically-driven world. An understanding of science will encourage students to nurture, care, respect, and develop responsible attitudes towards the natural world and contribute to sustainable development.

It is an undeniable fact that the modern world is faced with several pressing global challenges and issues, many of which are interlinked. These challenges include, among others: climate change, poverty, food security, energy crisis, sustainable development and sustainable use of terrestrial and marine resources, health-related issues, access to safe water, and natural calamities. The modern world, now considered a global village due to enhanced communication and increased mobility, has accentuated the sources and geographic extent of these issues. There is an urgent need to address these social, economic, and environmental challenges. Indeed, a close scrutiny of the 2030 Agenda for Sustainable Development (United Nations, 2015) clearly highlights the commitment of all member nations to address these global challenges as specified in the Sustainable Goals 2, 3, 6, 7, 9, and 13 to 15. Science will prepare our young people to address the challenges of the modern world – either as contributing scientists or as 21st century citizens who take informed decisions in their everyday life. A sound knowledge and understanding of science is the best way to help all of us understand and address the global challenges that impact on our lives.

It is universally acknowledged that science is one of the major foundations for innovation. To drive the economic agenda of Mauritius, we need a fully competent future generation of citizens who can bring about innovation. Effective science education nurtures the development of learners' logical, creative and critical thinking skills that are essential for innovation. In line with the mission of the Ministry of Education and Human Resources, Tertiary Education and Scientific Research, it is expected that science in the curriculum will impart a culture of research, a sense of rigour, and thinking that will foster innovation and build the foundation for knowledge and for the sustainable development of our Republic. Figure 13.1 summarises the aims of the science curriculum for Grades 7-9.

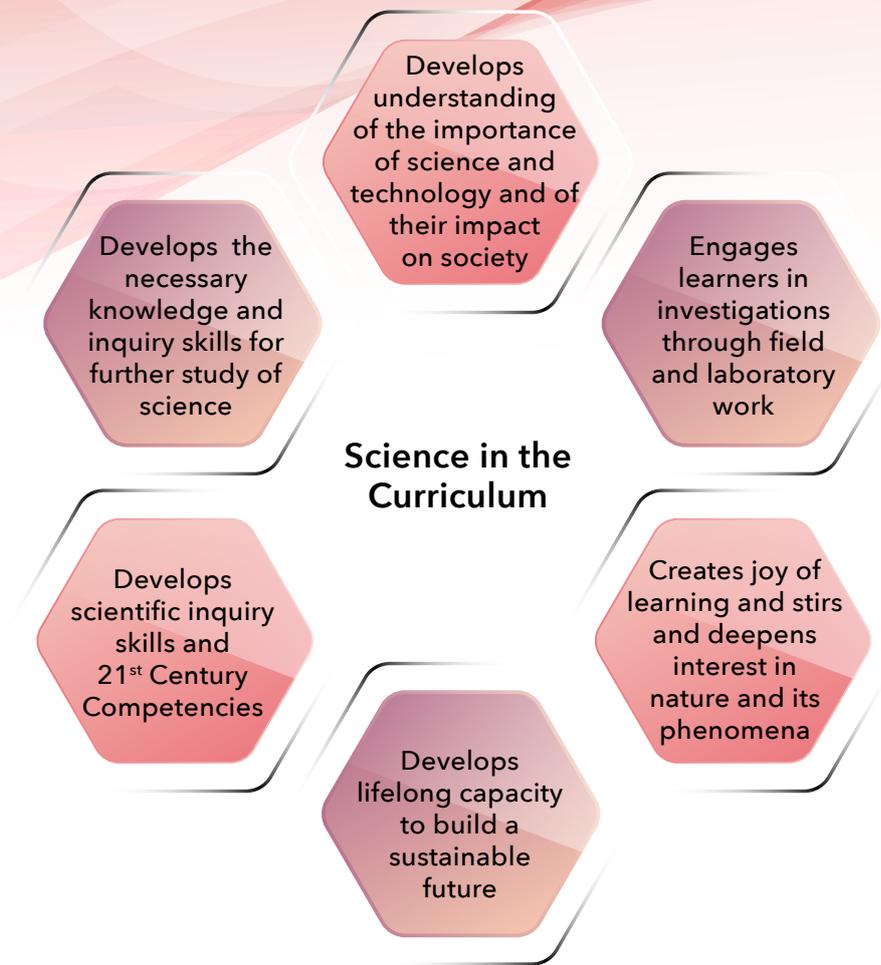


Fig 13.1: Aims of the Science Curriculum for Grades 7-9

13.1 Aims of the Science Curriculum

The Aims of the Science Curriculum are to ensure that learners:

- Develop knowledge and understanding of scientific concepts, as well as inquiry skills and attitudes related to science
- Explore science concepts and phenomena through scientific inquiry
- Gather data and information through observations, field and laboratory work by using appropriate measuring instruments and techniques
- Develop critical, logical, creative and innovative thinking skills as well as problem-solving skills
- Communicate scientific data and information in a variety of ways, including the use of ICT
- Develop and apply ICT skills across the science curriculum
- Acquire the foundational knowledge and skills for further learning of science or science-related subjects
- Develop respect, care and responsibility towards the environment
- Develop an understanding of the applications of science and technology in society
- Live sustainably and contribute to the science and technologically-driven society and take informed decisions as responsible citizens

13.2 Expected Learning Outcomes

By the end of Grade 9, learners should be able to:

- Demonstrate knowledge and understanding of scientific concepts and phenomena
- Apply scientific knowledge to solve problems in different contexts
- Explain common phenomena and situations that relate to their everyday life experiences and needs
- Investigate scientific concepts or phenomena through scientific inquiry
- Collect data using observation and appropriate instruments and techniques
- Demonstrate an appreciation of the importance of science and technology in the world
- Communicate scientific ideas, information and data using relevant science terminologies and supporting evidence in a variety of ways, including ICT
- Use ICT tools to search for, collect and analyse relevant scientific information and ideas
- Demonstrate knowledge, skills and attitudes that would enable them to make informed decisions to live sustainably and contribute to the science- and technologically-driven society

13.3 Unifying Themes of Science

The science curriculum emphasises the overarching themes and unifying ideas of science. The themes represent what science is, the way we do science and common themes that appear in many different scientific disciplines. They enable learners to see the connections within a particular scientific discipline and between, for example, chemistry and physics. Using a thematic approach, the teaching and learning of science is perceived not as moving from topic to topic, but with connections between them. Accordingly, by adopting a thematic approach, provisions are made for a unifying framework for teaching and learning science. It is hoped that this will help learners to move away from thinking of science as separate components falling under physics, chemistry and biology, but instead understand that science is part of everyday life, which can be understood from a combination of all the three components. The teaching and learning of science are facilitated by the adoption of the following approaches: scientific inquiry, and consideration of science technology and society which permeate the unifying themes.

The curriculum is presented under five unifying themes as shown in Figure 13.2 below. A short description of the themes is given thereafter.

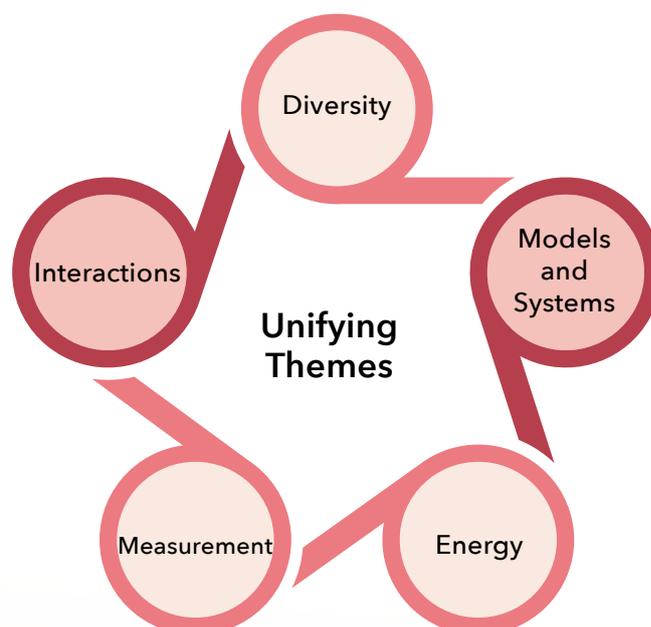


Fig. 13.2: Unifying Themes of the Science Curriculum

13.3.1 Scientific Inquiry

Scientific inquiry underlies any science. It relates to the process of experimentation. It refers to the many ways in which scientists study the natural and physical world and on the basis of which they propose explanations derived from these systematic investigations. It encompasses a set of logical and analytical procedures for observation, collection, and analysis of data and communication of findings.

13.3.2 Diversity

The theme of **diversity** in the curriculum ensures that learners understand and appreciate the complex world around us. It essentially refers to science topics and concepts which entail variety, types, forms and classification. For instance, it allows the study of the great variety, forms and types of living and non-living things. Furthermore, diversity helps in understanding the common characteristics of living things and how we organise and classify them in order to better understand them. It also includes the study of the variety of life forms through exploration and investigation of their features. Matter is explored by studying its states, as well as physical and chemical properties. More importantly, students will learn about the importance of this diversity and the means of sustaining it.

13.3.3 Models and Systems

A system is a number of independent components which interact with each other to perform a complex task. Students will understand the different parts, structure and functions of different systems around us. They will understand how the different parts interact to enable the whole system to function and perform a complex task. Systems can be natural or man-made. In the science curriculum, systems include biological systems such as cell and plant systems, respiratory, digestive and circulatory systems in humans. They also refer to physical systems such as the electrical and solar systems.

In science, **models** are used to represent scientific ideas, describe and explain phenomena, and also to make predictions. It is often a simplified scientific illustration of a real-world phenomenon or an illustrated component of a system. We, here, refer to only man-made models that enable us to make sense of the world around us. These models are physical, chemical or biological in nature. The particulate theory of matter is one such model.

13.3.4 Interactions

Interactions represent relationships between two or more concepts or ideas that have an influence upon one another. This influence among these concepts or ideas is fundamental to sustain the concept of interaction. Interactions exist within and between systems, and between systems and the environment. Forces, motion, energy, chemical changes, food chains, and food webs are examples of interactions that will help learners better understand and appreciate the interplay of living and non-living things.

13.3.5 Energy

Energy is an important unifying theme in science as all living things need energy. It has an impact on many non-living things too. This theme will allow learners to inquire about the different forms of energy and understand how human beings and other living things use energy. They

will also learn about the significance of energy transformations and conservation.

13.3.6 Measurement

Measurement is an integral part of any science engineering and occupies an important part in daily life. It is a way of generating and understanding scientific knowledge in any scientific inquiry. The theme of measurement brings together a multidisciplinary approach to measurement techniques and instrumentation in basic science. Both theoretical and practical aspects of measurement will be addressed. Starting with simple measuring techniques and instruments, learners will understand what is measurable and why, as well as how to measure things.

13.3.7 Science, Technology and Society

In essence, science is the systematic enterprise of gathering information based on observations, scientific hypothesis testing, and theory building, which then leads to explanations of phenomena around us. The relationship between science and technology is very close. To extend our abilities, technology makes use of scientific knowledge to change the world around us through innovative processes, systems and devices. It is important that learners can distinguish between the roles of science and technology, and understand how technology, coupled with the knowledge derived from science, profoundly affect society and the quality of life. Science technology and related concept will permeate the various themes.

13.4 Development of Inquiry Skills, Processes, Attitudes and Values

The curriculum provides opportunities for learners to develop and use scientific inquiry skills to explore phenomena. Central to the science curriculum is also the development of important values and attitudes.

Inquiry Skills and Processes, Attitudes and Values

Skills and Processes	
<p>Questioning Asking questions about animals, plants, objects and events in the immediate environment which may lead to investigations</p>	<p>Predicting Suggesting outcomes of an investigation, based on observations and prior knowledge</p>
<p>Observing Using the senses to gather information from the immediate environment</p>	<p>Investigating and Experimenting Carrying out simple investigations</p>
<p>Classifying Grouping objects according to common observable characteristics or hierarchical relationships</p>	<p>Measuring Selecting and handling simple apparatus for various tasks</p>
<p>Comparing Identifying similarities and differences between objects, concepts or processes</p>	<p>Inferring Explaining observations or data and drawing conclusions from simple investigations</p>

<p>Communicating</p> <p>Receiving and transmitting information orally, in writing or by drawing pictures, tables and models</p>	<p>Formulating a hypothesis</p> <p>Giving a general explanation for what is observed</p>
<p>Problem-Solving</p> <p>Considering a problem and finding a solution</p>	<p>Decision-making</p> <p>Analysing different options and making a choice</p>

Table. 13.1: Skills and Processes

Attitudes and Values	
<p>Curiosity</p> <p>Asking questions about objects and events and finding out more about events and objects on their own</p>	<p>Respect for Evidence</p> <p>Explaining their results and conclusions and listening to other students' results and explanations</p>
<p>Persistence</p> <p>Completing activities and persisting at tasks</p>	<p>Respect for Living Things and the Environment</p> <p>Showing sensitivity to living things and responsibility towards the environment</p>
<p>Cooperation</p> <p>Sharing with others and working together with others</p>	<p>Concern For Safety</p> <p>Observing safety instructions</p>

Table. 13.2: Attitudes and Values

13.5 Specific Learning Outcomes

13.5.1 Grade 7

By the end of Grade 7, learners should be able to:

Scientific Inquiry

- Demonstrate a simple understanding of the different fields of science
- Ask meaningful questions about nature and natural phenomena
- Conduct simple investigations by following a set of written instructions
- Make observations and collect data in an investigation
- Represent data in different forms (e.g. tables, diagrams, charts, and graphs)
- Analyse data recorded to make inferences and write a logical conclusion
- Use ICT for acquiring information and presenting results
- Demonstrate understanding of safety while working in the field and laboratory

Models

- Compare and contrast the structure of animal and plant cells
- Demonstrate understanding of the particulate model of matter
- Demonstrate understanding of the properties of matter and its states

Systems

- Recognise the cell as the unit of life
- Describe cellular organisation from cell, tissue, organ to body system
- Demonstrate understanding of the basic structure of the ecosystem and factors that contribute to its balance
- Demonstrate understanding of the structure and composition of our solar system and the universe

Diversity

- Demonstrate understanding of the characteristics of living things
- Recognise that life exists in unicellular and multicellular forms
- Show understanding of elements, metals, non-metals, mixtures and compounds
- Show an awareness of the Periodic Table as a classification of elements
- Demonstrate understanding of the components of air and their importance
- Demonstrate understanding of fundamental physical quantities
- Demonstrate understanding of the dependencies of physical quantities
- Compare the different types of celestial objects in our Solar System
- Recognise planets in the Solar System based on their appearance, relative position and size
- Recognise objects in the solar system, including planets, planetary satellites, comets, and asteroids

Interactions

- Demonstrate understanding of the factors that affect an ecosystem
- Investigate the presence of water, oxygen and carbon dioxide in the air through simple experiments
- Distinguish between physical and chemical changes

Energy

- State that the three states of matter differ in their energy content
- Infer that changes of states are brought about by gain or loss of heat energy
- Describe the transformation of energy in various devices and contexts, and infer that energy is conserved
- Describe different alternatives for sustainable production and use of energy resources
- Demonstrate understanding of electricity and simple circuits

Measurement

- Demonstrate understanding that different instruments are used to measure different physical quantities
- Measure length, mass and volume of liquid using appropriate apparatus and calculate other quantities (e.g. area and density)
- Express physical quantities in appropriate SI units
- Demonstrate understanding of light years for expressing distance between stars and the Earth
- Use selected techniques and instruments to measure selected data in biology
- Show an appreciation of accuracy in making measurements

Science, Technology and Society

- Show awareness that science and technology are present all around us by studying some common applications

- Demonstrate understanding of the importance of some metals in society
- Use a variety of print and electronic resources (including the Internet) to research the discovery of the cell and microscope through the life history of famous scientists
- Demonstrate awareness of astronomy as a science and the role of Galileo Galilei

13.5.2 Grade 8

By the end of Grade 8, learners should be able to:

Scientific Inquiry

- Formulate questions about a studied phenomenon and further develop the questions for further investigations
- Plan and conduct a simple investigation safely in the laboratory
- Record data using appropriate graphic representations (e.g. tables, diagrams, charts, and graphs)
- Draw and write conclusions based on collected data
- Write a report of an investigation that includes the experiment, data collected, graphic representations and conclusions drawn
- Use ICT for acquiring information and presenting results

Models

- Show understanding of molecules, radicals and chemical formulae
- Use valencies of elements and radicals to work out the formulae of compounds

Systems

- Demonstrate understanding of major parts and functions of the digestive system in the human body
- Describe the respiratory system in human beings
- Explain breathing and gaseous exchange in human beings

Diversity

- Recognise the main food groups, their sources, importance and associated deficiency diseases
- Recognise alloys, solutions and suspensions as mixtures
- Explain how different mixtures can be separated by magnetic attraction, filtration, decantation and evaporation
- Recognise, give examples and investigate different types of forces in Nature
- Compare and classify magnetic and non-magnetic materials

Interactions

- Identify acids, bases and salts as chemical substances, and recognise their uses
- Infer, through experiments, some properties of acids and bases
- Use the pH scale and indicators to identify acidic, basic and neutral solutions
- Explain how hydrogen can be prepared and tested in the laboratory
- Explain the causes and prevention of diabetes
- Recognise the effects of cigarette and other substances of abuse on the respiratory system
- Explain the causative agent of influenza, its mode of transmission and prevention
- Identify and investigate the characteristics of magnets and magnetic materials
- Demonstrate understanding of force as a fundamental interaction in Nature
- Demonstrate understanding of the effects of forces on the size, shape and motion of objects

- Relate pressure to force and area
- Demonstrate a simple understanding of pressure in liquids and gases
- Describe examples in daily life where pressure is useful

Energy

- Infer that heat energy is released when metals react with dilute acids
- Calculate kinetic energy and the changes in potential energy near the Earth
- Relate work done to the magnitude of a force and the distance moved
- Relate power to work done and time taken
- Demonstrate a simple understanding of energy efficiency

Measurement

- Demonstrate understanding of common laboratory equipment
- Use instruments to measure physical quantities accurately
- Distinguish between mass, weight and density by measuring them
- Express work, pressure and other quantities in appropriate units
- Demonstrate skills in recording non-numerical data in biology
- Show an appreciation of scientific attitudes such as respect for data and evidence obtained from measurements

Science, Technology and Society

- Demonstrate understanding of the benefits and limitations of science
- Demonstrate understanding of the importance of acids, bases and salts in society
- Demonstrate understanding of the applications of separation techniques
- Demonstrate understanding of common health problems prevalent in our society
- Show awareness of the life and work of Isaac Newton

13.5.3 Grade 9

By the end of Grade 9, learners should be able to:

Scientific Inquiry

- Develop a simple hypothesis and test it
- Conduct investigations safely in cooperation with others
- Record data using appropriate graphic representations (E.g. tables, diagrams, charts, and graphs)
- Process, interpret, and evaluate the results of an investigation
- Apply simple mathematical relationships to determine a missing quantity in a mathematical expression, given the two remaining terms
- Communicate the steps and results of an investigation in written reports and oral presentations
- Use a variety of print and electronic resources (including the Internet) to collect information as part of an investigation
- Use ICT to present information and results of an investigation

Models

- Recognise that stars are the source of light in outer space and that the Moon and planets shine by reflected light, not by their own light
- Explain that the light emitted by or reflected from objects helps us to see them
- Demonstrate understanding that light travels in straight lines if the medium through which it travels does not change
- Demonstrate understanding that light can be reflected and refracted using ray diagrams
- Perform simple constructions and calculations to show reflection and refraction of light
- Set up simple series and parallel circuits involving cells, bulbs, switches and resistors
- Calculate the current or voltage in simple direct current (DC) electric circuits

Systems

- Demonstrate an understanding of the circulatory system in human beings
- Describe the major parts of the male and female reproductive systems and their functions in human beings
- State common diseases associated with the reproductive systems
- Demonstrate understanding of the carbon cycle
- Infer the importance of photosynthesis and respiration in maintaining the composition of air
- Demonstrate understanding of the causes and effects of water and air pollution, including eutrophication, acid rain, and global warming
- Solve problems involving the conservation of energy in simple systems (e.g. falling objects and pendulum)
- Recognise the components of an electrical system and construct simple circuits from circuit diagrams
- Demonstrate understanding of current, voltage, emf, and resistance
- Investigate the effect of resistance and other variables on the current flowing in a circuit
- Use Ohm's law to solve simple circuit problems

Diversity

- Show understanding of biodiversity, its importance to humankind and how it can be protected
- Discuss the natural and human-induced factors that negatively impact biodiversity
- Explain how different mixtures can be separated by filtration, crystallisation, sublimation, distillation and chromatography
- Differentiate between luminous and non-luminous objects

Interactions

- Demonstrate understanding of salts and its applications
- Recognise photosynthesis as the fundamental process by which plants manufacture food
- Recognise the importance of biodiversity and show concern for how its threats contribute to global warming and climate change
- Represent chemical reactions using balanced chemical equations
- Investigate the reactions of some metals with oxygen, acids and water or steam
- Demonstrate understanding of the reactivity series and displacement reactions
- Show understanding of various physical quantities involved in the study of motion of objects

- Investigate the effect of forces on the motion of objects
- Plot and interpret distance/time and speed/time graphs for motion in a single direction
- Recognise, from the shape of speed/time graphs, the nature of motion (rest, constant and changing speed)
- Solve problems related to motion of objects and their graphical representations (s-t and v-t only)
- Solve simple problems using $F=ma$
- Demonstrate understanding of simple motion

Energy

- Identify greenhouse gases as gases which retain heat energy in the atmosphere
- Recognise that the increase in absorption of heat energy by the atmosphere is responsible for global warming
- Show understanding of how plants trap light energy for photosynthesis
- Compare the production of electricity using renewable and non-renewable sources of energy
- Distinguish between heat and temperature

Measurement

- Select and handle simple instruments to measure physical quantities accurately
- Measure current, resistance and voltage in simple circuits
- Record measurements accurately using appropriate instruments (e.g. quadrat, and stopwatch) in biodiversity, photosynthesis, and circulatory system in human beings
- Determine magnification of simple specimens under the microscope
- Measure and examine the dependencies between quantities
- Make predictions based on measurements

Science, Technology and Society

- Evaluate information critically, and express and justify different views, consistent with scientific knowledge and claims
- Identify some ethical issues associated with the applications of science and technology
- Demonstrate an understanding of the causes of climate change, its impact and measures to be taken to combat it
- Show awareness of the use of optical fibres in medicine and communications technology
- Show awareness of heart transplant through the life and work of Christiaan Barnard

13.6 The Science Curriculum for Basic Education: Standards for Implementation

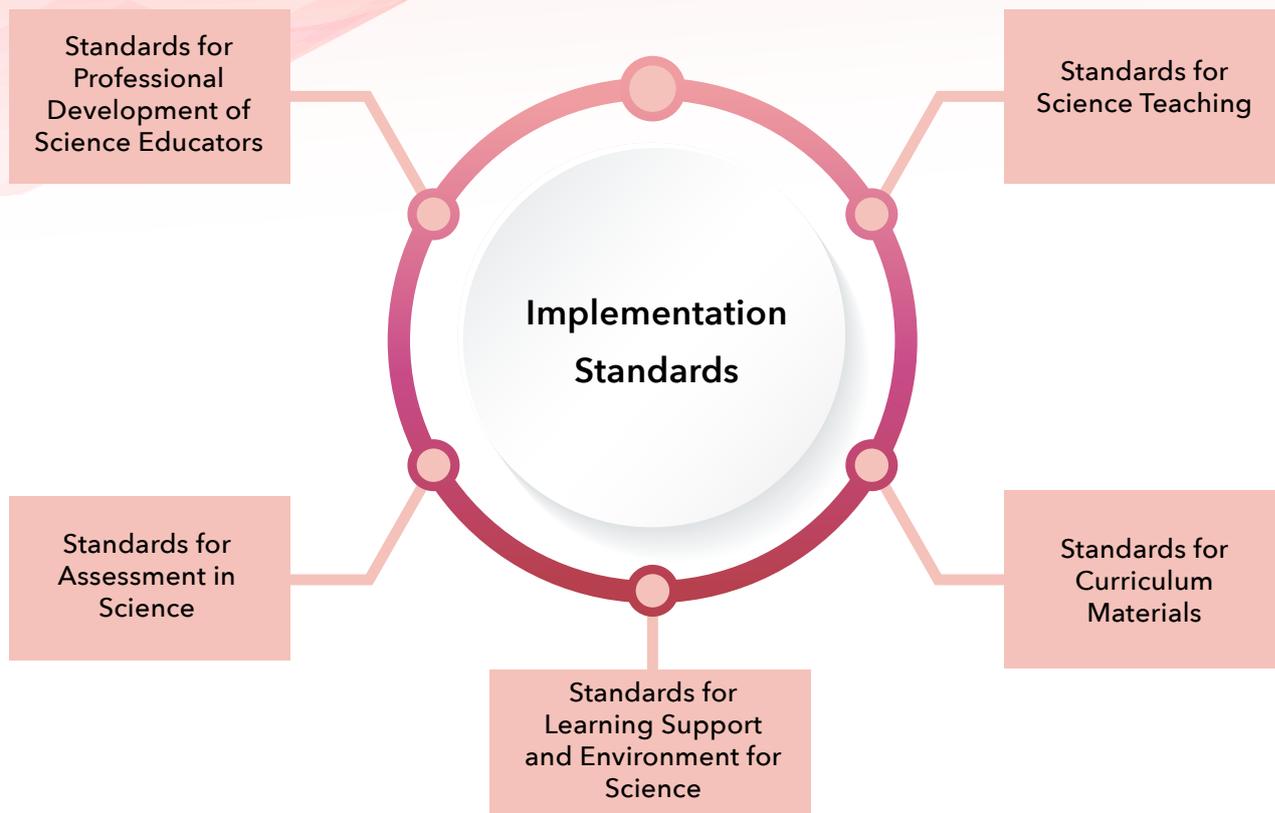


Fig. 13.5: Implementation Standards for the Science Curriculum

The NCF Grades 7-9 for science makes provision for the successful implementation of the framework by describing standards for science teaching, assessment, curriculum materials, professional development of science Educators, and learning support and environments, as depicted in Figure 13.5 above. These standards spell out our vision and provide a roadmap for making the science curriculum accessible to learners and ensure scientific literacy for all. They call for changes in the education system and represent criteria for education quality. They emphasise a novel way of teaching and learning science, assessing students' performance and achievement, developing and evaluating curriculum materials, educating and supporting Educators and ensuring an enabling environment where the curriculum is transacted. These standards will be described in detail in a separate document.