



**MINISTRY OF EDUCATION
DEPARTMENT OF EDUCATION**

Essential Curriculum

2008

**Curriculum and Instructional Leadership
Performance Standards Summary**

SCIENCE



PERFORMANCE STANDARDS ARE LEARNING EXPECTATIONS

“THE ESSENTIAL CURRICULUM”

The mission of the Bermuda Public School System (BPSS) is *to be the first choice in education by providing rigorous and stimulating learning experiences in safe, responsive environments from which our students emerge confident and prepared to compete and contribute locally and globally.*

Performance Standards are statements of what students should know and be able to do and how they should demonstrate their knowledge and skills at the end of each year. Included within the Performance Standards document are **strands, performance statements** and **assessment indicators** for English language arts, mathematics, science and social studies. It is important to note that the assessment indicators listed in this booklet represents the “**Essential Curriculum.**” They are the critical guidelines for ongoing and island-wide curriculum based assessment. They are guideposts in the journey our students make from the time they enter our schools to the time they graduate *confident and prepared to compete and contribute locally and globally.*

Physical Science (P) ← STRAND	
Physical science (P), which consists of concepts of chemistry and physics, involves study of matter and materials, forces and energy.	
Conceptual understanding should be demonstrated by: • Using a concept accurately to explain observations and make predictions • Representing the concept in a variety of ways, including words, diagrams and graphs, as appropriate	
PERFORMANCE STATEMENT	ESSENTIAL CURRICULUM
P1 - Matter and Materials - their properties, components, interactions and changes	SC.P6.P1 Students will produce evidence that demonstrates understanding of: a) Sometimes matter will not change back after it has been: b) New materials can be made by combining two or more at <i>Assessment Indicators:</i> • chemical and physical changes – first concept but not terms • Matter has mass-weight and volume • Assessment Indicators • understand properties of solids and liquids
P2 - Force and Motion - the relationship between force, mass and motion of an object and the nature and interaction of waves and matter	SC.P6.P2 Students will produce evidence that demonstrates understanding of: a) Not assessed at this level on the Bermuda Criterion Reference (BCRT)
P3 - Energy - the sources and forms of energy, including transmission and transformations and how energy helps explain the structure of matter and the	SC.P6.P3 Students will produce evidence that demonstrates understanding of: a) Not assessed at this level on the Bermuda Criterion Reference (BCRT)

Serving as guideposts, performance standards establish shared expectations for the:

- completion of each year of our school system,
- guidance in terms of how we may need to redirect our efforts during any given year of our school system
- direction in terms of what we should be able to expect of students entering each subsequent year of our school system.

As they serve as guideposts for teachers responsible for maximizing students’ learning experiences, performance standards tell us not only the **ultimate** goals for each year level but also provide direction towards achievement of the goals **during** each year.

Bermuda Performance Standards will be used to:

- emphasize the concepts and processes all students should learn with understanding.
- provide explicit goals for student expectation at the end of each year.
- guide Bermuda Criterion Reference and classroom assessments

Bermuda Public School System Performance Standards

Science (SC)

Physical Science (P)

Life Science (L)

Earth and Space Science (E)

Nature of Science (N)

M1 SCIENCE (SC)

Introduction to Science Performance Standards7

- Physical Science
- Life Science
- Earth and Space Science
- Nature of Science

References

Physical Science (P).....11

- P1 Matter and Materials
- P2 Force and Motion
- P3 Energy
- P4 Forces of Nature

Life Science (L)13

- L1 Diversity of Life
- L2 Heredity
- L3 Cells, Organs and Organ Systems
- L4 Interdependence
- L5 Flow of Matter and Energy
- L6 Evolution of Life

Earth and Space Science (E)16

- E1 Astronomy
- E2 Geology
- E3 Resources
- E4 Meteorology
- E5 Oceanography

Nature of Science (N)18

- N1 Scientific Investigation
- N2 Data Representation and Interpretation
- N3 Designed World: Science Technology and Society

M2 SCIENCE (SC)

Introduction to Science Performance Standards7

- Physical Science
- Life Science
- Earth and Space Science
- Nature of Science

References

Physical Science (P).....21

- P1 Matter and Materials
- P2 Force and Motion
- P3 Energy
- P4 Forces of Nature

Life Science (L)23

- L1 Diversity of Life
- L2 Heredity
- L3 Cells, Organs and Organ Systems
- L4 Interdependence
- L5 Flow of Matter and Energy
- L6 Evolution of Life

Earth and Space Science (E)26

- E1 Astronomy
- E2 Geology
- E3 Resources
- E4 Meteorology
- E5 Oceanography

Nature of Science (N)28

- N1 Scientific Investigation
- N2 Data Representation and Interpretation
- N3 Designed World: Science Technology and Society

M3 SCIENCE (SC)

Introduction to Science Performance Standards7

- Physical Science
- Life Science
- Earth and Space Science
- Nature of Science

References

Physical Science (P).....31

- P1 Matter and Materials
- P2 Force and Motion
- P3 Energy
- P4 Forces of Nature

Life Science (L)33

- L1 Diversity of Life
- L2 Heredity
- L3 Cells, Organs and Organ Systems
- L4 Interdependence
- L5 Flow of Matter and Energy
- L6 Evolution of Life

Earth and Space Science (E)36

- E1 Astronomy
- E2 Geology
- E3 Resources
- E4 Meteorology
- E5 Oceanography

Nature of Science (N)38

- N1 Scientific Investigation
- N2 Data Representation and Interpretation
- N3 Designed World: Science Technology and Society



BERMUDA SCIENCE PERFORMANCE STANDARDS (SC)

The study of science is an intellectual and social endeavour – the application of human intelligence to figuring out how the world works.

Benchmarks for Science Literacy: Project 2061 (1993)

The *Bermuda Science Performance Standards* document is an amalgam of widely respected science documents that have been developed in many different countries, including the United Kingdom, United States and Canada. As is easily recognizable in standards documents from other jurisdictions, *Benchmarks for Science Literacy* has been used as the basis for *Bermuda Science Performance Standards*. Science in the schools provides an introduction to many different scientific disciplines from the traditional physics, chemistry and biology to geology, environmental science and meteorology. These standards are therefore wide ranging and provide the foundation for not only scientific literacy, but also the critical knowledge and skills for those who intend to study science as a requisite for their careers.

The National Science Education Standards (NSES, National Research Council, 1995) define scientific literacy as the knowledge and understanding of scientific concepts and processes which are required for participation in civic and cultural activities, economic productivity and personal decision making. The philosophy of The Bermuda Science Curriculum (Bermuda Ministry of Education, 1997) echoes the intent of the NSES statement and indicates that science education should empower all students to make informed choices concerning personal, societal, environmental and technological issues, thus fostering an appreciation and a sense of responsibility for the future.

In Bermuda, science is considered a critical component of education for *all* children and is therefore mandated as a core subject from preschool through to senior school. *The Bermuda Science Performance Standards* are not a curriculum. They provide the framework for our year-by-year science curriculum that spans the fourteen years from preschool to senior school. They expand the “what” students should know and be able to do to the “how” and “to what extent” students should demonstrate their understanding of scientific concepts and skills.

As stated in the National Curriculum for England, the standards must be “*robust enough to define and defend the core of knowledge and cultural experience and flexible enough to give teachers scope to build their teaching around it in ways that will enhance its delivery to pupils*” (The National Curriculum for England, 2000).

The *Bermuda Science Performance Standards* are categorized into four (4) strands, recognizable as organizers in curriculum documents of many jurisdictions:

- 1. Physical Science (P)**
- 2. Life Science (L)**
- 3. Earth and Space Science (E)**
- 4. Nature of Science (N)**

The first three strands, communicate the knowledge and concepts of science using traditional categories. The Nature of Science emphasizes the way that science and scientists work and how, together with mathematics and technology, the world has been shaped by human endeavour.

The strands are divided into standards that spiral throughout the compulsory years of the science programme in Bermuda. When the goal is deep understanding it is essential for concepts to be revisited over time. Standards are further broken down into indicators for assessment.

Students show conceptual understanding when they can:

- *use a concept accurately to explain observations and make predictions, first in familiar then unfamiliar situations*
- *represent the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

Both aspects of understanding – explaining and representing – are required to meet the standard.

PHYSICAL SCIENCE (P)

Physical science, which consists of concepts of chemistry and physics, involves the study of matter and materials, forces and energy. There are four (4) physical science standards.

The student will produce evidence that demonstrates understanding of:

- P1 Matter and Materials** - their properties, components, interactions and changes
- P2 Force and Motion** - the relationship between force, mass and motion of an object and the nature and interaction of waves and matter
- P3 Energy** - the sources and forms of energy, including transmission and transformations and how energy helps explain the structure of matter and the universe
- P4 Forces of Nature** - gravitational, electrical and magnetic forces as the fundamental forces acting in nature

LIFE SCIENCE (L)

Life Science, which consists of concepts of biology and ecology, deals with the diversity of living organisms, their organization, life processes, relationships with one another and their environment. There are six (6) Life Science standards.

The student will produce evidence that demonstrates understanding of:

- L1 Diversity of Life** - the variety of living things and the processes responsible for the maintenance of life
- L2 Heredity** – biological traits and how they are passed on from generation to generation
- L3 Cells, Organs and Organ Systems** – the structure, function and reproduction of cells that maintain the organization essential for life and specialized organs systems that interact with each other to maintain internal balance
- L4 Interdependence of Life** – relationships amongst organisms and their dependence on their environment
- L5 Flow of Matter and Energy** - the linking of organisms to one another and their physical setting by the transfer and transformation of matter and energy
- L6 Evolution of Life** – the evolution of life on earth and natural selection as an explanation of biological processes

EARTH AND SPACE SCIENCE (E)

Earth and Space Science consists of concepts of astronomy, geology, resources, meteorology and oceanography. Earth and Space Science involves the study of the earth, the universe, their components and interactions. There are five (5) Earth and Space Science standards

The student will produce evidence that demonstrates understanding of:

- E1 Astronomy** - the current scientific view of the nature, components, matter and energy sources of the universe
- E2 Geology** - the features of the earth's surface, how they were formed and how they are continually changing
- E3 Resources** - the earth's limited and varied materials that supply many of the resources that humans use
- E4 Meteorology** - the interactions of structures of the earth's system and the sun's energy which cause weather and climate patterns
- E5 Oceanography** - the features of oceans and the impact of these features on the global ecosystem

NATURE OF SCIENCE (N)

The Nature of Science strand involves of the understanding and application of scientific investigative techniques and data analysis. Nature of Science also includes the study of the interrelationships among science, technology, and society. There are three (3) Nature of Science standards.

The student will produce evidence that demonstrates understanding of:

- N1 Scientific Investigation** - People can often learn about things around them by just observing those things carefully, but sometimes they can learn more by doing something to things and noting

what happens. Investigations are conducted for different reasons, which include exploring new phenomena, checking on previous results and comparing different theories. Investigations usually involve collecting evidence, reasoning, devising hypotheses, and making predictions.

N2 Data Representation and Interpretation - Data must be analysed in order to make sense of what has been collected. Sometimes the evidence collected might not be what you expected or might not be sufficient to draw a conclusion. Clear and accurate communication is important in doing science and an essential part of sharing an investigation order to inform others.

N3 Designed World: Science, Technology and Society - Over the course of the history of world exploration, humans have shaped and reshaped the world we live in by using technology in tandem with expanding science knowledge. Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Science influences society through its knowledge and world view. Technology influences society through its products and processes. Science and technology have advanced through contributions of many different people, in different cultures, at different times in history.

REFERENCES

It should be noted that there is a great deal of similarity amongst standards. The main sources for the Bermuda Performance Standards document contain hundreds of pages of detail that cannot be provided in the Bermuda *Science Performance Standards*. If further amplification of standards is required, it would be appropriate to research the sources cited in this section.

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Physical Science (P)

Physical science (P), which consists of concepts of chemistry and physics, involves the study of matter and materials, forces and energy.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

P1 - Matter and Materials -
their properties, components,
interactions and changes

SC.M1.P1

Students will produce evidence that demonstrates understanding of :

a) Matter cannot be created or destroyed, but merely changed.

Assessment limits:

- conservation of mass in a closed system

Physical properties of matter can be measured and changed. Equal volumes of different substances usually have different weights.

Assessment limits:

- phase change
- measurement tools rulers, graduated cylinders, balances, thermometers
- density – can calculate given formula

b) Materials can be classified as pure substances or mixtures, depending on their chemical and physical properties.

Assessment limits:

- e.g., pure substances have specific melting and boiling points no matter how much is present
- c) Mixtures are made of elements and/or compounds and they can be separated using properties of substances from which they are made such as density, solubility, particle size and boiling point.

Assessment limits:

- describe techniques and filtration, distillation, decanting process
- apply in new situations

d) Pure substances can either be elements or compounds and cannot be broken down by physical means.

Assessment limits:

- name some common elements and compounds- such as carbon, oxygen, hydrogen, nitrogen, sugar, common salt, water, vinegar, coinage metals, carbon monoxide, carbon dioxide, hydrogen peroxide and terms such as gasoline and fuel

P2 - Force and Motion -
the relationship between
force, mass and motion of
an object and the nature and
interaction of waves and
matter.

SC.M1.P2

Students will produce evidence that demonstrates understanding of :

a) Unbalanced forces acting on an object will change the speed of the object or the direction in which it is traveling and sometimes its shape. The larger the force, the greater the change in motion will be. When two substances that are touching move past each other, a frictional force is produced.

Assessment limits:

- canceling effect of balanced forces;
- gravitational force and weight- earth, space, moon
- force has both magnitude and direction (e.g. use of spring scale, dropping /kicking ball)
- formula speed=distance/time (apply to problem)

Physical Science (P) (continued)

Physical science (P), which consists of concepts of chemistry and physics, involves the study of matter and materials, forces and energy.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

P3 - Energy -

the sources and forms of energy, including transmission and transformations and how energy helps explain the structure of matter and the universe.

SC.M1.P3

Students will produce evidence that demonstrates understanding of :

- a) Energy cannot be created or destroyed, only changed from one form to another. Transformations of energy usually produce heat energy.

Assessment limits:

- example: burning fuel gives heat and light
- identifying forms of energy heat, light, sound, electrical
- do not test nuclear
- conversions including familiar examples such as fuel combustion in a car, electrical to sound in a CD player
- food as source of energy

P4 - Forces of Nature -

gravitational, electrical and magnetic forces as the fundamental forces acting in nature.

SC.M1.P4

Students will produce evidence that demonstrates understanding of :

- a) Objects exert gravitational forces on every other object.
b) The sun's gravitational pull holds the earth and other planets in orbit and holds moons in orbit around their planets.

Life Science (L)

Life Science (L) which consists of concepts of biology and ecology, deals with the diversity of living organisms, their organization, life processes, relationships with one another and their environment.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

L1 - Diversity of Life -

the variety of living things and the processes responsible for the maintenance of life.

SC.M1.L1

Students will produce evidence that demonstrates understanding of :

- Organisms can be grouped into plants, which use sunlight to make their own food and animals, which consume energy-rich foods.
- Similarities among organisms are used to infer how closely related the organisms are used. Details of internal and external structures are best used to classify organisms.

Assessment limits:

- simple classification keys
- animal and plant kingdom
- vertebrates and invertebrates
- microscopic living things

L2 - Heredity –

biological traits and how they are passed on from generation to generation

SC.M1.L2

Students will produce evidence that demonstrates understanding of :

Not assessed at this level on the Bermuda Criterion Reference Test (BCRT)

L3 - Cells, Organs and Organ Systems –

the structure, function and reproduction of cells that maintain the organization essential for life and specialized organ systems that interact with each other to maintain internal balance

SC.M1.L3

Students will produce evidence that demonstrates understanding of :

- Cells are building blocks of all living organisms.

Life Science (L)

(continued)

Life Science (L) which consists of concepts of biology and ecology, deals with the diversity of living organisms, their organization, life processes, relationships with one another and their environment.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

L4 - Interdependence of Life – relationships amongst organisms and their dependence on their environment.

SC.M1.L4

Students will produce evidence that demonstrates understanding of :

- a) In all environments – fresh water, marine, forest etc- organisms with similar needs may compete with each other for resources (food, space, water, air, shelter). The growth and survival of organisms depend on the physical conditions. In Bermuda many of the species are at the extreme limits of their geographical distribution.

Assessment limits:

- endemic and naturalized plants and animals
- introduced and invasive species in Bermuda

- b) Some organisms are better suited to survive in certain environments due to their characteristics.

Assessment limits:

- do not test the term adaptation at this level

- c) A species is at risk when there is a mismatch of adaptation and the environment.

Assessment limits:

- Bermuda – how did organisms get here and survive – flotsam, jetsam, flying, swimming, storm, ships etc.
- risk of invasive species in Bermuda
- species at risk - the cahow, tree frog, green turtle, cane toad and skink
- food chains and food webs including local examples

- d) Bermuda, as a small oceanic island, the land and water ecosystems are especially at risk due to the pressure of development.

- e) Organisms can be categorized as producers, consumers and decomposers of organic matter.

SC.M1.L5

Students will produce evidence that demonstrates understanding of :

- a) Food provides fuel and building material for all organisms. Plants make their own food by using energy directly from sunlight. Animals eat other organisms to obtain energy.

- b) All organisms depend on two main interconnected food webs, one in the ocean, the other on land. This becomes an indefinite cycle as organisms decompose after death returning material to the environment.

Assessment limits:

- Interpret food chains and simple food webs e.g. algae, tadpole, duck/ crane

L5 - Flow of Matter and Energy - the linking of organisms to one another and their physical setting by the transfer and transformation of matter and energy.

Life Science (L)

(continued)

Life Science (L) which consists of concepts of biology and ecology, deals with the diversity of living organisms, their organization, life processes, relationships with one another and their environment.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

L5 - Flow of Matter and Energy

- the linking of organisms to one another and their physical setting by the transfer and transformation of matter and energy.

L6 - Evolution of Life –

the evolution of life on earth, natural selection as an explanation of biological processes.

SC.M1.L5 (continued)

- c) Matter is transferred from one organism to another organism repeatedly. The amount of matter remains the same, although it might change in form and location.
- d) Energy can change from one form to another in living things. Animals oxidize their food and get energy, releasing some of it as heat. Almost all food energy comes from sunlight originally.

SC.M1.L6

Students will produce evidence that demonstrates understanding of :

Not assessed at this level on the Bermuda Criterion Reference Test (BCRT)

Earth And Space Science (E)

Earth and Space (E) Science consists of concepts of astronomy, geology, resources, meteorology and oceanography. Earth and space science involves the study of the earth, the universe, their components and interactions.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

E1 - Astronomy -

the current scientific view of the nature, components, matter and energy sources of the universe.

SC.M1.E1

Students will produce evidence that demonstrates understanding of :

- a) The sun is a medium sized star located near the edge of a disc shaped galaxy called the Milky Way. The sun is the closest star to earth.
- b) The universe contains billions of galaxies and each galaxy contains billions of stars.
- c) Telescopes show the characteristics of objects close to earth such as the moon and they are part of important technologies that can show that there are many more stars in the sky than one can see with the unaided eye. Satellites are an important kind of technology that have been put into orbit around the earth to send information from place to place, monitor earth's weather and other conditions, observe the universe.
- d) The sun and the stars are light sources. Planets are seen by reflected light. Light from the sun takes a few minutes to reach the earth. Light from the next star takes a few years to reach the earth.
- e) Nine planets of different size, composition and physical features rotate the sun in nearly circular orbits.

Assessment limits:

- **gravitational pull of the sun,**
 - **tides and gravity pull of moon and sun**
- f) Earth is orbited by one moon, artificial satellites and debris. Earth's moon orbits around the earth in a 28 day cycle. Moon phases describe what part of the moon is lighted by the sun and how much of that is seen from earth. Other planets have more than one moon and other kinds of objects, including ice particles, orbiting them.

E2 - Geology -

the features of the earth's surface, how they were formed and how they are continually changing.

SC.M1.E2

Students will produce evidence that demonstrates understanding of :

- a) Oceanic islands such as Bermuda are formed by volcanic activity along ocean floor.

E3 - Resources -

the earth's limited and varied materials that supply many of the resources that humans use

SC.M1.E3

Students will produce evidence that demonstrates understanding of :

- a) Human decisions have changed the earth's land, oceans and atmosphere. Bermuda as an oceanic island is especially unique and vulnerable.
- b) The sun is the ultimate source of most of the earth's energy resources and these resources are not renewable

Earth And Space Science (E) (continued)

Earth and Space (E) Science consists of concepts of astronomy, geology, resources, meteorology and oceanography. Earth and space science involves the study of the earth, the universe, their components and interactions.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

E4 - Meteorology -
the interactions of structures of the earth's system and the sun's energy which cause weather and climate patterns

SC.M1.E4

Students will produce evidence that demonstrates understanding of :

Not assessed at this level on the Bermuda Criterion Reference Test (BCRT)

E5 - Oceanography -
the features of oceans and the impact of these features on the global ecosystem

SC.M1.E5

Students will produce evidence that demonstrates understanding of :

- a) Most of the earth's surface is covered by water. Earth is the only planet that has liquid water on its surface.
- b) People have a significant impact on the ocean environment and ocean life.

Nature Of Science (N)

Nature of Science (N) consists of the understanding and application of scientific investigative techniques and data analysis. Nature of Science also involves the study of the interrelationships between science, technology, and society.

N1 - Scientific Investigation

-People can often learn about things around them by just observing those things carefully, but sometimes they can learn more by doing something to things and noting what happens. Investigations are conducted for different reasons, which include exploring new phenomena, checking on previous results and comparing different theories. Investigations usually involve collecting evidence, reasoning, devising hypotheses, and making predictions.

N2 - Data Representation and Interpretation -

Data must be analysed in order to make sense of what has been collected. Sometimes the evidence collected might not be what you expected or might not be sufficient to draw a conclusion. Clear and accurate communication is important in doing science and an essential part of sharing an investigation in order to inform others.

SC.M1.N1

Students will produce evidence that demonstrates understanding of :

a) Planning an investigation

Assessment limits:

- Select a question that can be answered by an investigation involving one factor
- Make a prediction about the outcome using scientific knowledge
- Choose appropriate equipment
- Write a method for the investigation

b) Obtaining evidence for investigation.

Assessment limits:

- Recognize the need to make additional observations and measurements when they are too different
- Use a range of apparatus with increasing precision
- (refer to curriculum Science Toolbox)
- Read analog and digital meters on instruments used to make direct measurements of length, volume, weight, elapsed time, rates and temperature
- Record measurements and observations on charts

SC.M1.N2

Students will produce evidence that demonstrates understanding of :

a) Summarising and organising data

Assessment limits:

- Represent data and results in multiple ways such as numbers, tables, graphs; diagrams
- Make double bar charts and pie charts
- Read bar graphs, line graphs and pie charts

b) Analyzing evidence and making conclusions

Assessment limits:

- analysing evidence and making conclusions analysing evidence and making conclusions
- Identify and explain a pattern
- Interpret bar graphs, line graphs and pie charts
- Draw conclusion based on gathered data
- Support conclusions with evidence from experiments or research
- Evaluate investigation (suggest what might have caused errors and identify ways to improve investigation)

Nature Of Science (N) (continued)

Nature of Science (N) consists of the understanding and application of scientific investigative techniques and data analysis. Nature of Science also involves the study of the interrelationships between science, technology, and society.

N3 - The Designed World -

Over the course of the history of world exploration, humans have shaped and reshaped the world we live in by using technology in tandem with expanding science knowledge. Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Science influences society through its knowledge and world view. Technology influences society through its products and processes. Science and technology have advanced through contributions of many different people, in different cultures, at different times in history.

SC.M1.N3

Students will produce evidence that demonstrates understanding of :

- a) Things found in nature are different from those that are made by humans. New products and systems can be developed to help solve problems, but there could be desirable or undesirable consequences.

Assessment limits:

- Plants growth require sunshine, air, water – things made by humans require an idea, resources and a design.
- Satellites as communication – when unusable, resulting in “space junk”; pesticides for plant growth can harm environment).

- b) Important contributions to the advancement of science, mathematics and technology have been made by different kinds of people in different cultures in different times.

Assessment limits:

- Scientists differ in what phenomena they study and how they go about their work. (astronomer, biologist, conservationist – deals with at risk organisms and habitats etc.)

- c) Diet, exercise, disease and toxic substances influence the physical health of individuals. Science has contributed to health and health technologies.

Assessment limits:

- Micro-organisms, viruses, bacteria, safe handling of food and water.

PLANNING NOTES

Physical Science (P)

Physical science (P), which consists of concepts of chemistry and physics, involves the study of matter and materials, forces and energy.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

P1 - Matter and Materials -
their properties, components,
interactions and changes

SC.M2.P1

Students will produce evidence that demonstrates understanding of :

a) Chemical changes occur when one or more substances react together to form another substance with different properties.

Assessment limits:

- chemical vs. physical changes
- recognition of occurrence of physical or chemical change
- b) Chemical reactions can be represented by using appropriate symbols, formulas and chemical equations.

Assessment limits:

- symbols and/or formulas for substances such as water, carbon dioxide, sodium chloride, hydrogen, oxygen, nitrogen, magnesium, magnesium oxide, magnesium hydroxide (milk of magnesia), magnesium sulphate (Epsom salts) hydrochloric acid, vinegar, baking soda
- counting atoms in a given formula
- chemical reactions - reactant vs. product in a reaction
- some examples of chemical reactions – dilute acid , vinegar, with calcium carbonate forming carbon dioxide; peroxide and manganese dioxide forming oxygen
- acids and bases, include testing using litmus paper, pH strips or solution (broad categories only –acid range, alkaline range and neutral)
- c) Burning and rusting are examples of oxidation – when oxygen is combined with another substance.

Assessment limits:

- burning of magnesium, carbon, wax, hydrogen, fossil fuels
 - using up oxygen as things burn (candle experiment)
 - rusting – especially Bermuda context – salt air makes things rust faster.
 - d) Reaction rates can be changed by certain factors.
- Assessment limits:
- identify faster reaction rate from diagram or description
 - suggest how a reaction rate can be made faster

P2 - Force and Motion -
the relationship between
force, mass and motion of
an object and the nature and
interaction of waves and
matter.

SC.M2.P2

Students will produce evidence that demonstrates understanding of :

a) Work is the use of force to move an object.

Assessment limits:

- work (w)= force (f) x distance (d)
- use of spring scale
- energy transferred when work is done
- unit joule

Physical Science (P) (continued)

Physical science (P), which consists of concepts of chemistry and physics, involves the study of matter and materials, forces and energy.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

P3 - Energy -

the sources and forms of energy, including transmission and transformations and how energy helps explain the structure of matter and the universe.

SC.M2.P3

Students will produce evidence that demonstrates understanding of :

- a) Energy cannot be created or destroyed, only changed from one form to another. Transformations of energy usually produce heat energy. Energy provides the ability to do work and exists in many forms.

Assessment limits:

- sound, light etc.

- b) Energy can be stored and transformed into the energy of motion.

Assessment limits:

- Understanding of kinetic v. potential energy

- c) Heat is transferred by collision of atoms, radiation and convection in fluids. Heat moves at different rates depending on where the objects are in relation to each other. When different parts of a substance are at different temperatures, energy is transferred from places where the temperature is higher to places where the temperature is lower.

Assessment limits:

- Conductors and poor conductors (insulators)
- expansion and contraction
- impact of heat on environment, warming atmosphere, oceans
- reducing heat loss from homes

P4 - Forces of Nature -

gravitational, electrical and magnetic forces as the fundamental forces acting in nature.

SC.M2.P4

Students will produce evidence that demonstrates understanding of :

Not assessed at this level on the Bermuda Criterion Reference Test (BCRT)

Life Science (L)

Life Science (L) which consists of concepts of biology and ecology, deals with the diversity of living organisms, their organization, life processes, relationships with one another and their environment.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

L1 - Diversity of Life -

the variety of living things and the processes responsible for the maintenance of life.

SC.M2.L1

Students will produce evidence that demonstrates understanding of :

Not assessed at this level on the Bermuda Criterion Reference Test (BCRT)

L2 - Heredity –

biological traits and how they are passed on from generation to generation

SC.M2.L2

Students will produce evidence that demonstrates understanding of :

Not assessed at this level on the Bermuda Criterion Reference Test (BCRT)

L3 - Cells, Organs and Organ Systems –

the structure, function and reproduction of cells that maintain the organization essential for life and specialized organ systems that interact with each other to maintain internal balance

SC.M2.L3

Students will produce evidence that demonstrates understanding of :

- a) Cells are building blocks of all living organisms. In any given organism there may be many millions of cells that repeatedly divide to make more cells for growth and repair.

Assessment limits:

- specialized cells: animal - sperm cells, nerve cells, blood cells, egg cells or ova; plant: root hair etc
 - Cell functions are similar in organisms
 - animal cell and plant cell
 - structure and function of organelles including common ones: nucleus, cytoplasm, cell membrane, mitochondria ones
 - plant cell – cell wall, vacuole, chloroplast
 - basic movement of molecules in and out of the cell - diffusion, osmosis
- b) Humans and other animals have body systems for obtaining and providing energy, defense, reproduction and the coordination of body functions. Different body tissues and organs are made up of different kinds of cells.

Assessment limits:

- organization of cells to tissues to organs to organ systems
- tissue - group of cells with similar structure
- organs made out of tissues
- different organs form organ systems
- functions of different systems and their coordination with each other (digestive, respiratory, circulatory, urinary)

Life Science (L)

(continued)

Life Science (L) which consists of concepts of biology and ecology, deals with the diversity of living organisms, their organization, life processes, relationships with one another and their environment.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

L4 - Interdependence of Life – relationships amongst organisms and their dependence on their environment.

SC.M2.L4

Students will produce evidence that demonstrates understanding of :

- a) In all environments – fresh water, marine, forest etc- organisms with similar needs may compete with each other for resources (food, space, water, air, shelter). The growth and survival of organisms depend on the physical conditions.

Assessment limits:

- Bermuda's 6 land habitats – listed in curriculum document
 - main species in each habitat
 - physical isolation and impact on species in habitats
- b) As a small oceanic island, the land and water ecosystems are especially at risk due to the pressure of development.
- c) Organisms can be categorized as producers, consumers and decomposers of organic matter.

L5 - Flow of Matter and Energy - the linking of organisms to one another and their physical setting by the transfer and transformation of matter and energy.

SC.M2.L5

Students will produce evidence that demonstrates understanding of :

- a) Food provides fuel and building material for all organisms. Plants make their own food by using energy directly from sunlight. Animals eat other organisms to obtain energy. All organisms depend on two main interconnected food webs one in the ocean, the other on land. This becomes an indefinite cycle as organisms decompose after death returning material to the environment.

Assessment limits:

- Interpret food chains and simple food webs
 - focus on land food webs
 - e.g .ant, lizard, kiskadee
 - decomposing matter, cockroach, toad
- b) Matter is transferred from one organism to another organism repeatedly. The amount of matter remains the same, although it might change in form and location.

Assessment limits:

- closed system
- c) Energy can change from one form to another in living things. Animals oxidize their food and get energy, releasing some of it as heat. Almost all food energy comes from sunlight originally.

Life Science (L)

(continued)

Life Science (L) which consists of concepts of biology and ecology, deals with the diversity of living organisms, their organization, life processes, relationships with one another and their environment.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

L6 - Evolution of Life –
the evolution of life on earth, natural selection as an explanation of biological processes.

SC.M2.L6

Students will produce evidence that demonstrates understanding of :

- a) The way in which cells function is similar in all living organisms.
- b) Thousands of layers of sedimentary rock provide evidence for the long history of earth and its life forms. Fossils of more recently formed rock layers are more likely to contain fossils resembling existing species.

Earth And Space Science (E)

Earth and Space (E) Science consists of concepts of astronomy, geology, resources, meteorology and oceanography. Earth and space science involves the study of the earth, the universe, their components and interactions.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

E1 - Astronomy -

the current scientific view of the nature, components, matter and energy sources of the universe.

SC.M2.E1

Students will produce evidence that demonstrates understanding of :

Not assessed at this level on the Bermuda Criterion Reference Test (BCRT)

E2 - Geology -

the features of the earth's surface, how they were formed and how they are continually changing.

SC.M2.E2

Students will produce evidence that demonstrates understanding of :

a) The earth is mostly rock.

Assessment limits:

- rock vs. mineral
- weathering of rocks - chemical/physical weathering
- explanation of the impact of weathering and erosion on rocks
- cave formation, disintegration of cliff faces and walls, degradation of building materials
- the rock cycle - rock forming processes
- Types of rock sedimentary – particularly limestone, metamorphic, igneous

b) The rock cycle includes the formation, weathering, sedimentation and reformation of rock. The forms of material change, but the total amount stays the same. Rocks are usually found in layers with the oldest at the bottom. Thousands of layers of sedimentary rock can give evidence to the long history of the changing surface of the earth and its life forms

E3 - Resources -

the earth's limited and varied materials that supply many of the resources that humans use

SC.M2.E3

Students will produce evidence that demonstrates understanding of :

- a) Humans benefit from the earth's resources such as water, air, soil and trees.
- b) Human decisions have changed the earth's land, oceans, and atmosphere. Bermuda as an oceanic island is especially unique and vulnerable.

Assessment limits:

- focus on land

Earth And Space Science (E) (continued)

Earth and Space (E) Science consists of concepts of astronomy, geology, resources, meteorology and oceanography. Earth and space science involves the study of the earth, the universe, their components and interactions.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

E4 - Meteorology -
the interactions of structures of the earth's system and the sun's energy which cause weather and climate patterns

SC.M2.E4

Students will produce evidence that demonstrates understanding of :

Not assessed at this level on the Bermuda Criterion Reference Test (BCRT)

E5 - Oceanography -
the features of oceans and the impact of these features on the global ecosystem

SC.M2.E5

Students will produce evidence that demonstrates understanding of :

Not assessed at this level on the Bermuda Criterion Reference Test (BCRT)

Nature Of Science (N)

Nature of Science (N) consists of the understanding and application of scientific investigative techniques and data analysis. Nature of Science also involves the study of the interrelationships between science, technology, and society.

N1 - Scientific Investigation

-People can often learn about things around them by just observing those things carefully, but sometimes they can learn more by doing something to things and noting what happens. Investigations are conducted for different reasons, which include exploring new phenomena, checking on previous results and comparing different theories. Investigations usually involve collecting evidence, reasoning, devising hypotheses, and making predictions.

N2 - Data Representation and Interpretation -

Data must be analysed in order to make sense of what has been collected. Sometimes the evidence collected might not be what you expected or might not be sufficient to draw a conclusion. Clear and accurate communication is important in doing science and an essential part of sharing an investigation in order to inform others.

SC.M2.N1

Students will produce evidence that demonstrates understanding of :

a) Planning an investigation

Assessment limits:

- Select a question that can be answered by an investigation involving one or two factors
- Use science knowledge to predict effect of variable (term variable not testable)
- Choose equipment capable of measuring to 1/10ths as appropriate
- Write/evaluate clear step by step procedure for investigation

b) Obtaining evidence for investigation.

Assessment limits:

- Select what to measure
- Make series of observations and measurements/ record clearly and accurately on charts
- Use a range of apparatus with increasing precision (nearest 1/10th)
- Read analog and digital meters on instruments used to make direct measurements of length, volume, weight, elapsed time, rates and temperature (refer to curriculum Science Toolbox)
- Know when to repeat measurements (when they are too different/ until they are considered correct (consistent))
- Calculate and record averages as required.
- Make further predictions based on patterns in results

SC.M2.N2

Students will produce evidence that demonstrates understanding of :

a) Summarising and organising data

Assessment limits:

- Summarise and organize data in tables and line and bar graphs; represent data and results in multiple ways such as numbers, tables, graphs, diagrams.
- Read bar graphs, pie charts and line graphs

b) Analyzing evidence and making conclusions

Assessment limits:

- Compare related data sets
- Interpret bar graphs, pie charts and line graphs
- Identify and explain a pattern
- Draw a conclusion related to the question being investigated
- Relate conclusion to science knowledge
- Support conclusions with evidence from experiments or research
- Evaluate investigation (describe and explain errors and improvement; suggest further investigations)

Nature Of Science (N) (continued)

Nature of Science (N) consists of the understanding and application of scientific investigative techniques and data analysis. Nature of Science also involves the study of the interrelationships between science, technology, and society.

N3 - The Designed World -

Over the course of the history of world exploration, humans have shaped and reshaped the world we live in by using technology in tandem with expanding science knowledge. Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Science influences society through its knowledge and world view. Technology influences society through its products and processes. Science and technology have advanced through contributions of many different people, in different cultures, at different times in history.

SC.M2.N3

Students will produce evidence that demonstrates understanding of :

- a) Things found in nature are different from those that are made by humans. New products and systems can be developed to help solve problems, but there could be desirable or undesirable consequences.

Assessment limits:

- Engines can decrease travel time, increase productivity, lessen need for manual labour
- More and better vehicles– problem of disposal of them in Bermuda, increased fuel consumption damaging to fragile ecosystem, increased air pollution)

- b) Important contributions to the advancement of science, mathematics and technology have been made by different kinds of people in different cultures in different times.

Assessment limits:

- Scientists differ in what phenomena they study and how they go about their work. (e.g., geologist studying rocks and minerals; specialist doctors treating patients)

- c) Diet, exercise, disease and toxic substances influence the physical health of individuals. Science has contributed to health and health technologies.

Assessment limits:

- Importance of good dietary habits, vitamins and minerals; disease, medicines and vaccinations; transplants and replacement of body parts; blood transfusions; harmful substances in the environment – soil, air and water; avoidance of toxic substances.

Physical Science (P)

Physical science (P), which consists of concepts of chemistry and physics, involves the study of matter and materials, forces and energy.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

P1 - Matter and Materials -
their properties, components,
interactions and changes

SC.M3.P1

Students will produce evidence that demonstrates understanding of :

a) Matter is made up of atoms that are too small to see, even using a microscope. Atoms of any element are alike, but different from atoms of other elements. Atoms are composed of a positively charged nucleus (containing neutrons and protons (+ve) and surrounded by electrons (-ve) Atoms may combine to form new molecules.

b) These particles are in constant motion. Increased temperature means greater energy of motion.

Assessment limits:

- use of particle model – states of matter, phase changes
- conservation in a closed system.

c) About 100 different elements have been identified, out of which everything is made. Some groups of elements have similar properties. The periodic table is a classification system of elements.

Assessment limits:

- Mendeleev's contribution
- broad structure – metals/nonmetals, groups and periods, families alkali metals, alkaline earth metals, halogens, noble gases, coinage metals
- symbols for first 20 elements and coinage metals

d) Chemical changes occur when one or more substances react together to form another substance with different properties. Chemical changes can be represented by using appropriate symbols, formulas and chemical equations.

Assessment limits:

- name simple compounds using standard convention e.g. oxides, chlorides
 - identification and counting atoms in an unfamiliar formula
 - word equations only terms – reactant and product; reactions include metal + acid forming hydrogen, metal carbonate+ acid forming carbon dioxide; manganese dioxide + hydrogen peroxide forming oxygen; acid +base =neutralization
 - chemical reactions that occur in the human body and during photosynthesis
- e) Some factors that influence reaction rates include temperature and particle size.

SC.M3.P2

Students will produce evidence that demonstrates understanding of :

a) Vibrations such as sound and earthquakes set up wave like disturbances that spread away from the source much like water waves. Sound waves enter the ear causing hearing, just as emission or reflection of light waves causes 'seeing.' Light travels in a straight line and can be reflected, refracted or absorbed.

Assessment limits:

- recognize, compare, contrast examples

P2 - Force and Motion -
the relationship between
force, mass and motion of
an object and the nature and
interaction of waves and
matter.

Physical Science (P) (continued)

Physical science (P), which consists of concepts of chemistry and physics, involves the study of matter and materials, forces and energy.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

P2 - Force and Motion -

the relationship between force, mass and motion of an object and the nature and interaction of waves and matter.

SC.M3.P2 (continued)

Students will produce evidence that demonstrates understanding of :

- b) White light can be split up into a spectrum of different colours. The human eye only responds to a narrow range of wavelengths. There are other types of radiation beyond the ends of the visible spectrum. Similarly, there are sound waves that we cannot hear – “ultrasound.”
- c) Waves move at different speeds in different materials. Light can travel through a vacuum, but sound requires a medium to travel (speed of sound).

P3 - Energy -

the sources and forms of energy, including transmission and transformations and how energy helps explain the structure of matter and the universe.

SC.M3.P3

Students will produce evidence that demonstrates understanding of :

- a) Energy is transferred from batteries to other components in electrical circuits. Electrical energy in circuits can produce heat, light sound and chemical changes. Components in a circuit resist a current flowing through them.

Assessment limits:

- Interpretation of circuit diagrams
- complete circuit
- understand parallel and series circuits

P4 - Forces of Nature -

gravitational, electrical and magnetic forces as the fundamental forces acting in nature.

SC.M3.P4

Students will produce evidence that demonstrates understanding of :

- a) Electric currents and magnets can exert a force on each other, that is, electric currents can produce magnetic forces and magnets can cause electric currents.

Assessment limits:

- static electricity – caused by friction
- current electricity
- magnets
- electromagnets example how to increase strength
- magnetic fields - illustrations

Life Science (L)

Life Science (L) which consists of concepts of biology and ecology, deals with the diversity of living organisms, their organization, life processes, relationships with one another and their environment.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

L1 - Diversity of Life -

the variety of living things and the processes responsible for the maintenance of life.

SC.M3.L1

Students will produce evidence that demonstrates understanding of :

Not assessed at this level on the Bermuda Criterion Reference Test (BCRT)

L2 - Heredity –

biological traits and how they are passed on from generation to generation

SC.M3.L2

Students will produce evidence that demonstrates understanding of :

- a) In some organisms all genes come from a single parent and in others half come from each parent.

Assessment limits:

- DNA contains information necessary to make an organism
- b) In sexual reproduction a single specialized cell from a female merges with a specialized cell from a male. As the fertilized egg multiplies, the same genetic information is copied in each cell. This cell division produces a small cluster of cells that then differentiate by appearance and function to form the basic tissues of an embryo. Patterns of human development are similar to those of other vertebrates.
- c) Selective breeding involves breeding individuals with particular inherited characteristics.

Assessment limits:

- Interpretation of completed Punnett square

L3 - Cells, Organs and Organ Systems –

the structure, function and reproduction of cells that maintain the organization essential for life and specialized organ systems that interact with each other to maintain internal balance

SC.M3.L3

Students will produce evidence that demonstrates understanding of :

- a) Cells are building blocks of all living organisms. In any given organism there may be many millions of cells that repeatedly divide to make more cells for growth and repair.

Assessment limits:

- comparison of fertilization of human and flowering plants
 - cells-sperm and ova
 - parts of flower including stigma, style, ovary, stamen, anther, filament
- b) Humans and other animals have body systems for obtaining and providing energy, defense, reproduction and the coordination of body functions.

Assessment limits:

- reproductive system;
- protection and support of fetus, including risk of harmful substances including drugs, viruses

Life Science (L)

(continued)

Life Science (L) which consists of concepts of biology and ecology, deals with the diversity of living organisms, their organization, life processes, relationships with one another and their environment.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

L4 - Interdependence of Life –
relationships amongst
organisms and their
dependence on their
environment.

SC.M3.L4

Students will produce evidence that demonstrates understanding of :

- a) In all environments – fresh water, marine, forest etc. - organisms with similar needs may compete with each other for resources (food, space, water, air, shelter). The growth and survival of organisms depend on the physical conditions. In Bermuda many of the species are at the extreme limits of their geographical distribution. As a small oceanic island, the land and water ecosystems are especially at risk due to the pressure of development.
- b) Coral reefs are physical structures produced by organisms. Corals need light and warm temperatures, thus grow in shallow, clear, warm waters. Vast numbers of species live on coral reefs and have evolved special symbiotic relationships.

Assessment limits:

- marine habitats – coral reefs, seagrass beds and mangrove forests
 - function of reef systems and risk to reef systems locally and globally
 - over fishing, fish pot ban, interpreting data of fish catch, invasive species e.g. lion fish
 - rocky coast as a habitat – structure and organisms that live there
- c) Ocean food chains are threatened by over fishing by people. As the large predatory fish stocks such as tuna, shark and swordfish decline, smaller fish near the base of the ocean food web are taken. This is a serious international problem that threatens the health of the oceans.

L5 - Flow of Matter and Energy
- the linking of organisms to
one another and their physical
setting by the transfer and
transformation of matter and
energy.

SC.M3.L5

Students will produce evidence that demonstrates understanding of :

- a) Food provides fuel and building material for all organisms. Plants make their own food by using energy directly from sunlight. Animals eat other organisms to obtain energy.
- b) All organisms depend on two main interconnected food webs in the ocean, the other on land. This becomes an indefinite cycle as organisms decompose after death returning material to the environment.

Assessment limits:

- Interpret food chains and simple food webs
 - focus on marine food webs
- c) Matter is transferred from one organism to another organism repeatedly. The amount of matter remains the same, although it might change in form and location.

Life Science (L)

(continued)

Life Science (L) which consists of concepts of biology and ecology, deals with the diversity of living organisms, their organization, life processes, relationships with one another and their environment.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

L6 - Evolution of Life –
the evolution of life on earth, natural selection as an explanation of biological processes.

SC.M3.L6

Students will produce evidence that demonstrates understanding of :

- a) Some individuals with certain traits are more likely to survive and reproduce than others. Changes in the environment can affect survival.
- b) Patterns in human development are similar to that of other vertebrates. Similarities among organisms are found in internal features as well. This infers a degree of relatedness.
- c) People can control some characteristics of plants and animals by selective breeding. This means that the descendants are different from their ancestors.

Earth And Space Science (E)

Earth and Space (E) Science consists of concepts of astronomy, geology, resources, meteorology and oceanography. Earth and space science involves the study of the earth, the universe, their components and interactions.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

E1 - Astronomy -

the current scientific view of the nature, components, matter and energy sources of the universe.

E2 - Geology -

the features of the earth's surface, how they were formed and how they are continually changing.

SC.M3.E1

Students will produce evidence that demonstrates understanding of :

- a) The sun and the stars are light sources. Planets are seen by reflected light.

SC.M3.E2

Students will produce evidence that demonstrates understanding of :

- a) The earth is mostly rock. Three quarters of the earth's surface is covered by a layer of water, some of which is frozen. Earth is surrounded by a blanket of air. The interior of the earth is hot. Heat flow and the movement of material within the earth cause earthquakes and volcanic eruptions and create mountains and ocean basins. Oceanic islands, such as Bermuda, are formed by volcanic activity along ocean floor.

Assessment limits:

- Earth layers - crust, mantle, inner core, outer core
 - identification of layers and recognize basic characteristics
 - formation of Bermuda using ridge and adapted hot spot theories
 - limestone caps and reefs
 - conditions for coral growth;
 - function of reef system - barrier/protection from storm surge, tsunami;, food source , beauty
- b) Waves, wind, water and ice reshape the earth's surface, such as removing evidence of the volcanic seamount that formed Bermuda. Bermuda is capped by sandy limestone rocks that are sedimentary deposits. Sandy beaches preceded beach dune formation in Bermuda. Beach sand in Bermuda can be pink due to the remains of an animal that has coloured its calcium carbonate skeleton red. Some changes in the earth's surface are caused by sudden events such as earthquakes, volcanoes and in Bermuda, hurricanes. However, other changes happen over long periods of time.
- c) Matching coastlines and similarities in rock types and life forms suggest that today's continents are separated parts of what was long ago a single continent.

Earth And Space Science (E) (continued)

Earth and Space (E) Science consists of concepts of astronomy, geology, resources, meteorology and oceanography. Earth and space science involves the study of the earth, the universe, their components and interactions.

Conceptual understanding should be demonstrated by

- *Using a concept accurately to explain observations and make predictions*
- *Representing the concept in a variety of ways including words, diagrams, charts and graphs, as appropriate*

E3 - Resources -

the earth's limited and varied materials that supply many of the resources that humans use

SC.M3.E3

Students will produce evidence that demonstrates understanding of :

- a) Human decisions have changed the earth's land, oceans and atmosphere. Bermuda as an oceanic island is especially unique and vulnerable.

Assessment limits:

- focus on marine
 - threats to health of reefs, seagrass beds and mangrove forests
- b) The sun is the ultimate source of most of the earth's energy resources and these resources are not renewable.

E4 - Meteorology -

the interactions of structures of the earth's system and the sun's energy which cause weather and climate patterns

SC.M3.E4

Students will produce evidence that demonstrates understanding of :

- a) Solar energy causes ocean and air currents. These currents impact upon weather patterns and climate.
- b) Water cycles throughout the earth system. It evaporates from the surface of the earth, rises, cools, condenses into rain or snow and falls again to the surface of the earth, collecting in rivers, lakes, soil and rock. Much of it flows back to the ocean.
- c) Weather can be described and studied in terms of properties of the atmosphere.

Assessment limits:

- factors that cause weather
- reading simple weather maps
- air masses, high and low pressure, fronts
- severe weather conditions such as hurricanes

E5 - Oceanography -

the features of oceans and the impact of these features on the global ecosystem

SC.M3.E5

Students will produce evidence that demonstrates understanding of :

- a) Most of the earth's surface is covered by water. Earth is the only planet that has liquid water on its surface.
- b) The open ocean regulates earth's climate, conditions of the atmosphere and provides food and many other resources.
- c) Coastal peoples of every culture developed a large amount of practical knowledge about the ocean and its organisms. As people gained skills in seamanship and navigation, this knowledge increased. Increasingly sophisticated technologies are being used to explore the oceans.
- d) People have a significant impact on the ocean environment and ocean life.

Nature Of Science (N)

Nature of Science (N) consists of the understanding and application of scientific investigative techniques and data analysis. Nature of Science also involves the study of the interrelationships between science, technology, and society.

N1 - Scientific Investigation

-People can often learn about things around them by just observing those things carefully, but sometimes they can learn more by doing something to things and noting what happens. Investigations are conducted for different reasons, which include exploring new phenomena, checking on previous results and comparing different theories. Investigations usually involve collecting evidence, reasoning, devising hypotheses, and making predictions.

N2 - Data Representation and Interpretation -

Data must be analysed in order to make sense of what has been collected. Sometimes the evidence collected might not be what you expected or might not be sufficient to draw a conclusion. Clear and accurate communication is important in doing science and an essential part of sharing an investigation in order to inform others.

SC.M3.N1

Students will produce evidence that demonstrates understanding of :

a) Planning an investigation

Assessment limits:

- Identify appropriate question being tested
 - Make a prediction about the outcome supported by data, science knowledge, or research
 - Choose equipment as in level M2 (capable of measuring to 1/10ths as appropriate)
 - Write/evaluate clear step by step procedure for investigation
- b) Obtaining evidence for investigation.

Assessment limits:

- Identify variables in an experiment and indicate which variables should be controlled
- Measure appropriate quantities. Determine the number of measurements, record and average as required /record clearly and accurately on charts
- Use a range of apparatus with increasing precision (nearest 1/10th)
- Read analog and digital meters on instruments used to make direct measurements of length, volume, weight, elapsed time, rates and temperature refer to curriculum Science Toolbox)
- Know when to repeat measurements (when they are too different for example). Calculate and record averages as required.
- Make further predictions based on patterns in results

SC.M3.N2

Students will produce evidence that demonstrates understanding of :

a) Summarising and organising data

Assessment limits:

- Summarise and organize data in tables and line and bar graphs; represent data and results in multiple ways such as numbers, tables, graphs, diagrams.
- Read bar graphs, pie charts and line graphs
- Choose appropriate scales for charts and line graphs

b) Analyzing evidence and making conclusions

Assessment limits:

- Compare related data sets
- Interpret pie charts and line graphs
- Identify measurements and observations that do not seem to fit the pattern
- Draw appropriate conclusions that fit the evidence
- Recognise whether the data collected is sufficient for conclusions drawn
- Support conclusions with evidence from experiments or research
- Use scientific knowledge to explain evidence
- Evaluate investigation
- Describe and explain errors and improvement; suggest further investigations

Nature Of Science (N) (continued)

Nature of Science (N) consists of the understanding and application of scientific investigative techniques and data analysis. Nature of Science also involves the study of the interrelationships between science, technology, and society.

N3 - The Designed World -

Over the course of the history of world exploration, humans have shaped and reshaped the world we live in by using technology in tandem with expanding science knowledge. Science cannot answer all questions and technology cannot solve all human problems or meet all human needs. Science influences society through its knowledge and world view. Technology influences society through its products and processes. Science and technology have advanced through contributions of many different people, in different cultures, at different times in history.

SC.M3.N3

Students will produce evidence that demonstrates understanding of :

- a) Things found in nature are different from those that are made by humans. New products and systems can be developed to help solve problems, but there could be desirable or undesirable consequences.

Assessment limits:

- tape recorders and digital TV's and play stations are applications of sound and light technology
- Selective breeding and long distance food transportation increase productivity, but affect risks and costs for producing food
- increased water traffic including ferries, personal water craft, jet skis - damage to the marine ecosystem – sea grass beds, reefs, fuel exhaust pollution)

- b) Important contributions to the advancement of science, mathematics and technology have been made by different kinds of people in different cultures in different times.

Assessment limits:

- Scientists differ in what phenomena they study and how they go about their work. (meteorologist, oceanographer, and other careers associated with science such as electrician)

- c) Diet, exercise, disease and toxic substances influence the physical health of individuals. Science has contributed to health and health technologies.

Assessment limits:

- as M2 – include movement across the placenta, risks to unborn child, technologies that help sight and hearing; medical technologies such as ultrasound, radiation techniques for cancer patients.

PLANNING NOTES



MISSION STATEMENT

The mission of the Bermuda Public School System is to be the 1st choice in education by providing rigorous and stimulating learning experiences in safe responsive environments from which our students emerge confident and prepared to compete and contribute locally and globally.



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