REPUBLIC OF TRINIDAD AND TOBAGO
MINISTRY OF EDUCATION

SECONDARY EDUCATION MODERNIZATION PROGRAMME

DRAFT

SECONDARY SCHOOL CURRICULUM

Form Three

Science

Curriculum Development Division
October 2003

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ABOUT THIS DRAFT

Under the umbrella of the Secondary Education Modernization Programme (SEMP), since the latter part of 1999, new secondary school curricula in eight (8) subjects – Language Arts (English), Science, Mathematics, Social Studies, Spanish, Physical Education, Visual and Performing Arts and Technology Education – have been in development. In this publication you will find the first drafts of the Form III curriculum guide produced for each of the above identified subject areas.

These Curriculum Guides represent 'a work in progress'. They are not the finished product. They intended to serve the following purposes:

(i) provide clear guidance to teachers for implementing effectively the instructional programme for a particular subject area at a particular class/form level.

(ii) present a sufficiently detailed learning plan for the respective subject areas and for the entire secondary school curriculum that would enable teachers, school administrators and other major stakeholders to give meaningful, constructive feedback on the draft curricula for the various subjects – that is, for them to be actively involved in the development process.

(iii) contribute to the further revision and refinement, through the feedback received at (ii) above, of this draft curriculum guide for Form III.

Teachers and other users of these Curriculum Guides should also carefully note the following:

- Teachers' Guides, Performance Standards, Assessment Manuals, Integration Matrices (linking content and essential learning outcomes in the relevant subject areas) are being developed and are in various stages of completion as companion documents to these Curriculum Guides. Accordingly, teachers and other users of these Draft Curricula can be assured that only certain areas, which may be interpreted as showing a lack of clarity, detail and/or adequate treatment, will be adequately addressed in the forthcoming above-mentioned companion documents.

- A series or orientation meetings and training workshops related to the effective implementation of the curriculum is being planned. At these workshops/meetings the concerns of teachers will be addressed and guidance given with respect to the interpretation/clarification of certain aspects of these draft Guides.

- These first draft publications of the respective Curriculum Guides have been issued in ring binders. This mode of presentation will facilitate correction of existing typographical errors, standardization of font sizes, formatting, layout etc, as well as the revision/refinement of the subsequent drafts – which will inevitably ensue from feedback/comments on these draft documents.

Finally, we hold the view that teachers, in particular, but other stakeholders as well, are key players in the curriculum development process. Teachers are integral to the development of curricula that are relevant and appropriate. The curriculum is the major vehicle for providing quality education which meets the needs of both the individual learner and the national development objectives of the Republic of Trinidad and Tobago. In this regard, we eagerly look forward to and indeed welcome the comments/suggestions of all stakeholders, especially teachers, which should be addressed to:

Director, Curriculum Development
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A Note to Teachers

The Ministry of Education through the Secondary Education Modernization Programme is seeking to reform the secondary education system. These draft National Curriculum Guides produced for eight subject areas are a key element in the current thrust to address the deficiencies identified in the system.

Draft curriculum guides have already been produced for years one and two of the secondary system. Implementation of the new curriculum began on a phased basis in September 2003. These draft guides for year three represent the conclusion of the first cycle of secondary school and together with those of years one and two prepare students for the National Certificate of Secondary Education, Part One.

The three sets of curriculum guides constitute the draft National Curriculum for the lower secondary school system. The National Curriculum is an important element of the School Curriculum which comprises all the learning and other experiences that each school plans for its pupils. It is expected that each school will undertake to develop the School Curriculum in alignment with the National Curriculum, fine tuning as necessary in response to the needs of their pupils and to the community.

Teachers too have curriculum functions to perform. Using the National Curriculum Guides they are expected to develop instructional programmes, determining the type and extent of curriculum integration and the teaching and assessment strategies to be employed to facilitate student success. They will also identify and develop appropriate learning materials and decide on how the curriculum will be individualized to suit students' capabilities, needs and interests.

The introduction of the new curriculum guides for forms one to three is being accompanied by several supporting initiatives. These include the

- phased technical upgrade of physical facilities
- provision of enhanced teaching and learning resources including textbooks
- increased use of educational technology
- introduction of a curriculum website at *www.curriculum.gov.tt*
- professional development opportunities for teachers, heads of departments, principals and vice-principals

- expanded schools transportation and meals programmes
- restructuring and decentralization of the education system.

As implementation proceeds, there will be careful monitoring to obtain feedback and to provide necessary support. Your comments and suggestions are most welcome and may be made on the website or in writing.
Final revision of the draft guides is planned for the academic year 2005-2006.

We are confident that this new curriculum will significantly enhance teaching and learning experiences in our secondary schools and consequently the achievement of the national educational goals.

Sharon Mangroo

Director, Curriculum Development (Ag)

December, 2003

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- Mr. Maurice Chin Aleong, Programme Coordinator, Dr. Stephen Joseph, Assistant Programme Coordinator, Quality Improvement and Mrs. Patricia Sealy and Mrs. Renée Figuera, Education Specialists

- Mr. Lloyd Pujadas, Director, Curriculum Development and leader of the SEMP Curriculum Development sub-component who led the year three activities

- Dr. Robert Sargent, International Consultant of Mount St. Vincent University who guided the process

- The principals who generously released teachers to participate in the curriculum writing process

- The administrative staff of the Curriculum Development Division who typed and retyped the documents

- The Division of Educational Services which printed early drafts for circulation

- Mrs. Marie Abraham, Editor who contributed her time, energy and knowledge to the editing of these documents

The Curriculum Officers and members of the Curriculum Writing Teams brought their knowledge, skills and practical experience of teaching and learning to the curriculum development process. Members of the writing team for this subject are listed below.

The Members of the writing team for this subject are:

NAME	SCHOOL/INSTITUTION
1. Mr. Henry Saunders	Curriculum Coordinator
2. Ms. Claudette Ible	Curriculum Officer – Team Leader
3. Dr. Marva Ribeiro	Curriculum Officer
4. Ms Phyllis Lutchman	Carapichaima Junior Secondary School

Integrated Science

Form III

Part One

INTRODUCTION

In its commitment to a comprehensive reform and expansion of the secondary school system, the Government of the Republic of Trinidad and Tobago in 1996, adopted the report of the National Task Force on Education as educational policy. The specific recommendations for the improvement of secondary education led to discussions with the Inter American Development Bank (IADB) for loan funding arrangements for a programme to modernise secondary education in Trinidad and Tobago. This programme, the Secondary Education Modernization Programme (SEMP) was formalized and has been designed to:

- address deficiencies identified in the education system;

- establish a firm secondary education foundation that would catapult Trinidad and Tobago into the 21st century assured of its ability to participate advantageously in the global economic village, smoothly traverse the information super highway and utilize cutting edge technology for the competitive advantage it provides;

- allow for adaptation to future demands; and

- produce good citizens

The deficiencies identified include:

- an unacceptably low level of academic achievement;
- unsatisfactory personal and social development outcomes: and
- curricular arrangements whose major outcomes were linked to the attainment of a minimum of five General passes in the Caribbean Examinations Council (CXC) examination.

The Secondary Education Modernization Programme (SEMP) consists of four articulated components:

(a) improved educational equity and quality

(b) deshifting, rehabilitation, and upgrading of school infrastructure

(c) institutional strengthening, and

(d) studies and measures for improved sector performance.

This document is evidence of the effort to address component (a) under which curriculum development falls.

THE CURRICULUM UNDERPINNINGS

This curriculum has been informed by the wealth of available curriculum theories and processes.
In the Final Report of the Curriculum Development Sub-Component submitted by J. Reece and K. Seepersad, the curriculum is defined, as a "plan for action" or a "written document that included strategies for achieving desired goals or ends." This is the definition that is applied here. The curriculum is herein defined as the written document that is to be used by teachers to plan effective learning opportunities for students in secondary schools.

Macdonald (1976) declares,

> 'Curriculum it would seem to me is the study of "what should constitute a world for learning and how to go about making this world". As such it is a microcosm… the very questions that seem to me of foremost concern to all humanity, questions such as what is the good society, what is the good life and what is a good person are explicit in the curriculum question. Further, the moral question of how to relate to others or how best to live together is clearly a part of curriculum.'

In essence Macdonald's statement establishes the basic forces that influence and shape the organization and content of the curriculum: the curriculum foundations. These are:-

(a) The Philosophy and the Nature of Knowledge
(b) Society and Culture
(c) The Learner
(d) Learning Theories

These foundations are at the heart or the centre of the dialogue essential to the development of a coherent, culturally focused and dynamically evolving curriculum. Of course the prevailing philosophical concerns and educational goals provide the base.

PHILOSOPHY OF EDUCATION

The following philosophical statements are at the foundation of the curriculum and are stated in the Education Policy Paper 1993-2003 as follows:

"WE BELIEVE

That every child has an inherent right to an education which will enhance the development of maximum capability regardless of gender, ethnic, economic, social or religious background. That every child has the ability to learn, and that we must build on this positive assumption. That every child has an inalienable right to an education which facilitates the achievement of personal goals and the fulfillment of obligations to society.

That education is fundamental to the overall development of Trinidad and Tobago.

That a system of 'heavily subsidized' and universal education up to age 16 is the greatest safeguard of the freedom of our people and is the best guarantee of their social, political, and economic well-being at this stage in our development.

That the educational system of Trinidad and Tobago must endeavour to develop a spiritually, morally, physically, intellectually and emotionally sound individual.

That ethical and moral concerns are central to human development and survival. Fundamental constructs such as "decency," "justice," "respect," "kindness," "equality, "love," "honesty," and "sensitivity," are major determinants of the survival of our multi-cultural society.

That the parent and the home have a major responsibility for the welfare of the child and that the well-being of the child can best be served by a strong partnership between the community and the school.

That the educational system must provide curricular arrangements and choices that ensure that cultural, ethnic, class and gender needs are appropriately addressed.

That students vary in natural ability, and that schools therefore should provide, for all students, programmes which are adapted to varying abilities, and which provide opportunities to develop differing personal and socially useful talents.

That we must be alert to new research and development in all fields of human learning and to the implications of these developments for more effective teaching and school improvement.

That the educational system must be served by professionals who share and are guided in their operations by a set of systematic and incisive understandings, beliefs and values about education in general and its relationship to the development of the national community of Trinidad and Tobago.

That there is a need to create and sustain a humanised and democratised system of education for the survival of our democracy.

That the democratisation and humanisation of the educational system are largely contingent on the degree to which the system is professionalised. The nature of educational problems are [sic] such that the professional core must be engaged in decision-making with respect to the problems that affect their expert delivery of the services to the clientele and ultimately to Trinidad and Tobago. Professionals must come to experience a real sense of 'control and ownership' of matters educational.

That from a psychological perspective, education is a means of looking out beyond the boundaries of the immediate. It can be the viable means which creates individuals with the intellect and capacity to develop and lead societies, communities, villages, and/or neighbourhoods and families of the future. It should be responsive to and stimulate the searing human spirit and the emphatic quest for human communication, interaction, love and trust.

That learning is cumulative and that every stage in the educational process is as important and critical for the learner's development as what has gone before it and what is to come. As such we must view educational programming and development in the round, recognising the importance of every rung on the ladder of delivery by intensifying our efforts throughout the system."

THE GOALS OF EDUCATION

Coming out of the articulated philosophy, formal education in Trinidad and Tobago must aim to:

- provide opportunities for all students to develop spiritually, morally, emotionally, intellectually and physically;
- develop in all students attitudes of honesty, tolerance, integrity and efficiency;
- provide opportunities for self-directed and life-long learning;
- provide opportunities for all students to develop numeracy, literacy, scientific and technological skills;
- promote national development and economic sustainability;
- promote an understanding of the principles and practices of a democratic society;
- equip all students with basic life skills;
- promote the preservation and protection of the environment;
- develop in all students an understanding of the importance of a healthy lifestyle;
- help all students acquire the knowledge, skills and attitudes necessary to be intelligent consumers;
- provide opportunities for all students to develop an understanding and appreciation of the diversity of our culture; and
- provide opportunities for all students to develop an appreciation for beauty and human achievement in the visual and performing arts.

An analysis of the educational philosophy of the Ministry of Education's Policy Paper (1993 – 2003) and of the goals for education derived from it by the Curriculum Development Division (as outlined above), taken with the research conducted in developed nations, has led to the identification of six areas in which all secondary students must achieve. These are universally accepted goals that have been developed and underscored by other educational jurisdictions and have been described as essential learning outcomes. These outcomes help to define standards of attainment for all secondary school students.

THE ESSENTIAL LEARNING OUTCOMES

The six outcomes are in the areas of:

- Aesthetic Expression
- Citizenship
- Communication
- Personal Development
- Problem Solving
- Technological Competence

The achievement of these essential learning outcomes by all students is the goal that every core curriculum subject must facilitate. The core curriculum subjects, their content, and the teaching, learning and assessment strategies are the means to fulfill this end.

It is expected that by the end of the third year of secondary school students' achievement in all six areas will result in a solid foundation of knowledge, skills and attitudes which will constitute the base for a platform for living in the Trinidad and Tobago society and for making informed choices for further secondary education.

The essential learning outcomes are described more fully below.

Aesthetic Expression

Students should recognise that the arts represent an important facet of their development, and that they should respond positively to its various forms. They should be able to demonstrate visual acuity and aesthetic sensibilities and sensitivities in expressing themselves through the arts.

Students should be able, for example, to:-

- use various art forms as a means of formulating and expressing ideas, perceptions and feelings;
- demonstrate understanding of the contribution of the arts to daily life, cultural identity and diversity;
- demonstrate an understanding of the economic role of the arts in the global village society;
- demonstrate understanding of the ideas, perceptions and feelings of others as expressed in various art forms;
- demonstrate understanding of the significance of cultural resources, such as museums theatres, galleries, and other expressions of the multi-cultural reality of society.

Citizenship

Students should be able to situate themselves in a multicultural, multiethnic environment with a clear understanding of the contribution they must make to social, cultural, economic, and environmental development in the local and global context.

Students should be able, for example, to:-

- demonstrate an understanding of sustainable development and its implications for the environment locally and globally;
- demonstrate an understanding of Trinidad and Tobago's political, social and economic systems in the global context;
- demonstrate understanding of the social, political and economic forces that have shaped the past and present, and apply those understandings to the process of planning for the future;

- examine issues of human rights and recognize and react against forms of discrimination, violence and anti-social behaviours;
- determine the principles and actions of a just, peaceful, pluralistic and democratic society, and act accordingly;
- demonstrate an understanding of their own cultural heritage, cultural identity and that of others and the contribution of multiculturalism to society.

Communication

Students should be able to, through the use of their bodies, language, tools, symbols and media, demonstrate their deeper understandings of synergies inherent in the exchange of ideas and information and thus communicate more effectively.

Students should be able, for example, to:-

- explore, reflect on, and express their own ideas, learning, perceptions and feelings;
- demonstrate understanding of facts and relationships presented through words, numbers symbols, graphs and charts;
- demonstrate sensitivity and empathy where necessary in communicating various kinds of emotions and information;
- present information and instructions clearly, logically, concisely and accurately for a variety of audiences;
- interpret and evaluate data, and express ideas in everyday language;
- critically reflect on and interpret ideas presented through a variety of media.

Personal Development

Students should be able to grow from inside out, continually enlarging their knowledge base, expanding their horizons and challenging themselves in the pursuit of a healthy and productive life.
Students should be able, for example, to:-

- demonstrate preparedness for the transition to work and further learning;
- make appropriate decisions and take responsibility for those decisions;
- work and study purposefully both independently and in cooperative groups;
- demonstrate an understanding of the relationship between health and lifestyle;
- discriminate amongst a wide variety of career opportunities;
- demonstrate coping, management and interpersonal skills;
- display intellectual curiosity, an entrepreneurial spirit and initiative;
- reflect critically on ethical and other issues;
- deal effectively with change and become agents for positive, effective change.

Problem Solving

Students should know problem-solving strategies and be able to apply them to situations they encounter. They should develop critical thinking and inquiry skills with which they can process information to solve a wide variety of problems.
Students should be able, for example, to:-

- acquire, process and interpret information critically to make informed decisions;
- use a variety of strategies and perspectives with flexibility and creativity for solving problems;
- formulate tentative ideas, and question their own assumptions and those of others;
- solve problems individually and collaboratively;
- identify, describe, formulate and reformulate problems;
- frame and test hypotheses;
- ask questions, observe relationships, make inferences, and draw conclusions;
- identify, describe and interpret different points of view and distinguish fact from opinion.

Technological Competence

Students should be technologically literate, able to understand and use various technologies, and demonstrate an understanding of the role of technology in their lives, in society, and the world at large.

Students should be able, for example, to:-

- locate, evaluate, adapt, create, and share information using a variety of sources and technologies;
- demonstrate understanding of and use existing and developing technologies appropriately;
- demonstrate an understanding of the impact of technology on society;
- demonstrate an understanding of ethical issues related to the use of technology in a local and global context.

THE CURRICULUM DESIGN AND DEVELOPMENT PROCESS

In order to achieve the outcomes as defined by the underpinning philosophy and goals, the Curriculum Division of the Ministry of Education embarked on a design and development programme consonant with the current approaches to curriculum change and innovation

CURRICULUM DESIGN

George A. Beauchamp (1983) says, “curriculum planning is a process of selecting and organizing culture content for transmission to students by the school. The process is very complex, involving input from many sources, but the organized end result of the process is the design of the curriculum.”

The varied perspectives as to the nature of knowledge, the nature of the learner, what should be learnt and how, and to what end, have resulted in three (3) major classifications of curriculum designs. Zais (1976, p.376) lists them as: subject-centered, learner-centered, and problem-centered designs. Also bringing influences to bear on the design is what Eisner and Vallance (1974) call the **"**orientations to curriculum." These orientations aid in the comprehension of what the curriculum is geared towards in terms of the development of the individual.

This curriculum displays a learner-centered design. It is based primarily on 'man-centered' philosophical assumptions employing constructivist theory. Its major orientation is to curriculum as self-actualization. It is student-centered, seeks to provide personally satisfying experiences for each student, and is growth oriented. As the student moves from one level to another, the activities expand to allow him/her new insights and approaches to dealing with and integrating new knowledge.

The curriculum design is defined by two structures, the substantive and the syntactic.
The substantive structure reflects the "range of subject matters with which it is concerned"; the syntactic structure describes the "procedures of inquiry and practice that it follows".

The substantive structure begins with a vision statement, a rationale, lists the general and specific outcomes of the programme, and establishes the nature of the connections with the other core subjects on the timetable. The syntactic structure is developed along a tabular format in which the intended outcomes are associated with activities making it easy to read and teacher friendly. The content finds coherence with Tyler's (1950) three criteria for the organization of learning activities: continuity, sequence and integration.

CURRICULUM DEVELOPMENT

The first stage of the curriculum development process consisted of stakeholder consultations held with a cross section of the community.

Consultations were held with primary and secondary school teachers, principals, members of denominational school boards, members of the business community, the executive of the TTUTA, representatives from the UWI, John S. Donaldson Technical Institute, San Fernando Technical Institute, Valsayn Teachers' College and Caribbean Union College, parents, librarians, guidance counsellors, students, curriculum officers and school supervisors. They were focused on the philosophy, goals and learning outcomes of education.

The results of these consultations were:

- agreement on the concept of a "core", that is, essential learning outcomes consisting of skills, knowledge attitudes and values that students must acquire at the end of five years of secondary schooling;

- agreement on the eight subjects to form the core;

- agreement on the desirable outcomes of secondary school education in Trinidad and Tobago.

THE CORE CURRICULUM SUBJECTS

These are subjects that every student is required to take in forms one to three. Students will be allowed to choose from a list of subject offerings thereafter.

Minimum time allocation is recommended for each subject. The principal as instructional leader of the school will make the final decision according to the needs of the students and the resources available at any given time.

The subjects and the time allocations are as follows:

Subject	**No. of Periods**	**Subject**	**No. of Periods**
English	Six	Mathematics	Five
Science	Four	Physical Education	Two
Spanish	Four	Technology Education	Four
Social Studies	Four	Visual and Performing Arts	Four

In Stage Two of the process the officers of the Curriculum Development Division studied the reports of the consultations, the Education Policy Paper, the reports of the Curriculum Task Force and of the Task Force for Removal of Common Entrance as well as newspaper articles and letters to the editor on education over the past five years.

The School Libraries Division and the Division of School Supervision assisted the Curriculum Development Division in this task. The result of the study was the identification and statement of a set of desirable outcomes and essential exit competencies to be had by all students on leaving school. All learning opportunities, all teaching and learning strategies, all instructional plans, are to contribute to the realization of these outcomes and competencies.

At Stage Three ten existing schools were identified to pilot the new curriculum. Teachers from eight subject areas were drawn from these schools to form Curriculum Writing Teams for each subject. Teachers with specific subject or curriculum development skills from other schools were also included in the teams. These teams met initially for three days then for one day per week during April to July 2000, to conduct the writing phase of the curriculum development. In this phase learning outcomes specific to each subject, which contribute to the fulfillment of the national outcomes were identified. Subject content, teaching and learning and assessment strategies to support these outcomes were developed.

The process of curriculum development for years two and three continued in a similar fashion. Curriculum Officers were assisted by teachers who were released from their teaching duties for varying periods of time.

The following curriculum document is the result of their efforts.

The International Consultant, for Curriculum Development, Dr. Robert Sargeant, (Associate Professor - Mount St. Vincent University, Nova Scotia, Canada) guided the curriculum design and development process.

Integrated Science

Form III

Part Two

Curriculum Content

Vision Statement

THE SCIENCE CURRICULUM WILL:-

- *Stimulate curiosity and creativity.*
- *Develop competence in the use of the knowledge and methods of science.*
- *Develop a critical awareness of the role of science in everyday living.*

RATIONALE FOR TEACHING SCIENCE

Science is a study of the biological and physical environment. It is a method of problem- solving, which requires that all the necessary resources and skills be used to gather objective evidence, to analyse and synthesise that evidence,then make inferences and draw conclusions. These activities require specific skills and habits of mind; for example, accuracy, discipline, and integrity in the application of scientific principles, which are fundamental to scientific activity. The science curriculum is designed to develop these skills and habits of mind. Science is also an art, which is intrinsically satisfying.

Some of the outcomes of science education are as follows.

Students of science will:

- *develop personal strengths*. These include the ability to read, write, complete mathematical operations, to develop communication skills, interpersonal and intra-personal skills, problem-solving skills, and critical attitudes to work. Students involved in science activities have many of their social and psychological needs met, e.g., recognition, affection, security, belongingness, etc. All these strengths can be developed in a properly conceptualised and implemented science programme.
- *demonstrate an awareness of social realities and natural phenomena.* Students' natural curiosity should be tapped and made the prime motivating device in inspiring them to learn about science.
- *enjoy science as a fun activity, which includes artistic experiences.* Creating projects, carrying out investigations that they planned, taking part in science games and contests, recognizing that recreational activities and sport, e.g., basketball and swimming, all have science information and explanations, make science more relevant for the student.
- *recognize science as a means of advising them on how to live healthy and safe lives.* Science teaches us about the causes and prevention of disease. It can also introduce students to the real, scientific reasons why they should avoid dangerous drugs and alcohol.
- *recognize vocational potentials*. The future revolves around science and technological competence. There is no vocation of the future that will be devoid of science and technology. A science education helps us to induct our students into this technological society.

It is clear therefore, that science helps us to understand ourselves as well as our environment. That understanding can naturally transfer to the development of the healthy, safe and successful interdependence of all peoples.

At the lower secondary level, students are given experiences in science that would lead them to have a conceptual understanding of the natural world, of man's place in it and of his responsibility to maintain and preserve it. At the same time, science education must prepare students who require scientific knowledge and skills for employment or further education in trades, technology, and other science-related fields.

Thus, greater emphasis is placed in the outcomes on relating science and technology to each other, and to the world outside the school and on the need for sustainable development. Students' understanding of the concept of sustainability is stressed in a variety of contexts (e.g., ecology). Communication skills and the use of appropriate terminology are given greater emphasis – for example, students are expected to describe what they are doing by using the terminology associated with specific scientific and technological concepts. This science curriculum also builds on and reinforces certain aspects of the language arts and mathematics curricula. For example, it emphasizes the importance of clear, concise communication and involves the use of various charts, tables, and graphs for communicating observations and measurements. It also includes other forms of communication – for example, the use of SI metric units, and experimental reporting. Care must be taken to ensure that expectations involving SI metric units and other communication-related knowledge and skills are consistent with the expectations in language and mathematics for the year level.

CHARACTERISTICS OF A GOOD SCIENTIST

The study and practice of science involve three important characteristics: attitudes, processes (methods) and products. To be a successful scientist requires that one must possess the right attitudes. Science helps us to develop a positive attitude to nature and how it affects us, and the environment.

Some attitudes that will serve us while engaging in science activities are curiosity, open- mindedness, healthy skepticism, perseverance, a positive approach to failure, co-operation, impartiality, humility and tolerance.

A good scientist must also be able to apply certain processes in the study and practice of science. The scientific ways of solving problems involve the application of special methodology related to the different types of thinking and reasoning skills. These can be divided into two areas: basic and integrated process skills. Basic process skills relate to enquiry skills such as observation, classification, communication, measurement, estimation, prediction and inference. Integrated process skills relate to conceptual understanding, while for science to make sense it must be placed in a familiar context and be relevant.

Observation is an important process in science as it requires the use of the senses, and requires that some form of measurement be made. Measurement is central to science, for the type of results may be seriously affected by the accuracy of the measurement. It is therefore crucial that students be properly grounded in the skills in length, mass, time, temperature and current measurement. Measurement skills will be developed throughout the programme.

GENERAL INTENDED LEARNING OUTCOMES

The following general intended learning outcomes are statements, which identify students' competencies upon completion of study of Integrated Science in the lower secondary school.

1. Understanding of the nature of science;
2. Empowerment through knowledge of the role of science in the complex social issues concerned with the environment;
3. Mastery of the skills and knowledge required for scientific enquiry;
4. Willingness to acquire and apply scientific and technological knowledge to the mutual benefit of self, society and the environment.

These outcomes can best be arrived at through investigative approaches where students assume an active role in meaning making. All activities within the units prepare students for the assessment tasks, by teaching for the development of the concepts and the skills required for solving problems in society and the environment that are related to the concepts.

STRUCTURE OF THE CURRICULUM DOCUMENT

The Science programme is designed to incorporate topic areas in the separate sciences, which are integrated during the teaching/learning process. A spiral curriculum is utilized to ensure that the smooth progression of development in science is attained. The deliberate sequencing of the units allows for the development of the knowledge and skills that are required to complete the final end-of-year assessment task. In all units there is an emphasis on the development of science communication skills. This is to be achieved by the use of written reports, oral presentations, and students' written journals. An overview of each unit and the general intended outcomes for that unit precede a table which presents the overarching concepts, specific learning outcomes, suggested strategies and assessment activities.

The document assumes that in some schools there would be the available technology for teachers' and students' use. At the lower secondary level, the use of word-processing software designed to assist students with data presentation, e.g., Microsoft or Corel databases, spreadsheets, word-processing, among others, is encouraged. Student expertise will increase as the opportunities to use the software increase. Presentation software is becoming very powerful and user friendly, and students and teachers should be encouraged to integrate these tools into the classroom. The Internet is a powerful research tool which should be used efficiently to avoid wasting time 'surfing'. Data analysis should always take precedence over data collection. Many strategies can be employed to save time. These include bookmarking of sites prior to the start of class, and printing material from selected sites for students' use in class. General information about science is available on many good sites that are already familiar to students.

Learning Outcomes/ Assessment

The learning outcomes are presented under three headings: E**nquiry Skills**, **Conceptual Understanding** and (**STSE) Science, Technology, Society and the Environment.**

The category of 'enquiry skills' describes outcomes that probe students' abilities to use both the cognitive and laboratory tools of science. These outcomes are based on activities that are mainly planned by the student with some guidance from the teacher.

'Conceptual understanding' refers to the knowledge which students gain from their experiences in and out of the class setting while carrying out investigations or having discussions or presenting findings and interpretations. These outcomes are derived from the overarching concepts in the topics in science. Although the concepts remain the same, the outcomes change depending on the age and developmental level of the student. Much of this conceptual understanding can best be assessed using alternative forms of assessment.

'STSE' describes outcomes which enhance the relevance of the science concepts and skills to be acquired by the students. These outcomes link environmental issues to societal concerns and the impact of technology. They provide opportunities to develop thematic links among the units. STSE outcomes are infused throughout the curriculum. They provide a springboard for the development of the end-of-year performance assessment tasks. Teachers will be assisted with the development of tasks, task-specific rubrics, checklists and rating scales. Generic rubrics will also be made available to teachers.

Suggested Strategies

The suggested strategies are given as examples of the types of engagements that students should have with the subject matter. Teachers are expected to develop their own learning activities in keeping with the particular characteristics of their students. They will be guided in this aspect by a teachers' guide with sample activities for each unit, and by Internet sites which will be noted in the guide. The suggested assessment activities are given as guides to point teachers in the direction away from an emphasis on paper and pencil tests. It also allows students with low reading and writing ability to use other strengths to demonstrate their learning. This document is expected to excite and encourage teachers to work together to find new and interesting ways to engage students in science. It places a high value on students' construction of new knowledge and on learning how to learn, realising that we can only guess at what is required in the future.

Units

The Science programme is divided into three strands, which are comprised of thirteen units. These provide the basic foundation for expanding on scientific knowledge, skills, values and attitudes for the next two years when students will be preparing for the Caribbean Examinations Council (CXC) or National Certificate of Secondary Examinations (NCSE). Teachers can use these units to prepare lesson plans.

The three units for Year 1 are:

- Living Matter/Cells and Micro-organisms
- Matter and Materials/The Particle Nature of Matter/Physical and Chemical Changes/Pure Substances and Mixtures
- Energy/Heat.

In Year 2 four units are to be completed:

- Living Matter/The Amazing Human Body/Maintaining Health/Diseases
- Matter and Materials/Solutions and Solubility
- Energy/Electricity/Magnetism.

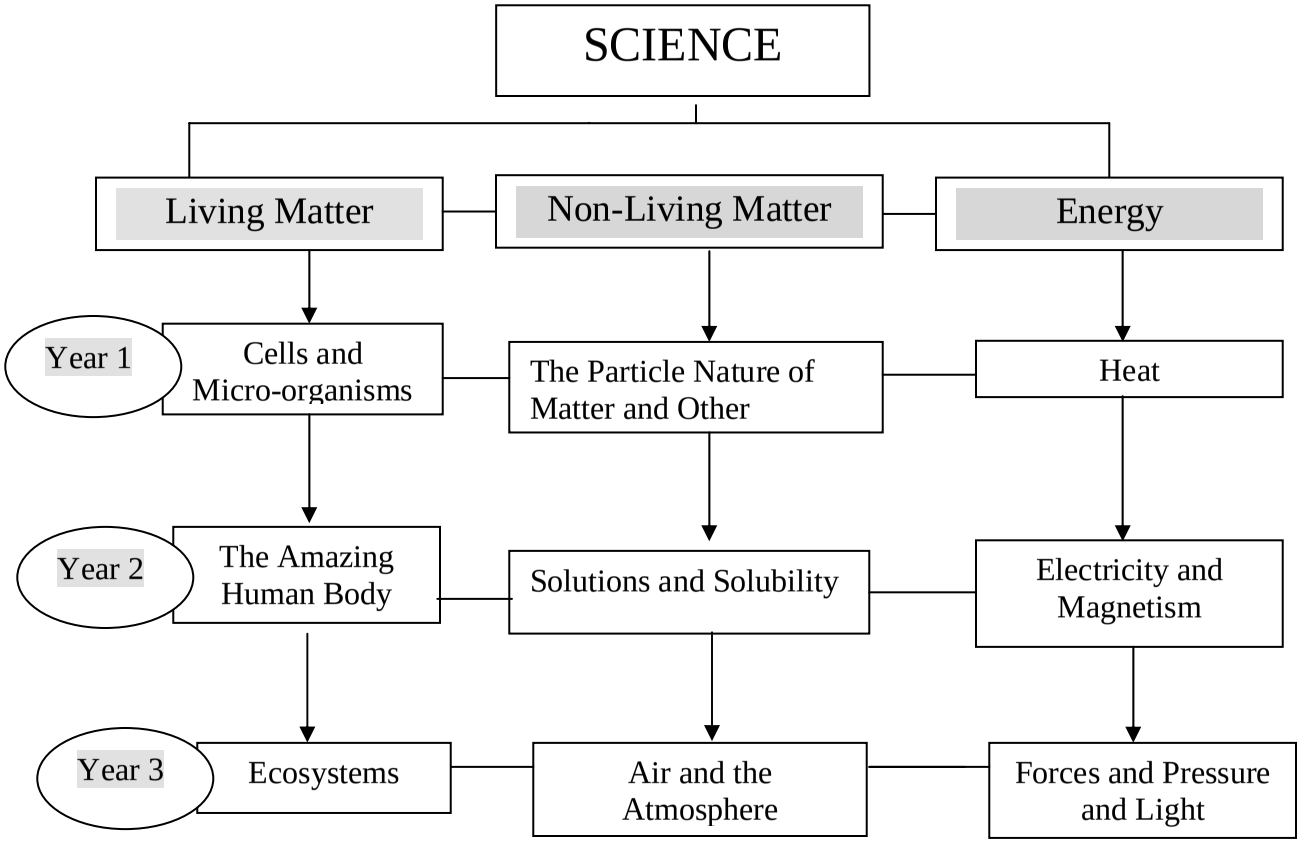
In Year 3 three units are to be completed:

- Living Matter/Ecosystems
- Matter and Materials/Air and the Atmosphere/Solar system
- Energy/Forces and Pressure/Light

It is expected that the student would develop the ability to make rational judgments about the impact of science on society and the environment. Computer-aided learning software can be used to facilitate the delivery of this programme. The curriculum in science also demands that the school librarians be brought into discussions with science teachers so that they could access resources for students and teachers and teach research skills.

FRAMEWORK FOR SCIENCE CURRICULUM

The following flow chart shows the inter-relationships and sequencing among the units in the curriculum.



Flow Chart Showing Framework for Science Curriculum

STUDENTS WITH SPECIAL NEEDS

Students with special needs may need additional supports to succeed at the secondary level. These students must be given special accommodations and concessions on an individual basis. Some examples of accommodations and aids which may be helpful include:

- Ensuring that peer helpers are available when working in groups.
- Providing handout sheets with sample calculations and specific skill instruction when required.
- Helping students create data charts into which they can record information.
- Notifying the diagnostic and prescriptive staff of the educational district when students are working on major assignments.
- Recording key words on the board when students are expected to make their own notes.
- Making audiotapes of notes for students who have low reading ability or who have difficulty with writing, e.g. students who are wheelchair – bound with weak arms. Use voice activated software.
- Allowing students to report verbally into an audio tape recorder, which the teacher can listen to in order to facilitate student's understanding.
- Utilizing students' strengths both for teaching and for their presentations that demonstrate their learning.
- Extending timelines where necessary, to allow students more time to process language and put their thoughts into words.
- Where an activity requires reading, giving it in advance to students with reading difficulties or providing the passage in print and accompanying audio format.

- Providing adaptive devices on the computer and carefully planned hands-on activities which allow visually impaired students to enjoy doing science.
- Consulting diagnostic and prescriptive staff to obtain more advice for working with students with special needs in the science classroom and laboratory.
- Including parents in the work of their children. Parents can prove to be an invaluable source of support and resources for all students.
- Students MUST be given concessions of time and specific supports for formal examinations.

This new science curriculum has been enriched to accommodate the needs of special learners.

Integrated Science

Form III

Part Three

Topic : Ecosystems

Overview

The study of ecosystems is an introduction to the study of ecology and involves investigation of the complex interactions among all types of organisms, and with their environment. Students will learn that ecosystems consist of communities of plants and animals that are dependent on each other as well as on the non-living parts of the environment (Plant-plant, plant-animal and animal-animal interactions). They will also learn about specific types of ecosystems and the biosphere. In investigating ecosystems, students will examine the effect of natural factors, such as climate changes, analyse issues related to environmental sustainability, and the impact of technological changes on the environment.

General Outcomes

At the end of the unit students will:-

1. demonstrate an understanding of the interactions of the abiotic and biotic factors in an ecosystem

2. investigate the interactions in any ecosystem, and identify factors that affect the balance among the components

3. demonstrate an understanding of the effects of human activities, as well as the effects of changes that take place naturally, on the sustainability of ecosystems.

COURSE OUTLINE

Ecosystems

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
1. Complex interactions take place in an ecosystem. 2. An ecosystem is a natural unit of living and non-living things through which energy flows and nutrients are recycled. 3. Habitats are small parts of the ecosystem where individual organisms live. 4. Photosynthesis and cellular respiration are processes, which are related to the cycling of energy, carbon, and oxygen through abiotic and biotic components of an ecosystem. 5. Natural and external factors affect the survival and equilibrium of populations in an ecosystem	Students will: <u>Enquiry Skill</u> • identify populations of organisms within an ecosystem and the factors that contribute to their survival in that ecosystem. <u>Conceptual Understanding</u> • identify living and non-living elements in an ecosystem • identify and explain the role of producers, consumers, and decomposers in food chains and their effects on the environment (e.g. plants as producers in ponds). • interpret food webs that show the transfer of energy among several food chains, and evaluate the effects of the elimination or weakening of any part of the food web. • explain the importance of plants as sources of energy (e.g. food, fossil fuels) • explain the importance of plants as producers of carbohydrates and oxygen.	• Students study an ecosystem such as a pond/tree/schoolyard • They prepare food chains and webs • Interactive session when teacher discusses pyramid of numbers • Many interactive sessions using film, computer simulations, charts and students' drawings to develop understanding of ecosystems • Students can be taken on field trips to observe habitats and the loss of habitats due to bush fires and cutting of roads • Presentations (using many visuals) by persons studying various environmental issues. • Students work together to develop understanding of the place of photosynthesis in food production for human beings	• Students design an ecosystem using an aquarium. They justify the use of everything placed in it. • Students design many small ecosystems and impose environmental conditions on each. Explain the effect of each type of condition on life in the ecosystem. • Students identify and research a local issue involving an ecosystem and propose a course of action and defend their position in written or oral form (e.g. participate in a debate on converting a grass lot into a parking lot.)

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
	• explain the importance of plants as habitats for wildlife. • explain that photosynthesis and cellular respiration are essentially reverse processes, and identify the reactants and products of their overall reactions. • describe the conditions that are essential for the growth and reproduction of plants and micro-organisms in an ecosystem • explain the connection between those conditions and various aspects of food supply for humans. • explain the long-term effects of the loss of natural habitats and the extinction of species (e.g. loss of members in the food chain)	• Students carry out in –class research on the impact of technological change and natural change on an ecosystem (e.g. the effect of the introduction of fertilizer and pesticides to soil, the effect of forest fires, and floods etc.) • Students could be taken on field trips to observe and/or study the effects of deliberate interference on specific habitats e.g. Beetham dump, Nariva swamp, and Invaders bay.)	• Students present a paper on how some chemicals are used to clean up oil spills, emphasizing the harmful effect of oil spills and the physical and chemical processes involved in the methods used. • Students debate on moral and ethical values concerning ecosystems (e.g. Are human beings responsible for preserving and protecting ecosystems?) • Students write letters to respective ministries, the EMA and other bodies which deal with environmental issues.

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
	<u>STSE</u> • investigate the impact of the use of technology on the environment (e.g. greenhouse effect, redirection of water flow for human needs, use of pesticides). • investigate the effect of acid rain and benefits of the recycling and waste-disposal industries • identify the importance of plants in the Trinidad and Tobago economy (e.g. farming, forestry, drug manufacturing, the nursery industry) • investigate the impact of the industrial use of plants on the environment	• research on acid rain and its effects. • investigate the existence of recycling facilities in Trinidad and Tobago • students catalog the effects of increased removal of forest trees on the local environment (flooding, depletion of water table etc.)	• Using a series of diagrams, illustrate the possible effects of acid rain on a selected habitat

Topic : Air and the Atmosphere

Overview

Air is a mixture of gases. This air makes up the earth's atmosphere and is essential for life on the planet. The atmosphere is made up of mainly nitrogen and oxygen. Other gases present are carbon dioxide, water vapour, and some noble gases. The gases in the air are moved around the earth in natural cycles. Today many other gases, e.g. nitrogen oxides and sulphur oxides are present in the atmosphere in industrial areas and along highways. The imbalance of gases in the atmosphere contributes to pollution.

General Outcomes

At the end of this unit students will:-

1. demonstrate an understanding of the composition of air

2. explain the cycles in nature, which contribute to environmental stability

3. demonstrate an understanding of the nature of air pollution and its effect on living things

4. identify ways to decrease pollution in the atmosphere

COURSE OUTLINE

Air and Atmosphere

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
1. Air is a mixture of gases. 2. The cycles in nature explain how certain gases are moved around the earth	Students will: <u>Enquiry Skills</u> • Perform investigations to determine the percentage of some gases in the air <u>Conceptual Understanding</u> • Describe the composition and the properties of air • Describe the uses of the gases in the air • Explain the cycles in nature, which show how water vapour, nitrogen and carbon dioxide are moved around the earth <u>STSE</u> • Investigate the uses of oxygen, carbon dioxide and nitrogen	• The teacher and students discuss the nature of air and students perform investigations to determine the percentage composition of gases in the air. • Through questioning, students develop the need to research about the cycles. They form groups and continue their investigations	· Students present the cycles in nature in innovative ways using visuals to illustrate.
3. Air can be polluted. 4. Air pollution is the alteration of the atmosphere in such a way as to create a hazard or potential hazard to the health, safety, and welfare of any living species	<u>Enquiry</u> Skills • Investigate the causes of air pollution	• A ‘natural flow’ into air pollution should occur. Air pollution problems arise during discussion and questions about air pollution are posed. Students choose to research a problem that occurs in their community. Planning and carrying out of the research is enabled and monitored by the teacher.	• Students are asked to write letters, to the editor of the local newspaper, about an air pollution problem in their community.

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
	<u>Conceptual Understanding</u> • Describe and explain the causes of air pollution. • Explain and make inferences about the effects of air pollution • Describe and explain the natural processes which clean the air <u>STSE</u> • Investigate causes and effects of air pollution in the country. • Suggest possible solutions to air pollution. • Describe some of the factors, which mitigate against the implementation of policies for reducing pollution of the atmosphere • Investigate the causes and effects of global warming	• World problems concerning air pollution are discussed. Video presentations are used.	• Students present to members of the local health authority and to representatives from an organization which monitors the environment, the results of their research with recommendations to solve the problems outlined.

Topic : Solar System

Overview

This study of the Solar system introduces students to an overview of some components of the system and related scientific principles involved in the maintenance of the system. Students will learn about the planets, their general characteristics and individual peculiarities. The importance of the Sun as a provider of energy will be emphasized. They will also be exposed to the technology which enables close study of celestial bodies to take place and those which have enhanced our communication capabilities in modern times.

General Outcomes

At the end of this unit students will:-

1. demonstrate an understanding of the structure of the Solar System.
2. demonstrate an understanding that each planet in the Solar System has its own unique features and characteristics
3. identify the Sun as a provider of energy
4. demonstrate awareness of the technology available for the study of celestial bodies and rapid communication.

COURSE OUTLINE

Solar System

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
1. The Solar system is one of the systems in the Universe 2. The Solar system consists of celestial bodies revolving around the Sun. 3. Nuclear reactions within the Sun produce large quantities of energy 5. Each planet has its own unique features and characteristics 6. Planets are held in their orbits by gravity 7. Technology allows close-up observation of the planets and their satellites	Students will: <u>Enquiry skills</u> • observe phases of the moon over a 1- month period and relate observations to tidal effects • observe planets and stars using binoculars or telescopes <u>Conceptual Understanding</u> • identify the components of the Solar system • describe the structure of the Solar system • identify the bodies in space that emit light and those that reflect. • discuss simply, fission and fusion reactions taking place in the sun • evaluate the importance of solar energy • discuss the physical characteristics of the planets e.g. size, distance from the sun, type of atmosphere, number of natural satellites (moons) etc.	• Maintain a log of changes in the shape of the moon over a 1-month period. Collect information on tides from newspaper. • Use of videos or other suitable material describing structure and behaviour of the various bodies in space. • Students make a model of the Solar system emphasizing the positions and sizes of planets relative to the sun. • Discuss differences between stars and planets. Consider the sun as the nearest star • Students work in groups, with each group researching all aspects of one planet for presentation to class	• Prepare a schedule for use by beach goers advising as to the time when the beach will be safe for bathers • Write a poem or a calypso describing the unique features and characteristics of the planets in the Solar system • Students present a proposal to NASA for exploration of a planet of their choice. What would be the value of this exploration to man? What kind of considerations would need to be made?

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
	• Describe the motion of some common celestial bodies • Discuss the methods used to make close observations of objects in space e.g. Hubble telescope, space probes, artificial satellites. <u>STSE</u> • Explore the use of artificial satellites in communication, environmental monitoring (GLOBE). • Consider medical research related to weightlessness etc.	• Visit to NIHERST planetarium. • Investigate how the shape of an ellipse varies with size and how this relates to distance of a planet from the sun. • Students research a range of objects in use such as Hubble telescope, Intelsat, Challenger. • Consider cable television transmission, Global Positioning System. • Effects on organs such as heart and skeletal muscles. Effect on blood circulation.	OR • Discuss considerations to be made in establishing a human colony on another planet • Discuss why astronauts have difficulty walking when they have returned from a space mission

Topic : Light

Overview

In this unit students will explore the properties of light. They will learn about how it travels and what happens when it falls on different materials. Students will design and use optical instruments and investigate their significance in everyday life. Dispersion of white light and production of colour will also be examined. The structure of the eye and its similarity to a camera will also be explored. The role of light in photosynthesis will be investigated.

General Outcomes

At the end of this unit students will:-

1. demonstrate an understanding of how light travels and how it interacts with different materials
2. design and use optical instruments and investigate their significance to everyday life
3. investigate the structure and function of the eye and compare it with that of the camera
4. investigate the role of light in photosynthesis

COURSE OUTLINE

Light

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
• Light is a form of energy which travels in straight lines • When light falls on an object it can be reflected, refracted, dispersed or absorbed • Optical instruments enable small and distant objects to be seen clearly	Students will: <u>Enquiry Skills</u> • Investigate the straight line propagation of light • Investigate the passage of light through opaque materials, mirrors, transparent glass/perspex blocks, prisms, lenses, translucent materials • Investigate the images formed by mirrors and lenses. • Design, make and test an optical device e.g. periscope, microscope, telescope, kaleidoscope <u>Conceptual understanding</u> • Explain that luminous bodies produce their own light	• Use of a raybox or cards and candle flame to demonstrate • Demonstrate how the focal length of a lens can be obtained using a distant object, a lens and a screen. Use of prism to demonstrate dispersion. Use of glass/perspex block to demonstrate refraction. Demonstrate effects of refraction e.g. pencil in glass of water • Students locate images produced by mirrors, lenses. • Use of common materials to construct the device. Design a method of testing the device. • Discuss the differences between luminous and non-luminous bodies	• Students construct a pin-hole camera • Create a bulletin board display of everyday materials or objects that are either transparent, translucent or opaque • Evaluate the efficiency of the device designed. • Students identify common devices that produce convergent, divergent and parallel beams.

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
	• explain the difference between a ray and a beam • discuss the types of beams • discuss formation of shadows • discuss the dispersion of white light • explain that the colour of an object depends on the colours of light it reflects • discuss the structure and function of parts of the eye • discuss defects of vision and methods of correcting them • discuss differences between the eye and the camera	• Use small and large light sources to demonstrate the difference between a ray and a beam • Demonstrate formation of shadows using small and large sources of light • Refer to formation of a rainbow and the blue colour of the sky • Coloured objects are viewed through light filters • Use of a chart and model of the eye • Determine number of students in class with normal/defective vision using a simple eye test	• Devise an optical system that produces a parallel beam • Students predict the location, shape and size of a shadow when a light source is placed in a given location relative to an object. • Students prepare a presentation to explain to their little brother/sister how a rainbow is formed. • Students draw and label a diagram of the eye to be displayed for Blind Awareness week.

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
	<u>STSE</u> • discuss the formation of solar and lunar eclipses • investigate the significance of optical instruments in everyday life • discuss common optical illusions • investigate the role of light in photosynthesis • investigate the use of coloured glass to preserve food or drink from light	• Use of models • Consider the importance of periscopes in submarines, endoscopes in diagnostic and surgical procedures • Demonstrate real and apparent depth e.g. coin in a sink filled with water • Compare the production of glucose in a plant kept in the dark and one kept in light • Consider green and brown bottles	• Students make poster to explain solar and lunar eclipses to dispel myths that some senior citizens may have about eclipses

Topic : Forces/Pressure

Overview

This unit on forces /pressure introduces students to forces that involve direct interaction (pushes and pulls between surfaces that are in contact). When students explore the effects of forces they will learn about the ways in which forces create movement in objects e.g. some movements result from an imbalance of forces, others from the release of stored energy (wound spring). Additionally, the study of forces will enable students to increase their understanding of control. This is achieved when students design and make devices which use energy. These activities lead to an understanding that all systems are made up of component parts that work together to perform certain tasks. This unit also shows the relationship between force and pressure. It allows students to investigate how pressure is caused in solids, liquids and gases and its effects on the operation of common devices.

General Outcomes

At the end of this unit students will:-

1. demonstrate an understanding of how movement is caused by forces and by energy that is stored and then released.

2. investigate how different forces affect the operation of everyday devices, and design and construct devices that use a form of energy to create controlled movement.

3 identify objects, devices and systems in everyday life that are affected by forces and movement and explain in what ways they are useful to people.

COURSE OUTLINE

Forces/Pressure

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
1. A force is anything, which changes or tends to change the state of rest or uniform motion of a body in a straight line. 2. For every action force there is an equal and opposite reaction force. 3. A force has magnitude and direction 4. A force acts on a body causing changes in motion; forces can be acting in directions opposite to that of the motions. 5. Some forces can also act from a distance. Forces can produce several effects. Force is measured in Newtons	Students will: <u>Enquiry Skills</u> • explore the effects of applied forces on solids • explore the force of elastic energy using rubber bands • investigate the effect of the same force and different masses • investigate the effect of applying equal forces on a body <u>Conceptual Understanding</u> Students will explain that: • pushes and pulls are examples of forces • a force produces a change in speed • a force is not needed to keep an object moving at a steady speed • a force can be balanced by another force, in which case there is no change in speed	• Discussion on sling-shot catapult. • Students investigate a wooden block attached to a spring balance and force applied. The surface on which the block rests is altered. • Examine some springy objects in common use (e.g. car springs, elastic bands, chest expanders). What is the force exerted by the spring used to do? • Investigate deforming forces on plasticene • Use tug o' war situation. • Brainstorming session on types of forces. • Discussion on situations of bodies moving with constant speed-action-reaction forces. Demonstrate with force measures	• Students will "interview" Sir Isaac Newton to clarify certain aspects of forces e.g. what a force does and how forces are used in everyday life. Students write a report of this interview for a Schools Science magazine

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
6. The earth exerts a force called gravity. 7. Inertia and momentum are properties of the mass of a moving object. Mass is measured in kg. A body has weight when it is in a gravitational field	• The earth pulls an object with a force that is called the weight of the object. • The pull of the earth accelerates an object that is falling • The extension of a spring is proportional to the force acting on it (Hooke's Law). • Friction is a force that acts in the opposite direction to the movement of an object. • All bodies resist being set into motion. Once moving they are difficult to stop. • Momentum depends on the mass of the object and its speed. <u>STSE</u> Students will: • Explain how friction affects our everyday activities • Investigate instances of the property of inertia in everyday life • Explore the property of momentum of a moving object and relate it to everyday life situations	• Discuss weightlessness and refer to space travel • Distinguish between weight and mass • Discuss frictional forces, walking, tyre surface design, aquaplaning, skidding. • Movement of passengers in bus which stops suddenly • Discuss energy involved in vehicular accidents involving large, slow-moving and small fast-moving vehicles	• Imagine that you have invented an anti-gravity spray. This liquid can cancel out gravitational force exerted on the earth. Just for fun you spray it all over your classroom, Principal's and Vice-Principal's offices. Write a short story or make a drawing describing the scene after you sprayed it. • Students are presented with pictures depicting friction in everyday life. For each example, they must indicate - where the friction is taking place - whether it is harmful or helpful - how it can be increased or decreased • Students present the results of their investigations and justify any decisions made based on data

Concepts	Specific Outcomes	Suggested Strategies	Assessment Activities
8. Pressure is the force that acts on 1m of a surface 9. Unit of pressure is the Pascal, Pa.	Students will: <u>Enquiry Skills</u> • investigate the relationship among pressure, force and area • investigate the effects of pressure of the air around us (atmosphere) • explore how air pressure can make an object hover <u>Conceptual Understanding</u> Students will explain that: • gases can exert a pressure • the pressure of a gas can be raised by compressing the gas or heating it • liquids can also transmit pressure • pressure acts perpendicular to a surface and in all directions. <u>STSE</u> Students will: • investigate how pressure can be used in common devices	• Use a solid block to determine pressure produced when placed on different edges. • Examine and perform experiments to show the action of drinking straw, siphon, rubber sucker. • Design simple devices that make use of the hovercraft principle • Demonstrate the action of pressure with a plunger, plastic bag or balloon filled with water	• Students explain why it may be better for an elephant to stand on their feet rather than a woman in stiletto heels. • Students explain why desert animals have broad feet. • Students explain how pressure in a liquid is used in the braking system of a vehicle

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