OECS Curriculum Harmonization

Science and Technology Education

Learning Outcomes

Grades K - 6

OERU CURRICULUM HARMONIZATION

SCIENCE

&

TECHNOLOGY EDUCATION

LEARNING OUTCOMES

GRADES K - 6

OERU
March 2007

Preface

The development of learning outcomes for the core curriculum in OECS primary and lower secondary schools is an essential part of the harmonization of OECS educational systems. The curriculum harmonization process commenced seven years ago with discussions between the OECS Education Reform Unit (OERU) and educational personnel in all member countries (See *Eastern Caribbean Education Reform Project: Initiative on curriculum and remediation – Design Mission report*, *February 1998*).

The initiative in Primary Secondary Science and Technology commenced in 2001, with a meeting of science and technology educators in St. Vincent and the Grenadines. Time was spent initially on defining science and technology, mainly because the primary curriculum concentrated on science only. A working definition has been developed and has been used consistently throughout the development of the programme.

Draft learning outcomes were developed and circulated for comments throughout the curriculum units in the OECS. Subsequent meetings of the working group were held in St. Kitts and Nevis, St. Lucia and Antigua and Barbuda. At each of these meetings teacher educators, teachers and principals formed part of the discussion groups. After the learning outcomes were adopted by the curriculum officers, instructional modules to serve as teachers' guides were planned and developed by members of the working groups. The learning outcomes and modules were all reviewed and edited by the two consultants who worked through all phases of the project.

Time did not permit a formal piloting of the learning outcomes and modules. Since in most cases the same curriculum officer worked on the lower secondary curriculum, also, there is the possibility of the primary curriculum benefiting from the experience gained in the piloting of the lower secondary programme.

The purpose of developing the learning outcomes and teachers' guide is to ensure that all children in OECS primary schools attain an acceptable level of knowledge, skills and attitudes associated with science and technology. Each member country retains the right and responsibility for integrating these outcomes into the national primary science and technology curriculum. As usual teachers will continue to use their initiative and resourcefulness in the implementation of the programme through the use of indigenous resources creating relevance.

The OERU is extremely grateful for the contribution made by all persons and institutions that have been involved in this developmental exercise. First, OERU expresses thanks to the Canadian International Development Agency (CIDA) for the high level of interest shown and the funding provided for the Eastern Caribbean Education Reform Project (ECERP). The Ministries and Departments of Education have contributed resource personnel, accommodation, refreshment, ground transportation, and some materials for workshops. Most important, however, have been the high level of cooperation and commitment to the reform effort displayed by both the administrative and professional sections of Ministries of Education.

The following science education professionals have made significant contribution over the five-year period.

Country	Participant	Designation
Anguilla	Mr. Worrell Brooks Webster	Education Officer, Science
Antigua and Barbuda	Mr. Earl Skerritt	Science Coordinator
	Ms. Kendra Thomas	Primary School Teacher
	Ms.Celia Frederick	Secondary school Teacher

	Ms. Gracelyn Ireland	Primary school teacher
British Virgin Islands	Ms. Beverlie Brathwaite	Education Officer, Science
Dominica	Mr. Frank Newton	Education Officer Science
	Mr. Gerald Corbette	Lecturer, Dominica State College
Grenada	Mr. Jervis Viechweg	Curriculum Officer, Science
	Ms. Janis Henry	Lecturer, T. A. Marryshow Com. College
Montserrat	Mr. Gregory Julius	Primary school Principal
St. Kitts and Nevis	Mr. Hilton Clarke	Curriculum Officer, Science
	Dr. Lincoln Carty	Former Curriculum Officer, Science
St. Lucia	Mr. Winston Blanchard	Curriculum Officer, Science
	Ms. Imelda Polius	Former Primary School Teacher
St. Vincent and the Grenadines	Mrs. Arlette Keane-Browne	Former Curriculum Officer, Science
	Mrs. Amaala Muhammad	Curriculum Officer, Science
	Mr. Kenroy Johnson	Principal, Secondary School

The OERU also expresses gratitude to the dozens of teachers, principals and students who have participated in discussions and consultations.

The actual planning and subsequent developmental process for the learning outcomes and Teachers' Guide became the responsibility of Dr. Cheryl Remy, former Senior Lecturer at Sir Arthur Lewis Community College, St. Lucia and Professor Winston King, Senior Lecturer, School of Education, UWI, to whom the OERU is very grateful. As a team, Dr. Remy and Professor King have encouraged workshop participants and module writers to think and to create ideas as the work progressed.

The staff at OERU together contributed in no small measure to these modules. Ms. Deborah Alphonse, Accounts/Administrative Assistant, Ms. Natasha Deterville, now Secretary to the Director of Economic Affairs in the OECS, and Ms. Cleotha Randolph, Documentation Officer, worked tirelessly arranging workshops and reproducing materials. Ms. Natalie Compton of Nagio Creations competently designed the layout of the guides and learning outcomes for printing and electronic reproduction.

Dr. Henry Hinds, then Curriculum Specialist at OERU, was responsible for the curriculum project. Mrs. Lorna Callender and Ms. Candia Alleyne, both former Heads of OERU, have supported the project organizationally and morally. Mr. Johnson Cenac, ECERP Officer, made significant contributions in various ways and at various times throughout the development of this work.

The Primary Science and Technology modules provide an excellent example of the fusion of talent, creativity, rigorous science and technology and cooperation to develop a valuable resource for teachers.

The OERU hopes that principals and teachers will continue to play their roles in making the outcomes and modules come to life in classrooms throughout the OECS. The commitment and effort surely will contribute to the enhancement of knowledge, and skills and the development of positive attitudes towards science and technology.

Henry Hinds, Head, OERU
March 2007

CONTENTS page

INTRODUCTION

These learning outcomes in both form and substance reflect the outcome of a series of five workshops that commenced in November 2001 and ended in March 2005. The participants of these workshops were practitioners in Science Education from the countries of the OECS and included regional science education consultants, science teacher educators, curriculum officers, science curriculum specialists, education officers and teachers at both the Secondary and Primary levels.

The developers of the learning outcomes view curriculum development as a participatory and developmental process that requires time, effort and commitment. Consequently, some of the hallmarks of this curriculum development process were:

1. **Rigorous inventory of the existing situation and projections for the future**

   This inventions was achieved by analysis of:

   - Current curricula where available
   - CXC-related curricula
   - Workplace requirements
   - CARICOM Technology Education Curriculum
   - Contextual factors such as:
     - teacher experience with the teaching of technology
     - the quality and capacity of the Science teaching force
     - availability of instructional and personnel resources
     - school system variables such as type of school, mode of transition from primary to secondary level
   - Trends in existing curricula in other regions of the world
   - Related literature

2. **Consultation with stakeholders throughout the sub-region to help shape the vision of the new curriculum:**

   Stakeholders included

   - Employers
   - Students
   - Teachers
   - Administrators
   - Private sector organizations
   - Public sector organizations

3. **Ownership by teachers:**

The process involved teachers at every stage of development, for example in

- developing the philosophy of the curriculum
- selection of topics for inclusion
- analysis and modification of curriculum documents
- writing and assessing Teachers' Guides
- identifying resource materials

4. **Commitment to Teacher Development:**

Mainly by

- training in Technology by hands-on experiences and reading material
- involvement in writing of Teachers' Guides

5. **Integration Across the Curriculum**

- Integrating Science with Technology
- Integrating Science and Technology with other school subjects

6. **Articulation between levels and continuity of ideas**

Mainly by

- development of scope and sequence tables
- creation of idea maps by persons involved in the curriculum development process
  (See Appendix)

RECOMMENDATIONS

If the materials developed are to be used successfully in the schools of the OECS, the major tasks of diffusion, adoption and implementation must be undertaken.

Diffusion: the spread of knowledge about the innovation from the development team to the wider system
Adoption: the decision to use the new materials.
Implementation: materials in use.

Diffusion, adoption and implementation are influenced by three main factors: teacher, curriculum materials, communication.

Teachers need to become acquainted with the innovation of teaching Science and Technology. Bearing in mind many teachers' reluctance to and fear of teaching Science at present, we should proceed slowly in infusing Technology Education. Undue haste is likely to further "turn off" the classroom teacher. This points to the need for teacher training and re-orientation as absolute imperatives. This process will help to facilitate adoption of the materials.

It is expected that teachers will become involved also in further refinement and adaptation of the curriculum materials at the country level. Like any other innovation, these new ideas and suggested practices will require time and resources for refinement, development, dissemination, implementation and institutionalization.

The collective wisdom of persons engaged in producing the curriculum materials is that the following strategies/methods of communication will be useful in the curriculum diffusion process in the OECS countries:

- Networking (including the use of e-mail)
- Demonstrations (for example, the use of model lessons)
- Parent Teachers' Associations
- Student clubs
- Conventions (evangelizing)
- Professional Organizations (for example, Science Teachers' Associations)
- Face-to-face contact
- Attractive packaging of the materials
- Mass media (include popular theatre, talk shows, radio programmes)
- Ministries of Education
- Science journals

After numerous deliberations on the level of specification of the outcome statements, the developers of the porgramme agreed that the documents should go beyond establishing a framework and standards for Science and Technology Education in the Primary schools of the OECS to the level of providing assistance to teachers for the delivery of instruction.

Consequently, the curriculum documents include:

A. An overview of Science and Technology Education for the Primary Level in the OECS. This overview consists of the following:
   - ❖ A Rationale for Science and Technology Education
   - ❖ Guiding Principles for the development of the learning outcomes
   - ❖ The organization of the learning outcomes
   - ❖ Concept Statements

B. The draft learning outcomes by Grade Band

C. Teachers' Guides for the delivery of Science and Technology education at the Primary level of the OECS. These take the form of modules in each grade band for each strand of the outcomes. Each module contains

- A Rationale for the module
- Units for each grade band:
  - The General and Specific Objectives for each Grade
  - Levels of Attitudes, Skills and Knowledge expected at the Grade Level
  - Materials needed for delivery
  - Content summary
  - Suggested Learning Activities
  - Suggested Assessment activities

Countries are able to use the documents at the level that best suits their own national curriculum development efforts. The development of the Teachers' Guides for example, does not preclude a country from developing its own modules for instruction. In every case, however, it is essential that teachers engage in activities to orient them to the philosophy and intention of the proposed Science and Technology approach and to help them develop the capability to deliver an inquiry and problem-solving based curriculum.

AN OVERVIEW OF the SCIENCE & TECHNOLOGY EDUCATION programme AT THE PRIMARY LEVEL IN THE OECS

WHY SCIENCE AND TECHNOLOGY EDUCATION? TOWARDS A RATIONALE

The Place Of Science and Technology Education In The School's Curriculum

Science is now a well-established subject in the curriculum of schools throughout the world, including the Caribbean. It derives its importance from its ability to

- develop and satisfy children's natural curiosity about their world
- develop critical thinking and inquiry, and
- help children adapt to a world that is increasingly scientific.

Technology as a discipline is much less well established (Mc Cade and Weymer, 1996). However there are compelling reasons for the inclusion of technology education in the general curriculum (Medway, 1989;Layton, 1990; Jones and Kirk, 1990). These may be summarized as:

Economic

One view is that inclusion will improve the image of technology where 'the cultural climate may be hostile to industry' (Gilbert, p.563). There is also the point that industry requires a skilled, adaptable work force to deal with rapidly changing tasks and developing technologies.
The Heads of Government of the Caribbean Community for example, at the Eighteenth Conference (Jamaica, July, 1997), acknowledged that

" the Member States of CARICOM face the challenge of competing successfully in a wholly new international economic environment in which the impact of scientific and technological change has created a knowledge-based global economy. For the people of the Caribbean to find their place in this environment, public and private sector policies must be directed towards the creation of a knowledge-based competitive workplace."

The Heads linked the economic development of the Caribbean Region and its competitive advantage to the science and technology capability of its citizens. They mandated the educational systems of the Region to address human resource development in Science and Technology.

Social

The general public is increasingly expected to make economic and social decisions, which latter depend on a sensitivity to the consequences of technology on the environment. Besides the purely social function, technology education should produce citizens who can use technological processes and products.

Educational

Technological tools are found everywhere in present-day activities. They are in the home, the school, on the roads, everywhere there is human presence. As Gilbert (op. cit.) puts it:

> "It motivates students to learn because the applicability of knowledge and skills can be readily seen, it provides a context for the integration of knowledge from many school subjects' (p. 564).

No less compelling reasons for the inclusion of technology education are the personal and political imperatives. Technology eEducation has the potential to contribute to personal development by fostering self–esteem, self-confidence and the realization of creative potential. Caribbean citizens expect to be provided with opportunities to develop their scientific and technological capability in an increasingly technological environment.

Following a consultative process involving stakeholders throughout the Region, a CARICOM initiative has proposed a blueprint for the Introduction of Technology Education in the Curriculum of Primary and Secondary schools in the CARICOM (1998). It proposes that the general objectives of a technology programme at the primary level should be:

- make children aware of the possibilities of the use of technology for their growth and development
- creatively use technology to design and produce gadgets and items
- develop positive attitudes in students and teachers towards technology education
- develop exploratory and research skills
- develop understanding of the use of technology in everyday life
- enable students to become literate in the area of technology
- sensitize students to the level of efficiency which results from the use of technology
- prepare students for more extensive studies in the various subjects at the secondary level
- establish values and develop attitudes associated with the use of technology
- develop awareness and understanding of the various forms and use of modern technology in society
- provide opportunities for innovation, creativity and problem solving

- provide opportunities for young children to learn basic technical skills
- provide students with the knowledge and skills to enable them to better understand the technological world around them
- provide a basis for motivating students to learn
- identify, observe and appreciate technology.

This Science and Technology curriculum endorses these objectives.

Although there is, generally speaking, broad agreement on the aims and objectives of science education and technology education programmes, there is deep disagreement about what should be included as content as well as the approach to be taken to the inclusion of technology in the school curriculum.

This great divide is due mainly to the fact that many writers have varying views as to what is science and what is technology.

What Is Science: What Is Technology?

There is ongoing debate about the distinction between Science and Technology. Gardner (1993) suggests that the issue is essential philosophical. Some like Layton (1977), point out that interaction between the two fields has so flourished in the last century that they have become intermixed. "Modern technology involves scientists who 'do' technology and technologists who function as scientists" (p.21). This is the case in such modern fields as aeronautical engineering, bioengineering and materials science.

While Gardner concedes that since the Industrial Revolution, more and more technologists are turning to scientific modes of research to develop and refine their products, he believes that

> "…the distinction in purposes – the scientist's aim of generating new knowledge and theoretical understanding and the technologist's aim of producing and improving artifacts, systems and procedures to meet human needs and desires – is worth maintaining". (p. 2).

For Mc Cade and Weymer (1996) it is the physical act of producing artifacts to satisfy human needs and wants that is the "heart and soul" of technology and what distinguishes it from other fields of knowledge.

Science may be defined as a way of exploring and investigating the world around us, both natural and man-made, with the aim of learning more about it and understanding it better. It is not only a way of knowing; it is also a way of doing, and each shapes the other. (Wenham, 1995)

Technology may be defined as "the use by human beings of what is available in their culture to solve their problems". (CARICOM Curriculum Guide, 2000).

According to Barak and Pearlman–Avnion (1999), there are at least eight approaches to School Technology. These range from a crafts-based approach to Applied Science to General Technology Concepts approach. Why then a Science and Technology Approach?

The Relationship Between Science And Technology

In addition to the interaction perspective cited above, there are three other philosophical positions that may be taken to characterize the relationship between Science and Technology. The four positions are:

One: Science precedes Technology. This view sees Technology as Applied Science (TAS)

Two: Science and Technology are independent

Three: Technology precedes Science. People have been making artifacts from the dawn of time.

Four: Interaction of scientists and technologists.

The historical record lends credence to each of the positions and so to base curricula in Science and Technology Education on one position or another, will necessarily distort the picture. However, notwithstanding the clear distinction of purpose as cited by Gardner, the evidence that in today's world there is increasing interaction of Science and Technology is incontrovertible.

Modern technology draws heavily on a thorough understanding of scientific knowledge. Sophisticated tools and processes are used in the practice of Science and are necessary to advance scientific knowledge. Technology may also provide motivation for the development of theory and research in Science. In addition, both are human enterprises that are affected by and affect individuals and the society as a whole.

Trowbridge and Bybee (1990) clearly depict the distinctiveness yet interrelatedness of both fields (Fig. 1).
This inter-relatedness offers a basis for attaining an educational goal that seeks to develop both Science and Technology and foster the relationship between them.

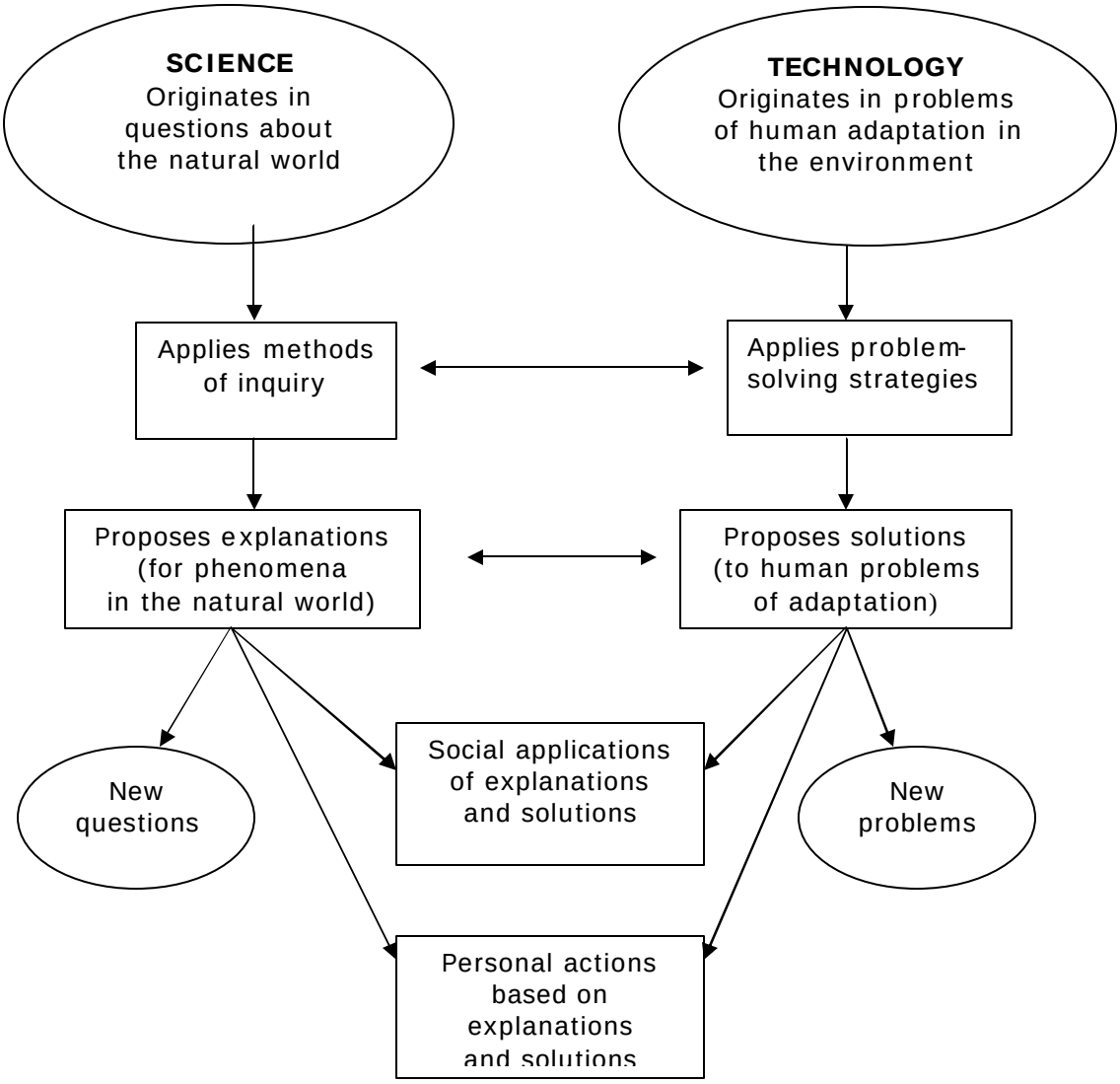


Fig.1 The relationship between Science and Technology and their relationship to educational goals.

Science And Technology In The School Curriculum

Linking Science to Technology Education in the Curriculum is not without precedent in other school systems. The National Curriculum in the United Kingdom (1988) takes a modest approach, linking aspects of Science and Technology. They list the abilities and attitudes that are important at all stages of education as:

(1) to explore and investigate their surroundings
(2) to communicate in a range of ways, and
(3) to develop the knowledge

Further, children should learn
(4) to develop an appreciation of science as a human activity

All these scientific activities will, in turn, lead children

(5) to reach a greater understanding of technology

The Ontario Curriculum (1998) offers Science and Technology Education. Its goals are for students to:

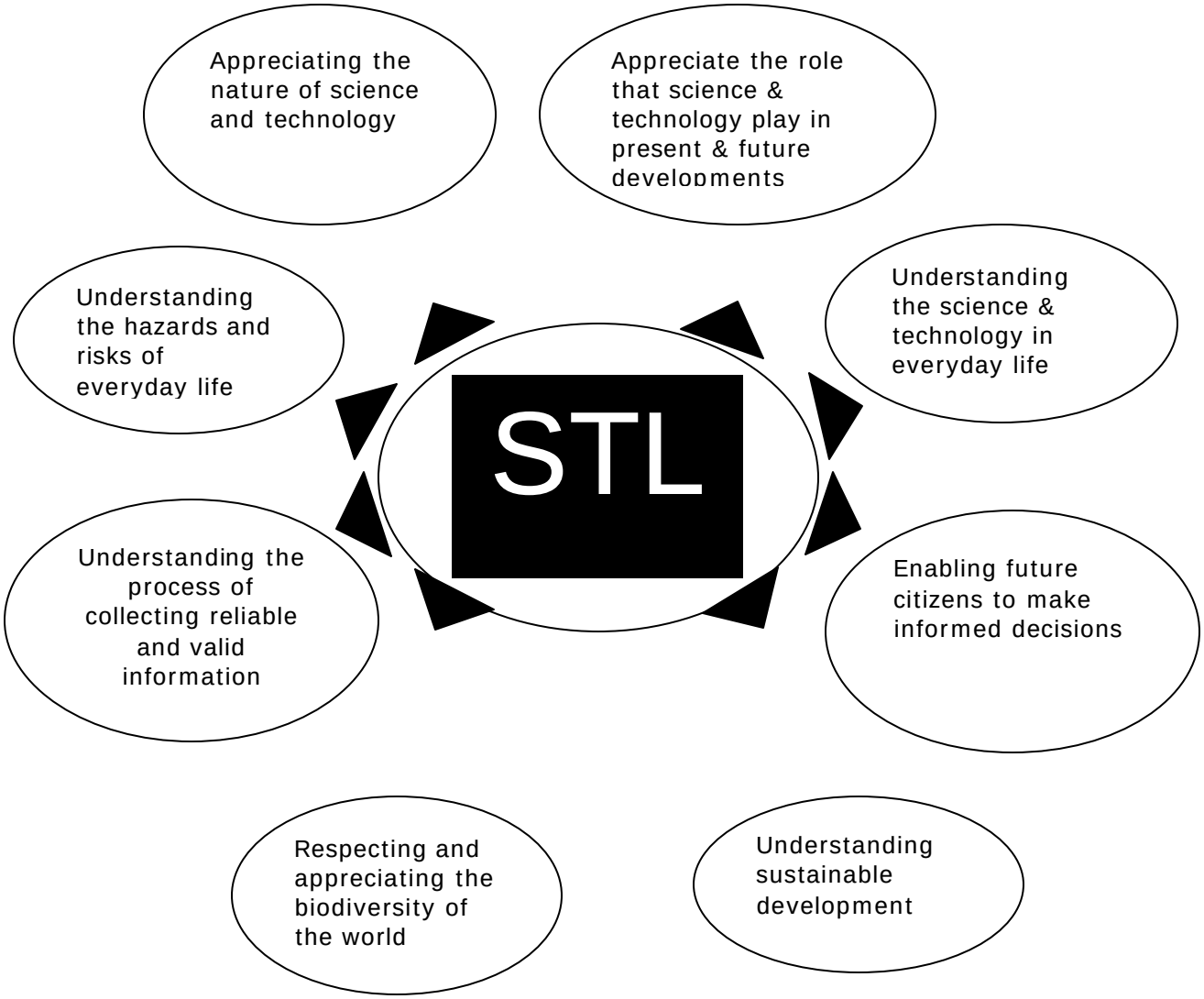
- understand the basic concepts of science and technology
- develop the skills, strategies, and habits of mind required for scientific inquiry and technological design; and
- relate scientific and technological knowledge to each other and to the world outside the school.

UNESCO's Resource Kit: Science and Technology Education: Science for the 21st Century (1999), argues for Science and Technology education from the point of view of its potential to develop scientific and technological literacy (STL). The document defines STL as:

> "Scientific and technological literacy is about understanding and applying concepts, process skills, attitudes and values which enable a person to relate science and technology to the life and culture of their own society'.

The aspects of STL they envisage are depicted in the diagram below (Fig. 2).

Fig 2. Scientific and Technology Literacy



The OECS Science and Technology Education Programme developed here merges technology and science education while attempting to preserve the essential nature of both. Further considerations in adopting this approach include:

Economy of time and resources

- Science is an established subject in school curricula across the region. Integrating Technology into the Science curriculum allows Science to be used as the "trigger" for Technology Education.
- There is duplication of some of the skills in Science and Technology which can then be handled jointly.
- Science teachers can be trained to incorporate technology. The shortage of Technology teachers may be more acute than the shortage of Science teachers.
- No separate teachers or curriculum time is required for technology education.

Opportunity for greater application of Science principles and greater attention to the scientific knowledge base of Technology

- The application of knowledge may serve to motivate students.
- Students have the opportunity to develop practical knowledge (required by the work place).
- The science knowledge base for many technology applications will be developed.

Among the trade-offs in merging Science and Technology in the school curriculum are:

- Technology may be stressed as applied science rather than as a separate field of knowledge.
- Technology may not be given equal treatment as science.
- It may be difficult to maintain the essential nature of both disciplines.
- Science teachers may resist the additional work.
- Some science teachers who are purists may object to the merger.
- Teachers may be inadequately trained.
- The scope of the science curriculum will have to be diminished.

Given the current history and capacity of the school system, the delivery of the programme at least initially, will likely, emphasize science more than technology.

❖ GUIDING PRINCIPLES FOR THE DEVELOPMENT OF SCIENCE AND TECHNOLOGY EDUCATION OUTCOMES AND MODULES FOR PRIMARY SCHOOLS IN THE OECS

PHILOSOPHY

The philosophy that guides the development of this programme is stated here as statements of belief for easy reference:

- **All students regardless of their circumstances can benefit from experiences in Science and Technology.**

  The learning outcomes should be adaptable to the needs of all children of primary school age throughout the OECS.

- **The context in which learning is to take place should inform the Science and Technology curriculum**

  In addition to consideration of faithfulness to the disciplines of science and technology a contextual approach will consider the appropriateness of the outcomes to the:

  - developmental stage of the learner
  - learning environment of the students, including the natural, socio-cultural and structural contexts

  In order for the students to achieve meaning from the curriculum their everyday experiences, the issues and products that affect their lives should provide the context for learning. The significance of the structure of the educational system in which the learning will take place is also important.

- **Science and Technology Education should be centred on inquiry and problem-solving activities.**

  By routinely engaging in inquiry and problem-solving activities, children have the opportunity to develop critical thinking skills which will help them adapt to a rapidly changing and increasingly scientific and technological world.

- **Conceptual development in Science and Technology is best achieved by focusing on understanding a few broad concepts rather than on memorizing many isolated facts.**

  Major ideas that are meaningful and appropriate should be identified and numerous opportunities provided for students to develop increasingly deeper understanding as they progress from one grade level to the next.

  Parallel development and integration of science and sechnology skills, knowledge and attitude learning outcomes are expected to encourage such conceptual understanding. Providing students with oppo rtunities to link concepts in science and technology with other school subjects should also broaden conceptual understanding.

CRITERIA FOR THE INCLUSION OF CONTENT IN THE SCIENCE AND TECHNOLOGY PROGRAMME

The following criteria guided the selection of the content base for the learning outcomes:

- Students should understand **basic ideas** in Science and Technology.
- These ideas should be stated as simple concept statements.
- Students should develop these ideas gradually by engaging in a variety of activities.

The basic ideas should :

- aid students' understanding of everyday events and develop the ability to solve everyday problems; and also the ideas be particularly relevant and applicable (but not restricted) to their local environment;
- be developmentally appropriate, that is, they should be within the students' mental and experiemential grasp;
- be accessible to and testable by students through the use of science and technology process and design skills;
- provide a sound basis for further science and technology education.

(Adapted from Harlen, 1985)

AIMS AND GOALS OF SCIENCE AND TECHNOLOGY EDUCATION AT THE PRIMARY LEVEL

Aims

Primary Science and Technology Education will

- help students develop scientific and technological knowledge, attitudes, and investigative and design skills
- sensitize students to the relevance of science and technology in their lives
- assist students in coping with their changing environment
- enable students to function in a world that is affected by new developments in science and technology.

Goals

To help students

- understand basic and relevant concepts in science and technology;
- accurately apply science concepts and technological processes to solve everyday problems;
- develop skills and attitudes associated with science and technology;
- understand the nature of science and technology and their roles in various aspects of life;
- develop the ability to communicate scientific observations and technological processes clearly and logically;
- develop an appreciation for society and the environment that will foster a richer, more satisfying and exciting view of life;
- understand the relationship between science, society, technology and the environment in a way that is consistent with societal values.

APPROACH TO INSTRUCTION

In order to achieve the goals of this programme it is essential that teachers adopt strategies based on the following principles.

1. Learning is an interactive activity

Learning is frequently enhanced by interactions with others. When exploring ideas, students must have the freedom to discuss their understandings with their peers, to exchange ideas about why and how things work, and to suggest changes that will support their point or lead them to a deeper understanding. Conversation about the task at hand is appropriate and essential if students are to delve deeply into meanings and challenge their understanding of a concept.

2. Students learn concepts more effectively in a relevant context

Most concepts in science have been known long enough that their representation in formulae, graphs, charts, diagrams, or other "coded" form are very familiar to those who know and use them. However, students often cannot see meaning unless the concept is presented in a manner that is familiar and relevant to their lives. The easily accessible natural environment of the Caribbean provides a suitable milieu for the provision of live specimens. The environment also encourages the investigation of natural phenomena in a way in which inquiry and experience are immediately relevant and meaningful.

The opportunities include real technological problems to be solved. Some problems may include the local solutions to providing fresh water, transporting materials, and other daily tasks. Solution may be innovative, diverse, and can display widespread understanding of fundamental scientific principles at the level of application.

Creating these meaningful experiences for students is the daily classroom challenge of the science teacher.

3. Concrete experience is more effective when it *precedes* symbolic or abstract presentation of ideas

In the past, it was often fashionable if not educationally defensible to do practical "lab" work after the relevant concept had been taught in class. Current research strongly suggests that practical and concrete experience is far more useful educationally if they *precede* the formal learning of the concept. For example, consider students using batteries and bulbs to create a simple circuit. The experience of doing this activity in several different ways

provides an experiential framework to examine the components of an electrical circuit and how they interact.

4. Consolidation of ideas is achieved when students have opportunities to demonstrate their understanding

When students understand something that they did not understand before, they are excited and eager to share their knowledge. Research shows that teachers can take advantage of this natural sequence by providing opportunities for students to show others what they have learned. This activity not only consolidates the understanding of one student but also provides motivation to others as well as a presentation of the concept from a point of view other than the teacher's. Performance may include traditional stand-and-tell type of presentations but also can be done through pictures, diagrams, stories, songs, skits, models, or many other formats.

5. Students require time and resources if they are to develop meaningful knowledge and capabilities in Science and Technology

Students require both time and exposure to a variety of resources and experience in order to develop their understanding, knowledge and skills in science and technology. Teachers should focus on a few large concepts as well as providing structured experiences with a variety of scientific and technological contexts.

6. Students' preconceptions and views influence their learning

The concepts and views that students already hold determine how they receive instruction in Science. The socio-cultural context is part of the environment that will determine these previously held views. Many studies have recognized that students often have alternative conceptions to those held by scientists about scientific phenomena. These are very powerful and difficult to change. Teachers must first challenge these misleading theories and help students construct better or more scientific theories.

7. There should be variety in the way information is presented and understanding is demonstrated

There are many kinds of intelligence and learning styles. Traditionally, children have been taught and tested using only language and logic. Other types of abilities (such as artistic and kinaesthetic) should be activated, thereby facilitating understanding and providing opportunity for all students to express meaning.

8. The teacher should become a facilitator of student learning

As real understanding is created in the minds of students, the role of the teacher must shift from being the source of all knowledge to becoming the facilitator of student learning.

Specific Teaching Strategies

Although use of specific strategies depends on both the students and the topic, the following list of strategies provides a spectrum that may be used to develop the concepts described above.

- Collaborative small group work, with appropriate training to ensure that it is efficient and includes learning for all group members;
- In-depth study of a few important thematic topics rather than a large amount of scientific facts and information;
- Hands-on activity that includes students identifying their own questions about real phenomena and the use of structured, guided and student-initiated inquiry activities;
- The use of resource-based learning in which a number of diverse sources is used for the provision of learning activities;
- Opportunities for students to reflect on what they have learnt and create a record in journals of how their ideas have changed;
- The use of problem-solving techniques that foster habits such as skepticism, acceptance of ambiguity, willingness to modify explanations, openness to challenge, and divergent thinking;
- The integration of Science and Technology with Language Arts, Mathematics, Social Studies Industrial Arts, Art, Drama and Music;
- The organization of field trips or the establishment of projects to investigate specific issues in Science and Technology, the use of indigenous technologies and the analysis of the scientific principles involved;
- The use of a series of inquiries instead of recipe-type laboratory exercises;
- The use of Case Studies (simulated or factual information and data about STSE events and phenomena) to foster critical thinking.

APPROACH TO ASSESSMENT

The main emphasis on student assessment in the programme is to provide information on specific student learning with regard to the full diversity of the learner outcomes including knowledge, skills and attitudes. The sustaining focus of student assessment is the student, and the processes that relate directly to student learning.

The main purposes of student assessment are as follows:

- Determine students' understanding and capabilities with respect to what is being taught
- Provide students with feedback related to achoevements of objectives of the programme
- Plan teaching based on feedback, so as to improve both instruction and learning
- Provide information on students' individual and group performance at a particular point in time to parents and administrators.

1. The assessment process must consider the full diversity of learning outcomes and thus utilize a variety of assessment approaches

In this science and technology curriculum, the learning outcomes are multidimensional. Not only are students expected to understand Science and Technology concepts, but they are also expected to apply them in a variety of contexts, to use problem-solving and inquiry skills, and to display certain attitudes and values. Therefore, assessment must include all types of outcomes intended in the curriculum – knowledge, skill and attitudes.

2. The assessment process must include both alternative and traditional methods

Traditional methods such as paper and pencil tests are inadequate to measure the full range of learning outcomes of this programme.
Teachers will need to add alternative methods of assessment to their repertoire.

3. Assessment must be an integral part of the teaching/learning process

Effective education requires a culture of teaching and learning where the role of the teacher is to guide students as they grow in their interaction with materials and with others, and to monitor their conceptual development. The teacher is expected to be concerned with *how* their students think, *how* they process information and *use* problem-solving and social skills. The teacher will therefore need to gain information about the students' progress in all these areas in order

to structure future learning experiences to meet their needs. In such a culture, assessment must be ongoing and must be embedded in the teaching/learning process.

4. Assessment must be authentic

The intent of the curriculum is that students should be able to use the knowledge and skills and to display the attitudes that they have learnt. Assessment should require students to display these capabilities in conditions under which they are normally applied. Students should be directly examined as they perform worthy intellectual tasks that require them to justify their answers, performances or products.

5. **Assessment must be fair and equitable**

Students of all abilities and backgrounds should have the opportunity to demonstrate the skills, knowledge and attitudes being assessed. Complete reliance on traditional methods of assessment excludes children whose reading and writing skills are limited.

6. Assessment should follow sound educational practice

Effective education demands that assessment be administered in ways that reflect current and sound educational practice. Assessment should be systematic and must be appropriate for the purpose for which it is designed and utilized; principles of validity and reliability must be applied appropriately.

ORGANIZATION OF THE LEARNING OUTCOMES

The Science and Technology Programme is organized around three domains:

- **KNOWLEDGE**
- **SKILLS**
- **ATTITUDES AND VALUES**

KNOWLEDGE

Students will have opportunities to learn and understand basic ideas in

- life science
- physical science
- earth and space science
- technology
- The relationship between Science and Technology and how they are influenced by and make an impact on the individual, society and the environment. (STSE)

SKILLS

Students will have opportunities to develop the skills for scientific and technological inquiry, for solving problems, for communicating scientific ideas and results, and for working collaboratively.

ATTITUDES AND VALUES

Students will have structured opportunities to develop appropriate attitudes within this area. Appropriate attitude development is a necessary component for the mutual benefit of self, society and the environment.

The learning outcomes for the different grade levels will be organized into three grade bands:

Grades K – 2 : These are aimed at students at the infant level of the primary school (ages 5 – 7)

Grades 3 & 4 : These are aimed at students at the Junior level of the primary school (ages 8 – 9)

Grades 5 & 6 : These are aimed at students at the Upper Junior level of the Primary school (ages 10 – 11)

The outcomes for each band are considered developmentally appropriate for the grade level.

❖ CONCEPT STATEMENTS

EARTH AND SPACE SCIENCE

In this strand the students will study:

- The Earth's Resources
- The Earth's Weather
- The Solar System

The students will come to understand that

EARTH'S WEATHER

The weather is the state of the atmosphere at any given point in time

There are elements that make up the weather suc,h as clouds, water vapour and precipitation.

The weather changes from time to time.

Weather affects the activities of humans and other living organisms.

EARTH'S RESOURCES

There are many things that are necessary for human survival.

The sources of these things are called resources.

These resources include the earth's air, water, rocks and soil

Resources may be classified as 'renewable' and 'non-renewable'.

Resources may be protected by different means.

THE SOLAR SYSTEM

The earth is a planet in space.

The earth is part of the solar system which consists of the sun, planets and their satellites.

The sun is a star.

Parts of the solar system affect one another

LIFE SCIENCE

In this strand the students will study:

- Ecosystems
- Structure and Function
- Classification and Diversity

The students will come to understand that:

ECOSYSTEMS

The environment is made up of living and non-living parts.

Plants and animals gain information about their environment by using their senses.

Animals and plants depend on one another for their survival and existence.

Plants and animals adapt to changes in their environment.

Natural and human-made changes in the environment may start imbalances that require further changes to counteract.

Human activity may have a negative impact on the natural environment.

Conservation practices help to protect the natural environment.

STRUCTURE AND FUNCTION

Plants and animals have structures (e.g. organs and systems) which have specific functions (e.g. digestion).

These structures are suited to their functions.

DIVERSITY AND CLASSIFICATION

The environment is made up of a variety of plants and animals.

These may be grouped according to their similarities.

PHYSICAL SCIENCE

In this strand, the students will study:

- Energy
- Forces, Motion and Structures
- Matter and Materials

They will come to understand that

ENERGY

Changes involving both living and non-living things require energy.

Energy has many forms, such as heat, electricity, and light.

Energy can be converted from one form to another and this occurs when changes take place.

Energy can be derived from many sources including the sun.

Energy is in great demand and non-renewable energy resources must be used wisely.

FORCES, MOTION AND STRUCTURES

Many types of forces such as gravity, magnetism, friction, are encountered in everyday life.

Forces have many effects on materials and objects, such as changing shape and direction, and these affect our daily activities.

Forces affect structures.

Simple machines are devices that use forces to make work easier.

Forces can change motion and do work.

MATTER AND MATERIALS

Matter exists in different forms such as solids, liquids and gases.

Matter can change its form.

Matter has properties (such as volume, weight and mass) that can be measured.

Matter can also be grouped as materials from which objects are made, such as metals, plastics, and glass.

These materials have different properties which determine their use.

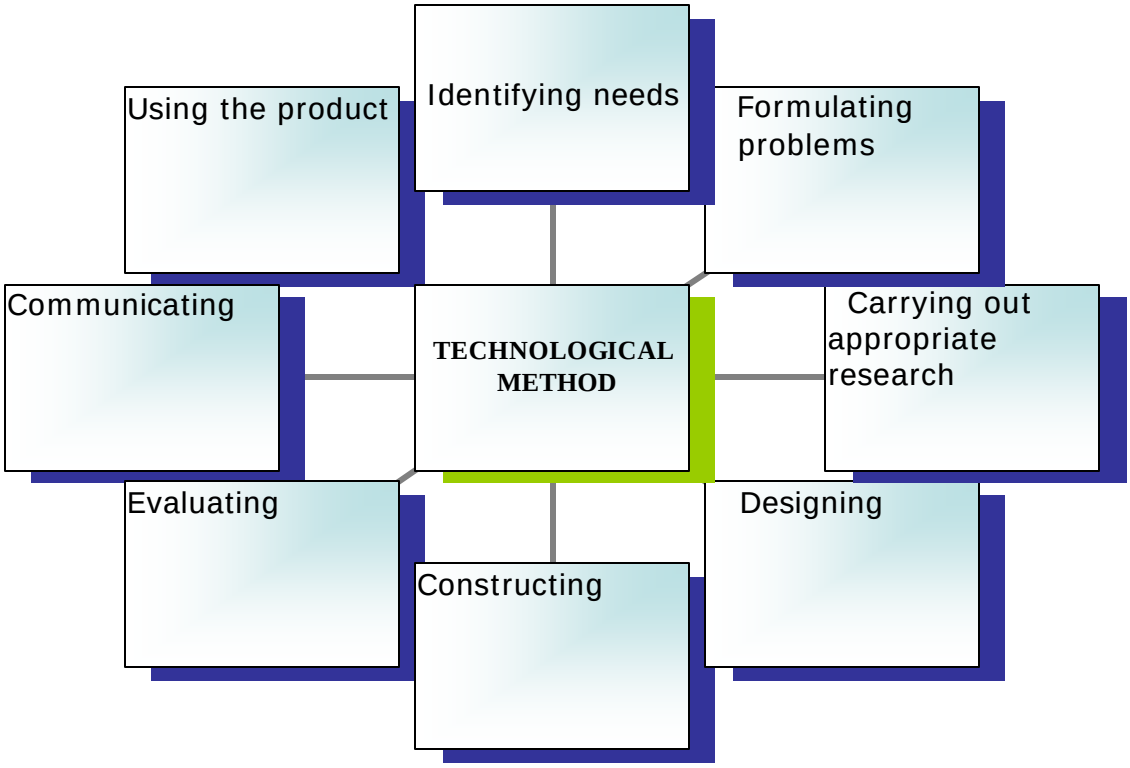
The properties of materials can be changed and this change extends their use.

TECHNOLOGY

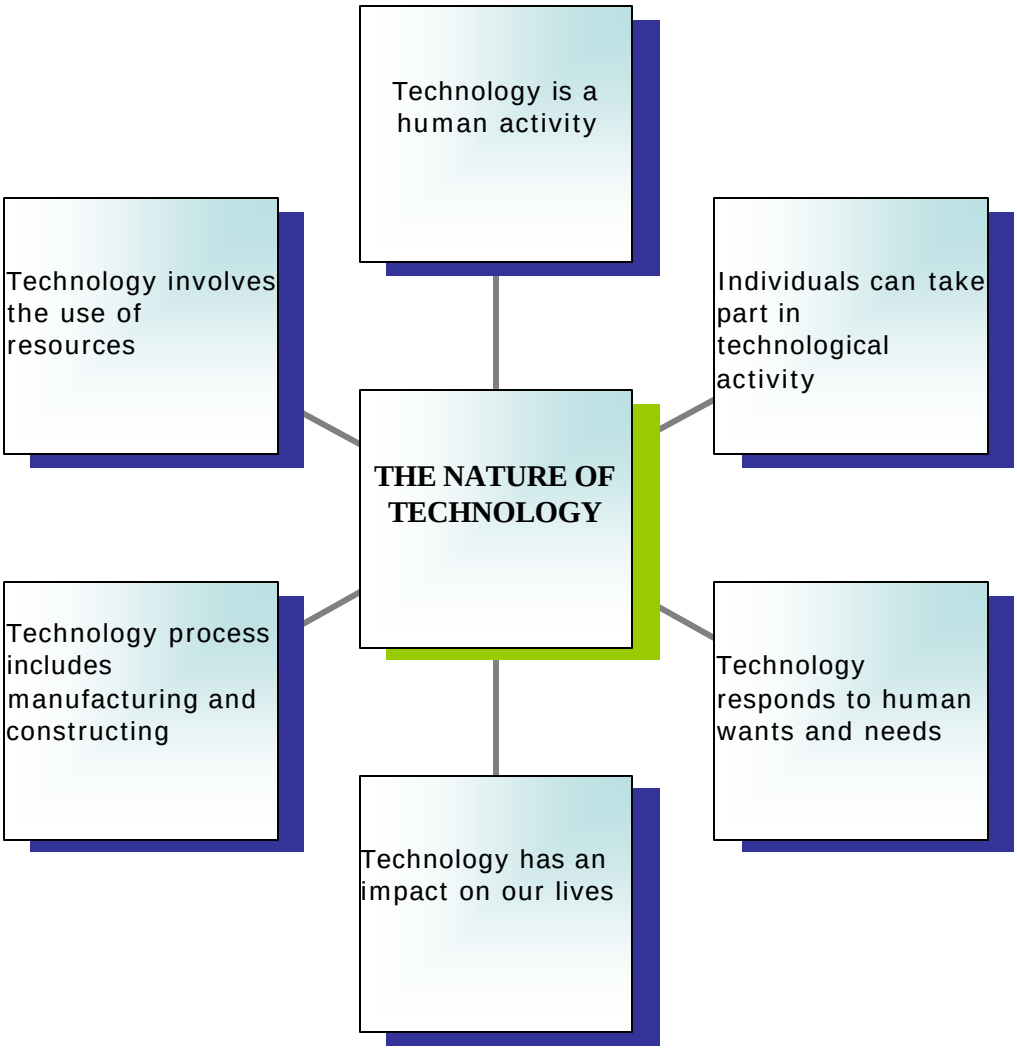
The development of technological capability and understanding, will take place along three dimensions:

- **Technological methods**
- **The nature of technology**
- **The use of Technology**

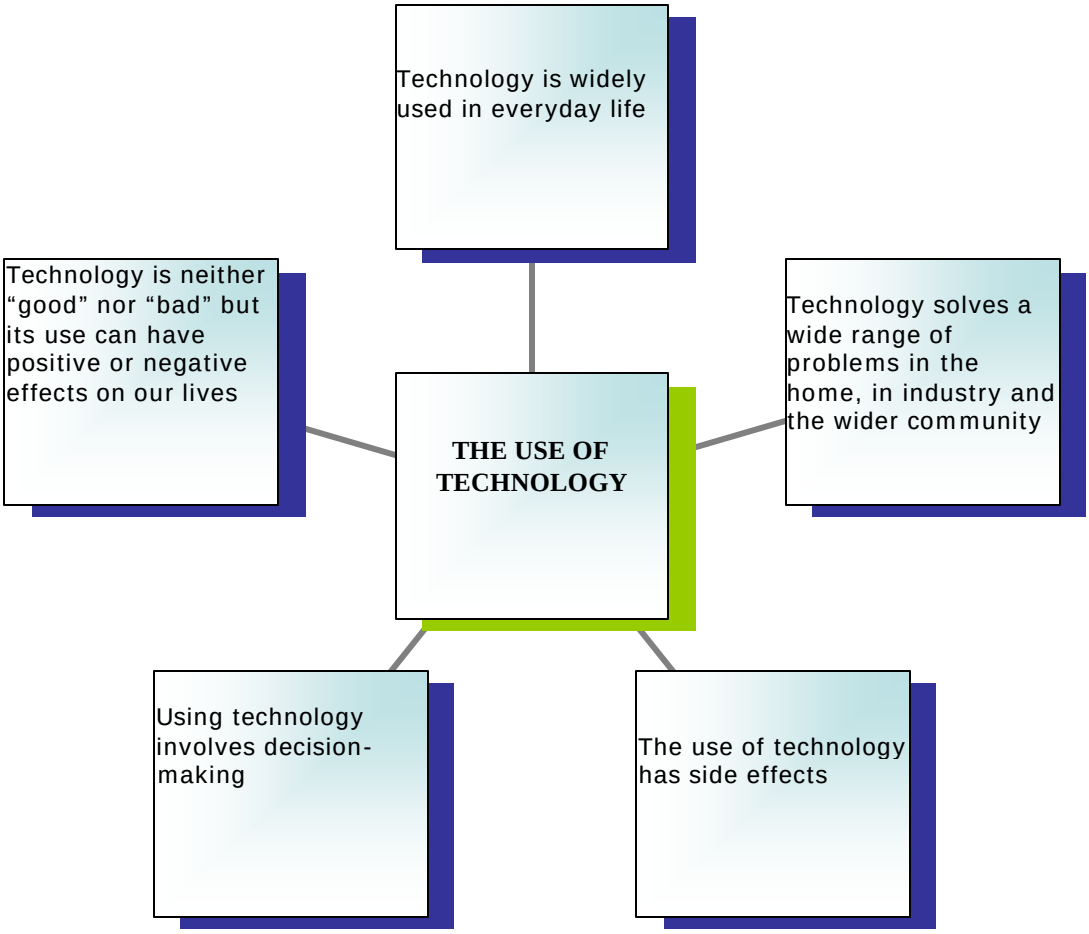
Technological methods involve the use of problem-solving, technological process and resources to find solutions to people's wants and needs.



The Nature of Technology



The Use of Technology

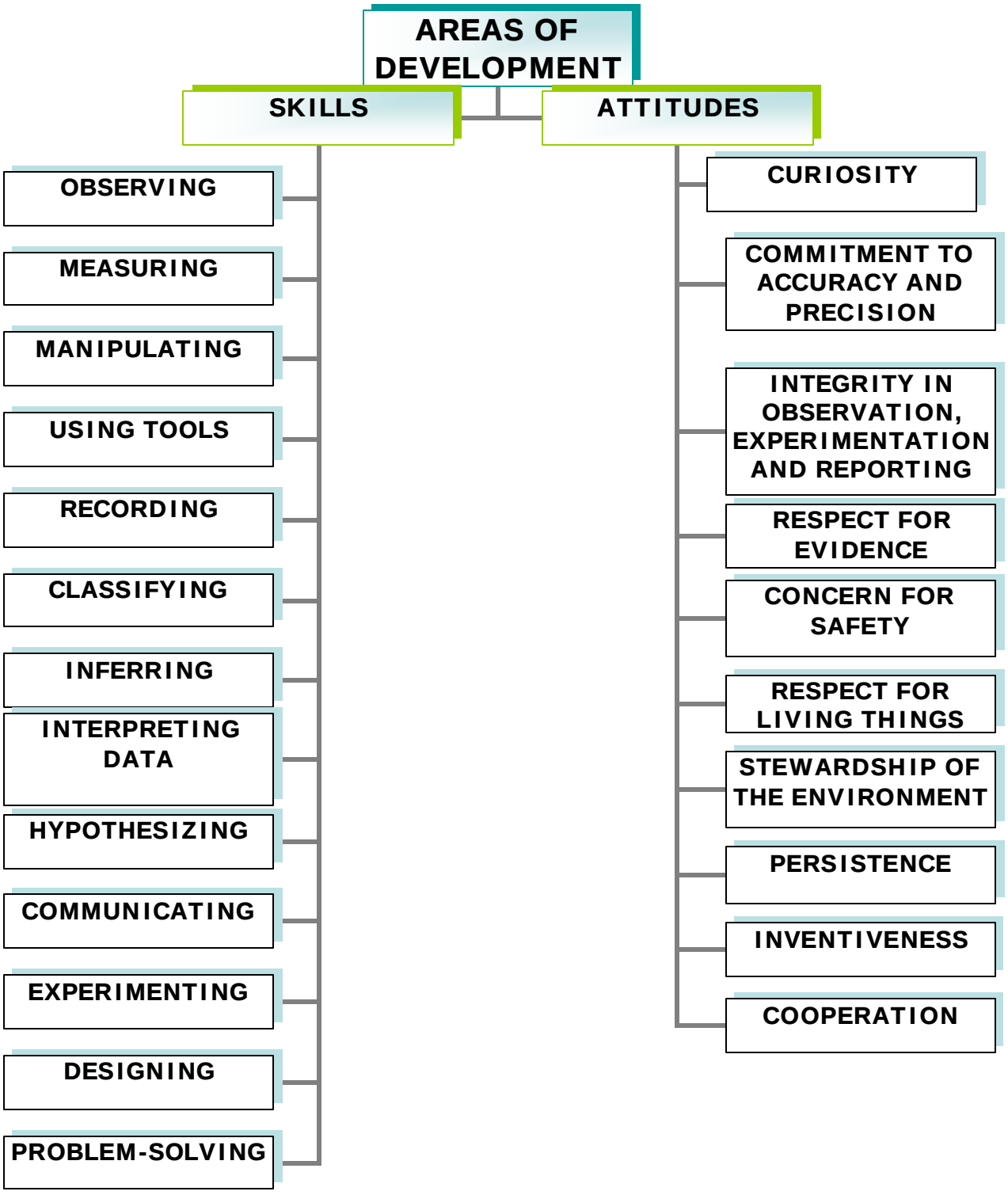


SCIENCE, TECHNOLOGY, SOCIETY AND THE ENVIRONMENT

In this area students will begin to develop the understanding that:

STSE
As humans try to understand the world and make products to meet their needs there are consequences:
The knowledge gained, the products made and the problems solved affect human life, the society and the environment.
There should be sustainable use of resources and efforts should be made to minimize ecological disturbances.
The impact of science and technology may be positive or negative, planned or unplanned, immediate or delayed.
People's values, beliefs and attitudes influence technological activity and use.

SKILLS AND ATTITUDES



The emphasis will be on students developing their ability to

- use the technological process to solve everyday problems
- use science process skills to gain information
- display appropriate attitudes and values associated with science and technology.

LEARNING OUTCOMES

In each grade band knowledge, skills and attitudes objectives in science and technology are integrated.

EARTH AND SPACE SCIENCE

EARTH'S WEATHER

GRADES K – 2

GENERAL OBJECTIVES

The students should be able to:

- become aware that the weather changes and it affects people's activities;
- realize that humans can make and use tools/instruments to measure the components of the weather;
- realize that humans can make things and structures to solve problems related to the weather (e.g. umbrellas, shutters, sunglasses, different types of clothing etc.);
- construct instruments to observe and record the conditions of the weather;
- construct a device to deal with weather conditions.

SPECIFIC OBJECTIVES

The students should be able to:

1. observe different types of weather – rainy, sunny, cloudy and windy;
2. observe changes in weather patterns over a specified period;
3. make weather charts, using pictures, to illustrate daily weather changes;
4. construct graphs (pictographs and/or bar graphs) to illustrate weather patterns over a specified period;
5. interpret data presented from objectives 3 & 4;
6. predict weather patterns;
7. discuss how the different types of weather affect one's activities;

8. identify articles of clothing, structures and devices that humans make to deal with different weather conditions;
9. draw a simple diagram to represent the water cycle;
10. identify and record the direction from which the wind is blowing at different periods;
11. differentiate between hot and cold without using a thermometer;
12. discuss what a thermometer is and what it is used for;
13. design and construct a simple wind vane with the four basic cardinal points to demonstrate wind direction;
14. design and construct a simple rain gauge to measure rainfall;
15. design and construct a simple anemometer to measure wind speed;
16. take and compare measurements of rainfall, temperature, wind direction and wind speed on different days;
17. design and make models of things used to solve problems related to the weather.

GRADES 3 – 4

GENERAL OBJECTIVES

The students should be able to:

- recognize the elements of the weather;
- understand the water cycle and its effects;
- construct and use instruments to measure elements of the weather;
- keep accurate records of weather and interpret them.

SPECIFIC OBJECTIVES

The students should be able to:

1. explain what is weather;
2. list the elements of weather (air/wind, clouds, water vapour, precipitation, temperature);
3. classify cloud types as stratus, cumulus and cirrus based on shape and height;
4. predict weather based on cloud types;
5. construct a model to represent cloud formation;
6. demonstrate how clouds are formed;
7. describe how clouds are formed;
8. discuss the useful and harmful effects of the wind;
9. use a compass to determine wind direction;
10. design and construct a wind vane to observe wind direction (Must have at least 8 cardinal points);
11. design and construct an anemometer to measure wind speed;
12. list the two main sources of water in nature's water cycle (ground water and surface water);
13. observe the evaporation and condensation of water;
14. identify the evaporation and condensation of water;
15. identify the heat source that powers nature's water cycle;
16. design and construct a model to represent the water cycle;
17. explain how temperature affects weather (evaporation, condensation and air movements);
18. use a thermometer to measure temperature;
19. design and construct a working thermometer;
20. record weather using standard symbols;
21. summarize and represent data from their recordings of the weather by using simple graphs;
22. distinguish between weather conditions by examining weather charts.

GRADES 5 - 6

GENERAL OBJECTIVES

The students should be able to:

- eplain the differences between climate and weather;
- uderstand the nature and impact of humidity.

SPECIFIC OBJECTIVES

The students should be able to:

1. state the differences between weather and climate;
2. define the term, “humidity”;
3. describe how weather patterns may be influenced by humidity.

EARTH'S RESOURCES

GRADES K – 2

GENERAL OBJECTIVES

The students should be able to:

- realize that there are many materials on Earth that humans use to make different objects for specific purposes;
- understand that if objects/materials are not properly disposed of they will pollute the land;
- realize that air and water are important to humans;
- realize that air and water can become polluted;
- realize that they can contribute to a clean environment;
- construct devices to clean the air;
- appreciate that people develop means of protecting themselves from air pollution.

SPECIFIC OBJECTIVES

The students should be able to:

Land

1. identify and name some objects found in their environment;
2. classify these objects according to:-
    - shape
    - colour
    - texture
    - size
    - composition (metal, wood, plastic, paper etc)
    - living and non-living
    - natural and human-made;
3. record data using pictographs and/or bar graphs;

4. identify items of litter around the school;
5. group the litter according to:-
    - size
    - colour
    - material made of (bottles, cans, paper, plastic, food waste)
    - recyclable and non-recyclable;
6. explain the dangers of litter (on a simple scale e.g. attracting animals with diseases, broken glass causing injury etc.);
7. discuss how the problem of litter in schools may be avoided;
8. organize and participate in a clean-up project;
9. construct a toy using discarded materials;
10. use sand to make sand sculpture and collage.

Air

The students should be able to:

1. infer that air is all around us;
2. state properties of clean air (tasteless, colourless, odourless);
3. describe conditions of air at different times (hot, cold, sticky etc.);
4. identify at least two air pollutants found in a particular area;
5. discuss how pollutants affect people's activities;
6. construct a trap for collecting dust particles from air;
7. compare the amount of pollution found in different areas using the constructed air trap.

Water

The students should be able to:

1. state the properties of water;
2. state different uses of water;
3. list places where water can be found;
4. infer that rain is water.

(This section can be tied in with weather and rain and the water cycle)

GRADES 3 – 4

GENERAL OBJECTIVES

The students should be able to:

- understand the concept of resources, using soils, air and water as examples;
- investigate the physical properties of soil, water and air.

SPECIFIC OBJECTIVES

Land

The students should be able to:

1. identify and name some of the earth's resources (to include air, water, rocks and soils);
2. classify resources as renewable and non-renewable;
3. collect and classify rocks;
4. illustrate how rocks and soils are related;
5. describe some uses of rocks to the environment (e.g. protecting the coast line, preventing/reducing erosion etc.);
6. investigate how people use rocks for different purposes (e.g.extraction of minerals, building, etc.);
7. design and make ornaments from rocks (e.g. paper weights);
8. classify soils as sand, clay and loam;
9. distinguish among various soils on the basis of physical properties (colour, texture, structure, components etc.).

Air

The students should be able to:

1. list the properties of air;
2. list and discuss ways in which air is important to people (cross reference with Energy);
3. infer the presence of air by the resistance it offers;
4. observe and describe the force exerted by air;
5. infer that air exerts a force which can bring about movement of objects;
6. demonstrate that air has mass;
7. observe the effects of air on falling objects;
8. design and construct an object to show how air affects the rate of fall;
9. compare their designs with the designs of others.

Water

The students should be able to:

1. describe the water cycle (cross reference - Earth's Weather);
2. identify ways in which water is important to human beings (include transportation, recreation);
3. compare the rate of evaporation of water under different conditions;
4. account for the differences observed in 3;
5. infer that weather affects evaporation of water in nature;
6. classify samples of water as hard and soft by their ability to form lather with soap;
7. classify substances as soluble or insoluble by their ability to dissolve in water;
8. identify the use of water as a solvent in everyday life.

GRADES 5 - 6

GENERAL OBJECTIVES

The students should be able to:

- discuss the role of humans in causing pollution of the environment;
- become aware of soil erosion and its causes;
- develop personal responsibility for reducing pollution;
- conduct investigations involving pollution of the environment;
- design and make objects related to their study of the earth's resources.

SPECIFIC OBJECTIVES

Land

The students should be able to:

1. identify evidence of soil erosion and suggest the agents of erosion;
2. describe what can be done to conserve soil;
3. describe ways of preventing soil erosion;
4. design and construct a model to represent soil erosion by flowing water;
5. discuss different ways of disposing of waste materials and suggest when these are appropriate;
6. display correct methods of garbage disposal;
7. discuss the advantages of reducing the amount of garbage in the environment;
8. classify litter as recyclable and non-recyclable;
10. participate in a clean-up project;
11. design and construct useful items from discarded objects and materials.

Air

The students should be able to:

1. state that air is needed for burning/combustion;
2. discuss how burning/combustion cause air pollution;
3. compare devices that burn different fuels in terms of the air pollution they cause;
4. compare the amount of air pollution found in two different areas;
5. hypothesize as to the reasons for the differences between pollution in the two areas;
6. design and construct a device to detect air pollution;
7. discuss the importance of having 'clean' air;
8. infer that cold air occupies less space than warm air;

Water

The students should be able to:

1. identify natural sources of water;
2. list ways in which people's activities may affect the water supply;
3. discuss the effects of water shortage on the environment and human activity;
4. state ways in which water sources may be polluted;
5. discuss how human's activities may result in water pollution;
6. discuss ways of reducing water pollution;
7. construct a device to determine the turbidity of water;
8. arrange water samples depending on degree of turbidity;
9. plan and design an experiment to make polluted water clean.

SOLAR SYSTEM

GRADES K – 2

GENERAL OBJECTIVES

The students should be able to:

- realize that daytime and nighttime occur in regular cycles;
- realize that humans have developed ways to provide light;
- understand that the sun, the planets and the moon are parts of the solar system;
- understand that Earth is a planet in the solar system;
- become aware of the movement of Earth relative to the sun.

SPECIFIC OBJECTIVES

The students should be able to:

1. observe and record natural occurrences the daytime and nighttime;
2. infer that daytime and nighttime occur in regular cycles;
3. distinguish between natural and human-made sources of light;
4. name the sun, the Earth and the moon as parts of the solar system;
5. infer the position of the sun at different times of the day;
6. identify the main phases of the moon: full moon, last quarter,new moon and first quarter.

GRADES 3 - 4

GENERAL OBJECTIVES

The students should be able to:

- understand the relationship among the sun, the Earth and the moon;
- recognize the planets in the solar system.

SPECIFIC OBJECTIVES

The students should be able to:

1. discuss the relationship among the Earth, moon and sun;
2. operationally define “rotate;”
3. operationally define “revolve;”
4. operationally define a planet, a star and a satellite;
5. identify the Earth as a planet in space;
6. identify the moon as the Earth’s satellite;
7. identify the sun as a star;
8. name the planets of the solar system and place them in their relative positions to one another;
9. list the components of the solar system (sun, planets and natural satellites);
10. name the planets of the solar system and place them in their relative positions to one other;
11. infer that the sun is the main source of light in the solar system;
12. construct a model of the solar system.

GRADES 5 - 6

GENERAL OBJECTIVES

The students should be able to:

- realize the conditions needed to support life;
- be aware that humans explore other parts of the solar system;
- identify technological inventions used in the study of the solar system and space exploration.

SPECIFIC OBJECTIVES

The students should be able to:

1. state the conditions needed on planets for the existence of life;
2. infer why life exists only on Earth;
3. identify instruments used to observe the solar system;
4. distinguish between manned and unmanned space exploration;
5. research and display vehicles used in the exploration of space;
6. research and discuss benefits of space exploration.

LIFE SCIENCE

DIVERSITY AND CLASSIFICATION

GRADES K – 2

GENERAL OBJECTIVES

The students should be able to:

- recognize that animals (including human beings) and plants are living things;
- appreciate the wide variety of animals and plants that exist.

SPECIFIC OBJECTIVES

The students should be able to:

1. name some living and non-living things;
2. classify living and non-living things;
3. classify animals on the basis of characteristics such as their size, body coverings, and the food they eat;
4. make a presentation displaying living and non-living things (e.g. a collage);
5. name some characteristics of living things;
6. role play the behaviour or habits of some animals;
7. iIdentify, by sight or by sound, a wide variety of animals;
8. make a representation of animals (e.g. scrapbook);
9. identify different kinds of plants;
10. name two types of leaves that are found in plants;
11. list different uses of leaves in everyday life.

GRADES 3 - 4

GENERAL OBJECTIVES

The students should be able to:

- appreciate that there are many different ways of propagating plants;
- classify plants according to their method of reproduction;
- appreciate that people cultivate plants for their own needs;
- classify animals as vertebrates and invertebrates.

SPECIFIC OBJECTIVES

The students should be able to:

1. classify plants into flowering and non-flowering; monocotyledonous and dicotyledonous;
2. describe the differences between monocotyledonous and dicotyledonous plants;
3. define propagation;
4. state two natural methods by which flowering plants can be propagated;
5. define (i.) seed (ii.) plant (iii.) tree (iv.) shrub (v.) vine (vi.) herb;
6. describe common methods of vegetative propagation;
7. demonstrate respect for plants in their environment;
8. suggest appropriate methods of propagation for (i.) obtaining diversity and (ii.) keeping the same characteristics in plants;
9. describe people's use of artificial plant propagation and materials (*production technology*) to satisfy their needs;
10. identify seeds as a means of reproducing different plants.;
11. define sexual reproduction;
12. link the seed to sexual reproduction in plants;

13. describe the process of germination in plants;

14. list the factors needed for germination to occur;

15. compare the rate of germination in a variety of seeds;

16. identify seeds as a means of reproducing different plants;

17. define (i.) vertebrates (ii.) invertebrate;

18. list the five classes of vertebrates;

19. describe the main features of each class of vertebrate;

20. compare the main features/characteristics of the classes of vertebrates;

21. make a model of any vertebrate from ‘throw away’ items.

GRADES 5 – 6

GENERAL OBJECTIVES

The students should be able to:

- explain how different organisms reproduce and compare their life cycles.

SPECIFIC OBJECTIVES

The students should be able to:

1. name different animals and state the method by which they reproduce;
2. explain the need for reproduction;
3. explain what the life cycle of an animal is;
4. describe the life cycle of an animal where the young and adult are alike;
5. describe the life cycle of an animal where the young and adult are not alike;
6. classify insects according to their type of life cycle;
7. describe the role of the butterfly in nature;
8. compare the human life cycle to that of another animal;
9. define pollination, cross-pollination and self-pollination ;
10. describe the processes of (i.) self-pollination and (ii.) cross-pollination;
11. distinguish between self-pollination and cross-pollination;
12. classify flowering plants according to the type of pollination they undergo;
13. name the agents of pollination;
14. identify pollen grains and ovules as the reproductive cells/gametes in a flower;
15. define fertilization as the fusion of male and female gametes;
16. explain how fertilization occurs in a flower;
17. appreciate the significance of the processes of pollination and fertilization in plants as a means of obtaining seeds;
18. define ‘seed dispersal’;
19. list the agents of seed dispersal and give examples of seeds that are dispersed by each method;

20.explain why it is important for seeds to be dispersed/scattered.

ECOSYSTEMS

GRADES K - 2

GENERAL OBJECTIVES

The students should be able to:

- recognize that animals and plants are living things that depend on each other for their survival;
- become aware of different plants and animals and their varying needs for food, shelter and protection;
- investigate the habitats and environments of plants and animals;
- develop and demonstrate a caring attitude toward animals, plants and other resources in the environment;
- appreciate the importance of recycling and conservation in maintaining balance in the environment;
- recognize the importance of clean air and water for the maintenance of life on earth;
- be aware of safety issues and exercise precautionary measures that limit the risk of harm to oneself, others and environment;
- understand that plants and animals gain information about their environment by using their senses;
- appreciate the use of the different sense organs in receiving information.
- recognize that plants and animals are interdependent and that they possess natural defences to help them to survive in the wild;
- understand the term, adaptation, in relation to interdependence;
- appreciate the importance of every part of the ecosystem in maintaining the environment.

SPECIFIC OBJECTIVES

The students should be able to:

1. name and identify some common pets;
2. identify the different foods for different pets;
3. describe and demonstrate appropriate ways of treating their pets;
4. identify precautionary measures that should be employed to maintain safety to self, others and environment and the pet itself when a pet is present;
5. identify homes/habitats of animals and plants;
6. observe homes of different types of animals;
7. determine how each home satisfies the needs (e.g. food, shelter, protection) of the animals that live there;
8. compare human vs. animal homes for similarities and differences;
9. appreciate the importance of caring for plants and animals and the environment in which they live;
10. investigate how organisms adapt to their habitats;
11. identify some features of organisms that are designed to enable their survival in their habitats;
12. appreciate that organisms are adapted to survive in their natural environments/ecosystems;
13. distinguish between actions that harm a habitat/the environment from those that preserve it;
14. demonstrate how one would care for a habitat/environment;
15. identify and predict actions that could harm named habitats/the environment;
16. observe a plant and identify the main parts;
17. classify plants (size, shape of leaves, flowering and non-flowering);
18. name the process of initial seed growth (germination);

19. state in simple terms the conditions necessary for seed growth;

20. discuss different uses of plants in the society;

21. describe how plants and plant parts can be processed into certain foods;

22. identify/name plants found in their country;

23. classify plants as food, ornamental decorative, shelter etc.;

24. list animals found in their country;

25. state features of different animals;

26. classify animals as domesticated, wild and useful;

27. discuss/explain what endangered species are and give examples of them;

28. outline ways to protect endangered species. e.g. (laws; changing of human behaviour);

29. name and identify each sense organ;

30. state what stimulates each sense;

31. identify different stimuli that affect the senses;

32. name the organ that is stimulated by sounds;

33. classify sounds by pitch and loudness;

34. construct and use simple musical instruments;

35. identify some ways in which plants and animals depend on each other (e.g. feeding, pollination, shelter, protection);

36. describe how some named organisms depend on each other;

37. compare feeding habits of organisms;

38. identify feeding relationships among organisms;

39. investigate predator-prey relationships;

40. construct simple food chains to represent the feeding relationships among plants and animals;

41. identify natural defences that animals use to help them survive (spines, camouflage, etc.);

42. state the various uses of water;

43. give simple definition of drought and discuss its effect;

44. discuss some ways in which water may be polluted;

45. identify ways in which water may be conserved;

46. appreciate that clean water is very important to human life and participate in its conservation;

47. identify items of litter around the school;

48. group the litter according to size, colour, material it is made of (bottles, cans, paper, plastic, food waste), recyclable and non-recyclable;

49. explain the dangers of litter (on a simple scale e.g. attracting animals with diseases, broken glass causing injury etc.);

50. discuss how the problem of litter in schools may be avoided;

51. trace garbage to its final destination;

52. state the meaning of solid waste;

53. identify methods of managing solid wastes in the home/school/community (recycling, etc.);

54. discuss how the problem of litter in schools may be avoided;

55. organize and participate in clean-up projects;

56. construct a toy using discarded materials/items;

57. define the term, environmental destruction;

58. iInvestigate the factors that result in environmental destruction;

59. identify some ways in which environmental destruction may be prevented.

GRADES 3 - 4

GENERAL OBJECTIVES

The students should be able to:

- recognize that plants and animals depend on each other for their survival and become aware of feeding relationships among animals;
- recognize the importance of conservation of the resources in the environment and apply conservation methods;
- appreciate and explain the concept of the ecosystem;
- investigate and describe the ecosystem of the local and regional environment;
- understand the impact of natural disasters and human activities on the balance of the environment/ecosystem.

SPECIFIC OBJECTIVES:

The students should be able:

1. construct simple food webs to show feeding relationships among animals in a given area (a tree and places close to it; a flower garden; a pond; etc.);
2. interpret simple food webs;
3. infer that food webs help to keep the balance in nature ;
4. identify factors that may disrupt the balance of nature;
5. state the consequences of disrupting the balance of nature;
6. investigate the characteristics of mangrove swamps, rainforests, ponds, etc.;
7. explain the importance of mangrove swamps, rainforests and ponds;
8. construct a model of an environment (a habitat);
9. explain the links between land structure and type of ecosystems;

10. discuss how ecosystems contribute to development (social, economic-e.g. fishing, ecotourism, etc.;

11. name the different types of ecosystems found in thier country and indicate their location on a map;

12. investigate the characteristics and importance of ecosystems in the region (other than own country);

13. name the main types of Caribbean ecosystems;

14. identify the countries in which specific ecosystems are located;

15. indicate the distribution/location of some regional ecosystems (*hilly/wet/rainforest)* on a map of a given country;

16. explain how ecosystems provide useful resources;

17. define conservation;

18. understand the concept of balance in the environment;

19. describe the role of recycling and other conservation methods in maintaining balance in the environment;

20. identify local ecosystems (specifically coral reefs, mangrove swamps, rain forests) in need of conservation;

21. identify and explain the importance of other resources that need to be conserved/recycled;

22. explain environmental conservation actions that may be taken in everyday life;

23. appreciate that the environment needs to be protected;

24. investigate conservation needs of their country (*focus on terrestrial);*

25. identify ways of conserving the environment;

26. identify ways in which humans interact with the environment;

27. investigate the effect of wave action on the environment (*e.g. beach, coral reefs*).

GRADES 5 – 6

GENERAL OBJECTIVES

The students should be able to:

- Recognize the complexity of feeding relationships among animals and be able to describe and represent them in some way;
- recognize that a change in an ecosystem can affect life in that system;
- develop responsibility for the protection of the environment;
- understand the impact of natural disasters and people's activities on the balance of the environment/ecosystem.

SPECIFIC OBJECTIVES

The students should be able to:

1. give examples of interactions among biotic factors in an ecosystem;
2. identify species in a food web as herbivores and carnivores, and as producers and consumers;
3. explain that living things compete for food and space in the environment;
4. identify animals competing for food in a food web;
5. identify food chains and food webs in an ecosystem;
6. explain competition among living organisms in an environment;
7. define (i.) species (ii.) population (iii.) overpopulation (iv.) quadrat (v.) birth rate (vi.) death rate;
8. list some factors that can affect population growth;
9. identify the impact of underpopulation/overpopulation of organisms on their habitat;
10. collect data on the number of specific organisms within a habitat;
11. estimate the population of a given organism in a small area/habitat;

12. identify natural water resources;

13. state ways in which water may be polluted;

14. identify marine pollutants;

15. suggest ways of preventing/reducing marine pollution;

16. compare the degree of air pollution in two different areas;

17. hypothesize about the reason for the differences in the two areas;

18. investigate the cause(s) of air pollution in the two areas (to test hypotheses);

19. design and construct a device to detect air pollution;

20. discuss the importance of having 'clean' air;

21. discuss how people's activities may result in air and water pollution;

22. construct a device to determine the turbidity of water;

23. arrange water samples according to their degrees of turbidity;

24. classify water as hard or soft;

25. identify ways of making hard water soft, and soft water hard;

26. identify situations where hard or soft water is required;

27. define surface tension;

28. state how surface tension can be broken;

29. identify and describe the effect of soap on the movement of water through cloth and paper;

30. plan and design an experiment to make polluted water clean;

31. discuss ways of reducing air and water pollution;

32. design and make brochures, posters, etc. on conservation of air and water;

33. describe the immediate environment;

34. identify some ways in which an ecosystem can change;

35. examine and describe a local ecosystem that has experienced change;

36. list factors that can bring about changes to ecosystems;

37. investigate the impact humans have on ecosystems;

38. recognize the role that humans play in protecting or destroying ecosystems;

39. demonstrate involvement in environmental protection;

40. appreciate the fragile nature of ecosystems;

41. describe an earthquake as a natural process and state what causes it;

42. identify ways in which earthquakes have an impact on the environment;

43. state the safety measures to be carried out during an earthquake and demonstrate each;

44. identify volcanic activity as a natural process in the environment;

45. explain how volcanoes are formed;

46. discuss the impact of volcanic eruptions on the ecosystem;

47. list useful and harmful effects of the presence of a volcano in an environment.

STRUCTURE AND FUNCTION

GRADES K – 2

GENERAL OBJECTIVES

The students should be able to:

- identify the structure and function of the main external parts of plants in the environment;
- describe the function of the main external parts of plants and animals in their environment;
- appreciate that plants and animals undergo changes from earliest stages to maturity.

SPECIFIC OBJECTIVES

The students should be able to:

1. name the main external parts of animals (vertebrates and selected invertebrates e.g. insects, spiders, crabs);
2. identify the main external body parts of various animals and their functions (include sense organs);
3. name the main external parts of plants (roots, stems, leaves, fruits, flowers);
4. identify the roots, stems, leaves, fruits and flowers of plants;
5. draw and label a diagram of the main external parts of a plant;
6. name the external parts of a flower;
7. compare the external parts of different flowers (shape, colour, size, texture);
8. state the role of each part of the flower;
9. identify and name the different stages in the development of animals in their environment;
10. identify and name the different stages in the development of plants in their environment.

GRADES 3 – 4

GENERAL OBJECTIVES

The students should be able to:

- identify different methods of reproduction among plants in the environment;
- understand the importance of growth, development and reproduction in plants and animals;
- identify parts of plants and animals and relate them to their function;
- understand that technology can be utilized in growth and propagation of plants (grafting, fertilizers, pruning);
- appreciate the importance of plants to humans.

SPECIFIC OBJECTIVES

The students should be able to:

1. describe the physical structures of the main parts of plants;
2. relate the features of these external structures of plants to their function;
3. discuss the uses of plants to humans;
4. state the conditions necessary for germination in plants;
5. observe and describe the stages in the process of growth in plants;
6. discuss the importance of growth, development and reproduction in plants and animals;
7. state the various ways in which technology is utilized in the growth and propagation of plants;
8. explain the effects of technology on growth and propagation in plants;
9. describe the external structures of animals;
10. relate the features of these structures to their function.

GRADES 5 – 6

GENERAL OBJECTIVES

The students should be able to:

- identify the structure and function of the major systems of plants and animals;
- describe the function of the major systems of plants and animals;
- appreciate the importance of technology in the functioning of the major systems in human beings.

SPECIFIC OBJECTIVES

The students should be able to:

1. state the major systems in animals (Digestive, Circulatory/Transport, Reproductive, Excretory, Respiratory, Nervous, Endocrine and Skeletal system);
2. identify the functions of each major system in animals;
3. state that the transport system is the major system in plants;
4. list the main parts of each system in animals;
5. describe the function of each part of the (i.) Digestive (ii.) Circulatory (iii.) Reproductive (iv.) Skeletal systems, in humans;
7. construct models of the various systems in humans;
8. name the main parts of the transport system in plants;
9. describe the function of the main parts of the transport system in plants;
10. identify technology utilized in the various systems in humans;
11. construct models of technological devices that are used in the various systems in humans.

PHYSICAL SCIENCE

ENERGY

GRADES K – 2

GENERAL OBJECTIVES

The students should be able to:

- develop an awareness of heat, light, sound, electricity in the context of changes taking place;
- develop an awareness of devices that use/convert/produce heat, light, electricity and sound;
- design and make devices powered by moving air and water;
- develop awareness of the importance of heat, light, sound, and electricity in our daily lives.

SPECIFIC OBJECTIVES

The students should be able to:

1. identify a variety of moving objects;
2. state a variety of ways in which objects move;
3. identify the conditions (inputs) needed for objects to move in a given situation;
4. design and make paper areoplanes and boats, windmills, water wheels;
5. identify food as a source of energy for themselves and other living things;
6. recognize the need for heat, light, sound, electricity in our daily lives ;
7. operate a simple device or system and identify the input and output (e.g. flashlight, lamp, toy);
8. list some uses of the sun in everyday activities;

9. identify devices that use moving air and moving water as energy sources (e.g. windmills, water wheels);

10. design and construct a device propelled by air (e.g. kite, balloon, rocket);

11. demonstrate how sounds can be made;

12. design and construct guitars, drums, bottle organ;

13. investigate the effect of manipulating variables on sounds produced;

14. identify devices in the home that use electricity;

15. identify ways in which technology related to energy use has enhanced the lives of people in the past and now;

16. imagine how their lives would change without heat and electricity;

17. state safety measures in using electrical devices.

GRADES 3 - 4

GENERAL OBJECTIVES

The students should be able to:

- appreciate the importance of heat and light in our everyday lives;
- realize that heat and light affect matter;
- identify fuels and the sun as sources of heat and light;
- understand that energy can be transferred from place to place in different forms.

SPECIFIC OBJECTIVES

The students should be able to:

1. identify natural and human-made objects that emit heat and light (sun, candle, fire, lamp);
2. appreciate the role of the sun as the *main* provider of heat and light on the Earth;
3. appreciate the role of human-made devices that provide heat and light in our daily lives;
4. state ways in which heat and light are used in everyday activities;
5. list examples of fuels used in their country in the home, for transportation, and production;
6. discuss some unintended consequences of using fuels for transport, and in production processes (e.g. pollution, depletion of resources etc.);
7. state ways in which solar energy is used in the home;
8. investigate the effects of heat on matter (e.g. change in temperature);
9. use a thermometer to measure temperature;
10. investigate the effects of light on materials;

11. trace the flow of energy in a system (e.g. sun → plants producing food);
12. give simple examples of energy transformation;
13. draw a time-line to show how technology for a particular purpose, for example, transport , heating, lighting, has changed over a period of time;
14. compare devices used to provide heat or light using selected criteria.

GRADES 5 - 6

GENERAL OBJECTIVES

The students should be able to:

- understand that electrical energy is transferred in circuits;
- use the design process to create a product.

SPECIFIC OBJECTIVES

The students should be able to:

1. name the parts of a simple electrical circuit;
2. set up simple electrical circuits;
3. distinguish between conductors of electricity and insulators;
4. design and make devices that demonstrate energy transformations (e.g. electricity to light; electricity to sound);
5. practise safety measures in using electrical devices.

FORCES, MOTION AND SRUCTURES

GRADES K – 2

GENERAL OBJECTIVES

The students should be able to:

- develop awareness of forces exerted by their own bodies and other objects;
- describe effects of forces;
- develop awareness of common structures and their uses;
- develop awareness of common simple mechanical devices and their uses.

SPECIFIC OBJECTIVES

The students should be able to:

1. demonstrate pushes and pulls;
2. give examples of situations where force is used;
3. identify forces at work in common situations;
4. demonstrate ways in which motion can be changed (start movement, increase speed, reduce speed, change direction);
5. identify structures in our everyday lives (houses, walls, bridges, vehicles, trees, coral reefs) and state their functions;
6. classify structures in different ways (e.g. size, shape, material from which they are made, natural and human-made);
7. make models of structures from materials provided;
8. identify simple mechanical devices (e.g. hinges, screws, screw drivers etc.).

GRADES 3 - 4:

GENERAL OBJECTIVES

The students should be able to:

- understand that objects can exert forces (such as magnetic force, electrostatic force and gravity) on other objects from a distance;
- realize that forces affect structures;
- develop the capability to alter the shape and strength of structures to minimize the effect of forces.

SPECIFIC OBJECTIVES

The students should be able to:

1. identify force as a push or pull by one body on another;
2. investigate the ways in which different forces e.g. magnetism, static electricity, muscular force, gravitational force, can change the speed and direction of a moving object;
3. observe the effects of magnets on the motion of different materials (e.g. iron filings will be moved by a magnet whereas grains of sugar will not);
4. observe different kinds of motion and indicate whether the motion is caused by gravity, static electricity, magnets or applied force, etc.;
5. observe different phenomena and formulate questions;
6. describe the visible effects of forces acting on a variety of everyday objects;

- a toy car when pushed - goes forward
- a ball when dropped - falls

7. demonstrate how a magnet works;
8. suggest novel ways of using magnets;
9. describe, using their observations, ways in which the strength of different materials may be altered;

10. investigate ways in which the strength of materials may be altered (e.g. adding additional layers);
11. observe that the materials used to make a tower affect its strength;
12. infer that the strength and stability of an object is dependent upon its shape;
13. observe and describe how natural and human-made structures are strengthened;
14. describe, using their observations, forces that can alter the shape of materials and structures (e.g. bending, squashing, stretching and pulling);
15. describe ways in which forces alter the shape of different structures and materials;
16. observe the cross-section of a tree;
17. observe animals with exo-skeletons and endo-skeletons;
18. describe using their observations the role of struts (e.g. to resist compression) and ties (e.g. to resist tension) in structures under load.

GRADES 5 - 6

GENERAL OBJECTIVES

The students should be able to:

- understand that the effect of forces varies with the size of the force;
- uUnderstand that simple machines transfer forces;
- investigate factors that affect the stability of structures;
- appreciate the use of simple machines in everyday life.

SPECIFIC OBJECTIVES

The students should be able to:

1. name the instrument used to measure force and the unit of force;
2. measure the force acting on an object using a spring balance;
3. design a simple instrument/device that can be used to measure force;
4. predict the position of forces in balancing a non-uniform object;
5. identify a number of common levers and describe how they work;
6. appreciate that levers make work easier;
7. name the different points of a lever;
8. measure the mass of an object using a simple lever;
9. predict the force that will balance a lever with an off-centre fulcrum;
10. identify the parts of a wheel and an axle;
11. list examples of wheels and axles;
12. explain the function of the wheels and axles listed in the examples;
13. research the use of wheels in a variety of situations and discuss their impact;
14. operationally define a simple machine;
15. list examples of simple machines;
16. appreciate the fact that machines makes work easier;

17. examine the use of simple machines in simple devices in the home and playground (e.g. openers, egg beaters, seesaws etc.);
18. determine experimentally that varying the **mass** of an object and the **height** from which it is dropped will vary the force exerted by the object;
19. design a device to prevent an egg from breaking on impact after being released from a raised platform;
20. determine experimentally that the surface area of a free-falling object affects the time for free-fall;
21. investigate the strength of materials with reference to the forces they can withstand;
22. suggest ways of strengthening materials in an effort to making them more resistant to forces;
23. infer that an inclined plane decreases the force required to lift an object;
24. identify examples of inclined planes in common use;
25. define the term, wedge;
26. explain how a wedge functions in making work easier;
27. list examples of wedges in common use and explain how they work.

MATTER AND MATERIALS

GRADES K - 2

GENERAL OBJECTIVES

The students should be able to:

- become aware of materials in their environment and their properties;
- become aware that people choose materials to make objects according to their properties.

SPECIFIC OBJECTIVES

The students should be able to:

1. identify and describe objects according to properties such as colour, size, shape and texture;
2. classify objects according to properties above;
3. distinguish between objects and the materials from which they are made;
4. identify different materials such as wood, glass, clay, plastic, rubber, metal
5. list objects made from the materials above;
6. investigate the properties of materials (e.g. transparency, hardness, strength);
7. match the properties of materials to their use;
8. choose materials suitable for making kites, windmills, water wheels, pot holders;
9. construct a simple object (as in 8) using chosen materials;
10. recognize that water can be solid or liquid;
11. describe the properties of solids and liquids using their senses;
12. give examples of solids and liquids;
13. compare the properties of liquids used in the home;
14. state that water can change from solid to liquid and from liquid to solid;
15. identify the conditions that cause changes from solid to liquid and back (e.g. water turns to ice in a freezer and ice turns to water when heated).

GRADES 3 - 4

GENERAL OBJECTIVES

The students should be able to:

- understand that the amount of matter and the space it occupies can be measured;
- materials may interact differently with other materials and objects.

SPECIFIC OBJECTIVES

The students should be able to:

1. list some physical properties of matter;
2. determine the physical properties (length etc.) of matter by using instruments such as thermometers, rulers, etc.);
3. measure definite volume and mass of materials;
4. give examples of physical change;
5. use a variety of ways and measurements to compare and contrast the physical properties of materials (soluble, insoluble, conductors, non-conductors of heat and electricity etc.);
6. describe the effect of magnets on materials;
7. describe the use of magnets in the home and community;
8. suggest novel ways of using magnets in the home or school;
9. demonstrate that certain materials reflect, transmit or absorb light;
10. describe and give examples of transparent, translucent and opaque materials;
11. identify properties of materials that make them suitable for specific purposes;
12. compare objects used for the same purpose but made of different materials and list the advantages and disadvantages of using each type of material.

GRADES 5 – 6

GENERAL OBJECTIVES

The students should be able to:

- investigate changes in materials and matter;
- classify changes as reversible or irreversible;
- appreciate that people bring about changes in materials to satisfy their needs;
- appreciate the changes taking place in at least one production process used in the home and one in industry.

SPECIFIC OBJECTIVES

The students should be able to:

1. identify and describe different ways by which materials can be changed;
2. identify melting, freezing, condensation and evaporation as changes of state that can be reversed;
3. infer that the mass of water remains the same when water changes from solid to liquid;
4. identify burning, rusting and decaying as changes that are non-reversible;
5. identify a production process taking place in the home;
6. draw a diagram to show the stages in the process;
7. identify and describe changes taking place in the process;
8. appreciate that humans use production processes to make products.

APPROPRIATE EXPECTATIONS AT THE DIFFERENT GRADE LEVELS FOR THE ATTITUDES, SKILLS AND TECHNOLOGY OUTCOMES ARE AS FOLLOWS:

GRADES K - 2

ATTITUDES:

	Students should be encouraged to:
Curiosity:	✓ Ask questions about objects and events. ✓ Find out more about events and objects on their own.
Inventiveness:	✓ Suggest new ways of doing things.
Respect For Evidence	✓ Explain their explanations and conclusions. ✓ Listen to other children's results and explanations.
Persistence	✓ Complete activities. ✓ Persist at tasks.
Respect For Living Things	✓ Show sensitivity to living things.
Cooperation	✓ Share with others. ✓ Work together with others.
Concern For Safety	✓ Observe safety instructions.

SKILLS:

In developing their skills of inquiry, problem-solving and design, the students are expected to:

Observing	✓ Use as many senses as are appropriate and safe to gather information. ✓ Identify differences and similarities between objects and events. ✓ Identify sequence in events.
Measuring	✓ Use simple measuring instruments or models of measuring instruments. At first use comparative terms such as bigger, smaller, and later use actual figures.
Manipulating	✓ Set up simple experiments to compare results. ✓ Manipulate simple equipment.
Recording	✓ Use pictures and charts to report results. ✓ Fill out simple tables to report results.
Classifying	✓ Group objects according to one or two criteria.
Communicating	✓ Talk freely about their activities and the ideas they have, with or without making a written record. ✓ Use appropriate vocabulary to describe their observations. ✓ Listen to others' ideas and look at their results. ✓ Report events by using demonstrations, role play, simple drawings, paintings and simple sentences.
Inferring	✓ Notice patterns in simple measurements and events.
Interpreting data	✓ Discuss what they find out in response to questions.
Experimenting	✓ Freely ask a variety of questions and suggest how they might be answered. ✓ Suggest how they could investigate to find out answers to questions.
Predicting	✓ Attempt to make predictions (even if not based on patterns)
Problem Solving	✓ Suggest solutions to simple problems
Designing	✓ Construct models either by following instructions or by using their own designs ✓ Select appropriate material to make models and gadgets.

TECHNOLOGY

Technological Methods	✓ Given problems, the children will be able to discuss and make simple gadgets.
Nature Of Technology	✓ Realize that some things are natural and people for their use make others. ✓ Realize that people use natural things and also make other things from them. ✓ Realize that they can design and make things which may be different from what others make. ✓ Share information with others. ✓ Realize that safety is important in using tools and making things.
<u>Use Of Technology</u>	✓ Appreciate the use of devices, tools and structures made by humans in the home and community. ✓ Appreciate the advantages of using these products. ✓ Realize that human-made things can pollute the environment.

GRADES 3 - 4

ATTITUDES:

	Students should be encouraged to:
Curiosity:	✓ Ask questions about objects and events. ✓ Find out more about events and objects on their own.
Inventiveness:	✓ Suggest new ways of doing things. ✓ Use equipment in novel ways.
Respect For Evidence	✓ Explain their explanations and conclusions using some evidence. ✓ Listen to other students' results and explanations. ✓ Begin to recognize when conclusions do not fit the evidence.
Persistence	✓ Complete activities. ✓ Persist at tasks.
Respect For Living Things	✓ Show sensitivity to living things.
Cooperation	✓ Share with others. ✓ Work together with others. ✓ Accept responsibilities.
Concern For Safety	✓ Observe safety instructions.

SKILLS:	In developing their skills of inquiry, problem-solving and design, the students are expected to:
Observing	✓ Use as many senses as are appropriate and safe to gather information. ✓ Identify differences and similarities between objects and events. ✓ Identify sequence in events.
Measuring	✓ Use simple measuring instruments or models of measuring instruments. At first use comparative terms such as bigger, smaller, and later use actual figures.
Manipulating	✓ Set up simple experiments to compare results. ✓ Manipulate simple equipment.
Recording	✓ Use pictures and charts to report results. ✓ Fill out simple tables to report results.
Classifying	✓ Group objects according to several criteria.
Communicating	✓ Talk freely about their activities and the ideas they have, with or without making a written record. ✓ Use appropriate vocabulary to describe their observations. ✓ Listen to others' ideas and look at their results. ✓ Report events by using demonstrations, role play, simple drawings, paintings and paragraphs. ✓ Use bar graphs, pictures, tables and charts to report results. ✓ Use books and other sources to find information.

SKILLS CONT'D

Inferring	✓ Notice patterns and relationships in simple measurements and events.
Interpreting data	✓ Discuss what they find out in response to questions. ✓ Compare their findings with their predictions. ✓ Notice changes when one variable is changed.
Experimenting	✓ Freely ask a variety of questions and suggest how they might be answered. ✓ Suggest how they could investigate to find out answers to questions. ✓ Have some idea of the variable that has to be changed or what different things are to be compared in an investigation. ✓ Suggest equipment, materials and procedure for conducting investigations.
Predicting	✓ Attempt to use evidence in making predictions.
Hypothesizing	✓ Attempt to explain things that are consistent with evidence. ✓ Suggest how something may have happened.
Problem Solving	✓ Suggest solutions to simple problems.
Designing	✓ Construct models either by following instructions or by using their own designs. ✓ Select appropriate material to make models and gadgets. ✓ Formulate problems, do appropriate research, and devise solutions. ✓ Select appropriate material to make models and gadgets. ✓ Evaluate their own designs using simple criteria.

TECHNOLOGY

Technological Methods	✓ Students will be able to formulate problems, do appropriate research and devise solutions (e.g. construct gadgets).
Nature Of Technology	✓ Look at past inventions in their historical context. ✓ Understand that products are replicable. ✓ Understand that others may be working on the same idea. ✓ Realize that they can use scientific knowledge in doing technology and that technology helps to develop reliable scientific information. ✓ Understand the importance of precision and safety in developing new products. ✓ Understand that technology is novel and creative. ✓ Understand that if the people in a country are creative and innovative, their country can progress. ✓ Understand that people use processes involving living things (Biotechnology) and materials (Production Technology) to satisfy their needs.
Use Of Technology	✓ Appreciate the use of devices, tools and structures made by humans in the home and community. ✓ Appreciate the advantages of using these products. ✓ Realize that human-made things can pollute the environment. ✓ Look at advantages and disadvantages to help them make decisions of what is the best technology that can be used in a particular situation. ✓ Realize that people may abuse and misuse technology. ✓ Understand that technology may have unintended consequences.

GRADES 5 - 6

ATTITUDES:

	Students should be encouraged to:
Curiosity:	✓ Ask questions about objects and events. ✓ Find out more about events and objects on their own.
Inventiveness:	✓ Suggest new ways of doing things. ✓ Use equipment in novel ways.
Respect For Evidence	✓ Use evidence to justify their conclusions. ✓ Listen to other students' results and explanations. ✓ Recognize when conclusions do not fit the evidence. ✓ Change their ideas in response to evidence. ✓ Point out contradictions in reports by their classmates. ✓ Show a willingness to review procedures and evaluate their work.
Persistence	✓ Complete activities. ✓ Persist at tasks. ✓ Repeat experiments when previous attempts have failed.
Respect For Living Things	✓ Show sensitivity to living things.
Cooperation	✓ Share with others. ✓ Work together with others. ✓ Accept responsibilities.
Concern For Safety	✓ Observe safety instructions.

SKILLS:	In developing their skills of inquiry, problem solving and design the students are expected to:
Observing	✓ Use as many senses as are appropriate and safe to gather information. ✓ Identify differences and similarities between objects and events. ✓ Identify sequence in events. ✓ Distinguish from many observations those that are relevant to an investigation.
Measuring	✓ Use simple measuring instruments or models of measuring instruments. ✓ Use units in measurement.
Manipulating	✓ Set up simple experiments to compare results. ✓ Manipulate simple equipment.
Recording	✓ Use pictures and charts to report results. ✓ Fill out simple tables to report results.
Classifying	✓ Group objects according to several criteria.
Communicating	✓ Talk freely about their activities and the ideas they have, with or without making a written record. ✓ Use appropriate vocabulary to describe their observations. ✓ Listen to others' ideas and look at their results. ✓ Write reports on their investigations. ✓ Use bar graphs, pictures, tables and charts to report results. ✓ Regularly and spontaneously use books and other sources to check or supplement investigations. ✓ Select appropriate methods to report events. Include drawings, reports and multi-media.

SKILLS CONT'D

Inferring	✓ Notice patterns in data. ✓ Draw reasonable conclusions from data.
Interpreting data	✓ Discuss what they find out in response to questions. ✓ Compare their findings with their predictions. ✓ Make associations with change in variables and results.
Experimenting	✓ Freely ask a variety of questions and suggest how they might be answered. ✓ Formulate problems to be investigated. ✓ Suggest how they could investigate to find out answers to questions. ✓ Plan to conduct investigations. Select equipment, materials and procedures for conducting investigations. ✓ Understand what is a fair test. ✓ Keep appropriate variables constant and vary the independent variable in experiments.
Predicting	✓ Use evidence in making predictions. ✓ Show how they have used evidence in making predictions.
Hypothesizing	✓ Attempt to explain things that are consistent with evidence. ✓ Suggest how something may have happened.
Problem Solving	✓ Suggest solutions to simple problems. ✓ Identify needs, formulate questions, conduct research and design solutions to problems.
Designing	✓ Construct models either by following instructions or by using their own designs. ✓ Select appropriate material to make models and gadgets. ✓ Formulate problems, do appropriate research, and devise solutions. ✓ Select appropriate material to make models and gadgets. ✓ Evaluate their own designs and the designs of others using simple criteria.

TECHNOLOGY

Technological Methods	✓ Students will be able to formulate problems, do appropriate research and devise solutions (e.g. construct gadgets).
Nature Of Technology	✓ Look at past inventions in their historical context. ✓ Understand that products are replicable. ✓ Understand that others may be working on the same idea. ✓ Realise that *they can use scientific knowledge in doing* technology and that technology helps to develop reliable scientific information. ✓ Understand the importace of precision and safety in developing new products. ✓ Understand that technology is novel and creative. ✓ Understand that if the people in a country are creative and innovative, their country can progress. ✓ *Understand that people use processes involving living things (Biotechnology) and materials (Production Technology) to satisfy their needs.*
<u>Use Of Technology</u>	✓ Appreciate the use of devices, tools and structures made by humans in the home and community. ✓ Appreciate the advantages of using these products. ✓ Realize that human-made things can pollute the environment. ✓ Look at advantages and disadvantages to help them make decisions of what is the best technology that can be used in a particular situation. ✓ Realize that people may abuse and misuse technology.

SCOPE AND SEQUENCE CHARTS

EARTH'S WEATHER

K – 2	3 – 4	5 – 6	7 - 9
Weather changes Elements of the weather	Elements of the weather (wind, clouds, precipitation, temperature) Water cycle and its effects Types of clouds	Elements of weather (humidity) Weather and climate	
Instruments to measure weather Weather charts Effect of weather on human activities Human-made devices to deal with weather conditions	Use weather instruments. Keep weather records Standard weather symbols Interpret weather records		
Make and use models of weather instruments (Rain gauge, anemometer, wind vane) Make models of devices to deal with weather conditions	Make weather instruments (working thermometer, anemometer, wind vane)		

EARTH'S RESOURCES

K – 2	3 – 4	5 – 6	7 - 9
Awareness of objects and the materials from which they are made	Concept of resources (e.g. air, soil, water)	Soil erosion Solid waste and its disposal Recycling	Energy and mineral resources
	Renewable and non-renewable resources	Burning and air pollution	Chemical and physical properties of water and other materials
Importance of air and water to people	Physical properties of air, soil and water		Chemical and Physical transformation of resources
Air pollution		Human activity and water and air pollution	
Litter		Comparing air and water pollution in different areas	
Personal responsibility to avoid littering Recycling litter		Personal responsibility in reducing pollution	
Awareness of devices to deal with air pollution			

SOLAR SYSTEM

K – 2	3 – 4	5 – 6	7 – 9
Day and night cycles Sun, earth and moon as parts of the solar system Earth's movement relative to the sun Artificial light	Stars, planets and satellites Relationship between the sun, the earth and the moon Rotation and Revolution	Conditions needed to support life. Space exploration Technological inventions used in studying the solar system	Structure of the Earth Changes in the earth's structure Water systems on Earth Earth in the larger Universe Motion of celestial objects

DIVERSITY AND CLASSIFICATION

K – 2	3 – 4	5 – 6	7 - 9
Living and non-living things Variety in living things Variation in humans Classification of animals and plants by external features	Reproduction in plants Ways of propagating plants Classification of animals as vertebrates and invertebrates	Reproduction and life cycles in different animals Pollination and fertilization in plants	Levels of organization in living things Formal classification system Continuation of species Simple genetics

ECOSYSTEMS

K – 2	3 – 4	5 – 6	7 – 9
Characteristics of living things Needs of living things Habitats of plants and animals Sensitivity to the environment	Interdependence – feeding relationships Ecosystems (local and regional) Maintaining balance Impact of people's activities on the ecosystem	Interrelationships in the ecosystem Conservation of the environment Impact of natural disasters on the balance of the ecosystem	Inter-relationships within ecosystems (food webs, competition) Recycling of matter in ecosystems Transfer of energy in ecosystems

STRUCTURE AND FUNCTION

K – 2	3 – 4	5 – 6	7 – 9
External structure of plants External structure of animals Function of external parts of plants and animals Appreciation that plants and animals develop and mature	Methods of reproduction in plants Relationship between structure and function in plants and animals Technology in the growth and propagation of plants Importance of plants to humans	Structure of major systems of plants and animals Function of major systems in plants and animals Technology in major systems in human beings	Cells – specialization and organization Relationship between structure and function

ENERGY

K – 2	3 – 4	5 – 6	7 – 9
Awareness of heat, light, sound and electricity and changes they bring about	Effect of heat and light on matter	Transfer of electrical energy in circuits	Forms of energy
	Sources of heat and light (fuels, sun)	Conductors and insulators	Energy sources
Awareness of devices that produce heat, light, electricity and sound	Energy transfer from place to place		Energy transfers
		Make device that transfers energy	Heat(Production and transfer)
Importance of heat, light, sound and electricity in the home	Importance of heat and light in everyday life		Nature of electricity
Make devices powered by air and water			Particle Theory

FORCES, MOTION AND STRUCTURES

K – 2	3 – 4	5 – 6	7 – 9
Forces as pushes and pulls Effects of contact forces Types of motion Common structures and their uses Classification of structures Simple mechanical devices	Non-contact forces Effect of forces on structures Effect of forces on motion Altering materials and structures to resist forces	Size of forces Simple machines Stability and strength of structures Use of simple machines in everyday life	Laws of Motion Machines Forces on and within structures Forces and fluids

MATTER AND MATERIALS

K – 2	3 – 4	5 – 6	7 – 9
Awareness of objects and materials in the environment Properties of materials Use of materials Relationship between properties and use of materials	Physical properties of matter Change of materials (physical changes)	Changes in matter by different means Reversible and irreversible changes Production processes in the home Use of production processes to satisfy human needs	Water and its properties Chemical and physical changes Atoms and elements

TECHNOLOGY

Grade Level	K – 2	3 – 4	5 - 6	7 – 9
Technological Process	Making things, given materials or choosing materials. Identify use of tools. Evaluate products on simple, single criterion Show and tell.	Identify problems, conduct research, plan, design and make, evaluate and suggest improvements in their work. Written reports.	Identify and formulate questions for investigation. Research, alter materials, design and make. Evaluate. Report using words and graphics.	Whole technological process.
Nature of Technology	Awareness of natural and human- made things. Awareness that people develop technology to solve problems Awareness of differences in design.	Making things is a dynamic process. Technology impacts on people's lives. Safety.	As for 3 – 4	Relationship between Science and Technology. Trade-offs Technology fields (biotechnology and production technology).
Use of Technology	Technology devices used in the home, school and community. How technology improves lives. Pollution. Choice of products to use.	As for K – 2. Abuse and misuse of Technology. Choice of products.	As for 3 - 4 Industrial use of Technology.	Indigenous technology. Research and Development in the Caribbean. Use of Technology to solve societal needs.

SCIENCE, TECHNOLOGY, SOCIETY AND THE ENVIRONMENT (STSE)

Grades K – 2	Grades 3 – 4	Grades 5 - 6	Grades 7 - 9
Use of animals and plants. Personal impact on the immediate physical and living environment. Pollution. Personal responsibility in maintaining a clean environment.	Human impact on the environment. Personal responsibility. Interdependence of the living and non-living environment. Conservation of the environment.	As for 3 - 4	Science and Technology as a human endeavor. Personal, societal and environmental impact of Science and Technology. Societal impact on Science and Technology. Sustainability. Careers

REFERENCES:

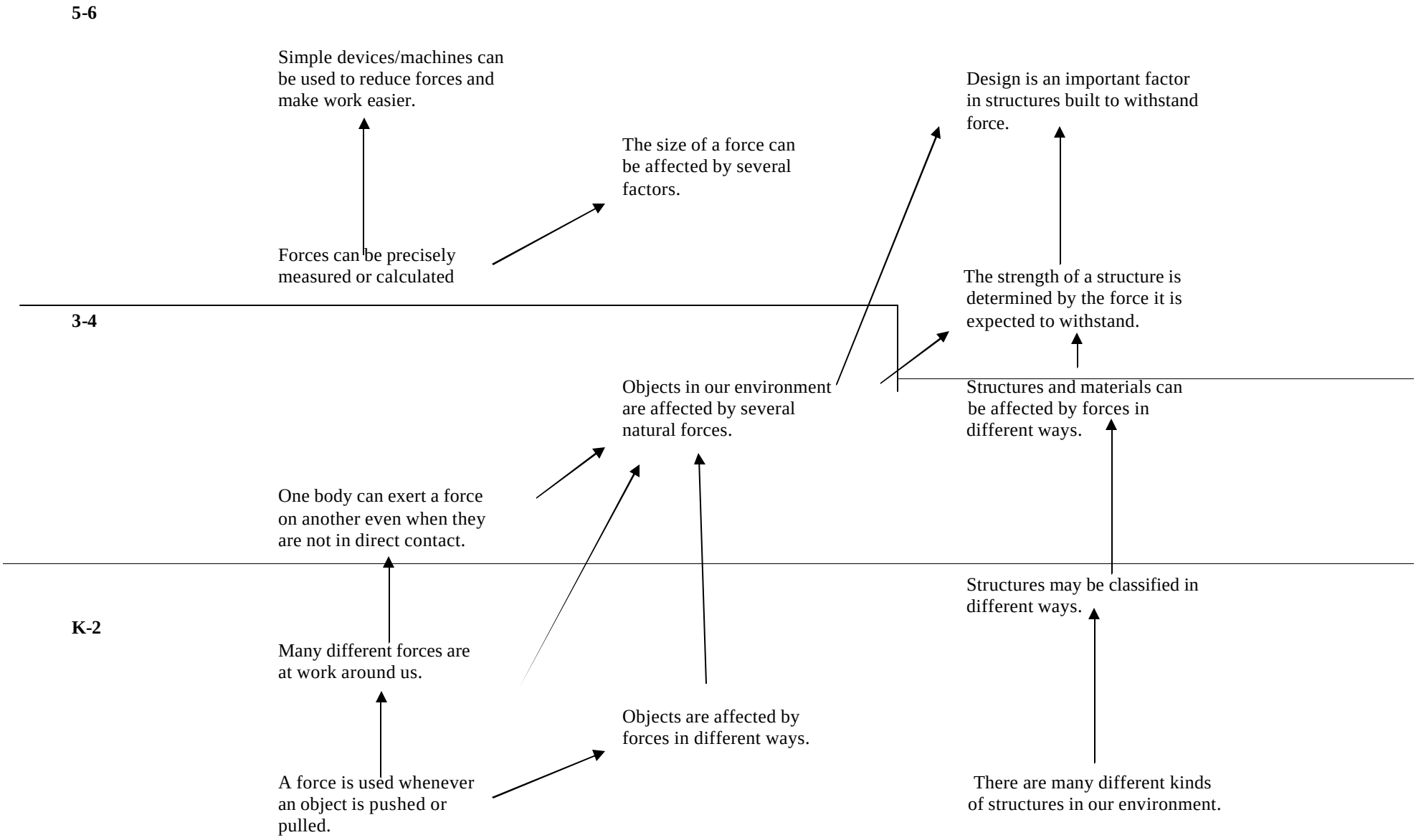
American Association for the Advancement of Science Atlas of Science Literacy Washington DC http://www.aaas.org/project2061/
Atlas of Science Literacy: Project 2061 Manufacturer: AAAS Press Released: 01 August, 2000 ISBN: 0871686686 Paperback
Barak, M., and Pearlman-Avnion, S. (1999). *Journal of Research in Science Teaching. 32 (2). 239 – 253*
Benchmarks of Science Literacy. (On line) Retrieved 20/03/02 from http://www.project2061.org
Education Research Centre. School of Education, U.W.I, Mona Jamaica. 1998. *Blueprint for the Introduction of Technology Educationin the Curriculum of Primary and Secondary Schools in the CARICOM (Phase 1).* Gerogetown, Guyana: CARICOM Secretraiat
Gardner, P.L. (1993) Science and Technology: Rethinking the Relationship. Paper presented at the UNESCO/Israeli Ministry of Science and Technology sponsored International Conference on Science Education in Developing Countries. Jerusalem.
Gardner, P.L.,(1992) The Application of Science to Technology**.** Paper presented at the 23rd annual conference of the Australasian Science Education Research Association. University of Waikato, Hamilton, New Zealand.
Gega, P.C. (1994) How to teach Elementary School Science. MacMillan.
Gilbert, J.K., (1992) The interface between science education and technology education. *Int. Jour. Science Education*. Vol.14 no.5, pp.563-578.
Harlen, W. (1985) *Teaching and learning Primary Science*. Paul Chapman Publishing Ltd. London.
Harlen, W. (Ed.) *Assessment in Primary School Science*. Commonwealth Secretariat/UNESCO
Mc Cade, J., Weymer, R. (1996) Defining the Field of Technology Education. *The Technology Teacher.* 55. (8), 40 – 46.
National Research Council. (1998). *A sampler of National Science Education Standards.* Merrill.

National Science Education Standards (1996) Center for Science, Mathematics, and Engineering Education (CSMEE) National Academy of Sciences, Washington, DC NATIONAL ACADEMY PRESS Washington, DC http://www.nap.edu/readingroom/books/nses/html/
National Science Teachers Association http://www.nsta.org/middleschool
Savage and Sterry (eds.), 1990. *A conceptual framework for Technology Education*
School of Education: UWI St. Augustine 2000. *A Curriculum Guide for Technology Education for Primary and Secondary Schools in the CARICOM.* CARICOM; Commonwealth Secretariat.
Science for All Americans. Online The Nature of Science. . Retrieved 2/03/02 from http://www.project2061.org
Science for All Americans. Online The Nature of Technology. Retrieved 2/03/02 from http://www.project2061.org
Trowbridge, L.W., and Bybee, R.W.,(1990) *Becoming A Secondary Science Teacher*. Merrill.
Wenham, M. (1995). *Understanding Primary Science. Ideas, Concepts and Explanations.* Paul Chapman Ltd. London.

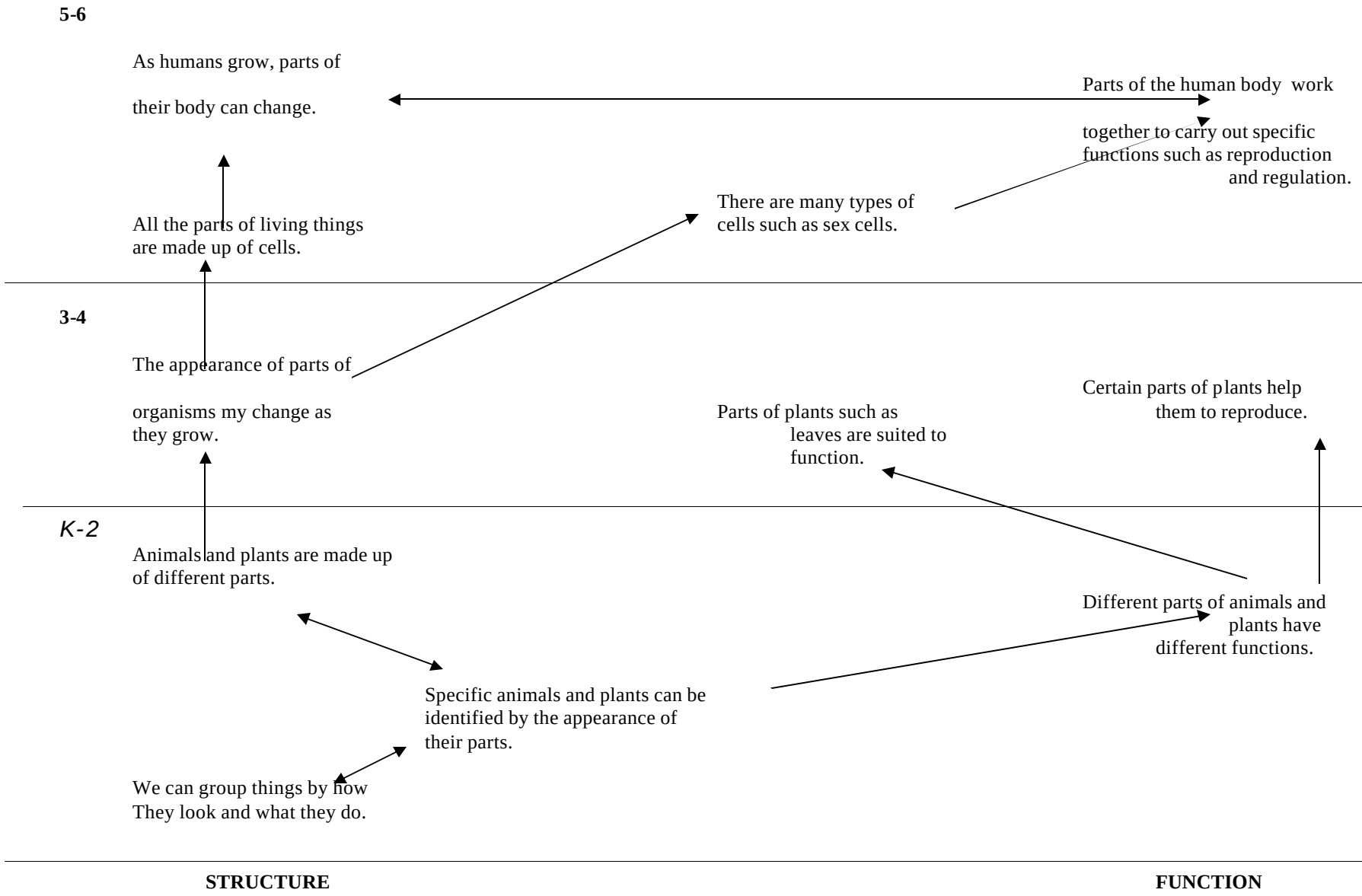
APPENDIX

IDEA MAPS

FORCES MOTION & STRUCTURES



LIFE SCIENCE:. STRUCTURE AND FUNCTION



Primary Science & Technology

Teachers need to become acquainted with the innovation of teaching Science and Technology. These books aim to help teachers become more equiped to teach Science and Technology with ease and also with a greater sense of direction.

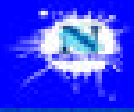
"Teaching and Learning Science and Technology has never been this much fun."

Manuals in the Teachers Guide Series include:

EARTH SCIENCES
- Resources
- WHEATHER
- THE Solar Systems

LIFE SCIENCES
- Diversity & Classification
- Structure & Function
- Ecosystems

PHYSICAL SCIENCES
- Energy
- Forces, Motion & Structure
- Matter & Materials



Organization of Eastern Caribbean States **Nagio Creations**