Distribution

- All relevant government ministries in The Bahamas
- All major public and private, scientific and technologically based organisations, institutions and commercial enterprises in The Bahamas
- All institutions of higher learning
- Corporate partners - nationally, regionally and internationally
- The engineering departments of all major resorts and hotels

APPENDIX II:

Credits

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Alan Pinto – Government High School

"Science Literacy for the general population is literacy that is required for a person to understand his/her immediate environment, which helps to solve day-to-day problems and which helps individuals to be self-reliant and improve their quality of life."

Innovations in Science and Technology Education, Volume VI, UNESCO Publishing

APPENDIX I:

Science and Technology Committee

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CONTENTS

EXECUTIVE SUMMARY

Science and Technology (S & T) strongly influence the growth, development and prosperity of all modern societies, including The Bahamas. This *Road Map for the Advancement of Science and Technology in The Bahamas* is intended to provide direction and guidance for focusing and accelerating national development in these important areas. As such, the *Road Map* places emphasis on building national and local capacity within the field of S & T. It also outlines the benefits of promoting innovation and undertaking the development and advancement of S & T knowledge, capabilities and systems, on a broad, national scale.

This *Road Map* is one of the products of several years of deliberation, debate, research, and action by the Science and Technology Committee of The Bahamas Environment, Science and Technology (BEST) Commission. The Science and Technology Committee was established in May of 2001, to fill an acknowledged gap in governmental policy, planning and execution processes, with regard to supporting, encouraging, managing and accelerating the development and growth of Science and Technology in The Commonwealth of The Bahamas. Since its inception, the Committee has had an evolving membership drawn from the ranks of the country's leading institutions and individuals involved in the study and application of S & T.

The Committee agreed to execute the Chairperson's idea of developing a document that emphasizes the important and vital role that S & T plays in the national development of The Bahamas. The *Road Map*, the name coined by the Deputy Chairperson, recommends and outlines: a National Agenda for S & T, including a definitive set of national goals and encouragement of a national innovation system; a national S & T policy framework, within the context of the priorities of Government agencies; a sound S & T infrastructure, including a listing of relevant infrastructural institutions and their roles; a rationale for education and research, including primary, secondary and tertiary level education imperatives, as well as areas of research that are of strategic importance and priority to national development.

The *Road Map* strongly recommends the establishment of a specific National Institute for the Popularisation of Science and Technology, Environmental Protection and Sustainable Development, and offers suggestions for the development and operation of complementary agencies, events and facilities.

Diagrams and text boxes that clarify and capture the essence of the linkages among and between the various fields and levels impacting and impacted by S & T are included for ease of reference. The centrality of S & T knowledge, its production and utilisation, and the recognition that political economy in this era is driven by knowledge, is clearly evident in the discussions throughout the document.

The *Road Map* concludes with an encouraging outlook for the future of Science and Technology in The Bahamas.

References

1) Adapted from "S & T System in India", Department of Science and Technology, Ministry of Science and Technology, Government of India (2002), http://dst.gov.in/st_system_india.htm

2) Adapted from: "Conceptual Diagram of National Innovation System", Annual Report on the Promotion of Science and Technology 2002 (Summary), Chapter 2: In the Era of Mega-Competition for Knowledge, pg. 2, June 2002, Ministry of Education, Culture, Sports, Science and Technology (MEXT), Government of Japan, http://www.mext.go.jp/english/news/2002/08/020801d.pdf

3) Adapted from "Science Policy of the Government of Israel", Israel Science and Technology Directory (1999 – 2004), http://www.science.co.il/SciencePolicy.asp

4) "A system of education in Science and Technology from the ground floor to the penthouse", by Dr. Llewelyn Curling, TECH NEWS, vols. 4 (1995), 5 (1999) and 6 (2001), School of Technology, The College of The Bahamas.

5) "Ambiguity in a technological world: the classification of engineering", by Dr. Llewelyn Curling, TECH NEWS, vol. 2 (1993), School of Technology, The College of The Bahamas.

6) "Recommendations for Improved Delivery of Science, Technology, and Technical and Vocational Education in The Bahamas", by Science, Technical and Vocational Sections,(1999), Department of Education, Nassau, The Bahamas.

7) "Developing and Managing Bahamian Education through The Eyes of Science and Technology", by Beverly J. T. Taylor, (1983), Ministry of Education, Nassau, The Bahamas.

Nations that do not participate in the advancement of science or do not generate new technology, or that do not have adequate access to Science and Technology, have fallen far behind in the pace of industrialisation and have been categorised as "*third world*", "*developing*", or "*lesser developed*". This terminology is in many instances synonymous with a certain level of poverty, need, lack of sophistication, or the sheer struggle to survive. Despite its relatively high standard of living, The Bahamas is still a developing state. This *Road Map* can be a tool to combat poverty, and to enhance economic stability, wealth and comfort.

Given the facilities, systems and services that currently exist and those that may yet evolve, the educational opportunities, the human potential, and the willingness and desire to achieve, the conclusion is that the future of Science and Technology in The Bahamas, and the benefits that they may provide, looks bright.

1. NATIONAL AGENDA FOR SCIENCE AND TECHNOLOGY

The national development of Science and Technology has the potential to provide such **benefits** as would improve the overall standard of living of the people, while providing the country with the ability to:

- increase the nation's productive capacity and efficiency;
- address issues related to achieving sustainable development;
- stimulate the ingenuity of the people to devise and implement solutions to technical problems, such as localised flooding and traffic congestion; and
- alleviate certain types of social ills, and minimise the effects of poverty.

In fact, it has been shown that in the modern age, effective utilisation of Science and Technology is a key to sustainable national development and prosperity.

Thus, there is a need within the country for greater research capacity, further scientific and technological education, skills development, knowledge expansion, and improvements in technological design and utilisation, and for more innovation, resourcefulness and problem solving capability. The Bahamas must have the interest and commitment, and must set priorities, for supporting planned, organised approaches and mechanisms toward achieving success in advancing Science and Technology.

Possible long-term advantages that may derive from the successful implementation of a comprehensive plan of action for S & T include the following:

- Constant advancement of Bahamian society and higher standards of living through the promotion, popularisation and effective use of S & T;
- Policy approaches that recognise and support the need for continual improvement, cooperation and cohesiveness between the public and private sectors with regard to scientific and technological research;
- Continual support of established systems for the sharing and dissemination of scientific and technological information and knowledge;
- Regular re-assessment and advancement of the state of science, mathematics, engineering, architecture and technology, including the state of education in these disciplines from kindergarten to university, in The Bahamas;

There must be a great national dedication to develop the expertise and provide the funds necessary to fulfil the overall objective. Toward this end, a three-pronged approach should be applied, involving:

i) education,
ii) training, and
iii) encouragement of innovation.

8. CONCLUSIONS AND OUTLOOK FOR THE FUTURE

This document constitutes a *Road Map* or strategic plan for the future advancement of Science and Technology (S & T) in The Bahamas. It calls for major changes to be made, new approaches to be taken and new developments to occur in the interest of realising the benefits of Science and Technology (S & T). A national agenda has been outlined which identifies priorities in national development and sustainability for S & T. The proposed national infrastructure for S & T consists of institutions, systems and services vital to the growth, development, application and use of S & T in The Bahamas. If we diligently strive to bring about such necessary support structures, organise and manage them well, The Bahamas may see rapid technologic and socio-economic advancement.

The use of technology increases the standard of living of a society, and the knowledge of science permits society to become more efficient at innovation. Thus, a society may increase its productivity with less effort – expanding its economy, producing at better than subsistence levels, permitting increased exports, gaining greater disposable and discretionary incomes, and increasing time for leisure. The increased incomes and greater tax revenues that result can permit individuals, organisations and the Government to undertake more ambitious projects utilising more sophisticated technology.

The development of S & T infrastructure is necessary to support economic advancement. Government is entrusted with the responsibility for managing the environment in which national growth and development takes place. Therefore, Government policies must be encouraging to the growth and development of S & T, providing a supportive framework to nurture both public and private endeavours. Government must also provide a regulatory framework that will strategically direct the growth of S & T for the public good.

This *Road Map* does not suggest that every possible area of S & T endeavour should be pursued, for no single society can be productive in every area of S & T. Selective pursuit is the wise approach to take. The hindrances and obstacles posed by the presence of chaos or inefficiency in necessary facilities, systems and services, can seriously inhibit progress in S & T. When improperly administered, S & T can bring harm rather than benefits. Thus, education, research and ethics are vitally important. Many highly advanced and beneficial S & T endeavours cannot be achieved in The Bahamas simply for lack of the necessary infrastructure.

Knowledge and education are necessary to produce growth and development. Continued advancement of knowledge through ongoing research is necessary to sustain growth and development. Access to information also must be provided in a national library and information system. All participants in S & T must become knowledgeable and exercise innovation in finding scientific and technological solutions to society's problems. The Bahamas must prioritise and build upon its strengths and advantages in S & T, to satisfy strategic subsets of its needs. Through international trade and cooperation, satisfaction of the balance can be made possible, to the benefit of all.

The following are projects/events that have contributed, or have the potential to contribute, to the popularisation of Science and Technology:

- Seminars for Careers in Science and Technology
- Science and Technology Exhibitions
- Children's Environmental Summit

7. 3 National Facilities:

The National Science and Technology Museum and Theme Park

The National S & T Museum and Theme Park (NSTMTP) would contribute to the popularisation of S & T in The Bahamas by offering:

- Educational and learning experiences (for all, especially the youth).
- Tourist attractions (revenue producing)
- Public entertainment (also revenue producing)

Development Plan: [The proposed location is the former Crystal Cay Marine Park.]
Stage I
Develop a preliminary concept.

Stage II
Solicit and obtain funding for the commissioning of one or more architectural firms to produce a complete and viable conceptual plan of the physical structures and their layout.

Stage III
Create a self-sustainable development and managerial structure, and establish an organisational framework with articles & rules of association. (Seek consultation with organisations such as The Grand Bahama Port Authority, The Public Hospitals Authority, and The College of The Bahamas. Use their examples to model the project administration.)

[*Possible sources of funding for Stages 1, 2 and 3:* The Government of The Bahamas, corporate entities and donor agencies.]

Stage IV
Acquire the funding necessary for construction or remodelling, and purchase of organisational assets. [*Possible sources of funding:* Government bonds, organisational grants, public contributions and other special gifts.]

Stage V
Begin construction/remodelling of the facilities, along with the purchase and installation of necessary assets.

Stage VI
Finish the project to operational stage. Commission executive officers and managers so that they may begin to operate, collect revenue and pay expenses, and to further plan, develop, and expand the facilities.

1.1 National Goals for Science and Technology

Recommended specific national objectives, with regard to the development, promotion, application and use of Science and Technology (S & T) in The Bahamas, include:

i) Establishment and maintenance of a government agency or consultative body for Science and Technology (S & T) that gives focus to strategic planning and facilitation of matters concerning Science and Technology;

ii) Formulation and implementation of effective and productive government policies with regard to S & T;

iii) Development of S & T infrastructure;

iv) Improvement of links between the primary, secondary and tertiary levels of education through encouragement and support for projects involving curriculum development, enhancement and restructuring;

v) Promotion and support for the advancement of S & T through institutions of higher learning and research organisations;

vi) Enhancement and further development, organisation and management of institutional systems and resource networks (e.g., libraries, databases and computer networks) as sources of information on S & T, and the dissemination of such information;

vii) Development and maintenance of a system of S & T statistical indicators, tools and procedures, and a statistical database, to record and assess progress, allow for comparison to international benchmarks, and inform S & T policy;

viii) Encouragement of S & T innovation with regard to national development, including economic progress and diversification;

ix) Encouragement and provision of support for the expansion and flourishing of reciprocal relations between S & T and other aspects of society, including education, industry, commerce, tourism, environment, etc., through cross-disciplinary projects.

x) Encouragement and provision of support for developmental research and projects involving *inter alia*:

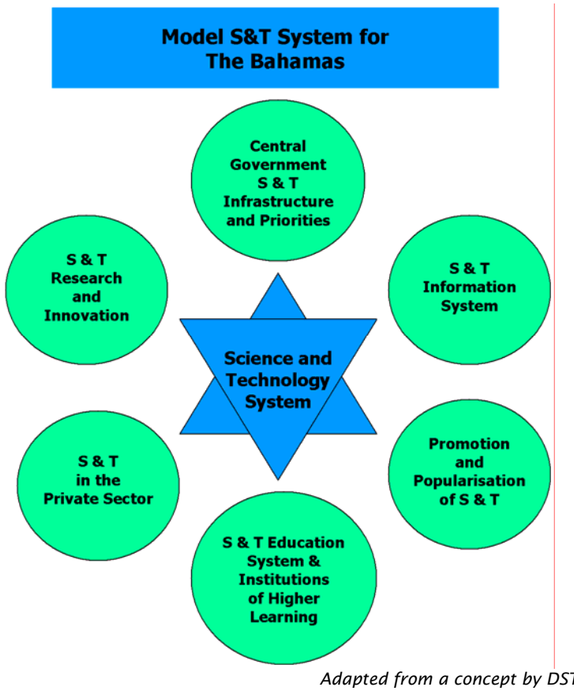
- modern and innovative fishing and processing methods and procedures, including mechanisation, for the expansion of the fishing and fish-processing industries;
- organic and mechanised agriculture, for quality tropical fruit and crop production;
- the introduction and use of renewable sources of energy;

xi) Popularisation of S & T – promotion of S & T to youth and the general public, and encouragement of the pursuit of excellence in S & T.

xii) Development of mechanisms for cooperation on matters of S & T within The Bahamas, regionally, and internationally;

xiii) Improvement of S & T efficiencies and conservation;

xiv) Promotion, encouragement and support of the innovative, physically and environmentally sound growth and use of S & T;



Adapted from a concept by DST, Government of India [1]

1.2 National Innovation System

Innovation is knowledge-based creativity and ingenuity. In S & T terms, it requires "big thinking" founded upon scientific and technological knowledge, skills and ability.

The process by which innovations are generated is related to a variety of factors, and the combinations of these factors are referred to as **innovation systems**. Social and economic systems, which vary from country to country, have a great impact on each country's innovation system, so the innovation systems of individual countries are referred to as **national innovation systems**.

7. PROMOTION AND POPULARISATION OF SCIENCE, TECHNOLOGY, ENVIRONMENTAL PROTECTION AND SUSTAINABLE DEVELOPMENT

The national promotion and popularisation of science, technology, the environment and sustainable development should be placed within the ambit of the Bahamas Institute for Science, Technology, Education, Research and Innovation (BISTERI). Otherwise, there should be a designated section that has this responsibility, placed within a larger umbrella body such as the Ministry of Education. Toward this goal, there should be employed a systematic development and operation of complementary agencies, events and facilities.

7.1 National Agencies:

The Science and Technology Resources Network

The Science and Technology Resources Network would be an organisation of **educational partners** that should work collaboratively with schools to improve the means whereby educational efforts might be translated into social and economic benefits to society.

The Terms of Reference intended to guide the partnership will be derived though collaboration between prospective partners, and by merging the "Expectations of Partnering" proffered by the respective potential partners. Educational Partners in the Science and Technology Resource Network will be expected to:

- Provide counselling and information necessary to link students and educators with various sectors of the community.
- Share resources with students and educators.
- Assist schools in improving, expanding and popularising Mathematics, Physical Education and the Sciences, as disciplines, and Technology as a way of life.
- Foster local civic and governmental, regional and international links, to improve educational achievements in S & T, locally, regionally and internationally.
- Act as models and examples of positive achievement, for students and educators throughout The Bahamas.

7.2 National Events

Some nationally held popularisation events may suffice as singular occurrences. Other events should be held regularly for consistency and continuity, and in order to facilitate planning, preparation and implementation. Depending on the degrees of complexity, impact and involvement, these events could be biannual, annual, biennial, triennial or quadrennial occurrences.

The following are some recommended indicators for conditions specific to The Bahamas, a relatively small, developing, archipelagic state:

i) Workforce/Labour

ii) Scientists and Technologists, by category or discipline, and as a percentage of the workforce

iii) Science and Technology Revenue and Expenditure, as percentages of GDP

iv) Research and Development Expenditure, as a percentage of GDP

v) Patents and Design copyrights Registered for S & T concepts, by category and by Applicant's Country of Residence

vi) Diplomas/Certificates: [a] breakdown by Major Fields (Applied and Natural Sciences, Engineering and Architecture, Social Sciences, Humanities, Arts and Linguistics)

vii) Associate Degrees: [b] breakdown by Major Fields (Applied and Natural Sciences, Engineering and Architecture, Social Sciences, Humanities, Arts and Linguistics)

viii) Undergraduate (Bachelor) Degrees: breakdown by Major Fields (Applied and Natural Sciences, Engineering and Architecture, Social Sciences, Humanities, Arts and Linguistics)

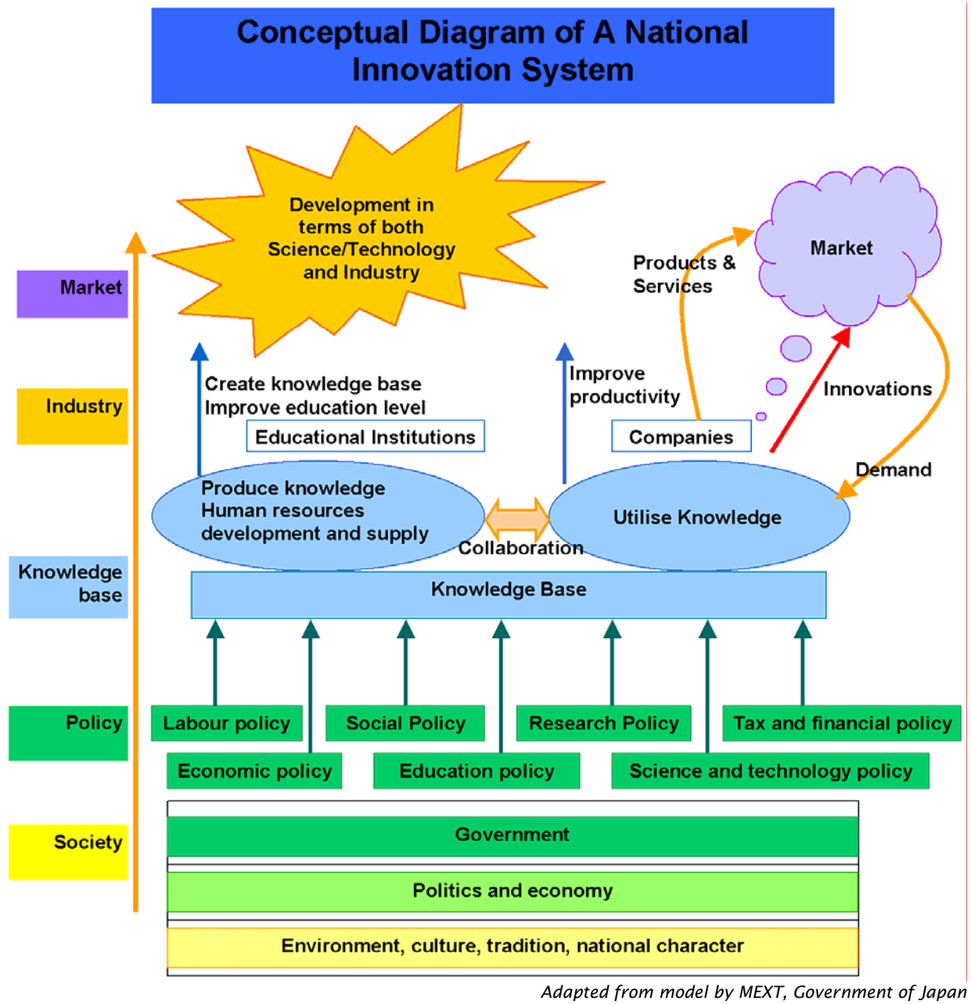
ix) Master Degrees: breakdown by Major Fields (Applied and Natural Sciences, Engineering and Architecture, Social Sciences, Humanities, Arts and Linguistics)

x) Doctorate Degrees: breakdown by Major Fields (Applied and Natural Sciences, Engineering and Architecture, Social Sciences, Humanities, Arts and Linguistics)

xi) Scholarships granted for study in Science and Technology

xii) International comparisons with selected countries, in indicators such as: number of university degrees in Science and Technology, and Science and Technology expenditures as a percentage of GDP.

[a] These include technical/trades and professional certificates/diplomas.
[b] These include technical degrees of technicians/mechanics/craftspersons and the two-year step towards four-year undergraduate degrees of professionals.



Adapted from model by MEXT, Government of Japan [2]

A working Science and Technology Policy is only one part of the larger concept of a National Innovation System. A thriving S & T System is the result of the development and cohesion of the relevant elements of a sound National Innovation System.

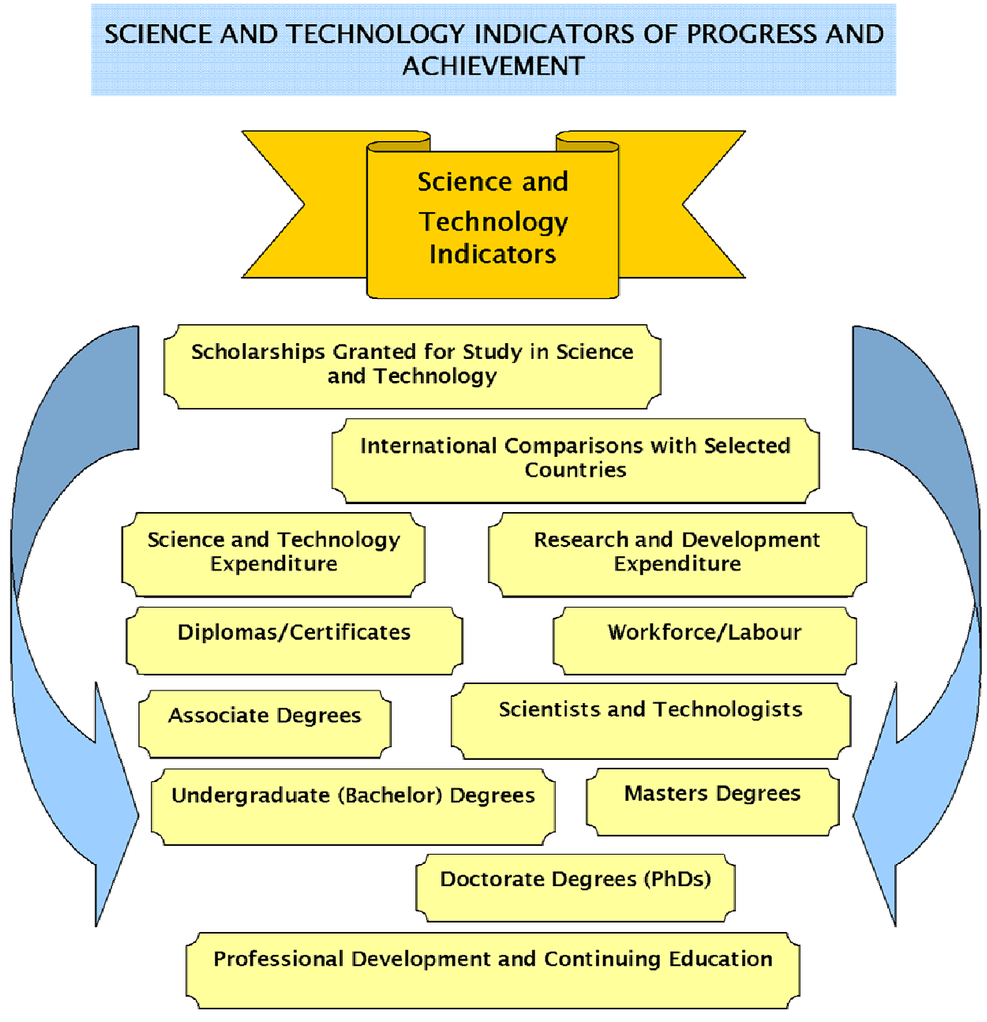
New scientific innovations, discoveries and inventions, will be made and there is no reason why they cannot be made here in The Bahamas. Bahamians have the potential and should have the opportunity to contribute to the development of new innovations, and to reap the benefits for the nation along the way. Any society that does not embrace scientific and technological advancement and innovation is left behind by those that do. The daily lives of all people can be improved by Science and Technology.

Great discoveries and inventions of the past include:

- Gutenberg's printing press, invented in 1440, has been rated the number one invention of all time, for its impact on the sharing of knowledge and the advent of the modern era.
- Thomas Edison's invention of the light bulb, in 1879, permits work and play to continue even at night.
- Sir Isaac Newton's formulation of the laws of motion, which mathematically describe the way objects move when a force acts on them, are still the foundation for the development of modern moving vehicles.
- Alexander Fleming's discovery of penicillin has saved countless lives from the ravages of infection and epidemic.
- The discovery of DNA (deoxyribonucleic acid) in 1953 meant that criminals could no longer hide, and children could no longer be denied.
- The discovery of semiconductors, and Claude Shannon's early work on binary numbers, Boolean algebra and electronic circuitry, led eventually to the development of today's computer technology.
- Dr. Charles Drew, an African-American, researched blood plasma preservation and established the world's first blood bank, for the Red Cross, revolutionising the medical profession.
- Jan Ernst Matzlinger, of Suriname, invented the first machine for lasting shoes – automatically sewing soles to the uppers, making the mass production of affordable shoes possible.
- Frederick Jones, an African-American, invented the first automatic refrigeration system for long-haul trucks, with a roof mounted cooling system, eliminating the risk of food spoilage during long-distance shipping.
- Percy Julian, an African American, developed a low-cost process to synthesise cortisone from soybeans, making this essential medicine readily available at a cost of only pennies per ounce.
- Dr. Thomas Lecky, of Jamaica, developed tropically adapted breeds of cattle, using gene transfer and progeny testing techniques.
- Dr. Conrad Douglas, of Jamaica, designed and built the Third World's first multi-variant continuous pilot plant capable of handling all types of bauxite.
- Dr. Norris Stubbs, a Bahamian civil engineer, developed and patented an apparatus and method for non-destructive damage detection in structures.
- Robin Glinton, a Bahamian research programmer, recently helped to develop a set of decision support tools for automating terrain analysis for military application.

6. SCIENCE AND TECHNOLOGY INDICATORS OF PROGRESS AND ACHIEVEMENT

Science and technology indicators are important for gathering statistics, and for monitoring and assessing progress. If some standardisation is followed, comparisons may also be made internationally. S & T indicators can be used to inform S & T policy and decision-making in much the same way that economic indicators such as the rate of unemployment, inflation and growth of the economy are used to inform economic, monetary and fiscal policy and decisions.



Therefore, effective community education should be utilised in The Bahamas, in order to promote public awareness of S & T, including its benefits and shortcomings, advantages and drawbacks, so that Bahamians will be prepared to act as responsible citizens participating fully in a technology-driven era. Possible strategies that may be employed to improve public awareness and appreciation of Science and Technology may include:

- Community-based initiatives of environmental importance, and showcasing innovative Science and Technology ideas, e.g. the Urban Renewal Project or using the outdoors as your laboratory.
- Public seminars, exhibitions and expositions on Science and Technology in general, or on specific themes including marine conservation, sustainability, and economic diversification.
- Cataloguing of traditional knowledge of practical science in use by local communities.
- Events geared specifically toward the general popularisation of science, technology, the environment, and innovation.
- Presentations made to community, civic, youth, and church groups, on general or specific S & T issues and themes.
- Dissemination of educational materials (pamphlets, posters, video tapes, books…) through the public libraries, government agencies, and community oriented groups.
- Development and utilisation of interesting, effective and progressive public service programmes for television and radio, on Science and Technology issues.
- Development of a regular, public lecture and exhibition series covering the basics of science, technology and environmental education and issues.

2. SCIENCE AND TECHNOLOGY POLICY

In order to assure strategic management and nurturing of S & T growth and development, government policies that are supportive and effectual must be adopted in all areas that directly or indirectly affect Science and Technology. These policies should be under regular review, and should be allowed to evolve as priorities change, and as new information becomes available.

A sampling of sectors and issues that influence or are influenced by Science and Technology:

- Agriculture and Fisheries
- Bioethics
- Biotechnology
- Construction and Urban Development
- Craft & Light Manufacturing
- Economic Development
- Education
- Energy Production and Usage
- Environmental Protection and Sustainable Development
- Import/Export Incentives and Restrictions
- Information and Communication Systems
- International Cooperation
- Music, Sports and Entertainment
- Natural Resources
- Patents and Intellectual Property Rights
- Public Funding and Procurement
- Public Health
- Research and Development
- S & T Indicators
- Social Behaviour, Welfare and the Eradication of Poverty
- Tax Incentives and Deterrents
- Tourism and Ecotourism

The following is a recommended **Draft Policy Statement for Science and Technology in The Bahamas:**

The Government of the Commonwealth of The Bahamas,

Noting that science and technology have a significant role to play in the growth and development of The Bahamas as a nation,

Recognising that, globally, science and technology have contributed to the betterment of humankind,

Acknowledging that science and technology are essential to cope with the problems of the modern age and to ensure a better quality of life for the citizenry,

Recognising that science and technology have the potential to benefit all sectors of the economy and society,

Recognising that educating its people in science and technology is an investment in improving the country's human capital,

Aware that the greatest asset of a small island developing state is its people, and that science and technology offer an opportunity to enhance this capital,

Acknowledging the importance of science and technology in the development and diversification of the Bahamian economy,

Recognising that one of the risks of being heavily dependent on a just few sectors for economic development is the accompanying potential for economic collapse,

Acknowledging that globalisation, and the accompanying emphasis on 'free trade' of goods and services, indicates that the Bahamian labour force must become more skilled in science and technology in order to be better positioned to compete on the global market, and

Determined to develop an informed and productive, technologically-skilled society, and to elevate the people of The Bahamas to the position of being one of the most formidable skilled-labour forces in the world,

Has decided to adopt the following Policy:

- To enact legislation to promote science and technology education and research, and to encourage individual initiative for the acquisition and dissemination of knowledge and for the discovery of new knowledge;

- To increase support for educational reforms to enhance the science and technology literacy of the citizenry, and to promote public education and outreach in science and technology at all levels of society by appropriate methods;

- To ensure that the creative/innovative talent of the nation, especially of the nation's youth, is encouraged across the full range of scientific activity;

- To increase support for scientific and technological advances, and to facilitate the use of technology in all sectors, for the enhancement of life for Bahamians;

- To secure for the people of The Bahamas all of the benefits that can accrue from the acquisition of scientific knowledge;

- To encourage and initiate, with all possible speed, programmes for the training of local scientific and technical personnel on a scale adequate to fill the country's needs in agriculture, fisheries, environment, education, industry and trade;

- To ensure an adequate supply of local scientists and researchers of the highest quality, by providing good working conditions and by recognising their work as an important component of the strength of the nation;

- Mitigating the social impact of natural disasters

viii) Education

- Theories of education
- Promotion of innovation, and Science and Technology education
- Engineering and technology education
- Environmental and agricultural education
- Geology, geography and archaeology education
- Physics education and research
- Chemistry education and research
- Mathematics education and research
- Social science and economics education
- Health education

5.3.2 Recommended Research Topics of Priority for The Bahamas

i) Tourism, Sustainable Development, and Carrying Capacity.

ii) Renewable and Alternative Sources of Energy – feasibility studies.

iii) Use of Geographic Information Systems (G. I. S.) for habitat mapping and resource delineation.

iv) Waste Minimisation and Management Technologies – efficient, economic, and environmentally viable.

v) Assimilation vs. Marginalisation of Immigrant Groups – Sustainability Impacts.

vi) Innovative methods of remediation in math and science basics, for primary and secondary school students.

vii) Effects of the environment on human health.

viii) Use of technology in agriculture and fisheries to improve food security.

ix) Effects of sand mining and dredging on coastlines and mangrove ecosystems.

x) Methods for Reducing Unaccounted for Water/Non-revenue Water – i.e. for improving the efficiency of water delivery through WSC Lines.

5.4 Community Education and Public Awareness

Increased knowledge and appreciation of Science and Technology, by a society as a whole, bolsters the capacity in that society for the significant growth and innovation that can result in a more vibrant economy. Further, the quality of life enjoyed by a society is dependent on the ability of its citizens and government to make educated decisions on how and when to take advantage of the phenomenal advances brought about by S & T.

- Medicine and health sciences

iii) Environmental Impacts and Pollution

- Biosafety and genetically modified organisms (GMOs)
- Insect pests – mealy bug, mosquitoes, etc.
- Noise, dust, and air emissions, visual pollution
- Land use and exploitation
- Farming and fishing methods, procedures, productivity and management
- Environmental protection and conservation
- Disaster preparedness
- Topography and preservation of the physical landscape
- Environmental management and remediation

iv) Environmental and Earth Sciences

- Biodiversity
- Biology –flora and fauna
- Ecology
- Entomology
- Plant life and indigenous vegetation
- Rocks and soils
- Groundwater systems

v) Marine Conservation and Coastal Zone Management

- Coastal and harbour design, protection and management
- Beach erosion: public policies and management
- Coastal processes and engineering
- Mangrove ecology
- Marine habitats and ecosystems
- Marine conservation

vi) Technology and Engineering

- Renewable energy sources – solar, wind, tidal, etc.
- Industrial engineering, and the growth and development of technology
- Computer software, information and communication systems
- Urban development and design
- Engineering and technology management
- Geographic Information Systems (G.I.S.) applications

vii) The Social Sciences

- Archaeology - antiquities and monuments
- Taxation and social benefits
- The creation and distribution of wealth
- Economic empowerment and the alleviation of poverty
- The causes of crime and poverty
- Behavioural science in the societal context
- Demographics and demography

- To facilitate scientific research in The Bahamas, as a basis for sound decision-making and policy-formulation;

- To undertake the establishment of a National Research Foundation, for the promotion, funding and facilitation of research, and technology transfer, especially in areas deemed significant to the country's development;

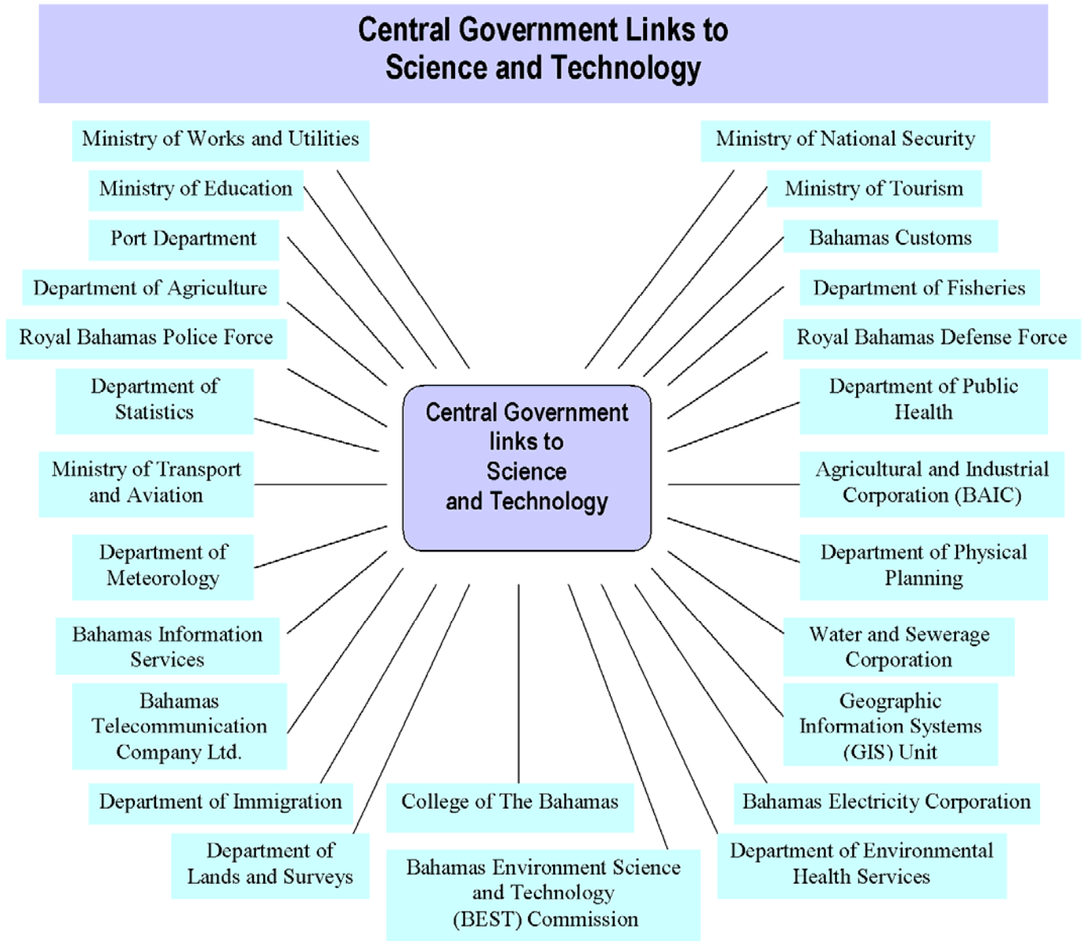
- To mandate and support the implementation of the recommended Priorities for Government Agencies, in National Science and Technology Policy. Such support may be in the form of facilitation of infrastructural development, promotion of international and regional cooperation, and encouragement of cooperation between Government Ministries, Departments and other Agencies, to the extent necessary for successful implementation;

- To prepare a National Science and Technology Plan for The Bahamas that will elaborate and prioritise action points for the development and popularisation of science and technology;

- To promote and facilitate whatever infrastructural development is necessary to enable Government Ministries, Departments and other Agencies to implement the National Science and Technology Plan;

- To promote such international and regional cooperation as would aid the fulfilment of the objectives of the National Science and Technology Plan; and

- To mandate the necessary cooperation between Government Ministries, Departments and other Agencies for the successful implementation of the National Science and Technology Plan, also to encourage cooperation with appropriate Non-Governmental Organisations and Private Sector entities toward this end.



5.3 Research

Scientific and technological research provides a better understanding of nature, and allows human beings to devise ways to improve life. Fields of investigation that may improve the conditions of life and work in The Bahamas are, inter alia:

- pure and applied science,
- local transportation,
- water and sanitation systems,
- telecommunications,
- urban development, and
- Science and Technology management.
-

These topics may be coupled with studies of organisational structure, business and utility management.

The establishment of more research institutes and programmes in The Bahamas will help to attract the brightest minds, both local and international – i.e. scientists who can help to conduct successful research programmes, and make the benefits of research a reality. Through research, The Bahamas can play an important role in the expansion of human knowledge, and can, in so doing, benefit locally from such advances and share those benefits with others.

5.3.1 Strategic Research

The following are some areas of research that may be of national or strategic importance. [Priorities should be strategically chosen, in acknowledgement of potential limitations in resources.]:

i) Sustainable Development and Economics

- Industrial growth and innovation
- Economic diversification and the use of technology
- Free trade
- Sustainable development
- Tourism, catering, and hospitality
- Tourism development and enhancement
- Public policy and management
- Business organisation and management
- Business development and economics
- Labour supply, demand and management

ii) Infrastructural Development and Improvement

- Systems for waste disposal and management
- Water resources, supply and management
- Stormwater management
- Transportation – public transportation, traffic management, etc.
- Indigenous design, construction, repair and maintenance of highways
- Public health and communicable diseases management

and financial support for S & T, and acquire and distribute funding in support of special projects.

v) To facilitate the College of The Bahamas in its move towards university status, the **upgrading of faculty as a body** [with respect to research capabilities], must occur in parallel with library development [that is, with the corresponding need for availability and accessibility of the information and services of a fully developed and enhanced library].

vi) Establish a **National Science and Technology Information Network** (a component of the NIN – see section 4) that will, inter alia, act as a clearing-house for the dissemination of research findings, and information related to research needs and opportunities. Generally speaking, the network should provide information services, inc. statistical data distribution and reporting.

vii) Establish **web sites** for the above recommended agencies.

5.2.2 Technology Education and Training

Technologists play an important role in modern society by providing analysis, scrutiny, and selection of the most appropriate technology alternatives for application in the development and improvement of practical technological systems, which may include many large public works. The following are examples of technology-dependent processes and systems:

- water works,
- building construction projects,
- harbours and ports,
- transportation systems,
- electrical and mechanical devices,
- manufacturing equipment, and
- electronic systems, etc.

These technological applications are in constant need of repair, maintenance and improvement, and new technologies are always on the horizon. Technologists help to close the gap between theory and practice, and to eliminate the technological voids that may appear in industry, as technology advances. Such gaps and voids are often reflected in the poor performance and limited durability of the technological processes and systems in use.

Therefore, it may be seen that there is value in ensuring a supply of qualified technologists in our society, by supporting the further development of technology education in The Bahamas, and by providing greater access to education through scholarship funds, bursaries and awards for prospective students.

2.1 Priorities for Government Agencies

The Committee has identified the following priorities for National Science and Technology Policy (in alphabetical order by agency) [3]:

Government Agency	Policy Objectives
Antiquities, Monuments & Museums Corporation	▪ To promote awareness of the Science and Technology involved in identification and preservation of antiquities and monuments, and to utilise best available technologies to achieve this. ▪ To promote such awareness through development or facilitating the development of a national museum.
Attorney-General's Office	▪ To develop adequate legislation related to patents and Intellectual Property Rights as well as access and benefit sharing related to research and development that uses natural resources of The Bahamas.
Bahamas Agricultural and Industrial Corporation	▪ To promote use of science and best available technologies in craft & light manufacturing. ▪ To promote utilisation of best available technologies and environmentally friendly technologies through its lending practices in conjunction with The Bahamas Development Bank.
Bahamas Customs Department	▪ To institute import and export incentives and restrictions in conjunction with Ministry of Finance to promote use of Science and Technology in the country as well as utilisation of green technologies that protect the Bahamian environment and its resources. ▪ To utilise best available technologies in border control and surveillance to improve efficiency and effectiveness.
Bahamas Electricity Corporation	▪ To support research and development of alternative sources of energy including systems for high temperature solar thermal energy production, thermal energy storage, and super conductivity. ▪ To facilitate use of green technologies in reducing energy use in The Bahamas. ▪ To engage in the development in a National Energy Policy inclusive of use of renewable and alternative sources of Energy.
Bahamas Environment, Science and Technology (BEST) Commission	*Environmental Planning and Protection:* ▪ To encourage research and development of environmental technologies aimed at pollution prevention and source reduction. ▪ To support basic and applied environmental research projects and surveys, including water and air pollution studies and monitoring systems. ▪ To increase international and regional cooperation in research related to combating desertification and climate change. *Science and Technology:* ▪ To support development of research institutions and regional research centres. ▪ To establish national infrastructures in specific areas of research

	defined as national priorities. ▪ To increase support for research and development with potential economic feasibility.
Bahamas Information Services	▪ To promote Science and Technology in the media. ▪ To assist in increasing awareness of Science and Technology and their benefits in The Bahamas.
Bahamas National GIS Centre	▪ To facilitate the use of GIS for habitat mapping and resource delineation. ▪ To promote use of GIS as a tool for decision-making within all Government agencies. ▪ To promote development of training programmes and curricula in use of GIS technology.
Bahamas Telecommunications Corporation	▪ To upgrade telecommunications infrastructure utilising advanced technologies. ▪ To diversify the base of service providers as well as services available.
College of The Bahamas	▪ To implement proposals and recommendations for improvement of the College of The Bahamas Library (see page 28). ▪ As the College of The Bahamas moves towards university status, to facilitate the upgrading of faculty as a body [with respect to research capabilities]. ▪ To utilise best available technologies in courses taught. ▪ To provide Science and Technology Bachelors degree programmes to increase opportunities in these fields for Bahamian students.
Cabinet Office (including NEMA)	▪ To promote Science and Technology and its benefits in The Bahamas. ▪ To adopt a National Science and Technology Policy and commit to its implementation. ▪ To promote disaster preparedness and develop a National Emergency Preparedness Plan and ensure its implementation. ▪ To implement mitigation measures for the environmental and social impacts of natural disasters. ▪ To promote construction and design, especially in coastal areas, that will ensure protection and management of coastal systems during natural disasters.
Department of Agriculture	▪ To explore biotechnology techniques to improve agricultural industry ▪ To develop biosecurity mechanisms for handling and transfer of GM crops and seeds and protection against biological invasions. ▪ To develop and promote utilisation of integrated pest management systems and more environmentally friendly techniques for pest management. ▪ To develop novel agricultural products and methodologies to increase food security and to enhance the competitiveness of Bahamian products on local and international markets. ▪ To collaborate with the Water and Sewerage Corporation to develop technologies for efficient use of water and utilisation of brackish water. ▪ To enhance agricultural production on the Family Islands and to employ information technology in agriculture especially in rural

a part of this project**, Science Laboratory Classrooms** and **Mathematics Laboratory Classrooms** would be established, in which Information Technology would be one of the main teaching tools.

5.2 Tertiary Level Education

Education increases knowledge – Knowledge increases the capacity to achieve and nurtures innovation – Innovation is part of the foundation for economic diversity and prosperity. Thus it may be reasoned that higher education is one of the keys to economic growth and development. Perhaps the greatest gift that one generation can give to the next is education, because it raises the standards of acceptability and the quality of living.

In the context of educational objectives, it is necessary to provide more extensive tertiary level education, building upon the foundations lain by primary and secondary levels of education. It is also necessary to develop students' abilities to acquire greater knowledge of Science and Technology through fundamental research.

5.2.1 Development and Enhancement

The following are some options for further development and enhancement of tertiary level education and research, in Science and Technology, in The Bahamas:

i) Encourage and support the development of specific **Bachelors and possibly Masters, Doctorate degree programmes** in S & T that may be of national or strategic importance, at local academic tertiary level institutions.

ii) Encourage and support the development of special **skills development programmes** in S & T at the technical level, which may be of national or strategic importance, at local tertiary level technical training institutions.

iii) Encourage the expansion of **educational opportunities** for students, and improvement of the interfaces between curricula at secondary and tertiary levels, to better prepare students for the progression and transition from one level to the next.

iv) With Government's financial support, establish a **National Science and Technology Research Fund** that would support special investigative studies of nationally importance, concerning infrastructure-related problems in Science and Technology.

v) Establish a **National Science and Technology Research Council** that will administer the National Science and Technology Research Fund and other endowments, for the support of research programmes throughout the country. The Council could also facilitate accessing and distributing other local and international funding that may be available for research activities. The Council should facilitate the collection and dissemination of information on scholarships

These recommendations should further develop the country's human resources in Science and Technology, strengthen and diversify the scientific and technological base of our school system, improve linkages between partners in education, and facilitate community awareness and involvement in S & T education. Overall, they can help to promote an innovative, entrepreneurial culture that will increase the country's capacity for sustainable development.

5.1.1 Institutional Strengthening

The following are projects that are now being executed, or that could be executed, to assist in institutional strengthening in the area of Science and Technology:

i) The Children's Environmental Summit

The purpose of the Children's Environmental Summit is to heighten students' awareness about how their actions impact the environment, and to provide a forum where they can share ideas about conservation and sustainable development of the environment. The Summit is a national event that brings together students from throughout The Bahamas, to share their perspectives on environmental issues that affect their islands, our country and the world. The students have the opportunity to formulate possible solutions and to discuss their role as environmental stewards.

ii) Seminar for Careers in Science and Technology

The purpose of this event is to increase and expand students' knowledge of advances in the scientific and technological fields, to explore the available career opportunities, and to recognise persons for their involvement and contributions in the area of Science and Technology. The inaugural seminar highlighted "Careers for Females in Science and Technology".

iii) Science and Technology Exhibition

The main goal of the Science and Technology Exhibition is to use students' project work to raise the general level of consciousness of S & T and of how it affects the daily lives of the Bahamian public. The Exhibition also provides opportunities for students to work individually or collaboratively to design and apply strategies in solving problems utilising principles of Science and Technology. The Exhibition is national in scope and includes students from primary, secondary and tertiary levels.

iv) Improving the Instructional Programme Through the Use of Information Technology

The main goal of this project would be to improve performance outcomes in Science and Technology. It would encourage teachers and students to keep abreast of global information, to use Information Technology in the classroom, and to access the Internet as a means of increasing their knowledge. It would expose students to programmes of remediation and/or acceleration through software, games and activities that meet their specific needs. This would also help to integrate traditional materials and equipment with technology, in technologically advanced programmes. As

	areas.
Department of Environmental Health Services	▪ To improve, develop and support methods of waste disposal, recycling and reuse. ▪ To develop novel methods of waste utilisation. ▪ To investigate and utilise appropriate waste minimisation technologies. ▪ To develop standards/acceptable levels for noise, dust, and air emissions. ▪ To utilise best available technologies in its regulation and surveillance activities to ensure efficiency and effectiveness.
Department of Fisheries	▪ To promote and utilise technologies associated with sustainable marine resource use. ▪ To facilitate the diversification of marine resource use industries including farming of marine resources.
Department of Immigration	▪ To promote research on the absorption process of all immigrants and special groups. ▪ To gather relevant statistics and research findings in cooperation with other government ministries, human-interest groups, non-governmental organisations, and academic research institutes. ▪ To promote international cooperation with Governments and research bodies dealing with immigration and its integration.
Department of Lands & Surveys	▪ To map topography of the entire Bahamas to facilitate preservation of the physical landscape. ▪ To promote coastal and harbour design and construction that ensures protection and management of coastal systems, including mangroves. ▪ To gather data on beaches, including sediment flow, to prevent beach erosion. ▪ To develop and implement coastal and Crown land policies and management plans in conjunction with the BEST Commission, Department of Physical Planning and other relevant Government agencies.
Department of Meteorology	▪ To complete storm surge atlas for the entire Bahamas to assist in land use planning. ▪ To promote meteorology and climatology as career options. ▪ To promote climate change and its impacts to assist in development planning in the country.
Department of Physical Planning	▪ To ensure preservation of the physical landscape through promotion and utilisation of best available technologies in planning, design and construction. ▪ To develop and implement land use policies in conjunction with the Department of Lands and Surveys, the BEST Commission and other relevant Government agencies. ▪ To promote preservation of mangrove systems in conjunction with the BEST Commission and other relevant Government agencies.

Department of Statistics	▪ To gather data on Science and Technology indicators so progress in these areas can be tracked over time. ▪ To gather statistics from agencies involved in natural resource management and assist these agencies in proper statistical methods to improve use of statistics in decision-making.
Ministry of Education	▪ To explore theories of education and implement them as appropriate. ▪ To further develop the country's human resources in Science and Technology, strengthen and diversify the scientific and technological base of our school system, improve linkages between partners in education, and facilitate community awareness and involvement in S & T education (see also detailed recommendations on page 31 and 32). ▪ To strengthen Science and Technology education in K-12 classes by developing new curricula, teaching aids and teacher retraining, to provide an understanding of Science and Technology to all students. ▪ To ensure the S & T curricula at K-12 levels are sound, sufficient, complete and appropriate. Interfaces between the different levels of Science and Technology curricula must be smooth and seamless, in order to maximise the efficiency of the educational process ▪ To ensure equal opportunity for science education in all sectors of Bahamian society. ▪ To provide more extensive tertiary level education, building upon the foundations lain by primary and secondary levels of education. It is also necessary to develop students' abilities to acquire greater knowledge of Science and Technology through fundamental research (see also detailed recommendations on pages 34 and 35). ▪ To increase support to academic institutions for increased ranks of students in science and engineering subjects. ▪ To ensure modern computer and Internet communication facilities for all public schools.
Ministry of Finance	▪ To facilitate economic diversification and the use of technology in conjunction with Trade & Industry, Financial Services & Investments, Office of the Prime Minister and Cabinet Office. ▪ To promote and facilitate public funding and procurement for the advancement of Science and Technology in the country. ▪ To institute taxation, including tax incentives and deterrents that will promote Science and Technology. ▪ To recognise the role of Science and Technology in the creation and equitable distribution of wealth. ▪ To facilitate economic empowerment and the alleviation of poverty through advancement of Science and Technology.
Ministry of Financial Services & Investments	▪ To pursue and contribute to economic diversification and promote investments in Science and Technology in The Bahamas in conjunction with relevant agencies. ▪ To recognise the role of Science and Technology in the creation and equitable distribution of wealth. ▪ To utilise science and best available technologies in decision-making and investigation and surveillance activities to ensure efficiency and effectiveness.

In order to ensure their level of scientific "literacy", our children must be exposed to comprehensive S & T education starting early in life. Effective S & T education prepares our students for their potential roles as adults, in a rapidly changing environment.

5.1 Primary and Secondary Level Education

The following recommendations are made for the further enhancement and development of Science and Technology Education, at the primary and secondary levels, in The Bahamas:

i) Support **curriculum development and implementation** for Science and Technology. Ensure that curricula are kept current and that programmes are properly implemented.

ii) Continue to expand opportunities for **teacher up-grading,** with greater emphasis being placed on current trends in S & T Education. This should include pre-service and in-service training.

iii) Continue to give focus to Environmental Education by expanding **The Bahamas Environmental Education Programme (BEEP),** which focuses on promotion of environmental awareness, curriculum development, development of resource materials, preparation and planning of technical staff, strengthening of partnerships, establishment of support groups and provision of scholarships.

iv) Continue to upgrade the **information technology training** of technical officers and teachers, and to integrate IT into the Science and Technology Instructional Programmes.

v) Reactivate the **Science and Technology Resources Network**, which is a network of corporate persons and other community members with interests in Science and Technology that will assist with technical support.

vi) Intensify the **strengthening of partnerships in education** between government and NGOs, parents, members of the business community, churches and other community members.

vii) Reactivate/expand **local professional organisations** for Science and Technology teachers.

viii) Establish a functioning **Science and Technology Resource Centre,** which would provide teachers and community members with Science and Technology resources for instruction and research.

ix) Restructure the Educational System to establish **specialised magnet schools for Science and Technology** that would cater to the needs of a greater percentage of the student population interested in developing special skills in Science and Technology.

5. EDUCATION AND RESEARCH

Undoubtedly, the key to understanding Science and Technology is some amount of education. And, there is a need to understand the scientific principles being discovered and introduced into daily life. Understanding imparts the ability to appreciate the technology that we see and use. For this understanding to be acquired, Science and Technology education must be provided in our schools and institutions of learning. A sound understanding of S & T will enable The Bahamas to participate more fully in a technology-driven era.

A few disciplines of the far-reaching world of Science and Technology:

- Biochemistry
- Computer technology
- Engineering
- Environmental science
- Health and medical sciences
- Meteorology
- Microbiology
- Modern physics

As scientific and technological knowledge expands, so too does its number of sub-disciplines and cross disciplines.

Scientific knowledge enhances growth and innovation, which results in a more vibrant economy, and will be a major determining element in the future advancement of The Bahamas. The country's ability to compete in the global S & T arena will be dependent on the ability of the educational system to equip the workforce with the knowledge and skills necessary to generate and cope with rapid scientific and technological changes.

S & T education identifies and fosters a variety of abilities and trends that contribute to the satisfaction of national manpower demands, which are as follows:

- A citizenry equipped with the basic scientific and technological skills, knowledge and understanding necessary to enable them to be productive and to contribute positively to a technologically advanced society;
- A sufficient proportion of able students choosing scientific and technological career paths;
- An adequate supply of candidates to be trained as skilled workers, that can function productively in the 21st Century;
- Administrators, managers, and civic leaders with sound technical and scientific knowledge and understanding;
- A population more prepared and able to change jobs and to acquire new skills, to keep pace with advances in Science and Technology;

Ministry of Foreign Affairs	▪ To promote and facilitate technology transfer and cooperation in the region and internationally. ▪ To facilitate appropriate national representation at regional and international meetings and other fora related to Science and Technology.
Ministry of Health/ Department of Public Health	▪ To increase support of disease oriented biomedical research with a special emphasis on medical problems prevalent in The Bahamas and related to its environment. ▪ To strengthen support of biomedical research in hospitals and to increase scientific interaction between academic institutions and hospitals. ▪ To support incorporation of novel medical technologies for early disease detection and treatment. ▪ To support health research projects and surveys, including epidemiological health surveys.
Ministry of National Security	▪ To support the development of novel methods and technologies in forensics, detection of explosives and drugs, and police intelligence work. ▪ To promote criminal-justice policies based on research on the root causes of crime and delinquency and their remedies.
Ministry of Social Services	▪ To utilise Science and Technology to determine the causes of crime and poverty to address these social ills. ▪ To utilise behavioural science in the societal context to determine any links with social problems.
Ministry of Tourism	▪ To develop a sustainable tourism policy and programme that would include utilizing science and green technologies. ▪ To engage in carrying capacity assessments for islands slated for developments, especially large-scale, using science and working with relevant agencies. ▪ To move from a mass tourism to a sustainable tourism model.
Ministry of Trade and Industry	▪ To expand The Bahamas' technological infrastructure. ▪ To promote and facilitate industrial growth and innovation through use of best available technologies. ▪ To pursue and contribute to economic diversification and promote investments in Science and Technology in The Bahamas in conjunction with relevant agencies. ▪ To create opportunities for global cooperation in industrial research and development. ▪ To promote cooperation between academic research institutions and high-tech industries to maximise commercial potential of basic research. ▪ To ensure trade does not negatively impact on Science and Technology development in The Bahamas. ▪ To recognise and formalise a mechanism to address the relationship between trade and environment issues.
Ministry of Transport and Aviation	▪ To promote use of best available technologies in transport and aviation including emissions technology and fuel-efficient vehicles. ▪ To promote and utilise best available technologies in disaster mitigation and clean-up in transport.

Ministry of Works	▪ To utilise best available technologies to achieve urban planning and development. ▪ To utilise GIS as a planning tool. ▪ To facilitate development of efficient transport systems to include adequate public transportation and traffic management. ▪ To promote indigenous design, construction, repair and maintenance of highways and structures. ▪ To promote environmentally friendly construction techniques and designs that conserve energy and water.
Office of the Prime Minister	▪ To promote and facilitate Research and Development in The Bahamas. ▪ To facilitate and commit to the advancement of Science and Technology in the country.
Port Department	▪ To promote coastal and harbour design that will ensure protection and management of coastal systems. ▪ To utilise science and best available technologies in regulation and surveillance activities.
Royal Bahamas Defence Force	▪ To utilise new technologies in its functions, including marine patrol and vessel apprehension (e.g. satellite imagery).
Royal Bahamas Police Force	▪ To utilise new technologies in its functions, including forensics and other technologies that can facilitate solving crime.
Water & Sewerage Corporation	▪ To compile and analyze data associated with fresh water resources, as well as supply and management to facilitate long-term planning to address sustainable resource use. ▪ To utilise new technologies, including computer modelling and GIS tools in mapping resources and planning. ▪ To explore and utilise, where appropriate, technologies related to sustainable potable water production and use as well as management of wastewater including storm water.

vi) Marketing the library, utilising: a presence on the World Wide Web, partnerships with local media, production and distribution of literature, sales, and sponsorships.

vii) Assisting the growth, development and maintenance of the library collections by: assigning special subject bibliographers to each school, installing a new acquisitions board, instituting a 5-year review cycle for reading lists, and conducting an LIMS budget reassessment.

viii) Utilisation of the Library Association of Great Britain formula for staffing the library system, i.e.:

- 1 staff member per 330 full time equivalent (FTE) students when the total number of FTE students is greater than 2500;
- 1 staff member per 200 FTE students when the total number of FTE students is less than or equal to 2500.

3. SCIENCE AND TECHNOLOGY INFRASTRUCTURE

A sound framework of underlying systems, services and institutions, for *Science and Technology*, is necessary for creating and sustaining an environment in which scientific advancement and discovery, and technological progress and application, can freely and efficiently take place. Such an environment must:

- Provide support for education, knowledge building and skill development;
- Financially support scientific and technological achievement and progress;
- Encourage achievement and the pursuit of excellence; and
- Provide pathways by which achievements can be made.

It is the role of Government to provide, as a minimum, the basic and most essential infrastructures, or infrastructural frameworks, within which the nation can develop and grow. Further, it is important to note that private entities form a part of and therefore enlarge the overall infrastructure and should both be supported and regulated by Government agencies.

For coordination and advancement on a national scale, many S & T systems, services and institutions must be public entities, and must therefore be provided for or supported by Government tax revenue. However, some non-governmental entities that are not necessarily national in scope may still be necessary to perform vital functions for the overall advancement of Science and Technology in the country.

The implementation of the *Road Map for Science and Technology* will warrant the design of many **infrastructural systems**, i.e. collections of related processes and procedures focused on S & T. These systems will be interdependent, crossing institutional boundaries where necessary, and expedient. They will reside in the infrastructural institutions that presently exist or that will be created heretofore.

Some of the required systems are already in place, e.g. The College of The Bahamas' educational and library systems, and research laboratories. These existing systems may need improvement and/or enlargement to fill specified needs. Some of the required systems will have to be newly designed and established, e.g. a system for obtaining funding for particular research programmes or projects may be established within the proposed National Science and Technology Research Council.

The overall goal of infrastructural institutions and systems is to provide **services** to their patrons, users and beneficiaries. The nature of these services and the responsibilities of the institutions must be clearly defined.

3.1 Infrastructural Institutions

Institutions for the support of Science and Technology (some of which are already existent) should include, but may not necessarily be limited to, the following recommendations:

i) **Ministry of Science and Technology** – This would be the coordinating body for Science and Technology in the country, and is where Science and Technology

4. LIBRARIES AND INFORMATION SYSTEMS

An important requirement for the growth and sustainability of Science and Technology, research and development is a library system that has the capacity to deliver information resources and services via a variety of media, including information technology. This provides support not only for the teaching and research needs of tertiary level institutions in The Bahamas, but also for the academic and research needs of a literate nation and its government.

Scientists and technologists, and the institutions and agencies that they serve, must make tangible commitments to the development of an S & T Library System for The Bahamas. Such a system may be developed by actively assisting and supporting the public libraries already in existence, and the library of The College of The Bahamas.

Recently, The College of The Bahamas, through its Library Subcommittee of the Strategic Plan Development Committee, conducted a systematic inquiry into the requirements for a library system that could meet the needs of a university environment and the community that it serves. In brief, this subcommittee agreed upon the following proposals and recommendations for improvement of the College of The Bahamas Library:

i) Addition of the new library service of journal and text binding and increased promotion of the existing library consultancy services.

ii) Establishment of a multi-campus-wide computer network that would link all areas of the institution, and facilitate the rapid discovery and exchange of information. An expanded network like this would become a part of The Bahamas National Information Network (NIN).

iii) Encouragement of collaborative efforts between the College and local communities, Local Government, island cooperatives, private sector organisations, or philanthropists, to provide and equip training centres to COB specifications.

iv) Open dialogue between COB and supportive establishments, such as local and overseas educational institutions (whose students use the library facilities), local hotels and resorts, clubs, companies, doctors and COB alumni, in order to obtain the necessary financing to accomplish goals for future growth and development.

v) Improvement of library budgetary and financial processes, through measures that may include:
   a) sensitisation of administrators to develop an appreciation for the essential role of the library in the educational process;
   b) merging development plans with funding strategies;
   c) establishment of a deposit account for collection funds;
   d) allocation of a measure of financial responsibility and accountability to the library staff; and
   e) initiation of shared cooperative acquisitions projects.

infrastructure should begin. It is the official public source of direction and funding for S & T and related issues. It should include a **Department of Science and Technology Statistics**.

ii) **Tertiary educational institutions** – These include degree-granting and vocational institutions, such as The College of The Bahamas, The Bahamas Technical and Vocational Institute, and Success Training College, among others. Institutions like these help to fulfil the training requirements for an S & T work force, and aid the discovery and expansion of knowledge and the solution of industrial problems through research. Mechanisms should be established to provide necessary public funding and support for S & T programmes at such institutions, to ensure them the opportunity to flourish.

iii) **Preschools, primary and secondary schools** – As the foundational educational institutions, the S & T curricula at these levels must be sound, sufficient, complete and appropriate. Interfaces between the different levels of Science and Technology curricula must be smooth and seamless, in order to maximise the efficiency of the educational process.

iv) **National Science and Technology Research Council** – This would be a public body that coordinates and administers public funding for S & T research.

v) **The Bahamas Environment, Science and Technology (BEST) Commission** – A Government entity with responsibility for certain matters of environment, Science and Technology.

vi) **National research laboratories and institutions** – These would exist as separate entities, within tertiary level educational institutions, for the conduct of research and problem solving in areas of importance to S & T. Possibilities include *inter alia* National Research Labs for Renewable Energy, Environmental Science, Water Resources, Highway and Transportation, and Weather and Building Construction. A similar phenomenon is practiced by major Science and Technology based enterprises, which establish Research and Development departments in order to find ways to improve their own productivity, efficiency, and the quality of products and services that they deliver.

vii) **National Library System (NLIBS)** & **National Information Network (NIN)** – These would be interrelated sources and repositories of all types of information, including data on Science and Technology. They rely heavily upon information technology, computer and communication systems. The NLIBS may be designed as a component of the NIN. The Bahamas National Information Network would be an information system incorporating the National Archives, public and special libraries, as well as other information-based organisations in The Bahamas.

viii) **Bahamas Institute for Science, Technology, Education, Research and Innovation (BISTERI)** – This organisation should offer programmes to increase interest and awareness in Science and Technology, and to encourage young people to pursue careers in various fields of S & T. It should develop and

manage science & technology seminars, workshops, conferences, competitions, museums and parks, for the purpose of promoting science, technology and environmental issues nationally.

ix) **The Public Utilities Commission** – This is an existing regulatory body that might perform a similar function for scientific and technological entities and organisations.

x) **Professional associations and regulatory bodies** – Some such organisations currently existing include: The Bahamas Institute of Professional Engineers (BIPE), The Bahamas Society of Engineers (BSE), The Institute of Bahamian Architects (IBA), and The Medical Association of The Bahamas (MAB).

xi) **Environmentally and ecologically concerned organisations and groups (NGOs)** – These include proactive and watchdog organisations, such as: The Bahamas National Trust (BNT), The Bahamas Reef Environmental and Educational Foundation (BREEF) and others that may be formed in the future. Being productive and informative, such organisations constitute an essential part of a balanced national infrastructure, and should therefore be acknowledged and encouraged.

Infrastructural Institutions for the Support of Science and Technology