MINISTRY OF EDUCATION



INTEGRATED SCIENCE
TEACHER'S GUIDE

GRADE 9

FOREWORD

It is acknowledged that thorough planning is essential for effective teaching and learning. Such planning is even more critical today when one considers the limited resources, both human and material, which are available.

The Ministry of Education, through the Secondary School Reform Project (SSRP), has developed curriculum materials that have been designed to improve the quality, equity and efficiency of secondary education. The curriculum materials include Levels 7-9 Curriculum Guides and Teacher's Guides for Language Arts, Mathematics, Science, Social Studies, Reading and Practical Activity Guides for Science. These materials have been tested in all secondary-aged schools nationwide and are considered useful in providing teachers with a common curriculum framework for planning, monitoring and evaluating the quality of teaching and learning. The curriculum materials also provide a basis for continuous student assessment leading to the National Third Form Examination (NTFE).

The initial draft curriculum materials have been subjected to evaluation, by respective Heads of Departments, form all ten Administrative Regions and Georgetown and they have been subsequently revised to reflect the views expressed by teachers.

The revised curriculum materials are now published as National Curriculum documents to provide consistency and support for teachers in the process of planning for an effective delivery of the curriculum. All secondary teachers must ensure that they make good use of these curriculum materials so that the quality of and learning can improved in all schools.

Ed Caesar
Chief Education Officer

PREFACE

The teaching of Science has shown sustained growth at the secondary school level in the past decade, and in order to maintain such growth, the Level 9 curriculum guide has been developed by a team of curriculum Science specialist.

The curriculum guide has objectives which are achievable targets of skills, knowledge, understanding and attitudes. The guide has also identified units, topics, content and strategies to be used, developed and reinforced.

It is the duty of the heads of department to prepare general schemes, which they can use to better inform the teachers in their departments in order to write a more detailed year/term plan.

There is no set format for the writing of schemes of work. This may vary from school to school and even teacher to teacher. However, the scheme of work for any academic year must be broken down into term schemes. Further, the term schemes can be broken up into a weekly outline, which identifies objectives to be completed each week.

In the curriculum process, feedback is a necessary condition for change and improvement, and I would urge all of our Science teachers to provide such feedback to the curriculum staff at NCERD and also as they visit to provide support that will enhance your classroom teaching.

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UNIT SEXUALLY TRANSMITTED DISEASES

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Sexually transmitted diseases	Research Report Classify	The names of the STD's which are caused by i) fungus ii) bacterium iii) virus	How the various STD's are transmitted How the disease is diagnosed and treated	Appreciate the need for self control and responsible sexual behaviours	Sexually transmitted diseases: -Yeast infections -Gonorrhoea -Syphilis -Herpes -HIV/AIDS	Activity Discussion	Can students: differentiate between the HIV positive condition and the AIDS condition?	**Health and Family life** Sexually transmitted diseases

UNIT NUTRITION IN ANIMALS

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Mammalian dentition	Plan Design Construct charts/models Interpret Observe Draw conclusions	The various ways of caring for our teeth The dental formulae for named carnivores and herbivores	Some methods of keeping our teeth clean and healthy are more beneficial than others The main structures of a tooth relate to their functions Carnivore and herbivore dentitions differ	Willingness to use the various methods to keep our teeth healthy Use of evidence for making judgements	Mammalian dentition	Activity Discussion	Can students: -relate the main structures of a tooth to their functions? -explain how the correct brushing action affects the health of our teeth? -state reasons for the differences between herbivore and carnivore dentitions?	**Health and family life** Care of our teeth **Food and Nutrition** Functions of the teeth **Agriculture Science** Mammalian dentition

UNIT NUTRITION IN ANIMALS

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Our digestive System	Plan and construct charts Interpret observations Design and plan investigations Record observations Research Record Communicate ideas logically and concisely	The parts of the digestive system and their physical functions What is: -diffusion - a villus Where villi are found in the digestive tract -Excretion -Secretion -Elimination have different purposes. The large intestine absorbs water	The muscular activity which results in the movement of food along the digestive tract The villi increase the surface area of the interior walls of the intestine The role of fibre in our diet	Show an interest in the functioning of the human digestive system. Curiosity about how the digested foods enter the blood stream Appreciate the importance of fibre in our diet	The human digestive system	Activity Discussion	Can students : -demonstrate and explain how peristaltic motion occurs ? -relate the parts of the digestive system to their physical functions? -identify the places in the digestive system where physical and chemical digestions occur and state examples of each.? -demonstrate and explain how villi increase the surface area of the interior walls of the intestines? -explain the need for fibre in our diet? -differentiate between - excretion - secretion - illumination using named examples?	**Home Economics** Digestion **Visual Arts** Making charts/ models **Health and Family Life** Diets

UNIT NUTRITION IN ANIMALS

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Nourishment	Classify Research Record Communicate Manipulate Observe	The six food groups, their sources and functions of their main nutrients The nutrients essential for a balanced diet The chemicals used in a named food test The causes and symptoms of -beriberi -kwashiorkor The methods used for the prevention and cure of -beri beri -kwashiorkor	Fibre is an important part of a balanced diet. Differences in age, sex and occupation of a person requires different diet A food sample can be tested for -protein -starch -fats/oils -glucose Many diseases can be prevented by using a balanced diet.	Curiosity about the six food groups Willingness to share ideas about balanced diets Concern for working in a clean and orderly environment Willingness to avoid deficiency diseases by being critical of food selection	The six food groups A balanced diet Food tests Deficiency diseases	Activity Discussion	Can Students: -name the six food groups, their sources and the functions of their main nutrients? -State reasons for different diets according to age, sex, and occupation of a person?	**Home Economics** Diets **Health and family Life** Diets

UNIT NUTRITION IN ANIMALS

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Enzymes	Investigate Identify	The meaning of:- -enzyme -catalyst The characteristics of enzymes The conditions necessary for enzyme activity The enzymes of man's digestive tract:- their -production sites -substrates -end products -hydrolytic reactions and their word equations	Enzymes differ from catalysts How the digestive enzymes work.	Shows an interest in enzymes in the digestion process Willingness to be critical of procedures	Enzymes in the human digestive system.	Activity Discussion	Can students: -differentiate between an enzyme and a catalyst? -plan and carry out an investigation of the conditions necessary for a named enzyme to be active?	**Home Economics** Digestion **Agriculture. Science.** Digestion

UNIT NUTRITION IN PLANTS

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Photosynthesis	Manipulate Observe Predict Communicate Investigate Draw Label Classify	The meaning of photosynthesis The word and chemical equations of photosynthesis Chlorophyll converts light energy to chemical energy The uses of the products of photosynthesis	A cross section of a leaf can be viewed under the microscope Leaves are adapted for photosynthesis Light, carbon dioxide and chlorophyll are important to the photosynthetic process A leaf can be tested for the presence of starch	Willingness to put forward ideas	Photosynthesis	Activity Discussion	Can students: -test a leaf for the presence of starch as product of photosynthesis? -explain the importance of light, carbon dioxide and chlorophyll to the photosynthetic process?	**Agriculture Science.** Photosynthesis
Food storage in Plants		Storage organs, their locations on plants and the type of food stored The categories of plant storage organs The names of classes of food present in storage organs	Storage organs can be tested for various classes of food. Various plants use their stored food	Use evidence for arriving at conclusions	Plant food storage organs		-name, describe and place various plant storage organs into their respective categories? -identify the classes of food present in a named plant storage organ?	**Agriculture. Science** Plant storage organs

UNIT OUR ENVIRONMENT

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Soil Organisms	Manipulate Observe Draw Classify Plan and design E.g. a wormery	Names and descriptions of soil organisms Soil organisms that are useful or harmful Classification of soil organisms	How named soil organisms are classified Harmful soil organisms can be controlled Temperature and light affect soil organisms	Patience and perseverance in collecting information	-Organisms living in the soil -Classification of useful and harmful soil organisms -Control of soil organisms	Activity Discussion	Can students: -explain how named soil organisms are useful to mankind?	**Agriculture.** **Science.** Soil organisms

UNIT OUR ENVIRONMENT

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Soil Properties	Observe Manipulate Measure Plan Draw Classify Communicate Interpret	The major soil components The names of the apparatus, materials and amount of substances needed for the identification of soil particles. Capillary action Soil erosion and leaching The types of soil and their properties	Soil samples are tested for:- -humus -air content -pH level -water retention -permeability To measure and compare the capillarity in samples of soil. Soil properties affect crop cultivation	Show an interest in the properties of soil	Soil -structure -properties -weathering -uses	Activity Discussion	Can students: -test samples of soil to find their pH levels? -explain how the properties of various types of soils affect crop cultivation?	**Agriculture.** **Science.** Soils

UNIT OUR ENVIRONMENT

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Feeding relationships in nature	Observe Plan Draw Label Classify Communicate	The meaning of**:** - food chain - food web - producers - consumers - ecosystem - carnivore - herbivore - omnivore - producers - prey - predator - decomposers	Food chains and food webs are related/linked Energy is transferred in a food chain/web	Curiosity about feeding relationships in an ecosystem	Feeding relationships and energy transfer in ecosystems Energy lost in food chains/webs	Activity Discussion	Can students: -construct a food web ? -explain how energy is transferred through a food web?	**Agriculture Science** Feeding relationships **Visual Arts** Drawing plants and animals

UNIT OUR ENVIRONMENT

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Man in his environment Pollution	Observe Hypothesise Explore Experiment Predict Communicate	The meaning of -pollution -pollutants Loud sounds over time cause deafness The names of air pollutants The causes of the greenhouse effect The location of the ozone layer The ozone layer protects life on earth Ultraviolet rays can cause cancers and blindness in humans The ozone layer has a hole Mining activity produces silt and increases erosion Sub-lethal levels of mercury pesticides and oil derivatives lower resistance to disease	Loud sounds damage our ears Dust affects plants and humans The greenhouse effect is affecting Guyana and is increasing the size of the hole in the ozone layer. The hole in the ozone layer affects life on earth Silt loads of rivers affects aquatic life and humans -Wells can be protected from contamination -Mercury poisoning occurs in humans	Show concern for the health of others and the protection of the environment. Show patience and perseverance in the collection of information Willingness to put forward ideas	Pollution i) noise ii) air iii) Water	Activity Discussion	Can students: explain how continuous loud noise damages the human ears? -explain how the greenhouse effect is caused? - explain how global warming is affecting life in Guyana? -explain the positive and negative effects of mining in Guyana? -explain how to protect well water from contamination?	**Social Studies** Pollution **Visual Arts** Drawing **Agriculture Science** Erosion **Social Studies** Mining

UNIT OUR ENVIRONMENT

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Other relationships in the ecosystem	Measure Estimate Observe Record Collect information Communicate Predict	The meaning of: -population -community -competition The types of feeding relationships which affect the size of populations The physical factors in an ecosystem.	The feeding relationships in an ecosystem affect the size of a named population. The size of a population is estimated. Population size is affected by physical factors.	Patience and perseverance in collecting data. Willingness to share ideas	Populations in an ecosystem Physical factors and populations	Activity Discussion	Can students: -describe the feeding relationships in a named ecosystem and state how these relationships affect the population of a named organism? -describe the physical factors of a named habitat and state how they affect the population of a named organism?	**Social Studies** Populations **Agriculture Science** Physical factors and populations

UNIT FORCES

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Magnets	Manipulate Observe Draw Communicate Plan Design Predict	A magnet has two poles The laws of magnetism The meaning of the term 'magnetic field'. A line of force has a certain direction The names of devices in the home in which magnets or electromagnets are found. The names of metals which can become magnetised	How an electromagnet and a doorbell are made. Some metals can become permanent magnets and others temporary ones. How magnets are made. Unknown poles can be identified. Lines of force are plotted using a compass.	Willingness to work along with others. Appreciate that magnets should be carefully handled and stored	Magnetism -Magnetic poles -Lines of force -Laws	Activity Discussion	Can students: -use iron filings to show the lines of force in a magnetic field and to make a drawing of the magnet and the lines of force? -demonstrate and explain how unknown poles can be identified?	**Social Studies** The compass
Stability		Stability depends on the base of an object and the height of the centre of gravity above the base	The centre of gravity of a flat, irregular piece of cardboard can be located. Objects are either stable, unstable or in equilibrium.	Willingness to put forward ideas to explain deviations	Force of gravity		-locate the centre of gravity of irregular pieces of cardboard?	**Social Studies** Transportation

UNIT OUR EARTH

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Earth resources	Observe Manipulate Explore Interpret Investigate Predict Communicate	The meanings of: -mineral -rock Types of rocks The rock cycle The properties of rocks Rocks are classified as hard, soft, consist of one or more minerals, crystalline or granular The most common rock forming minerals The names of minerals which are mined in Guyana. The uses of some minerals Some minerals are considered precious and semi-precious. The names and uses of some precious and semi-precious minerals which are located and mined in Guyana and the parts of the country where they can be found.	How -igneous, sedimentary and metamorphic rocks are formed. -the different types of igneous rocks are formed. a rock sample can be tested for carbonate a sample of glass is made Some minerals are considered precious and semi-precious How named precious and semi-precious stones are formed.	Curiosity about rocks Willingness to explore samples of rocks Willingness to ask questions	Rocks -Classification -Rock cycle -Mining in Guyana Precious and semi-precious stones	Activity Discussion	Can students: -use a chart of the rock cycle to explain the formation of igneous, sedimentary and metamorphic rocks? -make a sample of sedimentary rock? -classify rocks using Moh's scale? -name precious and semi-precious minerals found in Guyana and where they are located?	**Social Studies** Mineral resources **Agriculture Science.** Types of soil **Social Studies** Uses of mineral resources Locations in Guyana

UNIT OUR EARTH

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Earth resources	Manipulate Explore Communicate Investigate Observe Hypothesise	The names of minerals found in clay. There are various types of clay The names of some impurities found in clay and colours produced in the clay. The location of kaolin deposits in Guyana The uses of clay The components of cement The uses of cement	How clean clay is made How terracotta, earthenware, stoneware and china are made How cement and mortar are made	Willingness to respect and listen to opposing views Willingness to put forward ideas Willingness to ask questions	Clay -Classification -Colours and impurities -Uses Uses of clay Cement	Activity Discussion	Can students: -state reasons for the various colours of clay? -prepare a sample of clay and produce a terracotta article? -describe the main stages in the production of cement? -use cement to make a sample of mortar?	**Social Studies** Mineral resources **Agriculture. Science.** Types of soils **Social Studies** Uses of mineral resources **Visual arts** Ceramics **Social Studies** Construction industry **Mathematics** Measurement **Language** Reporting

UNIT ENERGY

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Waves	Observe Manipulate Measure Explore Investigate Communicate Predict Interpret	Transverse waves travel in a wavelike manner Water and light are examples of transverse waves Sound travels as longitudinal pressure waves Light waves can travel through a vacuum Sound cannot travel through a vacuum The denser the material, the faster the sound waves travel through it The meaning of frequency, amplitude and intensity Waves can be reflected An echo is reflected sound waves	The amplitude, frequency and wavelength of a wave can be measured How sound is produced and transmitted Sound travels best in solids Light waves travel faster than sound waves Different frequencies are produced The amplitude of a wave affects its intensity (loudness) Reflection occurs in longitudinal and transverse waves	Shows an interest in waves Willingness to question procedures and conclusions Use evidence to arrive at conclusions Show patience and perseverance	Transverse waves Longitudinal waves Frequency (pitch) Reflections of waves Measuring the speed of sound in air using echoes	Activity Discussion	Can students: demonstrate and explain reflection of sound waves? -measure the amplitude, and frequency of water waves? -carry out an activity to compare the speed of sound and light in air? -make apparatus to demonstrate and explain how the amplitude affects the intensity of sound?	**Social studies** Communications **Music** Sounds **Visual Arts** Construction of aids **Mathematics** Reflections

UNIT ENERGY

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Electricity	Observe Manipulate Interpret Experiment Predict Investigate Explore Report Communicate	The use of -ammeters -voltmeters -rheostat -galvanometer -a domestic electric meter	How ammeters and voltmeters are placed in circuits and read. How rheostats are used in circuits A parallel circuit differs from a series circuit	Show an interest in circuits Show concern for the safe use and handling of equipment	Series circuits Parallel circuits	Activity Discussion	Can students: -demonstrate that in a series circuit the current is always the same? -demonstrate that in a parallel circuit the total current is equal to the sum of the currents in the different branches?	
		The meanings and symbols of: -voltage -current -resistance -power -watt SI units for: -current -voltage -resistance -power Formulae: -$V=I \times R$ -$P=V \times I$ -$P=E/T$. The length and thickness of a wire affects its resistance.	Solve problems using -$V=IR$ -$P=E/T$ -$P=V \times I$ A dial electric meter is read resistance affects the current in a series circuit	Perseverance in solving problems involving electricity	Calculations involving electricity The electricity meter		-calculate the cost of using stated amounts of kWh?	**Mathematics** Equations

UNIT ENERGY

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Heat energy	Observe Interpret Hypothesise Communicate Predict Explore Experiment	Heat energy can be transferred by either: -conduction -convection -radiation Conduction occurs in solids The names of good conductors of heat and their uses The names of poor conductors (insulators) of heat and their uses Convection currents occur in liquids and gases Expansion causes liquids and gases to become lighter (less dense) White reflects most and black absorbs most radiant energy Radiant energy is able to travel through a vacuum	Heat is transferred in a solid Heat is transferred in liquids and gases Expansion causes liquids and gases to become lighter Convection currents cause land and sea breezes Different surfaces absorb differing amounts of radiant energy White clothes are preferred in the tropics	Show curiosity about conduction of heat energy Use evidence for arriving at conclusions Willingness to share ideas	Transfer of heat energy by -conduction -convection -radiation	Activity Discussion	Can students: -demonstrate and explain the transfer of heat energy by conduction? -demonstrate and explain the transfer of heat energy by convection currents? -demonstrate and explain the transfer of heat energy by radiation?	**Home Economics.** Cooking utensils **Social Studies** Convection currents **Home Economics.** Ovens Refrigerators **Home Economics.** Microwave ovens

UNIT ENERGY

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Heat and expansion	Observe Manipulate Explore Draw Measure	Solids, liquids and gases expand on heating Different metals expand at different rates. A bimetallic strip is made of two metals which expand at different rates. The advantages and disadvantages of the effects of heat on materials The names of appliances that use a thermostat	Heat energy causes materials to expand Thermostats control temperatures	Show concern for the safety of others	Expansion of materials	Activity Discussion	Can students: -demonstrate and explain the expansion of air due to heat energy?	**Home Economics** Pressure cooker

UNIT ENERGY

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Fuels as sources of energy	Observe Manipulate Communicate Draw Research Plan Investigate	A fuel is any substance that burns and supplies energy Examples of fossil fuels Charcoal is made from wood, peat or coal. The names of the products of fractional distillation of petroleum. Long hydrocarbon molecules are cracked by the use of heat and a catalyst.	Products of a burning candle can be obtained and identified Fossils fuels are a major source of pollution Fractions are collected at temperatures specific to each fraction/products Long molecules can be broken by cracking	Willingness to work with others and share ideas Concern for the protection of the environment Concern for the handling and use of materials and equipment Willingness to cooperate with others	Fossil fuels Fractional distillation Cracking long molecules	Activity Discussion	Can students: -identify the products obtained from burning a candle? -demonstrate how long hydrocarbon molecules can be cracked and name the products and their uses?	**Social Studies** Fossils Sources of energy
Alternative sources of energy		The names and uses of common hydrocarbons The names of alternative sources of energy suitable to Guyana	Energy is produced from alternative energy sources Alternative sources impact on the environment and the economy	Show curiosity about alternative sources of energy	Alternative sources of energy suitable to Guyana -solar power -wind power -hydropower -geothermal power -boigas -gasohol		-make a working model of a hydropower station and explain how electricity is produced?	

UNIT ENERGY

Topic	Learning Objectives				Content	Activities/ Methods/ Strategies	Evaluation	Areas of Integration
	Skills	**Knowledge**	**Understanding**	**Attitudes**				
Conservation of our forest resources	Observe Research Predict Interpret Communicate Explore Evaluate	The meaning of biodiversity and conservation The various ways that forests are useful The ways by which forests can be conserved. The non-timber forest products in Guyana The meaning of the term “eco-tourism” The types of eco-tourism The advantages and disadvantages of eco-tourism in Guyana	Our biodiversity should be conserved. The destruction of forests affects the land, rivers and biotic life A forest resource management plan is important for forest conservation Non-timber forest products are important to the economy of Guyana The various types of eco-tourism impact upon the environment and the local inhabitants	Concern for the application of scientific methods and knowledge in exploiting our forest resources Willingness to share knowledge and ideas Concern for the environment and local inhabitants	Our forest resources Non-timber forest products Eco-tourism	Activity Discussion	Can students: -explain the terms *biodiversity* and *conservation* -give local examples of biodiversity practices -name a non-timber forest product and state its importance to the economy of a village or Guyana? -name example of eco-tourism ventures in Guyana and their impact on the local inhabitants?	**Social Studies** Natural resources Forest products Tourism