APPENDIX 1:
PRODUCTS OF 1977 GUYANA WORKSHOP

PRIMARY EQUIPMENT

- equal arm balance
- battery holder
- colour filter box and pictures to go inside
- question and answer board
- mystery box
- sonometer
- windlass system
- comparison of heat absorption apparatus
- floating apparatus
- sundial

SECONDARY EQUIPMENT

Community High

- metre rule graduated in cm
- spring/lever combination
- opisometer
- caliper graduated in cm
- spring balance
- lever balance
- adjustable height measurer

CXC Integrated Science

- basic ripple tank
- ripple tank accessories: lamp support with lamp socket and heads, ripple bar support, rippler bar, flat triangular and rectangular perspex prisms, concave and convex lenses, plane and curved reflectors, single and double slits
- coated slide with double slits for observing diffraction
- polarimeter
- grease-proof screen
- biconvex (spherical) lens/mirror holder
- opaque screen and stand
- falling plate apparatus
- multiple-use ray box
- rectangular and triangular perspex prisms to contain liquids for refraction experiments
- plane mirror stands
- cylindrical mirrors
- a chest with standardized drawers/ kit containers
- transverse wave machine
- switch
- longitudinal wave machine
- resonance tube apparatus
- resonating strips apparatus
- battery holder

Taken from the Guyana Production Teacher Vacation Course 1977 Report, pp. 17-18.

APPENDIX 2:
CONTENTS OF JAMAICA 'IMPROVISATIONS IN SCIENCE HANDBOOK'

aquaria
aquatic collecting nets
balance
ball and ring
beakers
burners
biological models
bulb holders
cages for animals
circuit boards
containers
dissection tools
egg incubator
electromagnet
evaporating dish
filter funnel
filter paper
flower pots
hair hygrometer
galvanometer
graduated cylinder
light source
measuring instruments (length)
microscope
mirrors
overflow can
plant press
pressure pan
pulleys
separating funnel
stroboscope
sundial
terraria
test tubes
test tube holder and stand
tripod or heating stand
water clock
weather instruments

For information about this handbook, write to Mrs Janice HoLung, c/o Ministry of Education, Kingston, Jamaica.

APPENDIX 3:
SUMMARY OF RESPONSES TO SURVEY OF MATERIALS FOR A LEVEL PHYSICS

The survey contained a list of 209 items of equipment and respondents were asked to categorise them as listed below; not every teacher replied in full. They were also asked to indicate how many of the 135 books on the list supplied they possessed.

A. Reasonably adequate supply.

B. Not available, teacher would not use if supplied.

C. Not available, teacher would use if available but can manage without.

D. Available, but in seriously inadequate quantities.

E. Not available, badly needed.

Teacher	Apparatus and materials					Booklist	A Level Entry 1980
	A	B	C	D	E		
1.	104	4	27	39	35	6	40
2.	72	66	50	4	17	13	4
3.	15	27	61	30	76	7	32
4.	64	88	40	16	1	8	22
5.	66	42	62	26	13	13	6
6.	101	53	51	3	0	13	22
7.	75	19	91	23	1	11	?
8.	41	4	86	49	29	10	15
9.	93	13	57	11	35	14	8
10.	63	30	112	3	1	13	8
11.	65	98	26	15	4	14	11
12.	61	147	0	0	0	7	6
13.	109	1	29	33	37	18	6
14.	33	110	34	20	12	0	40
15.	73	71	32	3	29	9	11
16.	13	108	40	25	23	2	2
17.	11	30	131	31	6	2	8
18.	38	20	88	58	5	2	5
19.	8	10	87	92	9	8	?

APPENDIX 4:
SUMMARY OF RESPONSES TO SURVEY OF MATERIALS FOR O LEVEL PHYSICS

The survey contained a list of 215 items of equipment and respondents were asked to categorise them as listed below. Not every teacher replied in full.

A. Reasonably adequate supply.

B. Not available, teacher would not use if supplied.

C. Not available, teacher would use if available but can manage without.

D. Available, but in seriously inadequate quantities.

E. Not available, badly needed.

Teacher	Apparatus and materials					O Level Entry 1980
	A	B	C	D	E	
1.	47	115	1	1	50	19
2.	82	2	8	63	60	160
3.	60	152	0	3	0	180
4.	62	19	92	10	32	24
5.	96	3	95	14	7	?
6.	36	171	5	3	0	15
7.	86	1	85	39	2	50
8.	42	103	43	18	9	?
9.	18	25	45	20	106	17
10.	101	2	41	27	44	60
11.	21	59	8	12	114	15
12.	23	0	134	8	49	20
13.	0	152	0	0	63	9
14.	38	0	81	12	82	25
15.	18	122	34	26	15	?
16.	15	164	0	18	18	10
17.	27	87	60	3	36	120
18.	26	101	28	6	49	8
19.	20	26	75	35	59	110
20.	26	39	59	14	76	3

Teacher	Apparatus and materials					O Level Entry 1980
	A	B	C	D	E	
21.	12	0	17	21	165	12
22.	9	5	94	32	75	?
23.	15	54	2	33	111	26
24.	0	0	34	17	164	?
25.	92	1	35	72	14	60
26.	21	153	29	12	0	16
27.	57	24	83	50	1	?
28.	15	164	20	10	6	40
29.	114	53	27	11	10	56

APPENDIX 5:
SUMMARY OF RESPONSES TO SURVEY OF APPARATUS RESOURCES AND NEEDS OF LOWER-SECONDARY INTEGRATED SCIENCE TEACHERS

32 teachers were approached for this survey, and were asked to categorise each individual item of equipment as listed below. One teacher did not complete the survey.

Items marked with an * have been locally produced by one or two teachers themselves. For items marked n., see notes below.

Item		A	B	C	D	E
1.	tripods	27	0	1	3	2
2.	measuring cylinders	26	0	0	7	0
3.	glass tubing	25	1	2	5	0
4.	flasks	25	0	2	6	0
5.	bungs	23	2	3	4	1
6.	anatomical model, human ear	23	1	3	1	4
7.	bunsen burners	23	0	3	7	0
8.*	test tube holders	23	0	3	4	3
9.	glass rod	23	0	2	7	1
10.	test tube racks	23	0	1	9	0
11.	filter funnels	23	0	1	8	1
12.	beakers	23	0	0	9	1
13.	dissecting dishes	22	1	2	5	2
14.	retort stands, bosses and clamps	22	0	2	8	1
15.	cork borers and sharpener	21	0	4	2	5
16.	corks	21	1	1	8	1
17.	test tubes	21	0	1	11	0
18.	reagent bottles	20	2	3	6	1
19.	petri dishes	20	1	3	8	1
20.	metre and ½-metre rules	20	0	2	10	1
21.	anatomical model, human eye	19	2	5	1	5
22.	crucible tongs	19	2	5	5	2
23.	watch glasses	19	2	5	4	3
24.	gas jar cover glasses	19	1	5	5	3

Item		A	B	C	D	E
25.	rubber tubing, ordinary	19	2	2	7	3
26.	gas jars	19	1	3	6	4
27.	overhead projector	19	1	2	4	7
28.	thermometers	19	0	0	11	3
29.	clips for rubber tubing	18	2	4	6	2
30.	teat pipettes	17	3	5	8	0
31.	masses and hangers	17	2	3	7	3
32.	crystallising basins, evarporating dishes	17	0	4	11	1
33.	plane mirrors	17	1	1	8	5
34.	thistle funnels	16	2	6	7	1
35.	electrical switches	16	1	8	4	4
36.	crucibles	16	1	6	10	0
37.	bell jars	16	0	2	12	2
38.	voltmeters	16	1	2	11	3
39.	ammeters	16	0	2	13	2
40.	gauzes for tripods	16	0	2	8	7
41.	microscopes	16	0	0	15	2
42.	standard resistors	15	5	4	5	3
43.	chart of ear	15	3	6	2	6
44.*	chart of human eye	15	3	6	2	6
45.	pneumatic troughs	15	4	2	10	1
46.	desiccators	15	2	5	9	2
47.	hand magnifiers	15	0	2	9	7
48.	pipeclay triangles	14	2	11	3	3
49.	dropping bottles, 60 cm^3	14	4	6	6	3
50.	chart of human nervous system	14	3	6	3	6
51.*	chart of heart	14	5	5	2	7
52.	model of heart	14	3	6	3	7
53.	periodic table wall chart	14	0	7	3	9
54n.	spatulas	14	1	5	12	1
55.*	force measurers	14	1	5	7	6
56.	spotting tiles	13	6	8	1	5
57.	battery charger	13	3	9	3	4
58.*	chart of skin	13	3	7	3	7
59.	mortars and pestles	13	3	5	10	1
60.	asbestos mats	13	1	8	7	4
61.	crocodile clips	13	1	2	8	8
62.	Boyle's Law apparatus	12	6	9	0	6

Item		A	B	C	D	E
63,	plotting compasses	12	6	4	4	6
64.	deflagrating spoons	12	2	7	7	4
65.	beehive shelves	12	2	5	10	3
66.	converging lenses	12	0	1	15	4
67n.	magnets: bar, cylindrical, circular, horseshoe	12	1	1	15	4
68.	polystyrene spheres	11	6	11	3	1
69.	pulley with clamp	11	5	10	3	3
70.	ripple tanks and accessories	11	7	6	2	7
71.	copper wire, bare and cotton covered	11	3	8	4	6
72.	pendulum bobs	11	4	6	8	4
73.	scalpels	11	4	6	6	6
74.	dissecting needles	11	1	8	6	6
75.	ball and ring	11	4	6	5	7
76.	Liebig condensers	11	3	4	12	3
77.	scissors	11	1	4	10	6
78.	pulley sets	10	4	6	9	3
79.*	chart of kidneys	10	5	6	3	9
80n.*	circuit boards and components	10	0	5	7	10
81.	specimen tubes	9	5	12	1	5
82.	G-clamps	9	12	4	3	4
83.*	skeleton of frog	9	4	12	1	6
84.	cavity microscope slides	9	3	12	4	4
85.	small disposable syringes	9	2	9	7	5
86.	rubber tubing, thick-walled for vacuum work	8	6	9	7	3
87.*	skull of dog	8	7	11	2	5
88.	entomological pins	8	6	11	3	5
89.*	carbon electrodes and holder	8	6	8	5	6
90.	PVC covered connecting wire	8	6	7	5	7
91n.	magnetic needles on stands	8	4	9	4	8
92n.	resistance wire, bare and silk covered	8	1	6	8	9
93.	balance, lever type	8	3	1	17	4
94.*	preserved rat	7	8	11	1	6
95.*	butterfly and pond nets	7	2	15	3	5
96.*	skull of rabbit	7	7	11	1	7
97.*	cell holders for flashlight cells	7	4	13	3	6
98.	model of kidney	7	4	13	0	9

Item		A	B	C	D	E
99.	anatomical model, skull of man	7	4	12	1	9
100.	Y-tube connectors	7	6	5	10	4
101.	skeleton of human	7	3	8	0	14
102.	microprojector	6	6	16	2	3
103.	NiFe (alkaline) accumulators	6	9	10	1	3
104.	oscilloscope	6	8	11	1	6
105.	model eye kit	6	5	13	3	5
106.	aneroid barometer	6	7	10	2	7
107.	cellulose acetate and polythene strips for production of electrostatic charges	6	8	8	5	6
108n.	electrolysis cell	6	6	10	5	6
109.	fractional distillation columns	6	5	7	4	11
110n.	stopclocks, stopwatches	6	0	6	11	10
111.*	skull of cat	5	8	15	1	4
112.	skull of sheep	5	9	12	0	7
113.	l.t. power supply	5	11	8	4	4
114.	chart: anatomy of hen	5	7	12	0	8
115.*	human teeth chart	5	4	15	1	8
116.	compact light source	5	9	8	2	8
117n.*	tooth structure and decay chart	5	3	15	1	9
118.	lampholders, SBC	5	8	7	5	8
119.	transformers	5	4	8	4	11
120.	bar and gauge	4	17	9	1	1
121.	MES battenholders	4	18	8	0	3
122.	asbestos paper	4	11	13	2	3
123.	nutrition chart	4	4	16	1	8
124n.	cutter for glass tubing	4	1	18	5	5
125.	thermal conductivity kit	4	11	8	0	10
126.	model of skin	4	5	13	0	11
127.	gas syringe 100 cm^3 and holder	4	7	8	2	12
128.	Bourdon gauges	3	17	10	0	2
129.	polystyrene beads	3	10	14	1	4
130n.	magnet suspension strirrups	3	14	10	0	5
131.	metallised polystyrene spheres	3	13	10	0	6
132.	silica tube	3	10	13	2	5
133n.	convection in air apparatus	3	12	11	0	7
134.	electric vacuum pump	3	5	18	0	7
135.	quadrats	3	10	10	2	7

Item		A	B	C	D	E
136.	absorption tube, $CaCl_2$	3	9	12	2	7
137.	rocks and minerals set	3	8	11	1	9
138.	filter pump	3	8	10	4	8
139.	lamps, 12 V SBC axial filament, 24 W	3	11	6	3	10
140.	chinagraph pencils	2	17	9	1	3
141.	Malvern energy kit	2	14	12	1	3
142.	microphones	2	11	13	1	5
143.	jig for sodium chloride crystal lattice	2	12	13	0	6
144.	induced currents apparatus	2	15	7	1	8
145.	Visking tubing	2	8	12	1	9
146.	diamond structure	2	9	12	0	10
147.	model of kidney pelvis	2	6	15	0	10
148.	atom model	2	7	12	2	10
149.	4 mm plugs	1	16	11	2	2
150.	demonstration meter and dials	1	14	13	0	4
151.	calcite crystals	1	15	10	0	6
152.	Nuffield materials kit (solids)	1	13	12	0	7
153.	bicycle dynamo	1	14	10	2	6
154.	skeleton of cat	1	4	19	1	7
155.	rabbit dissection chart	1	7	16	0	9
156.	combustion tubes with hole 150 x 25 mm	1	13	9	1	9
157.	engine models	1	12	10	1	9
158.	combustion tubes, Nuffield type	1	11	10	3	8
159.	electromagnetic kit power supply	1	12	8	0	12
160.	Westminster electromagnetic kit	1	8	11	2	11
161.	kinetic theory model	1	4	12	1	15
162.	Nuffield combustion spoons	0	14	12	1	6
163.	convection in water apparatus	0	11	15	1	6
164.	foot pump with gauge and adapter	0	14	12	0	7
165n.	crystals kit	0	8	17	0	7
166.	2-dimensional kinetic theory kit	0	9	16	1	7
167.	dog whistle	0	8	16	0	8
168.	Ishihara colour blindness test book	0	5	13	1	13

Notes

54. Disposable plastic spoons are readily available and may be considered more satisfactory than ordinary spatulas, simply because they are disposable, reducing the risk of contamination of chemicals in bottles.

67. Scrap magnets can be obtained from radio repair shops and old refrigerators, and are much more interesting than the standard bar magnet polarised at the ends.

80. While circuit boards are made reasonably quickly in a teachers' workshop, and are bulky and therefore expensive in freight costs, the opposite is true of the accessories. Where there is some money available, consideration might be given to importing the components, even the pegs and cell holders of the boards if they can thus be brought in duty-free.

91. The Guyana Report (p.10) mentions a marble and steel strip magnetic compass. (The same principle can be used for the provision of simple electroscopes.)

92. Resistance wire is needed for purpose-built heaters and resistors, and for repairing metre bridges and potentiometers. The inadequate stocks reported may be a consequence of the bewildering variety offered in the catalogues, and it is likely that teachers could do with some help in the ordering and use of wire.

108. Combining approaches from Hubert Alyea of Princeton University, and C G Campbell in School Science Review, vol. 60, no. 212 (March 1979), pp. 528-530, Dr Dyer Narinesingh of the Chemistry Department, UWI St Augustine, has used test paper boxes on an overhead projector in effective demonstrations of chemical principles.

110. Given the spread of digital watches, laboratory stopclocks may become hardly necessary.

117. While tooth structure and decay charts have been observed in even primary schools, the impact of the dentist's X-ray would seem hard to beat.

124. Every home in the Caribbean has a triangular file for sharpening the domestic cutlass. Teachers do not appear to know how to use this file for cutting glass tubing.

130. When teachers have to suspend magnets, they commonly tie them up with string. The torsion in the string interferes with the behaviour of the magnet, and suspension stirrups can be easily made from 18 swg copper wire hung from nylon fishing line or very fine eureka wire. This is only one of many examples of the value of a good stock of wires.

133. Convection in air apparatus provides among the least of challenges in a region where kerosene lamp chimneys are so much a part of domestic life.

155. The ASEP (Australian Science Education Project) unit, Males and Females, which provides large photographs of rat dissection

stages, suggests how any teacher who knows a good photographer could arrange for any illustrations needed.

165. Most schools have nearly all of the items in the crystals kit. The unusual item is the baseboard which, however, is readily constructed in a few minutes by glueing any kind of strips into a square on a baseboard to suit the dimensions of the spheres chosen (these spheres could be spherical fruits of uniform size).

APPENDIX 6:
SPECIMEN TEXT FROM A 'SCIENCE IN THE PRESS' BOOKLET

FOOD AND CORROSION

Everyone is probably familiar with the metallic taste of canned juice. The average tin of canned orange juice contains copper 20 ppm, iron (ferrous) 30.40 ppm, iron (ferric) 100 ppm, aluminium, chromium, nickel and tin over 100 ppm.

Although iron and copper iron are absolutely essential for growth: iron fortification of food is always recommended to deal with iron deficiencies. Iron and copper result in nutrient destruction.

It is difficult to have canned orange juice with vitamin C. Copper and iron catalyse, the direct loss of vitamin C with copper being much more active.

If the minimal loss of vitamin C in beverages is to be obtained, control of copper and iron is necessary.

The destruction of vitamins A, E and K can be a direct process involving iron and copper but most often it is an indirect process coupled to rancidity formation (oxidation of fats).

The common reason for rancidity is the presence of metal; as most housewives are aware, if a metal spoon is dipped in peppersauce, the spoon corrodes, leaving a trace in the bottle and rancidity steps in.

Drinking water which is mixed with sea water and corrosive in the water mains may contain cadomium, leading to cardivosasular disease, to hypertension, and may also cause kidney damage.

Generally in foods, there is a minimum problem of metal - iron toxicity. Specific cases of toxic concentrations in foods have been reported with fish. Mercury accumulative in swordfish and certain large tuna pose a health hazard.

The leaching of lead by acidic beverages from improperly glazed pottery such as mugs represent a continuing problem. The problem occurs mainly with pottery from small enterprises.

Children playing with gasoline or paint are affected by lead which leads to brain damage.

Cooking acid food in an aluminium pot could lead to problems because of corrosion products.

Article from Trinidad Express Catholic Supplement, 25 November 1979.

Questions

1. One of the duties of a scientist is to present work in a clear manner so that it may be easily read. Re-write paragraph 2 ('Although iron and copper ....') and paragraph 6 ('The common reason for ....') so that they can be more easily read.

2. Describe the chemical reaction that occurs between the pepper sauce and the spoon that is described in the article as 'corrosion'.

3. The article states that canned orange juice contains copper, iron (ferrous), iron (ferric), aluminium, chromium, nickel and tin.

What is inconsistent about this statement and how could it have been expressed more accurately?

4. Do you think that it is possible to test for corrosion of a tin by orange juice by using the methods of qualititative analysis normally used in a chemistry laboratory? Support your answer.

5. Discuss the importance of vitamin C to human growth. List some of the richer sources of vitamin C available to babies in the Caribbean.

6. In the light of what you have read in this article, what advice would you give to your mother if she were about to make some guava jelly or to set some sorrel wine?

This specimen text is taken from Science in the Press 5: Technology 1 by Patricia Isaacs, School of Education, UWI Mona, Jamaica, and June Alfred, St Mary's College, Trinidad.

APPIL	Advanced Physics Project in Independent Learning
ASETT	Association for Science Education of Trinidad and Tobago
ASTJ	Association of Science Teachers of Jamaica
BASE	Barbados Association for Science Education
CARICOM	Caribbean Community
CASME	Commonwealth Association of Science and Mathematics Educators
CDB	Caribbean Development Bank
CEDO	Centre for Educational Development Overseas
CIDA	Canadian International Development Agency
CISC	Caribbean Integrated Science Curriculum
CLEAPSE	Consortium of Local Education Authorities for the Provision of Science Equipment (UK)
CROASE	Caribbean Regional Organisation of Associations for Science Education
CRSP	Caribbean Regional Science Project
CSE	Certificate of Secondary Education (UK)
CXC	Caribbean Examinations Council
DAYM	Schools Materials Manufacturing Centre (Turkey)
GCE	General Certificate of Education (UK)
ICASE	International Council of Associations for Science Education
NCERT	National Council of Educational Research and Training (India)
NSTA	National Science Teachers Association (USA)
OAS	Organisation of American States
PSSC	Physical Sciences School Curriculum (USA)
REAP	Rural Education and Agricultural Project (Belize)
RECSAM	Regional Centre for Science and Mathematics (South East Asia)
SAPATT	Science - a Process Approach for Trinidad and Tobago
SDSP	Secondary Departments Science Project (Guyana)
SEPU	Science Equipment Production Unit (Kenya)
SLAST	St Lucia Association of Science Teachers
SSP	Secondary Science Project (Kenya)
STAG	Science Teachers' Association of Guyana
StVAST	St Vincent Association of Science Teachers

TVC	Teacher Vacation Course (Guyana)
UG	University of Guyana
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
UWI	University of the West Indies
WISC	West Indies Science Curriculum
WISCIP	West Indies Science Curriculum Innovation Project (WISCIP/B and WISCIP/C were intermediate generations between WISCIP and WISC)