

Biology

for CSEC[®] Examinations 3rd Edition

Linda Atwaroo-Ali

Series Editor: Dr Mike Taylor

CSEC[®] is a registered trade mark of the Caribbean Examination Council (CXC).
BIOLOGY FOR CSEC[®] EXAMINATIONS THIRD EDITION is an independent publication
and has not been authorised, sponsored, or otherwise approved by CXC.



Macmillan Education
4 Crinan Street, London, N1 9XW
A division of Macmillan Publishers Limited

Companies and representatives throughout the world.

www.macmillan-caribbean.com

ISBN 9780-230-47948-7 AER

Text © Linda Atwaroo-Ali 2014

Design and illustration © Macmillan Publishers Limited 2014

The author has asserted her rights to be identified as the author/s of this work in accordance with the Copyright, Design and Patents Act 1988.

This edition published 2014

First edition published 2003

All rights reserved; no part of this publication may be reproduced, stored in a retrieval system, transmitted in any form, or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of the publishers.

Note to Teachers

Photocopies may be made, for classroom use, of pages 332–367 without the prior written permission of Macmillan Publishers Limited. However, please note that the copyright law, which does not normally permit multiple copying of published material, applies to the rest of this book.

Designed by Macmillan Education

Original design by Jim Weaver Design

Page make-up by Orchard Publishing, Cape Town, South Africa

Illustrated by Raymond Turvey (Turvey Books Limited) & TechType

Cover design by Macmillan Education

Cover Credit: Corbis/Walter Hodges (back cover), Digital Stock (front cover).

Picture research by Cath Dunn

The author and publishers would like to thank the following for permission to reproduce their photographs:

Alamy/Art Directors & TRIP p58(tl), Alamy/BANANA PANCAKE p262(cl), Alamy/Steve Bloom Images(xi), Alamy/Nigel Cattlin p266(br), Alamy/© Mark Conlin p72, Alamy/© Michael Grant p262(tl), Alamy/© David Hoffman Photo Library p68, Alamy/Image Source p279(tc,tr), Alamy/Brian Jackson p266(cr), Alamy/Robert Matton AB p273(blt), Alamy/Medical-on-Line p155(bl), Alamy/Richard Wareham Nassen p126(blt, blb), Alamy/Pidge Photography – Nature p9(tr), Alamy/Thomas Rey p7(tr), Alamy/Science Photo Library p266(bc), Alamy/© Gregg Vignal p278(br), Alamy/WILDLIFE GmbH p8(tl), Alamy/WildPictures p273(bl); **Corbis**/Paul Almsy p107, Corbis/Tom Bean p293, Corbis/Ken Cedeno p58(tr), Corbis/© Dr. George Chapman/Visuals Unlimited p97, Corbis/© Frederic Courbet p235(br), Corbis/© Cydney Conger p63(br), Corbis/ Terry W. Eggers p168(cr), Corbis/© Dave G. Houser p6(br), Corbis/Bob Krist p297, Corbis/© Joe McDonald p9(tcr), Corbis/© Martin Meyer p108, Corbis/© David A. Northcott p16 (tl), Corbis/© Steve Raymer p155(br), Corbis/© J.B. Russel/Syigma p66, Corbis/© Simko/Visuals Unlimited p6(tr), Corbis/© Paul Thompson/Eye Ubiquitous p7(cl); **Getty**/AFP p316(br), Getty/Daryl Balfour p178(cl), Getty/Franco Banfi p16(tr), Getty/CMS p138(br), Getty/David Cavagnaro p265 (cl), Getty/Danita Delimont p18(br), Getty/DEA/C. DANI p168(cl), Getty/Karen Desjardin p311(tr), Getty/Christopher Futcher p311(tc), Getty/George Grall p209(cl), Getty/Andrew Howe p239(cl), Getty/Jim Jurica p126, Getty/LatitudeStock/Ian Brierley (vii, cr), Getty/Lionel LOURDEL p69(c), Getty/Jamie Marshall - Tribaley Images p6(br), Getty/Matt Meadows p138(bl), Getty/Colin Milkins p245, Getty/Darlyné A. Murawski p29(tr), Getty/Nature/UiG p16(tc), Getty/OGphoto p266(tr), Getty/© Oxford Scientific p8(bl), Getty/Richard Packwood p49, Getty/Willi Schmitz p239(bl), Getty/Michael Sewell p235(bl), Getty/Steven Morris Photography p264, Getty/Andrew TB Tan p18(bl), Getty/VisionsofAmerica/ Joe Sohm p54, Getty/Watt Jim P178(tl); **MICROPRISM** (chapter Headers); **NASA** p63(bl); **Photoshot**/© NHPA pp20, p65(tl,cl), Photoshot/Oceans-Image p65(bl); **Psmicrographs**/Power & Syred pp4(cl), 6(tl); **Science Photo Library** pp155(bc), 185, Science Photo Library/STEVE ALLEN p265(br), Science Photo Library/CNRI p233, Science Photo Library/MARTYN F. CHILLMAID p344, Science Photo Library/E.R.DEGGINGER p9(tcl), Science Photo Library/WILLIAM ERVIN p314, Science Photo Library/EYE OF SCIENCE pp263(c, cr), 320, Science Photo Library/SIMON FRASER p36(br), Science Photo Library/SIMON FRASER, ROYAL VICTORIA INFIRMARY, NEWCASTLE UPON TYNE p188, Science Photo Library/STEVE GSCHMEISSNER p115, Science Photo Library/PROF. DAVID HALL p4(bl), Science Photo Library/ANDY HARMER p336(tr), Science Photo Library/ADAM HART-DAVIS p229(bl, br), Science Photo Library/STEPHEN J. KRASEMANN p30, Science Photo Library/ FRANCIS LEROY, BIOCOSMOS p255, Science Photo Library/JERRY MASON p322, Science Photo Library/JOHN MEAD p69(bl), Science Photo Library/ASTRID & HANNS-FRIEDER MICHLENER p6(tl), Science Photo Library/NATURE'S IMAGES P316(bc), Science Photo Library/CLAUDE NURIDSANY & MARIE PERENNOU p279 (bc), Science Photo Library/OMIKRON p211, Science Photo Library/David Parker p313, Science Photo Library/Photo Researchers, Inc. p219, Science Photo Library/ DR MORLEY READ pp9(tl), 36(bl), 316(bl), Science Photo Library/J.C. REVY, ISM p197 (cl,cll), Science Photo Library/Francoise Sauze p25, Science Photo Library/ CARL SCHMIDT-LUCHS p6(cl), Science Photo Library/MARK SMITH p9(cl), Science Photo Library/SUSUMU NISHINAG p151, Science Photo Library/ALEXIS ROSENFELD p336(cr), Science Photo Library/DAN SUZIO p197(crr), Science Photo Library/MARK THOMAS p55, Science Photo Library/MICHAEL W. TWEEDIE p315, Science Photo Library/WESTERN OPHTHALMIC HOSPITAL p231.

Map p255- Reproduced with the permission of the publisher from Global Health Report- Adult HIV Prevalence(15-19 years) 2011 by WHO Region (http://www.who.int/gho/hiv/hiv_013.jpg)

These materials may contain links for third party websites. We have no control over, and are not responsible for, the contents of such third party websites. Please use care when accessing them.

Although we have tried to trace and contact copyright holders before publication, in some cases this has not been possible. If contacted we will be pleased to rectify any errors or omissions at the earliest opportunity.

Contents

Series Preface vii

About this Book viii

Section A: Living Organisms in the Environment

1 The Variety of Living Organisms	2	<i>Chapter summary</i>	50
Characteristics of life	3	<i>Answers To ITQs</i>	50
The major groups of organisms	3	<i>Examination-style questions</i>	51
Classification of organisms on the basis of visible characteristics	9		
The binomial system	10	6 Population Growth, Natural Resources and their Limits	52
<i>Chapter summary</i>	12	Growth of natural populations	52
<i>Answers To ITQs</i>	13	Resources and their limits	55
<i>Examination-style questions</i>	13	<i>Chapter summary</i>	60
		<i>Answers To ITQs</i>	60
		<i>Examination-style questions</i>	62
2 Ecology and the Impact of Abiotic Factors on Living Organisms	15	7 The Effects of Human Activity on the Environment	63
Ecology	15	Humans and the environment	63
Environmental factors	15	Endangered and vulnerable organisms	64
Ecosystem, habitat, population, community	16	Other effects of human activity	66
Distribution of species	17	Impact of human activities on marine and wetland environments	70
<i>Chapter summary</i>	21	Impact of increase in greenhouse gases	72
<i>Answers To ITQs</i>	22	Conservation and restoration of the environment	72
<i>Examination-style questions</i>	24	<i>Chapter summary</i>	74
		<i>Answers To ITQs</i>	74
		<i>Examination-style questions</i>	75
3 Feeding Relationships between Organisms	24		
Producers and consumers	24		
Herbivores, carnivores and omnivores	25		
Predators and prey	26		
Food webs	27		
Decomposers and detritivores	28		
Special relationships	29		
<i>Chapter summary</i>	30		
<i>Answers To ITQs</i>	30		
<i>Examination-style questions</i>	31		
4 Ecosystem, Habitat, Population, Community	33		
Trapping the Sun's energy	33		
Pyramids of energy	37		
Pyramids of numbers	37		
Pyramids of biomass	38		
Bioaccumulation	39		
<i>Chapter summary</i>	40		
<i>Answers To ITQs</i>	40		
<i>Examination-style questions</i>	40		
5 The Cycling of Nutrients	42		
Biogeochemical cycles	42		
The carbon cycle	43		
The nitrogen cycle	46		
Acid rain	49		

Section B: Life Processes and Disease

8 Cells	78
Why we need microscopes	78
Plant and animal cells	79
Unicellular microbes	80
Cell specialisation in multicellular organisms	81
Movement of substances into and out of cells	83
<i>Chapter summary</i>	87
<i>Answers To ITQs</i>	88
<i>Examination-style questions</i>	89
9 Photosynthesis	91
Plants are the food supply for animals	91
Photosynthesis	92
Products of photosynthesis	96
Limiting factors in photosynthesis	96
Etiolation	97
<i>Chapter summary</i>	98
<i>Answers To ITQs</i>	98
<i>Examination-style questions</i>	99

10 Feeding and Digestion	100	16 Excretion, Osmoregulation and Homeostasis	181
Diet	101	Metabolism	181
A balanced diet	106	Excretory products in animals	182
Malnutrition	107	Excretory products in plants	183
Holozoic nutrition	108	The human excretory system	184
Digestion and absorption along the alimentary canal	111	Osmoregulation	189
Assimilation	116	Homeostasis	189
Functions of the liver	117	<i>Chapter summary</i>	192
<i>Chapter summary</i>	117	<i>Answers To ITQs</i>	193
<i>Answers To ITQs</i>	118	<i>Examination-style questions</i>	194
<i>Examination-style questions</i>	119		
11 Respiration	122	17 Movement	196
Aerobic respiration	122	The importance of movement in animals	196
Anaerobic respiration	125	Movement in plants	197
<i>Chapter summary</i>	127	The skeleton of humans	199
<i>Answers To ITQs</i>	128	<i>Chapter summary</i>	205
<i>Examination-style questions</i>	128	<i>Answers To ITQs</i>	205
		<i>Examination-style questions</i>	206
12 Gaseous Exchange	130	18 Irritability, Sensitivity and Coordination	208
Importance of gaseous exchange in humans	130	Irritability	209
Mechanism of gaseous exchange in humans	131	Stimulus	209
Importance and mechanism of gaseous exchange in plants	135	The sense organs of humans	210
Characteristics common to gaseous exchange surfaces	135	The nervous system	211
The effects of smoking	137	The endocrine system	217
<i>Chapter summary</i>	139	Drugs and the effects of drug abuse	219
<i>Answers To ITQs</i>	140	<i>Chapter summary</i>	222
<i>Examination-style questions</i>	140	<i>Answers To ITQs</i>	223
		<i>Examination-style questions</i>	224
13 Transport and Defence in Animals	142	19 The Eye, the Ear and the Skin	225
The need for a transport system	142	The eye	226
The circulatory system of humans	143	How we see	227
Blood	149	Sight defects and their corrections	230
Hypertension	152	The ear	232
The role of blood in defending the body against disease	153	How we hear	233
<i>Chapter summary</i>	156	Balance	234
<i>Answers To ITQs</i>	157	The skin	235
<i>Examination-style questions</i>	159	Temperature regulation in humans	237
		Temperature regulation in birds	239
14 Transport in Plants	160	Skin care	239
The importance of transport in plants	160	<i>Chapter summary</i>	240
Transport systems of plants	161	<i>Answers To ITQs</i>	240
Movement of water through a plant	163	<i>Examination-style questions</i>	242
Transpiration	166		
Adaptations in plants to conserve water	167	20 Reproduction in Animals	244
Uptake and movement of mineral salts	168	Reproduction	244
Transport of manufactured food	168	Reproduction in humans	246
<i>Chapter summary</i>	170	The male reproductive system	246
<i>Answers To ITQs</i>	170	The female reproductive system	247
<i>Examination-style questions</i>	172	Hormones of the gonads	248
		Fertilisation	250
15 Storage in Plants and Animals	173	Development of the embryo, fetus and placenta	250
Why do organisms store food?	173	Birth	252
Food storage in plants	173	The role of contraception	253
Food storage in animals	178	HIV/AIDS and other STDs	254
<i>Chapter summary</i>	179	<i>Chapter summary</i>	256
<i>Answers To ITQs</i>	179	<i>Answers To ITQs</i>	256
<i>Examination-style questions</i>	180	<i>Examination-style questions</i>	258

21	Reproduction in Plants		
	Life cycle of a plant		
	Structure of a flower		
	Pollination		
	Fertilisation and development of seed		
	Dispersal		
	<i>Chapter summary</i>		
	<i>Answers To ITQs</i>		
	<i>Examination-style questions</i>		
22	Disease and Humans		
	Health and disease		
	Pathogenic diseases and vectors		
	Social and economic implications of disease		
	<i>Chapter summary</i>		
	<i>Answers To ITQs</i>		
	<i>Examination-style questions</i>		
Section C: Continuity and Variation			
23	Mitosis		
	Chromosome number		
	The cell cycle		
	Importance of maintaining species chromosome number		
	The process of mitosis		
	Mitosis and asexual reproduction		
	<i>Chapter summary</i>		
	<i>Answers To ITQs</i>		
	<i>Examination-style questions</i>		
24	Meiosis	290	
	The importance of meiosis		290
	The process of meiosis		291
	Significance of meiosis		293
	<i>Chapter summary</i>		294
	<i>Answers To ITQs</i>		295
	<i>Examination-style questions</i>		295
25	Heredity and Genetics	296	
	Genes		297
	Examples of genetic effects		302
	Pedigree charts		304
	<i>Chapter summary</i>		306
	<i>Answers To ITQs</i>		306
	<i>Examination-style questions</i>		309
26	Variation and Evolution	310	
	Genetic variation		310
	Importance of genetic variation		312
	DNA testing and forensic science		313
	Natural selection		313
	Artificial selection		317
	Mutation		319
	Genetic engineering		321
	<i>Chapter summary</i>		323
	<i>Answers To ITQs</i>		324
	<i>Examination-style questions</i>		325
Section D: School-Based Assessment			
27	School-Based Assessment	328	
	Practical work in Biology		328
	School-Based Assessment contents		332
	Index		368

Series Preface, 3rd edition

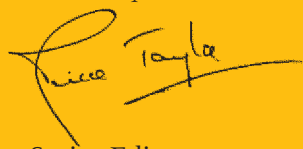
Macmillan's textbooks for the Caribbean Secondary Education Certificate (CSEC) Science subjects have been written by teachers with many years' experience of preparing students for success in their examinations. These revised third editions have been written to align with the new CXC syllabuses (to be first examined in 2015). Additional practical activities have been included to reflect the new emphasis on practical work, and new features (such as group work and discussion activities) will help teachers to cater to a variety of different learning styles within the classroom.

These books are specially designed to stimulate learning, whatever the reader's needs. Students starting a topic from scratch may need to be led through the explanation one step at a time, while those with prior knowledge of a topic may need to clarify a detail, or reinforce their understanding. Others may simply need to check that they understand the material.

Each CSEC science syllabus specifies the areas to be used for the School-Based Assessment (SBA). Each book in the series has a section designed to help students with their SBA, by offering advice on how to approach the task, presenting examples of good SBA work or suggesting suitable material to use within it. Teachers are free to photocopy these pages.

The CSEC Science series covers everything a student needs pass their CSEC examination, as well as providing a firm foundation for more advanced study at CAPE level.

Dr Mike Taylor

A handwritten signature in black ink that reads "Mike Taylor". The signature is written in a cursive style with a long horizontal stroke at the end.

Series Editor