

Cambridge University Press

0521022142 - Practical Exercises in Parasitology

Edited by David W. Halton, Jerzy M. Behnke and Ian Marshall

Frontmatter

[More information](#)

Parasitology is an immensely important aspect of biological science. This manual presents 50 easy-to-follow laboratory exercises for student practical (lab) classes. All the exercises are tried and tested by the authors and are used in a wide variety of university undergraduate teaching departments. They range from relatively simple observational exercises, using local materials and requiring little in the way of equipment, to more technically demanding experiments in physiology and molecular parasitology.

Each exercise includes a list of necessary equipment, consumables and sources of parasite material, instructions for staff and students, including aspects of safety, expected results and some analysis provided by questions; there are ideas for further exploration and information on similar exercises, and lists of selected further reading.

This book should be an essential purchase for all teachers of parasitology at the university undergraduate level and for students taking laboratory practical classes in the subject.

Cambridge University Press

0521022142 - Practical Exercises in Parasitology

Edited by David W. Halton, Jerzy M. Behnke and Ian Marshall

Frontmatter

[More information](#)

Practical Exercises in Parasitology

Edited by **David W. Halton**
Queen's University of Belfast

Jerzy M. Behnke
University of Nottingham

Ian Marshall
Liverpool School of Tropical Medicine



CAMBRIDGE
UNIVERSITY PRESS



Cambridge University Press
0521022142 - Practical Exercises in Parasitology
Edited by David W. Halton, Jerzy M. Behnke and Ian Marshall
Frontmatter
[More information](#)

CAMBRIDGE UNIVERSITY PRESS
Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo

Cambridge University Press
The Edinburgh Building, Cambridge CB2 2RU, UK

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org
Information on this title: www.cambridge.org/9780521791045

© British Society for Parasitology 2001

This publication is in copyright. Subject to statutory exception
and to the provisions of relevant collective licensing agreements,
no reproduction of any part may take place without
the written permission of Cambridge University Press.

First published 2001
This digitally printed first paperback version 2005

A catalogue record for this publication is available from the British Library

ISBN-13 978-0-521-79104-5 hardback
ISBN-10 0-521-79104-9 hardback

ISBN-13 978-0-521-02214-9 paperback
ISBN-10 0-521-02214-2 paperback

CONTENTS

List of contributors page xi

Preface xvii

General advice 1

1 Observational Exercises on Parasites

A Local wild and domestic hosts as sources of parasites

1.1 Parasites of the earthworm: *Monocystis* (Protozoa) and *Rhabditis* (Nematoda) 11

D. WAKELIN, D. I. DE POMERAI & J. M. BEHNKE

1.2 Parasites of marine molluscs (*Littorina*) 19

R. E. B. HANNA & D. W. HALTON

1.3 Parasites of fish:

(a) Whiting and *Diclidophora merlangi* (Monogenea) 31

D. W. HALTON

1.4 Parasites of fish:

(b) Plaice/flounder and *Lepeophtheirus pectoralis* (Copepoda) 37

P. A. HEUCH & T. A. SCHRAM

1.5 Parasites of domestic livestock:

(a) Pig and *Ascaris suum* (Nematoda) 45

J. M. BEHNKE

1.6 Parasites of domestic livestock:

(b) Sheep and *Fasciola hepatica* (Trematoda) 53

C. E. BENNETT

1.7 Parasites of crops:

Potato cyst nematode (PCN) *Globodera pallida* (Nematoda) 63

J. T. JONES

vi Contents

B Laboratory maintained species

- 1.8 Protozoan parasites of the intestinal tract of the cockroach,
Periplaneta americana 73
J. E. WILLIAMS & D. C. WARHURST
- 1.9 Protozoan parasites of the mouse intestinal tract 77
J. E. WILLIAMS & D. C. WARHURST
- 1.10 Rodent malaria 81
J. E. SMITH
- 1.11 Malaria: an example of a vector transmitted parasite 89
H. HURD & R. E. SINDEN
- 1.12 Larval and adult *Echinostoma* spp. (Trematoda) 97
B. FRIED
- 1.13 *Schistosoma mansoni* (Trematoda) 107
M. J. DOENHOFF, L. H. CHAPPELL & J. M. BEHNKE
- 1.14 *Hymenolepis diminuta* (Cestoda) 115
J. M. BEHNKE
- 1.15 *Heligmosomoides polygyrus* (Nematoda) 123
J. M. BEHNKE, L. H. CHAPPELL & A. W. PIKE

2 Ecology

- 2.1 Pinworms (Nematoda, Oxyuroidea) in the American cockroach,
Periplaneta americana 133
W. M. HOMINICK & J. M. BEHNKE
- 2.2 Distribution and microhabitat of a monogenean on the gills of
mackerel 141
C. R. KENNEDY
- 2.3 Population dynamics of *Gyrodactylus* on stickleback 147
R. C. TINSLEY
- 2.4 Intraspecific competition in the cestode *Hymenolepis diminuta*, in
rats 161
C. R. KENNEDY & J. M. BEHNKE
- 2.5 Transmission dynamics and the pattern of dispersion of the
cestode *Hymenolepis diminuta*, in the intermediate host
population 167
C. R. KENNEDY & J. M. BEHNKE

3 Physiology and Biochemistry

- 3.1 Hatching *in vitro* of oncospheres/hexacanth larvae of *Hymenolepis diminuta* 175
C. E. BENNETT
- 3.2 Activation of the cysticercoids of *Hymenolepis* species *in vitro* 183
J. M. BEHNKE
- 3.3 Membrane transport in the cestode *Hymenolepis diminuta*, *in vitro* 191
C. ARME
- 3.4 Glycogen utilisation and deposition in flatworm parasites 201
D. W. HALTON
- 3.5 Effects of classical transmitters on the motility of parasitic roundworms and flatworms 209
A. G. MAULE, N. J. MARKS & J. W. BOWMAN
- 3.6 Electrophysiology of *Ascaris suum* body muscle 219
R. J. MARTIN
- 3.7 Immunocytochemical localisation of neuroactive substances in helminth parasites 231
N. J. MARKS, A. G. MAULE & D. W. HALTON

4 Pathology and Immunology

- 4.1 Encapsulation of foreign matter (not-self) by earthworms 243
D. WAKELIN, D. I. DE POMERAI & J. M. BEHNKE
- 4.2 Opsonisation of trypanosomes 249
C. M. R. TURNER
- 4.3 Production and screening of monoclonal antibodies against *Leishmania promastigotes* 255
M. HOMMEL & M. L. CHANCE
- 4.4 Pathological effects of *Mesocestoides corti* and *Schistosoma mansoni* 267
J. CHERNIN
- 4.5 Quantification of lymphocyte populations in the spleen and thymus 277
J. CHERNIN

viii Contents

- 4.6 Use of basic indirect ELISA for the detection of antibodies produced by experimental immunisation 283

D. A. JOHNSON & C. MCGUIRE

- 4.7 SDS PAGE and Western blotting for the detection of antibodies produced by experimental immunisation 293

C. MCGUIRE & D. A. JOHNSON

5 Chemotherapy

- 5.1 Sensitivity of a coccidial parasite, *Eimeria*, to an ionophore, monensin 305

M. W. SHIRLEY

- 5.2 Egg hatch assay for determination of resistance of nematodes to benzimidazole anthelmintics 313

F. JACKSON, E. JACKSON & R. L. COOP

- 5.3 Larval migration inhibition assay for determination of susceptibility of nematodes to levamisole 321

F. JACKSON, E. JACKSON & R. L. COOP

- 5.4 Effect of anthelmintics on nematodes 329

D. L. LEE & J. E. SMITH

6 Molecular Parasitology

- 6.1 Purification of DNA 335

P. A. BATES, T. KNAPP & J. M. CRAMPTON

- 6.2 DNA digestion and gel electrophoresis 343

P. A. BATES, T. KNAPP & J. M. CRAMPTON

- 6.3 Restriction enzyme mapping 349

P. A. BATES, T. KNAPP & J. M. CRAMPTON

- 6.4 Construction of a genomic library 357

P. A. BATES, T. KNAPP & J. M. CRAMPTON

- 6.5 Detection and differentiation of *Entamoeba histolytica* and *E. dispar* by PCR 365

J. E. WILLIAMS & D. BRITTEN

- 6.6 Differentiation between parasite species by agglutination and detection of parasite surface carbohydrates, using non-conjugated lectins 375

G. A. INGRAM

- 6.7 Tentative identification of parasite and tissue surface
carbohydrates by conjugated lectins 385
G.A. INGRAM

7 Behaviour

- 7.1 Behaviour of the miracidia of *Fasciola hepatica* and demonstration
of other larval stages 397
C. E. BENNETT
- 7.2 Effects of age and environmental factors on the swimming
behaviour of the cercariae of *Cryptocotyle lingua* (Trematoda) 407
J. G. REA & S. W. B. IRWIN
- 7.3 Changes in host behaviour as a consequence of parasite
infection 415
H. HURD
- 7.4 Behaviour of the amphipod *Gammarus pulex*, infected with
cystacanths of acanthocephalans 423
D. B. A. THOMPSON & A. F. BROWN
- 7.5 Effects of *Schistocephalus solidus* (Cestoda) on stickleback feeding
behaviour 433
I. BARBER
- Appendix 1 Reagent index* 445
Appendix 2 UK suppliers 447
Appendix 3 US suppliers 450
Index 452

Cambridge University Press

0521022142 - Practical Exercises in Parasitology

Edited by David W. Halton, Jerzy M. Behnke and Ian Marshall

Frontmatter

[More information](#)

CONTRIBUTORS

C. Arme

Department of Biological
Sciences
Centre for Applied Entomology
and Parasitology
Keele University
Keele
Staffordshire ST5 5BG
UK

I. Barber

Edward Llwyd Building
Institute of Biological Sciences
University of Wales Aberystwyth
Aberystwyth
Ceredigion
SY23 3DA
Wales, UK

P. A. Bates

Division of Molecular Biology and
Immunology
Liverpool School of Tropical
Medicine
Pembroke Place
Liverpool L3 5QA
UK

J. M. Behnke

School of Life and Environmental
Sciences
University of Nottingham
Nottingham NG7 2RD
UK

C. E. Bennett

School of Biological Sciences
University of Southampton
Biomedical Sciences Building
Bassett Crescent East
Southampton SO16 7PX
UK

J. W. Bowman

Animal Health Discovery
Research
Pharmacia and Upjohn Co
301 Henrietta Street
Kalamazoo
MI 49001
USA

D. Britten

Department of Infectious and
Tropical Diseases
London School of Hygiene and
Tropical Medicine
Keppel Street
London WC1E 7HT
UK

A. F. Brown

Uplands Team
English Nature
Northminster House
Peterborough PE1 1UA
UK

xii List of contributors

M. L. Chance

Division of Molecular Biology and
 Immunology
 Liverpool School of Tropical
 Medicine
 Pembroke Place
 Liverpool L3 5QA
 UK

L. H. Chappell

Department of Zoology
 University of Aberdeen
 Tillydrone Avenue
 Aberdeen AB9 2TN
 Scotland, UK

J. Chernin

School of Biological Sciences
 University of Portsmouth
 King Henry I Street
 Portsmouth PO1 2DY
 UK

R. L. Coop

Moredon Research Institute
 Pentlands Science Park
 Bush Loan
 Penicuik
 Midlothian EH26 0PZ
 Scotland, UK

J. M. Crampton

School of Biological Sciences
 Life Sciences Building
 Crown Street
 Liverpool L69 7ZB
 UK

M. J. Doenhoff

School of Biological Sciences
 University of Wales
 Bangor
 Gwynedd LL57 2UW
 Wales, UK

B. Fried

Department of Biology
 Lafayette College
 Easton
 Pennsylvania 18042
 USA

D. W. Halton

School of Biology and Bio-
 chemistry
 Medical Biology Centre
 Queen's University of Belfast
 Belfast BT9 7BL
 Northern Ireland, UK

R. E. B. Hanna

Veterinary Sciences Division
 Department of Agriculture N. I.
 Stoney Road
 Belfast BT4 3SD
 Northern Ireland, UK

P. A. Heuch

National Veterinary Institute
 Fish Health Section
 PO Box 8156 Dep.
 N-0033 Oslo
 Norway

W. M. Hominick

CABI Bioscience
 Bakeham Lane
 Egham
 Surrey TW20 9TY
 UK

M. Hommel

Division of Molecular Biology and
 Immunology
 Liverpool School of Tropical
 Medicine
 Pembroke Place
 Liverpool L3 5QA
 UK

Cambridge University Press

0521022142 - Practical Exercises in Parasitology

Edited by David W. Halton, Jerzy M. Behnke and Ian Marshall

Frontmatter

[More information](#)List of contributors **xiii****H. Hurd**

Department of Biological
Sciences
Centre for Applied Entomology
and Parasitology
Keele University
Keele
Staffordshire ST5 5BG
UK

G. A. Ingram

Department of Biological
Sciences
University of Salford
Salford M5 4WT
UK

S. W. B. Irwin

School of Applied Biological and
Chemical Sciences
University of Ulster at
Jordanstown
Shore Road, Newtownabbey
Co. Antrim, BT37 0QB
Northern Ireland, UK

E. Jackson

Moredon Research Institute
Pentlands Science Park
Bush Loan
Penicuik
Midlothian EH26 0PZ
Scotland, UK

F. Jackson

Moredon Research Institute
Pentlands Science Park
Bush Loan
Penicuik
Midlothian EH26 0PZ
Scotland, UK

D. A. Johnson

School of Biological Sciences,
University of Nottingham,
Nottingham NG7 2RD
UK

J. T. Jones

Department of Zoology
Scottish Crop Research Institute
Invergowrie
Dundee DD2 5DA
Scotland, UK

C. R. Kennedy

Department of Biological
Sciences
Hatherly Laboratories
University of Exeter
Exeter EX4 4PS
UK

T. Knapp

The Royal Castle International
Centre for Lung Cancer Research
200 London Road
Liverpool L3 9TA
UK

D. L. Lee

Shildon Cottage
Blanchland
Nr Consett
Co. Durham DH8 95U
UK

I. Marshall

Division of Parasite and Vector
Biology
Liverpool School of Tropical
Medicine
Pembroke Place
Liverpool L3 5QA
UK

Cambridge University Press

0521022142 - Practical Exercises in Parasitology

Edited by David W. Halton, Jerzy M. Behnke and Ian Marshall

Frontmatter

[More information](#)**xiv** List of contributors**N. J. Marks**

School of Biology and Bio-chemistry
Medical Biology Centre
Queen's University of Belfast
Belfast BT9 7BL
Northern Ireland, UK

R. J. Martin

Department of Biological Sciences
College of Veterinary Medicine
Iowa State University
Ames
Iowa 50011-1250
USA

A. G. Maule

School of Biology and Bio-chemistry
Medical Biology Centre
Queen's University of Belfast
Belfast BT9 7BL
Northern Ireland, UK

C. McGuire,

University of Southampton
Dermatopharmacology Unit
Southampton General Hospital
Southampton SO16 6YD
UK

A. W. Pike

Department of Zoology
The University
Tillydrone Avenue
Aberdeen AB9 2TN
Scotland, UK

D. I. de Pomerai

School of Life and Environmental Sciences
University of Nottingham
Nottingham NG7 2RD
UK

J. G. Rea

School of Applied Biological and Chemical Sciences
University of Ulster at Jordanstown
Shore Road, Newtownabbey
Co. Antrim, BT37 0QB
Northern Ireland, UK

T. A. Schram

Department of Biology
Section of Marine Zoology and Marine Chemistry
University of Oslo
Norway

M. W. Shirley

Institute for Animal Health
Compton Laboratory
Compton
Nr. Newbury
Berkshire RG16 0NN
UK

R. E. Sinden

Department of Biology
Biomedical Sciences Building
Imperial College of Science and Technology
Imperial College Road
London SW7 2AZ
UK

J. E. Smith

Department of Pure and Applied Biology
The University
Leeds LS2 9JT
UK

D. B. A. Thompson

Scottish Natural Heritage
2 Anderson Place
Edinburgh EH6 5NP
Scotland, UK

Cambridge University Press

0521022142 - Practical Exercises in Parasitology

Edited by David W. Halton, Jerzy M. Behnke and Ian Marshall

Frontmatter

[More information](#)

List of contributors **xv**

R. C. Tinsley

School of Biological Sciences
University of Bristol
Woodland Road
Bristol BS8 1UG
UK

C. M. R. Turner

Parasitology Laboratory
IBLS
Joseph Black Building
University of Glasgow
Glasgow G12 8QQ
Scotland, UK

D. Wakelin

School of Life and Environmental
Sciences
University of Nottingham
University Park
Nottingham NG7 2RD
UK

D. C. Warhurst

Department of Infectious and
Tropical Diseases
London School of Hygiene and
Tropical Medicine
Keppel Street
London WC1E 7HT
UK

J. E. Williams

Department of Infectious and
Tropical Diseases
London School of Hygiene and
Tropical Medicine
Keppel Street
London WC1E 7HT
UK

Cambridge University Press

0521022142 - Practical Exercises in Parasitology

Edited by David W. Halton, Jerzy M. Behnke and Ian Marshall

Frontmatter

[More information](#)

PREFACE

This manual describes a range of well-tried practical exercises, drawn largely from the membership of the British Society for Parasitology, and currently used in the teaching of parasitology at undergraduate level. The primary aim is to promote and, hopefully, stimulate practical teaching in parasitology in institutions where levels of experience and resources devoted to the subject vary from substantial to none. For this reason, the exercises selected range from the simple, requiring little in the way of sophisticated equipment, and focusing on locally-available materials, to the more elaborate, in the fields of molecular biology and immunology; it is not intended to provide comprehensive coverage of practical parasitology. Use of the manual outside of the UK may require alternative materials and/or sources of materials.

Although the seven sections presented comprise information and exercises in different aspects of the subject, it is recognised that merging of a number of the exercises cited, or other modifications, may suit the local situation. For example, the species used in Section 1 could be substituted depending on availability; these and other adaptations are to be encouraged and, in many instances, alternative sources of material are suggested by authors. The decision on how best to produce a bench-top handout is a personal one, but readers are welcome to use the text and ideas presented here.

It is important to note that while every consideration to health and safety has been given by the authors, editors and the Society, no responsibility can be accepted if things go wrong. In the UK, we advise each laboratory co-ordinator to carry out a hazard assessment for any of the exercises used so as to ensure that the Control of Substances Hazardous to Health Regulations (COSHH, 1986), part of the UK Health and Safety at Work Act, 1974, are fully met. Note that these now include the Categorisation of Biological **xvii**

Cambridge University Press

0521022142 - Practical Exercises in Parasitology

Edited by David W. Halton, Jerzy M. Behnke and Ian Marshall

Frontmatter

[More information](#)

xviii Preface

Agents, according to hazard and categories of containment, prepared by the Advisory Committee on Dangerous Pathogens, 1995.

A number of exercises include the use of laboratory animals. In the UK, it is essential that Home Office regulations are followed and the local laboratory co-ordinator and/or department must take responsibility for this. The transfer of animals from one laboratory to another also requires Home Office approval.

The editors hope that the ideas presented here will contribute to securing the future of teaching in parasitology, and welcome any suggestions or comments for possible improvement and further development of the content.

Finally, we are indebted to the authors of the exercises that have been selected for this publication, but equally grateful to those who submitted exercises which, for a variety of reasons, we have been unable to include. We would also like to record our thanks and appreciation to many other colleagues for their encouragement, criticisms and comments, and especially the Council of the British Society for Parasitology for their continued support.

David W. Halton, Jerzy M. Behnke, Ian Marshall
January 2000