



Resource Guide in:
Sport and Exercise Physiology

INTRODUCTION

This guide provides an overview of essential texts, journals and related resources for staff teaching physiology in FE and HE institutions. It is also likely to be of interest to students and associated professionals.

Exercise Physiology is one of the major sub-disciplines of Sport and Exercise Science, and evolved from its parent discipline physiology. Sports physiology and exercise physiology are often used interchangeably, but there are subtle differences between the two. Wilmore and Costill (2004) clearly distinguish between these in the following definitions:

“Exercise Physiology is the study of how our bodies’ structures and functions are altered when we are exposed to acute and chronic bouts of exercise.”

“Sports Physiology further applies the concepts of exercise physiology to training the athlete and enhancing the athlete’s sport performance.”

As many textbooks do not distinguish between sports physiology and exercise physiology this guide will cover all aspects of sport and exercise physiology, although it is beyond the scope here to consider associated areas (eg. kinanthropometry, sport and exercise medicine, health and fitness, kinesiology, physical activity, measurement and evaluation), or specialist areas within exercise physiology (eg. nutrition, ergogenic aids, thermoregulation, altitude, body composition). However, as these areas are often covered in sport and exercise physiology modules, an additional section of relevant texts is included. Finally, as many websites are not peer-reviewed and are subject to change, only websites linked to textbooks are provided, and these generally contain links to other web resources.

ANNOTATED BIBLIOGRAPHY

This section contains an annotated bibliography of key exercise physiology texts.

McArdle, W.D., Katch, F.I. and Katch, V.L. (2007). *Exercise Physiology, Energy, Nutrition and Human Performance*. Baltimore: Lippincott, Williams & Wilkins

Previous editions of this textbook have been on most exercise physiology module reading lists since it was first published in 1981. The structure of the 6th edition is similar to previous editions and any significant differences are clearly presented in the Introduction. Additionally, new chapters on micro-gravity and molecular biology have been introduced. The additional teaching resources available to support this textbook are outstanding. These include:

- **Instructor's Resource CD-Rom** which includes more than 1200 test questions, 1000 powerpoint slides and every figure from the text. The system is pre-prepared for use in virtual learning environments.
- **Student CD-Rom** which includes an interactive quiz bank and a student work book.
- Line Advise Exercise Physiology allows on-line access to tutors. Although I have not used this service it appears to be another potentially excellent service offered by these publishers.
- By visiting <http://connection.lww.com/productarea.asp?area=2853>, tutors and students can access all of these additional resources.

Wilmore, J H and Costill, D L (2004) *Physiology of Sport and Exercise*. Champaign, Illinois: Human Kinetics

This textbook offers an improved version of the previous comprehensive text which was first published in 1994 and revised in 1999. This edition has been designed to better suit the needs of undergraduate students. A new historical chapter details the development of molecular biology and new research is highlighted in breakout boxes, focusing the students' attention on new trends and directions. There are several resources to support students and tutors including an instruction guide, test package and presentation package; these are available at the online study guide website <http://www.humankinetics.com/physiologyofsportandexercise/osg>. The instructor guide contains course syllabi, example lecture outlines, case studies and laboratory data. A series of Microsoft PowerPoint slides are available for each chapter within the presentation package. The website enables students to apply key concepts through the inclusion of virtual experiments so that they can record their physiological responses to exercise. Linked to this textbook is the online student guide which provides students with additional interactive learning activities. There is also the opportunity for staff to interface the test package with their university's virtual learning environment. This is a highly popular text for undergraduate courses.

Astrand, P O, Rodahl, K, Dahl, H A and Stromme, S B (2003) *Textbook of Work Physiology. Physiological Bases of Exercise*. Champaign, Illinois: Human Kinetics

This is the fourth edition of the classic textbook produced by Astrand and Rodahl. It combines many of the original issues in work physiology from the previous editions and is supported by more recent scientific findings. This book is appropriate for Level 3 and postgraduate students with a good level of knowledge in exercise

physiology. The presentation and format is much more user-friendly than in the previous editions.

Hale, T. (2005). *Exercise Physiology: A Thematic Approach*. Chichester: Wiley & Sons

This is one of the series of books by Wiley & Sons which is aimed at both undergraduate and postgraduate students. Each chapter begins with an objective test which students should be completed prior to and after reading the chapter. The chapters are clearly structured and the student should be able to achieve a series of learning objectives after reading each chapter and completing the associated tasks. Overall, a very useful textbook for new lecturers to base their lectures on, or for students to undertake self-directed study.

Sharkey, B.J. and Gaskill, S.E. (2006). *Sport Physiology for Coaches*.

This text, as the title denotes, is aimed at coaches and was developed to support undergraduate American students studying sports coaching, physical education or fitness conditioning. It is therefore a very applied text and should be recommended to students as a supporting text that provides a good applied knowledge rather than the theoretical underpinning provided by more traditional exercise physiology textbooks.

Roeborgs, R A, Ketevian, S J, and Keteyian, S. (2000). *Fundamentals of Exercise Physiology: For Fitness, Performance, and Health with Ready Notes and PowerWeb/OLC Bind-in Passcard*. St Louis: Mosby Year Book Inc.

This text is aimed at undergraduate students and provides a good overview of the acute responses to exercise as well as the long term benefits.

Tipton, C. (2006). *ACSM's. Advanced Exercise Physiology*. Baltimore: Lippincott, Williams & Wilkins.

This textbook contains 30 chapters from experts that have been edited together by Charles Tipton. This book is more appropriate for final year undergraduate students who already have a base of knowledge in exercise physiology. Due to the multiple authors, the chapters tend to stand alone and therefore would be a useful recommendation as a secondary source of reference.

Brown, S., Miller, W. and Eason, J.M. (2006) *Exercise Physiology. Bases of Human Movement in Health and Disease*. Baltimore: Lippincott, Williams & Watkins.

This new book provides an excellent text providing exercise physiology in both a clinical and an applied setting. Whilst the initial two sections are similar in content to most exercise physiology texts, there is a useful section titled Exercise Physiology for Clinical Populations. The book ends with a series of laboratory exercises. Although I have not used any of the additional material, as usual the publishers provide an extensive collection of support material including student and instructor resource CD-ROMs, a companion website and on-line teaching advise. These are available via <http://connection.lww.com>

Roeborgs, R and Keteyian, S J (2003) *Fundamental Principles of Exercise Physiology: For Fitness, Performance and Health*. New York: McGraw-Hill.

This revised paperback version provides an excellent overview of the fundamentals of exercise physiology at an introductory level. It is aimed at all students studying exercise physiology at undergraduate level and therefore adopts a generic approach. It is supported by an online learning centre <http://www.mhhe.com/roeborgs2e>. This contains Microsoft PowerPoint presentations, lecture outlines and discussion

questions. A useful supplement to the main textbook is the Ready Notes workbook, which contains Microsoft PowerPoint, slides chapter by chapter.

Foss, R and Keteyian S J (1998) *Physiological Basis for Sport and Exercise*. New York: McGraw-Hill.

This is a revised version of the original textbook by Edward Fox, which provides a sound introduction to exercise physiology for sport students. It offers a clear explanation of all aspects of exercise physiology, especially suitable for undergraduate Levels 1 and 2.

Powers, S K and Howley, E T (2004) *Exercise Physiology: Theory and Application to Fitness and Performance*. New York: McGraw-Hill.

A useful general text covering all aspects of exercise physiology, although it is written for an American audience. Special features include sections on the effects of space travel, reproductive disorders in women and creatine supplementation. It is supported by a comprehensive website <http://www.mhhe.com/powers5e>. This provides useful material for both lecturers and students, and there is also a handy set of ready notes which contain all of the Microsoft PowerPoint presentations for students to annotate.

Physiology Books

Brooks, G., Fahey, T., and Baldwin, K. (2004). *Exercise Physiology : Human Bioenergetics and its Applications*. London: McGraw-Hill

This is a useful textbook for students studying exercise science and provides a comprehensive survey of current data and research findings in exercise physiology.

Ehrman, J K, Gordon, P M, Nisich, P S and Keteyian, S J (2003) *Clinical Exercise Physiology*. Champaign, Illinois: Human Kinetics

Whilst this text is directed towards those preparing for the ACSM clinical exercise registry examination, it is a useful resource for third year undergraduates and postgraduate students. It provides information on key issues and areas of clinical exercise physiology including the special populations of children, the elderly and female athletes. It covers 24 diseases and conditions and each chapter addresses the scope of the condition, its physiology and pathophysiology, methods of treatment and exercise prescription related to the condition. Practical application boxes focus on reviewing current literature and exercise prescription.

Kamen, G (2001) *Foundations of Exercise Science*. Baltimore: Lippincott, Williams and Watkins

This text provides an overview to exercise science and is a useful general background text for all students studying sport and exercise science. The section on exercise physiology addresses the key areas of exercise physiology, adaptations to training, nutrition, health and the environment.

Kolkhorst, F W and Buono, M J (2004) *Virtual Exercise Physiology Laboratory*. Philadelphia: Lippincott, Williams and Watkins

A CD-ROM accompanies this excellent laboratory-based textbook. This resource provides 27 laboratory practical experiments with associated protocols and example data. Whilst this is not intended to replace the student's hands-on practical experience, the CD-ROM and text provide a useful supplementary source and help to create a useful learning experience.

Adams, G M (2002) *Exercise Physiology Laboratory Manual*. New York: McGraw-Hill

This laboratory manual focuses on labs that show the acute and chronic effects of exercise using relatively inexpensive equipment. This is an excellent text for supporting practical classes and contains sections on strength testing, anaerobic exercise testing, aerobic activity, cardiovascular tests, pulmonary testing, range of movement and body composition. This is a very useful 'hands on' laboratory manual.

ANNOTATED GUIDE TO JOURNALS

Journal of Sports Sciences

This journal is produced monthly on behalf of the British Association of Sport and Exercise Sciences and covers all disciplines related to sport and exercise sciences. Most issues contain at least one article on exercise physiology or training. One edition per year is dedicated to the proceedings of the BASES Annual Conference.

<http://www.tandf.co.uk/journals/titles/02640414.asp>

Medicine and Science in Sports and Exercise

This is the official journal of the American College of Sports Medicine and contains sections on clinical science, basic science and applied sciences. Each issue has numerous articles that are useful for both postgraduate and undergraduate students.

<http://www.ms-se.com/>

Sports Medicine

This journal focuses on commissioned review articles that interpret and evaluate current literature. These articles often provide an excellent overview of current research in all aspects of exercise physiology, particularly for those interested in more clinical aspects.

<http://www.adis.com/page.asp?objectID=55>

International Journal of Sports Medicine

The two main sections of this journal focus on physiology/biochemistry and training/testing. This is a useful journal for all students studying sport and exercise physiology.

<http://www.thieme.de/sportsmed/index.html>

Canadian Journal of Applied Physiology

This is the official journal of the Canadian Society of Exercise Physiology. It focuses on both basic and applied research between the biological sciences and physical activity, fitness and health. An annual supplement is dedicated to the abstracts from the annual meeting of the Canadian Society for Exercise Physiology. (This journal is also available online).

<http://www.humankinetics.com/products/journals/journal.cfm?id=CJAP>

European Journal of Sports Science

This is the official journal of the European College of Sports Science and is a completely electronic journal. Its website provides a searchable database, colour illustrations, numerous hypertext links to related subjects, and a print ready version of all articles. It covers all disciplines relating to sport science including exercise physiology.

[http://journalonline.tandf.co.uk/\(4zfpffeapw0zq355mf4o0oet\)/app/home/journal.asp?referrer=parent&backto=linkingpublicationresults,1:112787,1&linkin=](http://journalonline.tandf.co.uk/(4zfpffeapw0zq355mf4o0oet)/app/home/journal.asp?referrer=parent&backto=linkingpublicationresults,1:112787,1&linkin=)

Journal of Science and Medicine in Sport

This is the official journal of the Australian Association of Sports Sciences. In Australia this is the major multi-disciplinary publication on sport science and sports medicine. There are regular articles on physiological responses and adaptations to training, which are of relevance to students studying exercise physiology.

<http://www.sma.org.au/publications/JSMS/>

British Journal of Sports Medicine

This contains a series of original articles on exercise physiology including case studies and reviews. Although it has a strong clinical emphasis, it does provide articles that are useful for undergraduate level study, the level of which is appropriate because the main audience of the journal is not physiology specialists.

<http://bjsm.bmj.com/>

Research Quarterly for Exercise and Sport

RQES is a multidisciplinary journal that includes articles that address the art and science of human movement. There is a small section on physiology in every issue which provides some interesting original research articles.

http://www.aahperd.org/aahperd/template.cfm?template=rqes_main.html

The Journal of Sports Medicine and Physical Fitness

This journal includes articles on applied physiology in addition to other sports science disciplines. The breadth of articles available is particularly useful for sports science students.

http://www.lib.buu.ac.th/jweb/J%20of%20SpoMed/journal_of_sports_medicine_and_p.htm

Journal of Applied Physiology

This journal covers the entire spectrum of physiology, including human physiology. Although many of the articles are not relevant to sport and exercise physiology, this journal often contains articles that provide the physiological underpinning to human movement and is therefore useful at postgraduate level.

<http://jap.physiology.org/>

European Journal of Applied Physiology

This is an established journal, which includes both applied and specific research articles.

<http://www.springer.com/west/home/biomed?SGWID=4-124-70-1069762-0>

Strength and Conditioning Journal

This is probably the most applied of all the physiology journals and is therefore usually well received by students. It is the official journal of the American-based National Strength and Conditioning Association.

<http://nsca.allenpress.com/nscaonline/?request=index-html>

Scandinavian Journal of Medicine and Science in Sports

This journal represents the Scandinavian sports medicine and science associations and regularly contains original articles in sport and exercise physiology.

<http://www.blackwellpublishing.com/journal.asp?ref=0905-7188>

International Journal of Sports Physiology and Performance

This new journal focuses on research in sports physiology and related disciplines that have a direct practical application in enhancing sports performance. This journal is also available in a digital format. Human Kinetics also offers the opportunity to access IJSPP online for use with students and does not require copyright clearance.

<http://www.HumanKinetics.com/IJSPP>

RELATED RESOURCES

These textbooks provide additional information on topics that are useful to students studying sport and exercise physiology.

Specialised Sport and Exercise Physiology Topics

Weltman, A (1995) *The Blood Lactate Response to Exercise. Monograph 4.* Champaign: Illinois, Human Kinetics

This monograph provides a good background to the blood lactate response to exercise. This was one of the original texts that provided overwhelming evidence to support the claim that blood lactate response to exercise was a better indication of endurance performance than maximum oxygen uptake.

Eston, R and Reilly, T (2001) *Exercise Physiology Laboratory Manual: Tests, procedures and data: Volume II.* London: E & F N Spon

This is the second edition of this text, which is now sub-divided into two volumes. Whilst Volume I is a useful resource for laboratory experiments in anthropometry, Volume II is exceptionally useful for supporting practical laboratory classes in exercise physiology. Each chapter contains the theoretical underpinning of the topic, appropriate data collection techniques and example data. The inclusion of example data is a useful resource to support students with limited access to practical facilities.

Maughan, R and Gleeson, M (2004) *The Biochemical Basis of Sports Performance.* New York: Oxford University Press

This is a very useful text which provides sports students with an introduction to the biochemical processes that underpin performance and adaptations to training. It does not address biochemistry from the traditional viewpoint, but introduces it by considering how the biochemical processes are involved in a range of sporting activities. It is supported by a website at <http://www.oup.com/uk/orc/biosciences/>

Bar-Or, O (1996) *The Wingate Anaerobic Test. Monograph 1.* Champaign, Illinois: Human Kinetics

Although rather dated, this monograph provides some excellent material on all aspects related to the Wingate anaerobic cycling test.

Jones, A and Poole, D (2004) *Oxygen Uptake Kinetics in Health and Disease.* London: Routledge

This is the first text to focus purely on the oxygen uptake response to exercise, and should provide a valuable resource for Level 3 and postgraduate students interested in oxygen uptake kinetics.

Applied Topics

Maughan, R.J., Burke, L.M. and Coyle, E.F. (2004). *Food, Nutrition and Sports Performance.* London, Routledge. ebook

This publication comprises the outcomes of the IOC Conference held in Lausanne, Switzerland in June 2003. It is a significant development since the 1991 Conference and contains consensus statements and guidelines on how nutrition can be used to optimise performance and support training. It is a useful detailed text that provides further in-depth knowledge of the recent developments in sports nutrition.

Maughan, R J and Burke, L M (2002) *Sports Nutrition. Handbook of Sports Medicine and Science*. Oxford: Blackwell Publishers

Although the price of this book may be prohibitive, it does provide a useful practical insight into the basics of sports nutrition and is highly suitable for Level 1 and 2 sports science undergraduates.

Armstrong, L E (2003) *Exertional Heat Illnesses*. Champaign, Illinois: Human Kinetics

This book focuses exclusively on heat-related illness and provides clear practical advice on prevention and treatment of heat-related illnesses.

Wilber, R L (2004) *Altitude Training and Athletic Performance*. Champaign, Illinois: Human Kinetics

This text provides a recent guide on how to minimise the influence of altitude on performance and how to maximise the benefits of training at altitude.

Reilly, T. and Waterhouse, J. (2005). *Sport, Exercise & Environmental Physiology*. London: Elsevier, Churchill Livingstone

A very useful book for those who require more details on environmental physiology than those given in standard Sport & Exercise Physiology textbooks. The book contains a comprehensive coverage of all of the environmental factors that impact on performance under environmental stress. It covers the standard environmental stresses but also includes travel, space flight, air quality, noise and living and exercising in hostile environments.

Health and Fitness

Sport & Exercise Physiology Testing Guidelines. The British Association of Sport & Exercise Sciences Guide (2006). Edited by E. Winter, A. Jones, R. Davison, P. Bramley and T. Mercier. Volume 1, Sports Testing and Volume 2 Clinical Populations

This textbook provides a substantial update from the original BASES guidelines for the physiological assessment of elite athletes. Volume 1 contains guidelines and normative data for over 30 different sports, and Volume 2 focuses on the guidelines for exercise testing in clinical populations.

Whyte, G., Spurnay, N. and MacLaren, D. (2006). *The Physiology of Training*. London: Churchill Livingstone

This is one of a series of books titled *Advances in Sport and Exercise Sciences*. It is aimed at final year and postgraduate students. Leading authorities on aspects of training contribute 9 chapters that bring together a wealth of information on training for high level performers.

Heyward, V H (2002) *Advanced Fitness Assessment and Exercise Prescription*. Champaign, Illinois: Human Kinetics

This is a useful book for all students who need a background in fitness assessment and exercise prescription. An instruction guide is also available.

Maud, P J and Foster, C (2006) *Physiological Assessment of Human Performance*. Champaign, Illinois: Human Kinetics

This new edition offers individual chapters on assessment, which provide a theoretical underpinning on data collection procedures and normative data for a

range of fitness parameters. This is a valuable resource for students involved in collecting data in exercise physiology laboratory classes.

Hoffman, J (2002) *Physiological Aspects of Sport Training and Performance*. Champaign, Illinois: Human Kinetics

This book covers practical and applied aspects of fitness conditioning and exercise prescription. It provides a good in-depth review of all aspects related to designing a training programme for optimal performance.

Swain, D P and Leutholtz, B C (2001) *Exercise Prescription: A Case Study Approach to the ACSM Guidelines*. Champaign, Illinois: Human Kinetics

This textbook is particularly useful to those involved in delivering practically based modules which require elements of exercise prescription to be addressed.

Bouchard, C., Blair, S.N. and Haskell, W.L. (2006) *Physical Activity and Health; Champaign, Ill. Human Kinetics*

This is a comprehensive new textbook which integrates and examines the relationship between physical activity and health.

Hoffman, J. (2006). *Norms for Fitness Performance and Health*

This is an excellent new textbook which provides an extensive data set of normative values for a wide range of sporting populations on all aspects of Health and Fitness. The book is divided into three sections. The first provides details of test protocols and Parts 2 and 3 present normative data for performance / fitness tests and health profiles respectively.

Growth and Development

Armstrong, N. (2006). *Paediatric Exercise Physiology*. London: Churchill Livingstone

This is one of a series of books called *Advances in Sport & Exercise*. It covers the analysis of physiological responses to exercise and sex. It comprises a series of chapters by leading paediatric physiologists that cover all aspects of paediatric exercise physiology.

Malina, R M, Bouchard, C and Bar-Or, O (2004) *Growth, Maturation and Physical Activity*. Champaign, Illinois: Human Kinetics

This is an extensive textbook providing nearly 700 pages on maturation, physical activity and growth.

Rowlands, T.W. (2005). *Children's Exercise Physiology*. Illinois: Human Kinetics

The revised edition of this popular textbook is essential reading for students who are studying modules with an emphasis on paediatric physiology.

Anatomy

Watkins, J (1999) *Structure and Function of the Musculoskeletal System*. Champaign, Illinois: Human Kinetics

This textbook is aimed at students who need to understand how the musculoskeletal system links with the nervous system to produce human movement. This text would be a useful supplement to an exercise physiology text for undergraduate students.

Body Composition

Heymsfield, S.B., Timothy, M.D., Cohman, G., Wang, Z. and Going, S.B. (2005). Human Body Composition. Illinois: Human Kinetics

This new edition provides a comprehensive overview of the science underpinning techniques for determining body composition. The book provides clear descriptions of how to assess and interpret body composition data.

Sports Medicine

Brukner, P and Kahn, K (2002) *Clinical Sports Medicine*. Australia: McGraw-Hill

This is an Australian-based textbook that provides an excellent overview of a symptom-orientated, integrated, multi-disciplinary approach to sports medicine that will inform students studying sport and exercise physiology modules.

Spurway, N. and Wackerhage, H. (2006). *Genetics and Molecular Biology of Muscular Adaptations*

This is one of a series of books called *Advances in Sport & Exercise Physiology*. It is aimed at final year undergraduate and postgraduate students. It covers genetics, types of skeletal muscle, molecular exercise physiology, and adaptations to training.

TEACHING AND LEARNING STRATEGIES

The teaching and learning strategies for physiology modules is dependent on several factors including:

- Learning outcomes of the programme/module
- Associated modules within the programme
- Background knowledge of the students
- Group size and available resources
- Facilities

Sport and exercise physiology modules can appear in several different programmes and at a variety of levels. To ensure that appropriate material is delivered it is necessary to consider: the learning outcomes of the programme; the focus of the degree (eg. sport and exercise sciences in contrast to sports development); whether it is taught jointly with students from other pathways which will influence the amount of sports physiology in the programme; the levels at which it is included, and the extent to which physiology modules are compulsory or optional.

Other modules that are available on the programme will also influence the content of the physiology modules. For example, some programmes contain separate modules in anatomy, biochemistry, nutrition, growth and development, whereas other programmes combine all of these areas within sport and exercise physiology modules. Where there are other associated modules, duplication in module content should be avoided. These types of programmes (normally sport and exercise science) often allow a greater depth of specialism in physiology, as the aspect is often compulsory at all three levels. In contrast, for programmes such as sports development or leisure management, a broad-brush approach at Level 1 is more likely as this may be the only exposure that students get to exercise physiology.

The background knowledge of students on modules also needs to be considered. In contrast to sports development or leisure management students, students embarking on a degree in sport and exercise sciences have often taken science and/or sports related A-levels. Additionally, students on sports coaching degrees may need to apply physiological principles to coaching situations.

The size of the cohort will also influence the adopted teaching and learning strategy. It may be appropriate to provide lead lectures supported by smaller practical laboratory classes. Exercise physiology is best taught when students are exposed to practical demonstration or gain hands-on experience. However, where it is not possible to provide students with hands-on experience, there are several virtual laboratory practical resources available which give students with an insight into data collection techniques.

The extent of the practical facilities and resources available will also determine the facilitation of practical demonstration. However, it should be remembered that numerous experiments are possible using basic equipment such as a cycle ergometer, heart rate monitor and expired air collection equipment. Where facilities and resources allow, I favour the approach of a lead lecture providing the physiological theory supported by a laboratory demonstration/practical with a discussion/explanation of the experimental findings.

Assessment

Assessment for sport and exercise physiology modules varies throughout the UK. The assessment should reflect the learning outcomes and allow a differentiation in student ability to be identified. The type of assessment may vary according to the academic level of the module. For example, in examinations it is reasonably popular to use multiple choice/short answer questions at Levels 1 and 2 to assess the breadth of knowledge of a student across the spectrum of physiology, in contrast to critical essays at Level 3. Laboratory reports are a common procedure for assessing students involved in laboratory practicals. This method of assessment also helps to prepare students for writing their final year dissertation. At postgraduate and Level 3 study, a viva voce examination or practical demonstration/explanation is a good method for assessing students' practical, theoretical and applied knowledge. Poster presentations are also a useful way of assessing group work in a conference-based format.

The nature of the assessment should allow students to demonstrate that they have achieved the learning outcomes of the modules and is particularly important for laboratory reports, as students have often not been exposed to this mode of assessment and the scientific writing style that it requires.

With the recent increase in popularity of sport and exercise physiology modules, assessment methods need to be revised to ensure teaching staff do not spend a disproportionate amount of time assessing students in contrast to teaching. However, the issue of an increased staff workload due to higher student numbers can be addressed in several ways: computer-aided assessment, optional-scanning multiple choice tests, peer assessment, virtual learning based tests etc. For example, one method that has worked well with a cohort of 300 students is where:

A series of ten multiple choice tests with twenty questions per test are time released via Blackboard to coincide with the weekly lecture schedule. Students complete these multiple choice tests and receive immediate feedback in terms of their success. They can sit the test as many times as they want, based on the principle that if they don't do very well, they will revise the topic again and resit the test. The module is only formally assessed at the end of the module using a selection of the multiple choice questions already completed by the students. This use of formative assessment produced an average increase in student performance by nearly 10%.

Peer assessment and group work is another useful tool for improving student learning. An example of this is for students to compile a laboratory report in pairs with each student writing different sections. The students are then asked to proof read/comment on the other student's sections. The students then revise their sections and they produce a combined laboratory report, which is then assessed by the tutor.

About the Author

Dr Richard Tong is the Director of Learning and Teaching and a Principal Lecturer in Sport and Exercise Physiology at the University of Wales Institute, Cardiff (UWIC). Richard was also Discipline Director for Sport and Exercise Physiology for twelve years and was accredited by BASES as a Sports Scientist for twelve years. He has been teaching in Sport and Exercise Physiology for eighteen years and has taught at all levels from HND to Masters. His current research interests focus on high intensity

intermittent exercise with specific reference to rugby. He is also the BASES/Sport Liaison Officer for the Higher Education Academy Network for Hospitality, Leisure, Sport and Tourism.



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