

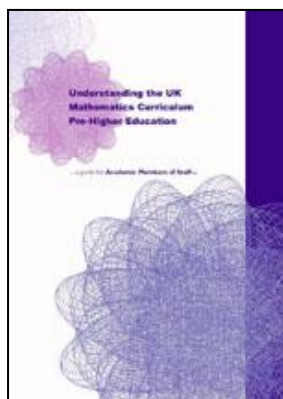
# Mathematical Challenges for Biologists

## Tuesday 16<sup>th</sup> November 2010

### University of Reading



A guide to what you can expect from new students:



**Understanding the UK Mathematics Curriculum Pre Higher Education:** a guide for academics in STEM subject areas. A considerable number of pre-higher education mathematics qualifications are available within the UK and, for those working within the higher education (HE) sector, it is not always clear what mathematics content, methods and processes students will have studied (or indeed can be expected to know and understand) as they commence their university-level programmes. This guide outlines the likely knowledge and capabilities of students with given prior qualifications in mathematics.

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#### Web-based resources funded by the Centre

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**NuMBers project** The project aims to strengthen the integration of statistical and other numerical methodologies into the bioscience curriculum. [web.anglia.ac.uk/numbers/](http://web.anglia.ac.uk/numbers/)

**SUMS** is a follow up to NuMBers and aims to encourage students to upgrade their maths skills. It contains links to other maths sites and resources for both student and teacher.

[www.step-up-to-science.com/sumsv3/](http://www.step-up-to-science.com/sumsv3/)

Both of the above projects provide a consistent and familiar environment for students using an approach based on examples relevant to specific areas of study. Teachers will have the benefit of knowing that tested numerical exercises are available for their students, without needing to prepare special materials.

#### Further online resources

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**Biomathtutor** provides a resource featuring blended teaching methods to support maths learning in life sciences. [www.ebst.co.uk/biomaths/intro.html](http://www.ebst.co.uk/biomaths/intro.html)

#### Maths Stats and OR Network

Resources which may be of help to teachers of Bioscience as well as students such as the MathCentre (below) and a link to the Learn Higher CETL. [www.mathstore.ac.uk](http://www.mathstore.ac.uk)

#### Below are three of the best links from this website

- **MathCentre.** Bioscience-specific for resources plus essential maths in a nutshell guides to download. A variety of formats available including video tutorials. <http://mathcentre.ac.uk/>
- **Maths Support Service:** This is a website with information and quizzes on various aspects of maths such as equations trigonometry and statistics. Also has refresher booklets available to download.

[www.cardiff.ac.uk/mathssupport/learningresources/mathsforbiosi/index.html](http://www.cardiff.ac.uk/mathssupport/learningresources/mathsforbiosi/index.html)

- **Mathematics in Medicine**

Mathematical Modelling Techniques. Problems brought to Mathematics from Medicine Study Groups. A wide range of topics from tissue engineering to anatomy are used in a mathematical context. These showcase maths applied to biological processes such as cell signalling and tissue culture. [www.maths-in-medicine.org/topics/](http://www.maths-in-medicine.org/topics/)

## Previous Centre events

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Science learning and Teaching Conferences with Maths presentations

- University of Warwick, 2005  
[www.bioscience.heacademy.ac.uk/hosted/sltc/2005.asp](http://www.bioscience.heacademy.ac.uk/hosted/sltc/2005.asp)
- Heriot-Watt University, 2009  
[www.bioscience.heacademy.ac.uk/hosted/sltc/2009.asp](http://www.bioscience.heacademy.ac.uk/hosted/sltc/2009.asp)

Biomathtutor: Where are we and where do we want to go?

[www.bioscience.heacademy.ac.uk/events/numeracybirm120907.aspx](http://www.bioscience.heacademy.ac.uk/events/numeracybirm120907.aspx)

## Bioscience Bulletin Articles

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Hawkins, D. Carter, T. and McCary, J. (2009) Support for Numerical Methods - NuMBers Issue 28 p8

[www.bioscience.heacademy.ac.uk/ftp/newsletters/bulletin28p8.pdf](http://www.bioscience.heacademy.ac.uk/ftp/newsletters/bulletin28p8.pdf)

Wood, E J. (2005) Non-Bean Counters. Issue 15 p1

[www.bioscience.heacademy.ac.uk/ftp/newsletters/ltsn15p1.pdf](http://www.bioscience.heacademy.ac.uk/ftp/newsletters/ltsn15p1.pdf)

## Selected Peer-reviewed Articles and Journals

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### Bioscience Education

Chester, V. (2008) Using Tablet Technology for University Lectures *Bioscience Education* 12-5 available at

[www.bioscience.heacademy.ac.uk/journal/vol12/beej-12-c5.aspx](http://www.bioscience.heacademy.ac.uk/journal/vol12/beej-12-c5.aspx)

Foster, K. (2008) Biomathtutor Evaluation - a Tutor's Perspective *Bioscience Education* 11-5

available at [www.bioscience.heacademy.ac.uk/journal/vol11/beej-11-r5.aspx](http://www.bioscience.heacademy.ac.uk/journal/vol11/beej-11-r5.aspx)

### Mathematical Biosciences

A leading international journal publishes research and expository papers on the formulation, analysis and solution of mathematical models in the biosciences. The journal serves biologists who are interested in forming mathematical models of biological processes and systems.

[www.elsevier.com/locate/mbs](http://www.elsevier.com/locate/mbs)

### International Journal of Mathematical Education in Science and Technology

This provides a medium by which a wide range of experience in mathematical education can be presented, assimilated and eventually adapted to everyday needs in schools, colleges, polytechnics, universities, industry and commerce. Contributions are from lecturers, teachers and users of mathematics at all levels on the contents of syllabuses and methods of presentation.

[www.tandf.co.uk/journals/titles/0020739X.asp](http://www.tandf.co.uk/journals/titles/0020739X.asp)

Tariq, V. N. and Jackson, V. (2008) Biomathtutor: evaluation of a new multimedia e-learning resource to support mathematics in the biosciences. *International Journal of Mathematical Education in Science and Technology* 39(8), 1003–1021

Tariq, V. N. (2008) Defining the problem: mathematical errors and misconceptions exhibited by first-year bioscience undergraduates. *International Journal of Mathematical Education in Science and Technology* 39(7), 889–904

### MSOR Connections

MSOR Connections is the quarterly newsletter of the Maths, Stats & OR Network and aims to promote, encourage, enhance and disseminate research, good practice and innovation in all aspects of the student learning experience within Mathematics, Statistics & Operational Research

<http://mathstore.gla.ac.uk/index.php?pid=37>

Tariq, V. (2004) Numeracy, Mathematical Literacy and the Life Sciences.  
*MSOR Connections*, **4**, 25–30

Tariq, V., Stevenson, J. and Roper, T. (2005) Biosciences: Towards Developing an Innovative E-learning Resource for Post-GCSE Students. *MSOR Connections*, **5**, 1–5

## **Books**

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A guide to the best-received Maths books for students in the Biosciences. Most have sections designed to assist in teaching core methods and may prove useful in designing maths-based assessment exercises.

### **Biomeasurement: A students guide to biological statistics**

D. Hawkins (2009), Oxford University Press

This book offers a refreshing, student-focused introduction to the use of statistics in the study of the biosciences. With an emphasis on why statistical techniques are essential tools for bioscientists, the book removes the stigma attached to statistics by giving students the confidence to use and further explore the key techniques for themselves. The book starts by placing the role of data analysis in the context of wider scientific method, and introduces the student to the key terms and concepts which are common to all statistical tools.

### **Maths for Science**

S. Jordan, S. Ross, P. Murphy (2008), Open University Press

Revision of mathematical skills and learning and practising new ones. Mathematical techniques are explained and the book includes worked examples, many with a scientific flavour, and questions to try, all with fully worked solutions. The topics explained in the book include scientific notation, units of measurement, arithmetic with fractions, rearranging equations, using graphs, radians, trigonometry, logarithms, probability and descriptive statistics, whilst the techniques of statistical hypothesis testing and differentiation are both introduced briefly.

### **\*Catch-up Maths and Stats for the Life and Medical Sciences**

M. Harris, G. Taylor and J. Taylor (2005), Scion Publishing

Many students now start life and medical science degrees lacking some of the core background knowledge which underpins their studies. Catch Up books are written to bring these students up to speed quickly and easily. Contains a maths section and an applied maths section to explain moles, pH etc

### **\*Essential Mathematics and Statistics for Science**

G. Currell and A. Dowman (2005) John Wiley and Sons Ltd

A combination of book and website provides ready-prepared material for lectures, tutorials and computer practicals.

\*Longer reviews available at: [www.bioscience.heacademy.ac.uk/journal/vol6/beej-6-R5.aspx](http://www.bioscience.heacademy.ac.uk/journal/vol6/beej-6-R5.aspx)

### **Statistics for Terrified Biologists**

H. van Emden (2008), Wiley-Blackwell

Basic methods are presented using straightforward, jargon-free language. Students are taught to use simple formulae accurately to interpret what is being measured with each test and statistic, while at the same time learning to recognize overall patterns and guiding principles.

Complemented by simple illustrations and useful case studies, this is an ideal statistics resource tool for undergraduate biology and environmental science students who lack confidence in their mathematical abilities.

### **Choosing and Using Statistics: A Biologist's Guide**

C. Dytham (2003) Wiley-Blackwell

This book helps to simplify the often complex and difficult task of choosing and using the right statistics package. This is a book for any student or professional biologist who wants to process data using a statistical package on the computer, to select appropriate methods and extract the important information from the often confusing output that is produced.

### **Ecological Census Techniques: A Handbook**

W. J. Sutherland (2006) Cambridge University Press

This practically focussed book describes how to plan a census, the practical details and shows with worked examples how to analyse the results. The first three chapters describe planning, sampling and the basic theory necessary for carrying out a census.

### **Resources from other subject centres**

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#### **Health sciences**

Starkings, S. (2003) Drug Calculation and the mathematics required for Nursing Learning and Development Centre, London South Bank University.

This report makes a case for providing remedial support, and recognises that many students entering nursing programmes will require such support to achieve the standard of competence in calculation practice required at the point of registration.

[www.health.heacademy.ac.uk/resources/article/sstarkings](http://www.health.heacademy.ac.uk/resources/article/sstarkings)

#### **Engineering**

Alpay, E. and Masouros, D. (2009) The design of a computer-based maths toolbox for engineering students.

A multifaceted, computer-based mathematics resource for undergraduate and pre-entry engineering students. Unlike other mathematics learning resources, design features are considered which effectively accommodate collaborative learning, student feedback, and formative and formal diagnostic testing, and enable teachers to readily adapt and structure content to meet specific learning needs.

[www.engsc.ac.uk/downloads/maths-gateway.pdf](http://www.engsc.ac.uk/downloads/maths-gateway.pdf)

#### **Physical Sciences**

Gladwin, R. (2009) Tackling the mathematics problem for Chemistry.

A further list of resources for tackling maths in science.

[www.heacademy.ac.uk/assets/ps/documents/toolkits/toolkits/mathsforchem\\_2009.pdf](http://www.heacademy.ac.uk/assets/ps/documents/toolkits/toolkits/mathsforchem_2009.pdf)

#### **Other resources**

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Ross, S., Jordan, S. and Butcher, P. (2006) Online instantaneous and targeted feedback for remote learners. Development of assessments for a distance learning course in 'maths for science', such that no hand-marking was required

[http://oro.open.ac.uk/15347/1/Ross,\\_Jordan\\_and\\_Butcher.pdf](http://oro.open.ac.uk/15347/1/Ross,_Jordan_and_Butcher.pdf)

Williams, J., Davis, P., Wake, G., Nicholson, S., Hutcheson, G. and Black, L. (2008). Keeping Open the Door to Mathematically-Demanding FE and HE Programmes. Swindon: ESRC

[www.tlrp.org/proj/wphe/wp\\_williams.html](http://www.tlrp.org/proj/wphe/wp_williams.html)

**S.U.M.S** is a free resource for people who teach statistics. It builds interactive, fun and highly effective tutorials designed to help students understand basic statistics.

[www.gla.ac.uk/sums/](http://www.gla.ac.uk/sums/)