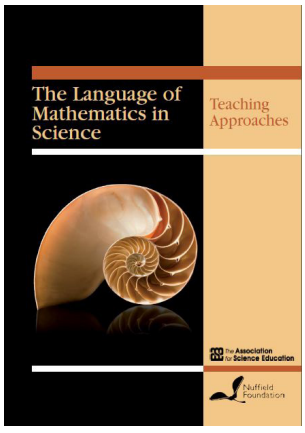
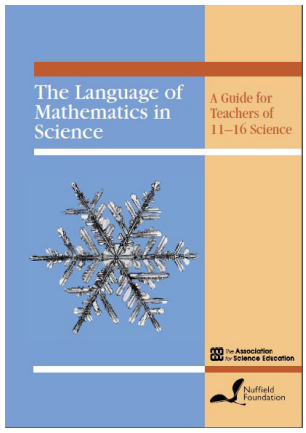
Book reviews





THE LANGUAGE OF MATHEMATICS IN SCIENCE:

A Guide for Teachers of 11–16 Science (Boohan R.) ISBN 978 0 86357 455 9 (140pp)

Teaching Approaches (Needham R.) ISBN 978 0 86357 456 6 (90pp)

Published by the ASE (The Association for Science Education), 2016.

The relationship between science and mathematics is a very strong one but, at least during secondary education, many students seem to have considerable difficulty in applying the mathematical ideas they learn about in mathematics classes when they come into science classes. This has been recognised as an issue for a long time and a number of reasons for the problem have been put forward. These include: (a) that the terminology used in mathematics and science classrooms for mathematical skills and operations are different – and thus cause confusion. (b) That learning sequences are not coordinated in the two subjects and thus students may be expected to use mathematical skills in science before meeting them in mathematics classes. (c) That some science teachers are themselves insufficiently aware of the mathematical skills required to develop scientific understandings. They may even apply mathematical rules by rote with little understanding of the rationale for, and limitations of, those rules.

These two useful resources for secondary school science teachers result from an important partnership in UK between the Association for Science Education and the Nuffield Foundation. The publication of these books was completed in July 2016 – they are available for purchase through the ASE although the text of each can be downloaded free from http://www.ase.org.uk/documents/language-of-mathematics-in-science-1/ and http://www.ase.org.uk/documents/ase-the-language-of-mathematics-in-science-teaching-approaches/ respectively. The information and guidance provided in these publications is primarily aimed at teachers in the UK but it is clearly relevant for science (and mathematics) educators everywhere who are able to communicate in English.

A brief overview of the first publication (A Guide for Teachers of 11–16 Science) is given below:

Introduction: the language of mathematics in science

Overview of chapters

1. Collecting data
2. Doing calculations and representing values
3. Choosing how to represent data
4. Drawing charts and graphs
5. Working with proportionality and ratio
6. Dealing with variability
7. Looking for relationships: line graphs
8. Looking for relationships: batches and scatter graphs
9. Scientific models and mathematical equations
10. Mathematics and the real world

Glossary for teachers

The publication puts an emphasis on understanding the nature of the mathematical ideas, and not just the techniques. This should help both the teachers and students make and justify judgements as to the appropriate mathematical techniques to use in various scientific contexts.

The 'overview of chapters' provides a very useful summary table of the sub-headings within each chapter together with the keywords used within the chapter. All keywords are collected in a glossary at the end of the book with an explanation of their meanings. Wherever keywords are used within the text a hyperlink is provided from the word to the glossary which makes it simple to check the meaning if needed. The sub headings and keywords for the first two chapters are given below:

Chapter 1: Collecting data	
1.1 Measuring and counting 1.2 Measurement, resolution and significant figures 1.3 Characteristics of different types of data 1.4 Naming different types of data 1.5 Where do data come from?	Key words: quantitative data, qualitative data, quantity, value, unit, resolution, scale, significant figures, range, variable, continuous, discrete, categorical, integer, experiment, survey, independent variable, dependent variable, control variable, factor, time series, raw data, primary data, secondary data
Chapter 2 Doing calculations and representing values	
2.1 Calculations and units 2.2 Fractions and decimals 2.3 Rounding and significant figures 2.4 Calculating means 2.5 Index notation and powers 2.6 Dealing with very large and very small values 2.7 Approximations and orders of magnitude	Key words: unit, quantity, compound measure, base unit, derived unit, variable, decimal, fraction, significant figures, round, integer, recurring decimal, decimal place, mean, arithmetic mean, index notation, index, power, exponent, square, cube, square root, cube root, reciprocal, unit prefix, standard form, standard index form, scientific notation, power of 10, order of magnitude, approximation, estimate

It is to be hoped that these ideas will help discussions between teachers of science and with their mathematics colleagues. Some modifications will be needed if the terminology used by the examination boards is not fully in line with the recommendations here.

Personally I wish such a guide had been available when I was teaching science in schools and when working in science teacher education – I was already familiar with many of the mathematical ideas. However, the review was interesting, the text engaging and I found a number of my mathematical gaps were filled by reading this text and some misunderstandings clarified. Most importantly I found myself feeling more secure in evaluating the appropriate mathematical technique to be applied in different circumstances. Overall this is a useful supporting resource for secondary science teachers although teachers would need carefully to tailor the content and weave it into the content and learning activities for their students.

The second publication (Teaching Approaches) is different in its intention. Eight significant issues are identified – these are listed below and the Section A provides a commentary on each:

1. Cross-curricular approaches to graph drawing
2. Deriving quantities from gradients
3. Using a literacy approach to interpreting graphs
4. Introducing terms used to describe data types
5. Joint mathematics and science day to teach equations and graphs
6. The vocabulary of graphs – an example of departmental collaboration
7. Molar calculations in chemistry
8. Interpreting graphs

Section B provides Teacher accounts, under the same eight headings as above, which describe the teaching of mathematics in classrooms. These illustrate ways in which the problems/issues have been addressed and provide examples of strategies that the reader may wish to adopt or adapt to their own context. These would find a valuable fund of ideas for the development of a school and/or science departmental strategy for improving effective literacy and numeracy across the board.

Overall, these two publications are valuable resources for both teacher and student development and should enrich and enhance the teaching, learning and practice of science in secondary schools. They are certainly worth a careful read!

Alan Goodwin
Manchester M. University, UK
alangoodwinuk@yahoo.co.uk