How effectively do science textbooks teach earth science?

Chris King, Alastair Fleming, Peter Kennett and David Thompson

A comprehensive survey of the earth science content of commonly used secondary science textbooks found inadequate coverage and a very high error/misconception level

Earth science educators in England and Wales had become aware of the poor quality of the earth science content of some science textbooks currently being used in secondary schools. This was highlighted by the abstract ‘Lies, damn lies and books on geology’ (Arthur, 1996) and supported by anecdotal evidence. To establish the scale of the problem a systematic survey was instituted in Spring 2001 involving experienced earth science educators from the Earth Science Teachers’ Association (ESTA) and the Earth Science Education Unit (ESEU) based at Keele University. The full report (of 20 pages, with 80 pages of appendices comprising detailed information on each book surveyed) was published by the Earth Science Education Unit (King et al., 2002) and is available from the ESEU at Keele. This article provides a summary of the report.

ABSTRACT
The earth science content of most commonly used secondary science textbooks was evaluated against the earth science statements in the National Curriculum for Science for England. Across the 51 texts evaluated, the general level of coverage was poor: more than half the earth science statements in the National Curriculum were inadequately covered or not covered at all. This critical situation was compounded by the very high level of error, averaging one error/misconception per page of earth science. Common errors/misconceptions in earth science are noted and corrected. Suggestions are made to improve this situation in the future.

Publishers of secondary science textbooks were invited to submit their current textbooks to the survey, with the following provisos:

- each textbook would be reviewed against a standard set of criteria taken from the National Curriculum for Science (NCS) for England (2000 version, QCA, 1999);
- errors and misconceptions would be logged;
- the reviews would be moderated across the evaluation team;
- the reviews would be compiled and a draft report prepared, based on them; this report would contain all the data collected, including details of each textbook, judgements of the earth science coverage, and lists of materials included beyond the NCS and of errors and misconceptions;
- the draft report would be circulated to all the publishers involved for comment and correction of perceived errors in the report;
- a final report would be prepared as an internal publication by the Earth Science Education Unit, taking account of the publishers’ comments and recommended corrections;
- the final report would be sent to all the publishers involved and to relevant government departments and would also be available to interested enquirers;
- articles based on the final report would be published, but would not include details related to individual textbooks.
The main objective of this approach was to provide a baseline of the character and extent of the earth science content of current secondary science textbooks, against which future publications could be judged. Meanwhile, by circulating details of the coverage and quality of individual textbooks to the publishers, it was hoped that improvements and corrections would be made to future editions and that publishers would be encouraged to collaborate more closely with the earth science education community than had hitherto been the case.

The Earth Science Teachers’ Association and the Earth Science Education Unit are very grateful to all the publishers who were willing to take part in the survey by submitting textbooks.

**Box 1 Key stage 3 National Curriculum for Science (2000) earth science statements.**

Notes: 1. Where statements have been subdivided, this is indicated by i, ii, iii, etc.
2. Items in wavy brackets are not statutory.

(Sc1 1aii) (about the interplay between empirical questions, evidence and scientific explanations using historical and contemporary examples [for example ... the possible causes of global warming])

(Sc1 2dii) (... how evidence may be collected in contexts [for example, fieldwork ...] in which the variables cannot be readily controlled (~ in an Earth science context))

Sc2 5aii about ways in which ... the environment can be protected ...

Sc2 5aii ... the importance of sustainable development

(Sc3 1eii) (how elements combine through chemical reactions to form compounds [for example ... most minerals] with a definite composition)

Sc3 2d how forces generated by expansion, contraction and the freezing of water can lead to the physical weathering of rocks

Sc3 2ei about the formation of rocks by processes that take place over different timescales ...

Sc3 2eii ... the mode of formation determines their texture and the minerals they contain

Sc3 2fii how igneous rocks are formed by the cooling of magma ...

Sc3 2fii how ... sedimentary rocks (are formed) by processes including the deposition of rock fragments or organic material, or as a result of evaporation ...

Sc3 2fii how ... metamorphic rocks (are formed) by the action of heat and pressure on existing rocks

Sc3 2fii about possible effects of burning fossil fuels on the environment and how these effects can be minimised

Sc3 3gii how acids in the environment can lead to ... chemical weathering of rock

Sc4 5aii about the variety of energy resources, including oil, gas, coal ... wind, waves ...

Sc4 5aiv ... the distinction between renewable and non-renewable resources

Sc4 5bii about the Sun as the ultimate source of most of the Earth’s energy resources ...

Sc4 5bii ... to relate this (the Sun as the ultimate source of most energy) to how coal, oil and gas are formed

17 statements
key stage 4 books or series (for 14–16 year-olds). The total number of individual books surveyed was 27 at key stage 3 and 24 at key stage 4, a grand total of 51 books. The books are listed at the end of this article.

**Criteria used for the assessment**

Each book or series was assessed against a set of statements taken directly from the latest (2000) version of the National Curriculum for Science (NCS) for England (QCA, 1999). Where appropriate, the statements were subdivided. The statements used are listed in Boxes 1 and 2.

Many of the books were written prior to the publication of the 2000 version of the NCS (published in 1999) and so comparisons between these books and the 2000 NCS need to be treated with care. However, since the 2000 version of the NCS was not greatly different from the previous version, the comparison exercise does produce valuable baseline data against which future publications can be judged.

The content of each textbook was judged against each of the statements listed in Boxes 1 or 2 and allocated to one of the following categories:

- **comprehensive** (going beyond the coverage implied by the NCS statement);
- **basic** (meeting the coverage implied);
- **less than basic** (not meeting the coverage implied);
- **none** (no coverage could be found in the obvious places in the textbook or through the index).

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**Box 2 Key stage 4 National Curriculum for Science (2000) earth science statements.**

**Notes:**

1. Where statements have been subdivided, this is indicated by i, ii, iii, etc.
2. Items in wavy brackets are not statutory.

\{Sc1 1b\} (how scientific controversies can arise from different ways of interpreting empirical evidence [for example, Darwin’s theory of evolution])

\{Sc1 2d\} (… how evidence can be collected in contexts [for example, fieldwork …] in which the variables cannot be readily controlled)

Sc2 3i that the fossil record is evidence for evolution

Sc2 3j how variation may lead to evolution or to extinction

Sc2 4bi how the impact of humans on the environment depends on social and economic factors, including … industrial processes and levels of consumption and waste

Sc2 4c about the importance of sustainable development

Sc3 2g about the variety of useful substances [for example, chlorine, sodium hydroxide, glass, cement] that can be made from rocks and minerals

Sc3 2pi how the Earth’s atmosphere … (has) changed over time

Sc3 2pii how the Earth’s … oceans have changed over time

Sc3 2q how the carbon cycle helps to maintain atmospheric conditions

Sc3 2ri how the sequence of … rock formation and deformation is obtained from the rock record

Sc3 2rii how the … evidence for rock formation (igneous rocks) … is obtained from the rock record

Sc3 2riii how the … evidence for rock formation (sedimentary rocks) … is obtained from the rock record

Sc3 2riv how the … evidence for rock formation (metamorphic rocks) … is obtained from the rock record

Sc3 2rv how the … evidence for rock … deformation is obtained from the rock record

Sc4 3mi that longitudinal and transverse waves are transmitted through the Earth …

Sc4 3mii … how (the) travel times and paths (of earthquake waves) provide evidence for the Earth’s layered structure

Sc4 3ni that the Earth’s outermost layer, the lithosphere, is composed of plates in relative motion …

Sc4 3nii … that plate tectonic processes result in the formation … of rocks

Sc4 3niii … that plate tectonic processes result in the … deformation … of rocks

Sc4 3niv … that plate tectonic processes result in the … recycling of rocks

Sc4 6f some uses of radioactivity including radioactive dating of rocks

22 statements
Where the textbook contained material additional to that required by the NCS, this was recorded as an ‘extra’ and the total number of ‘extras’ per book was recorded.

Each error/misconception found was also recorded. In the full report (King et al., 2002), for each of the errors/misconceptions found, the publisher was provided with information allowing corrections to be made. The erroneous quote (or reference to the incorrect diagram, etc.) with page reference was given and a suggested correction was provided, illustrating to the author and publisher that a more accurate explanation could be given, with a similar number of words and at the appropriate general reading level. The total number of errors/misconceptions in each textbook was recorded.

A tally was kept of the total number of pages relating to earth science. This was used to calculate the percentage of pages of earth science in the book or series, compared to the total number of pages in the book/series. Where the book was not one of a series and did not purport to cover the whole of the NCS, this was noted and taken into account in the final calculations.

Moderation was carried out across the team members by using the same reporting pro forma for each textbook. This pro forma was based on the evaluation format used in a previous survey of the earth science content of dual-award syllabuses (King et al., 1998, 1999). The pro forma was tested against a key stage 4 chemistry textbook by all team members and standards of interpretation of the statements and criteria were agreed at a moderation meeting.

Each book was then evaluated by a team member and the resulting pro forma submitted to the coordinator who checked and moderated each evaluation and prepared a complete set of evaluations. This complete set was circulated to all members of the team for checking; necessary corrections were made. Data from these moderated evaluations were the basis of the discussions and conclusions that appeared in the draft report. The draft report was sent to all the publishers involved for comment and correction, where necessary. Their feedback was incorporated into the final report, published by the Earth Science Education Unit (King et al., 2002). The findings of that report are summarised below.

### Results

The results are summarised numerically in Table 1. These figures provide the baseline data against which future publications will be judged. The numerical data should be considered in the light of the following:

- most of the books were written for the previous version of the National Curriculum for Science and so were unlikely to match very closely with all of the earth science statements in the current 2000 version for England (QCA, 1999), even though the 2000 version of the NCS is similar to the previous version;

<table>
<thead>
<tr>
<th>Criterion</th>
<th>KS3</th>
<th>KS4</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statements covered at ‘comprehensive’ level (mean %)</td>
<td>14.8</td>
<td>11.3</td>
<td>13.1</td>
</tr>
<tr>
<td>Statements covered at ‘basic’ level (mean %)</td>
<td>31.1</td>
<td>22.3</td>
<td>26.8</td>
</tr>
<tr>
<td>Statements covered at ‘less than basic’ level (mean %)</td>
<td>35.4</td>
<td>38.9</td>
<td>37.2</td>
</tr>
<tr>
<td>Statements covered at ‘none’ level (mean %)</td>
<td>18.7</td>
<td>27.6</td>
<td>23.2</td>
</tr>
<tr>
<td>Statements covered at ‘less than basic’ + ‘None’ levels – i.e. with inadequate coverage (mean %)</td>
<td>54.1</td>
<td>66.5</td>
<td>60.4</td>
</tr>
<tr>
<td>Earth science in the whole textbook (or textbook series) (mean %)</td>
<td>8.7*</td>
<td>10.0*</td>
<td>9.4</td>
</tr>
<tr>
<td>‘Errors/misconceptions’ per page of earth science (mean number)</td>
<td>1.1</td>
<td>0.9</td>
<td>1.0</td>
</tr>
<tr>
<td>‘ Extras’ (mean number)</td>
<td>5.9</td>
<td>4.5</td>
<td>5.2</td>
</tr>
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</table>

*Note: The Science at work books were excluded from the percentage calculations, since these were the only books devoted entirely to earth science and so distorted the overall percentages.
whilst most books were aimed at pupils of mixed ability; some were aimed at pupils of lower ability levels where comprehensive coverage of NCS statements might not be appropriate;

■ in some cases, only one volume of a set of books was submitted by the publisher to the survey;

■ some books were written as ‘revision guides’ rather than as comprehensive textbooks.

Despite these points, no overall pattern related to these issues emerged from the data, indicating no general impact on the findings.

Discussion

The purposes of the survey were to provide a baseline for future comparisons, as provided in Table 1, and to test the concern being voiced amongst earth science educators that ‘all is not well’ with the coverage of earth science in current science textbooks. This concern has proved to be well founded. Indeed, the evaluators repeatedly complained during their work of the poor quality of the published material they saw, of low levels of coverage, of misleading wording, of high levels of error and misconception and, in a number of cases, of the trivialisation of the earth science content, particularly in comparison with the coverage of other areas of science.

This situation in which, on average, more than half the earth science is inadequately covered (60.4 per cent of the statements) gives grave cause for concern, especially because it is the geological statements that are particularly poorly covered. This situation becomes even worse when the poorest textbooks are considered. In some books, nearly the whole of the NCS earth science content is inadequately covered or is even completely missing.

It is surely a matter for very serious concern by the majority of both the authors and publishers that the mean error/misconception level is as high as one error per page of earth science, particularly when most pages do not carry large amounts of text. The situation becomes even more damaging when the worst cases are considered, with some textbooks having up to two errors per page and the worst case of all having 2.5 errors per page (66 errors in 26 pages of earth science, with a number of pages having multiple errors).

Most of the textbook authors come from the science teaching tradition, and research has shown (King, 2001) that the majority of science teachers have received little or no education in earth science. Nevertheless, it should surely be incumbent on the authors to check the facts and their general understanding of a topic before ‘putting pen to paper’.

Likewise, publishers surely bear a responsibility for producing textbooks that are factually correct, and for putting checking mechanisms in place to ensure that this is so. The requirement for assessment bodies to produce factually correct and high-quality syllabuses and examinations should be just as binding on the publishers who produce the textbooks that pupils and teachers use as teaching and learning materials for examinations. Teachers and pupils generally regard textbooks as infallible reference works, clearly a mistaken view in some of the cases discussed here.

The poor coverage and the high error level is of particular concern in an area like earth science where the readers (teachers and pupils) often lack sufficient experience of the topic themselves to realise the problem. Since most science teachers use key stage 3 and 4 science textbooks as their main source of information for earth science teaching (as shown by King, 2001, and reinforced by findings of the Council for Science and Technology, 2000), earth science that is being taught on the basis of most of these textbooks must be of poor quality as well. Most science teachers will be horrified to find that their main source of earth science education is generally so poorly written and error-prone.

Although variable, the general percentages of earth science in science textbooks are comparable with the overall amount of earth science in the National Curriculum for Science so, except for those books that have well below the average level, the percentage of earth science content is acceptable. Likewise, it is encouraging to see that the mean number of ‘extras’ is relatively high. This is due to some extent to key stage 4 books containing key stage 3 material, and vice versa, but also to some authors making serious endeavours to use earth science contexts for teaching other areas of the science curriculum, a move that is warmly welcomed.

That earth science material can be written at a suitable level for pupils (and teachers) is shown by the fact that it was possible to rewrite nearly all of the erroneous material in a more accurate, more acceptable way, with similar numbers of words and at suitable levels. This was also illustrated by the best examples of textbooks encountered during the survey. There is room for improvement even there, but where authors and publishers have taken their job seriously,
the outcome is also warmly welcomed. Books like these can be used as examples for others to aspire to in the future.

Common misconceptions
A number of misconceptions were repeated in many textbooks. It is clear that these misconceptions are deeply rooted in the ideas held by not only authors and editors, but many others as well. These common misconceptions are discussed in Table 2. Since people with these misunderstandings may not recognise their significance, a common error of similar ‘magnitude’ is given in the table from another area of science, as an illustration.

Conclusions
The worst fears of the earth science education community have been realised in this survey. Indeed, it does seem that the phrase, ‘lies, damn lies and books on geology’ (Arthur, 1996) is particularly apt in this context.

With more than half the earth science in the National Curriculum for Science being inadequately covered and a mean error level of one error per page of earth science, the majority of the authors and publishers should accept responsibility for the poor material that they have produced and make real efforts to improve it in the future. This is particularly the case when teachers and pupils alike are depending on the textbooks to give them the grounding in earth science understanding that they will need for their examinations and in their future lives.

So, what of the future? Fortunately the effects of the survey are already bearing fruit. Some authors and publishers have begun to work more closely with the Earth Science Teachers’ Association and with the Earth Science Education Unit at Keele University to vet and improve materials before they are published. Meanwhile, members of ESTA and ESEU are very willing to assist authors and publishers in their efforts to produce high-quality earth science material. Part of the work of the Earth Science Education Unit is to develop the background knowledge and enthusiasm of the science teachers teaching earth science across the UK, by offering workshops in schools, at institutions of initial teacher education, and at other science events around the country. Authors and editors are most welcome to join ESEU workshops running in their localities free of charge. They will be able to enhance their own knowledge and understanding of earth science. They will also gain insights into the ways that earth science contexts can be used for the teaching of other areas of science to highlight the relevance of science in general and of earth science in particular. For details of local workshops, contact the ESEU administrator at the address given below.

The Earth Science Teachers’ Association has produced wide-ranging materials entitled ‘Science of the Earth’, to support the teaching of National Curriculum earth science at secondary level (see Kennett and King, 1998). These materials can be trawled for ideas, approaches and background that would enhance the preparation of the earth science content of future science textbooks. Authors and publishers are welcome to use these, subject to editorial agreement from ESTA and acknowledgement. They are available from the ESEU administrator.

Prior to the rolling publication of the ‘Science of the Earth’ materials, a survey was carried out of published activities related to earth science that had appeared in textbooks and other publications around the world. These activities were briefly described and catalogued in an article in Geology Teaching (Guy, 1986), available in university libraries and from ESEU. Other sources of earth science background and ideas for practical and investigational materials have been published by Brannlund and Rhodes (1995) and Tuke (1991) and are still available.

Meanwhile, members of ESEU and ESTA are currently involved in the Joint Earth Science Education Initiative, producing materials specifically to help teachers of biology, chemistry and physics with their teaching of earth science. JESEI, a collaboration with the Institute of Biology, the Royal Society of Chemistry and the Institute of Physics, has put more than 40 activities up on the JESEI website: www.jesei.org. These new materials are available to assist authors with their development of the earth science content of future secondary science textbooks, and can be used, subject to agreement between publishers and JESEI, and with suitable acknowledgement.

Thus a range of resources and opportunities are available to help authors and publishers improve on their past record of poor performance in this area. It is to be hoped that when a similar survey is conducted at some future date, we will find a great improvement.
Table 2  Common earth science misconceptions in science textbooks.

<table>
<thead>
<tr>
<th>Earth science misconception</th>
<th>Discussion</th>
<th>Misconception of similar significance in another science area</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Minerals and rocks are the same things.’</td>
<td>A mineral is an element or compound. Thus a mineral has a definite chemical composition, atomic structure and physical properties (that vary between fixed limits). A rock is a mixture of one or more minerals (or fragments of rocks) so the compositions and structures of most rocks can be very variable. However, some rocks are formed of predominantly one mineral, such as limestone (largely calcite), quartzite (largely quartz) and rock salt (largely halite). Igneous rocks usually contain more than one mineral.</td>
<td>Confusing mixtures and compounds (e.g. a mixture of iron filings and sulfur with iron sulfide).</td>
</tr>
<tr>
<td>‘Weathering and erosion are the same’ or ‘weather causes weathering’.</td>
<td>Weathering happens <em>in place</em> and so no solid material is removed. Weathering causes chemical breakdown or physical disintegration (e.g. by freeze thaw action, plant root growth). Erosion is the <em>removal</em> of material from the site. Erosion occurs when one or more erosive agents (such as gravity, wind, moving water, or moving ice) removes weathered material (so wind is an agent of erosion, not weathering). [Note: the chemical attack of rainwater on limestone removes material <em>in solution</em> and so is weathering and not erosion.]</td>
<td>Confusing the dissolving of salt and the ‘dissolving’ of calcium carbonate in acid.</td>
</tr>
<tr>
<td>‘If a rock contains fossils it must be sedimentary.’</td>
<td>Many low-grade metamorphic rocks contain fossils, where the heat and pressure of metamorphism have not been great enough to destroy them, e.g. many slates and some marbles.</td>
<td>All leaves contain starch.</td>
</tr>
<tr>
<td>‘Sedimentary rocks are formed by the compression of the overlying materials.’</td>
<td>Most sedimentary rocks cannot be formed by compaction alone. Some ‘cementation’ is required to ‘glue’ the grains together. Fluids flowing through the pore spaces deposit natural mineral ‘cement’. Only fine-grained sediment such as mud can be changed into sedimentary rocks like mudstone or shale by the compression of the overlying rocks alone. Sandstones and limestones need cementation.</td>
<td>Plants need only a source of light to photosynthesise.</td>
</tr>
<tr>
<td>‘Metamorphism is caused when rocks are buried and heated.’</td>
<td>Widespread (regional) metamorphism (that produces slates, schists and gneisses) requires regimes of very high compression and heating. These conditions only occur when plates collide. There is not enough compression or heating produced by burial alone to cause metamorphism. (Baking by hot igneous intrusions can cause localised metamorphism.)</td>
<td>Water can boil at 50 °C at normal (atmospheric) pressures.</td>
</tr>
<tr>
<td>‘Magma can produce granite or basalt.’</td>
<td>Granite and basalt are chemically very different and so cannot change from one to the other. When the <em>mantle</em> partially melts, dark magma forms. This iron-rich, silica-poor magma produces basalt if it cools quickly at the surface, or coarse-grained gabbro if it cools slowly at depth. When the crust partially melts, a paler, silica-rich magma is formed. This is rarely erupted as lava, but can explode as ash or pumice. Usually this magma crystallises slowly underground to form coarse-grained granite.</td>
<td>Confusing caustic soda (sodium hydroxide) with common salt (sodium chloride).</td>
</tr>
</tbody>
</table>

(continued)
<table>
<thead>
<tr>
<th>Earth science misconception</th>
<th>Discussion</th>
<th>Misconception of similar significance in another science area</th>
</tr>
</thead>
<tbody>
<tr>
<td>'The rock cycle is steady and continuous.'</td>
<td>The deposition and burial of sediments, and their change to sedimentary rocks may be relatively steady, as may the production of igneous rocks at ocean ridges. However, the metamorphism, igneous activity and uplift related to plate collisions only occur sporadically, separated by long intervals of geological time.</td>
<td>Digestive system processes are steady and continuous.</td>
</tr>
<tr>
<td>'Plates are made of crust' or 'crustal plates'.</td>
<td>The tectonic plates are plates of rigid lithosphere around 100 km thick. They overlie the ductile asthenosphere beneath, which flows slowly, moving the plates – thus there is a physical boundary between the solid lithosphere and the ductile asthenosphere. The lithosphere comprises the crust and the upper mantle, which are chemically different but physically solid and rigid. The crust is around 6 km thick in oceanic areas and averages 35 km thick in continental areas – much thinner than the lithosphere (see King, 2000, for more details).</td>
<td>Leaves are made of a layer of palisade cells only.</td>
</tr>
<tr>
<td>'The mantle is liquid', 'semi-liquid' or 'semi-solid'.</td>
<td>The mantle is almost entirely solid, as shown by the fact that it transmits seismic S-waves that can only pass through solid material. There is a zone in the upper mantle between the solid lithosphere above and the solid mantle below, called the asthenosphere, that is between 1 and 10% liquid (i.e. is 90–99% solid). As the molten material is largely present as films around the edges of crystals, it allows the solid material of the asthenosphere to flow very slowly. However, the mantle beneath can also flow, even though it is completely solid (see King, 2000, for more details). A good analogy is ice which, although solid (and capable of being broken by a hammer), can flow downhill in glaciers. When it is near its melting point it can flow more easily.</td>
<td>Glass is a liquid.</td>
</tr>
<tr>
<td>'Oil and gas are formed from dead sea creatures' (often implying the remains of fish and other large animals).</td>
<td>Oil and some natural gas are formed as microscopic plankton become buried and heated in the Earth’s crust. The oil-producing plankton are mostly microscopic plants. Most natural gas is formed as buried land vegetation becomes coal. ‘Oil and gas are derived almost entirely from decayed plants and bacteria’ (quote from Britain’s offshore oil and gas published by the UK Offshore Operators Association and the Natural History Museum; Clark et al., 1997).</td>
<td>Plastics are made from coal.</td>
</tr>
<tr>
<td>'Rocks containing metals are called ores.'</td>
<td>The minerals that make up most rocks contain metal compounds, but are not ores. The term ‘ore’ has an economic context. A rock or mineral deposit is only an ore if it is rich enough to be exploited commercially.</td>
<td>A coal seam one centimetre thick is a useful energy resource.</td>
</tr>
</tbody>
</table>
References


Parsons, R. ed. (2000?) GCSE double science, the revision guide, higher level: Biology; Chemistry; Physics. Kirkby-in-Furness, Cumbria: Coordination Group Publications.


Books assessed in the survey


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Earth science in science textbooks

King, Fleming, Kennett and Thompson


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Chris King is Director of the Earth Science Education Unit, Keele University, Keele ST5 5BG, where Peter Kennett also works. E-mail: eseu@keele.ac.uk
Alastair Fleming and David Thompson are Fellows in the Department of Education, Keele University, Keele ST5 5BG.

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Further information

The Earth Science Education Unit researches into earth science educational issues in the UK and offers advice to publishers and awarding bodies on earth science-related matters. ESEU also provides free INSET (apart from travelling and photocopying expenses) to science departments in secondary schools, at institutions of initial teacher education, and at other science events, through a network of facilitators across the UK. To find out more, contact the ESEU administrator, Bernadette Callan, Earth Science Education Unit, Keele University, Keele ST5 5BG, 01782 584437, eseu@keele.ac.uk or via the ESEU website, www.earthscienceeducation.com

Details of the Earth Science Teachers’ Association and ESTA membership are also available from the ESEU administrator, as are ‘Science of the Earth’ materials and past ESTA journals. The ESTA website is: www.esta-uk.org

Copies of the full 101 page report, *A report on the earth science content of commonly used secondary science textbooks: Spring 2002*, are available from the ESEU administrator, for the cost of photocopying and postage.
Methodology of Teaching Science will provide readers with a solid foundation on which to build expertise in teaching the subject. This text does a comprehensive examination by introducing students to science as a school subject. It covers aspects like instructional planning, unit planning, teaching aids, curriculum planning and science laboratories. It also outlines the role of a science teacher in developing a students' scientific aptitude and approach. Table of Contents. Cover.