



# OUTDOOR SCIENCE

*A co-ordinated approach to high-quality teaching  
and learning in fieldwork for science education*

A report by the  
Association for Science Education **Outdoor Science Working Group**

## 1 *Foreword*

In his autobiography, written as an old man, Charles Darwin remembered that “When ten years old I went for three weeks to Plas Edwards on the sea-coast in Wales, I was very much interested and surprised at seeing a large black and scarlet Hemipterous insect, many moths (*Zygæna*) and a *Cicindela*, which are not found in Shropshire”. That childhood experience formed the great man’s life work. Paul Nurse, Nobel Prize winner and today’s President of the Royal Society, speaks passionately of his schoolboy memories of counting spiders’ webs in his garden as the essential introduction to his scientific career. I too, in my undistinguished way, was taken on a school field trip to the Field Studies Council’s Malham Tarn Field Centre in Yorkshire at the age of fourteen, and at once decided to study biology.

That experience is shared by thousands of my fellow biologists – and by thousands more who, although they did not themselves become scientists, were introduced to the joys of nature in a manner far more direct and fulfilling than that provided by the most spectacular television programme, vivid book, or talented teacher. The study of biology, geology and the rest is a living experience, and without fieldwork it can be (and often is) killed stone dead. All our young people should have the chance to feel the excitement that Darwin did and I am glad to give my enthusiastic support to the ASE’s vision of bringing field work back to the centre of science education.

**Professor Steve Jones**, President  
Association for Science Education





## Summary

Compelling evidence from research points to the wide-ranging educational benefits of teaching and learning science through fieldwork\* in the natural and built environments. Yet, despite the strengths and advantages that fieldwork can bring to teaching at all ages, there has been a long-term and continuing decline in the provision and condition of outdoor education in science.

The Association for Science Education's Outdoor Science Working Group (OSWG) believes that this trend is detrimental to science education. In 2010, the OSWG, sponsored by the Nuffield Foundation, hosted a series of five, themed 'Inspirational Outdoor Science' seminars aimed at catalysing and gathering support, and providing a clear future direction.

The six recommendations published in this report are the product of the discussions which involved over 100 participants. As such, they provide a strong foundation for a shared and coherent approach towards increased uptake and improved quality of teaching and learning through fieldwork in science education.

\*Fieldwork here indicates all educational activities from early years through to post-16 which take place outside the classroom and make use of the outdoor natural and built environments.

## 2 Recommendations

### Recommendation 1

Future reviews of initial teacher training, Qualified Teacher Status standards and continuing professional development must ensure that fieldwork training is expected and provided for all trainee science teachers. A co-ordinated programme of teacher training in fieldwork should therefore be established to promote effective pedagogy for all university tutors and school teachers involved in pre-service and early career training.

### Recommendation 2

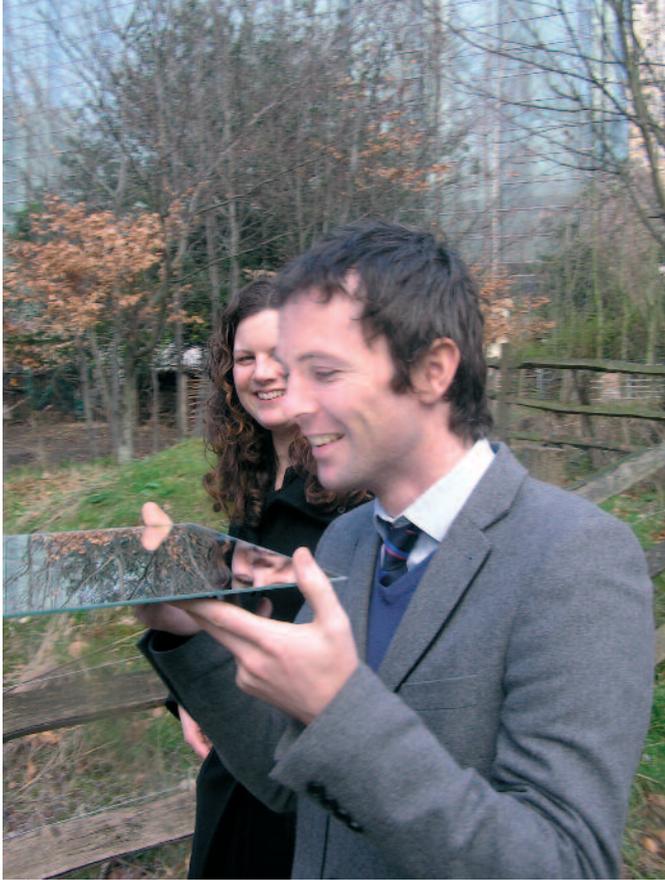
A dedicated outdoor science web-site, aimed at teachers, technicians and outdoor educators, should be created to signpost, exchange and compare high-quality fieldwork training resources. The website should encompass local and context-specific support and include contacts for expert advisers, local support networks, existing good practice, training events and fieldwork providers as well as published materials.



### Recommendation 3

Performance management and designations (for example, to AST or Excellent Teacher level) should include an opportunity for early-career teachers to demonstrate their effective use of fieldwork and for more experienced teachers to demonstrate their own role in providing fieldwork training for colleagues in other departments and schools (including across age phases and transitions).





#### Recommendation 4

Awarding bodies should be provided with the flexibility and support to significantly increase open-ended summative assessment and assessments that recognise skills which are primarily developed through fieldwork.

#### Recommendation 5

A co-ordinated research programme should be developed to further investigate the full range of educational impacts of fieldwork in science including case studies in formal/informal contexts, day/residential venues, local/remote sites and rural/urban communities.

#### Recommendation 6

Leading educational bodies, learned societies and high-profile supporters of outdoor education should use their combined influence to support positive attitudes towards fieldwork in science amongst their contacts and audiences (including headteachers, governors and parents). These institutions and individuals should focus particularly on areas such as raising the profile of fieldwork in whole school policies and development plans, a reduction in health and safety bureaucracy and the development of in-service professional development programmes.



## 3 Background

### 3.1

In recent years, researchers and policy makers across the world have increasingly called for greater attention to be paid to the educational potential of out-of-school settings, citing the many benefits, and indeed, the necessity, of learning in contexts other than the classroom<sup>1</sup>. In the UK, there has been a clear commitment to the provision of learning opportunities beyond those offered by classroom-based experiences. For example, in 2005, the Education and Skills Select Committee stated that: 'Education outside the classroom is of significant benefit to students. Academic fieldwork clearly enhances the teaching of science and geography...'<sup>2</sup> In November 2006, following the recommendations outlined by the Select Committee, the Department for Education and Schools launched a Learning Outside the Classroom Manifesto<sup>3</sup>. The Manifesto states that all children educated in England should gain direct experience of learning in different contexts.

### 3.2

However, whilst government documents and research findings point to the benefits of fieldwork, *it would appear that such opportunities are rarely taken up in practice*. Indeed, some research points to a *decline in the provision and condition of fieldwork* at primary and secondary levels, and that this is a long-term trend in GCSE and A-level science<sup>4,5</sup>. There is evidence that access to fieldwork opportunities – and the advantages that are thereby bestowed – is skewed towards the independent sector, and that the decline in A-level biology fieldwork has been more marked in state sector schools<sup>6</sup>. A study in London found that there are few planned opportunities for science fieldwork



for students at Key Stages 3 and 4 in inner-city schools and that where such provision did occasionally occur, it tended to focus on particular areas of the science curriculum, such as biology and ecology<sup>7</sup>.

### 3.3

Further research shows that the potential wider educational benefits of fieldwork – including teamwork, motivation and enthusiasm for the subject and its potential to influence positively the choice of science as a future subject to study – are valued less highly by secondary science teachers than by their geography counterparts<sup>8</sup>. There is also evidence that trainee science teachers are receiving a variable level of training to support fieldwork, with some receiving none at all.<sup>9</sup> Whilst this evidence is uneven, it is consistent, and has been for many years; taken

together these snapshots suggest that there has been a decline in science fieldwork and that without effective intervention the decline will continue.

<sup>1</sup> Dierking, L. et al. (2003) Policy statement of the "informal science education" ad hoc committee

<sup>2</sup> House of Commons Education and Skills Committee (2005) *Education outside the classroom*

<sup>3</sup> Department for Education and Skills (DfES) (2006) *Learning outside the classroom manifesto*

<sup>4</sup> Fisher, A. (2001) *The demise of fieldwork as an integral part of science education in UK schools*

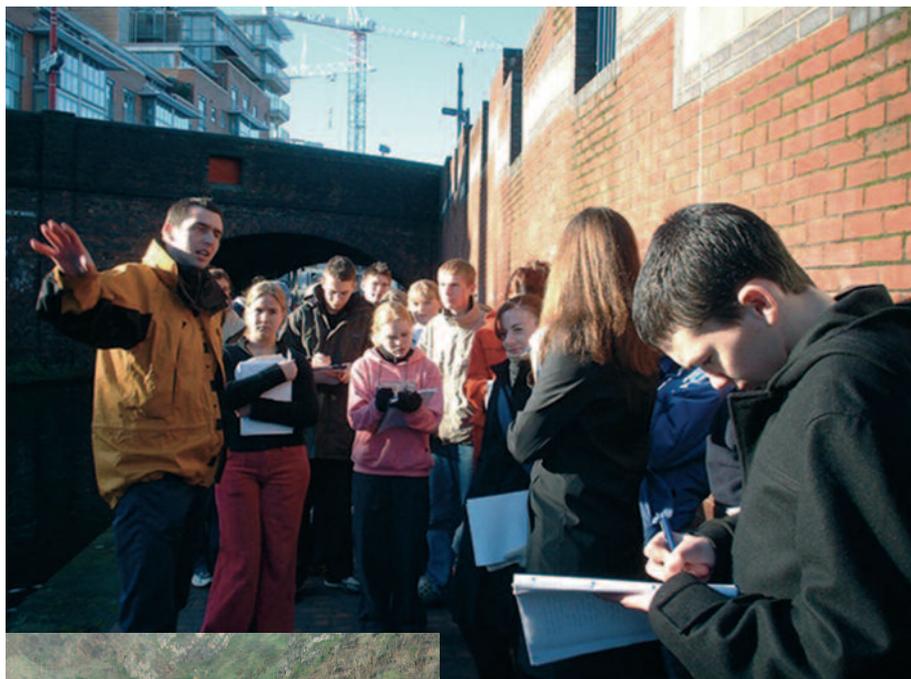
<sup>5</sup> Tilling, S. (2004) *Fieldwork in UK secondary schools: influences and provision*

<sup>6</sup> Wellcome Trust (2003) *Life study: Biology A level in the 21st century*

<sup>7</sup> Glackin, M. (2007) *Using urban green space to teach science*

<sup>8</sup> Tilling, S. (2004) *Fieldwork in UK secondary schools: influences and provision*

<sup>9</sup> Kendall, S. et al. (2006) *Education outside the classroom: research to identify what training is offered by initial teacher training institutions*



### 3.4

For a number of years, the Outdoor Science Working Group (OSWG) of the Association for Science Education (ASE) (for current membership, see appendix), has been working towards a strategy for identifying and tackling the key challenges facing all those who promote fieldwork, including teachers, teacher educators, non-governmental agencies (NGOs), policy-makers, inspectors and advisors, and other committed individuals and institutions.

### 3.5

The OSWG believes that the trends described above are detrimental to science education. We believe that all students deserve to benefit from a range of high-quality fieldwork opportunities (not just in biology and ecology but also in chemistry, earth science and physics) with the potential to gain knowledge, skills and experiences in school grounds, local parks, and in other urban and rural open spaces. However, we also acknowledge the challenges faced by teachers in providing such opportunities and note that there are many possible reasons why fieldwork is not being used to its maximum capacity. For example, the issues of health and safety, risk management and cost are amongst the most significant factors reported as limiting fieldwork<sup>10</sup>. Reviewing the literature on learning outside the classroom, Rickinson *et al.* also highlighted teachers' confidence and expertise in teaching and learning outdoors; requirements of school and university curricula and timetables; difficulties due to shortages of time, resources and support; and more generally the susceptibility of fieldwork to the 'wider

changes in the education sector and beyond'<sup>11</sup>. A recent report for Natural England noted that:

The challenges facing schools include those frequently mentioned such as the risk of accidents, cost and curriculum pressures. However, another set of challenges exists, at local, institutional and personal levels. These challenges include teachers' confidence, self-efficacy and their access to training in using natural environments close to the school and further afield.<sup>12</sup>

### 3.6

Nevertheless, despite the number and scale of the challenges, we are encouraged by the continued interest in learning outside the classroom reflected by the conclusions and recommendations in the recent report from the House of Commons Children, Schools and Families Committee<sup>13</sup> and the direct reference to fieldwork in the Ofsted science subject specific guidance (2010) for inspectors on making judgements on subject survey visits to schools<sup>14</sup>. We are further encouraged by the possibilities offered by the recent Schools White Paper, *The Importance of Teaching* (2010) around the review of initial teacher training, QTS standards and continuing professional development<sup>15</sup>.

<sup>10</sup> O'Donnell *et al.* (2006) *Education outside the classroom: An assessment of activity and practice in schools and local authorities*

<sup>11</sup> Rickinson *et al.* (2004) *A review of research on outdoor learning*

<sup>12</sup> Dillon, J. (2010) *Beyond barriers to learning outside the classroom in natural environments*

<sup>13</sup> House of Commons Children, Schools and Families Committee (2010) *Transforming education outside the classroom*

<sup>14</sup> Ofsted (2010) *Science Survey Visits. Generic grade descriptors and supplementary subject-specific guidance for inspectors on making judgements during visits to schools*

<sup>15</sup> Department for Education (2010) *The importance of teaching*

### 3.7

In the light of the real need to improve the quantity and quality of fieldwork coupled with distinct possibilities to affect change, the OSWG instigated and ran a series of day-long themed seminars and twilight consultation events during 2010, to energise the debate, to provide a catalyst for change, and to give the momentum necessary to address this major weakness in the provision of science education in the UK, and perhaps elsewhere. The seminars and the production of this report were kindly supported and funded by the Nuffield Foundation.

### 3.8

The themes of the seminars were initial teacher education; assessment; learning in informal contexts; continuing professional development;

and policy. The themes of the five seminars were chosen by the OSWG because they have been identified consistently throughout science education as strategically critical for building the capacity to deliver high quality science fieldwork in schools.<sup>16,17</sup>

### 3.9

The seminars and consultation events were held in a range of locations and were attended by more than 100 participants, including: teachers and lecturers; academics and researchers; representatives of the learned societies; professional associations; NGOs and the charitable sector; government and nongovernment agencies; awarding bodies; advisers and inspectors; employers and business (see appendix for a full list of participants).

### 3.10

Each event comprised introductory presentations followed by focused and facilitated discussion on specific themed questions and general questions including:

- What have been the successes and failures and resulting impacts, of recent outdoor learning initiatives on teaching and learning particularly in science?
- How do we identify and build on existing good practice in terms of outdoor learning in science?
- What changes in curriculum, assessment, pedagogy, training and supporting resources are needed to enable teachers of science to work together developing outdoor learning in science?
- What can we learn from research, in the UK and elsewhere, about effective outdoor learning and how can we implement transferable solutions into mainstream science education?



<sup>16</sup> Barker, S. et al. (2002) *Teaching biology outside the classroom. Is it heading for extinction?*

<sup>17</sup> Tilling, S. and Dillon, J. (2007) *Initial teacher education and the outdoor classroom. Standards for the future*

## 4 Issues emerging from the seminars

The key issues that emerged from the five seminars are summarised in the following sections. There is considerable overlap in areas such as initial teacher training, CPD, resource development, increased collaboration, and influencing attitudes and values towards fieldwork. The key issues were used to develop recommendations; each recommendation was chosen because it reflected issues which emerged as critical in two or more of the seminars.

### 4.1

#### Trainee and early career teachers seminar held at the University of Birmingham

##### 4.1.1 Strengthening initial teacher training (ITT)

ITT should provide science teachers with the competence, confidence and commitment to undertake fieldwork with minimal support during their induction as a Newly-Qualified Teacher (NQT). NQTs need to be able to plan and undertake fieldwork relatively autonomously, without the need for significant buy-in from senior management, whilst avoiding prohibitive costs. During their initial teacher training they need practical experience of planning and leading fieldwork and being able to evaluate and share experiences with other trainee teachers, particularly those working in other schools. Undertaking fieldwork during their initial teacher training also provides positive encouragement through highlighting that these activities are expected of science teachers. Research has shown that the level of fieldwork training in initial teacher training courses is variable, so that future reviews of the ITT curriculum must ensure that fieldwork training is provided for all trainee teachers<sup>18</sup>. A set of minimum requirements – known as the *Malham Protocol* – were identified in an earlier workshop hosted by the ASE's Outdoor Science Working Group<sup>19</sup>.

##### 4.1.2 Building CPD for newly-qualified teachers and technicians

Newly-qualified teachers face many demands on their time and CPD dedicated to fieldwork may be a low priority, even if it is made available. However, CPD for early-career teachers is important and needs to include support to biology specialists for 'thinking outside the ecology box', developing an open mind to the potential of fieldwork across the sciences amongst all science teachers and offering ideas and resources to stimulate new practices. Technicians also need professional development related to fieldwork approaches and equipment construction.

##### 4.1.3 Providing dedicated support for curriculum developers

Teachers who develop schemes of work require an understanding of, and competence in, fieldwork. Such teachers do not necessarily have experience of fieldwork and would benefit from a single, authoritative and up-to-date source of reference.

<sup>18</sup> Kendall, S. et al. (2006) *Education outside the classroom: research to identify what training is offered by initial teacher training institutions*

<sup>19</sup> Tilling, S. and Dillon, J. (2007) *Initial teacher education and the outdoor classroom. Standards for the future*





#### 4.1.4 Strengthening collaboration within schools

Successful fieldwork activities depend on collaboration which itself depends on existing collaborative structures within schools. Where these are strong, training days run by a local Advanced Skills Teacher/Excellent Teacher/Leading Teacher can be excellent ways to move schools forward in the provision of high quality fieldwork.

### 4.2 Continuing Professional Development (CPD) seminar held at the National Science Learning Centre, University of York

#### 4.2.1 Creating dedicated CPD Programmes

The development of comprehensive CPD programmes is critical, preferably linked to an accreditation scheme such as Chartered Science Teacher Status and to a national accreditation system for learning outside the classroom, Advanced Skills Teachers, or their equivalents, could be

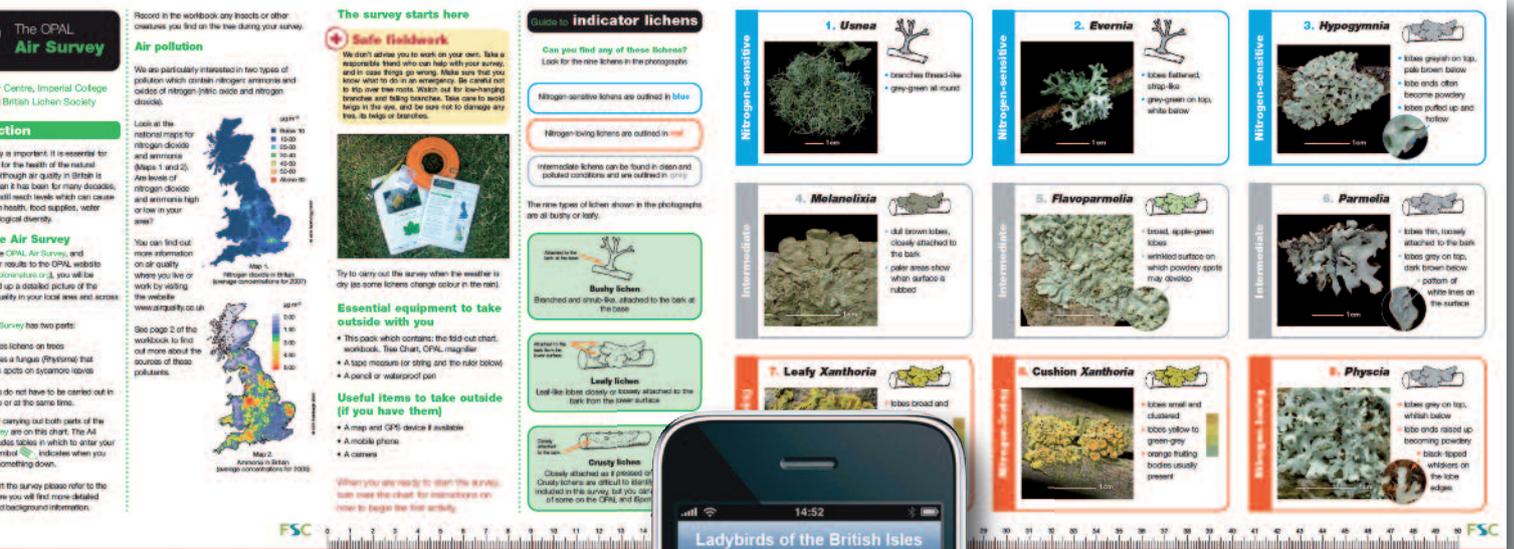


involved in the development and dissemination of such packages. A particularly fruitful area for CPD development is the primary/secondary transition (because of the CPD benefits to all primary and secondary staff involved). Such a programme might address the disconnect often noted between the positive fieldwork attitudes and expectations of primary school pupils and those in the lower years of secondary schools.

#### 4.2.2 Standardising performance management and recognising achievement

It is crucial to develop success criteria to enable teachers to evaluate the quality of their fieldwork and also to assess the progress of pupils, the latter possibly being developed using an Assessing Pupils' Progress (APP) approach. Good practice might also be developed in linking fieldwork to the performance management systems used in schools.





### 4.2.3 Signposting high-quality resources

There is a compelling need to provide support and signposting for anyone involved in promoting and delivering fieldwork in terms of what resources are available. One realistic option might be a website containing:

- descriptions of a range of high-quality outdoor investigational activities;
  - locations of local open spaces;
  - site-specific identification keys;
  - case studies of effective practice;
  - assessment and evaluation tools;
- together with recommendations on how these might be amalgamated into effective CPD courses.

### 4.2.4 'Kitemarking' good practice

A 'Kitemark' for science departments could be developed, involving fieldwork, whilst a similar 'Kitemark', based on the *Malham Protocol* (see para. 4.1.1) might be developed for providers of initial teacher training. This 'Kitemark' could prove a useful instrument for parents assessing schools for the quality of science provision offered to students, and may therefore have a place in any measure of school performance.

### 4.2.5 Raising the profile and status of fieldwork

The level of science fieldwork provision will only be raised if its value is recognised at all levels – from school to national government. It will be crucial to engage school leaders, including school improvement partners, headteachers, governors, senior leadership and management teams, CPD gatekeepers, heads of science and parents. Schools should also focus on fieldwork in their development plans. Evaluation and research must be central to all existing and new initiatives designed to promote fieldwork in order to

assess their effectiveness and impact, to support their long-term development, and to pass on the findings to others.

## 4.3 Assessment seminar held at the Cambridge University Botanic Garden

### 4.3.1 Developing open-ended assessment

There is a tendency to think that fieldwork will only take place in schools if there is a clear and explicit requirement in specifications and assessment criteria. As a result, there is a belief among many that assessment and specifications are the most effective mechanism by which to ensure that good fieldwork takes place. However, summative assessment can distort teaching and learning activities, reducing the quality of the student experience and measuring only a narrow range of skills and knowledge rather than all that fieldwork can offer. Allowing awarding bodies to develop open-ended assessment could promote a culture of in-depth teaching and learning which might inherently encompass the breadth of learning experiences gained through fieldwork.

### 4.3.2 Encouraging and rewarding fieldwork experience

Assessment best promotes fieldwork when it assumes students have a range of experiences upon which they might draw in responding to questions. Assessment questions designed to draw on such real life experience to gain higher marks/grades should promote fieldwork without restricting the learning experience.

### 4.3.3 Encouraging a wider view

Experience shows that assessment is, by its nature, a driving force in the compartmentalisation of the student learning experience. However, open-ended, carefully constructed assessment can be used to encourage students to bring different learning experiences together, and schools to think carefully about how such skills might be developed through cross-disciplinary projects.

### 4.3.4 Improved links between schools and fieldwork providers

A great deal of good practice in fieldwork lies outside the school science education community and opportunities for fieldwork providers and teachers to come together, formally and informally, and learn from each other should be encouraged.

### 4.3.5 Influencing attitudes and values

The level and quality of fieldwork provision will depend not just on assessment and awarding bodies, but also on the attitudes and values of a range of people from teachers, senior managers, governors and parents through to government decision makers such as the Department for Education and Ofqual. A determined and widespread approach is needed to change the perceived relevance and value of fieldwork.

## 4.4 Learning in informal contexts seminar held at the Science Learning Centre South West

### 4.4.1 Supporting local and context-specific groups and individuals

Informal educators tend to be focused regionally or locally and/or be context-specific, so may be unaware of schemes run by other individuals, institutions or providers. In some cases enthusiastic individuals may benefit from partnership and communication possibly using a common web portal and frequent face-to-face group meetings. Longer-term sustainability would be supported by more

prolonged contacts between schools and providers. Building close relationships with teachers (and headteachers) is important to sustain work. This might begin with a small project and build up to something with greater impact and a degree of sustainability enhanced by its promotion through the website.

### 4.4.2 Encouraging collaboration

For informal education to be effective in supporting formal education, teachers need time and space to collaborate and try out activities themselves before teaching them. The links between informal educators and teachers could be strengthened through the work of organisations



such as local authorities and the Association for Science Education. It would be useful to find out how this exchange works in other countries and also in other subjects and education areas.

#### 4.4.3 Engaging with the voluntary sector

Partnerships between schools and providers might be developed more quickly and effectively with the help of local volunteers. There are a large number of 'amateur experts', such as those who contribute to the Open University's iSpot scheme, who might be available to support fieldwork in schools.

#### 4.4.4 Strengthening and sharing approaches to evaluation

Both formal and informal sectors seek to evaluate young people's learning gains through fieldwork. For example, informal educators often video pupils' responses to activities and this

methodology could be applied in schools. In exchange, the informal sector could learn more about assessment and measuring the progress of children from the school sector. There should also be a more formal evaluation of the full range of benefits from outdoor learning, which could be shared across both sectors.

#### 4.4.5 Building and sharing the research and evidence base

Research findings are frequently complex and available in a fragmented manner. Busy teachers need to access research findings which are 'joined-up' and in a comprehensible format. They need real evidence of the value of outdoor activities. Both formal and informal educators need research into questions such as: how do creative approaches (for example, storytelling and performance) enhance learning and enjoyment in science; whether field visits near school are just as good as those further afield; if the learning value of seeing things *in situ* is different to that in museums; and, how children perceive local features compared with more distant 'exotic' ones.

#### 4.4.6 Transferring good practice from formal to informal educators

Informal educators could learn from the same initiatives which formal educators have found successful within the school environment, for example: cross-curricula work through integrated planning (especially science, mathematics and geography); cross-subject linking during teacher training; problem-solving activities; removing extreme health and safety barriers; a commitment to demonstrating the relevance of learning; an emphasis on developing team-work; smoother transitions between primary and secondary schooling; off-curriculum days for teachers to explore resources; support

from headteachers/heads of department; assessment by measuring laughter, nervousness and other emotional responses.

### 4.5 Policy seminar held at King's College London

#### 4.5.1 Linking top-down and bottom-up policy

Curriculum specifications, official guidance and framework documents produced by awarding bodies, Ofsted and Ofqual should routinely include reference to outdoor learning where appropriate. Schools and teachers should be able to adapt such guidance to appropriate local examples and circumstances.

#### 4.5.2 Developing whole school policies

Whole-school policies related to out-of-classroom learning need to be developed and supported by headteachers and governors.

#### 4.5.3 Learning from other age phases

Initiatives such as Eco-schools, Healthy Schools, Sustainable Schools and the effective use of outdoor space have all been adopted more enthusiastically by early years and primary education than by secondary schools. Secondary schools can learn from work done in early years and primary education to develop outdoor learning. The use of initiatives such as collapsed timetables may ease the constraints which have curtailed the uptake of fieldwork in 11+ education.

#### 4.5.4 Identifying supporters

There is a need to identify a well-known personality or 'brand' (for example, the BBC) to raise the profile of fieldwork and to endorse supportive policies.



## 5 Acknowledgements

ASE's Outdoor Science Working Group is grateful to the Nuffield Foundation for recognising the importance of science fieldwork and for funding the seminars and follow-up consultation events leading to this report and recommendations.

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Ms Marianne Cutler, *Association for Science Education*

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Mr Roger Lock, *University of Birmingham*

Ms Ginny Page, *Science and Plants for Schools*

Dr Stephen Tilling, *Field Studies Council*

### Host institutions for seminars

Cambridge University Botanic Garden

King's College London

National Science Learning Centre

Science Learning Centre South West

University of Birmingham

### Participants at the seminars and follow-up consultation events

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 Claire Williams, *OCR*  
 Mark Winterbottom, *University of Cambridge*  
 Emily Yeomans, *Wellcome Trust*



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“ The study of biology, geology  
and the rest is a living experience,  
and without fieldwork it can be  
(and often is) killed stone dead ”

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