Introduction

Points in our lives where we move from one phase to another have a significant impact. From childhood to adolescence, from being single to having a partner, changing jobs, retirement – often these are stressful times. Perhaps we have forgotten what it was like for us on that first morning in a new school, nervous in a new environment but expectant and excited too. Going to a new school is a 'rite of passage' in our early lives and, at transfer to secondary school, an entry into adulthood. As we learned from Amin and Lisa, science is one of the most exciting prospects about a new school. But their subsequent learning journeys, like countless others', are not as smooth as they might be. Part of the problem is work repeated without sufficient new interest and challenge for pupils and it is why the title of this book is phrased as a rhetorical question – *Starting Science … Again?* This book is about helping the Amins and Lisas of this world make their way in a life enriched by, and increasingly dependent on, understanding science.

In 1985 the UK government was developing policy before introducing a 'national curriculum' that would define the content of subjects and how these were to be organised across the statutory age-range of schooling (5–16). During that process it was recognized that developing a science curriculum as a continuum demanded careful thought.

> The development of science in primary schools imposes an added responsibility on the schools to which the pupils transfer: they have to ensure, if the goal of making science from 5 to 16 a continuum is to be realized, that pupils' early start is neither ignored nor undervalued but rather reinforced and exploited in their subsequent work. Suitable arrangements for ensuring continuity and progression are therefore essential. (DES/WO, 1985: para. 32:11)

Perhaps it was a worry that teaching science in primary schools would be such a new development for many schools, which made government advisers cautious. So against this background the great national curriculum experiment came into being. With a spirally constructed, age-related design for learning (more of this in Chapter 1) came an expectation that teaching should be planned, especially at stages involving transfer from one school to another, to avoid needless repetition of work, and that would be capable of recognizing pupils' previous achievements and progressing these accordingly. But why was this seen as particularly important in science rather than in subjects such as mathematics, history or geography? It may have been that subject content, key ideas and skills in science, are seen as having to be progressively developed rather than compartmentalized into study of different periods as in history, regions as in geography or levels

of numerical manipulation and abstraction as in mathematics. In these subjects it is easier to hive off different content to different programmes (and so ages) of study, though in reality I am sure progression in those subjects is much more complex than this. From the pupils' perspective things are a little simpler. In secondary school you are now studying the Tudors and not Romans and South America not England. But in science it is forces, energy, living things and materials – again. That this is natural because we have to progress learning of the 'big ideas' of science in a gradual way is lost on young minds ready and eager to learn new things. There are two ways of dealing with the problem. One is to adopt a *tabula rasa* approach where the teacher starts science as a new subject as if everything done before counted for nothing. Another, more fruitful approach, would be to find out what has been done before and design teaching that builds from those earlier experiences, no matter how naive and unsophisticated they might seem, persuading learners that knowing and understanding science requires careful, continual construction. Ruth Jarman, who led the way with her studies of primary–secondary transfer in science, sees secondary teachers as either *resumptionists*, most likely to repeat work because they doubt pupils' understanding or levels of competence, or as *recognitionists*, more likely to value previous learning and to collaborate with primary colleagues (Jarman, 1997). The aim of this book, then, is to increase the number of recognitionists and reduce the numbers of resumptionists.

A book about research *in* practice

In science education there has been a tendency to publish books for the researcher-scholar and a different set of books for the practitioner-teacher. This book is different. There are plenty of materials, activities and suggested actions for the practitioner-teacher to take directly 'off the shelf' or to adapt for their own situations. But I think doing just that would be a waste as it misses an understanding of how, when and why the recommended actions are likely to be most successful. Teaching, like medicine and law, is moving towards what is known as *evidence-based practice* (more of this in Chapter 10). Increasingly, trainee and practising teachers and managers are being asked to justify decisions on how to teach, and what resources support it, based on evidence of what works best. In this book I set out the strategies and methods used to improve progression and continuity in science against the research background used to design them and the outcomes as seen from perspectives of the main beneficiaries – pupils and teachers. As such it is a book that places research *in* the context of classroom pedagogy and pupil learning.

Schools are increasingly being asked to evaluate what they do and provide evidence to justify their choice of actions. It is important that teachers have effective tools to do this. *Starting Science … Again* shares the methods of evaluation

and background studies so that these can be used or adapted to help self-evaluation and action research.

Structure of the book

Each chapter begins with an overview of its content so that the reader has a clear idea of what it contains and the matters discussed. At the end of each chapter is a summary of the key points and suggestions for actions that teachers and others might want to consider. Where appropriate and useful there are questions to stimulate reflection and discussion. For those unfamiliar with the English National Curriculum or the school system in the UK, there is a glossary of important terms used in the book.

Chapter 1 concerns ways in which science learning is structured and the extent to which progression and continuity should have been assured by a national curriculum.

Chapter 2 presents evidence that after transfer to primary schools many pupils regress in science. The strategies used to address this post-transfer decline are reviewed.

Chapter 3 is concerned with pupils' views on the transition from primary to secondary school science. On the positive side pupils enjoy and look forward to science as a subject – particularly practical work – but they rarely see development of their skills as a continuous process.

In Chapter 4 we turn to the teachers' voices. It seems that secondary teachers do not trust the levels at which primary pupils have been assessed and accept that work, especially experiments, are often repeated. The implications of this are discussed.

In Chapter 5 Celia Moore reviews actions that schools can take to improve primary–secondary transfer. These include, open evenings, induction days and peer mentoring. Celia discusses the emotional needs of pupils and how administrative and other policies can make a huge difference to the progress of pupils after entry to secondary school.

Chapter 6 considers the use of bridging units to tackle discontinuities in teaching and disruptions in progression in science learning. The methods are evaluated so that teachers and others can get the most out of using this approach.

In Chapter 7 a more flexible approach to bridging the primary–secondary learning gap is considered. At the core of this approach is the need to make specific reference to pupils' previous work and what they will do next.

In Chapter 8 we consider the thorny issues of assessment and share some of the successful approaches developed in work at York.

In Chapter 9 we show how teachers can work together to better understand each others' approaches. Celia Moore adds case studies of interesting work in Wales and Suffolk that take co-teaching to new levels.

In the final Chapter 10 factors that drive policy on transfer and transition are considered, as are conditions under which many of the suggestions in this book might work best.

How to use this book

It would be possible to use this book very selectively. For example one could dive straight into Chapter 6 and read about how bridging units were designed and used and be aware of some of the pitfalls. Such a reader might then be better prepared to develop their own bridging programme. Those who want to know something about observing colleagues in an alternate phase of teaching could go directly to Chapter 9, or those interested in planning liaison meetings or induction visits could go to Celia Moore's chapter (5). The student teacher preparing for an essay on progression and continuity might go straight to Chapter 1 for background reading or the policy-maker wanting overall conclusions and ways forward to the final chapter. Of course, I hope there will be readers who want a more complete story of this complex and fascinating area. For them the book can and should be read as a whole.

The York-based science transfer projects

Much of the material in this book comes from two projects on primary–secondary transfer in science based at the University of York. Both projects were funded by the AstraZeneca Science Teaching Trust which provides support for professional and curriculum development in science education (www.azteachscience.co.uk). The projects involved pupils and teachers in over 80 primary schools and 16 high schools in three separate local authorities (LAs), the City of York, North Yorkshire and the East Riding of Yorkshire. From 2002 until 2007 a programme of training was offered to LA inspectors, senior managers, teachers and advisory teachers from schools, colleges and LA services interested in improving continuity and progression in science. Over 70 groups have been trained, and talks and workshops provided in 10 different countries.

The first project, the Science Transition AstraZeneca York (STAY) project involved a team of science educators and teachers from primary and secondary schools in research and development of a programme of teaching to be used either side of the primary–secondary transfer. Two 'bridging units' Fizzy Drinks and Bread were subsequently taught and evaluated in schools in York and the East Riding. A second study called the North Yorkshire AstraZeneca Science Pedagogy and Progression (NYASPP) project involved a team of nine educators and expert teachers in development and evaluation of flexible approaches to transitions known as Scientific Enquiry Progression Tasks (SEPTs). Naturally, I have drawn heavily on this material.