“I do and I understand”
Half a century of curriculum development
Foreword

It is 50 years since the then Secretary of State for Education, Sir David Eccles, announced in the House of Commons that the Nuffield Foundation would be investing £250,000 towards the cost of a long-term development programme to improve science and mathematics teaching.

Since 1962, the Foundation has supported some 60 major curriculum projects and countless smaller ones. The largest and best known projects have been in science and mathematics, but the story goes much wider, covering languages (ancient and modern), design and technology, economics and business, English, history and more besides.

This booklet tells the story of the Nuffield Foundation’s work in curriculum development through the people and projects that have defined its work over the last 50 years.

We look back on the origins of the Foundation’s involvement in the school curriculum, examine some of the common themes underpinning its work, and reflect on the lessons learned. We conclude with a look at how the Foundation’s current activities are building on past innovations to deliver high quality education research and development.

The projects described in the following pages result from collaborations between very many people and institutions. The Foundation has acted as convenor and funder, and sometimes as instigator; but the work has been done by teachers, academics, scientists, civil servants, examiners, publishers, students, designers and many more. It is their work and their inspiration that we celebrate in this booklet.

Anthony Tomei, Director
Inspiration
In the early 1960s, there was no statutory, centralised control of the curriculum and government policy was against direct intervention. Yet at the same time, there was a growing consensus among government, leading scientists, Her Majesty’s Inspectorate (HMI) and the Science Masters’ Association (now the Association for Science Education) that science education was in need of major reform.

In 1961, recognising this desire for change, the Nuffield Foundation convened a meeting attended by government ministers and other key figures in science and education. At the meeting, John Lewis, a physics teacher from Malvern College, spoke about his recent experiences in the Soviet Union, where he had been impressed by science teaching that was supported by a wealth of centrally produced resources. Realising the potential for the Nuffield Foundation’s intervention, the Director, Leslie Farrer-Brown, began to explore the possibility of a major education project. He presented his proposal to Trustees at the end of 1961 and was enthusiastically supported by Sir Alexander Todd, a Trustee of the Foundation and a Nobel prize-winning scientist and chair of the government’s Advisory Committee on Scientific Policy. Trustees decided not only to fund the project, but to develop it in-house.

In 1961, John Lewis, a physics teacher from Malvern College, spoke about his recent experiences in the Soviet Union, where he had been impressed by science teaching that was supported by a wealth of centrally produced resources. Realising the potential for the Nuffield Foundation’s intervention, the Director, Leslie Farrer-Brown, began to explore the possibility of a major education project. He presented his proposal to Trustees at the end of 1961 and was enthusiastically supported by Sir Alexander Todd, a Trustee of the Foundation and a Nobel prize-winning scientist and chair of the government’s Advisory Committee on Scientific Policy. Trustees decided not only to fund the project, but to develop it in-house.

Leslie Farrer-Brown’s proposal became the Science Teaching Project, which sought to modernise science education for all 5- to 18-year-olds. It began with O level courses in biology, chemistry and physics, followed by mathematics and junior science courses for 5- to 13-year-olds, a science course for teaching in secondary modern and comprehensive schools, and a suite of advanced level science courses. It was the first large-scale attempt to reform both teaching approaches and content in school mathematics and science.

“An excellent and most generous action...”
On April 4th 1962, in response to a Parliamentary question, the Minister of Education, Sir David Eccles, announced:

“The Nuffield Foundation has decided to make available £250,000 towards the cost of a long-term development programme to improve teaching in these subjects [science and mathematics]. This is an excellent and most generous action for which I am very grateful...”

The accompanying press release stressed the cooperative nature of the venture, which involved the Curriculum Study Group, Her Majesty’s Inspectorate, all branches of the educational service, professional scientific institutions, industry, the Science Masters’ Association, the Association of Women Science Teachers, the Gulbenkian Foundation, and the American curriculum reform movement.
The Nuffield Foundation has been involved in many curriculum projects since the 1960s, covering a range of subjects, ages and approaches. But there are a number of underlying themes that are consistent throughout all its work.

Innovation

The Foundation’s independence as a funder enables it to stimulate projects that are innovative or experimental. The early projects encouraged active exploration by students and used practical work as a way of introducing scientific concepts. For example, ‘I do and I understand’ was not only the title of the 1960s Nuffield Mathematics teachers’ guide – it was the central tenet of the project. Similarly, the Nuffield O level physics team wanted students to “be a scientist for the day”. Classroom resources from these projects demonstrated an approach based on problem-solving and discussion rather than teacher-lecture.

In more recent years, these early approaches have been criticised for confusing teaching and learning approaches with the methods of the discipline. For example, there was an assumption that students could ‘rediscover’ scientific theories which took years of research to develop.

Innovation also relies on identifying innovators. The practice of backing talented people combined with the Foundation’s ‘open door’ to proposals of exceptional merit means there is no single ‘Nuffield approach’. For the same reason, a focus on science, technology and mathematics education has not excluded work in other areas such as languages, history, economics, and citizenship.

Influencing policy

The Nuffield Foundation has been influential in education policy since Leslie Farrer-Brown convinced the Ministry of Education to start the Science Teaching Project with O level courses rather than A level.

More recently, the 1998 report, Beyond 2000, proposed that science education should include ‘science for citizenship’ as well as preparing scientifically able students for further education in science. This recommendation was endorsed by the House of Lords Science and Technology Committee and had a major influence on the Qualifications and Curriculum Authority (QCA) in its drafting of the 2006 national science curriculum.

Similarly, this influence can be seen in the debate about post-16 mathematics education. The Foundation’s 2010 report, Is the UK an outlier?, by Dr Jeremy Hodgen, highlighted the comparatively low levels of participation in post-16 mathematics in the UK. This finding was quoted heavily in the 2011 Advisory Committee on Mathematics Education (ACME) report, Mathematical Needs, and was referenced in both Carol Vorderman’s report on mathematics education and the Wolf Report on Vocational Education. In response to this growing body of evidence, the Secretary of State said in 2011 that a desirable goal would be for the vast majority of pupils to be studying mathematics to the age of 18 within the next decade.

Evidence-informed practice

The move of the Nuffield team to Chelsea College in the 1970s encouraged a two-way exchange of ideas between curriculum developers and researchers. The Foundation continues to support research and its translation into policy and practice today through grant-making and evidence-informed curriculum development.

This approach can be seen in Nuffield Primary Science, which was led by Professor Paul Black in the 1980s. Professor Black’s team used research evidence relating to primary school children’s ideas about science to provide practical guidance for teachers.

In 2002, the Foundation funded Professor Jonathan Osborne’s IDEAS project (Ideas, Evidence and Argument in Science Education), which developed materials designed to support teachers’ understanding of the nature and function of argument in science. It was inspired by research evidence suggesting that the opportunity to consider why some ideas are wrong is as important as understanding the justification for accepted ideas.

Quality

The Nuffield name is associated with high quality resources for teaching and learning. Central to this quality assurance is a development process that includes a school-based trial stage and the subsequent opportunity to make revisions in light of feedback from teachers.

Although the Foundation no longer operates a publications group as it did in the 1960s, it has continued to undertake in-house curriculum development in partnership with commercial publishers. This model has enabled the Foundation to utilise the marketing expertise and networks necessary for the widespread trialling and adoption of new courses, as well as the means to invest in the production of books and electronic resources.

In the last decade, increasing use has been made of websites to communicate with teachers and disseminate resources, for example through a suite of websites offering practical activities in biology, chemistry and physics.
Lessons learned

One of the Foundation’s early aims in its education projects was to demonstrate the value of curriculum development, and to inspire other organisations to do the same. The expectation was that curriculum development would be carried forward in universities and by the Schools Council, set up in 1964.

Timely evaluation

Significant change in schools takes time. The dissemination and impact of innovations has to be judged over decades, not years. Short-term evaluations tend to give results that are hard to interpret and which may be misleading.

A holistic approach

Curriculum development is most effective when it considers in parallel content, teaching approaches, teacher professional development, and assessment.

From the 1960s onward, Nuffield Foundation projects have included the development of questions for use in class, and collaboration with examination boards to reform assessment. In the 1990s, the Foundation funded the Assessment Reform Group, which made recommendations on how assessment policy and practice at all levels could take account of relevant research evidence.

Professional development of teachers has always been important to the adoption of new projects. The 1960s science projects used action research methods, which involved careful briefing of teachers on the underlying philosophy of the development. The 1990s Nuffield Primary Science resources included four ‘in-service’ training modules.

More recently, the potential for professional development has been challenged by the difficulties teachers experience in putting aside the necessary time.

Lessons learned

Wider political context

Experience has revealed a number of key factors in successful curriculum development. The science projects of the 1960s had widespread impact in part because they were developed in response to educational and political consensus for change. This remains true today. In 1995, the Foundation initiated a review of science education in order to have some concrete proposals in place for the end of the government’s five-year moratorium on curriculum change. This review began with a seminar series and ended with Beyond 2000.

More recently, growing consensus about the inadequacy of post-16 mathematics pathways provided the Foundation with an opportunity to commission research that could provide the evidence base for reform.

Assessment for Learning

In 1996 the Foundation funded Paul Black and Dylan Wiliam to carry out a literature review on the use of assessment to help with learning. They found decisive evidence that ‘formative assessment’ could improve learning, and published a booklet for practitioners called Inside the Black Box. A further project, also funded by the Foundation, showed teachers how to apply the principles in practice. The underlying idea, now widely known as ‘assessment for learning’, is quoted in the research and policy literature in many countries.

Reflecting on the project, Professor Paul Black quotes a student who said of her teacher, a participant in the development project: “Now I know she is interested in what I think, not in whether I’ve got the right answer”.

“Some projects have had an immediate widespread influence with a large take-up by teachers; some have been a bit too radical for the majority of teachers at their time but have come to significantly influence later developments more indirectly; some have been thwarted by political changes but have nevertheless had a strong influence on national policy.”

Professor Margaret Brown, King’s College London

Timing

There is an inevitable element of risk in supporting new initiatives and not all of them are successful, particularly if the timing is wrong. For example the Advanced Mathematics project featured modern mathematics, including its applications in art and music, to promote independent study and exploit the power of programmable calculators and computers.

The project was launched in 1994 just as league tables began to have a major influence on school decision-making. As a result, this innovative and challenging course was adopted by very few schools and colleges and was short lived.

“I do and I understand” Half a century of curriculum development
There has been an increasing government role in the development and regulation of the curriculum, for example, in the introduction of the National Curriculum in 1988 and subsequent rationalisation of the awarding bodies. In recent years, government control has receded slightly, as successive governments have given greater autonomy over the curriculum to free schools and academies. Commercial publishers have also played an increasing part in curriculum development, and there has been a changing emphasis on teacher professional development.

The Nuffield Foundation works within this changing social and political context, requiring a flexible approach. Many curriculum projects have been developed in-house. Others have been commissioned, or supported through responsive grant-making. But underpinning all this work is a commitment to support an evidence-informed approach, at both policy and classroom level.

Current focus

In the last two years, there has been a change in government for the first time in 13 years, a review of the National Curriculum (currently underway), and a wider debate about the role of various education agencies. As a result, the Foundation’s focus has shifted to supporting smaller scale development and interventions rather than large, in-house projects. Trustees are keen to strengthen the links between strong research evidence and the resources and teaching approaches that exemplify it.

Our work in science and mathematics education is part of a wider education programme. Other priority areas for us include Foundations for learning, focusing on the early years; Secondary education transitions, examining the significance and impact of transitions into, through and out of secondary education; and Women’s education and student parents, aimed at improving opportunities for access and support to education.

Science and mathematics for all

The Foundation is committed to supporting education projects that ensure all young people develop the understanding and skills required to play an informed role in society. This commitment is evident in the philosophy of projects such as Twenty First Century Science. It is an approach that requires the provision of different pathways appropriate for different students’ needs.

Similarly, the Foundation is currently advancing the case for wider participation in post-16 mathematics. Trustees have awarded a grant to Dr Jeremy Hodgen for a follow-up study to Is the UK an outlier?, and we have recently published findings from a project to examine the mathematical content of A level assessments in six subjects (alongside a similar project by SCORE). Trustees are also keen to promote mathematical and statistical thinking in social sciences and in the wider world, for example, through support of projects such as the Royal Statistical Society’s getstats campaign.

Working in partnership

From the roll-out of the Science Teaching Project, to the development of three practical science websites, the Foundation has always sought to increase its expertise and impact through collaboration with others. A recent drive to disseminate and embed our education projects in schools and colleges has involved forming partnerships with the Science Learning Centres, Teach First, the National Centre for Excellence in the Teaching of Mathematics, and the Centre for the Use of Research and Evidence in Education. We are working with Teach First Higher Education Access Programme for Schools, which links mentors with sixth form students, and the Realising Opportunities programme, run by a group of research intensive universities. We are also working with the Brightside Trust to develop a mentoring programme combining face-to-face and web-based support.
Minister of Education, Sir David Eccles, announces the Nuffield Foundation will grant £250,000 towards a programme to improve science and mathematics teaching.

First German publications from the Nuffield Languages Project.

More information about all these projects, including details of their development and links to available resources, can be found in our online archive at www.nuffieldfoundation.org

Publication of the French course, Triclore. Its descendent, Encore Triclore, lives on today.

Teaching Primary Science is designed for teachers with little background knowledge in science.

Launch of the Russian course, Novaya Iskra, which is still in use today.

Teaching methods from the Science Teaching Project are applied to modern languages and the Cambridge School Classics Project.

A levels in Biology, Chemistry and Physics enable different examining groups to determine the form and content of the assessment scheme. Revised editions were published between 1985 and 2000.

Teaching Primary Science applies the philosophy of ‘I do and I understand.’ First edition sells over one million copies.

First German publications from the Nuffield Languages Project.

A level Physical Science combines common areas of chemistry and physics but fails to convince medical schools that it offers a viable alternative to pure chemistry.

Nuffield Working with Science offers a series of applied science resources in response to the raising of the school leaving age in 1972.

Nuffield Science 13-16 provides a modular, integrated science course for comprehensive schools.

Nuffield Home Economics encourages a scientific, investigative approach to technology education.

Nuffield Co-ordinated Sciences meets new requirements for all pupils to spend 20 per cent of their curriculum time doing science.
Half a century of curriculum development

Timeline continued...

Nuffield Advanced Mathematics exploits the power of programmable calculators and computers, but few schools adopt the course.

Nuffield Science in Practice resources support GNVQ courses in schools and colleges.

Pathways through Science offers differentiation in a double-award GCSE science course.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Nuffield Secondary Design and Technology aims to make the subject accessible, and rooted in practice.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

Nuffield Secondary Mathematics provides a step-by-step ladder of achievement from any starting point.

Nuffield Secondary Science provides materials based on research into children’s ideas about science.

Beyond 2000: Science education for the future, argues that the science curriculum should be designed to develop the scientific literacy of future citizens.

Free-Standing Mathematics Qualifications and AS level Use of Mathematics provide post-16 mathematics to support study in other subjects.

Nuffield Design and Technology is extended to primary schools.

Salters-Nuffield Advanced Biology uses realistic contexts to engage students with biological principles.

Pathways through Science offers differentiation in a double-award GCSE science course.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Secondary Mathematics provides a step-by-step ladder of achievement from any starting point.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Timeline continued...

Nuffield Secondary Mathematics provides a step-by-step ladder of achievement from any starting point.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.

Nuffield Primary History offers resources based on seven key principles for teaching and learning history.

Science for Public Understanding AS level course applies the principles of Beyond 2000.

www.practicalphysics.org, developed in partnership with the Institute of Physics, provides practical protocols and guidance for teachers and technicians.