



“The Stimulating Physics Network has unrivalled reach, working with teachers in more than half of all maintained secondary schools in England.”



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“Your SPN session gave us one of the most productive and effective INSET sessions I’ve ever had!”

MEASURING IMPACT, EVALUATING SUCCESS

An independent report on the first phase of the Stimulating Physics Network **2009 – 2011**

A PUBLICATION FOR:

- Stimulating Physics Network Partner Schools
- Schools with an interest in working with the Stimulating Physics Network to enhance their physics teaching and learning
- Policymakers and stakeholders in science education and teacher development (including ITT/CPD providers, outreach departments, learned societies, and charitable bodies)

Background and Introduction

The Stimulating Physics Network is a project funded by the Department for Education (DfE), managed by the Institute of Physics (IOP) in partnership with MyScience.co Ltd (which runs the Science Learning Centre network).

The Stimulating Physics Network is based on the principle that physics is an important, relevant and intellectually challenging discipline that all pupils should have the opportunity to experience through high-quality teaching.

The objective of the project is to improve the quality of pupils' physics experience in schools and to reinvigorate a culture of physics in science departments, as indicated by an increase in the uptake of physics at A-level. Within this, the Stimulating Physics Network has a series of aims:

- to raise the profile and perceived value of physics in schools;
- to support the professional development of physics teachers;
- to develop pupils' perceptions of physics as exciting, accessible, aspirational and relevant to their lives.

This document reports on the impact of the Stimulating Physics Network with respect to each of these three aims, during its first phase of operation (2009 - 2011).



The help given was unique as I cannot think of another way of accessing this information, knowledge and ideas.

Teacher at an SPN Partner School



Operation of the Stimulating Physics Network

The Stimulating Physics Network works with physics teachers and schools through two distinct yet complementary strands. Our 'Global Support' offers programmes of workshops, networking opportunities and other professional development events in every region in England. These programmes are delivered through a 50-strong team of Physics Network Co-ordinators (PNCs), and are available to all physics teachers in all schools, free of charge.

The second strand focuses on developing intensive partnerships with selected schools. A team of 23 Teaching and Learning Coaches (TLCs) work with a cohort of 276 Partner Schools, facilitating tailored programmes of CPD for individual departments and non-specialist teachers of physics, developing both subject knowledge and 'pedagogical content knowledge' (PCK)¹.

The evidence in this report comes from a range of sources, including:

- an independent evaluation of the Stimulating Physics Network²;
- independent research into mentoring and coaching models used by the Stimulating Physics Network, led by the University of Nottingham³;
- reflective activities and diagnostic tests of subject knowledge completed by non-specialist teachers of physics attending Stimulating Physics Network Summer Schools;
- project reports made periodically to the DfE;
- case studies of Partner Schools completed by Teaching and Learning Coaches.

Further information on the aims, operation and strands of the Stimulating Physics Network, including contact details, can be found at stimulatingphysics.org.



¹ Shulman, L. (1987) 'Knowledge and teaching: foundations of the new reform' Harvard Educational Review, 57, pp.1-22

² Babcock Research (2011) Evaluation of the Stimulating Physics Network: Final Report

³ Hobson, A.J. & McIntyre, J. (2011) 'Never leave yourself open to [someone] thinking I'm stupid: performativity and the case for external mentors for teachers', paper presented at the European Conference for Educational Research, 13th September 2011, Berlin

Aim: To raise the profile and perceived value of physics in schools

The Stimulating Physics Network aims to develop the perception of physics in schools, amongst pupils and teachers, and particularly in partner schools. Recent longitudinal studies have shown the value of whole-school approaches to improving pupil achievement in the sciences⁴.

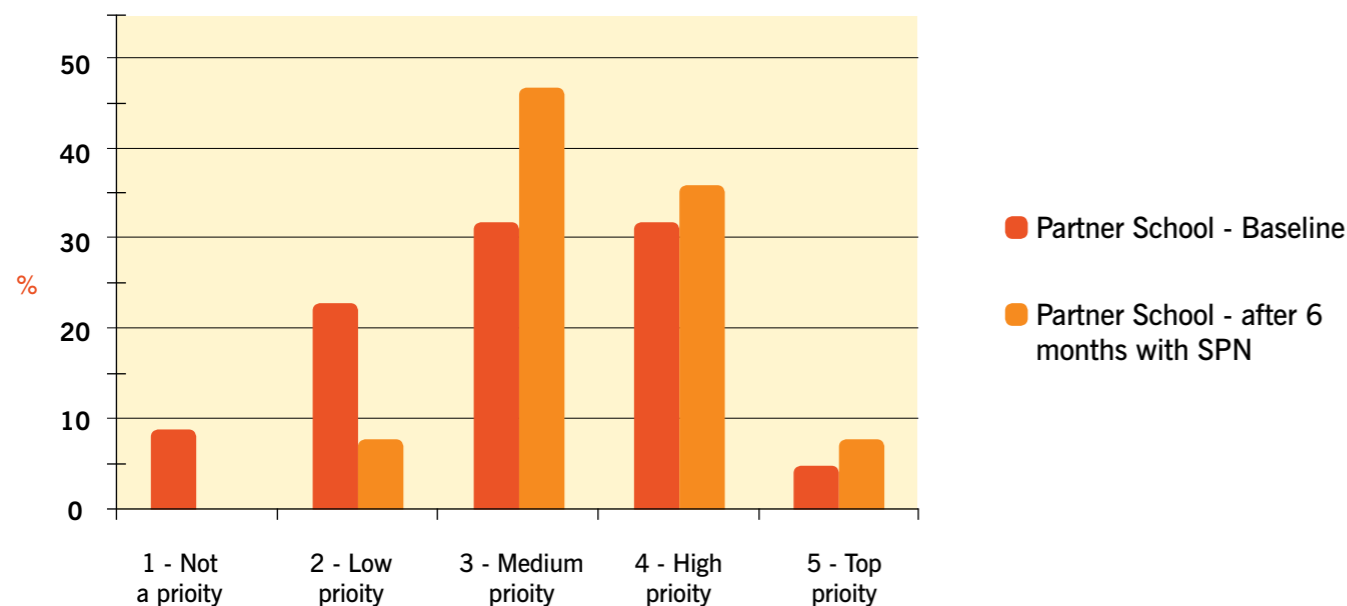
The Teaching and Learning Coaches, along with the External Liaison Officers (ELOs) employed by the Science Learning Centres, work closely with the senior leadership team in SPN Partner Schools to align the aims of the programme with whole-school strategies.

Independent research showed that the value Partner Schools gave to physics increased after six months' engagement, specifically:

- school leaders were more likely to “strongly agree” that a vacancy in the physics department should be filled by a specialist physics teacher;
- school leaders gave a higher priority to physics when allocating extra resources in the school;
- heads of physics departments felt that physics-based CPD was given a higher priority by school leaders;
- a majority of physics teachers would either regularly, or always, seek to ensure physics was taught by specialists; compared to 40% in a control group of schools;
- after six months' engagement with the project, the proportion of physics teachers who felt that their school gave physics a lower status than other subjects, fell from 12% to 3%.

The graph below shows how the perception of physics in Partner Schools changed over time; the increase in perceived value was greater than in a control group of schools over the same period⁵.

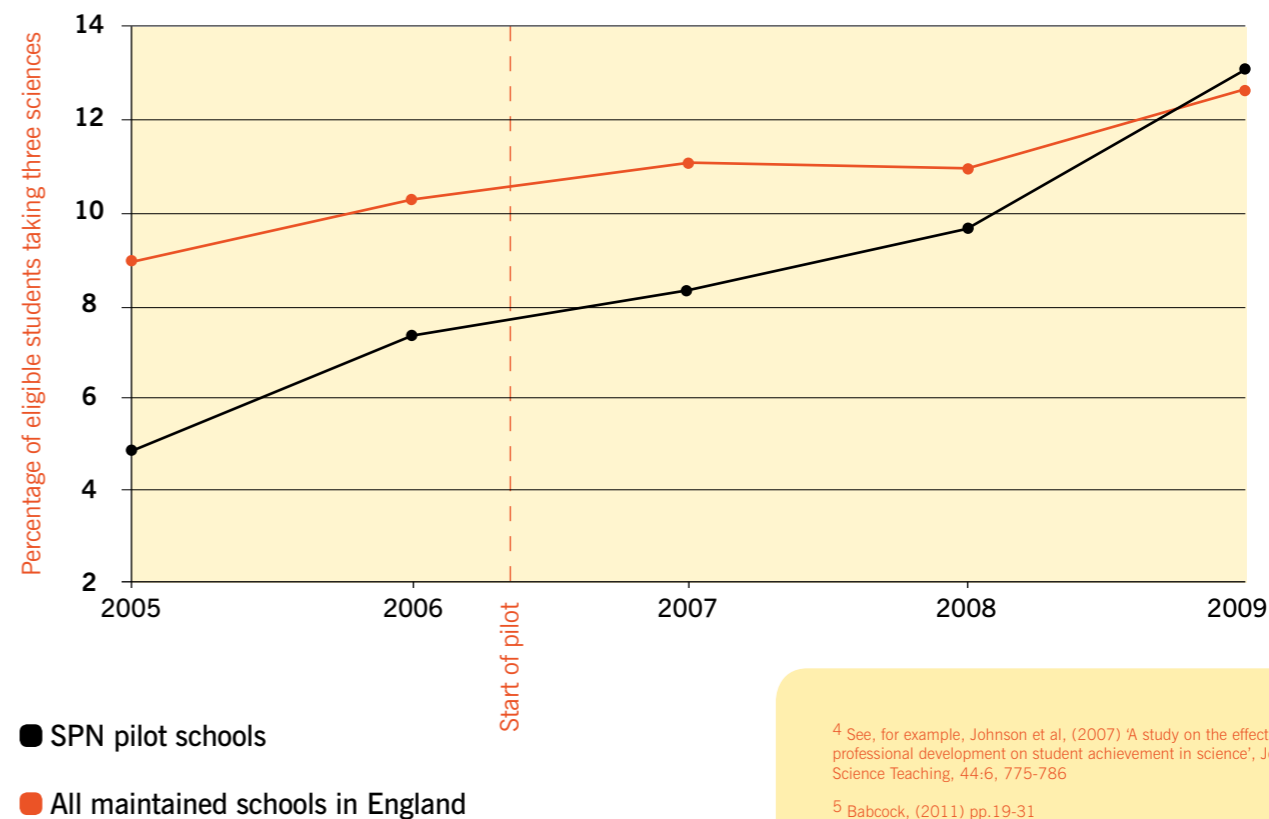
Physics teachers' perceptions of the priority given to physics by their school (Partner Schools)



In Partner Schools, the average number of physics-based ‘enrichment and enhancement’ activities delivered to pupils nearly doubled within six months. These included science clubs, national and regional science competitions, lectures outside the classroom, and taster days at universities⁶.

Longitudinal analysis from a pilot group of schools working with the Stimulating Physics Network showed improved attitudes towards both physics and the sciences generally, in the number of pupils who choose to take the Triple Science GCSE. The chart below shows that the proportion of eligible pupils taking Triple Science, in pilot schools and nationally. Between 2007 and 2009, the uptake in pilot schools went from less than 80% of the national level to slightly above it.

Proportion of eligible pupils taking Triple Science



⁴ See, for example, Johnson et al, (2007) 'A study on the effect of sustained, whole-school professional development on student achievement in science', Journal of Research in Science Teaching, 44:6, 775-786

⁵ Babcock, (2011) pp.19-31

⁶ Babcock (2011), pp.5, 34



Aim: To support the professional development of physics teachers

Pupil achievement has been consistently linked to the quality of teaching provision⁷; the quality of teaching depends on good subject knowledge and a sound understanding of content pedagogy⁸.

In the period 2009 – 2011, the Stimulating Physics Network demonstrated unrivalled reach, working with teachers in more than half (over 1,700) of all maintained secondary schools in England. Over 97% of the teachers attending ‘global support’ workshops felt that the workshop would have a positive impact on their classroom practice. In total, the field workers of the Stimulating Physics Network led over 39,000 teacher-hours of CPD⁹.

Partner Schools work intensively with Teaching and Learning Coaches to facilitate the development of teachers’ subject and pedagogical knowledge. Teaching and Learning Coaches are selected for their expertise and enthusiasm in teaching physics, and all have recent experience of teaching physics and managing professional development. Teaching and Learning Coaches create a bespoke programme of CPD workshops and events for each physics department.

I wanted to let you know that you inspired us – not just how to teach this subject, but also inspired us to want to know more physics! You were truly fantastic - inspiring and refreshing, and I think I speak for us all when I say your SPN session gave us one of the most productive and effective INSET sessions I’ve ever had.

Teacher at an SPN Partner School



Teaching and Learning Coaches also engage in collaborative teaching, taster lessons, masterclasses, physics shows for pupils, and work with physics technicians, advising on the use and sourcing of physics equipment. Teaching and Learning Coaches can also support in-school interventions aimed at increasing the number of girls studying A-level physics. One Teaching and Learning Coach reported that ‘demonstrations of

practical techniques were shown – such as how to use a spark counter in radioactivity and how to set up and use a ripple tank. Discussions also included common misconceptions and how to avoid perpetuating them’.

One teacher working in a Stimulating Physics Network Partner School reported that “my knowledge and understanding of the subject has deepened immensely”; another that “what I used to think were simple ideas are not so simple! It makes it easier to see why pupils go wrong, and correct their thinking”.

After six months, the amount of physics-based CPD in Partner Schools had doubled in comparison to a control group of schools¹⁰; and that 34% of Partner Schools had taken out a subscription to a physics journal, up from 19%¹¹. This indicates the schools’ engagement in the teaching of the subject and the reinvigoration of a culture of physics.



Summer Schools

Non-specialist teachers¹² in Partner Schools also have the opportunity to attend, free of charge, a four-day residential Summer School; hosted at either an Oxford college or the National Science Learning Centre in York. The Summer Schools are led by Teaching and Learning Coaches, and provide an intensive series of workshops, along with the opportunity share good practice with colleagues from across the country. Feedback on the workshops and the Summer Schools as a whole has been consistently positive, and teachers’ responses indicate a lasting impact on both their own capability and the practice in their department¹³.

“A fundamental change in thinking on forces – I understand it much better now. I will rewrite the forces, energy and electricity schemes of work to bring in new ideas”

⁷ See, for example, McKinsey (2007) How the world’s best-performing school systems come out on top; and DfE (2010) The Importance of Teaching: A Schools White Paper

⁸ Brant, J. (2006) Subject knowledge and pedagogic knowledge: ingredients for good teaching? An English perspective. *Edukacija*, 94 (2). pp. 60-77

⁹ IOP (2011) Stimulating Physics Network: Report to the DfE, March 2011

¹⁰ Babcock (2011): p.5

¹¹ *Ibid.*, p.31

¹² Defined as those who teach physics but do not have an academic or teaching qualification in physics, or a related discipline

¹³ Plenary reflections of teachers attending the Oxford Summer School, 2011

“The course has enhanced my subject knowledge and identified my own misconceptions, and those my pupils will have. I have come across a whole range of activities and practicals that I will implement”

“Will be introducing the rope method of teaching electric circuits to Year 7 students”

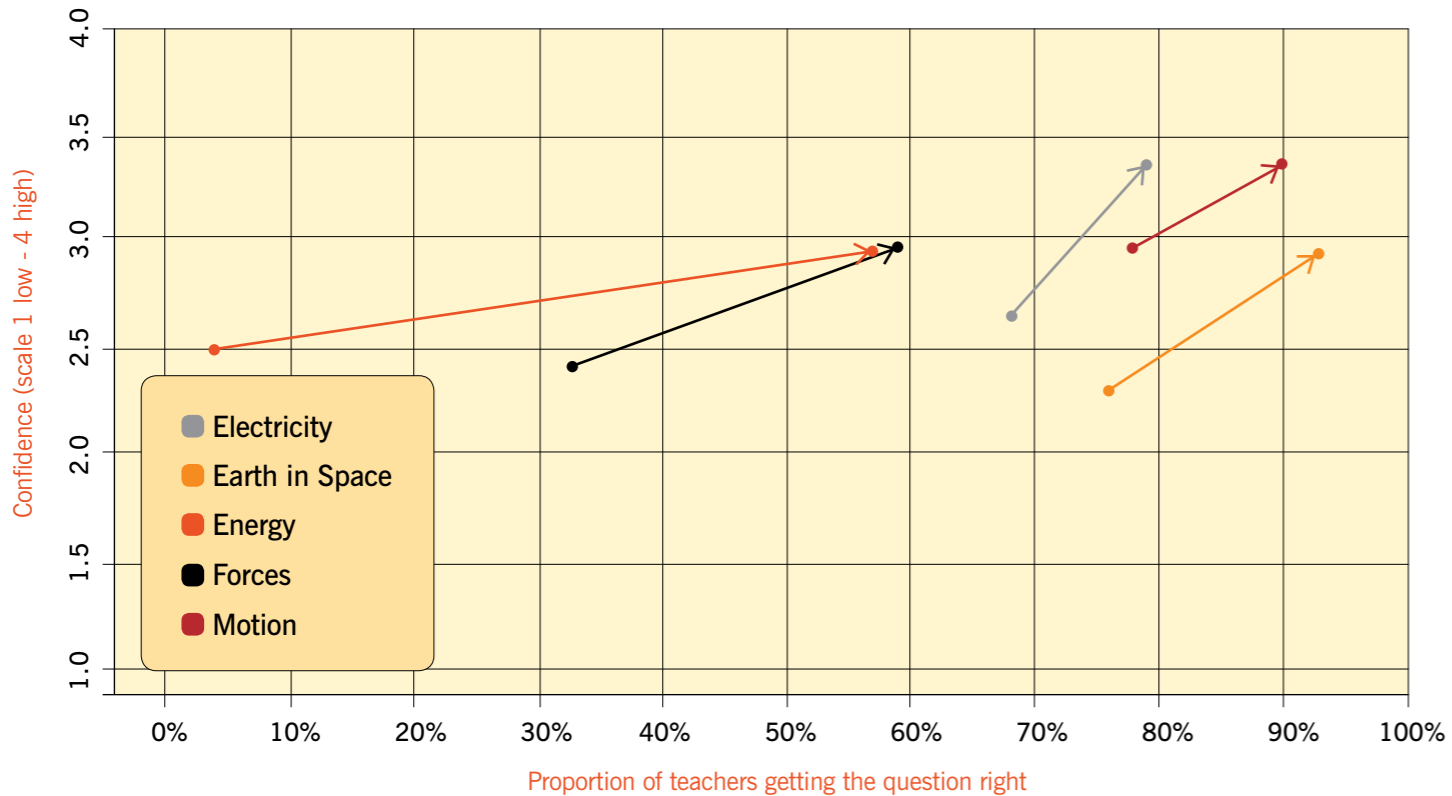
“I cannot thank the Teaching and Learning Coaches enough as their approach has not only given me a few ‘light-bulb’ moments but challenged me to think about how and when to use models”

“The teaching of energy will be dramatically changed.”

“I will set up an INSET to pass on everything I have learned to the rest of my department”

In the 2011 Summer Schools, teachers were asked to complete short tests of their physics knowledge before and after the event; as the graphs below show, there was a clear increase in physics knowledge and perceived confidence amongst the teachers¹⁴.

Impact Analysis (York, ‘Year One’ teachers)



The arrows on this graph represent the change in the test results for the cohort, from the beginning to the end of the Summer School.

Professional Identity

The Stimulating Physics Network aims to develop the professional identity of non-specialist teachers of physics, to the point where they perceive themselves as a ‘physics teacher’, rather than – for example – a ‘biology teacher who teaches some physics’. Development of professional identity can influence the quality of teaching, identification with the subject, and willingness to engage with CPD and reflective practice¹⁵.

A growing sense of professional identity can be seen through improved confidence with the subject of physics. After six months’ participation in the Stimulating Physics Network, non-specialist teachers of physics reported an increase in confidence in every aspect of teaching physics; in the same period, the confidence of non-specialists in a control group of schools actually decreased¹⁶.



	SPN		CONTROL	
	BEFORE	AFTER	BEFORE	AFTER
Teaching physics lessons from a scheme of work	3.5	3.6	3.7	3.6
Devising physics lessons that truly engage students	3.0	3.5	2.9	2.8
Designing practicals / experiments	2.6	2.8	2.6	2.2
Explaining the scientific principles behind practicals / experiments	3.2	3.4	3.1	2.8
Answering unexpected and complicated questions in class	2.7	2.9	2.9	2.6
Show students what it is like to think like a physicist	2.6	2.8	2.9	3.0
Teaching more complex physics theories / giving relevant examples	2.4	2.6	2.3	1.8

Scale: 1 - not confident at all 2 - not very confident
 3 - fairly confident 4 - very confident

¹⁴ Summer School Report, 2011

¹⁵ For more on this, see Helms, J.V. (1998) ‘Science – and me: Subject Matter and Identity in Secondary School Science Teachers’ *Journal of Research in Science Teaching*, 35:7 pp.811-834

¹⁶ Babcock (2011): p.28

Following key theories of adult learning and professional development¹⁷, Teaching and Learning Coaches ensure that any programme of CPD is negotiated with the school and teachers, to ensure non-specialist teachers have ownership of the learning process. One Teaching and Learning Coach reported that ‘staff were given time to audit their own needs and decide, as a department, the CPD they needed’.

Independent research¹⁸ has highlighted the benefit of the Teaching and Learning Coach acting in this ‘external mentor’ role to teachers, which allows non-specialist teachers to build their confidence without fear or restriction. One non-specialist said, “I’ve used the Teaching and Learning Coach loads and can ask stuff that I would feel a bit too stupid to ask colleagues... Teaching and Learning Coaches don’t seem to judge”; and one Teaching and Learning Coach reported, “Teachers need someone to develop a long-term relationship with who they can consult without feeling they will be judged... a critical friend, who will support and challenge in a non-judgemental way”.



Non-specialist teachers of physics who have engaged with the programme have reported, directly or implicitly, a range of ways in which their professional identity as a physics teacher has developed:

“There is no way at all before this [Stimulating Physics Network] that I would have volunteered to teach GCSE physics but now I look at it and I think ‘Why not?’ “

“[After my NQT year] I would like to try and specialise in physics as a second subject”

“We are going to have a lot of discussion with the department – some will take the ideas on board easily, but I can foresee a lot of disagreement!”

“...One of the most productive and effective INSET sessions I’ve ever had. We were still talking about physics when we all met in the pub that night!”

“I really will be looking to dig out equipment that has been sitting unused... and make GCSE physics fun and approachable for staff and students... I also want to run a physics roadshow... and language development... and careers...”

¹⁷ e.g., Knowles, M. et al, (1998). ‘The Adult Learner: the definitive classic in adult education and human resource development’. Fifth edition. Houston: Gulf.

¹⁸ Hobson & McIntyre (2011)

Case study

Inspiring enthusiasm at a Stimulating Physics Network Partner School

None of the six science teachers at this Partner School had a degree in physics or engineering but one of the teachers, a biologist, had discovered a passion for physics and after retraining on the SASP course was now forging ahead as the department’s KS4 co-ordinator and physics teacher. As a Teaching and Learning Coach, my aim was to spread this enthusiasm throughout the department and enhance their physics knowledge and confidence so that they could inspire their students.

Over the last year, I have run CPD sessions on gravity and space, KS4 astrophysics, electricity and electric fields as well as energy, offered guidance on implementing new approaches into their KS3 scheme and observed KS5 lessons. The responsiveness and enthusiasm of the teachers has certainly inspired me. They have all grasped the opportunity of working with the Stimulating Physics Network to re-discover their understanding of physics teaching, as feedback I have received from the teachers shows:

“Looking at the electricity scheme of work and rearranging the topics, linking in ideas about magnetic and electric fields was very useful. The CPD sessions have clearly pointed out things we all knew but didn’t emphasise in lessons..”

“I’ve been teaching for fifteen years and I’m being reminded what ‘proper’ rather than ‘school’ physics is – I’ve had to relearn it.”

This willingness to learn new things characterises the whole science department, even the technicians have seized the chance to work with me and increase their knowledge and skills by attending a technicians’ training day.

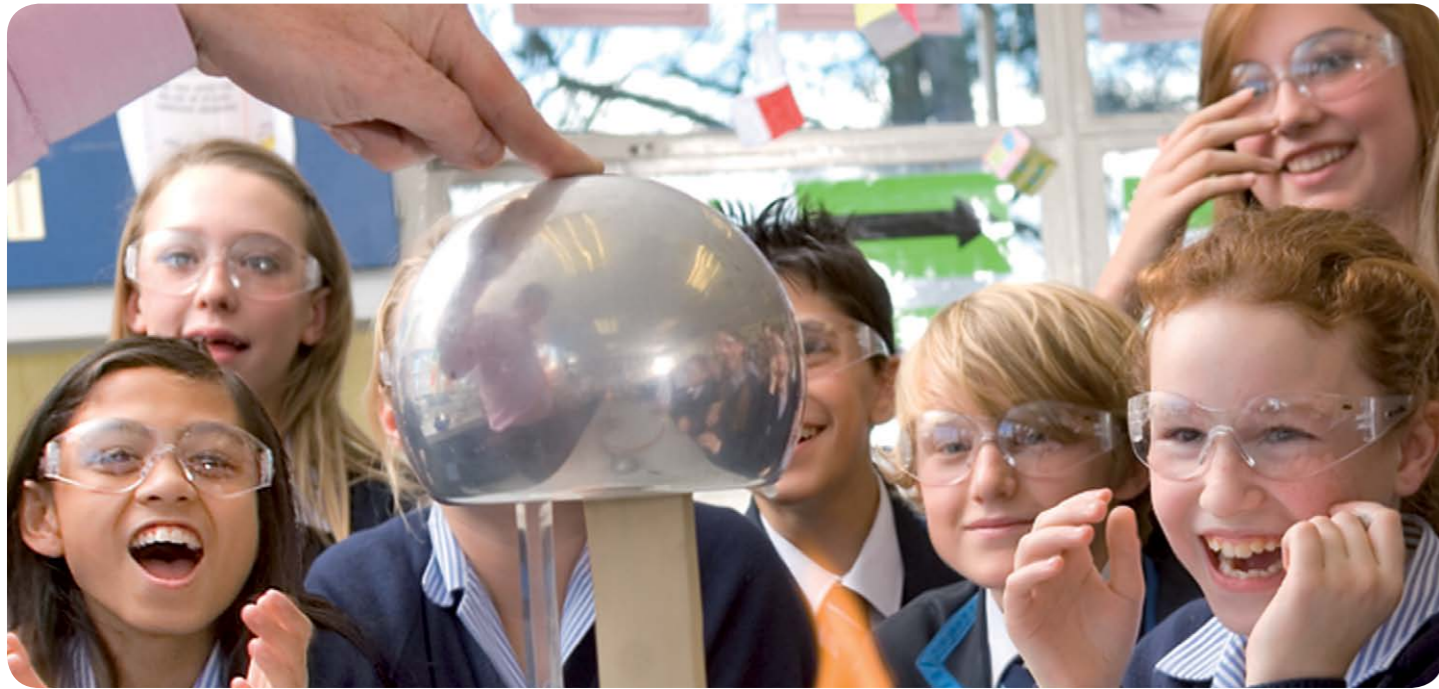
The impact on students is seen in the change in teaching methods the staff report:

“It has given us confidence not to follow the textbooks but to think through the physics ideas ourselves. I find the group discussions [during CPD sessions] useful, I let the kids go through the same process themselves in lessons.”

“I correct myself more and reconsider my language...I really like the models we have been introduced to, the rope model and orange liquid.”

Undoubtedly the success of SPN within this Partner School would not have happened without an enthusiastic head of department and a team of teachers open to learning new things, but with their commitment the results are all positive... A greater percentage of the higher ability GCSE students are choosing to continue with physics, from 15% three years ago to 20% this year. The department has achieved 92% A* - C in GCSE physics despite having no staff member with a physics-related degree.

Teaching and Learning Coach
South East



Aim: To develop pupils' perceptions of physics as exciting, accessible, aspirational and relevant to their lives

The Stimulating Physics Network aims to address the disparity between the uptake of A-level physics, and the uptake of biology, chemistry and mathematics (particularly in the case of girls)¹⁹. We believe that an increase in A-level numbers represents an improvement in pupils' experience of physics at school between the ages of 11-16.

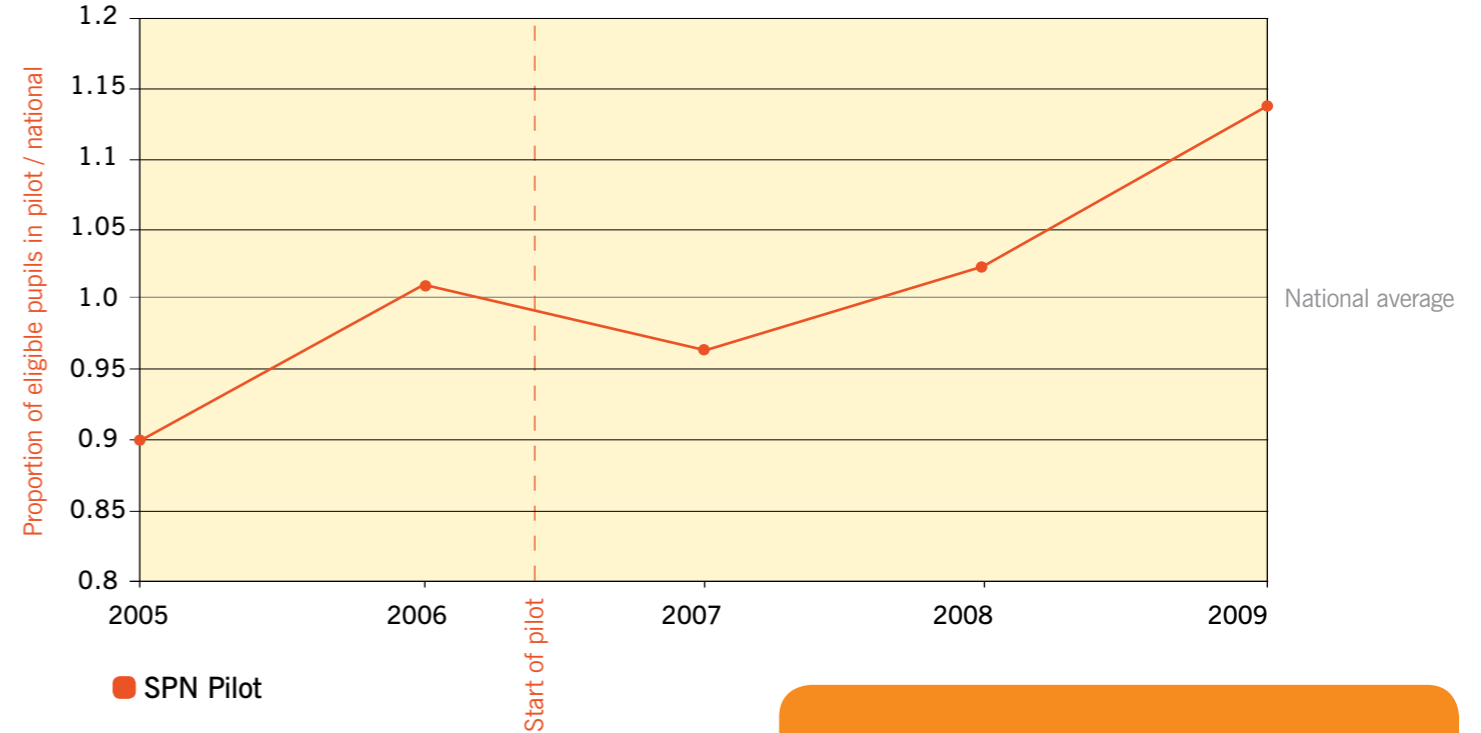
After six months with the Stimulating Physics Network, 40% of Year 11 pupils responding to an independent evaluation suggested they were 'likely' or 'very likely' to choose physics at A-level²⁰. During the pilot period of the Stimulating Physics Network project (2005-2009), the uptake of AS-level physics in participating schools increased from 4% below the national average to 14% above the national average (see opposite page).

Discovering new and practical ways of teaching physics was helpful in building models or ideas that were more relevant to the students' everyday lives. This was especially useful in the 'waves' topic where I used video clips of ray guns, sound weapons and, my favourite, the iPhone cooking popcorn. They were a great lead in to the topic and sparked discussion.

Teacher at an SPN Partner School



The proportion of eligible pupils in SPN pilot schools who choose AS-level physics, divided by the proportion of eligible pupils taking physics nationally²¹



One teacher reported that "[before Stimulating Physics Network] the maximum number of students we would get in Year 12 studying physics would be about 20, in 2009 we had 38 physics students in Year 12 and 7 in Year 13. Now [September 2010] we have 40 in Year 12 and 25 in Year 13 – it's a record!"

One Teaching and Learning Coach reported that, in another school, "there has been an increase in numbers starting AS physics from 11 in 2008-09, to 18 in 2010-11."

It is worth noting that the overall AS-level numbers for all sciences in Stimulating Physics Network pilot schools went up – in other words, any increase in physics was not at the expense of biology and chemistry. In addition, the number of AS-level maths candidates also increased above the national average – which may be attributable to the interdependence of physics and maths²².

The demonstrations had our students talking about what Science is and many of the experiments... liquid nitrogen was very popular!

Teacher at an SPN Partner School



¹⁹ JCQ (2011) 'Provisional AS Results – June 2011'

²⁰ Babcock (2011) p.6

²¹ IOP (2011) 'Impact of Stimulating Physics: longitudinal analysis of the pilot', Internal Report

²² Ibid.

In response

“When we first created the Stimulating Physics Network we knew that schools with knowledgeable and enthusiastic physics teachers generate a healthy supply of students choosing to take physics beyond GCSE, but that there were many schools where students were not choosing physics or were being denied an opportunity to take it. Our aim, therefore, was to help these schools provide their students with the opportunity, the desire and the grounding to take a subject which develops their intellectual capability and opens doors for them later in life.

“It is, of course, very encouraging that this independent report highlights the positive impact the Stimulating Physics Network is having on physics teaching and learning in many schools across England, inspiring and enabling more students to pursue this vital subject post-16. The work done by our enthusiastic teams of Teaching and Learning Coaches and Physics Network Co-ordinators is bringing physics expertise into schools and giving teachers access to inspiring, practical and effective approaches to engaging their students with all aspects of physics. However, the success of the Stimulating Physics Network is in no small measure down to the teachers, technicians and senior managers that we engage with in our Partner Schools. Through a whole-school approach, it is possible to create an environment in which physics thrives by embedding subject knowledge in teaching, bringing real-world applications and experience into extra-curricular projects and enhancing the careers resources available, so that students can realise the opportunities and excitement physics can offer.

“The success of the current work of the Stimulating Physics Network has meant that our funding has been confirmed by the government for a further two years, meaning that we can now build on our programme and engage with more schools, teachers and students around the country. Please do contact the Stimulating Physics Network team if you would like to engage with us to inspire your students.”

Charles Tracy
Head of Education Pre-19, The Institute of Physics

stimulatingphysics.org



► Get in touch

To get connected with the Stimulating Physics Network contact your regional External Liaison Officer. They will be able to give you details of events and courses happening across your region. If you want a workshop on a particular

day then you could create a cluster group with two or three other schools and look to organise a session with a Physics Network Co-ordinator for a day and time that suits you. Contact your External Liaison Officer to find out more.

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To keep up to date with what workshops and events are being planned for your area visit: stimulatingphysics.org/regions and select the page for your region.

Although the listings are split into regions there are no boundaries to our support, so if, for example, you work in London but find it easier to get to one of the East of England events then just contact the relevant PNC or ELO and book yourself a place.



STIMULATING
PHYSICS
NETWORK

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teaching and learning

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