

PGCE Science

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Introduction and Aims

The course has been structured to reflect the current secondary curriculum in science, first published by QCA in 2007, with implementation in schools starting in September 2008. However, the Department for Education is currently conducting a review of the primary and secondary National Curriculum. The early parts of the course address aspects of the range and content of the K.S.3 programme of study by considering key scientific ideas that underpin it in relation to the areas of energy, electricity and forces; chemical and material behaviour; organisms, behaviour and health; the environment, Earth and Universe.

Emphasis is also placed on the key concepts and processes that underpin the study of science and how science works.

Teaching sessions will explore aspects of science subject knowledge associated with the range and content of the secondary curriculum, key processes and concepts as well as many pedagogical themes that are particularly pertinent to the teaching and learning of science.

The teaching and learning style adopted in most sessions is one which models an active approach to learning with an emphasis on the development of your ability to develop a teaching style that allows all pupils to become active and motivated participants in science lessons. There will be opportunities to experience a variety of teaching and learning activities that can take place in a school science classroom and that present science as a diverse and exciting subject. High value will be placed on your development as a creative teacher of science.

For teaching at KS4 you will be expected to develop and **enhance** your subject knowledge for teaching in one science discipline, i.e. biology, chemistry or physics and the associated laboratory skills. There will be sessions and tutorial support available to assist you with this. The aim is to enable you to feel confident in teaching your **enhanced** area of science up to KS4/5 and with support the other science disciplines at KS4. You will be expected to be confident to teach all areas of the science curriculum at least up to KS3. Sessions will develop the application of subject knowledge to the process of teaching and learning.

In addition, some time is devoted to exploring out of school learning opportunities and industry links.

TERM ONE

In this term we prepare trainee teachers for the demands of the first teaching experience. You will be introduced to the Science National Curriculum at Key Stages 3 and 4 and to the structure of school science courses. There will be workshop sessions designed to enhance your subject knowledge and understanding including key practical skills. You will begin to audit your subject knowledge and work on developing a secure understanding of the many strands of the National Curriculum Programmes of Study. Curriculum studies sessions provide some opportunities to practise typical experiments carried out in the secondary school science classrooms. Here are some of the areas that you will be introduced to in the first term of teaching sessions:

- Your science subject knowledge: three sciences to GCSE
- What is your view of Science? / Nature of Science – Unravelling preconceptions
- Introduction to the National Curriculum and School Science courses
- Organisation of science in schools; resources and schemes of work
- Laboratory organisation and management; health and safety issues

- Looking at the key scientific ideas within the range and content of the secondary science curriculum; progression in knowledge and understanding, practical techniques, range of teaching and learning strategies, relevant ICT applications
- Key processes and concepts that underpin the study of science and how science works
- Planning effective science lessons with clear objectives and consideration of engagement and motivation
- Developing teaching strategies which support the needs of all pupils
- Supporting the EAL learner
- Uses of ICT in Science teaching and development of ICT skills
- How children learn?
- An introduction to effective classroom and behaviour management
- Communication and use of language in science
- Assessment for Learning and its importance in planning

You will also undertake a primary placement with a look at some of the issues concerning transition from KS2 to KS3 Science.

Many of the science curriculum studies sessions will allow you to explore and enhance your understanding of subject knowledge and in addition introduce you to a range of teaching and learning strategies through exploration of a range of pedagogical issues.

Subject Knowledge

What is subject knowledge?

Subject knowledge for teaching is more than just an extensive knowledge and understanding of the facts, laws, theories and applications of science. It also includes the subject specific pedagogy that goes with this. Having good subject knowledge means that you have developed a good working knowledge of how to teach your subject, the barriers that pupils face when learning science, the typical misconceptions that pupils and teachers may hold, knowledge of effective practicals, models and analogies to illustrate the concepts, good experimental skills and a strong scientific attitude, i.e. an enquiring mind, an understanding of the role of evidence, a healthy scepticism. The list goes on!

It goes without saying that an effective teacher must have excellent subject knowledge and skills. The expectation is that you will be confident and able to teach all areas of science at least up to KS3. At KS4, your primary focus of development is within your specialist and enhanced area of science for the PGCE which is likely to be closely related to your degree background or has already been enhanced via a subject knowledge enhancement course in physics or chemistry. Your development of subject knowledge, recognition of any weaknesses and consequent action is an extremely important part of your training to become a science teacher. You will need to continually audit your knowledge and work to address any deficiencies. Some of the sessions will help you to do this but there is insufficient time at University to look at your understanding of all areas of the school curriculum. Consequently it is an important aspect of your study outside University. You must continually read and question your knowledge. It is also important to keep up to date with advancement in the understanding of science and its applications to society. This is always of interest to many pupils and helps to foster interest and motivation. **KEEP READING.** You will be expected to keep an electronic record as evidence of auditing and developing your subject knowledge. The record will show how your subject knowledge for

teaching has been improved with examples of the steps you have taken to address any gaps and weaknesses.

Peer Tutoring Sessions

Explaining scientific ideas and demonstrating their application to others is an excellent way to develop your own subject knowledge and to practise explaining and communicating scientific ideas, both essential attributes for teaching.

During peer tutoring sessions you will work in peer groups of 4 or 5. During the sessions you will work together to:

- explore the work prepared for the pre course targets with each individual taking turns to prepare some tutorial work for the group.
- Identify some areas of weakness in your knowledge and understanding and work together to plan the steps required to address these.

There will be peer-tutoring sessions for 1-2 hours on some Friday afternoons. All members of the group will need to plan and prepare for these sessions during the week. Suggested topic areas that have caused trouble in the past are:

electromagnetism	osmosis	neutralisation	waves
Chemical equations and calculations		voltage, current, power	kidney function
Genetics	chemical structure and bonding	circular motion	life cycle of stars

Micro-teaching sessions

In addition there will be an opportunity for each of you to plan and deliver a 5-minute slot of micro-teaching to the rest of the PGCE group. This will be done in groups of 3 or 4 where you collaborate to construct a lesson and deliver approximately an episode(s) of it. Teaching requires secure knowledge and understanding of the subject matter; selection and preparation of resources, monitoring and assessment whilst teaching; teaching a clearly structured sequence which interests and motivates pupils and effective use of time and resources to name a few. These sessions allow you to practice and will be organised as part of a rolling programme.

GCSE Exam

This is used to serve as a more formal audit of your GCSE subject knowledge and as a continuation of the initial audit conducted at interview. You will answer questions on GCSE papers for Physics, Chemistry and Biology. You are allowed to use texts for areas that still need revision. Afterwards you will use the marking schemes to mark each other's papers. Hopefully this will be a real confidence booster as you prepare yourselves to get fully started with teaching.

TERM TWO

During this term we aim to consolidate and extend the skills, knowledge and understanding of science teaching gained from Term One, with emphasis moving to pupil learning. Issues such as special educational needs, EAL learners, classroom management, assessment and differentiation are revisited and developed. There will be a session to explore strategies to support pupils identified as gifted in science. There will be a three-day placement at Islington Sixth Form Centre for some observation and participation in sixth form teaching. This provides further opportunity for you to enhance subject knowledge for teaching in your specialist area. Included in this term is a three-week project, which focuses on a curriculum area to be explored in school (see outline for Project 1 in the handbook). You will continue to work on developing a secure understanding of all areas of science, particularly those areas covered by your specialism for teaching at GCSE and beyond. There are further

sessions to extend and develop ICT skills and to develop knowledge and teaching strategies for some of the more challenging Science topics from Physics, Chemistry and Biology.

TERM THREE

These final sessions are designed to provide a range of opportunities to reflect on skills, knowledge and understanding developed by the end of SE2 and to support the construction of the Professional Practice Portfolio and CEDP. You will be supported in planning for your investigation of a current educational issue, in relation to an identified area of the subject curriculum for Project Two (See outline for Project 2 in the handbook). Presentations for Project 2 will take place in the final week.

Subject Tasks

These are additional to the tasks and assignments set in Teacher Education sessions. They are set throughout the year and their purpose is to enable you to develop particular aspects of knowledge and skills, which will enhance your expertise within your subject area. They are designed to be formative but you may wish to refer to them in your reflective and evaluative writing for the professional practice portfolio and include them as evidence within the appendix.

Some of these tasks are ICT based and some are school based. It is important to keep up with them and meet the deadline for formative feedback.

Subject Studies

Task	Date Set	Due date
Reading and summary writing	Pre-course	Peer review on 12/9/11.
Subject knowledge auditing (summative)	Pre-course for 16/9/11	Tutorials and final professional practice portfolio
Subject knowledge development tasks	Pre-course	Tutorials, peer tutoring sessions.
Peer tutoring preparation	16/9/11	Peer tutoring sessions
Plan, prepare, deliver and evaluate micro-teaching	21/9/11	14/10/11 or 24/10/11
Out of school learning presentation (summative)	10/10/11	17/5/12 peer review for portfolio
GCSE papers	23/9/11	7/10/11
Mark GCSE papers	7/10/11	10/10/11
ICT task	23/9/11	7/10/11
DART activity	13/10/11	14/10/11 peer review
Project 1 Part 1 (Draft)	12/9/11	18/11/11 Formative feedback
Reading and reading log	On going	Tutorials

School placement

Task	Date Set	Due date
School profile booklet (with science tasks) (summative)	Start of SE1 Start of SE2	Tutorials and final professional practice portfolio.

Tutorials

These will consist of individual and group tutorials. For each tutorial you must complete the relevant pages of your professional development journal.

Tutorial 1: Individual tutorial before SE1. This will review progress with pre-course tasks, subject knowledge and set some early targets.

Tutorial 2: seminar to discuss proposals for project 1.

Tutorial 3: Individual tutorial before SE2 to review progress and identify targets for SE2

Tutorial 4: Group tutorials to consider project 2 proposals

Tutorial 5: To review targets for NQT year.

ICT and your subject

It is important to develop your knowledge, understanding and skill in the use of ICT to support teaching and learning in your subject area. You will have some access to the ICT software that we have in the Education department and the interactive white boards. It is strongly recommended that you use this access to practise and extend your skills. The use of ICT will be addressed within curriculum studies sessions wherever possible with consideration of some of the possibilities for using ICT to support your own professional learning, and to enhance the teaching and learning of science. It is also expected that you will make use of your school based training to further your development with the use of ICT. You should aim to cover at least the following:

- Diagnosis and auditing of personal ICT skills
- Theoretical input on teaching and learning using ICT
- Preparation of teaching resources using ICT and to cover use of e.g. Word or Publisher, Excel, Inspiration, PowerPoint
- Formation and use of spreadsheets, hyper linking
- Exposure to different teaching strategies and uses of ICT, e.g. data logging, use of IWB, information handling, web search
- Examination and evaluation of a range of websites, CD Roms, software specific to science
- How ICT can support the wider professional role
- Awareness of ethical issues

Secondary ITE Teaching & Assessment Calendar 2011-12 Autumn Term (1/2)

	12/9	19/9	26/9	3/10	10/10	17/10
Uni wk	2	3	4	5	6	7
Mon	CS1 Course induction	CS9 Chemistry	CS17 Physics	CS19 School Day	CS25 Kew Gardens	
	CS2 Science curriculum	CS10 Explaining and questioning	CS18 Creative writing	CS20 School Day	CS26 Kew Gardens	
Tue	PS1 Children's Rights & Teachers' Responsibilities 10-11 Lecture 11.30-1 Workshop	PS3 Inclusion (1): Patterns of inequality 10-11 Lecture 11.30-1 Workshop	PS5 Inclusion (2): SEN Primary Briefing 10-11 Lecture 11.30-1 Workshop	PS7 Classroom Behaviour (1) 10-11 Lecture 11.30-1 Workshop	PS9 & 10 Carousel of workshops including: (i) Inclusion (3): EAL (ii) Looking after your voice	
	PS2 How Children Learn (1) 2-3 Lecture 3.15-4 Workshop: Set presentation task	PS4 How Children Learn (2) 2-4 Workshop: Planning presentations	PS6 How Children Learn (3) 2-4 Workshop: Presentations on learning	PS8 Pebble Pad and QTS 2-4 Workshop: ICT	(iii) Peer assessment for Primary Report (iv) Student Voice – what students want from lessons	
Wed	CS3 Nature of science	CS11 Planning for learning				
	CS4 Fun with slime	CS12 Lesson planning for micro teaching				
Thu	CS5 Biology	CS13 Role of practical work		CS21 Planning for good behaviour	CS27 Micro teaching	
	CS6 Modelling and analogy	CS14 Safety in the lab		CS22 Collaborative group work	CS28 Micro teaching Evaluation	
Fri	CS7 Key Processes	CS15 Use of ICT 1		CS23 Use of ICT 2	CS29 Micro teaching	
	CS8 SK audits	CS16 Peer Tutoring		CS24 Peer Tutoring	CS30 Peer Tutoring	

CS=Curriculum Studies; PS=Professional Studies; IS=Independent Study

Secondary ITE Teaching & Assessment Calendar 2011-12 Autumn Term (2/2)

	24/10	31/10	7/11	14/11	21/11	28/11	5/12	12/12
Uni wk	8	9	10	11	12	13	14	15
Mon	CS 31 Language and numeracy in science						PS11 Project 1: Medium term planning 10-11.30 Lecture	
	CS32 DART activities EAL learners						CS35 Project 1 briefing/seminar	
Tue	CS33 Assessment practice						CS36 Earth science	
	CS34 Assessment and monitoring Use of the PDJ						CS37 Earth science	
Wed	IS							
	IS							
Thu	IS							
	IS							
Fri	IS							
	IS							

CS=Curriculum Studies; PS=Professional Studies; IS=Independent Study

Secondary ITE Teaching & Assessment Calendar 2011-12 Spring Term

	2/1	9/1	16/1	23/1	30/1	6/2	13/2	20/2	27/2	5/3	12/3	19/3	26/3
Uni wk	18	19	20	21	22	23	24	25	26	27	28	29	30
Mon	Bank	CS46 Physics KS4	CS52 GCSE coursework				IS						
	Holiday	CS47 Science in the news	CS53 Being a specialist of biology, chemistry or physics				IS						
Tue	CS38 Study time/Tutorials	PS12 Classroom Behaviour (2) 10-11 Lecture 11.30-1 Workshop	PS14 Inclusion (6): SEN 10-11 Lecture 11.30-1 Workshop				IS						
	CS39 Study time/Tutorials	PS13 Project 2: Teacher as researcher 2-2.45 Lecture 3-4 Workshop	PS15 Inclusion (7): Planning for inclusion on SE2 2-4 Workshop				IS						
Wed	CS40 Study time/Tutorials	CS48 Chemistry KS4	CS54 Setting up classroom 'talk' for discussion work in science				IS						
	CS41 Study time/Tutorials	CS49 Biology KS4	CS55 SE2 Profile booklets and SE2 briefing				IS						
Thu	CS42 Study time/Tutorials		CS56*				IS						
	CS43 Study time/Tutorials		CS57*				IS						
Fri	CS44 Study time/Tutorials	CS50 Science for all / Differentiation	CS58*				IS						
	CS45 Study time/Tutorials Submission: Project 1	CS51 – Personalising learning- gifted pupils, EAL learners, SEN	CS59*				IS						

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* Additional 'intervention' workshops may run on these days to provide focused support for students with concerns arising from SE1

Secondary ITE Teaching & Assessment Calendar 2011-12 Summer Term

	16/4	23/4	30/4	7/5	14/5	21/5	28/5	4/6	11/6
Uni wk	33	34	35	36	37	38	39	40	41
Mon				Bank	CS60 Reflection on SE2 and portfolio briefing			IS	CS68 Curricular enhancement, e.g. RSPCA
				Holiday	CS61 Project 2 briefing			IS	CS69 Curricular enhancement, e.g. RSPCA
Tue					PS16 Contemporary education policy 10-11.15 Lecture 11.45-1 Workshop			IS	PS18 Preparing for your NQT year 10-11.15 Lecture 11.45-1 Workshop
					PS17 Portfolio peer assessment 2-4 Workshop			IS	CS70 CEDP and NQT targets
Wed					CS62 Project 2 seminars			IS	CS71 NQT year tutorials
					CS63 Project 2 seminars			IS	CS72 NQT year tutorials
Thu					CS64 Out of school learning presentations / Project 2 proposals			IS	CS73 Project 2 presentations
					CS65 Out of school learning presentations / Project 2 proposals			IS	CS74 Project 2 presentations
Fri					CS66 Intervention workshops as required			IS	CS75 Project 2 presentations
					CS67 Intervention workshops as required Submission: Portfolio			IS Submission: Project 2	CS76 Project 2 presentations

CS=Curriculum Studies; PS=Professional Studies; IS=Independent Study

Curriculum Studies Sessions

Term One 2011

Week beginning 12th September

CS1. Induction (Q7, Q14)

Welcome to students and staff. This opening session will outline the course and the expectations for your professional training and completion of the PGCE. You will peer review your written summaries.

Task: organising files, subject audits, reading log, completion of any outstanding pre-course tasks, preparation for Tutorial 1

Readings:

Amos, S. and Boohan, R. (2002) *The Changing Nature of Science Education*, in Amos, S. and Boohan, R (eds) *Teaching Science in Secondary Schools*: Routledge Falmer pp3-21

Dunne, D. (1998) *The Place of Science in the Curriculum* in Radcliffe, M (ed) *ASE Guide to Secondary Science Education*: ASE

Millar, R. and Osborne, J. (1998) *Beyond 2000: Science Education for the Future*, London: Kings College London, School of Education

Millar, R. (2002) *Towards a science curriculum for public understanding* in Amos, S. and Boohan R (eds) *Teaching science in Secondary Schools*: Routledge Falmer pp113-128

Monk, M. and Dillon, J. (2000) *The Nature of Scientific Knowledge* in Monk, M. and Osborne, J (eds) *Good Practice in Science Teaching: What research has to say*. Open University Press

Osborne, J. (1998) *Science for citizenship* in Radcliffe, M (ed) *ASE Guide to Secondary Science Education*: ASE

Ratcliffe, M. (1998) *The Purposes of Science Education* in Radcliffe, M (ed) *ASE Guide to Secondary Science Education*: ASE

Reiss, M. (2002) *What is science?* in Amos, S. and Boohan, R (eds) *Teaching Science in Secondary Schools*: Routledge Falmer pp. 40-54.

Wellington, J. & Ireson, G. (2008) 'Becoming a teacher' in *Science Learning, Science Teaching*: Routledge, pp. 26-44.

CS2. The Secondary Science Curriculum and Teaching Schemes (Q15,Q22)

This session will look at the ways in which the science curriculum may be organised and delivered in different schools. We will look at the DfE website

<http://www.education.gov.uk/>

the archived National Strategies website.

<http://webarchive.nationalarchives.gov.uk/20110202093118/http://nationalstrategies.standards.dcsf.gov.uk/>

the QCDA website for the National Curriculum

<http://curriculum.qcda.gov.uk/key-stages-3-and-4/subjects/key-stage-3/science/index.aspx>

and the organisation of GCSE science reflecting on progression and continuity in learning.

Readings:

Asoko, H. and Squires, A. (2002) *Progression and Continuity* in Amos, S. and Boohan, R *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Wellington, J. & Ireson, G. (2008) *Planning and managing learning in science*, in *Science Learning, Science Teaching*: Routledge ch 5

Williams, J. (1998) Choosing and Using Published Science Schemes Radcliffe, M (ed) *ASE Guide to Secondary Science Education*: ASE

Youens, B. (2005) Factors which Affect Planning in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 125-140

CS3. The Nature of Science Teaching about How Science Works (Q14, Q15)

More discussion about the 'Nature of Science'. What is science? Is there a scientific methodology? An opportunity to explore your own views about the nature of science. We will also consider the "role of evidence"

What is meant by "How science works"? A closer look at this aspect of the KS4 programme of study and how some of the new GCSE specifications have made arrangements for teaching and assessing pupils' skills in investigative science and their knowledge and understanding of how science works.

Readings:

ASE Ideas and Evidence in *School science review* June 2006

Gott, R. and Duggan, S. (2006) Investigations, scientific literacy and evidence in Wood-Robinson, V (ed) *ASE Guide to Secondary Science Education*, Hatfield, Association of Science Education

Nott, M. and Wellington, J. (2002) Using critical incidents in the science laboratory to teach and learn about the nature of science in schools in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Osborne, J. (1998) Learning about teaching the Nature of Science in Radcliffe, M (ed) *ASE Guide to Secondary Science Education*: ASE

Ratcliffe, M. (2002) Teaching for Understanding in Science Enquiry in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Watson, R. and Wood-Robinson, V. (2002) Learning to investigate in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

CS4. Thinking creatively- fun with slime

Can you think creatively and use empirical evidence to suggest particle models?

CS5. Key Ideas in Biology (Q14, 25)

This session will look at key scientific ideas for Key Stage 3 biology. You will consider some common misconceptions that pupils may hold and perhaps challenge some of your own misconceptions. You will also have an opportunity to practise and develop your microscope skills.

Readings:

Reiss, M. (ed) (2002) *Teaching Secondary Biology*, London: John Murray for the ASE

Ross, K., Lakin, L., Callaghan, P. (2004) Difficult ideas in biology in *Teaching Secondary Science*: David Fulton, pp. 106-114.

CS6. Modelling and Analogy (Q14, Q25)

The use of models, analogies and visualisation in science teaching and learning will be introduced with a chance to make your own 'cell' model.

Task: Aim to make use of a model or analogy in your micro teaching.

Readings:

Boohan, R. (2002) *Learning from models, learning about models* in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Gilbert, G. (2002) Explaining with models in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

CS7. Key Processes in science (Q14, Q23, Q25)

This session will provide an opportunity to explore and practise some of the key processes in science through design of a practical investigation. We will also consider the development of numeracy skills through science teaching and learning.

Readings:

Lenton, G. and Stevens, B. (2002) Numeracy in science in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Wellington, J. & Ireson, G.(2008) Numeracy in science education in *Science Learning, Science Teaching*, Routledge, pp. 246-254.

Wellington, J. & Ireson, G. (2008) Investigations in science, *Science Learning, Science Teaching*: Routledge, ch8

CS8. S.K audits, personal reviews, Peer tutoring (Q7, Q11, Q26)

An opportunity to review the S.K audits started pre-course and personal action plans using pebble pad. The peer tutoring groups will be set up and you will plan and organise future peer tutoring sessions by selecting topics and group leaders for each session.

Summary Tasks: Peer-tutoring preparation, files, subject audits, preparation for individual tutorials.

Week beginning 19th September

CS9. Chemical and material behaviour (Q14, Q25)

This session will look at the key scientific ideas for KS3 chemistry. You will consider some misconceptions that pupils may hold and perhaps challenge some of your own misconceptions. A particular focus will be progression in pupils' learning and teaching to promote understanding. Concept mapping will be introduced.

Readings:

Johnson, P. (2002) Progression in children's understanding of a 'basic' particle theory: a longitudinal study in Amos, S. and Boohan, R (eds) *Teaching Science in Secondary Schools*: Routledge Falmer pp. 236-249.

Ross, K., Lakin, L., Callaghan, P. (2004) Difficult ideas in chemistry in *Teaching Secondary Science*: David Fulton, pp. 88-98.

CS10. Explaining and Questioning (Q12, Q26, Q27)

We will explore the attributes of good explanations in science and how to develop the ability to provide good explanations for children.

Active Questioning: Questions play a very important part in the teaching and learning of science. This session will explore the types of questions used, why they are used and techniques for effective questioning in the classroom. There will be an opportunity to practice your own questioning style.

Readings:

Amos, S. (2002) Teachers' questions in the science classroom in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Carr, D. (2002) The art of asking questions in the teaching of science in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Harrison, C., Simon, S. and Watson, R. (2000) Progression and differentiation in Monk, M. and Osborne, J (eds) *Good Practice in Science Teaching: What research has to say*: Open University Press

Wellington, J. & Ireson, G. (2008) The art and craft of science teaching in *Science Learning, Science Teaching*, Routledge, pp. 3-25.

CS11. How do pupils learn in Science and how can this be linked with lesson structure? (Q5, Q18, Q19, Q22, Q23, Q25)

You will have an opportunity to consider some of the theories about how children learn science and how we can make use of these in our teaching. How can we support pupils in their acquisition of knowledge and understanding of concepts in science?

Lesson structure and planning will be introduced. We will look at the lesson planning template and examples of different lesson plans.

We will consider the setting of challenging and appropriate learning objectives – and using them to plan structured lessons. This will be followed through during the school visit days and then practised through the mini teaching when you will have a chance to do some lesson planning in small groups considering lesson objectives, resources, activities, transitions, assessment and timing.

Readings:

Adey, P. (2002) Children's thinking and science learning in Amos, S. and Boohan, R (eds) *Teaching Science in Secondary Schools*: Routledge Falmer pp. 147-153.

Bliss, J. (2002) Learning science: Piaget and after in Amos, S. and Boohan, R (eds) *Teaching Science in Secondary Schools*: Routledge Falmer pp.154- 163.

Leach, J. and Scott, P. (2000) Children's thinking, learning, teaching and constructivism in Monk, M. and Osborne, J (eds) *Good Practice in Science Teaching: What research has to say*. Open University Press

Leach, J. and Scott, P. (2002) The demands of learning science concepts: issues of theory and practice in Amos, S. and Boohan, R (eds) *Teaching Science in Secondary Schools, (eds.)*: Routledge Falmer pp. 140-146.

Shakespeare, D. (2003) Starting an argument in science lessons, in *School Science Review*, 85 (311) 103-108

Scaif, J. (2008) Focus on learning in science in Wellington, J & Ireson, G. (eds) *Science Learning, Science Teaching*: Routledge pp. 65-129.

Solomon, J. (2002) Group Discussions in the classroom in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Lesson Planning Readings:

Baxter, M. (2002) Planning for Teaching and Learning in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Youens, B. (2005) Planning and evaluating lessons in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 125-140.

CS12. Planning for micro-teaching

The micro-teaching groups will be set up and you will begin working together on the lesson plans.

Classroom Tasks and Resources: What can pupils do in the classroom? Well designed and varied tasks will make a lesson more engaging. We will review some teaching and learning resources and activities and then consider some guidelines for preparing your own. Your own creativity will frequently make the best resources. Worksheets need careful consideration and writing. How can we get the best out of them?

There are many good teaching resources available but your own creativity can often make the best teaching aids. An explanation that includes the use of a well designed teaching aid, particularly a three dimensional model or game, might make the learning accessible to a wider range of pupils, particularly for difficult concepts. Remember that pupils can also design three-dimensional aids, games etc to enhance their understanding and explanations. Aim to develop a good range of your own teaching resources over the year. You can begin by developing a creative teaching aid to use in your mini teaching.

Readings:

Frost, J. & Turner, T. (2005) Selecting and Using Resources in *Learning to Teach science in the secondary school*: Routledge-Falmer, pp. 176-209.

Baxter, M. (2002) Planning for Teaching and Learning in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Shakespeare, D. (2003) 'Starting and argument in science lessons, *School Science Review*, 85 (311) 103-108

Solomon, J. 'Group Discussions in the classroom' in *Teaching Science in Secondary Schools*, (eds Amos, S. and Boohan, R.): Routledge Falmer

Youens, B. (2005) Planning and evaluating lessons in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 125-140.

Task: Lesson plan and preparation for micro teaching

CS13. Role of Practical work (Q14, Q25)

Practical work in science is one of the distinctive features of science lessons and one that most pupils enjoy. How can we make it most effective in terms of promoting learning and generating interest? What are the different purposes and types of practical work and when and how should it be done?

Readings:

Frost, J. (2005) Planning for Practical Work in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 157-175.

Wellington, J. & Ireson, G. (2008) Practical work in science education in *Science Learning, Science Teaching*, Routledge, pp. 180-198

CS14. Managing safe practical lessons (Q3, Q21, Q31)

One of the best and most exciting bits about teaching science is that it is a practical subject; children can move around and do things and there are opportunities for some spectacular "bangs" and light shows. The organisation and management of a practical science laboratory involves a number of interrelated skills and these are the focus of this session. Health and safety issues are clearly an important aspect of this. Will the children be safe in your hands?

You will have spent a day in school this week and will have seen some varying behaviour from different classes and pupils. This is a chance to discuss and reflect on what you have seen. Maintaining discipline in the science classroom is essential for enjoyment of learning, effective learning and safety. How is it achieved? We will consider some strategies.

Readings:

Borrows, P. (2002) Risk assessment in science for secondary schools in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Borrows, P (1998) Safety in Science Education in Radcliffe, M (ed) *ASE Guide to Secondary Science Education*: ASE

Ross, K., Lakin, L., Callaghan, P. (2004) Health, safety and laboratory management in *Teaching Secondary Science*: David Fulton, pp.162-171.

CS15. ICT 1. (Q14, Q17)

Readings:

Wellington, J. & Ireson, G. (2008) Using ICT in science education in *Science Learning, Science Teaching*: Routledge, pp. 257-288. **Task: Preparation for demonstration of use of ICT for teaching and learning.**

CS16. Peer tutoring (Q6, Q14, Q25)

Time to work within your peer tutoring groups.

Summary weekly Tasks: Setting up and organising resources file, planning and preparing peer tutoring and micro-teaching, start GCSE papers, ICT task

Week beginning 26th September

CS17. Key Ideas in physics (Q14, Q25)

This session will look at some key scientific ideas for key stage 3 physics. You will consider some common misconceptions that pupils may hold and perhaps challenge some of your own misconceptions. A particular focus will be the use of active teaching methods, pupil talk in the classroom and how pupils need to extend their thinking from concrete examples to a more abstract view. You will also have the opportunity to carry out some common school experiments and develop your own practical skills. This will be an opportunity to practise building electrical circuits, refresh and enhance your own understanding of key terminology and address some misconceptions. We will consider some of the key issues when teaching about electricity to pupils and think about teaching strategies.

Readings:

Boohan, R. and Ogborn, J. (1996b) Differences, energy and change: a simple approach through pictures. *School Science Review*, 78 (283), 13-20

Frost, J. (2005) Physics and Astronomy in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 72-81

Millar, R. 'Teaching about energy' University of York

Shipstone, D. (2002) A study of children's understanding of electricity in simple DC circuits in Amos, S. and Boohan, R (eds) *Teaching Science in Secondary Schools*: Routledge Falmer

CS18. Creative Writing (Q23, Q25)

The use of story telling and creative writing in science will be explored with different activities.

Readings:

Prain, V. and Hand, B. (2002) Pupils Learning through writing in science in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

You will spend 3 days in a primary school and will have a case study assignment to complete for your portfolio.

Summary Weekly Tasks: Primary placement case study, planning and preparing mini-teaching, GCSE papers

Week beginning 3rd October

CS19 &20. Planning and lesson delivery in action

You will be split into two groups, A and B. each group will visit a school with a University tutor. There will be an opportunity to observe some lessons and the focus will be on lesson planning and organisation of practical work.

Readings:

Baxter, M. (2002) Planning for Teaching and Learning in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Frost, J. (2005) Planning for Practical Work in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 157-175.

Wellington, J. & Ireson, G. (2008) Practical work in science education in *Science Learning, Science Teaching*, Routledge, pp. 180-198

Youens, B. (2005) Planning and evaluating lessons in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 125-140.

CS21 Classroom and behaviour management in science lessons

What are the issues? How can we plan lessons to promote good behaviour and improve engagement.

CS22 Collaborative group work

We will also consider planning for guided group work in science and ways to encourage collaborative work and 'talking about' science.

CS23. ICT 2 (Q14, Q17)

Opportunities for demonstration of different uses of ICT.

Readings:

Wellington, J. & Ireson, G. (2008) Using ICT in science education in *Science Learning, Science Teaching*: Routledge, pp. 257-288.

CS24. Peer Tutoring (Q6,Q14, Q25)

Time to work within your peer tutoring groups.

Summary weekly Tasks: Mark GCSE papers, prepare for microteaching, and prepare for peer tutoring

Week beginning 10th October

CS25 & CS26 'Out of school learning' Visit to Kew Gardens (Q14, Q24)

Out of School Learning- Teaching and learning about science does not just have to take place in a classroom. Well-planned trips can enhance learning and teacher pupil relationships. This trip also provides subject enhancement in plant biology.

Readings:

Wellington, J. & Ireson, G. (2008) Using out-of-school sources to enrich science education in *Science Learning, Science Teaching*, Routledge, pp. 319-336.

Task: Preparation for out of school learning presentation for peer review and final portfolio

CS 27, 28 & 29. Micro teaching and Engaging science lessons

Micro teaching (Q7, Q8, Q9, Q14, Q15, Q17, Q19, Q22, Q23, Q25, Q26, Q29)

Be well prepared for your micro teaching sessions. Plans need to be submitted on pebble pad at least 24 hrs in advance and evaluations later on the same day.

The importance of lesson evaluation and its role in future lesson planning will be explored. We will draw upon the lesson planning and evaluation that you have been doing for the micro teaching. The requirements for teacher training and QTS will be outlined.

Readings:

Kind, V. & Taber, K. (2005) Acting to teach science in *Teaching school subjects: science*: Routledge, pp. 158-178.
Youens, B. (2005) Planning and evaluating lessons in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 125-140.

CS 30 Peer Tutoring (Q6, Q14, Q25)

Time to work within your peer tutoring groups to develop your subject knowledge.

Summary weekly Tasks: DART activities, micro teaching preparation, peer tutoring, preparation for out of school learning presentation,

Week beginning 17th October

School Experience 1 Induction

Week beginning 24th October

CS31. Use of Language in science and developing literacy (Q23, 25)

Science teaching occurs mainly through the medium of language, both spoken and written. This session explores how teachers, pupils and texts use language and some teaching and learning strategies to reduce the language barrier for pupils and to support the development of literacy skills.

Readings:

Jones, C. The role of language in the learning and teaching of science in Amos, S. and Boohan, R (eds) *Teaching Science in Secondary Schools*: Routledge Falmer

Teaching Science in Secondary Schools, (eds Amos, S. and Boohan,R.): Routledge Falmer

Newton, D. (2002) There's more to communication than just words in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Ross, K., Lakin,L., Callaghan, P. (2004) Language and learning in *Teaching Secondary Science*: David Fulton pp. 28-35.

Wellington, J. & Ireson, G. (2008) Language in science teaching and learning in *Science Learning*, Science Teaching, Routledge, ch 9

CS32 EAL Learners in Science (Q18, Q19)

This session will explore some of the issues and some strategies.

Readings:

Ross, K., Lakin,L., Callaghan, P. (2004) Language and learning in *Teaching Secondary Science*: David Fulton, pp. 28-35.

DfES Aiming High: Guidance on the assessment of pupils learning EAL

www.multiverse.ac.uk

www.naldic.org.uk/ITTSEAL2/teaching/ealnsubjects.cfm

Task: Prepare a DART activity which utilises some of the strategies discussed

CS 33 and 34. Assessment and monitoring in science (Q11, Q12, Q13, Q26, Q27, Q28)

We will peer review the DARTS activities you prepared.

A particular focus will be **assessment for learning** strategies. Formative assessment while a lesson is in progress is an advanced skill that you should aim to start developing during teaching practice. "Did all the pupils learn what you planned them to learn?"

Introduction to Assessing Pupils' Progress (APP)

<http://curriculum.gcda.gov.uk/key-stages-3-and-4/subjects/key-stage-3/science/assessing-science/index.aspx>

<http://webarhive.nationalarchives.gov.uk/20110202093118/http://nationalstrategies.standards.dcsf.gov.uk/secondary/science/assessment>

What do the different N.C levels mean? Looking at pupils work. How can we use assessment to promote learning and raise standards? Strategies for monitoring learning in the classroom.

Readings:

Black, P. and Harrison, C. (2002) Formative assessment in Monk, M. and Osborne, J (eds) *Good Practice in Science Teaching: What research has to say*: Open University Press

Daws, N. and Squires, A. (2002) Formative assessment in secondary science in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer

Frost, J. & Turner, T. (2005) (eds) Assessment in science in *Learning to Teach science in the secondary school*: Routledge-Falmer, pp. 210-248.

Hayes, P. (1998) Assessment in the classroom in Radcliffe, M (ed) *ASE Guide to Secondary Science Education*: ASE

CS 34 Briefing for SE1 (Q1,Q2,Q3)

You will be prepared for the first teaching practice, introduced to the Professional Journal and given administrative materials. This will be an opportunity to look at your mark for the GCSE exam and review your personal learning plans in your subject audit, look at your lesson plans, files. Are you ready for SE1?

Readings:

Frost, J. & Youens, B. (2005) Becoming a science teacher: Managing your Professional Development in Frost, J. & Turnet, T. (eds) *Learning to Teach science in the secondary school*: Routledge-Falmer, pp. 9-20.

Longman, I. (2005) Working within a Science Department in Frost, J. & Turnet, T. (eds) *Learning to Teach science in the secondary school*: Routledge-Falmer, pp. 21-29.

Task Update your Subject knowledge audit

Summary weekly tasks: Teaching resource/plans, S.K audit

An opportunity to engage in independent study. Refer to the provided reading list with key and recommended texts, science teaching resources and texts, journals etc and use the reading log to record the main points, relevant quotes etc. This will come in use for the formal written assignments. Prepare and organise all your files. Make sure your professional journal and SK audit or all updated.

Week beginning 5th December

You return to London Met for two days.

CS35. Project 1 Seminar and Medium Term Planning (Q22, Q23, Q24)

You will be introduced to an approach to medium term planning and relate this to your initial planning for Project One. Hopefully by now you will have written and received feedback on a draft of Part 1.

Readings:

Youens, B. (2005) Factors which affect planning in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 107-124

SE1 Evaluation: Looking back at SE1. What have you learnt? How are you progressing? What do you need to develop? How can we evaluate our teaching?

CS36. & CS37. Earth Sciences (Q14, Q25)

These workshops are delivered by the Earth Sciences Education Unit from Keele University. They provide a useful opportunity for development of subject knowledge with lots of fun practical activities.

Readings:

Turner, T. (2005) *Earth Science* in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 82-90.

Term Two 2012
Week beginning 2nd Jan

CS38 – CS45

Independent study and tutorial time

Week beginning 9th Jan

CS46. Physics enhancement (Q14, Q25)

Another “hands on” practical session and a further chance to develop your subject knowledge and consider different teaching strategies. A particular focus will be some of those areas of Physics considered to be difficult.

Readings:

Ross, K., Lakin,, Callaghan, P. (2004) Difficult ideas in physics in *Teaching Secondary Science*: David Fulton, pp. 99-105.

CS 47. Science in the news (Q14, Q24, Q25)

This session explores how we can make links between the curriculum and the “world outside”. We will trial some resources making use of news items.

CS48. Chemistry enhancement (Q14, Q25)

Another “hands on” practical session and a further chance to develop your subject knowledge and consider different teaching strategies. A particular focus will be some of those areas of chemistry considered to be difficult.

Readings:

Ross, K., Lakin,L., Callaghan, P. (2004) Difficult ideas in chemistry in *Teaching Secondary Science*: David Fulton, pp. 88-98.

CS 49 Biology enhancement (Q14,Q25)

A further chance to develop your subject knowledge and consider different teaching strategies with a practical “hands on” session.

Readings:

Ross, K., Lakin, L., Callaghan, P. (2004) Difficult ideas in biology in *Teaching Secondary Science*: David Fulton, pp. 106-114.

CS 50. Science for ALL (Q1, Q10, Q13, Q18, Q19, Q21,Q25,Q26,Q27,Q28)

Enabling every child not only to “do” science but to achieve their full potential is quite a challenge. We will reflect on the diverse nature of the pupils in a London classroom and we will begin with a discussion on ethnicity and gender issues. We will consider some typical individual learning needs, e.g. EAL, SEN and there will be some discussion of ability groupings and differentiation. We will consider some strategies for differentiation to provide inclusive lessons that challenge and include everyone. We will consider strategies and resources that can be used to extend and develop pupils learning in science. The initial focus will be planning to use a variety of **differentiation** strategies.

Readings:

Adey, P. (2006) Scientific thinking: how can we accelerate and generalise it? in Wood-Robinson, V (ed) *ASE Guide to Secondary Science Education*: ASE pp. 205-212.

- Ireson, G & Twidle, J.** (2006) Inclusion and special needs in science in *Secondary science: Reflective Reader*. Learning Matters, pp. 24-31.
- Keogh, B. and Naylor, S.** (2002) Dealing with Differentiation in Amos, S. and Boohan, R (eds) *Aspects of Teaching Secondary Science: Perspectives in Practice*: Routledge Falmer
- Wellington, J. & Ireson, G.** (2008) Inclusive science education: meeting the needs of all children in science in *Science Learning, Science Teaching*, Routledge, pp. 156-179.

CS 51 Controversial issues in science: Using Human Rights – teaching about and teaching through. (Q1, Q2, Q3, Q10, Q14, Q19, Q25)

These sessions considers the use of a rights respecting approach as a framework for teaching about controversial issues in science. It also considers a rights respecting pedagogical approach for introducing collaborative group work and debate into science lessons.

Modern science has its roots in many different societies and cultures. Drawing upon this and making science relevant to the everyday experiences of pupils is an important aspect for ensuring engagement in science lessons and improving motivation.

Readings:

- Donnelly, J.F.** (2004) Ethics and the science curriculum *School Science Review 86(315)*: ASE
- Hall, E.** (2004) Ethics and the science curriculum *School Science Review 86(315)*: ASE
- Levinson, R.** (2005) Science for Citizenship in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 251-269.
- Maloney, J.** (2005) Sex and Health *Education* in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 270-281.
- Radcliffe, M.** (2004) Teaching ethical aspects of science – is cross-curricular collaboration the answer *School Science Review 86(315)*: ASE
- Reiss, M.** (1993) *Science Education for a Pluralist Society*, Open University
- Ross, K., Lakin, L., Callaghan, P.** (2004) Inclusion and science for all in *Teaching Secondary Science*: David Fulton pp. 186-194
- Wellington, J.** (2004) Ethics and citizenship in science education: now is the time to jump off the fence *School Science Review 86(315)*: ASE

Task: Prepare and plan use of a teaching resource that uses a rights respecting approach, e.g. to promote a cultural understanding of science, to teach about the ethical and moral implications of the applications of science, to teach about a controversial issue in science, to teach about human rights.

Week beginning 16th Jan

CS52/3. GCSE Coursework in science

CS54 Classroom Talk in science

This session will explore a framework for setting up discussion work in science using materials developed by the Biosciences society.

CS56-CS 59

These days are reserved for intervention work to provide focussed support for students with concerns arising from SE1.

These days may also be used for observation and participation in sixth form science work at Islington Sixth Form Centre subject to availability.

The agenda includes information on the various pathways at post 16 level, opportunities to observe and participate in a range of AS and A2 classes and workshops and a day spent at the Vocational Science centre. The PGCE group will also organise and run a discussion group for sixth formers.

Term Three 2012

Week beginning 14th May

CS60. Reflection on SE2 (Q7,Q8,Q9) and Portfolio Briefing

This day will be spent on reflection and evaluation of SE2, in order to prepare for the completion of the Professional Practice Portfolio.

CS61. Project Two Briefing and Discussion (Q13)

An introduction to the areas for exploration in Project 2. This will include possible questions for school-based investigation, appropriate initial reading, and the assessment criteria.

Readings:

Kind, V. & Taber, K. (2005) Doing action research in science education in *Teaching school subjects: science*: Routledge, pp. 242-256.

CS62 & 63. Project 2 seminars (Q32,Q33)

An opportunity to share and discuss reading and project plans: agreeing a research question, deciding what would count as appropriate data for addressing the question, looking at various methods for collecting data and paying attention to validity and reliability issues

CS 64 & CS 65. Out of School Learning(Q14, Q24)

These will be done in small groups and peer reviewed.

An opportunity for students to use skills developed during the ICT sessions to create a presentation based on the exhibits, materials or architecture of an interesting out of school learning location.

CS 66 & CS 67. Intervention workshops as required

Tutorial support to review progress with project two.

Project 2 Independent study

Week beginning 11th June

CS 68 & CS 69 Curricular Enhancement

Opportunity for some workshop time to enhance the science curriculum.

CS70. CEDP (Q7,Q8,Q9)

Preparing transition point one for your CEDP. Targets for NQT year.

Levinson, R. (2005) Beyond Qualified Teacher Status: Becoming a Professional Teacher in Frost, J. & Turner, T. (eds) *Learning to teach Science in the Secondary School*: Routledge-Falmer pp. 282-295.

CS71 &72 Tutorials for NQT year

CS 73 to 76 Presentations of Project Two

You will give a ten-minute PowerPoint presentation to a small group, identifying key features of your project and findings.

CELEBRATING ACHIEVEMENT

Summative Assignments

Project One Suggested Areas:

See weblearn for more information.

In this project you will need to work on a topic area from the programme of study for science. Your project will analyse the chosen subject topic area and develop a short sequence of lessons for that particular class. Science departments will have schemes of work in place but you will need to **design your own**. Your sequence of lessons must show how you have incorporated (i) concepts and / or (ii) processes and / or (iii) curriculum opportunities in addition to covering the range and content for the topic area.

We recommend that you begin reading and working on Part one of this assignment immediately and produce a draft for formative written feedback by the **18th November**. This will provide time for feedback before you return at the start of December to be briefed for the planning part of the project.

It is important to discuss plans with your tutor and school mentor

Project Two Suggestions:

Below are some suggestions for areas to investigate. However you will need to formulate your own specific project question, perhaps within one of these areas.

An investigation of the needs & provision for pupils learning science as EAL learners

An investigation into the development of literacy in science

An investigation into the potential of ICT for raising motivation and achievement in learning science

An investigation into the potential of Assessment for Learning in raising motivation and achievement

An investigation into the role of practical work

An investigation into the role of Out of School Learning

An investigation into the issues of KS2/3 transition

An investigation into making science teaching inclusive and catering for individual needs, eg Gifted learners, SEN, pupils with literacy difficulties

Investigation of a teaching and learning focus identified by the National Strategy in relation to science, e.g. development of pupil talk in science, group work

Reading

The Learning Resources Centre (LRC) contains a wide range of books about the teaching and learning of science, together with teaching resources such as school textbooks and videos. More teaching resources are kept in the Education department. There is a lengthy reading list in this handbook and some reading suggestions for particular sessions. Many of these suggested readings come from the key texts. Those key texts that will be valuable throughout the course are indicated below. Trainee teachers are advised to read regularly, following up on each session if possible and to use the reading log to record main points, useful quotes etc. This discipline will enhance your development as a teacher and also make the formal written assignments less stressful.

The LRC also contains a number of journals that we encourage you to consult regularly, such as *School Science Review*, *Education in Science*, *Education in Chemistry* etc.

Key Texts

You will need a good set of GCSE textbooks to support your background knowledge in Science and an A Level book in your specialist area.

Amos, S. Boohan, R. (eds) (2001) *Teaching Science in Secondary Schools: a reader*. Routledge Falmer and "*Aspects of Teaching Secondary Science*": *Perspectives on Practice*: Routledge Falmer

Driver, R et al (1994) *Making Sense of Secondary Science; research into children's ideas*, London: Routledge

Frost, J. & Turner, T. (eds) (2010) *Learning to Teach Science in the Secondary School*. Routledge

Kind, V and Taber, K. (2004) *Teaching School Subjects 11-19: Science*: Routledge

Monk, M. Osborne, J. (eds) (2000) *Good Practice in Science Teaching: What Research has to say*, Milton Keynes: Open University Press

Parkinson, J. (2002) *Reflective Teaching of Science 11-18* Continuum

Ross, K.A, Lakin, L and Callaghan,P. (2010) *Teaching Secondary science and constructing meaning and developing understanding*, London: David Fulton

Wellington, J. & Ireson, G. (2008) *Science Learning, Science Teaching*: Routledge

Wood-Robinson, V. (ed) (2006) *ASE Guide to secondary Science Education*: Hatfield, ASE

You should also consider acquiring one or all of the following books:

McDuell, B.(2000) *Teaching Secondary Chemistry*, London: ASE/John Murray

Osborne, J.F., & Freeman, J. (1989) *Teaching Physics; a guide for the non specialist*, Cambridge University Press

Reiss, M. (2000) *Teaching Secondary Biology*, London: ASE/John Murray

Sang, D. (2000) *Teaching Secondary Physics*, London ASE/John Murray

Wellington, J. & Osborne, J.F (2001) *Language and Literacy in Science Education*, Buckingham: Open University Press

Building up your own resources

Set up box files for your science resources and ideas. Collect photocopies of useful journal articles, newspaper cuttings, ideas from books, good work sheets, web pages etc. You will need to decide how to categorise and file them, but make them accessible. They will be invaluable to you later on.

We recommend reading the **Times Educational Supplement** (weekly) and the **Guardian Education** section (Tuesdays) or the **Independent Education** section (Thursdays) for current educational issues and debates.

Reading List

The books below give a background to science education.

- Adey, P. & Shayer, M.** (1994) *Really Raising Standards*, London: Routledge
- Alsop & Hicks** (2001) *Teaching Science*, Kogan Page
- Amos, S. Boohan, R.** (2001) *“Teaching Science in Secondary Schools”: a reader and “Aspects of Teaching Secondary Science”: Perspectives on Practice*: Routledge Falmer
- Association for Science Education** (1996) *Safeguards in the school laboratory*, 10th edition, Hatfield: ASE
- Association for Science Education** (1998) *Topics in safety*, Hatfield: ASE
- Bentley, D & Watts, M** (Eds) (1992) *Communicating in School Science*, Falmer
- Black, P.** (1998) *Testing: Friend or Foe?* Ondon The Falmer Press.
- Black, P., Harrison, C. Marshall, B. William, D** (2003) *Assessment for Learning Putting it into Practice*, Open University Press
- Brown, S et al** (1995) *500 Tips for Teachers*, Kogan Page
- Bulman, L.** (1985) *Teaching Language & Study Skills in Science*, London: Heinemann.
- Cleminson, A.** (2000) *Physics for Secondary Scientists*, Brunel University
- Centre for Science Education**, Sheffield City Polytechnic (1992) *Active Teaching and Learning Approaches in Science*, London: Collins Education
- DfEE** (1996) *Safety in Science Laboratories*, London: HMSO
- Driver, R.** (1983) *The pupil as a scientist?* Milton Keynes: Open University Press
- Driver, R.** (ed) (1985) *Children’s Ideas in Science*, Buckingham: Open University Press
- Driver, R et al** (1994) *Making Sense of Secondary Science; research into children’s ideas*, London: Routledge
- Ellington et al** (1998) *Using Games and Simulations in the Classroom*, Kogan Page
- Fairbrother et al** (Eds) (1995) *Teaching Assessing Pupils* ASE
- Fensham et al** (Eds) (1994) *The Content of Science – Constructivist Approach to its Teaching and Learning*, Falmer Press
- Frost, J. & Turner, T.** (2005) *Learning to Teach Science in the Secondary School*: Routledge-Falmer
- Frost, R.** (1997) *The IT in Secondary Science Book*, London: IT in Science
- Frost, R** (1998) *Data logging in Practice* IT in Science
- Frost, R** (1998) *Software for teaching science* IT in Science
- Kind, V and Taber, K** (2005) *Teaching School Subjects 11-19: Science*, Routledge
- McDuell, B.**(2000) *Teaching Secondary Chemistry*, London: ASE/John Murray
- Millar, R.** (1996) *“Towards a science curriculum for public understanding”* School science review, Mar 77 (280) pp 7-18
- Monk, M & Dillon, J** (Eds) (1995) *Learning to Teach Science* Falmer Press
- Monk, M. Osborne, J.** (2000) *Good Practice in Science Teaching: What Research has to say*, Milton Keynes: Open University Press
- Osborne, J.F., & Freeman, J.** (1989) *Teaching Physics; a guide for the non specialist*, Cambridge University Press
- Parkinson, J.** (2002) *Reflective Teaching of Science 11-18* Continuum
- Parkinson, J.** (2004) *Improving Secondary Science Teaching*: Routledge Falmer
- Postlethwaite, K** (1993) *Differentiated Science Teaching* Open University
- Ratcliffe, M.** (1999) *Guide to Secondary Science Teaching*, Hatfield: Association for Science Education
- Reiss, M.** (1993) *Science Education for a Pluralist Society*, Open University
- Reiss, M.** (2000) *Teaching Secondary Biology*, London: ASE/John Murray
- Sang, D.** (2000) *Teaching Secondary Physics*, London ASE/John Murray

Sang, D. Wood-Robinson, V (2000) *Teaching Secondary Scientific Enquiry*, London ASE/John Murray

Thorpe, S. Deshpandi and Edwards, C. (1994) *Race, equality and science teaching: a handbook for science teachers*, Hatfield: ASE

Turner, T. and De Marco, W. (1998) *Learning to Teach Science in the Secondary School*, London: Routledge

Wellington, J. (2000) *Secondary Science : Contemporary Issues & Practical Approaches* Routledge

Wellington, J. & Ireson, G. (2008) *Science Learning, Science Teaching*: Routledge

Wellington, J. & Osborne, J.F (2001) *Language and Literacy in Science Education*, Buckingham: Open University Press

Wilson, E (1999) *Teaching Chemistry to KS4: a non specialist handbook*, Hodder & Stoughton

Winterbotham, M (1999) *Teaching Biology to KS4: a non specialist handbook*, Hodder & Stoughton

Wood-Robinson, V. (2006) *ASE Guide to secondary Science Education*: Hatfield, ASE

Useful websites

It is impossible to keep up to date with these, but I suggest you keep a record of useful websites throughout the year.

Here are a few to get you started:

www.practicalbiology.org

www.practicalchemistry.org

www.practicalphysics.org/

<http://nationalstrategies.standards.dcsf.gov.uk/secondary/science>

www.naldic.org.uk

www.multiverse.org.uk

www.kented.org.uk/ngfl/

www.lancsngfl.ac.uk/

www.inclusion.ngfl.gov.uk/

Appendix

Reading log
Lesson observation templates
Lesson plan
Guidance notes
Model of completed lesson planning template
Lesson evaluation template

(All available electronically)

Science lesson Observation

Date : Class: Number of pupils:	Ability grouping: Support staff: Time:
Topic area:	
Teaching Objectives:	Key Words:
Resources Used:	ICT/ Numeracy opportunities:
Teaching and learning activities:	Literacy/ Oracy opportunities:
Safety Issues:	H.W:
Strategies for differentiation/inclusion:	
Assessment strategies	Learning outcomes:
Class and behaviour management	
Other comments:	

London Metropolitan PGCE Science Observation

Date:

Class:

How does the teacher settle the class?

How are the pupils organised?

How does the teacher introduce the learning for the lesson?

What are the pupils' learning activities and how are they structured?

**How does the teacher keep the pupils on task and motivated?
How does the teacher manage changes in activity?**

What are the learning focuses of the lesson? Consider subject knowledge and N.C.

What are the learning outcomes of the lesson?

How does the lesson end?

Science Lesson Plan

Date: **Year group:** **Lesson time:** **Grouping:** **Number of pupils:**

Personal development target:

Setting the scene (Key Question):

Learning objectives(s) for sharing with pupils:

Possible misconceptions or difficult aspect(s):

Key terminology:

Learning Outcomes	Assessment strategies (during and after lesson)	Lesson Evaluation (Were targeted pupils able to achieve the outcomes- Yes/No/To some extent?)
(A) All pupils will:		
(M) Most pupils will:		
(S) Some pupils will:		

Resources:

Risk Assessment:

Lesson Notes (Script)

Use this section to write a script for the oral parts of your lessons, e.g. questions you will ask, explanations and instructions that you will give.

Lesson Evaluation Notes

Begin by considering the learning outcomes. To what extent were pupils able to achieve these? If not, aim to identify some reasons why not and then use these to develop your next lessons.

Guidance notes for completing the template

Page 1

Setting the Scene:

- How does the lesson fit in with prior learning, with the scheme of work, exam specification, curriculum etc? Provide a reference to the curriculum documentation.
- What is the bigger picture?
- How does the lesson relate to a real life context?
- Why are they learning it?
- How can you introduce the lesson?

Lesson objectives:

- Use the National Curriculum, departmental scheme of work, GCSE specification, etc to select appropriate objectives. Provide a reference to the documentation used. e.g. from N.C.
- You probably won't use the same language when sharing these with the class. In the lesson you should use appropriate 'pupil friendly' language when sharing the objectives. e.g. try phrasing as a question, or use WALT (what are we learning today) and WILT (what I am looking for), check the dept policy here?
- Don't forget objectives that are not necessarily from the range and content, e.g. key concepts and processes, How science works, citizenship, literacy, numeracy etc.

Other Objectives

- Make the links with language for learning, numeracy, ICT, citizenship where appropriate.

Prior Learning

- Consider learning at KS2 or in a previous year or in the previous SOW, previous lesson etc?

Barriers to Learning

- Important aspect- what might the pupils find difficult and why?
- Don't just write this down! Use it in your planning and lesson delivery.
- Will a model/analogy help convey the science?

Outcomes (how pupils demonstrate their learning)

- These must contain active verbs, e.g. label, recall, draw, describe, explain...
- Use N.C level descriptors or GCSE grade descriptors to help you differentiate
- Outcomes should include verbs, e.g. name, state, measure, record, describe, compare, calculate...
- Use Blooms Taxonomy
- **Make sure you plan teaching and learning activities that provide opportunities for pupils to meet these outcomes.**

Assessment

- Give your assessment strategies. Aim for a range- not just questioning. Specify the detail, e.g. what questions will you ask?

Resources

- What will be needed e.g. equipment, apparatus, texts, worksheets (it helps if these are labelled), card sorts etc
- How will the resources be managed and distributed?

Risk assessment

- Note the main hazard
- Give precautions

The Learning Sequence

- What are the different learning episodes?
- How will you sequence the learning so that pupils can build up their understanding and make progression?

- How much time will you allow for each learning episode?

Page 2 The lesson script

Lesson episodes

- There are many models for lesson structure- (you don't have to use the same one all the time). Think about what will work with the topic area and class.
- Give the main stages e.g. starter, main, plenary if you are following a 3 part lesson, or 4, or 5 parts
- Try the constructivist stages
- Try the 5 E's- engagement, exploration, explanation, extension, evaluation

Timing

- State how long each stage will need.
- Consider and plan for the transitions.

Learning Focus

- An important column – don't leave blank!
- What is the learning focus of each activity?
- Link the activities to the outcomes (may be easier to number the outcomes and then put the numbers in the column)
- This column is there to ensure you have a close match between your outcomes and T&L activities, e.g. if you have said pupils will 'be able to describe.....', they need an opportunity to describe, perhaps through a presentation, question on a w/k sheet, with a writing frame etc

Pupil and Teacher Activities

- This doesn't have to come last. You may find yourself working backwards on the template!
- Most important part? Write clear details of each activity.
- You will also need your own script to begin with extra notes

Differentiation

- Consider strategies for main ability groups such as:

By task e.g. different activities, worksheets, extension and enrichment

By intervention e.g. challenging questions when circulating or providing assistance

By support e.g. writing frames, key word activities, repetition, modelling, dictionaries, visuals, use of T.A

By pupil groupings

- How can you provide support to ensure all levels of outcome can be met? More able also need support.
- Remember variety is the key- not just lots of different tasks, but different ways of presenting and explaining the key points
- You need to consider specific individual needs, e.g. EAL, SEN

Remember- someone else should be able to follow your plan.

Tips

- **Try not to let the lesson plan template restrict your creativity.**
 - **Plan your explanations and questions- you may need a script.**
 - **Move on from just planning a series of pupil activities to really considering how you can convey the key learning points in the science.**
 - **Could you use a model or analogy? Will a demonstration help? Do you need to give some examples?**
 - **Plan carefully for movement around the room, distribution of resources and giving instructions (you may need further notes or a script for this)**
 - **Be prepared and willing to deviate from your plan**
- Complete a full evaluation for each class per week.**

Weekly Evaluation sheet

Lesson dates:

Class:

Aim to address some of the following but always come to a conclusion and consider development points for the next week of lessons:

- General overview, i.e. What went well? What went less well? Did you enjoy the lessons?
- Quality of Learning. Do you think the learning outcomes were achieved by all, most, a few pupils and to what extent? How do you now? Were your assessment strategies adequate? Will you need to revisit any of your lesson objectives?
- Misconceptions. Did pupils find any aspects difficult or hold misconceptions?
- Quality of motivation and engagement. Were pupils interested to learn? How did you know? Did they remain focussed on the teaching and learning activities?
- Quality of resources. Were these adequate and sufficiently varied?
- Inclusion. Were all pupils able to participate and at an appropriate level. Were you able to meet individual needs?
- Class management

Conclusion:

- Identify any pupils that you need to target for the next lessons and why?
- Did you make progress against your developmental targets?

Development points (link to QTS):

- Identify an aspect that you wish to improve/develop in subsequent lessons

Sample Science Lesson Plan				
Date:	Year group:	Lesson time:	Grouping:	Number of pupils:

Personal development target: Design differentiated H.Ws that extend and consolidate learning
QTS link: Q24

Setting the scene:

Most pupils will have looked at different habitats at KS2 and many will have some familiarity with this from library books, television and experience, e.g. from living in different climates, travel.

The key questions are related to the National Curriculum range and content 3.3d:

How organisms can vary? How variation may lead to their survival in changing environments?

Pupils will have opportunities to obtain relevant information from secondary sources, e.g. textual and electronic (KP 2.2a) and contribute to presentation of findings (KP 2.2a)

Prior Learning: study of different habitats at KS2

Learning objectives(s) for sharing with pupils:

These will be displayed for all to read and consider.

- What is our habitat and how can we describe the conditions?
- How do living organisms vary and how can that variation help them to survive in their habitat?

Learning barriers

timescale of adaptation, plant adaptation

Key terminology:

conditions, feature, habitat, organism, variation

Learning Outcomes	Assessment strategies (during and after lesson)	Evaluation
(A) All pupils will: Give examples and describe conditions of some different habitats	Complete table listing different habitats and conditions (water, temperature, light)	Yes could manage this in groups but not sure all are confident with terminology, such as conditions
(M) Most pupils will: Give an example of features for a plant and animal from a particular habitat and explain how it helps survival	Research to find examples and produce labelled drawing	Most had one example and could identify features. Explanations weaker and not sure they would be able to produce a written explanation.
(S) Some pupils will: Predict and explain possible features for an unknown (imaginary) environment.	Design activity for H.W - present ideas back to class next lesson. Oral suggestions as a plenary	A few more able pupils did this well.
Resources	Special Provision	
Video clip of habitat Key words plus hyperlink to pictures on IWB-prepared using Smart board note book. Mini white boards Laminated different habitat photos- one per group Tables to complete with example done. IWB resources showing example of plant adaptation A3 paper + pencils, crayons, blutak Range of books- different reading age, complexity Computers set to appropriate website Video clip for Home Work and support HW sheets.	TA to work with Sean, Aisha and help them complete table for a habitat and to work with their group at computer for research task. EAL pupils have resources with visual clues.	

Risk Assessment: N/A

Learning Sequence

Lesson episode	Timing	Learning focus	Pupil Activity	Teacher Activity	Class /Gp/ Pair/Ind	Differentiation
Starter: Engagement Elicitation	Timing 10	Learning focus Key word- habitat Other Key words	Pupil Activities Watch clip/ listen to lesson objective Look at key words on board. Speak to partner- which ones they think they know? Show on mini white boards or paper one they want to know more about. Class discussion about key words	Teacher Activities Show video clip of habitat with animals/plants. Introduce lesson objectives: Notice words that they are less sure about. Take contributions from class and explain key words. Show links to pictures. Encourage pupils to say words	Class Pairs	Visual clues Emphasise saying key words
Transition			Pupils move to sit in groups.	Group names on board. Ask pupil to put photos on each table. Do register.		
Main: Introduction Exploration	15	key words- habitat, condition	Groups look at photos and work together to record habitat and conditions in table. One pupil from each group shares a habitat and conditions with rest of class	Explain purpose of task. Give instructions on how to complete table. Use example to help. 5 mins to look at two photos and record in table. Then each group moves to next table. Circulate and monitor. Choose a pupil from each group to share one habitat with rest of class.	Gps	Prepared table to model expectations of task. Mixed ability groups. Choose pupil to present.
Transition	5		Pupil from each group describes one habitat.	Say: Now you will look for features of a plant or animal that will help it survive in a habitat.		

Main: Development Elaboration	20	key word- feature, survival	Listening Research (text or electronic) to find examples. Draw and label example of plant and animal adaptation (on A3 paper divided in two). Pairs stick up A3 paper onto display board at end. Tidy tables and stick A3 papers onto display board with blu-tak. Look at other work	Explain next task and its purpose. Show example on IWB Choose pairs to use computer	pairs	Computer access for some pupils – Sean with ADHD. Set up computers at correct webpages. Different texts.
Transition	2		Pupils copy H.W into planners.	Say now going to consider some unusual and difficult habitats. Introduce HW task and give out sheets.		
Plenary: Extension and evaluation	8	How variation of features can help survival in different habitats. Predicting features for plant or animal in unusual habitat	Listening and watching. Individual contributions. Write HW in planners.	Use a video clip, e.g. of unusual landscape to show habitat (volcanic?) Then take some suggestions from class as a plenary. Stress key words. Ask pupil (EAL) to click on correct words to link to pictures as you do this.	class	IWB- key words and visual clues.
Homework		Predicting features for plant or animal in unusual habitat	Design organism with survival features for a habitat with given conditions. State plant or animal. Label adaptive features. Or more structured wk sheet with pictures and key words for some.			HW task sheets- 2 versions