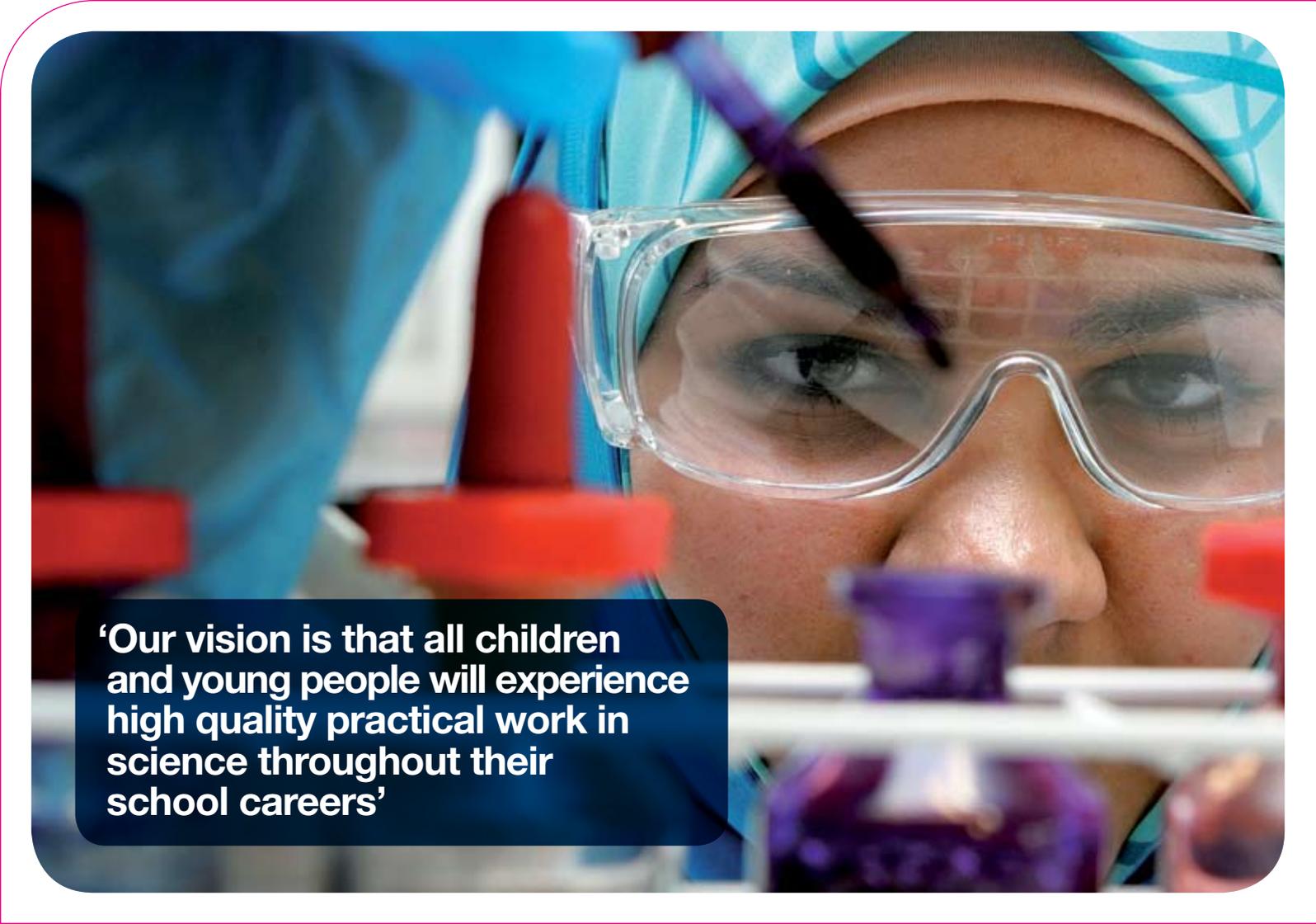




Getting practical

A framework for practical science in schools



‘Our vision is that all children and young people will experience high quality practical work in science throughout their school careers’



Introduction

It is important for children and young people to experience good quality practical science at school. But, what is practical work in science? Why is practical work in science such an essential part of a science education? What are the purposes of practical work? How, when and where should it be carried out, to maximise its effectiveness? And how can the quality of practical work in science be improved?

This booklet will help you to recognise and plan for a wide variety of high quality science practical work, ranging from out of the classroom learning to opportunities for students to practise specific techniques and procedures.

When you have read this booklet, you may like to look at the accompanying resources. These resources link the indicators of high quality practical work to selected biology, chemistry and physics activities for primary and secondary schools. They are designed to help in a practical way, as you consider the issues raised in 'Getting Practical'.

What? –

A definition of practical work in science

Practical work in science is a ‘hands-on’ experience which prompts thinking about the world in which we live. It is made up of a core of two activity types:

- scientific techniques and procedures, both in the laboratory or the field, and;
- scientific enquiries and investigations.

Each of these core activities not only supports the physical development of skills but also helps shape the understanding of scientific concepts and phenomena. The hands-on approach offered by practical work often challenges students’ preconceived ideas and as a result deepens their scientific understanding.

In addition, teacher demonstrations are a valuable experience of practical work in science experience. They allow, for example,

students to gain first hand experience of more spectacular experiments. Demonstrations are also useful for modelling scientific procedure, thus enabling students to develop their own skills.

Complementary activities

Scientific understanding often progresses through the un-programmed event, so the real world cannot always be satisfactorily simulated on a computer screen. Modelling therefore complements but doesn’t replace practical work in science. Students should also have opportunities for a wide range of communication activities, including reading and writing of text, use of diagrams and interactive models, group discussions and role plays.

Practical work in science

Techniques and procedures

Pupils engage in:

- using a wide range of equipment and handling materials and living things
- making observations, taking measurements
- working safely

Enquiries and investigations

Pupils engage in:

- using practical skills to undertake scientific enquiries and investigations
- asking questions and planning to answer these or test an idea
- collecting data systematically, analysing and interpreting data and evaluating their methods
- considering the validity and reliability of their evidence when drawing conclusions

Teacher demonstrations

Teachers:

- use these to teach about complex or hazardous situations
- can then focus on process of enquiry
- are able to model the procedures and processes of science

Why? – The purposes of practical work

Practical work is not a part of science for its own sake but because:

- science is an empirical subject,
- learning is very often more effective when it incorporates hands-on experience,
- science contributes to increasing knowledge and conceptual understanding.

Any particular piece of work needs to have its objectives made explicit to pupils if they are to benefit fully from it. Omitting this can lead to pupils experiencing practical work merely as a break from the more routine activities of listening and writing.

Skills Development

- Planning
- Manipulation of equipment
- Observation
- Analysing
- Evaluating

The development of Personal, Learning and Thinking Skills (PLTs) and How Science Works (HSW)

Experiential Learning

- Test out own ideas
- Test out theories
- Develop problem solving strategies
- Develops team work and taking responsibility
- Develops students as self learners

Practical Science Supports:

Independent Learning

- Students work at their own pace
- Students work at their own level
- Supports differentiation by outcome, task and questioning
- Builds student confidence

Learning in Different Ways

- Working in teams
- Working as individuals
- Manipulating materials and objects
- Observing using all senses
- Informal dialogue with peers and teachers

How, When, Where? – recognising high quality practical work

All high quality practical work will be:

- **Integrated** into all science long term schemes of learning so that most lessons will include some hands-on activity to provide a stimulating learning environment.
- **Well-planned** through inclusion in medium term schemes of learning and lesson plans, so that resource provision and class management can be organised effectively.
- **Adaptable** to suit the range of classes and individual pupils. Hands-on activity will expose differences and the teacher needs to consider adaptations for variations in ability, prior experience, interest, motivation and behaviour. There must be explicit success criteria for differentiated activities.
- **Time-efficient** so that the tension between the time-consuming requirements of practical

work, where pupils' think themselves into the task and develop practical skills, is balanced against the pressure of covering the curriculum content.

The quality of practical work experiences should be judged by the progress students make in their learning and measured against agreed success criteria. Practical work should not be judged by the quantity of time spent on it. For example, complete investigations will probably be rare activities, as elements of the investigative process and of the practical techniques can be studied in shorter time periods.

Some high quality practical work will include:

- **Self-directed enquiry** by individuals, or more commonly by groups, which promotes ‘pupil ownership’ of their science and can be motivating and enjoyable.
- **Investigations to encourage team-work** with members being given particular roles in the planning, implementing, interpreting and communication of the work.
- **Extended enquiry or projects** which encourage pupil autonomy and opportunities for decision making.
- **Challenges to existing ideas and established concepts:** a stimulating demonstration can prompt pupils’ thinking – ‘brains-on’ accompanying ‘hands-on’ experience.
- **Out of the classroom** activities to present science in ‘real-life’ situations such as fieldwork in the natural environment, and with science-related activities in industry, healthcare etc.
- **Use of ICT** for handling and presenting data **and contemporary technical equipment** to relate science techniques in school to modern practice, to encourage pupils to think about working with science beyond school.
- Exposing pupils to the ‘messiness’ of **using real data**, in contrast to computer models or simplifications in media reports.
- Opportunities to **practice specific skills and techniques**.

Improving the quality of practical work in science

Continuing to improve the quality of practical work in science is the responsibility of many people. Teachers, schools, Government and its agencies and local and national bodies all have a role to play.

What can I do?

Wider issues

Share good practice with colleagues
Lead my science department by promoting high quality practical work

Resources

Use ICT for data capture and analysis

Continuing professional development

Make use of CPD provision to improve quality and increase confidence in practical teaching

Curriculum development, delivery & assessment

Use *Explore, Discover, Inspire: Practical Work in Science*
Try out new practical activities to support learning

What can my school do?

Develop science department and school leadership to promote high quality practical work
Have appropriate pupil behaviour policies to ensure safe working

Provide accessible and reliable ICT
Ring fence funding to ensure standards are met
Provide appropriate laboratory spaces and facilities

Enable teachers and technicians to take up CPD opportunities

Ensure there is appropriate curriculum time for practical science
Allow preparation time for teachers and technicians
Provide appropriate technical support, especially from qualified technicians

What can others do?

Disseminate good practice and highlight shortcomings
Provide clear safety advice
Develop and share understanding of how to teach and assess the varied purposes of practical work

Develop curriculum resources to support change
Provide appropriate funding for equipment and resources
Fund and support the development of appropriate laboratory spaces and facilities

Provide relevant and suitable CPD opportunities for using and assessing practical work

Develop new practical ideas for the contemporary curriculum
Ensure the science curriculum values hands-on experience
Develop assessment tools that recognise hands-on experience
Support the development of technicians

Who can help?

ITT and CPD providers CLEAPSS, SSERC, SCORE, ASE, IOP, RSC, IOB

Publishers, curriculum development agencies
Funding agencies

CPD providers (e.g. subject and professional associations, science learning centres, CLEAPSS, SSERC, Local Authorities)

Government, its agencies (DCSF, DIUS, QCA, Ofqual, National Strategies, TDA)
Awarding bodies
Curriculum development agencies, Subject and professional associations

Best Practice – practical work in science is an entitlement for all pupils

At regular intervals, all pupils should have opportunities in their science lessons which are:

‘Brains- on’ as well as **‘hands-on’**, to promote effective learning.

Enquiry-based, complete or part investigations simulating the work of scientists.

Self-directed (including groups), to encourage pupil-ownership, motivation and independence.

Timely – effectively planned into most science lessons.

Purposeful – and demonstrating clearly to pupils the different purposes of practical work in science.

Relevant to pupils’ personal interests and concerns in everyday life.

Adaptable to suit the varied needs of individual pupils and groups.

Connected to the world beyond the classroom – including fieldwork, projects and visits.

Technically authentic and contemporary, including the use of

ICT for data collection and analysis and for simulations and modelling.

Coherently planned and managed to cover the whole science curriculum.

Engaging all pupils in the ‘messiness’ of real-world data.

A joint venture by:



75% recycled

This publication is printed
on 75% recycled paper



When you have finished with
this publication please recycle it

6-9 Carlton House Terrace, London SW1Y 5AG Tel: +44 (0)20 7451 2554 email@score-education.org www.score-education.org

Supported by Department for Children, Schools and Families