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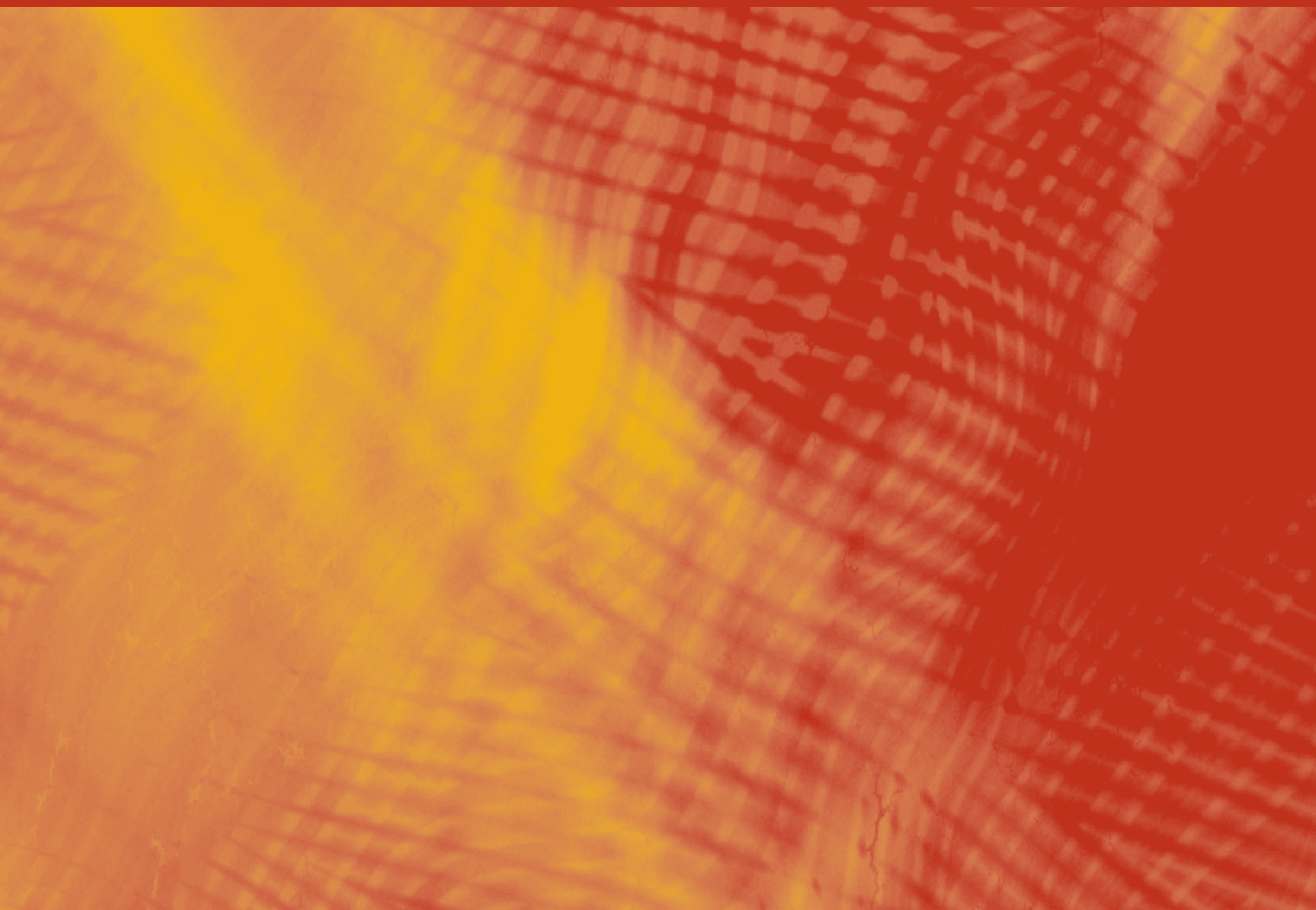
# Science in Primary Schools, Phase 1

Janet Varley, Clíona Murphy and Órlaith Veale



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# Science in Primary Schools, Phase 1

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# Contents

# EXECUTIVE SUMMARY

The formal implementation of the Irish Primary Science Curriculum (Department of Education and Science [DES], 1999a) commenced in September 2003. The National Council for Curriculum and Assessment (NCCA) is conducting and has commissioned research to examine the extent of this curriculum's implementation. This report represents the culmination of the commissioned research's first phase, which has focussed on the experiences of primary pupils in school science. Findings in this report are based on data gathered from a survey, in which 1030 pupils from third to sixth class completed questionnaires, and data gathered from a case study of 11 primary schools, in which pupils were observed during science lessons, interviewed and asked to complete questionnaires. These data were gathered between October 2007 and February 2008.

Findings and recommendations are summarised here.

## Summary of Findings

- Primary children are enthusiastic about primary school science. The majority are well-disposed towards learning about virtually all of the content areas outlined in the Primary Science Curriculum.

- Primary children are very positive about hands-on science and appear to have opportunities to engage in it, applying a range of scientific skills as a result. In general, children are working collaboratively in small groups when they conduct hands-on activities. The majority of children enjoy working in this way.

- Some pupils may not be afforded regular opportunities to engage in hands-on science. In particular, child-led investigations appear to be used infrequently. There are also relatively few instances of children engaging in designing-and-making activities.

- Children seem to have few opportunities to apply certain scientific skills. The application of some scientific skills for older pupils appears to lack appropriate breadth and complexity.

- Some children may be experiencing teacher demonstration and teacher explanation as dominant features of their primary science learning. Although most children feel positive about these strategies, some have negative or ambivalent views.

- Reading and writing feature in science lessons and include: copying from the board; reading textbooks; and completing worksheets and workbooks. Pupils' attitudes towards using these methodologies are not entirely positive. Pupils do not appear to be experiencing a varied range of possibilities for recording and communicating their work.

- Children are very enthusiastic about working on science outside the classroom. They also express positive views about going on science-related trips and having visitors who engage them in scientific work at school. These experiences are extremely memorable. However, children may encounter these rather infrequently, if at all.

- Children are positively disposed towards the notion of using ICT in science. However, children's actual experiences of using ICT in science lessons appear to be extremely limited.

- The majority of children's experiences of school science relate to the strands Living things, Energy and forces and Materials. The breadth and depth of pupils' learning within these content areas cannot be determined from the data gathered. Children's reported experiences often mirrored activities provided for teachers in the Primary Curriculum Support Programme (PCSP) in-service workshops or the Discover Primary Science resource pack (Discover Science and Engineering [DSE], 2007).

- Children's experiences of science within the strand units of forces, and properties and characteristics of materials, appear to be rather limited. Children's reports of lessons relating to the strand of Environmental awareness and care are infrequent in comparison with the other three strands.

- In general, primary children are not necessarily relating their school science experiences to the wider world or to future aspirations.

## Summary of Recommendations

- Comprehensive in-service support for primary teachers in the form of continuing professional development courses should be provided. This is proposed for teachers who have a role as a science co-ordinator or post-holder. A bursary scheme and/or provision for substitute cover to facilitate attendance is envisaged. Areas of focus for in-service should include those noted as areas of concern in the findings. These teachers must also be provided with appropriate time for disseminating ideas gained from such professional development to the staff in their schools. This recommendation should provide teachers with the confidence and opportunity to take ownership for school development in science.

- This report recommends that colleges of primary teacher education should be supported to provide in-depth science education academic courses as an option in the Bachelor of Education (B.Ed) degree. Some colleges of primary teacher education offer students an academic subject to take to degree level. However, as yet, none offer science education within this context. Students undertaking such a course would gain a thorough grounding in relevant scientific content and pedagogical knowledge. These primary science 'specialists' would serve to

build capacity and expertise in the primary sector in the longer-term. Such courses would be in addition to existing curriculum science courses taken by all B.Ed students.

- Additional, ring-fenced funding for consumable science resources should be provided to schools every year on a capitation basis. Funds should also be made available for schools to ameliorate their ICT equipment, where it is of insufficient quality to support learning in science.

- It is recommended that future special events aimed at children should focus on whole-school approaches that involve teachers, drawing on their expertise. Such events could also extend over a period of time. These approaches would be beneficial for supporting teachers and pupils beyond the timeframe of the events themselves.

- Existing materials for primary science on the PCSP website should be enhanced, focussing on the areas of concern identified in the findings. It is also recommended that a teacher feedback forum be incorporated into the website. This would allow teachers to comment on, or add to suggested activities, thus sharing existing expertise and experience.

- In order to complete the picture of curriculum implementation, research to assess primary pupils' subject knowledge and skill levels should be conducted. This report does ***not*** recommend mandatory national testing of pupils in science as a means to this end.

- Another research study of similar scope to the one reported here should be conducted in a few years' time. This would assess the impact of any ongoing or future initiatives, including those that occur as a consequence of the other recommendations in this report.

# Section 1:

# Introduction

In this opening section of the report a brief overview of some of the curriculum developments regarding primary science in Northern Ireland, England and Wales, Australia and the Republic of Ireland are presented. Some issues of concern relating to the teaching and learning of primary science in these countries are also considered.

## 1.1 International Overview of Primary Science Curriculum Implementation

Primary Science has the potential to spark children's interest in the sciences. Irish and UK policy documents suggest that another aim is to promote scientific literacy (Royal Society of Chemistry 2001; Task Force on the Physical Sciences, 2002). Primary science offers the opportunity to harness young children's natural curiosity. Ideally, during science, children should be provided with opportunities to manipulate materials, ask questions, hypothesise, predict and test their predictions. As with other primary science curricula, these views are central to the Primary Science Curriculum[1] in the Republic of Ireland (DES, 1999a).

Unfortunately, the reality in primary science classrooms is often very different from approaches suggested by published curricula. Reports from the UK and Australia, for example, have indicated concerns about primary science, in some cases revealing a gulf between the intended and the actual curriculum as experienced by pupils (Department of Education for Northern Ireland [DENI], 2002; Her Majesty's Inspectors of Schools, 1999; National Research Council, 1996; Australian Science, Technology and Engineering Council [ASTEC], 1997; Department of Employment, Education and Training, 1989).

1 In this report, the phrase Primary Science Curriculum will be used throughout, to avoid any possible confusion with discussions of post-primary science curricula in Ireland or elsewhere.

### 1.1.1 England, Wales and Northern Ireland

In England and Wales, science has been a core subject at primary level since the 1980s and the current science curricula have been in place since 1999 in England and 2000 in Wales (Department for Education and Employment/ Qualifications and Curriculum Authority, 1999; Qualifications, Curriculum and Assessment Authority for Wales, 2000). In 1990, a statutory curriculum was introduced in Northern Ireland (DENI, 1990). The entire Northern Ireland curriculum was reviewed in 1992 and again in 1996, which resulted in a significant reduction in the scientific knowledge content and the inclusion of technology with science. A new curriculum, "The World Around Us" was subsequently introduced in Northern Ireland, which integrates Geography, History, Science and Technology (Council for the Curriculum Examinations and Assessment, 2007). The aim of this integrated curriculum is that the children should be given opportunities to explore their environment and to investigate in a range of ways in order to make sense of their world, both past and present.

However, despite the various curricular reviews and developments, recent inspection reports from Northern Ireland and elsewhere in the UK indicate that there are still concerns regarding the teaching and learning of science in primary schools. In 2001 for example, Randall, a member of the original working party for the National Curriculum for Science in England and Wales, expressed concern about the ways in which science was being taught at primary level. She wrote of seeing formal science lessons that appeared to be so prescribed that children were simply following instructions. There seemed to be few opportunities for children to explore or investigate their own questions or further their own intellectual development (de Boo and Randall, 2001). Recently, a report on science in primary schools from the Office for Standards in Education (OFSTED, 2004), indicated the need for emphasising scientific enquiry as a part of

internal and external assessments of science. The report also recommended that more training was required that would provide teachers with the confidence and expertise to facilitate their pupils in conducting scientific enquiry in class. There are also similar concerns in Northern Ireland. In 2002, for example, a report from the Department of Education in Northern Ireland (DENI, 2002) recommended that primary pupils be provided with opportunities to develop their own investigations and that students be provided with adequate challenges across their various ranges of ability.

In Northern Ireland, and indeed in many places throughout the UK, pupils' interest in science declines with age, with this downward trend starting during the primary school years and continuing at post-primary level (Murphy and Beggs, 2002; Jarvis and Pell, 2002). The creation of negative attitudes towards science may be linked to the apparent lack of hands-on investigative work at primary level, described above, which may in turn be related to teachers' confidence to teach enquiry-based science. In relation to this, a recent UK-wide study by Murphy, Neil and Beggs (2007) reported that, of all the issues impacting on primary science, teachers' confidence and their ability to teach science were the areas of greatest concern to teachers. These factors were reported by half of all teachers surveyed (Murphy et al., 2007).

### 1.1.2 Australia

Science, as opposed to 'nature study' has been part of the curriculum in Australian primary schools for over forty years. Australia comprises eight states/territories, each of which has constitutional responsibility for school education. In 1991 the Australian Education Council (AEC) began to develop national statements and profiles for eight broad key learning areas, including science. Since 1994, all states and territories have been implementing different versions of a national

science curriculum, aimed at promoting scientific literacy (Goodrum, Hackling and Rennie, 2000).

However, Australian studies have revealed that many primary teachers are still not teaching science (ASTEC, 1997; Goodrum et al., 2000). Goodrum and co-workers conducted a large-scale study, which investigated the quality of science teaching and learning in Australian primary (and secondary) schools. Their findings revealed that in general the actual curricula being taught in most Australian schools were different from those outlined in the intended curriculum frameworks. The curriculum documents in the states / territories in Australia generally provide frameworks for science curricula that are focused on developing scientific literacy and helping students progress toward achieving the stated outcomes (Goodrum et al., 2000). Goodrum and colleagues provided a number of descriptions regarding the composition of ideal curricula in the Australian states / territories. Four of their nine themes are particularly pertinent to the current report, and these are summarised as follows:

- Teaching and learning of science is centred on enquiry. Students investigate, construct and test ideas and explanations about the natural world;
- The teaching-learning environment is characterised by enjoyment, fulfilment, ownership of, and engagement in learning and mutual respect between the teacher and students;
- Teachers are life-long learners who are supported, nurtured and resourced to build the understandings and competencies required of contemporary best practice; and
- Excellent facilities, equipment and resources to support teaching and learning are available.

However despite the provision of these frameworks, Goodrum and colleagues reported that the actual curricula being implemented in most schools throughout Australia were different from the intended (ideal) curriculum. They found that there was a great degree of variation in the ways in which science was taught throughout the states / territories.

In some primary schools, for example, they found that often science was not taught at all. In other classrooms there still appeared to be an emphasis on didactic approaches of using texts and involving pupils in taking notes. Although teacher-centred classrooms appeared to be the norm, a range of teaching strategies within this approach was employed. These included the children being engaged in hands-on activities and being provided with opportunities to conduct investigations, albeit ones that tended to be teacher-directed rather than pupil-led. There was also evidence that group work and discussion were common activities.

Another finding from this study indicated that science in primary schools tended to be predominantly classroom-based. For example, one-third of students commented on the fact that they never went on science trips, 50% said they never visited zoos or museums and 64% revealed they never had science speakers in to talk to them about science. These findings were corroborated by the data obtained from the teachers.

Although some teachers were still employing more traditional, didactic approaches to teaching science, it was reported that the majority of these teachers indicated that they would be content to explore more progressive, child-centred approaches if provided with adequate encouragement and professional development (Goodrum et al., 2000). However the study also indicated that the limited opportunities for professional development made it difficult for both

experienced teachers and new graduates to participate in an ongoing learning cycle. One teacher indicated, "there is an attitude that once trained, the teacher has the skills and knowledge to cope. There is no nurturing of teachers or encouragement of life-long learning" (Goodrum et al., 2000, p. 160). Recommendations arising from this extensive research study in Australia focussed on teachers as the key agents of change, with proposals including enhancement of in-service and pre-service education, and resource support.

### 1.1.3 The Republic of Ireland

In Ireland, prior to the introduction of the Primary Science Curriculum (DES, 1999a), a survey was conducted by the Irish National Teachers' Organisation (INTO, 1987). This study indicated that although 87% of primary teachers questioned had a nature table in their classrooms, only 31% involved their pupils in conducting science experiments (INTO, 1987). In 1990 the NCCA review of science in the *Curaclam na Bunscoile* (DES, 1971) also revealed that there was a lack of emphasis on basic science in the middle and senior classes and an apparent lack of confidence amongst teachers regarding the teaching of science (NCCA, 1990). The NCCA (1990) and INTO (1987) reports both recommended the provision of in-service courses in science to facilitate teachers in implementing new science programmes, "the transmission of new science programmes will have only minimal impact unless they are accompanied by a genuine commitment to provide in-service education for all teachers" (INTO, 1992, p.46). In addition to this, the INTO recommended that a nationwide programme of in-service education be established prior to the implementation of any new science curriculum.

International studies conducted at a time when the *Curaclam na Bunscoile* was in operation (DES, 1971) also highlighted concerns about the teaching and learning of science in Irish primary schools.

The International Assessment of Educational Progress (IAEP, 1988) report revealed that Irish children aged 9 and 13 performed less well in science- related activities than their counterparts in other countries. It also revealed that Irish girls had the lowest average science proficiency score of any group involved in the survey. This was largely attributed to the neglect of science in primary schools. A later survey, the Third International Mathematics and Science Study (TIMSS) showed that, although Irish 9-year-olds' performance in science was above the average for the countries participating, pupils performed poorly in physical science topics (Martin, Mullis, Beaton, Gonzalez, Smith and Kelly, 1997). In addition, only 5% of Irish primary teachers in the study used group work as a teaching strategy in most or all of their science lessons. This figure was lower than that given for virtually all of the other participating countries.

A number of initiatives were undertaken to address these concerns. At primary level the Primary Science Curriculum and accompanying Teacher Guidelines (DES, 1999a;b) were published, and science was included as a subject in its own right. This science curriculum aimed at improving the level of achievement in science and science-related activities amongst Irish primary school children. With the introduction of the Primary Science Curriculum, the DES provided a number of supports for teachers. This included the Primary Curriculum Support Programme (PCSP), amongst other agencies. The Primary Science Curriculum has now been compulsory in schools since September 2003. At this stage the NCCA is conducting and has commissioned research to review its impact.

There are two phases of commissioned research within this science review. The current report presents the findings from the first phase of the commissioned research. The findings relating to primary children's experiences of the Primary Science Curriculum are presented and are based on an analysis of data gathered from

classroom observations, children's questionnaires and group interviews. Typical experiences that are reported and discussed include the subject content areas encountered by children, how children are learning science and their perceptions of and attitudes towards science in school. The second phase of commissioned research explores the impact that children's experiences of science at primary school have on their engagement with science at post-primary level. Findings from this second phase will provide important information on curriculum continuity. Phase 2 will also consider the effect of curricular developments in both primary and secondary sectors on pupils at the start of their post-primary school careers.

The next section of this report presents an overview of the Primary Science Curriculum (DES, 1999a) and supports for it. The design and structure of the study are described in Section 3, while Sections 4 and 5 present the findings from the survey and case study. Finally the indicative findings are considered and conclusions and recommendations presented in Section 6.

# SECTION 2:

# SCIENCE IN

# PRIMARY SCHOOLS

This section opens with a brief overview of the differences between the *Curaclam na Bunscoile* (DES, 1971) and the Primary Science Curriculum (DES, 1999a). This is followed by a more detailed account of the aims, content and skills underlying the Primary Science Curriculum. The section closes with a brief discussion of some supports for implementing the Primary Science Curriculum that have been made available to teachers and their pupils.

## 2.1 The Primary Science Curriculum: Overview

The Primary Science Curriculum (DES, 1999a) represents a development and considerable expansion in comparison with the equivalent section of the *Curaclam na Bunscoile* (DES, 1971). The *Curaclam na Bunscoile* placed a great emphasis on biological and environmental science, while elementary science that incorporated physical as well as biological topics was only a significant component of the programme for fifth and sixth classes. There are notable changes between these two curricula including an increased emphasis on the development of scientific skills from junior infants to sixth class. In addition, the 1999 curriculum encourages the development of pupils' scientific knowledge within physical and biological areas at all class levels. Some of the aims of the Primary Science Curriculum are outlined below:

- The development of scientific and technological knowledge and understanding through the exploration of human, natural and physical aspects of the environment;
- The development of a scientific approach to problem-solving which emphasises understanding and constructive thinking;
- To encourage the child to explore, develop and apply scientific ideas and concepts through designing and making activities and creative action;

- To help the child to appreciate the contribution of science and technology to the social, economic, cultural and other dimensions of society;

- To enable the child to communicate ideas, present work and report findings using a variety of media; and

- To foster the children's natural curiosity, so encouraging independent enquiry.
  (DES, 1999a, p.11)

The Primary Science Curriculum is compulsory for all children from junior infants to sixth class. It supports children in learning about physical and biological aspects of the world, developing pupils' knowledge and understanding through the skills of *working scientifically* and *designing and making.* Knowledge and understanding for each age group is presented in four **strands:** Living things, Energy and forces, Materials and Environmental awareness and care. Each of these strands is further divided into **strand units** as shown in Table 2.1.

Table 2.1 illustrates that the suggested breadth of conceptual development is similar at each class level, although detailed descriptions in the curriculum itself show that the depth and complexity of treatment increase as pupils progress from infants to sixth class (DES, 1999a). It is worth noting that the curriculum is based on a spiral approach, whereby aspects of the biological and physical environment can be explored at each class level. It is not intended that all strand units be taught in each year, but for each pair of classes, it is suggested that some units could be taught in only one of the classes, whilst others could "profitably be taught in each class" (DES, 1999a, p. 53). Pupils in any school that followed this spiral approach would therefore encounter material related to each of the strand units in at least four classes at primary level.

| Table 2.1: Summary of strands and strand units in Primary Science Curriculum | | | | |
|---|---|---|---|---|
| | **Living things** | **Energy and forces** | **Materials** | **Environmental awareness and care** |
| **Infants** | • Myself<br>• Plants and animals | • Light<br>• Sound<br>• Heat<br>• Magnetism and electricity<br>• Forces | • Properties and characteristics<br>• Materials and change | • Caring for my locality |
| **1st and 2nd classes** | • Myself<br>• Plants and animals | • Light<br>• Sound<br>• Heat<br>• Magnetism and electricity<br>• Forces | • Properties and characteristics<br>• Materials and change | • Caring for my locality |
| **3rd and 4th classes** | • Human life<br>• Plants and animals | • Light<br>• Sound<br>• Heat<br>• Magnetism and electricity<br>• Forces | • Properties and characteristics<br>• Materials and change | • Environmental awareness<br>• Science and the environment<br>• Caring for the environment |
| **5th and 6th classes** | • Human life<br>• Plants and animals | • Light<br>• Sound<br>• Heat<br>• Magnetism and electricity<br>• Forces | • Properties and characteristics<br>• Materials and change | • Environmental awareness<br>• Science and the environment<br>• Caring for the environment |

In addition, there are a number of science skills that the children are expected to develop over the course of their eight years in primary school. Table 2.2 summarises these skills.

| Table 2.2: Summary of working scientifically and designing and making skills in the Primary Science Curriculum | | |
|---|---|---|
| | **Working scientifically** | **Designing and making** |
| **Infants** | Questioning<br>Observing<br>Predicting<br>Investigating and experimenting<br>Estimating and measuring<br>Analysing<br>Sorting and classifying<br>Recording and communicating | Exploring<br>Planning<br>Making<br>Evaluating |
| **1st and 2nd classes** | Questioning<br>Observing<br>Predicting<br>Investigating and experimenting<br>Estimating and measuring<br>Analysing<br>Sorting and classifying<br>Recognising patterns<br>Interpreting<br>Recording and communicating | Exploring<br>Planning<br>Making<br>Evaluating |
| **3rd and 4th classes** | Questioning<br>Observing<br>Predicting<br>Investigating and experimenting<br>Estimating and measuring<br>Analysing<br>Sorting and classifying<br>Recognising patterns<br>Interpreting<br>Recording and communicating | Exploring<br>Planning<br>Making<br>Evaluating |

| | | |
|---|---|---|
| **5th and 6th classes** | Questioning<br>Observing<br>Predicting<br>Investigating and experimenting<br>Estimating and measuring<br>Analysing<br>Sorting and classifying<br>Recognising patterns<br>Interpreting<br>Recording and communicating<br>Evaluating | Exploring<br>Planning<br>Making<br>Evaluating |

Table 2.2 illustrates that the skills children should utilise at each level are broadly similar in range. However, it is expected that the skills should be extended and developed at each class level, as pupils progress from infants to sixth class (DES, 1999a). For example, it would be acceptable that children predicting in infant classes would 'guess or suggest what will happen next in structured situations' (DES, 1999a, p. 20). An example of this could include: "I think it will stick to the magnet". By fifth and sixth class, however, children's ability to engage in predicting should be more sophisticated, and such children should be enabled to:

- Offer suggestions (hypotheses) based on a number of observations and data available about the likely results of the investigations;
- Make inferences based on suggestions and observations; and
- Propose ideas or simple theories that may be tested by experimentation.
  (DES, 1999a, p. 78).

A child in fifth or sixth class could therefore be expected to predict and indeed base a hypothesis on some prior knowledge or experience. A suitable example here might be:

> *Last week, I found out that steel things like spoons and paper clips were attracted to magnets, but the aluminium foil and trays weren't. I think steel is attracted to magnets, so I could use a magnet to sort steel food cans from other cans.*

An additional feature of progression in the scientific skills is that pupils in the senior classes would be expected to demonstrate more autonomy in planning and carrying out their own investigations, compared with younger pupils who might conduct 'simple investigations set by the teacher' (DES, 1999a, p. 20).

In summary, the Primary Science Curriculum (DES, 1999a) encompasses significant differences in the breadth, depth and nature of primary science teaching, compared with that envisaged in the *Curaclam na Bunscoile* (DES, 1971). Support for existing teachers and pre-service teachers, in their implementation of the Primary Science Curriculum, was therefore essential. Key aspects of the professional development and other supports provided are discussed below.

## 2.2 In-Service and Support for Curriculum Implementation

This section presents a brief overview of some of the supports provided to promote primary science and the implementation of the Primary Science Curriculum.

### 2.2.1 In-service/Government-led support

Science, as introduced in the 1999 curriculum, was supported by teacher in-service from the Primary Curriculum Support Programme (PCSP), as detailed in Table 2.3 below.

| Table 2.3: In-service and implementation schedule for science | | |
|---|---|---|
| **School Year** | **In-service** | **Formal Implementation** |
| **2000-2002** | The Science Developmental Initiative<br>Seminar – 1 day<br>On-site visits | |
| **2002-2003** | Science In-service<br>Seminar – 2 days<br>School planning – 1 day | |
| **2003 to date** | | Science |

The Primary Curriculum Support Programme (PCSP) is a support organisation that was set up by the DES in 1999, prior to the launch of the Primary School Curriculum (DES, 1999c). Its purpose is to support teachers in implementing the curriculum, through work at school, local and national level. In relation to support for primary science, the PCSP was initially involved in the Science Developmental Initiative, which ran over the course of two academic years, between 2000 and 2002. In the first year, approximately 150 schools were involved, and approximately 200 schools took part in the initiative in the second year. In each year, the in-service involved a 1-day seminar, which was followed by additional on-site visits. This initiative was the precursor to the in-service for all national schools.

In the academic year 2002-3 the PCSP provided teachers in all national schools with an in-service course to support them in planning and teaching the Primary Science Curriculum. This comprised two seminar/ workshop days, and a further day dedicated to school planning. As part of this in-service, teachers were provided with opportunities to engage in hands-on activities suitable for use in the primary classroom. The activities were connected with the strand units of: plants and animals; magnetism and electricity; and materials and change. The exemplar activity in the latter involved a fair-testing investigation in which different powders were mixed with water. The

hands-on nature of science and the skills associated with the Primary Science Curriculum were covered in the in-service workshops, although progression in these skills was not a particular feature of the in-service provided at the time.

Science has continued to be supported by cuiditheoirí[2] through the Regional Curriculum Support Service (RCSS) as part of the PCSP. In such cases, support is provided for science only when requested. The PCSP has also developed, and is in the process of developing, online materials for supporting teachers in teaching the Primary Science Curriculum (PCSP, n.d.). Their website includes: further examples of hands-on activities; guidelines for planning and integration of science within Social, Environmental and Scientific Education (SESE); links to other science education websites; and a list of suggested suppliers of primary science equipment.

Financial support for equipment purchase has also been provided. A once-off grant was supplied for the purchase of curricular equipment and non-consumable materials for science in primary schools (DES, 2004). This grant was allocated on a capitation basis and was calculated on the number of pupils in each primary school as of 30th September 2003. The grant aid awarded was €1,000 per school plus €10 per pupil (DES, 2004). Currently, however, primary schools do not receive funding that is ring-fenced for science.

### 2.2.2 Pre-service teacher education in primary science

Since the implementation of the Primary Science Curriculum, newly qualified teachers have taken up employment, most of whom have engaged in study at one of the colleges of teacher education in Ireland. Colleges of teacher education at primary level in Ireland

2 Cuiditheoirí support teachers at a local and regional level, in co-operation with the Education Centre Network. They can provide school visits, drop-in sessions and workshops (PCSP, n.d.).

currently require all students to complete courses relating to primary science. The number of hours provided for curriculum science varies from college to college. Table 2.4 illustrates the number of compulsory curriculum science hours that pre-service primary teachers studying for the Bachelor of Education (B.Ed) degree are afforded in the colleges of education in Ireland.

Table 2.4: Compulsory curriculum science courses for pre-service teachers in the three year Bachelor of Education degree: Number of hours

| Year of Degree | CICE, Dublin | Coláiste Mhúire, Marino, Dublin | Froebel College, Dublin | Mary Immaculate College, Limerick | St. Patrick's College, Dublin |
|---|---|---|---|---|---|
| 1st Year | 14 hours | 14 hours | 35 hours in total | 6 hours | 0 hours |
| 2nd Year | 14 hours | 14 hours | | 6 hours | 44 hours |
| 3rd Year | 7 hours | 14 hours | | 0 hours | 0 hours |
| Total | 35 hours | 42 hours | 35 hours | 12 hours | 44 hours |

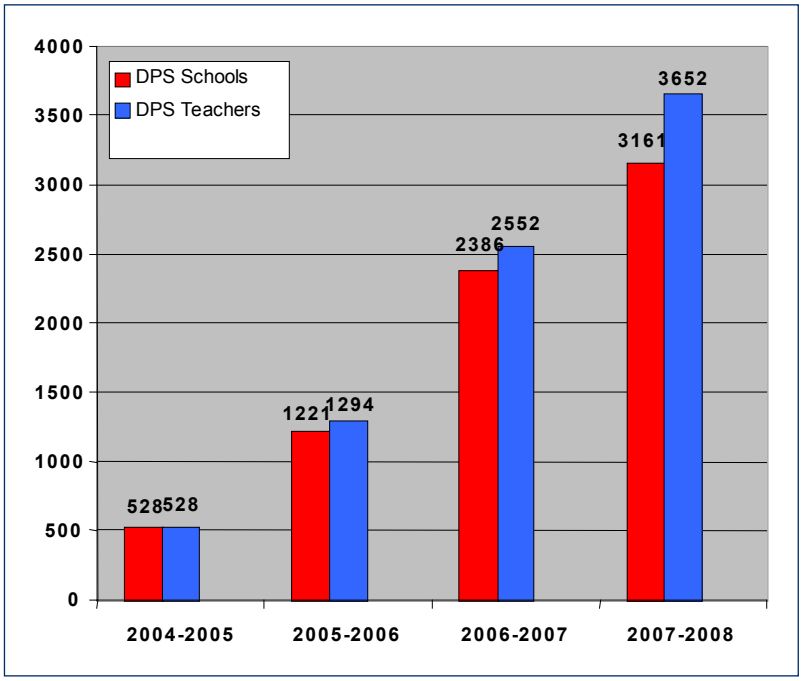
The content of the science curriculum courses in all the colleges is similar in that in general they aim at providing students with the opportunity to use and learn about using a range of methodologies in the teaching of primary science. Particular emphasis is placed on science as a skill-based process and on the importance of children experiencing science through an active learning environment. The curriculum science courses also aim at familiarising students with the cognitive development of the child and place emphasis on acknowledging the children's scientific understanding and common alternative conceptions. Aspects of the courses are also aimed at developing the students' personal conceptual and procedural knowledge in science.

Many other organisations have also provided existing teachers with opportunities for developing teaching skills and knowledge in primary science, via in-service days, summer courses and other primary science initiatives. Schools and individual teachers have participated in these to varying degrees. Some of the major initiatives are described below.

### 2.2.3 Discover Primary Science

The Discover Primary Science programme (supported by Forfás) is one such initiative. Figure 2.1 illustrates the number of teachers and schools that have taken part in the Discover Primary Science initiative since 2004.

**Figure 2.1: Number of schools and teachers taking part in the Discover Primary Science initiative per year**




(Source: Discover Science and Engineering)

The figures for 2007-2008 represent an uptake of this initiative in 90% of Irish primary schools. The figures in the red columns highlight the number of schools that took part in each year. Teacher

numbers are indicated in the blue columns. In most instances, just one teacher in a given school takes part in the Discover Primary Science programme in a given year. Participating teachers and their principals are encouraged to support the dissemination of the programme in school, for example by communicating the ideas to other staff.

The Discover Primary Science programme provides a resource for primary teachers and their pupils. It aims to make science fun and interesting for all children, principally through engagement with hands-on science activities. As part of this initiative, a hands-on training session is provided for all participating teachers, who are also supplied with a range of resources. This includes a pack consisting of 37 science activities that are related to aspects of the Primary Science Curriculum strands Living things, Energy and forces and Materials, with a focus on the physical sciences. The pack includes helpful hints for teachers, detailed activity notes, scientific background information on the content addressed in each activity and links to the relevant Primary Science Curriculum strand units and skills (Discover Science and Engineering [DSE], 2007). The Discover Primary Science scheme also promotes pupils' engagement with science via visits to science centres or by inviting visitors to the school.

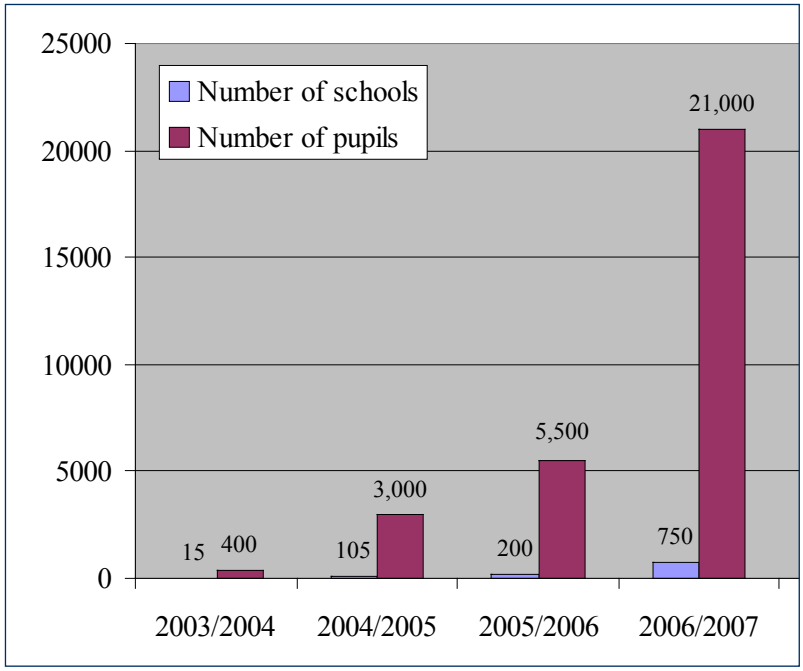
### 2.2.4 The K'NEX Challenge

Another initiative aimed at helping primary children to develop their scientific conceptual knowledge and skills is one supported by STEPS to Engineering, Ireland (Science, Technology and Engineering Programme for Schools). The *K'NEX Challenge* is aimed at providing primary school children with an introduction to the world of engineering and design. The pupils taking part in the K'NEX Challenge work in teams to design and build a model using K'NEX kits. The challenge provides the children with the

opportunity to apply the four science skills related to designing and making, as outlined in the Primary Science Curriculum.

The number of schools and primary pupils taking part in the K'NEX challenge since 2003 is shown in Figure 2.2. In general, one class per school is able to participate in the programme. Due to increased demand, STEPS to Engineering introduced a new programme *(*The *K'NEX Experience)* in the 2007-2008 school year. There are currently 750 classes/ schools (21,000 pupils) taking part in the K'NEX experience.

**Figure 2.2: Number of schools and pupils taking part in the K'NEX Challenge per year**




(Source: STEPS to Engineering)

### 2.2.5 Eureka

A third initiative was developed by The Irish Independent Newspaper which, for the past four years, has been publishing a weekly primary science magazine, *Eureka*. It promotes hands-on science through a weekly thematic approach. The magazine covers

aspects of each Primary Science Curriculum strand during the year. In the current academic year 2007-2008, 20,000 primary school pupils from all over Ireland have subscribed to *Eureka* through their schools. The magazine is available in English or Irish, with 10% of pupils subscribing to the Irish language edition. At this point it is also worth noting that several publishers have produced teachers' guides and pupil workbooks, aimed at the Irish market, since the introduction of the Primary Science Curriculum.

It can be seen that the initiatives described above have reached a large number of primary teachers and pupils, and that ongoing supports also appear to be available. With such assistance in place it is hoped that the approaches promoted in the Primary Science Curriculum are being translated into valuable and memorable learning experiences for children.

The current report focuses in depth on primary children's experiences of the science curriculum and aims at answering the question: *What is science like for children in primary school?* Results of the work carried out in primary schools are reported here. An in-depth account of how the research instruments were developed and how the data were analysed is presented in the next section (Section 3).

# SECTION 3:

# DESIGN

# AND METHODS

This section describes the rationale for the design of the study and the strategies and research instruments employed. Detailed information is provided in relation to the strategies used and sampling approaches taken. This is followed by an account of the development and piloting of research instruments, including details of the analytical methods employed subsequent to data collection.

This study focussed almost exclusively on collecting data from children. It therefore sought to continue and extend the emphasis placed on gathering children's views as an essential part of reviewing curriculum implementation (NCCA, 2005). In so doing, the study also accorded with goals set out in the National Children's Strategy, that "children should have a voice in matters which affect them" and that "their lives will benefit from evaluation, research and information on their needs, rights and the effectiveness of services" (Office of the Minister for Children, 2000, p.11). It was felt that children should be enabled to comment on their perceptions of, and developing attitudes towards school science and would "provide reliable responses if questioned about events that are meaningful to their lives" (Scott, 2000, p.99).

The study therefore set out to collect data relating to children's experiences of, and attitudes towards primary school science. It aimed to examine the following questions:

- What are children's perceptions of and attitudes towards school science?
- To what extent are children engaging with hands-on science?
- To what extent are pupils collaborating with each other in their science activities?
- Are pupils using ICT in their scientific learning?

- What other teaching and learning approaches are children experiencing in science lessons?
- With which areas of subject content are pupils engaging at school?

## 3.1 Research Strategies

A **survey** was chosen as a means of gathering information from a large number of pupils in a wide range of schools countrywide. It provided an opportunity to find out pupils' experiences of and attitudes towards many aspects of school science from a representative proportion of the Irish primary population. Data gathered on such a large scale allowed for subsequent quantitative analysis, including a consideration of pupil responses according to a range of variables. It was decided that pupils from third to sixth class only would be asked to participate in this aspect of the study. These pupils would have had several years' experience of science within the 1999 curriculum on which to reflect. In addition, it was felt that younger pupils might have had difficulty completing a questionnaire of the scope envisaged for this study. The survey used two different questionnaires as instruments for collecting data: a pupil questionnaire and a brief teacher questionnaire (Appendix A). Consent was obtained from school principals for pupils to participate (Appendix B).

A **case study** of a small sample of schools was designed to add depth to and triangulate with the findings of the primary pupils' survey. The case study provided opportunities to find out more detailed information about the ways pupils respond to science in their classrooms. The results discussed in this report relate to pupils who were observed during science lessons and interviewed in small groups in the period from October 2007 to February 2008. Data from the case study schools were gathered from pupils using pupil observations and group interviews. As this phase of the study involved the

researchers having direct contact with pupils, consent was obtained from school principals and from parents or guardians for pupils to participate (Appendix B). The class teachers also completed a brief contextual questionnaire, which was identical to that used for teachers in the survey (Appendix A). In the case study, pupils from third to sixth class were also asked to complete a questionnaire a few days before the observed lesson, which was identical to that used in the survey (Appendix A). Table 3.1 summarises the research design and research instruments used for the two strategies employed.

Table 3.1: Summary of research design

| Strategy | Research Instruments | Schools | Classes | Pupils |
|---|---|---|---|---|
| **Survey (3rd-6th only)** | Pupil Questionnaire | 70 | 70a | 1526a |
| | Teacher Questionnaire | 70 | 70 | n/a |
| **Case Study of eleven schools (S.I.-6th) b** | Observation Schedule | 11 | 15 | 311 (Including 30 target children, 2 per class) |
| | Group Interview | 9 | 11 | 45 |
| | Pupil Questionnaire | 6 | 8a | 171a |
| | Teacher Questionnaire | 11 | 15 | n/a |

a Numbers indicate classes/ pupils given questionnaires to complete, not numbers returned.

b Further details of the 11 schools and their participation in each aspect of the case study are provided in Appendix C.

## 3.2 Sampling

### 3.2.1 Pupil survey

A random sample of 70 schools (stratified by size, location, recognised disadvantaged status, gender mix and medium of instruction) was identified for participation in the survey. A class level from third to

sixth was randomly assigned to each of the sample schools before contact was made. Schools were telephoned and invited to participate in the survey, which commenced in November 2007. Each school was asked to administer the questionnaire to all pupils from *one class only* containing the assigned class level. In this way, 1526 pupils were invited to participate in the survey. The class teachers were also asked to complete the brief contextual questionnaire. A guidance sheet and letter of explanation about the research accompanied each set of questionnaires sent (Appendices A and B). In the majority of cases, schools were happy to participate in the study. Where schools indicated during initial contact that they could not participate, a school of similar profile was selected at random from the original sample frame.

It was not possible to stratify the random sample to include a representative proportion of special schools, as the database used did not specify this information. However, two special schools were in the random sample and a small number of pupils from one of these participated in the study. It should also be noted that the contextual questionnaire asked teachers to identify the number of pupils in their class with special needs and 17 responding mainstream schools had some pupils in this category.

### 3.2.2 Case study

#### Schools

From the outset of the study, schools that reflected different types in the Irish Primary School system were approached. The DES list of National Schools was consulted and a representative list of primary school categories drawn up. Ultimately, 11 case study schools agreed to participate, which collectively represented schools that:

- Teach through the medium of English or Irish (Gaelscoil);

- Are in the school support system (SSP) under the Delivering Equality of Opportunity in Schools (DEIS) action plan for educational inclusion, or not;
- Have some pupils with English as a second language;
- Are single sex or mixed;
- Have split or single age group classes;
- Are rural or urban;
- Are multi-denominational or Roman Catholic.

The profiles of the schools participating in the case study are further described in Appendix C. In spite of extensive efforts the researchers were unable to recruit a special school. One reason for this difficulty is related to the fact that special schools have very small class sizes. In discussions with staff at the special schools approached, it was felt that the presence of an unfamiliar adult in such classes would have too great an impact on the pupils involved. It should be noted however, that at least nine of the case study classes were known to contain pupils with special needs, working on an integrated basis with other pupils.

## Target children observed in science lessons

Classroom observations were conducted in 15 case study classes (senior infants to sixth), drawn from 11 different schools. This information is presented in Appendix C. As well as observing the whole class, two pupils, *target children*, from each class were selected for closer observation using the structured observation schedule described in Section 3.3. The target children were selected by the researchers using purposive, convenience sampling. Pupils were chosen for convenience from groups that were located close to the

seating position of the researcher. In mixed classes, however, a purposive sample of one boy and one girl was chosen, taking the above consideration into account. A total of 30 pupils from 15 different classes were selected for structured observation in this way.

#### Group interview children

Groups of children from 11 case study classes were interviewed. Five interviews were conducted with children from first and second classes, three with children from third and fourth classes and three groups of children from fifth and sixth classes were also interviewed. Pupils from first and second class in the case study were not asked to complete the questionnaire, so it was especially important to gather interview data from these children. In view of this, a greater number of interviews were conducted with children from first and second classes than with children from third and fourth, or fifth and sixth classes. Each interview group comprised three to five children. In each case the teacher selected the children to be interviewed. The researchers asked that pupils should be selected who would be confident in an interview situation, but who also reflected a range of ability levels within the class. All of the children interviewed volunteered to take part in the group interviews and were informed about the purpose of the interviews. Written consent from their parents or guardians had also been obtained (Appendix B).

## 3.3 Instrument Development, Piloting and Data Analysis

### 3.3.1 Pupil questionnaire

#### Instrument development

The pupil questionnaire was designed in a format that, based on piloting, was felt to be readable and relatively quick and easy for pupils to complete (Appendix A). The initial section elicited

information about the gender, age and the class of the pupil. Other contextual information regarding each class of pupils was elicited via a short teacher questionnaire (Appendix A).

The main part of the pupil questionnaire elicited responses via a three-point (smiley face) Likert scale format. These attitudinal questions were grouped in five broad categories under the following headings (Appendix A):

- Six items on attitudes to school: "What I think about school"
- Eighteen items on attitudes to learning specified primary science topics: "I enjoy learning about…"
- Sixteen items on attitudes to ways of learning science in the classroom: "I enjoy science when…"
- Five items on attitudes to school science: "What I think about science" grouped with
- Four items on pupils' perceptions of the nature of science: "What I think about science".

Pupils were then asked to respond briefly to several open questions. These asked pupils to describe their favourite school science lesson and a science lesson that they did not enjoy. In each case, pupils were asked to provide reasoning for their choice. In a final section, pupils were asked to draw a picture of "yourself and your class doing science at school" (Appendix A).

These questionnaires were developed following consultation of a range of literature (Jarvis and Pell, 2002; Murphy and Beggs, 2002; Kind, Jones and Barmby, 2007; Reid, 2003; Stark and Gray, 1999; Dawson, 2000; Woodward and Woodward, 1998). However, since no previous large-scale surveys of this type had been conducted in an

Irish context, some adaptation of materials from exemplars was necessary. In particular, some attention was paid to the wording of the Likert scale items so that science content areas from across the curriculum were described in child-friendly terms. These 18 items, prefaced by the phrase, 'I enjoy learning about…', also reflected key aspects of content from each strand and strand unit within the curriculum for third to sixth classes. In addition, the 16 items prefaced by the phrase, 'I enjoy science when…' were chosen to reflect methodologies likely to have been experienced by pupils in learning primary science.

## Piloting

The questionnaire was piloted rigorously in two schools. The two pilot schools were mixed, urban schools containing a proportion of pupils with special needs and some with English as a second language. The medium of instruction of one of these schools was English, the other Irish. Questionnaires were piloted with pupils from third to sixth class. Adjustments to instruments and re-piloting were undertaken to ensure acceptable content validity. A larger-scale pilot of the final version of the questionnaire allowed reliability analysis to be conducted. Grouped Likert items gave alpha values of 0.7 or higher (Cohen, Manion and Morrison, 2000), which was deemed acceptable.

## Data analysis

Data from the closed response items and Likert scale items on the pupil questionnaires were coded and entered into SPSS (Statistical Package for the Social Sciences), version 14.0. Information gained from the teachers' contextual questionnaires was entered alongside pupil responses, so that pupils' responses could be analysed at a later stage in relation to their school contexts.

The open question responses and pictures were analysed by two members of the research team using the constant comparative method for developing categories (Glaser and Strauss, 1967). Categories emerging from the responses were coded, discussed and re-coded until no new categories emerged from the data. At this point, an inter-rater reliability analysis was undertaken with 100 previously uncoded questionnaires. Inter-rater reliability values calculated subsequently were all 'good' or 'excellent' (Robson 2002, p.342) with Cohen's Kappa (K) values of 0.660 or higher. To facilitate quantitative analysis of the questionnaire responses as a whole, the open question and picture codes were also entered onto SPSS. It should be noted that there were cases in which pupils had responded to a question, but their response could not be coded because it could not be deciphered. This applied to some written and pictorial responses. Such instances were recorded as *uncodable*, a type of missing data, on entry to SPSS.

### 3.3.2 Teacher questionnaire

#### Instrument development

The teacher questionnaire was designed in a format that was felt to be readable and relatively quick and easy for teachers to complete (Appendix A). The questionnaire was only intended to provide contextual information regarding each class of pupils and was not intended to gather information about the teachers' own backgrounds or attitudes to teaching primary science. It enabled the researchers to find out information about the survey pupils that it would have been inappropriate to ask the pupils to provide for themselves, for example, information about the school type, numbers of special needs pupils in the class and so forth (see Appendix A). Suitable categories for inclusion were devised, based on those used by the NCCA in the Teacher Template Study as part of their Primary Curriculum Review.

### Piloting

The teacher questionnaire was piloted with teachers from the pilot schools described above. Adjustments and re-piloting were undertaken to ensure acceptable content validity.

### Data analysis

Data obtained from the teacher questionnaires were entered into SPSS alongside pupils' data from the relevant school and class, to facilitate further analysis of the pupil data.

## 3.3.3 Observation schedule

### Instrument development

The aim of the observation instrument used in this study was to obtain information relating to the scientific process skills as identified in the Primary Science Curriculum (DES, 1999a). Following a review of methodological literature (Denscombe, 2003; Robson, 2002; Cohen et al., 2000) it was decided that systematic observation would be the most appropriate method to be adopted for this study. A systematic observation schedule that was adapted from the Science Processes Observation Categories (SPOC) of Cavendish, Galton, Hargreaves and Harlen (1990), was utilised to make structured observations of two target children in each class over 2-minute periods at fixed intervals (Appendix D).

The main characteristics of a systematic observation schedule are:

- The capture of a behavioural event by an observer;
- The coding of this event; and
- The subsequent analysis of these events in search of patterns.

It was felt that the use of this structured observation schedule was particularly apt as it gave an insight into the array of different scientific skills utilised by children in the typical environment of the classroom. The observational instrument used in this study obtained a minimum of occurrence not a frequency of occurrence of each particular category. For example, if during a 2-minute period of observation a target child engaged in predicting on several occasions, the *predicting* category was coded only once for that two minute period (Appendix D). This allowed a picture of the regularity of occurrence across the 15 classes to be obtained. Each structured observation focused on one pupil at a time, and the term target child was used to distinguish them from the other pupils in the class. Details of teacher talk and activity as appropriate to the target child were also noted. The first two minutes of each case study observation were spent choosing two target children for that class. Sampling of the target children is described in Section 3.2. This was followed by the remaining observation structure as outlined in Appendix D. It should be noted that this observation structure required the researcher to focus on a given target child for 2 minutes out of every 15 during a lesson. The number of 2-minute observations of specific target children therefore depended on the duration of the lesson in which they were observed. During a lesson lasting 40 minutes, for example, each of the two target children in that class would be observed for three separate periods of 2 minutes.

## Piloting

The observation schedule was piloted rigorously with pupils from first to sixth class in one pilot school. The pilot school was a mixed, urban school containing a proportion of pupils with special needs and some with English as a second language. The medium of instruction of this school was English. During piloting the structured observational sheet was reformatted to facilitate the taking of

additional field notes. Adjustments and re-piloting were undertaken, with the researchers conducting paired observations to assess inter-rater reliability in relation to the structured observations. The final version of the classroom observation schedule (Appendix D) met acceptably high scores of inter-rater reliability.

### Data analysis

The data for every category code from each of the 15 case study classes were totalled. This initial phase was done by hand and data were unitised and colour coded. These figures were combined and tabulated onto a single observation sheet (Appendix E) to provide a total figure for each description. The data for each category were subsequently entered onto an electronic version of the observation schedule. The accompanying field notes were transcribed for analysis.

## 3.3.4 Interview schedule

### Instrument development

Group interviews as opposed to individual interviews were chosen. The intention was that the group interview would use the dynamics of the group to gain information and insights into the children's experiences of school science, something that might less likely be gained through individual interviews. Every attempt was made to make the children feel at ease. As recommended by Tammivaara and Scott Enright (1986) "Teacher-like controlling behaviours", such as telling the children not to "fidget" or to "sit up straight", were avoided. The children addressed the researchers by their first names and an informal chat preceded every interview to allow the children time to form a relationship with the researcher.

An interview schedule was designed, which comprised seven broad open-ended questions, aimed at establishing the children's

experiences and perceptions of science in school (Appendix D). The interviews were semi-structured in an effort to "let the interviewees develop ideas and speak more widely on the issues raised by the researcher" (Denscombe, 2003, p. 167).

## Piloting

The semi-structured interview schedule was piloted with pupils from senior infants to sixth class in the one of the schools used for piloting the questionnaires. Adjustments to the questions and re-piloting were undertaken to ensure that pupils understood the questions asked. Additional strategies for eliciting responses from younger pupils were developed and piloted. The final version of the semi-structured interview guide is in Appendix D.

## Data analysis

The interviews were taped and transcribed. The transcriptions were put into a word document. The children's responses were read and re-read to establish and refine units of meaning to be reported and to identify any apparent links, patterns and similarities or differences. This unitising of data was conducted by hand, colour coding and numbering the different responses. Two researchers coded the interview transcripts to establish inter-rater reliability.

The findings, obtained from the data collected during the survey and case study are presented in Sections 4 and 5 respectively.

# SECTION 4:

# PUPIL SURVEY:

# FINDINGS

In this section, the findings from the pupil survey are presented and analysed. These will be discussed in relation to the original aims of the study, as follows:

- What are children's attitudes towards school science?
- To what extent are children engaging with hands-on science?
- To what extent are pupils collaborating with each other in their science activities?
- Are pupils using ICT in their scientific learning?
- What other teaching and learning approaches are children experiencing in science lessons?
- Which areas of scientific subject content are pupils experiencing at school?

In analysing data relating to each of the above questions, material will be presented from responses to the Likert items, written responses and pictorial responses as appropriate. This will allow for an internal triangulation of data from different parts of the questionnaire. To contextualise the pupils' responses, some overall profile data about the schools and pupils will be presented first.

## 4.1 Profile of Respondents

### 4.1.1 Schools

Of the 70 schools drawn from the sampling frame, responses were received and collated from 47 schools. This represents a school response rate of 67%. The responses represent pupils from schools which:

- Teach through the medium of English or Irish;

- Are in the school support system (SSP) under the (DEIS) action plan for educational inclusion, or not;
- Are mixed, girls only or boys only;
- Have split or single age group classes;
- Are rural or urban;
- Are mainstream or special schools.

Data about the school types represented in the survey are summarised in Table 4.1.

**Table 4.1: Profile of schools responding to the pupil survey**

| Medium of instruction | DEIS status | Gender mix | Class organisation | Location | Mainstream/ Special |
|---|---|---|---|---|---|
| English 44 | DEIS 8 | Mixed 34 | Split classes 19 | Rural 26 | Mainstream 46 |
| Irish 3 | Not DEIS 31 | Girls only 7 | One level 23 | Urban 21 | Special 1 |
| | Unknown 8 | Boys only 6 | Unknown 5 | | |
| Total 47 | Total 47 | Total 47 | Total 47 | Total 47 | Total 47 |

N for schools = 47

### 4.1.2 Pupils

Questionnaires were sent to a total of 1526 pupils in the survey schools. Of these, 1030 pupil questionnaires were returned and coded for analysis in this report. This represents a response rate of 67% for pupils. Girls made up 51% of the respondents and boys 49%. A

breakdown of the ages and classes of the pupils is shown in Tables 4.2 and 4.3 respectively.

| Table 4.2: Age profile of pupils | | | |
|---|---|---|---|
| | | Frequency | Percent |
| Age | 8 | 83 | 8 |
| | 9 | 292 | 28 |
| | 10 | 319 | 31 |
| | 11 | 242 | 23 |
| | 12 | 90 | 9 |
| | 13 | 3 | <1 |
| Total | | 1029 | 100 |

| Table 4.3: Class profile of pupils | | | |
|---|---|---|---|
| | | Frequency | Percent |
| Class | 3rd | 260 | 25 |
| | 4th | 318 | 31 |
| | 5th | 273 | 27 |
| | 6th | 179 | 17 |
| Total | | 1030 | 100 |

N=1030; 1 missing response, not shown N = 1030

In the contextual teacher questionnaire, teachers were asked to indicate the number of special needs pupils in their classes. A total of 54 pupils (5% of all respondents) fell into this category, although the anonymous nature of the questionnaire meant that these pupils' responses were not individually identifiable. This figure comprised 52 pupils from a total of 17 mainstream schools and two pupils from a unit in the one special school that responded to the survey.

## 4.2 Pupils' Attitudes to School and School Science

### 4.2.1 Attitudes to school

Data relating to pupils' attitudes to school in general were gathered in the first six items in the Likert response section of the questionnaire (Appendix A). These are summarised in Table 4.4.

Table 4.4: Pupils' attitudes to school (Figures expressed as percentages)

| What I think about school | Yes | Not sure | No | Total |
|---|---|---|---|---|
| I like school | 52 | 33 | 14 | 99 |
| I'm happy at school | 71 | 22 | 6 | 99 |
| I work as hard as I can in school | 80 | 17 | 2 | 99 |
| I find school interesting | 55 | 31 | 12 | 98 |
| I enjoy doing school-work | 34 | 40 | 25 | 99 |
| I enjoy working with my friends at school | 92 | 5 | 2 | 99 |

N=1030; totals do not add up to 100% owing to missing responses.

For most pupils, school would appear to be a sociable and happy place, as 92% of respondents enjoyed working with their friends at school, and 71% of respondents claimed to be happy there. Pupils were more diffident about admitting that they actually liked school and found it interesting, with 52% and 55% of pupils responding positively to these respective categories. Pupils' relationship with school work garnered a mixed response, with a very substantial 80% claiming that they worked as hard as they could at school, and yet only 34% were prepared to say that they enjoyed school-work. These responses about school in a general sense are contrasted with pupils' attitudes towards science at school in the next section.

### 4.2.2 Attitudes to school science

Data relating to pupils' general attitudes to school science (Table 4.5) were gathered in the final section the Likert responses of the questionnaire, after pupils had answered many items relating to their attitudes to specific aspects of school science (Appendix A).

**Table 4.5: Pupils' attitudes to science at school (Figures expressed as percentages)**

| What I think about science | Yes | Not sure | No | Total |
|---|---|---|---|---|
| School science is easy | 43 | 42 | 14 | 99 |
| School science is interesting | 75 | 16 | 8 | 99 |
| I like science better than other subjects | 30 | 29 | 39 | 98 |
| I look forward to science lessons | 55 | 31 | 13 | 99 |

N=1030; totals do not add up to 100% owing to missing responses.

Encouragingly, three-quarters of respondents claimed that they found school science to be interesting, which contrasts with only 55% of pupils claiming that school itself was interesting (Table 4.4). Just over half of pupils stated that they looked forward to science lessons, which was a more ambivalent response, and only 43% of pupils claimed that school science was easy. Pupils' relationship with the ease of school science appears to be a complex one. In the written (open) responses on the questionnaire, only one pupil claimed to enjoy a science lesson because it was easy, whereas 60 pupils had not enjoyed a specified science lesson because it was too easy, even a repeat of previous work (Table 4.6, Section 4.3 and Table 4.7, Section 4.6). In contrast, some pupils appeared to enjoy the challenge that science can bring (19 responses, see Table 4.6) whereas some pupils did not enjoy a science lesson because it was considered too difficult (30 responses, see Table 4.7).

Nearly a third of pupils claimed to like science better than other subjects (30% of respondents). Whilst this figure might seem low, it should be borne in mind that science only represents one of twelve subjects on the primary school timetable, so the fact that this proportion of pupils claimed to like science better than other subjects is an extremely positive outcome for school science. In general then, it would seem that pupils are positive about some aspects of school life and are well disposed towards school science.

A picture[3] drawn by a pupil in an Irish-medium school (Figure 4.1) perhaps sums up this latter point. In the next section, pupils' attitudes towards, and engagement with hands-on science will be considered.

Figure 4.1: "I love science": Images relating to Energy and forces (Girl, 5th class)


## 4.3 Hands-on Science

### 4.3.1 Definitions

Before considering the data relating to hands-on science, it is necessary to establish precise meanings of terms used. In this report, *hands-on science* is taken to mean any practical or investigative work in which the pupils themselves handle the materials, living things and/or equipment. Such experiences afford pupils concrete opportunities to understand and learn about the world around them. In addition, hands-on science enables pupils to develop key scientific skills as outlined in the Primary Science Curriculum (DES, 1999a) including,

3 In this report, pupils' pictures are shown as drawn, without re-sizing or amendment, for authenticity.

for example, observing, predicting and measuring. In this report hands-on science also encompasses design-and-make activities. Hands-on science includes closed activities, teacher-directed approaches and child-led open investigations. These types are described in detail in the Primary Science Curriculum Teacher Guidelines and would serve different purposes in relation to the development of conceptual understanding and/ or scientific skills (DES, 1999b).

*Investigations* represent a subcategory of hands-on science. The current report considers investigations to be quite pupil-directed, typically characterised by pupils trying to answer a question, which they may even have posed for themselves. Investigations may contain some aspects of teacher guidance but from third class onwards, the curriculum indicates that there should be some element of independent decision-making (DES, 1999a). Such work would include the use of key scientific skills, for example, questioning (pupils raising questions), planning, fair testing and perhaps problem-solving.

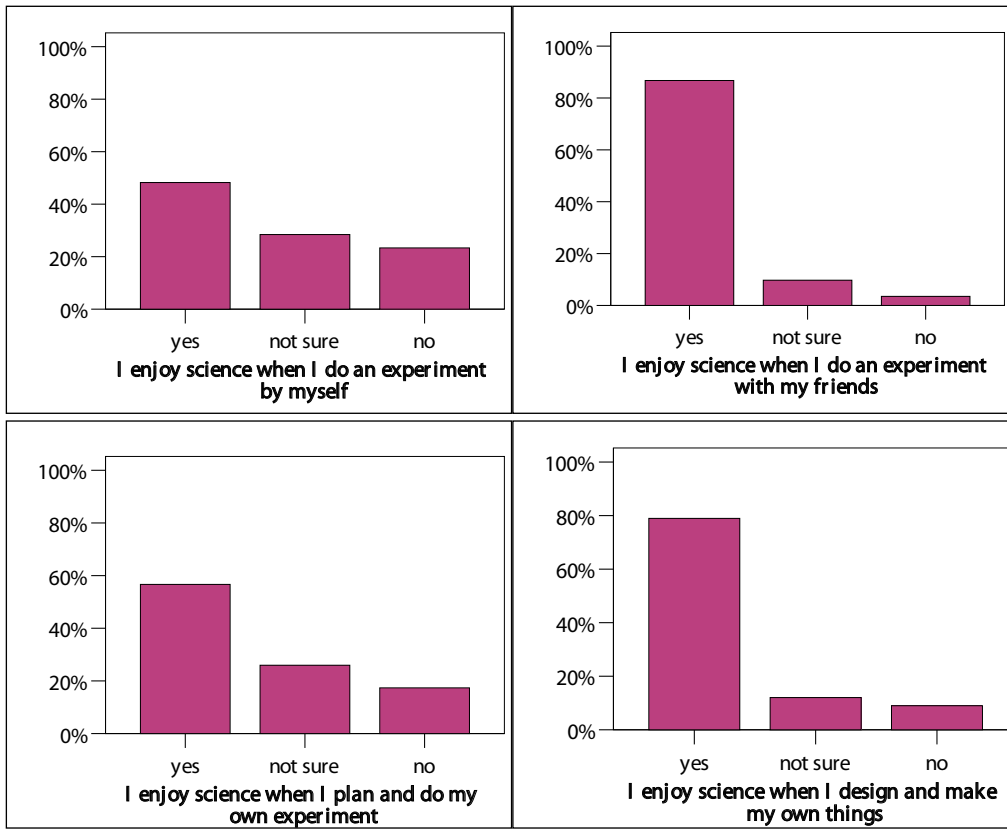
The term *experiment* was used by the researchers in the pupil questionnaire and frequently by pupils in their responses. It was felt that pupils would not necessarily be familiar with the term hands-on science or the specific meaning of the word investigation, so these terms were avoided when wording the questionnaire. In focus group discussions when developing the questionnaire, the term "experiment" was understood and used by pupils to mean any form of scientific practical work. It should be noted here that experiments could include those conducted by teachers as a *teacher demonstration*, as opposed to those being carried out by pupils. Teacher demonstrations would not constitute hands-on experiences for pupils and their value in developing pupils' own scientific skills would therefore be rather limited.

Going outside to do science usually involves aspects of hands-on work but this type of experience will be discussed separately in Section 4.6.

### 4.3.2 Attitudes to hands-on science

Four Likert response items referred to hands-on science. The responses to these items are presented in Figure 4.2. Pupils' attitudes to these aspects of hands-on science are mostly positive, peaking with 86% of respondents claiming to enjoy doing experiments with their friends. Designing and making was also very popular, with 78% of pupils claiming to enjoy this. Pupils were more cautious in their enthusiasm for planning and doing their own experiments, with only 56% responding positively. This statement had been worded to imply a more pupil-led investigation as defined above. Pupils' relative caution for this may be due to a number of factors, although the possibilities that pupils were unhappy with or unfamiliar with this way of working have to be considered. Doing an experiment 'by myself' attracted the least positive response, with fewer than 50% of pupils claiming to enjoy this. It may be the case that this is connected with pupils' attitudes to or indeed experiences of working alone rather than their attitudes towards hands-on science as such. This will be discussed in more detail in Section 4.4. Although broadly positive, a cautionary note should be sounded here: The responses to these Likert items provide only attitudinal data about hands-on science. Evidence for pupils' *engagement* with hands-on science is presented next, in considering the responses to the open questions on the questionnaire.

Figure 4.2: Hands-on science: Pupils' responses to Likert items




For all questions, N=1030. Percentages do not add up to 100% owing to missing responses (<2% of cases).

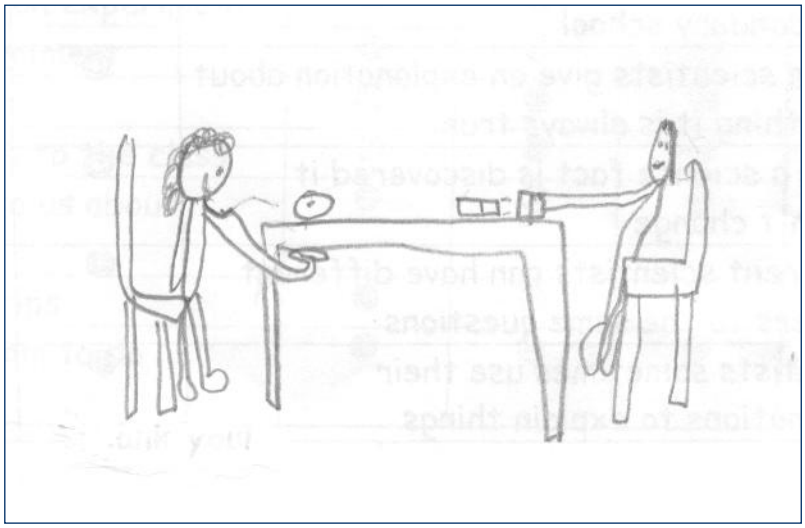
### 4.3.3 Engagement with Hands-on Science: Open Responses

Pupils indicated their participation in, and enthusiasm for hands-on science via their responses to the open questions. In the first of these, pupils were asked to describe a favourite science lesson (Table 4.11, Section 4.7). Where appropriate, these were coded according to the subject content of the lesson, and hence to the relevant curriculum strand (DES, 1999a). However, such responses also showed pupils' engagement with hands-on work. Examples included, "when we poured different liquids into a jug to find out which was the lightest" and "when we do a cool experiment like we checked would stuff

dissolve quicker or slower in hot water". In describing their favourite lessons, 29 pupils also referred to 'doing experiments' of an unspecified nature, and a further 43 described design-and-make activities.

It was when pupils were invited to explain *why* they had enjoyed their favourite lesson that positive attitudes towards, and engagement with, hands-on science became especially apparent. These data are presented in Table 4.6. Pupils referred specifically to doing experiments, handling materials and making things in 161 cases (15% of responses) as the reason for enjoying their favourite lesson. This ranked as the third most common category of response, after generic references to 'fun' or 'interesting' lessons (274 responses) and more specific references to results or observations (186 responses). In the latter category, some pupils also indicated wonder and surprise created by hands-on experiences: "I liked the way the oil stayed at the bottom"; "[you] look in the mirror to see your writing all squiggly"; "I enjoyed it when it [light bulb] lit up"; "I put one [magnet] under the table and one on top, I could move the top one without touching it" (Figure 4.3).

**Figure 4.3: Pupils investigating how magnets work (Girl, 4th class)**

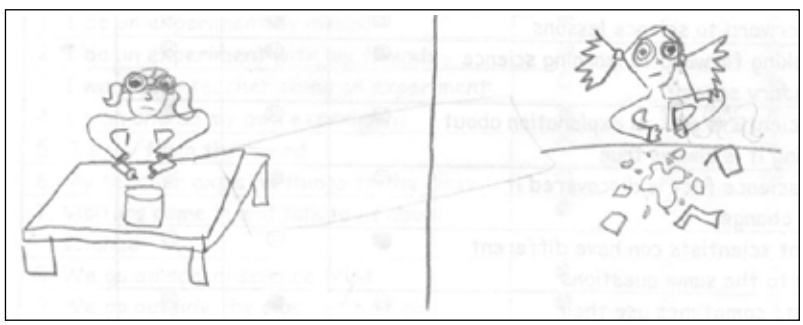


| Table 4.6: Favourite science lesson: Why did you enjoy it? | |
|---|---|
| | No. of responses |
| Interesting/ fun/ cool, unclarified | 274 |
| Events/ results/ observations | 186 |
| Experiment/ handling materials/ making things | 161 |
| Learning/ learning new things | 143 |
| Love science, love topic | 55 |
| Friends/ group work | 51 |
| Blank/ don't know | 42 |
| Went outdoors/ different e.g. trip | 41 |
| Everyday relevance/ useful to know | 28 |
| Challenging, thinking hard | 19 |
| Messy/ wet | 11 |
| Everyone got a turn | 7 |
| Future study/ occupation | 6 |
| Writing | 4 |
| Don't like science | 3 |
| Help others incl. teacher | 2 |
| Time | 2 |
| No writing/ no reading | 2 |
| Working alone/ independently | 2 |
| Used internet | 1 |
| Reading science book | 1 |
| Easy | 1 |
| Talking about it | 1 |
| Total | 1044 |

n for question = 1009. Of these, 33 pupils gave more than one reason, each of which was added to relevant categories. Total number of coded responses is therefore 1044.

It was not always possible to tell in this category of *events/ results/ observations* (Table 4.6) whether pupils had handled the equipment and materials for themselves, so not all 186 responses can be deemed to indicate engagement with hands-on work. However there were other indicators of hands-on experiences, including references to opportunities to get messy or wet (11 responses). It seems to be the case that, where pupils are conducting hands-on science, these are extremely memorable experiences, a notion supported by Figure 4.4.

**Figure 4.4: Hands-on science produces surprising results (Girl, 5th class)**



In assessing whether pupils are experiencing hands-on science or not, however, some mention should be made of evidence from the open questions about science lessons that were not enjoyed. A full list of response categories appears in Table 4.7 in Section 4.6 and Table 4.12 in Section 4.7. Pupils' descriptions often confirmed that these less enjoyable experiences had been hands-on in nature, for example: "… when the honey stayed at the bottom, water in the middle and the syrup at the top"; "…when we tested how long it takes for water to turn to ice."; and "…when we put stuff in water to see if they floated or sank".

When providing reasons for disliking their chosen science lesson (Table 4.7, Section 4.6), pupils did refer specifically to some negative consequences of hands-on work. The most significant category included 65 references to experiences that were unpleasant, smelly or made pupils feel squeamish. The main culprits here were: work with

eggs; making "volcanoes" (vinegar mixed with baking soda); and collecting mini-beasts. Other negative aspects included experiments that had not worked or needed repeating (26 responses); where pupils had hurt themselves (4 responses) or hands-on work where the procedure or results had been dull (4 responses), or there had been insufficient equipment (1 response). On a more positive note, these negative comments were generally uncommon and did at least indicate that pupils were experiencing hands-on science, even if they had not been very enthusiastic about it. Interestingly, 19 pupils referred to the fact that there had *not* been any hands-on science as a reason for disliking a specified lesson.

Further evidence that pupils are engaging with hands-on science was apparent from an analysis of the images of primary school science. Exemplar pictures are provided in Figures 4.5, 4.6 and 4.7, which are then followed by a discussion of the pictorial responses as a whole.

**Figure 4.5: Successful circuit-building (Boy, 5th class)**

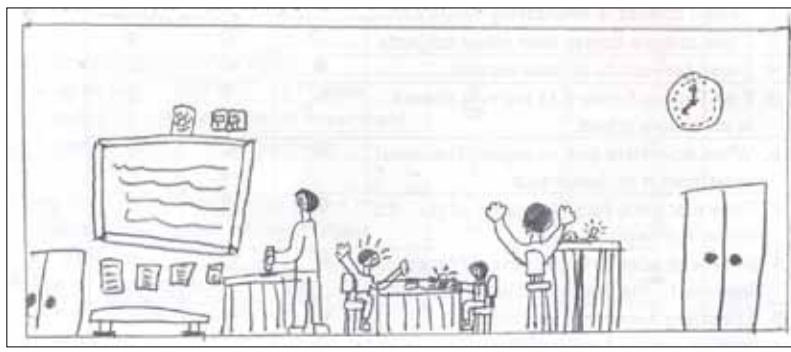


**Figure 4.6: Plant growth investigation - results (Girl, 5th class)**

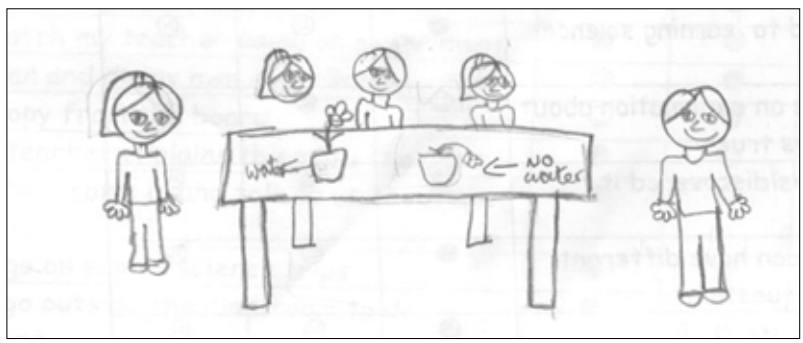
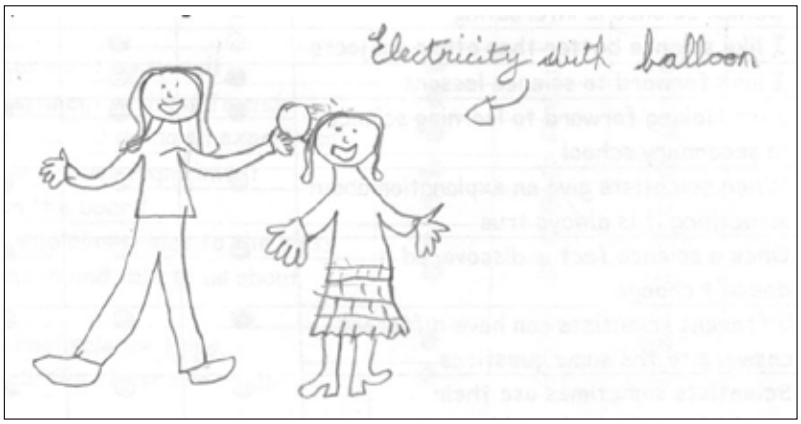


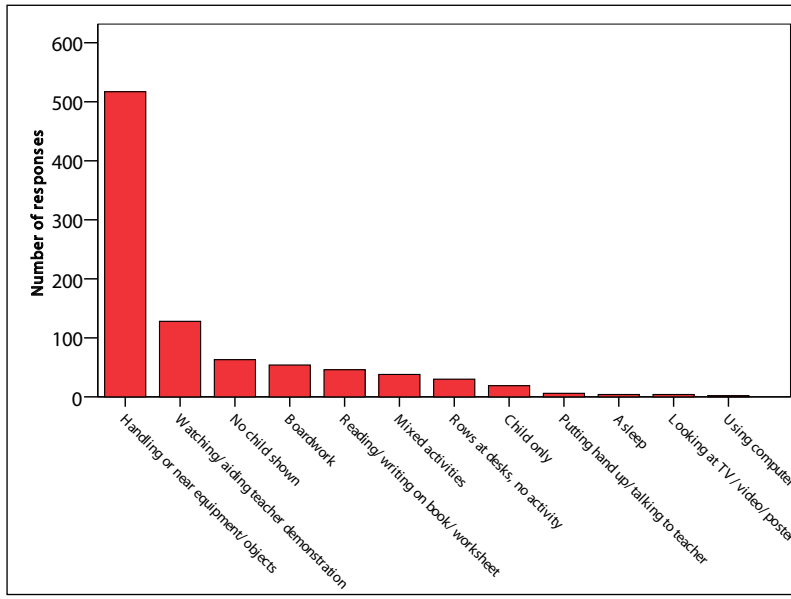
Figure 4.7: Finding out about static electricity (Girl, 4th class)




The pictures that pupils drew of 'yourself and your class doing science at school' provide the most emphatic evidence that pupils are engaging with hands-on work. Pupils' images of school science overwhelmingly depicted realistic school settings in which pupils were conducting hands-on work. The pictures were coded with regard to the following features: type of setting (scenario); pupil grouping; pupil activities; teacher activities and evidence of ICT use. The activities in which pupils were engaged are discussed here. These data are presented in Figure 4.8.

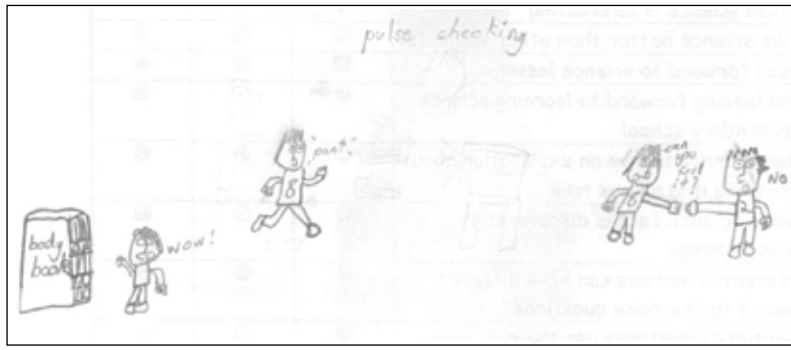
A total of 517 (57%) of the pictures coded showed pupils engaging in hands-on science, as indicated by pupils actually handling materials, living things or equipment (e.g. Figures 4.5 and 4.7) or standing near these objects (e.g. Figure 4.6). These included some images of pupils engaged in design-and-make activities, for example, constructing a model lighthouse incorporating an electrical circuit. A further 39 pictures showed classrooms in which a mixture of activities was taking place, including some hands-on science (see Figure 4.9). In this category, the different activities were not split for separate coding as it was felt that if pupils represented school science as involving a mixture of strategies, such as hands-on work, reading, writing and so on, that it was important to reflect this image of school science as a separate category.

Figure 4.8: Images of primary science: Pupil activities




n = 911; missing/ uncodable responses not shown

Figure 4.9: Mixed activities: An investigation on pulse rate and a pupil checking books about the body (Boy, 3rd class)




### 4.3.4 Hands-on science: Concluding remarks

These images present encouraging evidence to support the idea that pupils are engaging in hands-on science, including some designing-and-making activities. Considering evidence from responses to the relevant Likert items, written responses and pictorial responses, the majority of pupils appear to be experiencing hands-on science that is both memorable and generally positively regarded. At this point, however, it should be noted that two issues regarding hands-on

science were not resolvable by analysis of responses to the pupil questionnaires.

Firstly, in most cases it was difficult to tell whether the hands-on experiences presented were teacher-directed and hence rather prescribed activities, or whether pupils were engaging in more autonomous investigative work. It is therefore hard to conclude whether all pupils' scientific skills, especially those of questioning (pupils raising questions) and investigating and experimenting (DES, 1999a) are being fully developed.

Secondly, it was not possible to tell how *frequently* hands-on experiences were part of pupils' science learning. In the questionnaire, pupils were not invited to judge how often they engaged in hands-on science, as this was thought to be a question that primary age pupils could not answer with any reliability. Therefore the images and remarks made by children may refer to one-off instances of highly memorable hands-on experiences or alternatively, they may represent a typical mode of learning. There is some circumstantial evidence for both possibilities, discussed below.

On the negative side, there were some classes where only one or two hands-on activities were described across the class as a whole, which would suggest a relatively limited base of experience, although it could simply indicate a limited memory on the part of the pupils. Others made reference to 'doing lots of experiments', but in a previous year or in another teacher's class, which implied that current experiences were more restricted. Pupils in one class drew images that did not depict hands-on work or drew laboratory-based, fantasy images of science. The degree of hands-on experience on offer to these pupils would be a matter of some debate. All of these raise a concern that hands-on science may not be a frequent experience for some pupils and may not be universal for all pupils.

To finish on a positive note, in most classes in the survey, pupils between them provided a range of examples of different hands-on activities. This suggests that in these classrooms, pupils are participating in a wide and varied array of enriching and memorable hands-on scientific work.

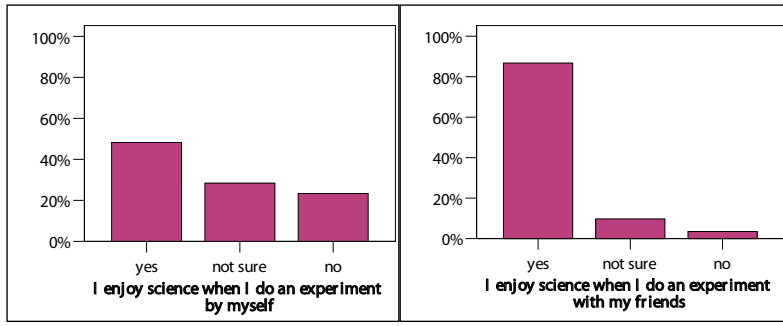
One key aspect of the type of hands-on work promoted in the Primary Science Curriculum (DES, 1999a) is that pupils are encouraged to work in a collaborative manner. This aspect of pupils' work in primary science will be discussed next.

## 4.4 Collaborative and Group Work

### 4.4.1 Attitudes towards working in groups

Pupils' attitudes towards, and experiences of working together in science will now be examined by analysing responses to pertinent sections of the questionnaire. Responses to relevant Likert items are presented in Figure 4.10.

**Figure 4.10: Pupils' attitudes to experiments alone and in groups**




For both questions, N=1030. Percentages do not add up to 100% owing to missing responses (<2% of cases).

These two items were presented one after the other in the pupil questionnaire (Appendix A). It might therefore be reasonable to assume that pupils responded to the differences between these two statements – that is, the type of pupil grouping suggested. These data would appear to indicate that a greater proportion of pupils enjoy

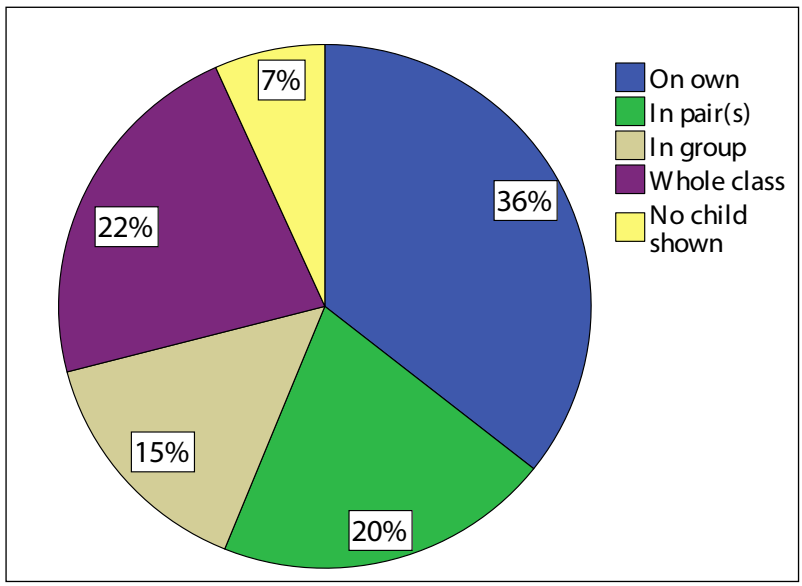
science when they do an experiment with their friends (86%) than when they do an experiment by themselves (49% of responses). Whilst this promotes the notion that pupils are positively disposed towards working in groups, it does not provide evidence that pupils are regularly engaging in group work. The extent to which pupils were collaborating in their scientific learning can perhaps be better explored by recourse to the pupils' responses to the open questions.

### 4.4.2 Engagement with Group Work in Science: Open Responses

Pupils cited reasons related to working in groups – more particularly with friends – as positive aspects of their favourite science lessons (Table 4.6, Section 4.3). *Friends and group work* accounted for 51 (5%) of all responses to this question. In contrast, only two pupils cited working independently as the reason for enjoying their favourite lesson. In providing reasons for disliking a science lesson, five pupils cited difficulties in working with others. Two pupils mentioned working alone as the reason for disliking a particular science lesson (Table 4.7, Section 4.6). As the numbers of responses are small, these data only provide limited evidence of pupils' engagement with group work.

Broader evidence that pupils are working in groups was provided by the children's drawings. Figure 4.11 summarises the depictions of pupil groupings in children's drawings. The most frequent depiction was of pupils working by themselves, with 334 pupils (36%) showing this grouping. Pupils depicted themselves working in pairs in 192 pictures (20% of responses) and in groups in 139 pictures (15% of responses). If pair work is seen as a form of group work, then a total of 331 pictures (35% of responses) showed pupils working with at least one other pupil.

Figure 4.11: Images of primary science: Pupil groupings

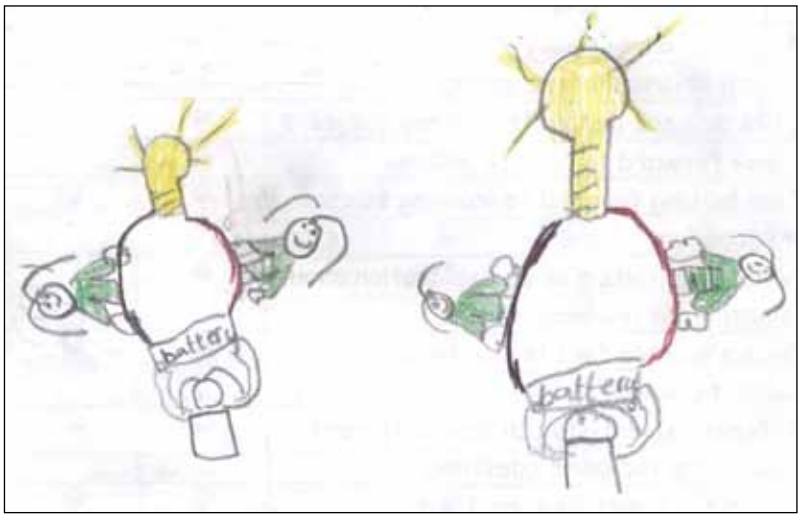



n = 937; missing/ uncodable responses not included

Encouragingly, where pupils were depicted working with other pupils, they were predominantly engaged in hands-on work. The pictures showed pupils working together on hands-on activities on 263 occasions (29% of responses; tabulation not shown). It should be noted that pupils' desire to draw group situations may have been hampered by their artistic skills or indeed the time available for completing this last part of the questionnaire. In this regard, it may be worth noting that at least one drawing depicting group or pair work was seen in every class of pupils who participated in the survey.

It is difficult to assess the exact nature of the group work in which pupils were engaged. For many of the images, it was not always possible to tell whether pupils were sitting together but essentially working separately, or genuinely collaborating in their work. Again, this may be a reflection of the drawing ability of pupils, although some examples clearly showed the positive impact of truly collaborative group work (see Figure 4.12).

Figure 4.12: Collaborative circuit-building (Girl, 5th class)



As a final caution in relation to a discussion about group work, it may be worth noting that 209 (22%) of all pupils' drawings depicted whole class situations. That is where pupils were not working in groups at all (Figure 4.11). The vast majority of these pictures showed images where pupils' focus of attention was the top of the class, for example, boardwork, teacher demonstration, teacher questioning or watching television. These accounted for 161 depictions (17% of all images). Clearly then it appears that group work is not an entirely universal image of classroom science.

In summary, it would appear that the vast majority of pupils view working with their friends in science in a positive light. Over a third of pupils actually depicted experiences of working with others in science, and by inference, this figure may well be larger. Over a quarter of pupils clearly experienced group work whilst engaged in hands-on science. On analysis of data from the questionnaires, however, it is not possible to ascertain the degree of collaboration that takes place when pupils are in groups, nor is it possible to state the frequency with which pupils engage in group work during science lessons.

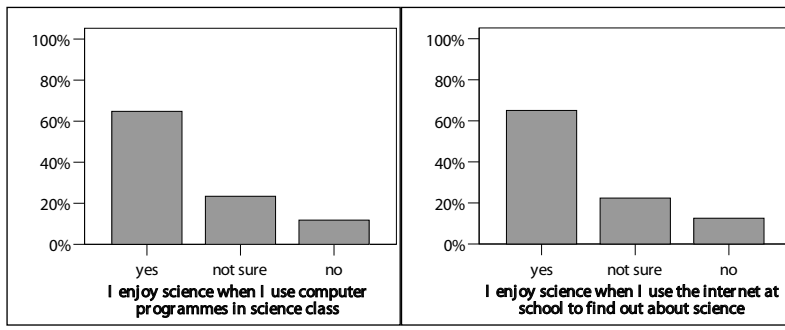
This chapter will now consider a range of other teaching and learning methodologies that may be used in primary science classrooms, and the impact that these appear to have on pupils. The first issue to be considered is the use of ICT.

## 4.5 Use of ICT in primary science

### 4.5.1 Attitudes towards using ICT in science

Pupils' attitudes to using ICT in school science were also measured via responses to the relevant Likert scale items. These are summarised in Figure 4.13.

Figure 4.13: Pupils' attitudes towards using ICT in science class




For both questions, N=1030. Percentages do not add up to 100% owing to missing responses (<2% of cases).

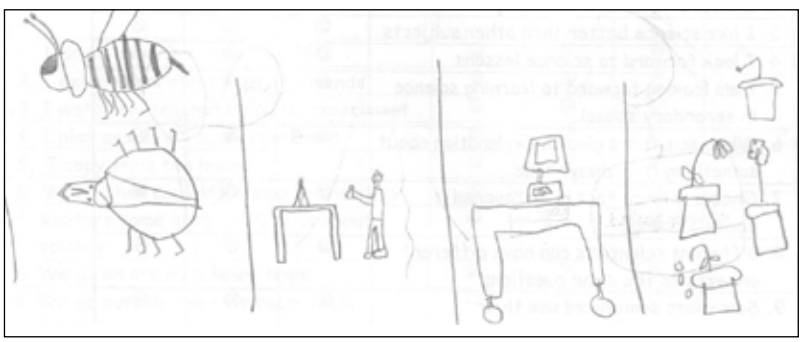
A note of caution should be sounded at this point: Whilst showing broadly positive responses, these items only evaluated pupils' *attitudes* towards using ICT in science and did not measure levels of *experience* of using ICT in this context. In order to establish whether ICT use was a prevalent feature of primary science lessons, pupils' responses to the open questions will now be considered.

### 4.5.2 Engagement with ICT in science: Open responses

In their descriptions of favourite science lessons, just three pupils mentioned a lesson involving computer use (Table 4.11, Section 4.7) and only one pupil stated that a reason for enjoying a science lesson was that they had used ICT - the internet (Table 4.6, Section 4.3).

ICT use was absent from pupils' responses relating to science lessons they had not enjoyed. Very few pupils – just 22 (2%) - drew computers or interactive white boards as part of their science scenarios. Only two of these responses showed pupils using the computer as the sole activity in the science classroom (Figure 4.8, Section 4.3). In the other 20 cases, ICT equipment was drawn as part of the work in a science classroom, or indeed as just one of the features of scientific working (see Figure 4.14).

**Figure 4.14: ICT equipment as one aspect of school science (Boy, 3rd class)**



Whilst this image of ICT as an integrated part of classroom work in science is encouraging, it is a concern that so few pupils depicted ICT use. Perhaps pupils are working on the computer in science lessons, but this is somehow not regarded as 'science' and is therefore not mentioned. It may also be the case that some pupils only use computers in a designated room and that, even if work is related to science, pupils regard such lessons as computer lessons, not science lessons. It is not possible to say if either of these explanations holds true for pupils in the survey. It would appear however, that although pupils are largely positive about the *idea* of using ICT in science, such experiences may be very limited or at best, not explicitly linked in the children's minds to the business of learning science.

Attention will now turn to other teaching and learning approaches with which pupils are engaging in science, and the impact that these experiences are having on pupils.

## 4.6 Other Approaches to Primary Science

A range of other approaches merit discussion, namely: teacher demonstration and explanation; reading, writing and the use of visual aids; and science outside the classroom, on trips and with visitors. All these were mentioned by pupils in their responses. Table 4.6 (Section 4.3) refers to reasons that pupils enjoyed particular science lessons, Tables 4.11 and 4.12 in Section 4.7 refer respectively to favourite science lessons and ones that pupils had not enjoyed. Reasons given by pupils for not enjoying a specified lesson are presented in this section, in Table 4.7.

Table 4.7: Science lesson you didn't enjoy: Why didn't you enjoy it?

| | No. of responses |
|---|---|
| Blank/ don't know/ not sure | 288 |
| Boring/ uninteresting/ not fun, unclarified | 271 |
| Always enjoy science | 70 |
| Unpleasant/ smelly/ squeamish | 65 |
| Don't like science/ this topic | 55 |
| Writing/ copying off board/drawing/ colouring in | 31 |
| Too difficult | 30 |
| Didn't work/ had to keep repeating experiment | 26 |
| Time – too much; too little; waiting | 25 |
| No hands-on work | 19 |
| Teacher demonstration/ just watching | 16 |
| Listening | 8 |
| Cruel | 7 |
| Group work | 5 |
| Test/ learning off | 5 |
| Reading | 4 |
| Hurt myself | 4 |

| | |
|---|---|
| Results/ procedure dull e.g. didn't move | 4 |
| Working alone | 2 |
| Didn't get picked to help teacher | 2 |
| Video/TV/ Poster | 2 |
| Not enough equipment | 1 |
| No talking allowed | 1 |
| Boys' subject | 1 |
| Total | 1002 |

n for question = 998. Of these, 4 pupils gave more than one reason, each of which was added to relevant categories. Total number of coded responses is therefore 1002.

### 4.6.1 Teacher demonstration and explanation

#### Pupils' attitudes

Pupils' responses to the two relevant Likert items in the questionnaire are presented in Table 4.8.

Table 4.8: Pupils' attitudes to teacher demonstration and explanation (Figures expressed as percentages)

| I enjoy science when... | Yes | Not sure | No | Total |
|---|---|---|---|---|
| I watch my teacher do an experiment | 56 | 26 | 17 | 99 |
| My teacher explains things to the class | 71 | 20 | 8 | 99 |

N=1030; totals do not add up to 100% owing to missing responses.

Pupils were extremely positive about teacher explanations, with 71% of pupils claiming to enjoy such experiences. Over half of pupils (56%) also stated that they enjoyed watching their teacher do an experiment. In this context, it should be noted however, that this ranks considerably below pupils' positive attitudes towards doing an experiment "with my friends" (Figure 4.10, 86% of responses). Figures 4.15 and 4.16 illustrate some pupils' experiences of the teacher-led methodologies.

Figure 4.15: The teacher explains plant growth (drawn by 4th class boy)

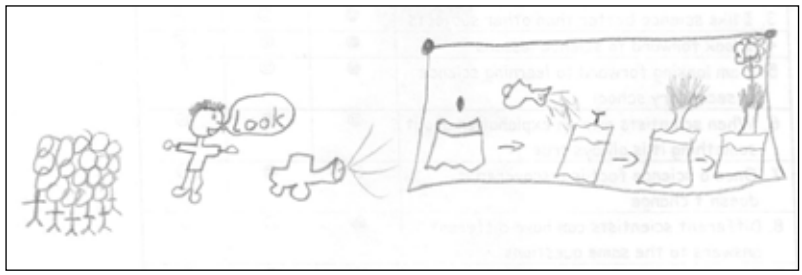
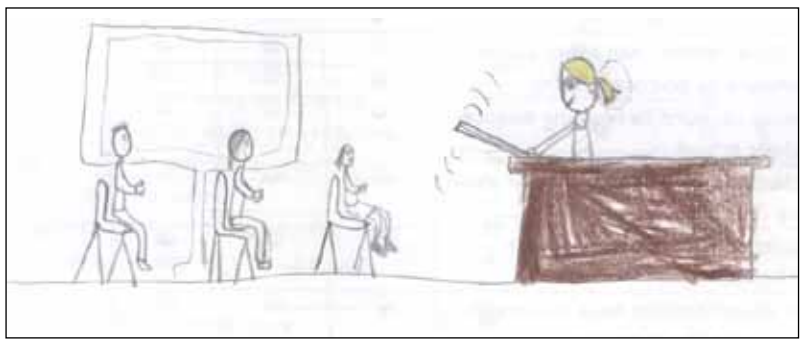



Figure 4.16: The teacher demonstrates sound vibrations, using a ruler (drawn by 5th class girl)



## Engagement with teacher demonstration and explanation: Open responses

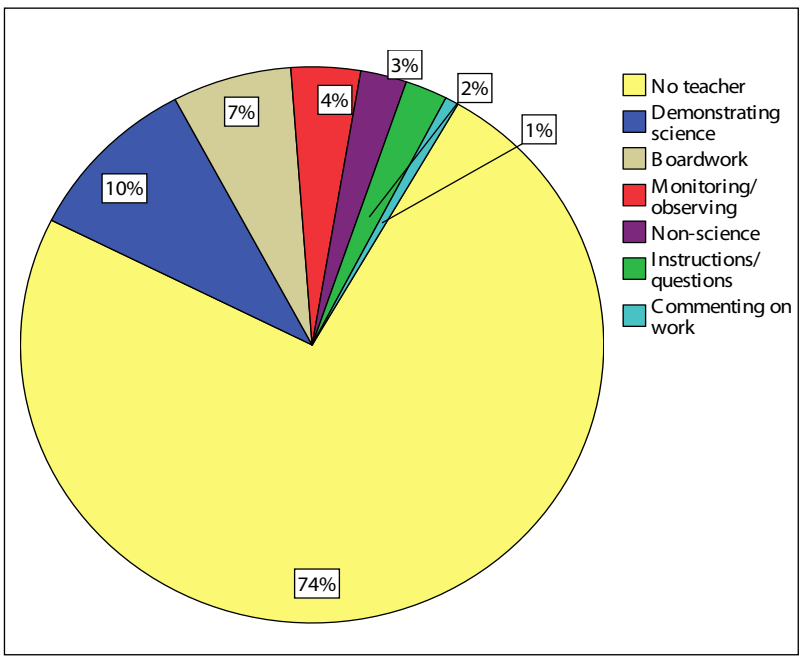
Whilst pupils appear to have broadly positive attitudes to these methodologies, they are having a negative impact on some. In offering reasons for disliking a specified science lesson in the open responses, 16 pupils cited 'having' to watch a teacher demonstration, a further eight had not enjoyed listening to the teacher and two pupils were unhappy because they had not been picked to help the teacher (Table 4.7).

Whilst positively viewed by most pupils, there would be a concern that these approaches might limit pupils' own development of scientific skills, even in teacher demonstrations where pupils provided assistance (2 responses, Table 4.6, Section 4.3). It was therefore important to ascertain whether these methodologies were prevalent in pupils' images of science teaching. Figure 4.8 (Section 4.3)

illustrates that, after hands-on science, watching a science demonstration was the second most common image that the pupils drew of themselves in science class. A total of 128 pictures (14%) showed this set-up. A note of explanation is needed here: pupils did not always clearly draw a teacher in these situations, although where the teacher was absent, the scene had to depict an experiment taking place with the whole class looking on, to be coded in this category.

The role of teachers, where they were depicted, is also revealing in this regard. Figure 4.17 summarises these data. It should be noted that nearly three-quarters of pupils' drawings did not show a teacher at all, however the instructions had asked pupils to draw "yourself and your class doing science at school" (Appendix A), so many may have deliberately omitted the teacher in following these instructions. Where teachers were shown, the most common activity was demonstrating science. A total of 92 pictures (10%) showed this.

**Figure 4.17: Images of primary science: Teacher activities**




n for question = 937; missing/ uncodable responses not included

It is difficult to say how frequently children are being taught science through teacher-led, whole class methodologies. However, these kinds of approaches are not especially advocated in the primary curriculum or exemplar materials (DES, 1999a;b). It is therefore a concern that these images, especially of teacher demonstration, are clearly in evidence. The reasons for teachers choosing to do a teacher demonstration rather than offering pupils a hands-on experience are not the subject of this research study and they are likely to be varied and complex. However, it is clear that this is an issue that merits further attention.

### 4.6.2 Reading, writing and the use of visual aids

#### Pupils' attitudes

Likert responses to items on the questionnaire that relate to these classroom methodologies are collated in Table 4.9.

**Table 4.9: Pupils' attitudes to reading, writing and the use of visual aids (Figures expressed as percentages)**

| I enjoy science when... | Yes | Not sure | No | Total |
|---|---|---|---|---|
| I read my science schoolbook | 44 | 32 | 23 | 99 |
| I copy from the board | 32 | 32 | 35 | 99 |
| I fill in my workbook/ worksheet | 56 | 26 | 17 | 99 |
| I write about something I have done in science class | 48 | 29 | 22 | 99 |
| We watch science programmes at school | 58 | 22 | 19 | 99 |

N=1030; totals do not add up to 100% owing to missing responses.

Pupils are quite ambivalent about these activities in science class. The methods attracting the most positive responses were watching science programmes at school, and filling in a workbook or worksheet, which attracted positive responses from 58% and 56% of pupils

respectively. Reading, writing about "something I have done" and copying from the board in science class attracted the most negative responses, with less than half of pupils responding positively to these activities. In the most negatively construed activity, over one-third of pupils disliked copying from the board. Whilst some of these attitudes may not be surprising, the prevalence of these methodologies in pupils' open responses needs to be considered to judge their impact.

## Experience of reading, writing and use of visual aids: Open responses

Some pupils referred to these activities in a negative way when discussing their example of a science lesson that they had not enjoyed (Table 4.7). Writing, copying from the board, drawing and 'colouring in' were claimed by 31 pupils (3% of responses) as reasons for not enjoying a science lesson. A few pupils mentioned reading (4 responses) and watching a video or looking at a poster (2 responses) in this regard. In citing reasons for enjoying favourite lessons (Table 4.6, Section 4.3), two pupils mentioned the *lack* of reading and writing as a positive feature, whilst in contrast, four pupils had enjoyed writing and one respondent had enjoyed reading their science book.

These data might suggest that these methodologies are not very prevalent in science classes, however the pictorial data need to be considered in addition. Figure 4.8 (Section 4.3) shows the activities, in which pupils were engaged, in their images of science classes. Boardwork accounted for 54 images (6% of pictures, see example in Figure 4.18), whilst reading or writing, with a book or worksheet, accounted for a further 46 images (5% of pictures, see example in Figure 4.19). Looking at the TV, a video or a poster was shown in just 4 responses. It should be noted that in all these cases however, the activity described was the *sole* activity of the child/ren and was not shown in conjunction with hands-on methodologies (see

examples in Figures 4.18 and 4.19). These images contrast with the 39 pictures coded as *mixed activities*, which showed pupils doing a range of work, often reading or writing but also additionally engaged in hands-on science (see Figure 4.9 in Section 4.3 and Figure 4.20).

Data from the teachers' contextual questionnaires is also relevant to this section. Of the 47 schools that responded to the survey, the teachers in 34 classes (72% of responding classes) said that they used a science textbook. Some of these textbooks are known to have accompanying pupil workbooks, although neither teachers nor pupils were asked if workbooks were in use. Teachers in the survey were not asked about the ways in which they used these publications, however it should be noted that the Primary Science Curriculum Teacher Guidelines suggest that such books may be used to support investigative work but state that, "science lessons **should not be workcard or textbook based**" (DES, 1999b, p. 27; emphasis in the original). The impact of such publications on the amount of reading and writing experienced as part of science class is unclear from these data. In fact, pupils from both categories, whether or not their teachers stated that a textbook was used, drew images of reading and writing as science class activities.

**Figure 4.18: Pupils engaged in board work (Girl, 6th class)**

Figure 4.19: Pupils writing in science class (Girl, 3rd class)

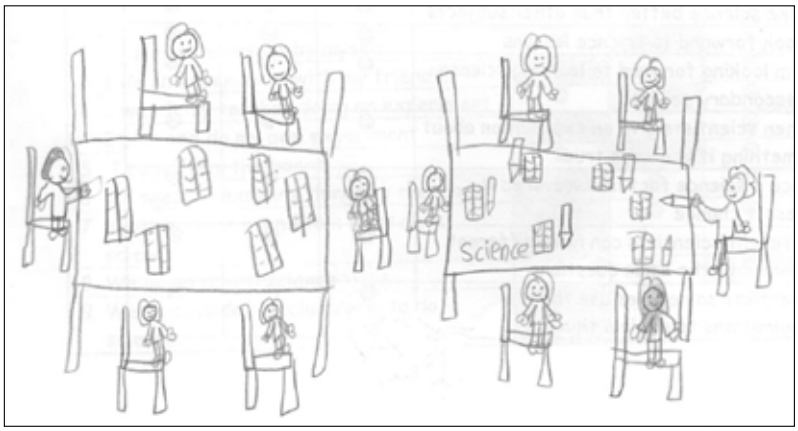
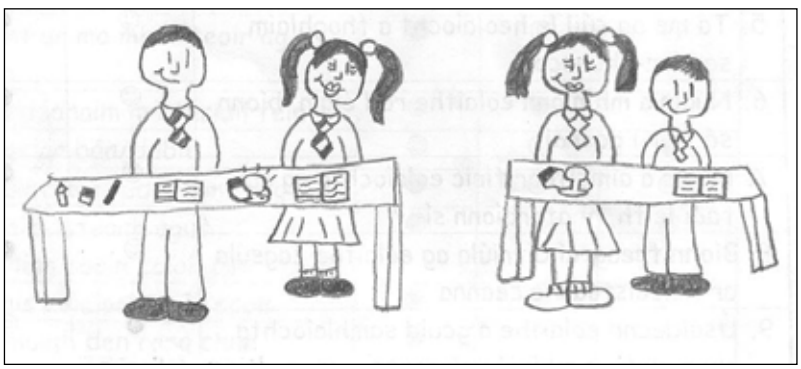



Figure 4.20: Pupils engaged in mixed activities, including recording and hands-on work (Girl, 4th class)



In conclusion it should be noted that pupils have fairly negative or at best ambivalent views towards reading, writing and using visual aids in science class. There is evidence that reading, writing or copying from the board, when taken together, are used regularly enough to feature as the class activity in over 10% of pupils' drawings of science class. It should be noted at this point that the Primary Science Curriculum does envisage that pupils from third to sixth class should use reading and writing as a part of scientific skill development. For example, these activities could be part of investigating and experimenting in "collecting information…from a variety of sources" (DES, 1999a, p.79) and in recording and communicating, producing "written accounts" (DES, 1999a, p.80). Figures 4.9 and 4.20 appear to illustrate these types of approach. However, it is not possible to say

from these data whether all pupils' use of reading and writing falls into these categories, although in the case of images of and references to board work, this seems unlikely.

### 4.6.3 Science outside the classroom, on trips and with visitors

#### Pupils' attitudes

Likert responses to items on the questionnaire that relate to these methodologies are collated in Table 4.10.

**Table 4.10: Pupils' attitudes to science outside, on trips and with visitors (Figures expressed as percentages)**

| I enjoy science when... | Yes | Not sure | No | Total |
|---|---|---|---|---|
| We go outside the classroom to do science | 81 | 12 | 6 | 99 |
| We go on school science trips | 75 | 12 | 12 | 99 |
| Visitors come in and talk to us about science | 70 | 19 | 10 | 99 |

N=1030; totals do not add up to 100% owing to missing responses.

Pupils are extremely positive about all these ways of learning science. The open responses provided additional insight into these types of experience.

#### Experiences of working on science outside the classroom, on trips and with visitors: Open responses

Many pupils described favourite lessons within the strand unit of plants and animals and some of these had clearly involved working outside. A very common favourite here was collecting mini-beasts (Figures 4.21 and 4.22), although pupils had also observed plants and identified birds in these enjoyable lessons.

Figure 4.21: Favourite science lesson: Outdoors (Boy, 4th class)

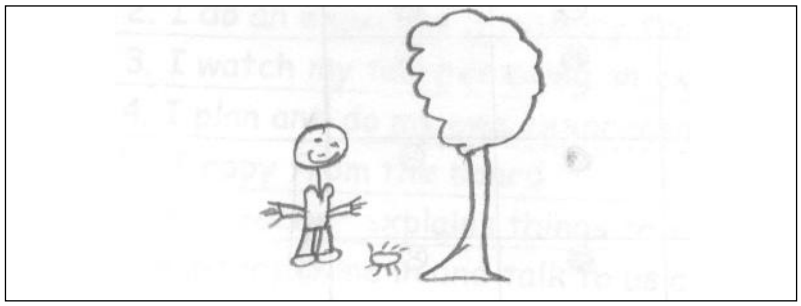
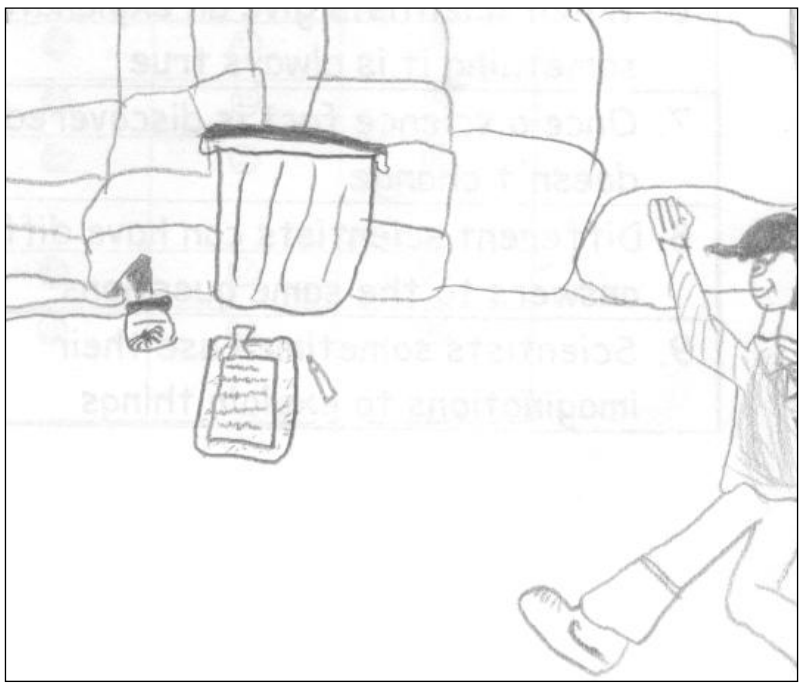


Figure 4.22: Discovering mini-beasts in an urban environment (Boy, 3rd class)



Pupils in 12 cases (1%) referred generically to 'going outside' to do science in their favourite lessons (Table 4.11, Section 4.7) although the content of these was unclear. A further 46 pupils (4%) described science sessions where they had gone on a trip or a visitor had come to the classroom. When explaining why their favourite lessons were enjoyable, 41 pupils (4%) stated that going outside or on a trip was the reason (Table 4.6, Section 4.3). It is interesting to note that, for some pupils 'going outside' was seen as being different and as such, it may have been a relatively rare experience.

Only three pupils wrote of science lessons involving a trip or visitor that had not been enjoyed (Table 4.12, Section 4.7). Some pupils described lessons they disliked, coded within the strand Living things, which had included collecting mini-beasts outdoors. Collecting and looking at mini-beasts featured as reasons for disliking lessons, including some of the 65 responses describing science experiences as "unpleasant" and seven concerns with cruelty (Table 4.7, Section 4.6). These responses all provided additional evidence of pupils conducting hands-on work outside.

Pupils in some classes had clearly been enthused by visitors or trips. In such cases, several respondents from the same class referred to the same visitor or trip, so it was possible to build quite a detailed description of the events. These included visiting a local canal or beach, going to bird sanctuaries or nature reserves, and attending primary science events hosted by third level institutions. Some pupils spoke warmly of visitors to their schools, or staff at nature reserves, who had assisted with bird watching, pond dipping and other hands-on activities. The role of staff in tertiary level centres appeared to be of a slightly different nature, with pupils describing staff carrying out exciting science demonstrations and some activities in which the pupils were able to participate.

The impact of all these special events appears to be almost entirely positive, and it seems that for pupils these are extremely memorable. However, it is unlikely that special visitors and trips are a regular feature of the timetable even in the schools where these were described. Working outdoors within the school environment has the potential to be extremely motivating as well, and it is a more accessible resource. It is therefore of some concern that pupils did not refer to working outdoors more frequently, and interesting to note that, of the 906 depictions of school science that were

classifiable as to the setting, only 53 (5%) showed pupils outdoors, the vast majority (86%) depicting activities within the classroom.

The final issue to be considered in relation to the survey data is the areas of subject content that pupils are experiencing at school. This is discussed next.

## 4.7 Scientific Subject Content

This section considers pupils' experiences of, and attitudes towards scientific subject content. The four strands of subject content in the Primary Science Curriculum are: Living things; Energy and forces; Materials and Environmental awareness and care (DES, 1999a). These are subdivided into strand units as described earlier in Section 2.1. Pupils' descriptions of favourite science lessons and lessons that they did not enjoy were coded according to the relevant strand where appropriate. These data are presented in Tables 4.11 and 4.12. Evidence of pupils' engagement with school science related to the four strands will be discussed in turn, starting with the strand Living things, which includes the strand units of human life and plants and animals.

| Table 4.11: Pupil responses to "Describe your favourite science lesson" | |
|---|---|
| | No. of responses |
| Energy and forces | 339 |
| Living things | 258 |
| Materials | 200 |
| Topics not in Primary Science Curriculum | 54 |
| Trip/ visitor | 46 |
| Design and make | 43 |
| Experiments (unspecified) | 29 |
| Environmental awareness and care | 29 |
| Blank/ don't know | 26 |
| Outside (topic unspecified) | 12 |
| Like all science lessons | 10 |
| None – don't like any science lessons | 5 |
| ICT lesson | 3 |
| Total | 1054 |

n for question = 1011. Of these, 38 pupils gave responses that fitted into more that one category, each of which was coded. Total number of coded responses is therefore 1054.

| Table 4.12: Pupil responses to "Describe a lesson you didn't enjoy" | |
|---|---|
| | No. of responses |
| Living things | 260 |
| None, like all science | 223 |
| Energy and forces | 190 |
| Blank / don't know | 127 |
| Materials | 81 |
| Topics not in Primary Science Curriculum | 63 |
| Environmental awareness and care | 12 |
| All, I hate all science | 9 |
| Trip/ visitor | 3 |
| Design and make | 3 |
| Total | 971 |

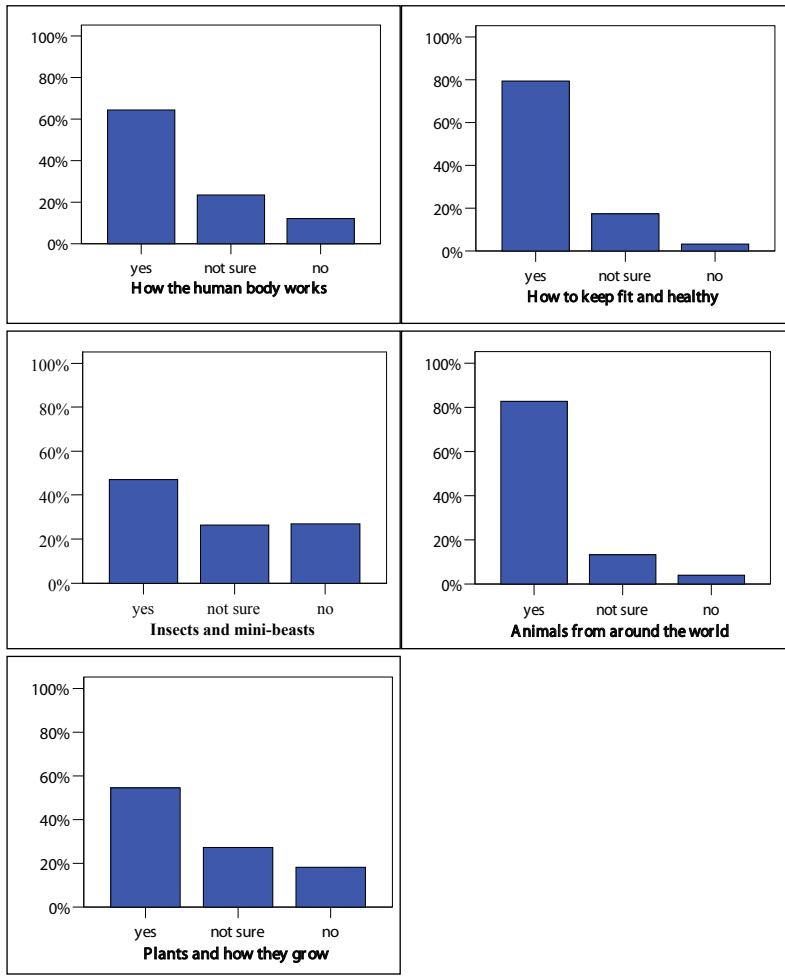
n for question = 967. Of these, 4 pupils gave responses that fitted into more than one category, each of which was coded. Total number of coded responses is therefore 971.

### 4.7.1 Living things

#### Pupils' attitudes

Pupils' responses to the relevant Likert items are presented in Figure 4.23.

**Figure 4.23: Pupils' attitudes towards learning about Living things I enjoy learning about…**




For all questions, N=1030. Percentages do not add up to 100% owing to missing responses (<2% of cases).

Within the strand of Living things, pupils showed the strongest positive attitude towards learning about animals from around the world (83% yes) and the strongest negative attitude towards learning about insects and mini-beasts (27% no). Insects and mini-beasts was

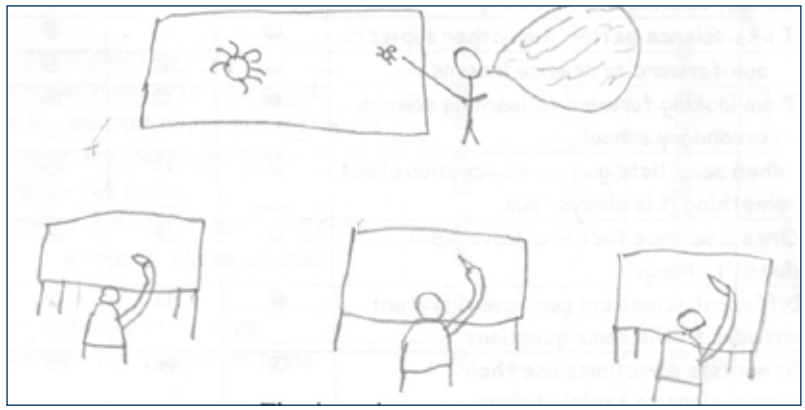
the only topic in this strand in which less than half the respondents expressed positive enjoyment of learning.

## Experiences of school science relating to Living things: Open responses

Additional insights into pupils' experiences may be gleaned from the open responses. Pupils were asked to describe a favourite science lesson and this was coded according to strand where appropriate (Table 4.11). Lessons falling within the strand of Living things accounted for 258 (25%) of all lessons described, the second most common category. Pupils described many different lessons, including collecting mini-beasts, planting seeds, learning about animals and the human body. A further 46 pupils mentioned trips and visitors, and in a number of these responses, pupils had learned about Living things, principally by observing plants and animals in their natural habitats. These were discussed earlier, in Section 4.6.

Given the popularity of Living things as the subject of favourite science lessons, it was surprising that so few drawings (5%) showed pupils working outside, but in almost all of these cases, they were engaged in hands-on work related to Living things (see examples in Figures 4.21 and 4.22 in Section 4.6.3). Activities involving learning about Living things were principally depicted in classroom settings and many of these showed hands-on activities (see examples in Figures 4.6 and 4.9, Section 4.3), although in other cases the approaches were rather more teacher-led (see Figure 4.15 in Section 4.6, and Figure 4.24).

Figure 4.24: Pupils learning about mini-beasts in the classroom (Boy, 4th class)



Pupils were also asked to describe a science lesson that they had not enjoyed (Table 4.12) and the most common category for these was in the strand Living things. A total of 223 pupils (23% of responses) described such experiences. Many of these involved lessons in which mini-beasts were collected, or where pupils learned about the workings of the human body. Reasoning provided in some of these cases related to a dislike of mini-beasts or squeamishness about them or about the human body, or to a concern about cruelty to mini-beasts (Table 4.7, Section 4.6). In other reasons provided, a total of 55 pupils stated that they had not enjoyed a lesson because they did not like the subject matter – and in many of those cases the subject was insects and mini-beasts. These data may help to explain some pupils' lack of enthusiasm for learning about insects and mini-beasts, reported earlier (Figure 4.23).

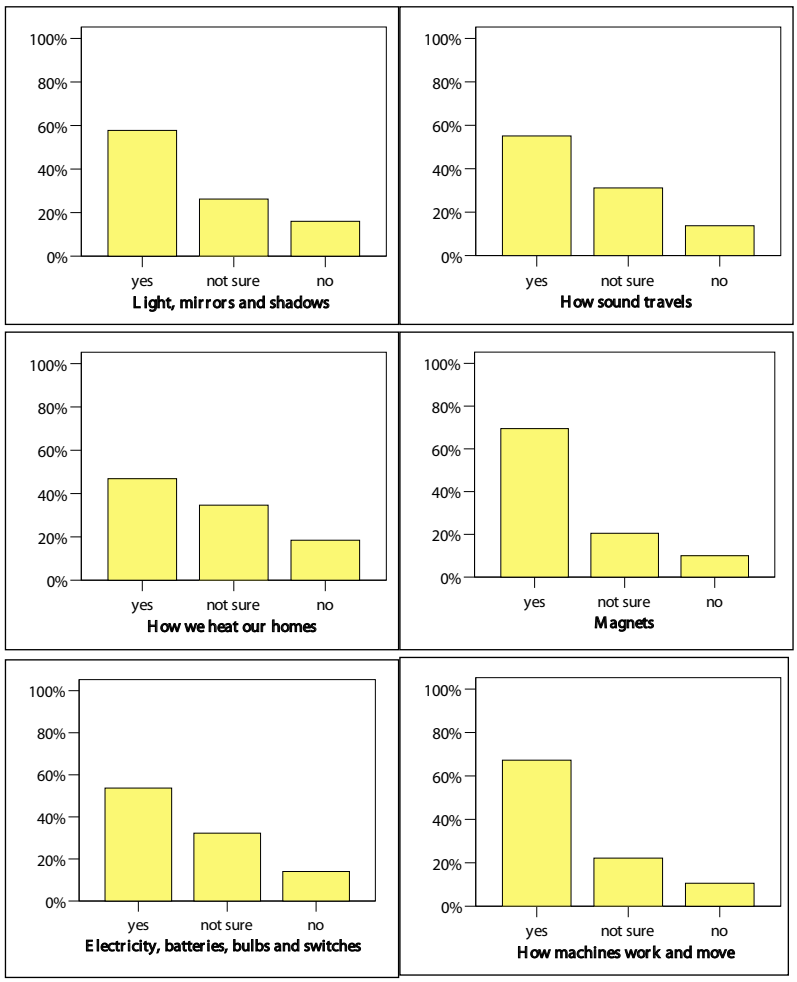
### 4.7.2 Energy and Forces

Pupils' experiences of school science relating to the strand Energy and forces will now be considered. This strand encompasses the strand units of light, sound, heat, magnetism and electricity and forces.

## Pupils' attitudes

Figure 4.25 summarises the responses to the Likert items relating to aspects of the strand units within the strand of Energy and forces.

**Figure 4.25: Pupils' attitudes towards learning about Energy and forces I enjoy learning about…**




For all questions, N=1030.

Percentages do not add up to 100% owing to missing responses (<2% of cases).

Within this strand, pupils showed the strongest positive attitude towards learning about magnets (69% yes) and the strongest negative attitude towards learning about how we heat our homes (18% no). The latter topic was the only one in this strand to which less than half the respondents expressed a positive attitude.

## Experiences of school science related to Energy and forces: Open responses

By far the largest category of response in Table 4.11 was pupils describing favourite lessons within the strand Energy and forces, most commonly those relating to magnets and electricity (exemplified in Figures 4.3, 4.5 and 4.7 in Section 4.3.3 and Figure 4.12 in Section 4.4). A total of 339 pupils (32% of responses) mentioned lessons whose content related to this strand as a whole. Many of the 43 design and make lessons also related to projects within the strand Energy and forces, such as constructing periscopes, or lighthouses with electrical circuits.

Although this is encouraging, there were some concerns about these data. Pupils claimed a strongly positive view about learning about "how machines work and move" (67% yes, Figure 4.25) and yet very few pupils gave examples of lessons within the related strand unit of forces in the open questions or pictures. The most common example was of various kinds of floating and sinking investigations, with several pupils mentioning an activity termed the "dancing raisins" – in which pupils observe raisins in fizzy water, as they float and then sink, then float and so on. A few pupils drew also an activity involving a "rocket balloon" attached to a string. No pupils drew images of making and testing parachutes and pupils in only one school provided images of testing toy cars, a "rollercoaster" activity conducted under the supervision of a visitor to the school. This lack of exemplars is surprising, especially given that these activities are stated as suggestions in the Primary Science Curriculum (DES, 1999a). There were also few images that could have been described as relating to the strand unit of heat, although pupils did describe lessons involving measuring temperatures, and some lessons relating to the strand unit materials and change (discussed later) may have offered opportunities for children to learn about heat. Activities relating to sound were in evidence, mainly the string telephone,

although other images were provided (see Figure 4.16, Section 4.6.1). Lessons about light included those where rainbows were created using prisms, and pupils investigating mirrors and mirror-writing.

The strand of Energy and forces was also well-represented in pupils' examples of lessons that they did not enjoy. In this case the subject matter mentioned in this response was more balanced in relation to the different strand units with the exception once again of forces, where floating and sinking activities dominated. A total of 190 of these less favoured lessons (20% of responses) were categorised in this strand unit.

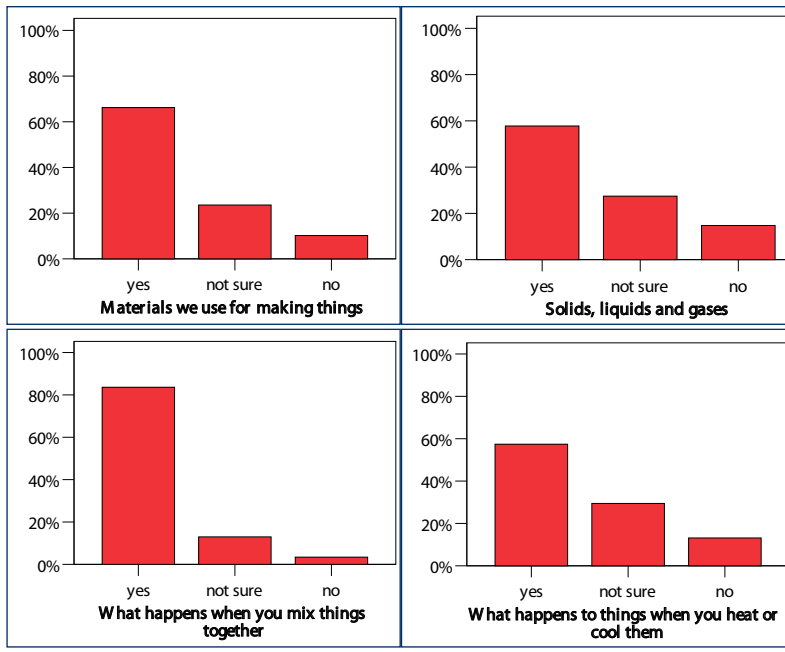
### 4.7.3 Materials

Pupils' experiences of science lessons relating to the strand Materials will now be considered. This strand encompasses the strand units properties and characteristics of materials and materials and change.

#### Pupils' attitudes

Figure 4.26 summarises responses to the Likert items relating to aspects of the strand units within the strand Materials. Within the strand of Materials, pupils showed the strongest positive attitude towards learning about what happens when you mix things together (83% yes). Pupils' attitudes towards solids, liquids and gases and what happens to things when you heat or cool them scored the lowest positive attitudes (both 57%) although in this strand, no topic was especially negatively construed.

**Figure 4.26: Pupils' attitudes towards learning about Materials I enjoy learning about…**




For all questions, N=1030. Percentages do not add up to 100% owing to missing responses (<2% of cases).

## Experiences of school science related to Materials: Open responses

Varied examples of favourite lessons were provided by pupils from the Materials strand, including: mixing liquids, making ice, making "lava lamps" and "fizzy rockets" and creating "volcanoes" out of vinegar and baking soda (for example, in second panel of Figure 4.14, Section 4.5.2). A total of 200 pupils described favourite lessons that were coded within this strand (19% of responses). Pupils clearly enjoyed these experiences and found them to be memorable, especially, it seems, the ones involving fizzing or 'exploding' material (see Figure 4.4, Section 4.3.3).

It is worth noting at this point that there appeared to be far more descriptions and depictions of lessons relating to materials and change than to properties and characteristics of materials. However,

this may simply be a reflection of the dominance of references to the "volcanoes".

In describing a lesson that had not been enjoyed, 81 responses (8%) related to this strand (Table 4.12). These were from a broad range of areas within the strand, although two that attracted particular attention were: an investigation involving eggs and vinegar; and the "volcanoes" again. In both cases, several pupils commented that, as the work had been smelly, this was their reason for not enjoying the lesson (Table 4.7, Section 4.6).

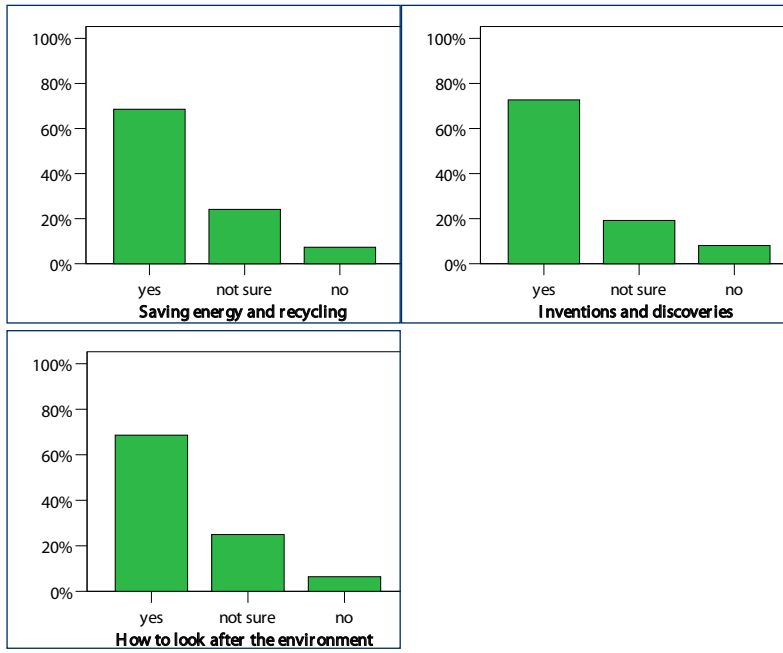
### 4.7.4 Environmental awareness and care

Pupils' experiences of science lessons linked to the strand Environmental awareness and care will now be considered. In third to sixth class, this strand incorporates the strand units environmental awareness, science and the environment and caring for the environment.

#### Pupils' attitudes

Figure 4.27 summarises responses to the Likert items relating to aspects of the strand units within this strand. Within the strand of Environmental awareness and care, positive attitudes towards all three items on the questionnaire were seen. Learning about inventions and discoveries was the one that attracted the most positive response (72% yes).

Figure 4.27: Pupils' attitudes towards learning about Environmental awareness and care I enjoy learning about…




For all questions, N=1030. Percentages do not add up to 100% owing to missing responses (<2% of cases).

## Experiences of school science related to Environmental awareness and care: Open responses

Very few, just 29 pupils (3%) mentioned lessons relating to Environmental awareness and care. These included three references to learning about inventions and discoveries and some descriptions of recycling projects and making compost. It should be noted, however, that some types of lessons categorised separately under Living things, working outside or going on trips could also have potentially encompassed a broader environmental dimension that was not described by the pupil (Table 4.11). Where pupils did mention learning about the environment, some did suggest that it was an enjoyable lesson because it was "important to learn how to save the planet".

Pupils mentioned very few examples of lessons that had not been enjoyed, which related to this strand. Just 12 lesson descriptions (1% of responses) were coded in this way (Table 4.12). Pictures of pupils working outdoors were also relatively infrequent (discussed in Section 4.6) and none clearly showed pupils engaged in environmental activities as opposed to activities relating to plants and animals.

It appears that pupils are enthusiastic about learning in this strand but, if they are learning about issues relating to the environment, these are apparently not very memorable experiences. It is appreciated that some of the areas described in this strand of the Primary Science Curriculum relate to developing good attitudes rather than engaging in hands-on activities, which may explain pupils' lack of responses. It may also be the case that some of the potential activities in this area, such as litter-picking, looking at local traffic congestion by doing a traffic survey, or using a recycling bin at the school, would either not be regarded as science, or not even be regarded as lessons. However, it is still a matter of concern that this strand was so poorly represented in pupils' memories of science at school compared to the other three.

### 4.7.5 Scientific subject content: Concluding remarks

Overall, pupils expressed overwhelmingly positive attitudes towards learning virtually all types of scientific subject content. More than 50% of pupils claimed that they enjoyed learning about science subject matter specified in 16 of the 18 Likert items in this part of the questionnaire. The topic attracting the most positive response was learning about "what happens when you mix things together" (83% yes). The topic attracting the most negative response was "insects and mini-beasts" with 27% of pupils stating that they did not enjoy learning about this topic. It should be noted at this point, however,

that the Likert item responses only measured pupils' attitudes towards learning these areas of subject content. It was not possible to tell from these data whether pupils were encountering these topics frequently in their science lessons, or to determine the quality of any learning in these areas.

Many pupils clearly value the opportunity to acquire new scientific subject knowledge and stated the reason for their selection of a favourite science lesson as enjoyment of learning, particularly "learning new things" (Table 4.6, Section 4.3). A total of 143 pupils, 14% of respondents indicated this type of reason for liking a science lesson. For comparison, when discussing reasons for not enjoying a science lesson, 60 pupils (6% of respondents) stated that lessons had been too easy often referring to repeating topics or covering things they knew already. These references to learning are interesting, but the data gathered do not provide particular evidence for the quality or progress in learning that pupils might be making in relation to specified scientific subject content. It should be noted, however, that this study did not aim to assess pupils' learning or knowledge of scientific subject content.

The responses to the open questions indicate that primary pupils appear to be having many memorable experiences in a wide range of scientific content areas. The majority of recalled lessons covered aspects of content from the strands Living things, Energy and forces or Materials. These lessons have been easily remembered, and many of the more positively viewed ones involved hands-on experiences. That hands-on science lessons are highly memorable is indicated by the detail of pupils' descriptions and a number of examples that pupils described, which had occurred in a previous class.

The *frequency* of pupils' engagement with science within the strands Living things, Energy and forces and Materials is less clear from these

data. However, it should be noted that very few pupils described topics within the strand Environmental awareness and care. This would appear to indicate that, for pupils in this survey, science lessons within this strand are infrequent in comparison with the others.

## 4.8 Pupil Survey Findings: Summary

A large number of primary pupils from a varied range of locations and school types in Ireland participated in this survey. This has provided a wealth of data relating to pupils' perceptions and experiences of science in primary schools. This section has covered the responses to the pupil survey in detail, and where possible, has triangulated data between question types in order to clarify or corroborate the material presented. There are a number of issues arising out of this analysis, which will be summarised in relation to the themes of the research indicated at the start of this section.

### 4.8.1 Children's attitudes towards school science

Pupils are generally positively disposed towards school science and have positive attitudes towards most of the areas of scientific subject content that feature in the Primary Science Curriculum (DES, 1999a). Pupils also have positive attitudes towards learning science in the ways that would be strongly emphasised in the curriculum, principally hands-on methodologies.

### 4.8.2 Hands-on science

Pupils are positively disposed towards hands-on science, including designing and making activities. Overall, there is good evidence for pupils' engagement with a wide range of different activities that would be classed as hands-on science, although the evidence for pupils' participation in design-and-make projects is more limited. It is interesting to note that examples relating to designing-and-making

mostly appeared to relate to ideas presented in the Discover Primary Science pack (DSE, 2007).

For individual classes within the survey, it is hard to establish the frequency with which pupils engage in hands-on science, and in some cases there might be relatively limited experiences on offer. In addition, although hands-on experiences are in evidence, it is not possible to discern the level of pupil autonomy and hence range of skill development that is occurring. It is hard to say whether many pupils at this level are conducting pupil-led investigations, for example.

### 4.8.3 Group work in science

In general, pupils feel positive about working in groups and group work appears to be relatively widely used as a strategy in science lessons. Whilst group work appears to be a reasonably common feature of primary science classrooms, it is unclear from these data whether pupils are genuinely collaborating when working in groups in science.

### 4.8.4 ICT in science

Pupils express very positive attitudes towards ICT use in science. However, there is very little evidence that pupils see ICT as a memorable or routine feature of science lessons. It appears that pupils generally do not seem to be experiencing ICT use as an integral part of science.

### 4.8.5 Other teaching and learning approaches

Teacher demonstrations of science appear as a feature of primary classrooms. Whilst positively viewed by most pupils, the opportunities for pupils to develop their scientific skills through these experiences would be a cause for concern. On occasion, pupils also appear to be engaging in work that might be regarded as didactic or involving

limited interaction. Such methodologies include: looking at or copying from the board; listening to teacher explanations; and reading or writing. Of these, only teacher explanations are viewed especially positively by pupils.

Pupils have very positive views about working outdoors in science, going on trips and having visitors to support their scientific learning. Examples of special trips and visitors are relatively uncommon, although where described, they appear to have a positive impact on the class concerned. Pupils' accounts of working outdoors in more familiar contexts, such as the school grounds, are also reported with relatively low frequency, and this is of more concern, as the resource is readily available. Pupils' work outdoors appears to link almost exclusively to scientific content related to plants and animals.

### 4.8.6 Scientific subject content

Pupils appear to be experiencing lessons that encompass a good range of scientific content across the three strands of Living things, Energy and forces and Materials. On many occasions, positively viewed lessons within these content areas have involved pupils in hands-on science. It is interesting to note that numerous examples of these hands-on lessons described by pupils mirror activities promoted in either the PCSP in-service days or the Discover Primary Science pack (DSE, 2007).

Taking pupils' responses as a whole, it is not possible to tell how much children are learning about scientific subject content as a result of their science lessons, although it should be noted that this was not a focus of the research. As pupils were invited to describe individual lessons in the open responses to the questionnaire, it is not possible to tell how or indeed whether their experiences were integrated into schemes of work to promote progression of conceptual understanding.

There are some infrequently reported aspects of content and, in these instances, pupils' learning would most likely be very limited. For example, there is relatively little evidence of pupils describing lessons relating to the strand unit of forces, with the exception of floating and sinking, or relating to the strand unit of properties and characteristics of materials. An area of particular concern is that there is very limited evidence of pupils engaging in lessons relating to any strand unit within the strand Environmental awareness and care. It may be of relevance to note that the initial PCSP in-service workshops did not involve teachers in trying out hands-on ideas for teaching in the above areas of scientific subject content.

From these data, it is possible to suggest that for a proportion of pupils in the survey, their most memorable science experiences relate to activities tried out by teachers in the PCSP in-service workshops or in the Discover Primary Science pack. On one level, this is extremely encouraging, as it shows that these initiatives have almost certainly had an impact in some schools, and as a result, pupils are engaging in hands-on science representing a range of physical and biological topics. It is of more concern, however, that other areas of scientific subject content seem to be under-represented both in pupils' descriptions and in the two aforementioned sources of ideas. The link between these two observations may be more than coincidental and could imply that some teachers are finding it difficult to provide memorable experiences for their children if supporting ideas are not available.

Recommendations arising out of these points will be discussed in Section 6, in conjunction with issues arising from the analysis of case study data. Section 5, which follows, considers the data gathered during the case study conducted in 11 primary schools.

# Section 5: Case Study: Findings

In this section findings from the data gathered in the case study schools are analysed. In a similar manner to Section 4, these findings are considered in relation to the original aims of the study, in terms of the children's attitudes towards and experiences of school science. The first half of this section presents data obtained from the classroom observations. The subsequent part focuses on data obtained from the group interviews and case study pupils' questionnaires. The section concludes with a discussion of findings from all aspects of the case study.

## 5.1 Classroom observations

Classroom observations were conducted in 15 different science classes in 11 different schools. In total, 311 pupils from senior infants to sixth class were observed. Details of the case study classes and schools are provided in Table 3.1 (Section 3.1) and Appendix C. Data relating to observations of each whole class were gathered in the form of field notes, taken at fixed intervals as described in the observation time-frame in Appendix D. As well as observing the whole class, two pupils, target children, from each class were the focus of more detailed observation using the structured observation schedule described in Section 3.3 and Appendix D. Altogether, 30 target children from 15 different classes were the subject of structured observation. Each target child was observed for periods of 2 minutes at fixed intervals during their science lesson (Appendix D). Over the course of the 15 lessons, a total of 81 such observation periods were used for data gathering.

The findings from the structured observations and field notes are presented and discussed in relation to the following broad aims of the study:

- Which scientific subject content areas are children experiencing at school?

- How are children learning science at school?

### 5.1.1 Subject content areas

#### Strand units taught during observation visits

The scientific subject content areas of the observed lessons are outlined in Table 5.1.

| Table 5.1: Scientific subject content of observed lessons | | | |
|---|---|---|---|
| Strand | Strand Unit/ Topic | No. of classes (N=15) | Class group |
| Living things | Myself | 1 | 2nd Class |
| | Plants and animals | 2 | Senior Infants<br>1st Class |
| Energy and forces | Light | 1 | 6th Class |
| | Sound | 1 | 2nd/3rd Class |
| | Magnets | 2 | 1st Class<br>4th Class |
| | Forces | 1 | 4th Class |
| Materials | Properties of materials | 3 | 2 x 2nd Class<br>6th Class |
| | Materials and change | 4 | 1st Class<br>3rd Class<br>6th Class<br>3rd-6th Class |
| Environmental awareness and care | N/a | 0 | N/a |

The Materials strand had the largest representation of the lessons observed. Out of the 15 science lessons observed, seven were based on the Materials strand. In three instances lessons were taught about the properties of materials while the remaining four focused on materials and change. Two of the lessons based on the properties of materials focused on air and its properties, and the third was based on investigating the properties of ice and melting. All four of the lessons that concentrated on the strand unit materials and change explored the effects of mixing

various powders with different liquids. In one of these, the lesson focused entirely on the fair testing process, when investigating these materials. The children in this lesson were also provided with opportunities to test their predictions and record their results.

Of the lessons observed, five were focused on the strand Energy and forces. In two instances children explored the properties of magnets. Light and its necessity for sight was explored by another class. The forces of gravity and air resistance were investigated by a further class, where the children designed and made parachutes from different materials. Sound was the topic for a combined second/ third class, where the children were introduced to the concept of sound vibrations. Out of the 15 lessons observed, three were focused on topics from the Living things strand of the curriculum. One of these lessons focused on the strand unit Myself, where the children explored their teeth. Animals from around the world and their habitats were the focus of the other two lessons. None of the lessons observed covered topics from the Environmental awareness and care strand.

### 5.1.2 How children learn science at school

The structured observation schedules and field notes provide data regarding the ways in which children are learning science at school. These data will be presented in this section under the following headings:

- Teacher-directed learning;
- Collaborative learning;
- Children conducting hands-on activities;
- Utilising science skills;
- Reading and writing in science class;
- Use of ICT.

## Teacher-directed learning

The data obtained from the observation schedules and field notes provide information regarding how the teachers directed learning in the observed science lessons. There were a number of different types of teacher-directed learning approaches apparent in the data. Definitions of the different teacher-directed approaches and how frequently each approach occurred during the observed lessons are outlined in Tables 5.2 and 5.3.

### *Teacher talk*

Providing instructions on the task at hand and commenting on the children's oral responses were aspects of teacher talk that were recorded on many occasions in the observation schedule (Table 5.2). Recapping on previous work, introducing topics, posing questions, providing information on the topic and eliciting information from the children were aspects of teacher talk that were recorded in the field notes in all 15 lessons observed (Table 5.3). Providing instructions or information on tasks was recorded 11 times and encouraging children to predict events and record findings was recorded eight and four times respectively (Table 5.3).

### *Teacher listening*

Asking for accounts of progress, listening to pupils and collating their ideas typified instances where teachers listened to their pupils during the lessons observed. In the observation schedules, high numbers of occurrences were recorded in these three categories, 29, 73 and 54 times each out of a possible 81 observation periods.

The field notes indicated that in some instances whiteboards, blackboards and flip charts were utilised to collate the children's ideas. In other instances the children's ideas were collated orally. The data obtained from the field notes also indicated that in one second/third class, the teacher utilised concept maps to collate the children's ideas regarding sound and vibrations. In another lesson, a teacher teaching first class collated her pupils' ideas regarding where they lived and their surroundings on a flip-chart sheet.

| Table 5.2: Target children's interactions with teacher-directed learning: Approaches recorded in the structured observation schedule | | |
|---|---|---|
| Category | Definition | No. of 2 minute periods in which recorded (Max. for any category = 81) |
| **Teacher talk** | | |
| Giving instructions on task | Teacher instructions about how to carry out an aspect of the task | 45 |
| Giving information on task | Teacher provides facts or information about content | 37 |
| Comment on pupil's answer (on task) | Refers to teacher's evaluative remarks about the children's responses/ activities | 52 |
| **Teacher listening to pupils** | | |
| Asking for account of progress | Teacher's request to pupil/ whole class to say what they have done/ found | 29 |
| Listening to pupils | Teacher listens to pupils | 73 |
| Collating pupils' ideas | Teacher brings together class ideas | 54 |
| **Teacher activity** | | |
| Demonstrating activity/ what to do | Teacher carries out whole or part of the activity to show how to use the equipment | 16 |
| Writing on/ correcting/ checking pupils' written work | Teacher looks at/ corrects pupils' work | 3 |

| Table 5.3: Children's experiences of teacher-directed learning:Approaches recorded in the field notes | |
|---|---|
| Approaches observed | No. of classes (Max. for any category = 15) |
| **Teacher Talk** | |
| Recapping on previous work | 15 |
| Introducing topics | 15 |
| Posing questions | 15 |
| Information about the topic | 15 |
| Eliciting information | 15 |
| Instructions on the hands-on task | 11 |
| Encouraging children to predict events | 8 |
| Encouraging children to record | 4 |
| **Teacher activity** | |
| Modelling how to use equipment | 8 |

*Teacher activity*

Teachers showing pupils how to use equipment prior the children engaging in an activity was recorded on 16 out of 81 occasions for the target children and in 8 out of 15 classrooms in the field notes. The field notes indicated that in one of the observed lessons, the teacher demonstrated all the science activities to the class, while the children observed. However, despite an absence of collaborative group work in this lesson, the field notes indicated that the children were actively engaged for the duration of the lesson and readily "helped when asked".

## Collaborative learning

The classroom observation schedules permitted a record to be taken of the different types of pupil/pupil interactions in which the target children were engaged over the course of the observed lessons. Table 5.4 provides an overview of these data.

**Table 5.4: Pupil / pupil interaction involving target children: Recorded in the structured observation schedule**

| Category | Number of 2 minute periods in which recorded (Max. for any category = 81) |
|---|---|
| Pair work | 10 |
| Group | 22 |
| Alone | 3 |

The data in Table 5.4 indicate that in 32 instances out of a possible 81 observation periods, the children were either working in pairs or groups, whereas target children working on their own was only recorded in 3 out of a possible 81 instances.

The field notes also indicated that in 12 lessons children were engaged in collaborative work during the observed science lessons. The data gathered from the field notes revealed a number of different ways in which the children were engaged in working collaboratively. Table 5.5 summarises these findings.

| Table 5.5: Children working collaboratively, as recorded in field notes | | | | |
|---|---|---|---|---|
| Strand | Topic | Class | Grouping | Example |
| Living things | Myself | 2nd | Pairs/ alone<br>Pairs/ alone | Children worked on a snakes and ladders game revising teeth<br>Using mirrors to observe their teeth |
| | Habitats | 1st | Pairs | Matching animals to habitats cards and worksheet |
| | Habitats | Senior Infants | Groups | Children in groups/ pairs discussed various habitats |
| Energy and forces | Light | 6th | Pairs | Worked in pairs to determine the blind spot |
| | Sound | 2nd/3rd | Pairs and groups | Children worked in pairs to make their concept map on sound. They worked in pairs and groups on activities on sound |
| | Magnets | 1st | Pairs | Children working in pairs finding which materials are attracted to magnets |
| | Magnets | 4th | Groups | Children worked in groups testing various materials for magnetic properties |
| | Forces | 4th | Groups/ pairs | Children worked in groups or pairs carefully measuring materials for a parachute |
| Materials | Properties of materials | 2nd | Groups | Children worked in groups predicting and recording air pressure activity |
| | Materials and change | 3rd-6th | Pairs | Children worked in pairs adding vinegar to baking soda |
| | Materials and change | 1st | Groups | Children worked in groups dissolving powder in water and recording results |
| | Materials and change | 6th | Groups | Children explored a fair test investigation in groups |

As indicated in Table 5.5, the children were observed working collaboratively with their peers in 12 of the 15 case study classrooms. The field notes recorded different ways in which the children worked in groups. These included instances where the children set one another tasks and took turns completing the hands-on activity. There were examples recorded of children working in groups to investigate the properties of magnets, another class worked in small groups to devise and conduct a fair test investigation and another class investigated parachutes in small groups. The data also revealed that on-task discussion was evident amongst these small collaborative groups. In one instance in a split-level class it was noted that the children were working in pairs and the older children were paired with younger class members. In general the data obtained from the field notes indicate that the majority of children observed were seated in groups or pairs. However, there were times during classes where children moved seat to work independently. In some cases, children were sitting alone if a partner was absent. It would appear from these data, that, where pupils were engaging in hands-on activities, they were also typically working in a collaborative manner with other pupils.

## Children conducting hands-on activities

In the structured observation schedules for all 15 classes, there were 27 instances out of a possible 81 observation periods recorded where the target children were using equipment purposefully (Table 5.7).

The field notes also recorded that in 12 of the 15 observed classes, the children were engaged in hands-on activities. Some examples of the children using equipment purposefully in hands-on science class as recorded in the field notes are summarised in Table 5.6. All of these hands-on activities engaged children in one or more aspects of the skill of investigating and experimenting.

| Table 5.6: Examples of children engaging in hands-on activities. Recorded in field notes | | | |
|---|---|---|---|
| Strand | Topic | Class | Hands-on activity |
| Living things | Myself | 2nd | Using mirrors to help children recognise the position of their teeth |
| Light | | 6th | Using worksheets from the Discover Primary Science activity booklet to locate each child's blind-spot<br>Making a flicker card to show that the persistence of vision can cause the brain to become muddled |
| | Sound | 2nd/3rd | Making a straw oboe to examine how pitch changes |
| | Magnets | 4th | Investigating which type of materials are attracted to magnets |
| Materials | Properties of materials | 2nd | Investigating the effect of air pressure on water |
| | Materials and change | 1st | Mixing powders with water |
| | | 6th | Exploring fair testing with different powders and liquids |
| | | 3rd–6th | 'Volcano' – exploring the reaction that occurs when vinegar is mixed with baking powder |

Table 5.6 illustrates that the children were given a wide range of activities, which enabled them to engage in hands-on science. The scientific skills that pupils were developing during these activities will be considered next. It should be noted at this point, that no data were gathered about pupils' use of the skills of designing-and-making, as no lessons involving such activities were observed.

## Utilising science skills

The observation schedules and field notes indicate that the children were provided with numerous opportunities to apply various scientific skills. Table 5.7 provides an overview of the different types of skills that the target children were observed utilising, and the rate of occurrence of these skills.

Table 5.7 illustrates that the target children in the classes were observed utilising a number of the skills of working scientifically as outlined in the Primary Science Curriculum. These included observing, predicting, investigating and experimenting, estimating and measuring and analysing. Observing was the skill that was recorded most frequently on the structured observation schedule. Using materials or equipment purposefully, an aspect of investigating and experimenting, was the second most frequently recorded skill, followed by predicting and analysing. The employment of each of the skills outlined in Table 5.7 will be considered in turn. It should be noted that the skill of recording is discussed in a later section, in relation to pupils' engagement with reading and writing.

| Table 5.7: Science skills used by the target children. Recorded in the structured observation schedule | | |
|---|---|---|
| Category description | Definition | No. of 2 minute periods in which recorded (Max. for any category = 81) |
| Observing | | |
| Making observations | The target pupil is observing what happens during an event | 36 |
| Predicting | | |
| Hypothesising/ Predicting | Suggesting an explanation for an event, pattern or finding | 15 |
| Investigating and experimenting | | |
| Planning independently | A child writing/ using equipment independently and purposefully in deciding what to do for planning | 4 |
| Using other materials/ equipment purposefully | Actively using materials or equipment other than for measuring | 27 |
| Collecting/clearing equipment | Pupil is collecting or putting away equipment | 11 |
| Estimating and measuring | | |
| Using measuring instruments inc. counting | Actively using a measuring device | 6 |
| Analysing | | |
| Interpretation | Drawing a conclusion or inference for which there is some evidence in the children's findings | 15 |

*Observing*

The data indicate that the scientific skill that was most often recorded for the target children was observing, noted in 36 instances out of a possible 81 observation periods. The field notes provide details on the types of observation in use (Table 5.8).

**Table 5.8: Examples of children making observations. Recorded in field notes**

| Strand | Topic | Class | Description of observation skill |
|---|---|---|---|
| Living things | Myself | 2nd | The children were asked to use mirrors to look at their own teeth and using their fingers and tongue they were asked to observe the differences between the different types of teeth |
| Energy and forces | Light | 6th | Observing what happens when a double-sided picture is flicked quickly |
| | Sound | 2nd /3rd | Children are encouraged to observe the vibrations of sound by:<br>Looking at paper balls rise and fall on the cling film covering a plastic cup, as they speak into a hole cut in the bottom of the plastic cup<br>Note the differences in sound vibrations when a ruler is placed on the edge of a desk and plucked<br>Feel the desk as their partner bangs the side-vibrations |
| | Magnets | 1st | Observe which objects found in the classroom were attracted to magnets |
| Materials | Properties of air | 2nd | Groups were asked to observe a scrunched up piece of tissue stuffed into the bottom of a glass jar as it was turned upside down and placed into a basin of water. On removing the jar from the basin the children were asked to observe what, if anything, happened to the tissue |

| | | | |
|---|---|---|---|
| | Fair testing | 6th | Make careful observations of what happens when unknown powders are mixed with different liquids. Children are encouraged to use different senses when making these observations |
| | Materials and change | 3rd-6th | Observing the effects of adding vinegar to baking soda |

The field notes indicated that in 13 out of the 15 observed lessons, the children were employing their observation skills. These data also revealed that the children were actively encouraged by their teachers to make observations about their activities. In four instances they were encouraged to use senses other than sight.

*Predicting*

In the observation schedule it was recorded that on 15 out of a possible 81 observation periods, the target children were noted to be making predictions. The field notes also indicated that children in 10 of the classes were asked to make a prediction about what would happen in the hands-on activity set for that class. Table 5.9 provides an overview of the data obtained from the field notes regarding how the children utilised their prediction skills.

The field notes illustrate that the children were asked to make individual predictions as well as discussing their predictions in groups. Some of the children's predictions were recorded and others were just collated orally. However the field notes did not appear to suggest that the children were basing their predictions on previous experiences, and therefore at times the children's predictions appeared to be more guesses than predictions, even for the older pupils. The similar nature of predictions made in classes of widely differing ages can be seen with particular reference to the lessons on magnets seen at both first and fourth class levels, and the lessons on materials and change seen at both first and sixth class levels (Table 5.9). In some cases however, the teachers did refer back to the children's predictions after they had conducted an activity or investigation.

| Table 5.9: Examples of children predicting. Recorded in field notes. | | | | |
|---|---|---|---|---|
| Strand | Topic | Class | Grouping | Description of predicting |
| Living things | Teeth | 2nd | Individual | Predict what they felt would happen to an egg when it is put into a basin of coke. |
| | Habitats and animals | S.I.<br>1st | Individual<br>Individual | Predict which animal lives in different habitats<br>Predict which animal lives in different habitats |
| Energy and forces | Sound | 2nd | Individual | Predict what will happen to the sound when a straw oboe is cut |
| | Magnets | 1st<br>4th | Individual & groups<br>Individual & groups | Predict which types of materials are attracted to magnets<br>Predict which types of materials are attracted to magnets |
| Materials | Properties of materials | 2nd | Individual | Predict what will happen to a piece of tissue at the bottom of a jar when placed upside down into a basin of water |
| | Properties of materials | 2nd | Individual | Predict what will happen to the level of the water in an upside down jar when a rubber tube is place under the lip of the jar and the teacher blows into the tube |
| | Materials and change | 1st<br>6th | Individual & Group<br>Individual & Group | Predict what will happen when an unknown powder is mixed with various liquids<br>Predict what will happen when an unknown powder is mixed with various liquids |
| | Materials and change | 3rd-6th | Pair | Predict what will happen when vinegar and baking powder are mixed |

*Estimating and measuring*

The data obtained from the observation schedules revealed only 6 instances out of a possible 81 observation periods of target children utilising the skill of measuring. The field notes indicated that in 3 of the 15 classes observed, children were engaged in measuring. Table 5.10 illustrates examples of the instances where the skill of measuring was employed.

**Table 5.10: Examples of children measuring. Recorded in field notes.**

| Strand | Topic | Class | Description of measuring |
|---|---|---|---|
| Energy and forces | Light | 6th | Measure the distance from the eye to the blind spot |
| | Forces | 4th | The hands-on work involved carefully measuring out and constructing the parachutes, ready for testing in a subsequent lesson. |
| Materials | Fair testing | 6th | The pupils were asked to measure out various powders and liquids to ensure a fair test |

In one lesson, exploring forces, pupils carefully measured out and constructed parachutes, ready for testing in a subsequent lesson. There was a lot of emphasis on fair testing in this class with the teacher reminding the children to measure fabric very carefully. Measuring was also a skill observed in two classes engaged in the Materials strand of the curriculum. The data reveal that children in one class were encouraged to measure carefully during their fair-test exploration of dissolving materials. Here the pupils carefully measured out the same amount of liquid per sample. Sample powders were also carefully measured before adding to the respective solvents. The data would appear to indicate therefore, that the children were measuring for the purpose of conducting a fair test investigation. However, the data appeared to indicate that in all cases, it was the teachers rather than the children themselves who were making

decisions regarding what or how to measure. The measuring activities also did not involve any where measured outcomes might enable children to look for subsequent patterns in their results.

*Analysing*

The observation schedule indicated that on 15 out of a possible 81 observation periods, target children were utilising the analytical skill of interpreting (Table 5.7). The field notes also recorded instances where the children utilised their analytical skills (sorting and classifying, recognising patterns and interpreting). Table 5.11 illustrates some examples of these. It is worth noting the similarities in the field notes' descriptions of some of the analytical skills seen in different classes. In particular, the skills of analysis of fourth class pupils investigating magnets were virtually identical to those seen in a first class lesson on magnets, which raises a concern about the degree of challenge in the use of analytical skills being afforded to the older pupils through this particular activity. The hands-on lessons observed generally promoted qualitative approaches to data gathering, and in consequence, analytical skills relating to data sorting and pattern recognition were not seen.

*Questioning*

The data revealed that children were not being provided with opportunities to develop their questioning skills. Only three instances of children questioning (raising their own questions) were recorded in the combined observational schedules, and two of these instances were recorded in the same class.

| Table 5.11: Examples of children utilising analytical skills. Recorded in field notes. | | | | |
|---|---|---|---|---|
| Strand | Topic | Class | Analysis used | Description of analysing skill |
| Living things | Habitats/ animals | S.I. | Sorting and Classifying | Sorting and classifying animals according their habitat. |
| | Habitats/ animals | 1st | Sorting and Classifying | Sorting and classifying animals according their habitat. |
| Energy and forces | Magnets | 1st | Sorting and Classifying | Sorting materials that are attracted to magnets. |
| | Magnets | 4th | Sorting and Classifying | Sorting materials that are attracted to magnets. |
| Energy and forces | Magnets | 1st | Recognising patterns | Recognising poles of magnets |
| | | 4th | Recognising patterns | Recognising poles of magnets |
| Energy and forces | Sound | 2nd/3rd | Interpreting | When a sound is made it causes vibrations |
| | Magnets | 4th | Interpreting | Following free exploration, interpreting which materials are attracted to magnets |
| Materials | Properties of materials | 2nd | Interpreting | Air takes up space and can put pressure on materials |

## Reading and writing in science class

The observation schedules and field notes indicate that children frequently appear to be engaged in reading and writing activities during science lessons (Tables 5.12 and 5.13).

*Reading*

The field notes show that in 13 out of the 15 observed classes, pupils were involved in reading. The data obtained from the field notes indicate that material the children were given to read included combinations of posters (4 classes), concept maps (1 class), instructions and information sheets about activities (4 classes), and other types of worksheets. Children were also asked to read material written on the board, while children in two classes utilised the interactive whiteboard when reading. The posters used contained background information on the topics, prompt questions to help clarify the investigative process and instructions on the task to hand. Target children were noted to be reading in 11 out of a total of 81 possible instances.

| Table 5.12: Children's reading materials. Recorded in field notes. | |
|---|---|
| Text | Number of classes (Max. for any category=15) |
| Worksheet | 10 |
| Teaching aids | 6 |
| Blackboard/interactive whiteboard etc. | 10 |

*Writing*

The observation schedule showed that the target children were writing in science class, using writing as a means of recording on 3 out of a possible 81 observation periods and writing by copying from a book, worksheet or the board during 23 out of a possible 81 observation periods.

The field notes indicated that fourteen of the fifteen classes observed were engaged in writing, or pictorial recording, at some stage during the observed science lessons. Table 5.13 provides an overview of kind of recording activities and the number of classes that were engaged in each type over the course of the observed lessons.

| Table 5.13: Examples of children's modes of recording. Taken from field notes. | |
|---|---|
| Category | Number of classes (Max. for any category=15) |
| Copies | 3 |
| Worksheet | 10 |
| Recording | 9 |
| Drawing | 2 |
| No writing | 1 |

### Use of ICT

There were two recorded instances of ICT use in the observation schedules. The field notes revealed that only two of the fifteen classes utilised ICT during the observed science classes. Both of these classes were in the same school and utilised interactive whiteboards as part of the observed science lessons. The field notes indicated that the children in both of these classes appeared to be comfortable with the technology used. Both of these teachers used the interactive white boards to help the children acquire new reading words, provide them with information about the content of the lessons and provide the children with instructions regarding the hands-on activities.

## 5.1.3 Summary of findings from the case study classroom observations

In summary, the data obtained from the observation schedules and field notes suggest that:

- Materials and Energy and forces were the two strands with the greatest representation in the lessons observed. Lessons from Living things (animals and human life only) were not as common. No class involving content from the Environmental awareness and care strand was viewed;

- Teacher-directed learning appeared to form a significant element of the observed science classes. The data revealed numerous instances of teachers directing the science classes through talking and showing pupils what to do, with a strong emphasis on teachers listening to their pupils. Recapping on previous work, introducing topics, posing questions, providing information on the topic and eliciting information from the children were examples of teacher talk that were recorded. Teachers also made requests for accounts of progress and were involved in collating their pupils' ideas;

- Of the 15 case study classes, 12 were observed engaging in hands-on science activities. These hands-on lessons included 11 which were largely teacher-directed and 1 that involved a child-led investigation. No design and make hands-on activities were observed. In one class pupils were engaged in watching their teacher demonstrating activities. The two remaining classes of pupils did not engage in hands-on science or watch a teacher demonstration;

- The children were provided with opportunities to develop some of their scientific skills. This was particularly the case for observing and investigating and experimenting (using equipment purposefully) and to a lesser extent for predicting and analysing. However, the data indicate that the children were provided with fewer opportunities to employ the skills of estimating and measuring and questioning (pupils raising their own questions). In addition, the skills which pupils were observed to be utilising in different classes did not always differ appreciably in complexity between younger and older pupils. This raises questions about the challenges being afforded to older pupils in their skill development;

- Reading and writing were typical features of science and were seen in 13 and 14 out of the 15 observed science lessons respectively. Reading material included teaching aids and posters, teacher designed worksheets and also information on the interactive whiteboard. Typical writing activities included recording results and completing worksheets that recapped on the science lesson;

- There were only two examples of ICT use recorded during science class. These classes were in the same school and the interactive whiteboard was utilised in both classes in the observed science lesson.

The data from the group interviews and pupils' questionnaires provide further information about the experiences of the case study pupils in primary science, and their attitudes towards it. These will be discussed in the following section.

## 5.2 Group Interviews and Pupil Questionnaires

Group interviews were conducted with a total of 45 children from 11 of the 15 classes observed. Pupils from first to sixth class were interviewed. These group interviews were conducted after the observed science lessons. The interviews aimed at exploring the children's experiences and perceptions of science in school in more depth. Pupils from third to sixth classes only in the case study were also asked to complete the pupil questionnaire (Appendix A). Out of a maximum possible of 171 case study pupils in these classes, 119 pupils (70%) completed and returned the questionnaires.

The data obtained from these group interviews and questionnaires are presented and discussed in relation to the following broad aims:

- Which scientific subject content areas are children experiencing at school?
- How are children learning science at school, and what are their attitudes towards learning science in these ways?

### 5.2.1 Subject content areas

In the interviews the children were asked about the kinds of things they learned in science class. Table 5.14 illustrates the strand units and topics the children mentioned and discussed.

| Table 5.14: Children's responses regarding the scientific subject matter of lessons. | | | |
|---|---|---|---|
| Strand | Strand unit / Topic | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Living things | Human body | 8 | We learned about how much (air) our lungs hold (2nd)<br>Well… if there's a lot of light in the room, your pupil will go smaller... because it's trying to keep out as much light as it can to stop our eyes from getting damaged. And it dilates when there's only a little bit of light in the room… because it's trying to get as much light in as it can (6th)<br>We learned a tiny bit on the eye, about how when it goes into your eye, your vision is upside down (6th)<br>We were learning about teeth, the kinds of teeth we have (2nd)<br>We did our senses...our touch… our smell...our sights… (1st) |
| | Plants | 2 | We planted bulbs (3rd)<br>We did trees taking in oxygen (3rd)<br>We plant it was like a daffodil, except it's smaller and a point bit had to go at the top because that's where it breaks open (3rd)<br>When we were planting bulbs, we had to get this wooden thing with a kind of, it's not really spiky just like a brown stick… and we had to move all, get all the muck all out of the way (3rd) |
| | Observing mini-beasts | 7 | We did minibeasts… we shook the tree… and it went upside down and we saw what came out (5th) |
| Strand | Strand unit / Topic | No. of interview groups addressing category (N=11) | Examples of children's comments |

| | | | |
|---|---|---|---|
| Energy and forces | Light | 2 | We made these cards with pictures on either side. But when we spinned them, the pictures joined together... when your eye sees something, they take, your brain hold it for one-tenth of a second… precipitation [persistence] of vision (6th) |
| | Sound | 1 | We learned about how sound travels and we did a few experiments to prove it (2nd/ 3rd) |
| | Heat | 0 | |
| | Magnetism | 8 | Play with magnets (4th)<br>My favourite bit was when we got to see what things will attract and what things wouldn't (4th) |
| | Electricity | 3 | We did a bulb experiment where you could light bulb (6th)<br>We saw how electricity and magnets are linked… we made an electromagnet (6th) |
| | Forces (floating and sinking) | 3 | Play with water ( 4th) |
| | Forces (other) | 1 | All the air was pulling the water back down again to make sure that it didn't come up (2nd) |
| Strand | Strand unit / Topic | No. of interview groups addressing category (N=11) | Examples of children's comments |

| Table 5.14 continued: Children's responses regarding the scientific subject matter of lessons. | | | |
|---|---|---|---|
| Materials | Properties of materials | 3 | Had to see if it was a gas or a liquid (3rd)<br>We did about air... when we put the jar upside down (2nd) |
| | Materials and change | 6 | We learned that if you mix a powder and a solid that it could either explode or just change colour (6th)<br>Putting in uh, bread soda, baking soda and then mixing it with water (4th)<br>Well this was probably on the first day we did science. We got these biscuits and we had icing. They had two colours, two um, primary colours. And we mixed them together to see what they would make. And we mostly mixed red and blue (2nd) |
| Environmental awareness and care | Recycling | 3 | We did compost (3rd)<br>We do recycling in school… we reuse, and re-choose (1st)<br>I'm on the green team (1st) |
| | Litter | 2 | We did about the environment and how you care about the world around you and not to drop litter (1st) |

## Living things

Within the Living things strand, children appear to have had more experiences of lessons relating to animal and human life than plant life. Many of the children discussed instances where they collected and observed mini-beasts or when they talked about different animals and their habitats (Table 5.14). These were generally regarded in a positive light.

## Energy and forces

On the other hand however, there were fewer recollections of instances where the children had encountered science lessons relating to strand units within the Energy and forces strand. Whilst the group interviews revealed that many of the case study classes had met the topic of magnetism (8), the number of references and recollections relating to the other strand units was comparatively low. None of the children made references to lessons linked to the strand unit heat (Table 5.14). It is important to note that the children's recollections regarding the topics they had experienced within the Energy and forces strand were again extremely positive (Table 5.14).

## Materials

Children from a number of the group interviews recalled aspects of both strand units within the Materials strand that they had met at school (Table 5.14). The children's recollections of their experiences with materials were extremely positive.

## Environmental awareness and care

The comparatively low number of case study interview groups who recalled having lessons relating to the Environmental awareness and care strand of the curriculum could suggest that this strand is not being addressed to the same extent as the other strands. Only three interview groups discussed activities linked to the environment in school, with two of these discussing "litter" and one discussing the fact that the school had a green flag (Table 5.14).

It is important to note however that the data gathered from the children's interviews is based on what the children remembered doing during science lessons in school. There may be some areas that their teachers may have taught, that the children were for whatever reason unable to recall. In addition to this, it may be the case that their teachers were teaching other aspects from the science curriculum, aspects that the children may not have realised were science. The data is very encouraging in terms of the various science lessons the children recalled taking part in and on many occasions enjoying. However the question regarding the extent of learning that has taken place amongst these children does arise. It should be noted at this point that the assessment of primary pupils' scientific knowledge was not in the remit of this study and so pupils' understanding of scientific concepts was not explored during the interviews. Pupils' recollections of, and attitudes towards different ways of learning science at school are considered next.

### 5.2.2 How the children have learned science and their attitudes towards learning science in these ways

During the interviews the children were asked about the kind of things they did in science class. They were also asked about aspects of school science that they liked and disliked and which aspects they would like to do more often. The children's responses to these questions will be considered in turn under the following seven headings:

- Teacher-directed learning;
- Children conducting hands-on activities;
- Utilising science skills;
- Collaborative learning;
- Reading and writing in science class;
- ICT; and
- Science outside the classroom.

## Teacher-directed learning

***Listening to the teacher***

Listening to the teacher talking about science and explaining scientific facts was something five of the case study interview groups reported doing in science class (Table 5.15).

**Table 5.15: How I learn science at school: Children's responses relating to teacher-directed learning.**

| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
|---|---|---|
| Listening to the teacher | 5 | You have to listen a lot, so like you understand so you have to like, pay full attention and write things down (4th)<br>You just have to listen and you don't have to do loads of work (3rd)<br>Listening to teacher (4th) |
| Watching the teacher do science demonstrations | 6 | Normally teacher does them up the top of the classroom (6th)<br>We just saw the students [student teachers] doing it… they erupted volcano… they made it with clay and then they painted it and they put something into it … vinegar and a powder … I think it was baking soda.. (3rd) |

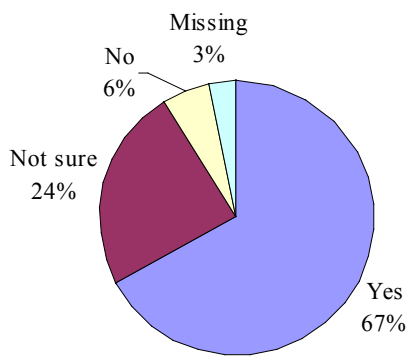
Many of the comments regarding listening to the teacher were rather negatively expressed (Table 5.15). In the group interviews, four of the case study groups expressed a dislike of listening to their teachers during science class (Table 5.16). Pupils in four of the group interviews also suggested that this was an aspect of school science that could be reduced (Table 5.17).

Figure 5.1: The teacher explains about butterflies. (Boy, 4th class)

| Table 5.16: Things I dislike about science class: Children's responses relating to teacher-directed learning. | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Listening to the teacher | 4 | If she stopped like going on and on… just sort of um, I don't know why she was doing it [explaining things] but it was really annoying (3rd)<br>...teacher should like stop like stalling, like going over the things again. Like continue on with the thing, not just like saying it over and over again so we'll remember it (4th)<br>If she kind of just tells it to us, then you're kind of more inclined to take it in. Like today I feel like I've kind of contained a lot (because when you are doing science) it's fun. Like sometimes when it's boring you just sit there, and it just kind of goes in one ear and out the other… But I think the teacher is bored too. Because she's just then after a while, she just drones on and on… and we're not even listening any more.... And you get distracted ... (6th)<br>I didn't really like today, because the teacher just kept going on and on about the same stuff. … rah, rah, rah (3rd) |

| Table 5.17: Things which I would like to do less often in science class: Children's responses relating to teacher-directed learning. | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Listening to the teacher | 4 | We don't want to be sitting there being bored listening to a teacher going on about what science is. We just want to be doing it (4th)<br>I'd rather they did experiments with us rather than just talking (6th)<br>Less of teacher talking and explaining and more of you actually doing it (4th)<br>More experiments instead of teacher keep on talking (4th) |

**Figure 5.2: I enjoy science when my teacher explains things to the class** *(N=119)*



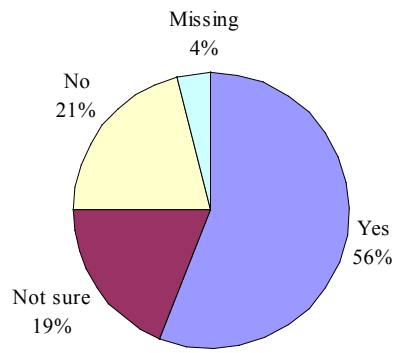

However, in the questionnaires 67% of the case study respondents indicated that they enjoyed science class when their teacher explained things to the class, although conversely, 30% indicated that they were either unsure about, or did not enjoy listening to their teacher (Figure 5.2).

*Watching teacher demonstrations*

Watching the teacher do experiments (teacher demonstrations) was something that pupils in five of the case study group interviews reported doing in science class. This was also an aspect of science that these children recalled in a positive manner.

In the questionnaires, 56% of the children indicated that they enjoyed watching their teachers do experiments. On the other hand, 40% of the children indicated that this was something they were unsure of or did not enjoy (Figure 5.3).

**Figure 5.3: I enjoy science when I watch my teacher doing an experiment** *(N=119)*




## Children conducting hands-on activities

Conducting hands-on activities was something that interviewees from 10 out of the 11 case study classes reported doing. All of the comments relating to participation in hands-on science were positive (Table 5. 18).

| Table 5.18: How I learn about science in school: Children's responses relating to hands-on science | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Hands-on science | 10 | Science is doing experiments and stuff and learning about the world and things that might happen. Stuff like that (6th)<br>You can do stuff that you normally wouldn't do like, play with magnets and water and things like that (4th)<br>Science is fun and you get to do loads of experiments and find out new things (4th) |

However, while a high number of pupils in the case study interview groups reported conducting hands-on activities in science class, it is important to note that the data did not appear to indicate that hands-on activities were conducted on a regular basis in science class: "Well we haven't done loads of science yet. But we probably will".

The interviews were conducted between mid-October to the end of November and some of the data appeared to suggest that the science lessons that had been observed just prior to the interviews were one of the first or second science classes that pupils had done that year, for example: "Well it was my first science class, well my first real one. I found it different to other ones that I've done…we had different equipment…"; and "… we don't do very much science."

Conducting hands-on experiments and handling equipment was an aspect of school science that pupils in 10 of the case study interviews reported enjoying (Table 5.19).

| Table 5.19: Things I like about science: Children's responses relating to hands-on science | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Doing experiments/ hands-on | 10 | Well my favourite bit was when we got to see what things will attract and what things wouldn't (4th)<br>When you are just sitting down reading the [science] book it is just like a normal work. But I like science because you got up and you did stuff that was fun, but you learned as well (6th)<br>Figuring out stuff, mixing like… connecting stuff... like circuits, like connecting magnets and things (6th)<br>I like messing around with the magnets (4th)<br>I love doing experiments and things (6th) |

In these responses, children recalled the science classes, in which they had personally engaged in hands-on activities, with great detail. It is also worth mentioning the enthusiastic nature of the children's responses, when recalling these instances (Table 5.19). Pupils in the vast majority of the case study interview groups (9) expressed a wish to do more hands-on activities in science class (Table 5.20).

| Table 5.20: Things I would like to do more often in science class: Hands-on science. | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Experiments/ hands-on | 9 | We could probably have more fun doing it if we actually got to do it ourselves, rather than just reading from books and stuff (6th)<br>I'd rather they do experiments with us instead of talking to us … because I like doing stuff more than listening to stuff (6th)<br>I'd like to do more experiments (6th) |

## Utilising science skills

With regard to the application of scientific skills, pupils in the majority of the case study interview groups reported conducting observations (10) and testing things (7) (Table 5.21). There were also references made in relation to applying the skills of measuring (5) and predicting (3) during science class (Table 5.21). Discussion was something seven of the case study interview groups reported doing in science class. Positive comments regarding making observations were given by children from three of the case study interview groups and pupils in five of the case study interviews specifically mentioned 'mixing things' as an aspect of science class they had done, and liked (Tables 5.21 and 5.22).

| Table 5.21: How I learn about science in school: Children's responses relating to scientific skills | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Making Observations | 10 | We all had to close our eyes and had to try and listen to the sounds… (1st)<br>You get to see it growing … and see how it lives (4th)<br>We put a coin in Coke…. Left it there for a couple of weeks. And then X's tooth fell out and we put I into the Coke.. and it got all black an like some were dissolved and it got smaller and smaller (4th) |
| Predicting | 3 | And like if it was going to bubble, or if it was going to go like a volcano or something, like that you'd think about that first (6th)<br>We had to try and guess what colour they would turn out (2nd)<br>It's just weird… it's like you're betting on a horse. I think this horse is going to win. I think this apple will float (3rd)<br>At the time I didn't think it would float because it's sort of heavy…but I think it ended up floating. (3rd)<br>You have to feel stuff and guess if it's a gas or if it's concrete (3rd)<br>The science that we're doing now is just about, it's not like hard science. It's only you don't have to answer any questions, you just guess and then we learn them after … at the end of the class we then we find out after, because she (teacher) opens all the things that we were meant to guess (feely bags) (3rd) |

| Table 5.21 continued: How I learn about science in school: Children's responses relating to scientific skills | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Experimenting and investigating (testing things) | 7 | When you put it [magnet] on one side, they connect well but the other side they wouldn't… it is reaction, repelling… and they could attract (6th)<br>I remember last year we tested things, like if they float or not (4th)<br>We made a clown. An experiment that we did on the human body… Then we put a piece of clay on the hands. And we did the experiment again and it didn't fall off (2nd) |
| Experimenting and investigating (mixing things) | 5 | I like that you can mix colours (2nd)<br>The way you make things like that explode… I like the chemicals (2nd)<br>[Science] is changing, changing different things. It's like mixing chemicals to get um a different kind of chemical to explosions, light effects (2nd)<br>Mixing stuff… like vinegar and baking soda (3rd)<br>We poured a little bit of that mixture into a camera film canister… and ran away and it shot up (6th) |
| Measuring | 5 | You can measure things (4th)<br>We sucked the bugs up and got little containers and then we counted how many bugs we got and how many of each. (6th) |

| Table 5.22: Things I like about science: Children's responses relating to scientific skills | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Observing | 3 | It's really fun [science] because you have to think what is gas and you have to feel all the stuff like (3rd) |
| Investigating and experimenting (mixing things) | 5 | I like that you can mix colours (2nd) The way you make things like that explode… I like the chemicals (2nd) |

Interestingly, pupils in three of the case study interview groups explicitly expressed a desire to be afforded more opportunities to 'figure things out for themselves' (Table 5.23). The provision of more opportunities to engage in design and make activities was also suggested (Table 5.23).

| Table 5.23: Things I would like to do more often in science class: Utilising science skills | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Figuring things out for ourselves | 3 | Figuring stuff out (3rd) Seeing what they do and playing with them and that (4th) |
| Design and make | 3 | I'd like to do more inventions… Once I went to this camp. It was sort of like a games science camp. I like inventing something. Like I invented a guitar and that was very good (2nd) |

The group interview data suggest that the skills that were most commonly used in science class were observing and investigating and experimenting (Figure 5.4). Measuring was something that the

children in five of the group interviews discussed while pupils in three of the group interviews reported being provided with opportunities to make predictions. Aspects of the skill of recording and communicating, pertaining to reading and writing, will be considered elsewhere in this section. The skills of questioning (pupils raising questions) and analysing were not mentioned by children in the group interviews.

**Figure 5.4: Children investigating magnets (Girl, 6th class)**

## Collaborative Learning

The interview data also indicate that working in groups and/or pairs was a way of working in science class that pupils in all of the case study interview groups had experienced (Table 5.24).

| Table 5.24: How I learn science in school: Collaborative learning | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Working in pairs | 7 | I suppose in some strands of science it's better to do things, with someone else. Like if there's, if it involves holding loads of wires to batteries or something… but some things I suppose you could do on your own. But I don't really think it matters that much (6th)<br>I like working [in pairs] you could just show them how to do it (6th)<br>You can give them a helping hand (6th) |
| Working in groups | 6 | We worked in groups then as well, so yeah, usually we do work in groups. And it's very fun working in groups, because we can all help each other if we're stuck. (2nd/ 3rd)<br>I like working in groups but I like working on my own as well, so I like them the same (6th)<br>It is quicker and like everyone will get a chance and you get to work together (6th) |

Working in groups was an aspect of science class which pupils in nine of the case study interview groups recalled in a positive manner (Table 5.25). Positive aspects of working in groups included listening to each other, sharing ideas and helping one another handle and manipulate equipment.

| Table 5.25: Things I like about science in school: Collaborative learning | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Working in groups | 9 | It's good because you get to hear what other people say, like what they thought about it (4th)<br>It's good working in groups because you can work with your friends… and it's much easier as well (4th)<br>It's a lot funner because you get to kind of learn more, because you hear other people's opinions (4th)<br>[Working on your own] takes a bit longer, because you have to figure more stuff out. And like if you're working in groups, some person could figure something out, And then the rest figure stuff out, instead of working it all out on your own (6th) |

On the other hand, pupils in five of the case study interviews offered reasons indicating why they disliked working in groups in science class (Table 5.26). Some of the negative experiences of working in groups that the children recalled during the interviews included references to incidents where there were arguments regarding organisation of tasks and the distribution of materials. Pupils in two of the interviews also provided reasons for preferring to work alone during science class (Table 5.26).

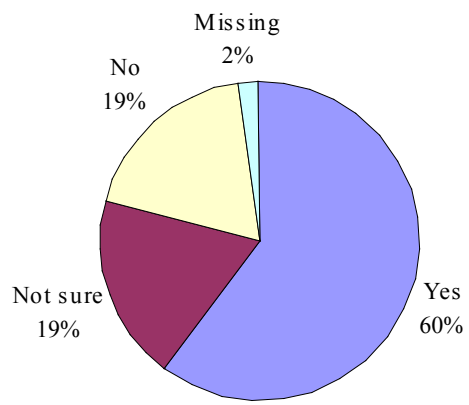
| Table 5.26: Things I dislike about science in school: Collaborative learning | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Working in groups | 5 | ...say if your friend does something wrong, it'd probably end up in a big fight or something like that (4th)<br>I used to have a person, and he hardly ever talked. He only talked, like when, he doesn't like talking (2nd) |
| I like working on my own | 2 | I like working on my own, because it's like what D said, you're not fighting over what… who's going to hold the battery, and who's going to make sure the wire is tight enough and everything (6th)<br>Well I liked working on my own with the magnets. Because when you're working in partners, everyone keeps taking everything (6th)<br>If other people I was in the group with were messing, or they weren't following instructions, I'd prefer to work on my own… (2nd) |

When asked what they would like to do more often or less often in school science, pupils in two of the case study interviews explicitly said that they would like to do more group work in science class (Table 5.27).

| Table 5.27: Things I would like to do more often in science class: Collaborative learning | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Example of children's comments |
| Group work | 2 | I think more working in groups because it would be better because you'd be able to hear more people's opinions. And you'd have more help if you're stuck (4th) |

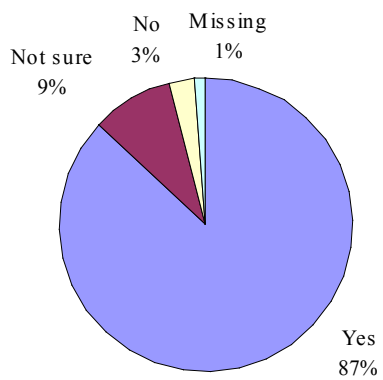
In the case study questionnaires, 60% of the respondents indicated that doing experiments on their own was something they liked, while 38% of the children in the case study group interviews indicated that doing experiments on their own was something they were either unsure of or did not enjoy doing (Figure 5.5).

**Figure 5.5: I enjoy science when I do an experiment by myself** *(N=119)*



In contrast, doing experiments with their friends was something that 87% of the case study respondents indicated that they liked, while only 12% indicated this was something they either did not enjoy or were unsure whether they enjoyed it (Figure 5.6).

**Figure 5.6: I enjoy science when I do an experiment with my friends** *(N=119)*




One could also draw the conclusion from Figures 5.5 and 5.6 that a majority of children in the case study classes indicated that they enjoy doing experiments, whether they are conducting them on their own or with their friends. However a higher percentage of children indicated that they liked doing experiments with their friends than on their own.

In the case study questionnaires, the children were also asked to draw pictures of themselves working in science class. Their drawings depicted children working on their own, in pairs, in groups and in whole class situations. Figure 5.7 summarises the number of children who drew pictures in each of the categories mentioned above. Examples of pupils' drawings of collaborative work are shown in Figures 5.8 and 5.9.

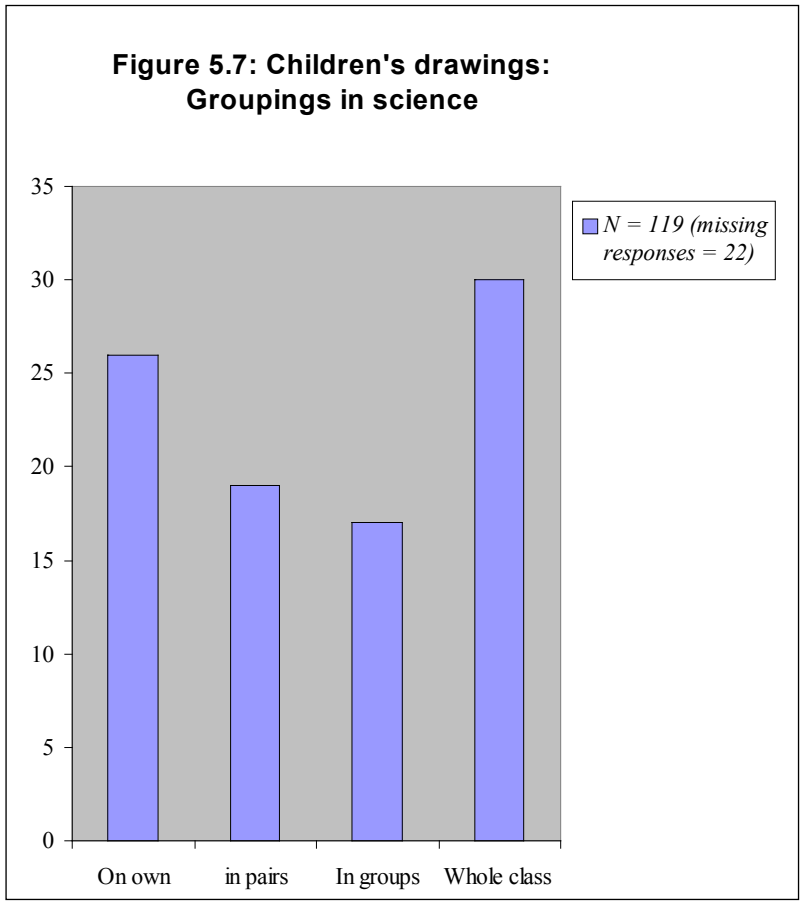



Figure 5.8: Children working together (Boy, 6th class)

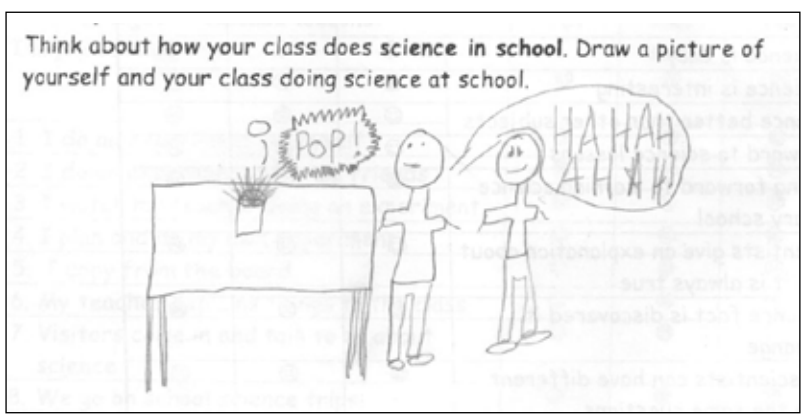


Figure 5.9: Children sharing equipment, collaborative work (Girl, 6th class)


The children's drawings of themselves working in science class appear to corroborate how they described learning in science class in their interviews.

## Reading and writing in science class

***Reading***

Reading about science in school was something that pupils in eight of the case study interviews recalled doing in science class (Table 5.28). In general, many of the children's comments regarding reading in science class were negative. In the interviews, reading about science was something pupils in two of the case study interviews said they disliked, indicating their preference for conducting an activity instead (Table 5.29).

| Table 5.28: Things I do in science class: Children's responses relating to reading and writing. | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Reading about science from textbook | 8 | Writing a bit, listening. You might read and sometimes you'd do the experiment. But most of the time you'd listen to the teacher, and you'd be reading from book (4th)<br>Listening and reading from books (4th)<br>Science is easy enough once you read through it and you know how to do it (6th) |
| Writing about science | 11 | Science is when you you're writing it down in your copy, you can draw a picture (3rd)<br>We had to write, I got fish… so you had to draw a picture of a fish up the top and fish in Irish is iasc and you then write stuff about fishes (2nd)<br>If we were writing in science, it would be to remember things like (4th )<br>You have to write the words of the food and that they eat (1st)<br>Writing what the teacher says (4th)<br>You don't have to do loads of writing... (3rd)<br>Well we don't write in the book… We write in our copies and we basically copy it out of the book, which I think is kind of pointless… if she [teacher] kind of just tells it to us then, you're kind of more inclined to take it in … (6th) |

| Table 5.29: Things I dislike in science class: Reading and writing. | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Reading | 2 | I don't think it's [science book] is good. I prefer just… as opposed to just reading something over and over and over again until it's drilled into your head, but you don't really know what it means (6th)<br>The only part I don't like about it [science] was we had to read about it. It's boring (6th)<br>...Except for the reading parts as well, because I don't be able to wait any longer to do the experiments. I like to do, say we're working with magnets or liquids and powders, and the teacher reads it out, I do be all fidgety because like, I want to do the experiments (6th)<br>Normally it would be out of the book first and then we do the experiments… we take ages at the book… it takes about half an hour to get through about this much writing (6th)<br>We do need to do some reading to you know, wise up on the facts about whatever topic you're covering. But you know … it's just going over it again and again… if [the teacher] would let us read it ourselves (6th) |
| Writing | 4 | Science book is boring. I noticed last year when we were doing our summer tests, and we had science and history and everything. But mostly in science, is what I realised that, you're reading the book, but it doesn't actually give you very much information… is that mostly it's just like you could try this. OR to do this colour in a picture of a leaf and show your teacher (6th)<br>I don't really like writing in science I just want to get on with it (4th)<br>Not really [like writing in science] … I just want to get on with it….<br>Well we don't write in the book. We write in our copies. And we basically copy it out of the book, which I think is kind of pointless. (5th)<br>Write down things that the teacher said (4th)<br>She asks one person, and then everybody has to write it the same (3rd)<br>I don't like writing [in science workbook] because you always have to write in the small letters (1st) |

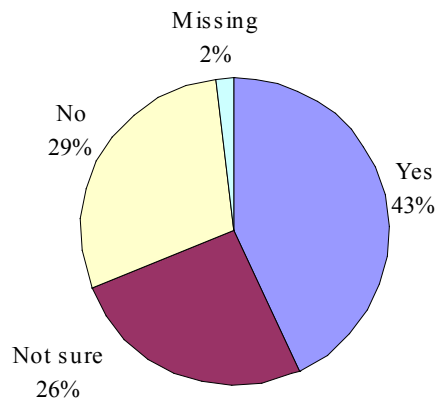
This was also an aspect of science which pupils in two of the case study interviews maintained they wanted to do less often (Table 5.30).

**Table 5.30: Things I would like to do less often in science class: Reading and writing.**

| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
|---|---|---|
| Reading | 2 | Less studying stuff [in the book] (4th) |
| Writing | 3 | More experiments and less writing (3rd)<br>Less writing (4th) |

The children's questionnaire responses regarding reading also revealed similar findings. In response to the statement "I enjoy science when I read my science school book", 42% of the children in the case study classes indicated that they agreed with this statement. However, 55% of the students indicated that they were unsure of or disliked reading their science books (Figure 5.10).

**Figure 5.10: I enjoy science when I read my science schoolbook (N=119)**



*Writing*

In the group interviews, pupils in all of the 11 case study interviews talked about writing in science class (Table 5.28). Writing in workbooks, on worksheets, from the blackboard and in their copies were examples of the science writing the children typically reported (Table 5.28). Children in six of the groups also talked about drawing pictures in science class. The children had positive and negative views of their experiences of writing in science class (Tables 5.29, 5.30 and 5.31).

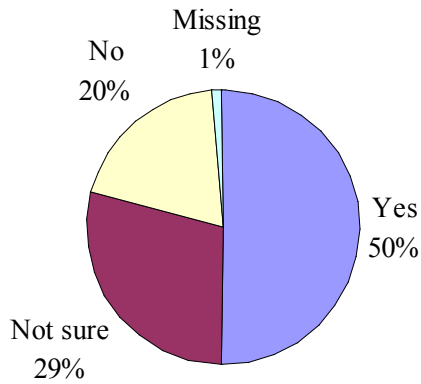
**Table 5.31: Things I like in science class: Writing**

| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
|---|---|---|
| Writing | 6 | I like writing in science (2nd)<br>I think it's worthwhile (4th)<br>I think [writing in science is good] because when you write it down you remember it (4th)<br>Science is when you're writing it down in your copy … you can draw a picture (3rd) |

Pupils in just over half of the case study interview groups reported liking writing in science class (Table 5.31). However, it is worth noting that positive comments regarding writing in science often referred to the *brevity* of many scientific writing tasks in comparison with other subjects. Pupils also commented on the extent to which writing about science helped them to remember what they had learned (Table 5.31).

In contrast, pupils in four of the interview groups reported writing as an aspect of science they disliked (Table 5.29). Negative aspects regarding writing in science that were reflected on, generally referred to the children's preferences for conducting experiments and activities as opposed to writing about them. Writing in science class was an aspect of science which pupils in three of the case study interviews maintained they would like to do less often (Table 5.30).

**Figure 5.11: I enjoy science when I copy from the board** *(N=119)*




The findings from the case study pupils' questionnaires revealed similar results. Figures 5.11, 5.12 and 5.13 illustrate the children's responses to the three questionnaire items that related to pupils' attitudes to writing in science class.

**Figure 5.12: I enjoy science when I fill in my workbook/ worksheet** *(N=119)*

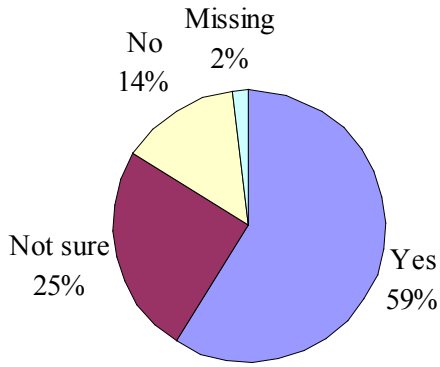
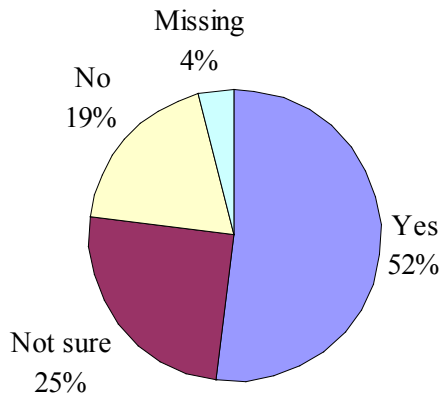


**Figure 5.13: I enjoy science when I write about something I have done in science class** *(N=119)*




The data from the case study questionnaires revealed that, when responding to the three items that related to writing in science class, just over half of the children in these case study classes indicated that writing in science class was something they enjoyed. Whilst this sounds positive, it should be borne in mind that the same data indicate that just under half of the case study questionnaire respondents were unsure of, or felt negative about aspects of writing in science class.

## ICT

In the questionnaires only one child out of the 119 case study children responding to the questionnaire drew a picture of a child on a computer (Figure 5.14).

Figure 5.14: ICT in science (Boy, 4th class)


When asked in interview about the use of ICT during science class, none of the case study pupils reported using ICT as part of their science classes. In the interviews, pupils in five of the groups reported using science software in computer class (Table 5.32).

Table 5.32: Using ICT for science: Responses from group interviews

| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
|---|---|---|
| Use ICT for science outside of science class | 5 | We have computers every Friday and sometimes we add a bit of science to that. We're doing a project in science (6th)<br>… sometimes the other classes are using it [computer room] but whenever the teacher thinks we are behaving and we actually have an opportunity we do (2nd)<br>… We google earth… but we've only been on the computer once in second class (2nd)<br>We had Sammy Eolaíochta computer programme but we used to do that last year. There is something called Encarta but we don't have it here. There's lots of science stuff (2nd) |

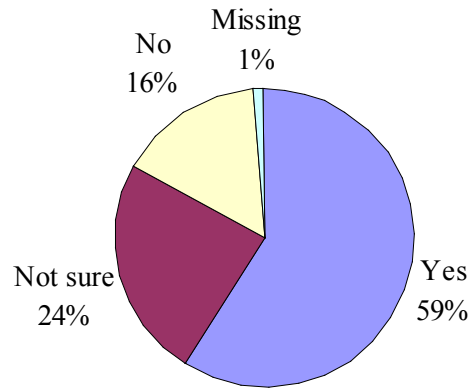
None of the case study interview groups expressed a like or dislike for using ICT in science class, which perhaps is not surprising as none of them recalled instances where they had utilised ICT as part of their science classes. However, pupils in four of the interview groups mentioned that they would like to be given more opportunities to utilise ICT during science class (Table 5.33).

**Table 5.33: Things I would like to do more often in science class: Utilising ICT**

| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
|---|---|---|
| ICT | 4 | We don't get to use the computer [in our classroom]… would like to do more science computer (2nd)<br>We went onto this website and it had loads of ideas, and that was way better than the science book (6th). |

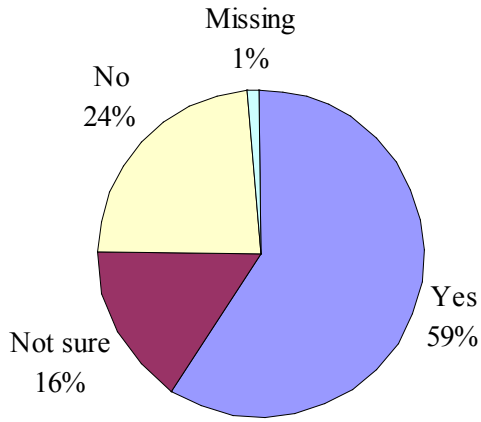
Despite the group interview pupils' responses, which did not report using the computer during science class, 59% of the children responding to the questionnaires indicated that they enjoyed science when using computer as part of science class (Figure 5.15).

**Figure 5.15: I enjoy science when I use computer programmes in science class** *(N=119)*




In a similar manner 59% of the children responding to the questionnaires indicated that they enjoyed science when using the internet at school to find out about science (Figure 5.16).

**Figure 5.16: I enjoy science when I use the internet at school to find out about science** *(N=119)*




Figures 5.15 and 5.16 indicate that using ICT during science class and to learn about science is something that 59% of the case study questionnaire respondents claim to enjoy. These data conflict

somewhat with the infrequency of reported use of ICT in the group interviews. It seems that perhaps pupils like the *idea* of using ICT in science, even if they are not being afforded opportunities to do so.

## Science outside the classroom

Occasions where the children had gone on science field trips or had learned about science outside the classroom, were recalled by pupils in six of the case study interview groups (Table 5.34).

| Table 5.34: How I learn about science in school: Doing science outside the classroom | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Science outside the classroom | 6 | We go down to the beach and we'd learn about stuff like how the earth was made of an explosion into water and stuff… and we found sea snails and a few cockles (2nd/ 3rd)<br>Everybody got to plant one bulb outside in the courtyard with E… we picked about four head gardeners. And then they had to do loads of … they had to help E. And then the others can go around the courtyard and then everybody had to line up and plant their bulb. (3rd)<br>We went to the beach and we went in the playground outside (2nd)<br>One time we went out in a castle where there was a park… and we went to Dublin and we entered a museum (1st)<br>We went bird watching to Bull Island… and we saw loads of birds (6th)<br>We went outside and picked potatoes (6th)<br>We had jars that had a magnifying glass on the top and air holes so that the insects could breathe (6th) |

Learning about science outside the classroom was something about which pupils in four of the interview groups expressed an enjoyment (Table 5.35).

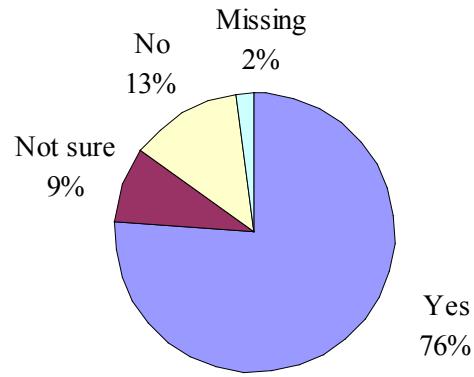
| Table 5.35: Things I like about science in school: Science outside the classroom. | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Science outside the classroom | 4 | We went outside and we were guessing how long it would take for our bulb to grow (3rd)<br>I think one of the funnest things is going out to the yard and exploding things (6th) |

Pupils in five of the group interviews mentioned that doing science outside the classroom was something they would like to do more in future (Table 5.36).

| Table 5.36: Things I would like to do more often in science class: Science outside the classroom | | |
|---|---|---|
| Category | No. of interview groups addressing category (N=11) | Examples of children's comments |
| Science outside the classroom | 5 | I'd like to do more of going outside to learn science (3rd)<br>Yes I'd like to go on more trips (4th) |

The data from the case study questionnaires appear to corroborate the data obtained from the interviews, in that a very high percentage (>75%) of the children indicated that they enjoyed going on science trips (Figure 5.17) and doing science outside the classroom. In this latter category, 79% of pupils indicated a positive response. It appears that, when it was experienced, the case study pupils were very positively disposed to going outside the classroom to do science.

**Figure 5.17: I enjoy science when we go on school science trips** *(N=119)*




### 5.2.3 Summary of findings from the case study classes' interviews and questionnaires

The data obtained from the case study group interviews and questionnaires regarding the children's experiences of science in school indicate that:

- The strands that the children recalled experiencing most often were Living things (animals and human life) and Materials. The children did not discuss lessons from the strands Environmental awareness and care and Energy and forces to the same extent.

- The children have had very positive experiences of, and hold positive perceptions of science in school. Science is a subject that children in all the case study classes appear to find interesting and informative.

- The children enjoy watching their teachers conduct demonstrations but, more particularly, they enjoy being provided with opportunities to engage in hands-on activities. In all of the case study interviews, pupils indicated that they would like to do more hands-on activities in science class.

- Although some of the children expressed a like of reading and writing in science class, these were aspects of science for which some expressed a dislike. They were also aspects of science the children expressed a desire to do less often in school. Similar results were obtained regarding listening to their teacher during science class.

- The use of ICT during science class does not appear to be commonplace in

- the case study classes. However, this was an aspect of science in which the children expressed an interest and which they expressed a desire to experience more often.

- Learning about science outside the classroom does not appear as a frequent

- experience in the case study classes. However, the children indicated enthusiasm for this approach and a desire to learn about science in this context more often.

The significance of these findings as they relate to the data obtained from the classroom observations and field notes will now be considered.

## 5.3 Case Study Findings: Summary

### 5.3.1 Teacher-directed learning

The observation schedules indicated that there was evidence of teacher-directed learning in all 15 case study classes. All of the classes observed spent time listening to their teachers during science class. Typical instances of teacher talk included teachers recapping on previous work, introducing topics, posing questions, providing information on the topic and eliciting information from the children. The observation schedules also indicated that teachers showing pupils

how to use equipment was typical of teacher-directed approaches. Teacher demonstration, whilst not a common feature of teacher-directed learning, was observed.

The interview data corroborate the findings from the observations. They indicate that teacher-directed learning, where their teachers talked about content and explained what to do, were typical features of the children's recollections of science classes. In the case study questionnaires, although children indicated that they enjoyed listening to their teachers, other children indicated that they did not enjoy this or were unsure whether they enjoyed this aspect of science class. The interview data also indicate that some pupils do not enjoy listening to their teacher talking in science. Others indicated that this was something they would like to do less frequently in science class.

### 5.3.2 Hands-on science

In the interviews children in 10 of the case study classes referred to hands-on activities that they had done during science class. All of the children's recollections relating to hands-on activities were positive. Pupils in 9 out of the 11 interview groups who discussed hands-on activities expressed a desire to do more of these.

The observation schedules confirmed that hands-on science was a feature of science classes, as they revealed that in 12 of the 15 case study classes observed the children were engaged in hands-on science. However, it is important to note that there was only one instance recorded where the children led their own investigations. In the remaining 11 instances, the children were engaged in hands-on activities that were essentially directed by the teacher.

### 5.3.3 Scientific skills

Observation was the most common skill used in science class noted in the structured observation schedules and field notes. Children

were encouraged to observe carefully during hands-on science. The second most common skill recorded related to an aspect of investigating and experimenting, namely using equipment purposefully. The use of other scientific skills was not as prevalent. The observation schedule revealed that children were given opportunities to pose their own investigable questions in only 2 of the 15 case study classes.

The data obtained from the interviews corroborated these findings, in that the children made references to their experiences of making observations during hands-on activities. In five of the interviews, children discussed utilising their measuring skills, which was not as apparent in the observation schedules. On a more negative note however, the interview data provided no references to the skills of questioning or analysing, which tends to corroborate the limited nature of these findings obtained from the classroom observations.

### 5.3.4 Collaborative learning

The data from the observation schedules and field notes indicated that in 12 of the 15 classes children were working collaboratively in pairs and/or small groups. In these groups the children discussed ideas and conducted tasks together. The data from the group interviews corroborate these findings in that children in all of the interviews discussed their experiences of working collaboratively, in pairs and/or small groups. The children had mixed feelings about working in groups and working alone and discussed advantages and disadvantages of working in groups in depth.

### 5.3.5 Reading and writing

Observation schedules, field notes and interviews all indicated that reading and writing were aspects of science that featured regularly in science class amongst all of the case study classes. Reading was recorded in 12 of the observed classes and children in 14 of the

classes were observed writing. The observation schedules and field notes indicated that the main focus of reading in 10 of the classes was teacher-designed worksheets, and that nine classes involved pupils in writing in order to complete these worksheets. In contrast, the observation schedules indicated that only four classes made written records of their predictions, whilst six classes engaged in recording their results.

The data from the interviews indicate that reading and writing were aspects of science about which the children had mixed feelings. The data indicated that younger children appeared to hold more positive views regarding writing in science class. In the senior classes, positive attitudes related to the relatively *low quantity* of writing required in science compared to other subjects. Responses seen in the case study questionnaires confirmed an impression that pupils have mixed feelings towards reading and writing in science.

### 5.3.6 ICT

The observation schedules indicated that only 2 of the 15 classes that were observed, utilised ICT during their science class. In the interviews, pupils in some of the case study classes indicated that they utilised science programmes during computer class, however, none of the case study pupils that were interviewed reported utilising ICT as an integral part of their science class. Children expressed a desire to use more ICT in science class. The data from the case study questionnaires corroborate these findings in that a high percentage of the children indicated positive attitudes towards using ICT in science class but actual descriptions of ICT use were very rare.

### 5.3.7 Science outside the classroom

All of the science lessons observed were conducted inside the classroom. The data from the interviews and questionnaires indicate

that learning about science outside the classroom is an aspect of science the children enjoy and would like to do more of in school.

The data from the survey and the case study will be considered together in the next section, after which overall conclusions will be drawn about the work conducted.

# SECTION 6: CONCLUSIONS, RECOMMENDATIONS AND NEXT STEPS

This section presents overall conclusions that can be drawn about primary science when considering the data collected during the survey and case study of primary school pupils. Recommendations in relation to primary science are then discussed. The section concludes by highlighting the issues that are under consideration in Phase 2 of the current study.

## 6.1 Conclusions

The findings presented in Sections 4 and 5 provide valuable insights into some of the key issues surrounding pupils' experiences of science in primary school. These will now be considered together. Key findings will be discussed under the following headings, which relate to the questions posed at the start of the study:

- General attitudes to primary school science;
- Hands-on science;
- Collaborative work in science;
- ICT in science;
- Other teaching and learning approaches; and
- Scientific subject content.

### 6.1.1 General attitudes to primary school science

In general, pupils are extremely well-disposed towards science at primary school. Positive attitudes were expressed towards school science, both in the survey and by pupils during group interviews in the case study. Enthusiasm for science was evident in all classes that participated in the case study. Pupils enjoy many different aspects of their primary science experiences, which are discussed in more detail below. Many pupils also appear to gain a sense of satisfaction from

these experiences of school science, especially learning about or finding out about "new things".

One issue of concern at this stage is the relatively few comments from pupils about the *relevance* of the science they are learning, either in relation to their everyday lives or to their future aspirations. In the survey, only 3% of pupils expressed interests in scientific work at school for these reasons (Table 4.6, Section 4.3) and few references were made to such reasons during the interviews. Perhaps pupils may not be linking the science they do in school to the wider world of science and technology, including their local and home environments. This is of concern in relation to Primary Science Curriculum implementation, as it indicates that pupils may not be fully appreciating one of its key aims, "the contribution of science and technology to the social, economic, cultural and other dimensions of society" (DES, 1999a, p. 11). This issue will be re-visited later in the section.

### 6.1.2 Hands-on science

Survey and case study pupils are extremely positive about hands-on science. The researchers all sensed a great enthusiasm on the part of pupils who were engaged in hands-on activities in the lessons observed. The interest, even impatience to 'get on with' the hands-on aspects of science lessons was evident in the group interviews: "I do be all fidgety because like, I want to do the experiments". In contrast, the high level of engagement with materials and concentration of pupils in the observed lessons, once hands-on activities were underway, was also notable.

The frequency of hands-on experiences is more a matter of debate. The prevalence of pupils' images of hands-on activities in the questionnaire responses both in the survey (57% of images) and in the case study (48% of images, 3rd-6th classes only) is encouraging.

However, whilst obviously memorable, it is less clear whether hands-on science is a regular feature of these primary science classrooms. The evidence from the survey is circumstantial and appears to be mixed. Survey pupils from within some classes described many different hands-on experiences, whereas pupils in other classes described only one or two such experiences overall. The evidence from the case-study suggests that, although pupils are engaging with hands-on science, they would like to do more of it and indeed more science: "More experiments and less writing"; "Well we haven't done loads of science yet. But we probably will".

## Designing and making as a feature of hands-on science

In relation to the frequency of hands-on experiences, it is worth noting that relatively few examples of designing-and-making activities were apparent in the data as a whole. Pupils expressed a great enthusiasm for designing and making their own things, with 87% of pupils in the case study questionnaires (3rd–6th classes only) and 78% of survey pupils indicating positive attitudes. However, only 4% of pupils in the survey and only 5% of pupils in the case study questionnaire described a favourite science lesson that had actually involved a designing-and-making project. Interestingly, most of these appeared to echo suggestions made in support materials provided by the Discover Primary Science initiative (DSE, 2007). None of the lessons observed in the case study had a design-and-make focus to it.

This apparent lack of designing and making activities is a concern for two reasons: Firstly, the development of pupils' scientific skills related to designing and making could be hampered by such limited experiences and indeed these skills are not discussed in the next subsection because there is so little evidence for their use. Secondly, design-and-make projects offer pupils the opportunity to "explore, develop and *apply* scientific ideas and concepts" (DES, 1999a, p. 11;

emphasis added), a key aim of the Primary Science Curriculum. Such activities could involve pupils in making links to the world around them via problem-solving and developing an appreciation of technological applications, issues which are also at the core of the curriculum aims (DES, 1999a). This final point is worth considering in the light of earlier comments regarding the pupils' perceptions of the relevance of science to their everyday lives.

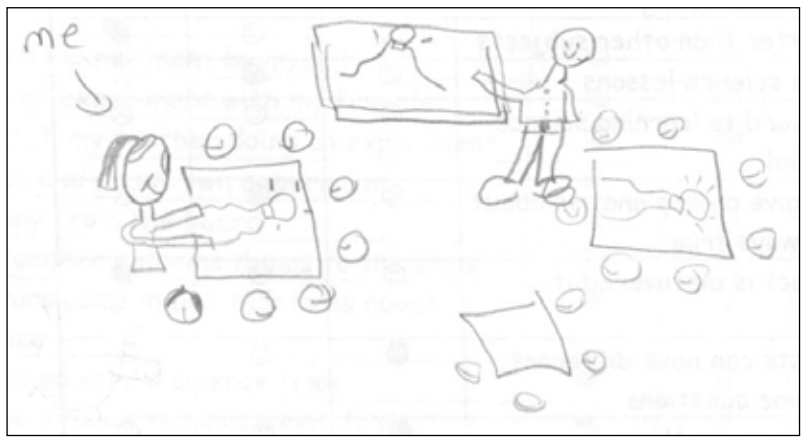
## Types of hands-on science

In the case study, 11 of the 15 observed lessons involved pupils in hands-on activities that were essentially directed by the teacher, with just 1 of the 15 lessons offering pupils an opportunity to conduct an investigation that they had planned for themselves. These represented approaches to hands-on science that offered children different levels of autonomy. In the survey and case-study questionnaire responses, images of these types of hands-on science were also seen, although clear examples of pupil-led investigations were infrequent. Examples of more prescribed activities were seen in pictures where the pupils were engaged in hands-on activities but directions were either on the board or being given by the teacher (see example in Figure 6.1 and Figure 5.9 in earlier Section 5.2.2). There were also some examples of lessons that were described in such a way that it was evident that pupils had followed a given procedure, for example, "dancing raisins, you just put a raisin in lemonade and they jump up and down".

Different types of approach to hands-on work are suggested in the teacher guidelines. The teacher guidelines describe "closed activities", which emphasise development of conceptual understanding, "open investigations", which are aimed at promoting pupil autonomy and the application of skills, and "teacher-directed" approaches, which allow for a more structured acquisition of key skills (DES, 1999b, pp. 54-55). All these types of hands-on experience were evident from an

analysis of the data in this study, although the data appear to indicate that open, child-led investigations are not very common. This balance in favour of prescribed or teacher-directed approaches rather than pupil-centred investigations was also noted as a feature of hands-on approaches in an Australian review of primary science (Goodrum et al., 2000), discussed in Section 1.1.2.

**Figure 6.1: Hands-on science: Pupils follow teacher directions (Girl, 4th class)**




In general, all types of hands-on science were viewed favourably by pupils and there was evidence that some were acquiring scientific conceptual knowledge as a result. A pupil in a group interview exemplified this view: "At the time I didn't think it would float because it's sort of heavy…but I think it ended up floating". The concern here is that the hands-on activities in which pupils are engaging might suggest an imbalance in favour of closed activities, which could have an impact on the breadth and depth of pupils' development of scientific skills. The relative infrequency of child-led investigations is a particular concern in relation to the Primary Science Curriculum's stated aim of fostering "children's natural curiosity, so encouraging independent enquiry" (DES, 1999a, p. 11). Concerns about the prescribed nature of pupils' science activities were also raised in a study of primary science in England and Wales (de Boo and Randall, 2001), discussed in Section 1.1.1. The issue of

skill development, as seen in the current study, will now be discussed in further detail.

## Scientific skills

The survey did not provide information about individual scientific skills that pupils were developing, except in the case of designing and making, discussed earlier, and writing as a form of recording and communicating, discussed later. However, the case study and in particular the classroom observations were revealing in this regard.

Skills which appeared to be a common feature of pupils' hands-on experiences in these classrooms were: Observation; and using equipment, a feature of the skill of investigating and experimenting. In contrast, skills which appeared in a more limited number of scenarios included: Questioning (pupils raising questions); predicting; independent planning (a feature of investigating and experimenting); estimating and measuring and analysing.

Predicting was seen in some classrooms, but the type of predicting seen was of a very basic type, and similar at all class levels – that is, pupils stated, or rather guessed, the likely outcome with little or no recourse to everyday experiences or existing knowledge. "It's like you're betting on a horse. I think this horse is going to win. I think this apple will float". Making a prediction that is simply a "guess" is only suggested as appropriate for infant classes in the Primary Science Curriculum (DES, 1999a, p. 20). It is therefore of some concern that older pupils were apparently not afforded opportunities to progress beyond this level.

Measuring and the use of numerical data in general were extremely limited, with a narrow range of measuring devices being used by children, namely rulers and non-standard measuring equipment such as teaspoons. In consequence, the outcomes of observed hands-on

activities were almost exclusively qualitative, with no evidence of charts or graphs being used. In the group interviews, few references were made to other science activities that had involved measuring. The Primary Science Curriculum refers to the use of measuring for the identification of numerical patterns in data within the skills of observing, estimating and measuring, analysing and recording and communicating from third class upwards (DES, 1999a). A concern arising out of this study is that older pupils are being insufficiently challenged to develop scientific skills that relate to these quantitative approaches.

Pupils appear to be having opportunities to utilise a range of scientific skills. However, the application of different scientific skills would appear to be uneven in comparison with the ideals suggested in the curriculum. This may be linked to the types of hands-on experiences on offer, as discussed above. Perhaps teachers are unconfident about knowing how to provide experiences to develop certain skills or indeed how to ensure that pupils make progress within a skill. In relation to this, it is worth noting that a survey conducted with primary teachers in Northern Ireland by Sweeney and Alexander (2002) showed that nearly 50% of teachers indicated that they needed further support in how to teach the process (scientific) skills. This contrasted with only 6% who felt they needed to develop their own scientific subject knowledge in order to be better teachers of primary science. These findings may also be of relevance to the current context.

### 6.1.3 Collaborative work in science

The Primary Science Curriculum advocates the use of small group teaching so that "children can work together", which offers pupils opportunities to "share ideas and communicate their findings" (DES, 1999b, p. 52). The current research provides very encouraging evidence that this is happening in many schools.

Pupils in both the survey and the case study expressed enthusiasm for working with their friends in science. The response to the Likert item "I enjoy science when I do an experiment with my friends" gained a positive answer from 86% of survey pupils and 87% of pupils in the case study (3rd – 6th classes). This contrasted with positive responses of 49% and 60% for the respective groups when pupils were asked if they enjoyed science "when I do an experiment on my own".

Pupils in the survey cited working with friends or in a group as a reason for liking a favourite science lesson in 5% of cases. A stated dislike of group work was rare. In the interviews, pupils from 9 of the 11 classes expressed positive views about collaborative working and clearly appreciated some of the benefits: "...you get to kind of learn more, because you hear other people's opinions"; "...you'd have more help if you're stuck". Two sets of pupils expressed a desire to work in groups more often. Pupils in the group interviews were also quite vocal about some disadvantages of working in groups and could see that, in some circumstances working alone could be beneficial.

The frequency of working collaboratively in small groups was hard to establish definitively from the survey responses. However, 35% of pupils' drawings depicted paired or group situations, which is extremely encouraging, especially given that at least one pupil from every class in the survey drew such a grouping. In examining the pictures, it was less clear how collaborative some of these small group experiences might have been. The case study was more revealing in this regard. Collaborative pair work or group work took place at some point during 12 of the 15 lessons observed. It would appear that collaborative work is a significant feature of primary science pupils' experiences of working. This mirrors findings from a review of primary science in Australia (Goodrum et al., 2000), discussed in

Section 1.1.2. Encouragingly, the majority of pupils in the current study appeared to be positively disposed towards this way of working and were conscious of the benefits that it could bring.

### 6.1.4 ICT in science

Pupils in both the survey and case study expressed very positive views about using ICT, principally by using computer programmes, or going "on the internet". However, the evidence for actual use of ICT in science lessons, whether via computers or interactive whiteboards was extremely limited. No other types of ICT equipment, for example digital cameras or sensors, were in evidence in any of the data collected in this study. The apparent lack of ICT use as a part of science classes is of particular concern when its value in a range of situations is given some emphasis in the Primary Science Curriculum (DES, 1999a, p. 9).

The case study data point to a possible explanation for the infrequency of responses, in that some pupils referred to using science programmes in computer lessons, which took place at a designated time and location in the school: "We have computers every Friday and sometimes we add a bit of science to that". Perhaps images and descriptions of ICT use in science lessons were under-represented because of the separation of computer use in this way. Other images of ICT as a feature of lessons, let alone for science, were rather more worrying: "…we don't get to use the computer [in the classroom]"; "we've only been on the computer once in second class".

Descriptions of, and images of ICT use in primary science classrooms were very limited and, where computer use did occur, it was not necessarily integrated with the scientific learning in the classroom. This is of great concern, since ICT use is seen as an essential aspect of the scientific skills of experimenting and investigating and of

recording and communicating, the latter from infant classes upwards (DES, 1999b, p. 21). In addition, ICT use, in appropriate contexts, has the potential to help pupils make links to the technological world and hence make their classroom experiences more relevant to their everyday lives.

Studies in other countries have raised similar concerns about the use of ICT in primary science classrooms. In a survey of Australian primary children, over half indicated that they never used computers in science (Goodrum et al., 2000). A recent study of primary teachers in the UK indicated that less than 50% of teachers felt confident in using ICT for science teaching (Murphy et al., 2007) and it may be the case that a similar factor is affecting ICT use in the current study. The availability of ICT equipment in an Irish primary context also has to be considered, as a recent survey by the Irish Primary Principals' Network indicated that 43% of schools were working with "outdated, partially functioning computer equipment" (IPPN, 2008a, p. 1). Some pupils' comments in this study are perhaps relevant in this regard: "There is something called Encarta but we don't have it here" and "[when asked about computer in the classroom] I don't think it works".

### 6.1.5 Other teaching and learning approaches

#### Teacher demonstration and teacher explanation

Teacher demonstration, in the context of this report, is defined to mean a situation where the teacher shows the pupils an *entire* experiment, without the pupils having any hands-on experience except where invited to assist. This approach is not particularly advocated in the teacher guidelines, although it is suggested for "certain aspects of the science curriculum" (DES, 1999b, p.55).

In this study, it would appear that pupils are only moderately positive about this type of methodology (56% of the survey and case study respondents), although during the group interviews, pupils did talk about teacher demonstrations in a relatively positive light. It is difficult to say how frequently teacher demonstrations feature in pupils' experience of science, however there is evidence that it is a part of the overall picture. Pupils in 5 of the 11 group interviews described previous lessons that had involved a teacher demonstration, and 1 of the 15 lessons observed included this methodology. The survey pupils' drawings of school science depicted teacher demonstrations in 10% of drawings. Whilst this figure is low, it should be noted that this was the most common representation of the teacher.

Some of these pictures showed the "volcanoes" (vinegar and baking soda) experiment, which might have been done as a teacher demonstration for reasons of safety or expense. In other cases it was less clear why a teacher demonstration might have been used instead of hands-on activities. Safety fears could be allayed by referring to a safety guide produced for primary teachers by the Irish Science Teachers' Association (ISTA/ASE, 2004). However, perhaps it is simply the case that some teachers are, as yet, rather unconfident about offering hands-on activities.

According to the questionnaire data, pupils in the present study were well-disposed towards their teachers explaining to the class, with 71% of survey pupils and 67% of the case study respondents expressing a positive view. The group interviews revealed more negative impressions, with pupils in four of the group interviews indicating a dislike for this methodology, and a desire to reduce its frequency: "Less of teacher talking and explaining and more of you actually doing it [hands-on science]". Teacher explanation was a feature of every one of the 15 classes observed and it took a range of forms,

from showing pupils what to do or providing instructions for a hands-on task, to providing subject knowledge information about a topic. All these strategies are described as suitable whole class methodologies in the teacher guidelines (DES, 1999b).

Teacher demonstrations and teacher explanations appear to be a part of pupils' experience of primary school science. Whilst there are times when such approaches are beneficial and indeed essential to learning, it would be a concern if such methodologies dominated over, or eclipsed pupils' own hands-on experiences. This appears to be the case at least for some pupils: "Normally teacher does them [experiments] at the top of the class".

## Reading and writing

Pupils in all parts of this study were quite negatively disposed towards reading and writing as part of their science experiences and were particularly unenthusiastic about copying from the board. However, it seems that these experiences are at least an occasional feature of many science classes. In the survey pupils' pictures of their science classes, 6% showed pupils engaged in looking at or copying from the board, and a further 5% were reading, writing or looking at visual aids. Eight of the group interviews revealed that pupils had spent time reading in science lessons and in two of these, pupils expressed a wish to do less reading in science. Writing came in for criticism too, with pupils in three interviews wishing they could do less writing in science and four interview groups stating that writing was an aspect of science they disliked.

Reading and writing are envisaged as useful scientific skills in the curriculum (DES, 1999a), when couched in terms of investigating and experimenting, "collecting information from a variety of sources" (p. 79) and in recording and communicating, "producing written accounts" (p. 80). However, there is no suggestion in the

curriculum that written forms of recording should accompany every hands-on experience and indeed the curriculum recommends a "variety of methods" for recording and presenting findings (DES, 1999a, p. 80). In this context it may be worth noting that, of the 15 classes observed, 10 involved the pupils in recording their findings in written form.

It is less clear that all the kinds of reading and writing to which pupils referred in this study are of value in developing these specific scientific skills. One concern here is that copying from the board appeared as an image of science classes, a strategy that would presumably limit pupils' ability to communicate their own thoughts and findings. There was also some evidence of negatively construed science experiences dominated by textbooks and worksheets: "We could probably have more fun if we actually got to do it ourselves, rather than just reading from books and stuff"; "We write in our copies. And we basically copy it out of the book, which is pointless"; "I don't like writing in [science workbook] because you always have to write in the small letters". Comments of this kind are of concern given that the Primary Science Curriculum Teacher Guidelines state that "science lessons **should not be workcard or textbook based**" (DES, 1999b, p. 27; emphasis in the original).

## Working outside the classroom

Pupils in both the survey and case study elements of this research expressed very positive attitudes towards going outside to do science, whether in the school grounds or as part of a trip. Where such experiences had occurred, pupils offered detailed descriptions of events and hands-on activities in which they had engaged, virtually all of which were connected with learning about plants and animals, principally animals.

However, relatively few instances of such events were recorded in the data. In the case study, no lesson outside was observed, although it should be noted that all 15 observations took place between October and February, which may not have been the ideal time for working outdoors. During group interviews, pupils from six different classes recalled occasions on which they had worked outdoors in science: "We went bird watching to Bull Island…and we saw loads of birds"; "We had jars that had a magnifying glass on the top and air holes so that the insects could breathe". In the survey, pupils' pictorial responses showed that just 5% of pupils' drawings depicted outdoor scenes, although a figure of 10% was recorded in pupils' drawings in the questionnaires from the case study pupils (3rd-6th class). In both groups, just a few pupils described favourite lessons that had explicitly involved working outdoors, often commenting that they had enjoyed such experiences because they were different; this might be an indicator of the relative infrequency of such events. The timing of this research, during the winter months, has to be considered when interpreting the low frequency of responses relating to work outside.

To summarise, it seems that pupils enjoy working outside but they may be having fairly limited opportunities to engage in science in this context. The main focus of working outside, where described, was in learning about animals. A few instances of learning about plants and a very small number of examples of environmental projects outside were found in these data. There were virtually no references in any of the data, to scientific activities involving pupils in learning about Materials or Energy and forces in an outdoor context. This is unfortunate, as some strand units, for example light (the sun and shadows), sound (sounds in the environment) and forces (friction; exploring toys by pushing and pulling) might be quite effectively explored whilst working outside. Indeed a key aim of the Primary Science Curriculum involves engaging pupils in the exploration of

"human, natural and physical aspects of the environment" (DES, 1999a, p. 11). Once again, it seems, opportunities to link pupils' scientific learning to everyday experiences in their local environment, may be being missed.

In describing the topics that pupils might approach by working outside, the discussion has moved onto considerations of the scientific subject content that they are experiencing in school. This will be discussed in more detail in the next section.

### 6.1.6 Scientific subject content

There is a wealth of evidence to suggest that pupils are engaging in lessons that cover scientific subject content in the strands Living things, Energy and forces and Materials. Many of these experiences appear to be memorable and enjoyable and have involved hands-on learning at some point. The majority of pupils appear to be very enthusiastic about learning all areas of scientific subject matter, with the exception of insects and mini-beasts, and heat. These data do not provide evidence, however, for the frequency with which pupils are experiencing science in any given strand or strand unit. It is therefore unclear whether or not individuals are engaging with subject matter at an appropriate level of depth or breadth to provide for progression in learning.

It is interesting to note at this point that many of the hands-on activities described by pupils, or seen during classroom observations, appear to mirror those covered during the PCSP in-service training days or described in the Discover Primary Science pack (DSE, 2007). In some cases, the provenance is clear: Some pupils referred to "Discover Primary Science" in the questionnaires, and others used the titles of activities given in the pack, such as "dancing raisins" or "sinking feelings". In the observed lessons, one teacher used photocopied materials from a Discover Primary Science activity and

another teacher stated that the fair testing activity relating to materials and change, provided during the PSCP workshop, was the basis for the lesson. It would appear that, where supports have been made available, teachers are using them to provide children with hands-on experiences.

Although coverage of strands and strand units appear to be in evidence, the extent of pupils' learning of conceptual knowledge as a result is not clear from the data gathered during this study. It should be noted, however, that the assessment of pupils' subject knowledge was not an intended aim of the current research. One area within these three strands, which might be a cause for concern, however, is the strand unit of forces. It appears that few pupils are engaging with the strand unit beyond carrying out floating and sinking investigations. Thus, learning about machines, levers, pulleys, structures and motion would be very limited. This may also have relevance to an earlier expressed concern about a lack of examples of pupils engaging in design and make projects. There is also a concern about the relative infrequency of pupils' experiences with subject matter relating to properties and characteristics of materials and the impact that this is likely to have on learning.

A recent study of UK primary teachers found that the topic of friction (an aspect of forces) was the one in which teachers had the lowest confidence to develop children's understanding (Murphy et al., 2007). A lack of teacher confidence in teaching about forces may have some relevance to findings in the current study. It is also worth noting that hands-on ideas for teaching about forces were not a feature of the PCSP in-service training days, and that the few examples of activities relating to forces that were described in this study often appeared to mirror those found in the Discover Primary Science pack (DSE, 2007).

The most significant issue arising from data about scientific subject content, however, is pupils' apparent lack of experiences within the strand Environmental awareness and care, in spite of highly positive attitudes being expressed towards this area of learning. It may be of relevance to note here that the PCSP workshops did not focus on ideas for hands-on experiences within this strand and the Discover Primary Science pack (DSE, 2007) focuses principally on promoting the physical sciences.

It may be the case that pupils are engaging in environmental projects, such as recycling or litter picking, but do not regard and therefore report these as science lessons. However, learning about Environmental awareness and care is not simply about recycling and litter. This strand also involves pupils in gaining an appreciation of their environments in a much wider sense, including home and local area, and for older pupils, an appreciation of technology, its applications and the contribution of science and technology to society (DES, 1999a). Indeed, two of the eight key aims of the Primary Science Curriculum link to developing environmental responsibility and an awareness of the contribution of science and technology to society (DES, 1999a). Again, it would seem that pupils' means of linking their scientific experiences to the everyday, and to the world of science and technology are not being fully fostered.

### 6.1.7 Concluding summary

This section has brought together the data from the survey and case study parts of the current report. Before making recommendations arising out of this work, a summary of the overall conclusions will be provided. These will be presented as positive outcomes and areas of concern.

## Positive outcomes

***Attitudes to school science***

Primary children appear to be enthusiastic about primary school science. They are well-disposed towards learning about virtually all of the content areas outlined in the Primary Science Curriculum.

***Hands-on science***

Primary children enjoy hands-on science and appear to be afforded opportunities to engage in it. A range of hands-on science experiences appear to be on offer to children, which vary in the level of pupil autonomy afforded. It appears that children are being provided with opportunities to apply some scientific skills. A common feature of primary science lessons is that children are working collaboratively in small groups when they conduct hands-on activities. Children generally enjoy working in this way.

***Other teaching and learning approaches in science***

Some children have positive views about teacher demonstration and teacher explanation in science class and these strategies are in evidence. Children are very enthusiastic about working on science outside, on trips and with visitors. These experiences are extremely memorable. Children are also positively disposed towards the notion of using ICT in science.

***Subject content areas***

The majority of the children's reported experiences of school science relate to the strands Living things, Energy and forces and Materials. Pupils feel positive about learning about virtually all aspects of subject content as described in the Primary Science Curriculum.

## Areas of concern

### *Attitudes to school science*

Pupils express negative attitudes towards some areas of teaching and learning in science, principally aspects of reading and writing. In other areas, such as working outside, learning about the environment, and using ICT, pupils hold very positive views but these seem to be somewhat aspirational, as there is little evidence for such experiences.

### *Hands-on science*

Some pupils may not be having regular opportunities to engage in hands-on science. Child-led, autonomous investigations appear to be used relatively rarely as a hands-on strategy. Children seem to have few opportunities to apply certain scientific skills. The application of some scientific skills for older pupils appears to lack the appropriate breadth and complexity envisaged by the Primary Science Curriculum. There are relatively few instances of children engaging in designing-and-making activities and thus skill development in this area would, by inference, be limited.

### *Other teaching and learning approaches in science*

Some children may be experiencing teacher demonstration and teacher explanation as dominant features of their primary science learning and some pupils have negative or rather ambivalent views about these strategies. Children have quite negative views about reading and writing in science lessons. These methodologies are also in evidence, including copying from the board, reading textbooks and completing worksheets and workbooks. As such, pupils do not appear to be experiencing the full range of possibilities for recording and communicating their work that would be envisaged within the Primary Science Curriculum. Children may not be engaging with scientific work outdoors, on trips or with visitors very frequently. Children's experiences of using ICT as an integral part of science lessons also appear to be extremely limited.

***Subject content areas***

Children's experiences of science within the strand units of forces and properties and characteristics of materials appear to be rather limited. Children do not appear to be engaging with topics within the strand of Environmental awareness and care to the same extent that they are with the other three strands. In general, primary children are not necessarily relating their school science experiences to the wider world or to their future aspirations.

## Overview

Primary science in Irish schools appears to have come a long way since the concerns expressed prior to the introduction of the current curriculum (INTO, 1987). The 'Nature Table' is long gone, and instead, many pupils are gainfully employed in science lessons which use interactive, hands-on strategies. In asking the pupils what they think about primary science, this report has gained a valuable insight into the reality of the Primary Science Curriculum from the point of view of its most important participants. The spirit of this curriculum is in evidence in many of the primary schools that took part in the study, and it appears that pupils are responding positively as a result. At this point, the efforts of teachers and the support agencies that have led to this level of engagement must be recognised. While a considerable amount has been accomplished in a mere five years since the formal introduction of the Primary Science Curriculum, complacency at this juncture would be foolhardy. It is therefore important to be mindful of studies relating to primary science curriculum implementation in other countries, which revealed ongoing concerns 15 or more years after introduction (discussed in Section 1). This does not have to be the case for the Irish primary system, if appropriate further action is taken to continue and sustain the process of implementation. Recommendations relating to this are presented below.

## 6.2 Recommendations

This study has focussed on children, however the suggestions for ways to enhance their experiences of science in the future involve recommendations relating principally to other parties involved in primary education. Many resources are already in existence to support Primary Science Curriculum implementation, but the most significant are human resources. These include: primary science education experts within the PCSP, INTO and Colleges of primary teacher education; primary science personnel within agencies such as Forfás and Discover Science and Engineering; school principals and science co-ordinators; and classroom teachers. In general, the recommendations which follow focus on ways in which these human resources can be directed towards further enhancement of pupils' experiences within the Primary Science Curriculum.

### 6.2.1 Continuing professional development

Evidence presented in this study supports the notion that in-service provision for teachers can impact on Primary Science Curriculum implementation. Many of the hands-on science activities that children described in this study appeared to mirror, or were known to be those presented in the PCSP in-service workshops prior to curriculum implementation (discussed in Section 2.2.1). These included activities which involved investigating magnets, making simple electrical circuits and conducting investigations relating to dissolving.

This study raises concerns about the application of some areas of the curriculum, for example: the development and progression of all scientific skills; pupil-led investigations; designing-and-making; teaching within the strand units of forces and properties and characteristics of materials; teaching within the strand Environmental awareness and care; integrating ICT into the science classroom and helping pupils to link their learning in science to the wider world. It

may be of relevance to note that many of these areas were not the focus of hands-on experiences in the initial PCSP in-service workshops. Some of these areas are also not within the remit of the Discover Primary Science pack (DSE, 2007), which aims to promote the physical sciences. It would appear then, that a proportion of teachers, whose pupils participated in this study, are providing experiences for pupils where supports and resources for activity ideas are available. This raises concerns about the current confidence of some teachers to develop their own ideas for teaching science in other areas. This would have consequences for coverage of the full range of scientific subject content areas and by extension, the full range of scientific skills.

Further in-service support for teachers is therefore recommended. This is not the first study in Ireland to make this point. A recent report by the Irish Council for Science, Technology and Innovation (ICSTI, 2005) noted that the professional development of primary teachers in a life-long learning context was not as advanced in Ireland as in other countries, and it recommended training and support "before, during and *after* the introduction of new…[science] curricula" (p. 2; emphasis added). Studies in other countries have shown that, even after curriculum implementation, teachers lack confidence in teaching primary science (Murphy et al., 2007) and that further in-service support is a common request (Goodrum et al., 2000).

It is recommended that the nature of in-service provision for Irish primary science now needs to progress beyond a "show the teachers how to do it" approach (Jarvis and Pell, 2004, p. 1808) to incorporate more opportunities for action, reflection on action and in-depth treatment of themes. In this way it is hoped that teachers would gain the confidence to develop their own ideas for teaching and promoting science in schools. In other countries, this kind of

approach to professional development has been shown to have a significant impact. Primary teachers in England, who participated in a 10-day in-service course spread over a period of 6 months, developed increased confidence to teach science and this had a positive impact on their pupils' learning (Jarvis and Pell, 2004). In another study, a survey of primary teachers in the UK showed a strong positive correlation between confidence to teach science and the amount of professional development undertaken (Murphy et al., 2007).

The current recommendation for in-service of a comprehensive nature is proposed for teachers who have a particular enthusiasm for science and might already have a role as a science co-ordinator or post-holder in a school. A bursary scheme and/ or provision for substitute cover to enable such teachers to attend courses would be part of this recommendation. Suitable providers for in-service courses of this type already exist and include: the PCSP/ science cuiditheoirí; the INTO; and colleges of primary teacher education. For greatest impact, it would be vital for these teachers to be provided with appropriate time in school for disseminating ideas gained from such in-service to the whole staff, for example through supporting whole-school planning, and facilitating in-school workshops for staff. In this way it is hoped that schools could move towards taking ownership of school development in science.

### 6.2.2 Pre-service primary teacher education

Continuing professional development for existing qualified teachers has been discussed in the preceding section. However, the pre-service preparation of primary teachers could also be fruitfully developed in relation to the aim of improving pupils' engagement with all aspects of the Primary Science Curriculum. The rationale for recommending additional supports at pre-service teacher level is twofold: Firstly, these individuals have their whole careers ahead of them, so

providing extra support during pre-service education would reap long-term benefits for the primary system; and secondly, many pre-service teaching students already have good science qualifications on entry to college. A recent survey of all first year B.Ed students in Ireland showed that 96% had a science qualification at Junior Certificate level or higher, with 71% having at least one science or science-related qualification at Leaving Certificate level (Waldron, Pike, Varley, Murphy and Greenwood, 2007).

It is unlikely, however, that even well-qualified entrants would have a secure background in all aspects of scientific subject content. Furthermore, a foundation in scientific subject knowledge would not by itself be a guarantor of good primary science teaching. Pre-service teachers would therefore be expected to develop their pedagogical content knowledge and curricular knowledge relating to primary science during their teacher education courses. These have long been established as factors, additional to subject knowledge, that are considered essential to the development of good practice in primary classrooms (Shulman, 1986).

This report therefore recommends that a proportion of B.Ed students, with good science qualifications on entry to college and an interest in science, should be provided with the opportunity to undertake a specialist science education course over the three years of the B.Ed degree. This would occupy similar time and status to the academic subjects currently available to B.Ed students at some of the colleges of primary teacher education and would be in addition to any existing provision of curriculum science courses intended for all B.Ed students (discussed in Section 2.2.2). Currently, none of the colleges of primary teacher education in Ireland offer a 'specialist' science education course of the duration and depth envisaged, although it should be noted that these are available to pre-service teachers in colleges in the UK, including those in Northern Ireland

(Waldron et al., 2007). Teachers with this specialist background in science education would have a positive impact on schools; this could even start during pre-service education. A project conducted in Northern Ireland involved pre-service science specialist student teachers working in a collaborative, team-teaching role with experienced primary teachers who were not specialists in science teaching. The outcomes indicated benefits for pre-service and experienced teachers alike, and more particularly, for the pupils involved (Murphy, Beggs, Carlisle and Greenwood, 2004).

### 6.2.3 Financial support for purchase of equipment

This report has shown that hands-on science has an extremely positive impact on pupils' experiences of, and attitudes towards science. It is also an approach that is central to the aims and approaches outlined in the Primary Science Curriculum documents (DES, 1999a;b). However, hands-on activities cannot be made available to children as a regular feature of their science lessons unless schools have the funds to purchase and replenish consumable equipment. A grant was provided for schools at the introduction of the Primary Science Curriculum (DES, 2004), although this was one-off and specifically earmarked for the purchase of non-consumable equipment. Recent surveys in the UK and Australia indicate that primary teachers cite resources, or the lack of them, as a key factor affecting their teaching (Murphy et al., 2007; Goodrum et al., 2000). This does not have to be the case for Irish primary schools.

Unfortunately, it appears to be less than clear that funds for science resources can be guaranteed from school budgets. Recent surveys conducted by the IPPN have shown that 80% of schools depend on fundraising from parents to cover a shortfall in "basic running costs" (IPPN, 2007, p. 1) and that 74% of parents are asked for additional voluntary contributions to cover the purchase of curricular materials every year, with over a third reporting difficulties with paying this

contribution (IPPN, 2008b). The resources necessary for effective implementation of the Primary Science Curriculum should not be dependent on unpredictable funding of this kind. To ensure the provision of high-quality resources for hands-on science at primary level, it is therefore recommended that additional, ring-fenced funding for consumable science resources should be provided to schools every year on a capitation basis from the DES.

This report provides evidence that the use of ICT in science lessons is very limited. It seems possible that at least some of this may be attributable to the nature and quality of ICT resources available in schools (IPPN, 2008a). A further recommendation therefore, is that funds should be made available for schools to ameliorate their ICT equipment, where it is of insufficient quality to support learning in science. This could include, for example, grants for the purchase of digital cameras and sensors, and science-related computer programmes to support the recording and reporting of pupils' investigations.

### 6.2.4 Special events for children

The current report provides evidence that special events such as trips, workshops and visitors are extremely motivating for children. However, a concern is that these experiences are rather infrequent, so their impact may be limited. Teachers and pupils in an Australian review reported these types of event with a similar lack of frequency (Goodrum et al., 2000). Many of the experiences described by children in the current study appeared to be isolated events in which visitors to the school, or staff at science events or centres ran the activities. The impact of such approaches in affecting school science practices is therefore inferred to be rather limited.

A number of organisations currently promote primary science events in Ireland, but perhaps it is timely to re-consider the ways in which

some of these are created. It is recommended that future initiatives aimed at children should focus on whole-school approaches that involve the teachers, building or drawing on their expertise. These approaches could also extend over a period of time, perhaps integrating with other curricular areas. Where pupils make visits to science centres, advice about pre-visit and follow-up activities could also be provided to ensure that the enthusiasm engendered by the visit itself is fostered within the school environment. One possible model for a whole-school, high impact strategy of the kind recommended here is already in evidence in a Social, Personal and Health Education (SPHE) project to promote healthy eating, which is currently operating in a number of Irish primary schools (Food Dudes, 2006).

### 6.2.5 National bank of resources

Many of the children's descriptions of science lessons involving hands-on activities appeared to emanate from activity ideas already provided to teachers, such as those in the PCSP workshops and Discover Primary Science packs (DSE, 2007). It appears that, where available, teachers are using resource ideas. However, the current study also indicated areas of science where pupils' experiences were much less in evidence. These included: designing-and-making; child-led investigations; activities in the strand units of forces and properties and characteristics of materials; activities within the strand of Environmental awareness and care; and the use of ICT in science.

The PCSP has already developed, and is developing on-line supports for primary science (PCSP, n.d.), some of which are periodically featured in the INTO members' monthly magazine, *In Touch*. A recommendation arising out of this report is that the existing PCSP on-line materials should now be enhanced to include significant supports for the areas listed above. Sufficient details would need to be provided for even an unconfident teacher to tackle suggested

activities. In the light of the current findings, it would also be useful to provide detailed information to support teachers' development of their pupils' scientific skills at an age-appropriate level. The PCSP website's links to other web-based resources could also be enhanced, with a particular focus on resources that pupils could use, for example, for recording and reporting investigations.

It is also recommended that a teacher feedback forum be incorporated as part of the PCSP website. This would allow teachers to comment on, or add to suggested activities, thus drawing on and valuing expertise and experience.

### 6.2.6 Further research

This study did not aim to assess pupils' levels of knowledge and understanding of scientific concepts or skills. However, in order to complete the picture of curriculum implementation, it would be important to consider undertaking research in these areas. It would be relevant to conduct such a study when all pupils have experienced the Primary Science Curriculum (DES, 1999a) throughout their primary careers. As the curriculum was implemented from September 2003, this research could be conducted in the academic year 2010-2011. This report does *not* recommend mandatory national testing of pupils in science as a means to this end. National science tests in Northern Ireland have been suggested to have a deleterious effect on older primary pupils' engagement with, and attitudes towards science (Murphy and Beggs, 2002).

It is also recommended that another study of similar scope to the one reported here should be conducted in a few years' time. The current study has presented a 'snap-shot' of Primary Science Curriculum implementation and it would be important to consider whether progress has been made in the key areas of concern raised in this report. Another review would act to assess the impact of any

ongoing or future initiatives, including those that arise from the other recommendations in this report.

## 6.3 Next Steps

This report summarises the majority of the work conducted in primary schools. One aspect of the data collected so far has not been presented, and this relates to primary pupils' perceptions of, and attitudes towards science in post-primary school. It was felt that these data could be discussed in a more relevant context within the report of Phase 2 of this study. In addition, it is hoped that in Phase 2 of the study, pupils' attitudes towards key aspects of school science can be examined in relation to the age and/ or class of pupils. Once the data from Phases 1 and 2 are available, it would be possible to consider whether there are any significant trends in attitudes seen in pupils from third class up to first year in post-primary school.

Phase 2 of the study focuses mainly on pupils in their first year at post-primary school. A survey and case study approach is being taken to gather data about these pupils and their attitudes towards and perceptions of post-primary school science. An initial report on this phase of the study is due for submission on Friday, 14th March, 2008.

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# GLOSSARY

These are definitions for key terms as they are used in the current report.

**Boardwork:** This involves the use of a whiteboard or blackboard. The teacher uses the board to write or draw material for the attention of the whole class. Boardwork includes: the teacher collating points from a class discussion using the board; putting up materials that will act as an *aide-mémoire* for use during the lesson (e.g. key words; a list of instructions) or putting up material for pupils to copy down. Boardwork therefore also includes the process of pupils consulting material on the board and/or copying from it.

**Collaborative work:** This is any kind of class activity in which pupils operate together in a purposeful manner, sharing equipment, ideas, tasks and/or discussions. For this type of approach, pupils would typically be in pairs or small groups. It should be noted that, in a classroom setting, pupils may regularly sit in pairs or groups, but the work assigned may be of an individual or whole class nature, and not involve pupils in any collaborative activities.

**Experiment:** This was a term commonly used by pupils during this research study and indeed used by the researchers in devising the wording of the pupil questionnaire. In focus group discussions with pupils during piloting of the questionnaire, the term was understood to mean any kind of scientific activity which involved use of materials, equipment and/or exploration of living things. It therefore encompassed both **hands-on science** and **teacher demonstration**, and its meaning in relation to these terms would be interpreted according to context. To avoid confusion, the researchers have avoided using this term in the narrative of the report, wherever possible.

**Hands-on science:** This term is used to denote any activity that involves pupils in the handling of concrete materials, equipment and/

or living things for the purpose of learning science. Hands-on science also includes pupils participating in activities as the 'living things' e.g. an investigation on breathing rate. This term encompasses at one extreme, work in which pupils manipulate materials and so on, but according to instructions provided entirely by the teacher, perhaps with a specific subject knowledge goal in mind; and at the other extreme, work which is child-led with pupils making many decisions about procedure, equipment and so on, independently of teacher instruction. Hands-on science has the potential to develop pupils' scientific skills, but the precise skills developed will depend on the type, and degree of teacher direction involved in the task at hand. In this report, hands-on science also includes activities of designing and making.

**Investigations:** In this report, these are understood to be a subcategory of hands-on science. These are characterised by pupils attempting to answer a question, which they may even have posed for themselves. Examples might include: What will happen to the light bulb if I add more batteries to the circuit? Or: Where will I find the most woodlice? Depending on the age of the children, pupils would be expected to show an increasing degree of autonomy in planning and decision-making regarding the procedures of carrying out the investigation. Investigations therefore have the potential for pupils to utilise many scientific skills.

**Mini-beasts:** This term is in common usage in primary classrooms and primary science publications and is a child-friendly term that describes animals that would be classed as invertebrates e.g. snails, worms, spiders, insects and woodlice. As such it is more technically accurate than describing such animals collectively as 'insects' or 'bugs' and it does not have the negative connotation associated with the phrase 'creepy-crawlies'.

**Pairwork:** This is a subcategory of **collaborative work,** where a pupil is just sharing ideas, equipment and so forth with one other child.

**Strand:** This term is used in the primary science curriculum (DES, 1999a) to mean a particular broad area of scientific subject knowledge. In this curriculum there are four such strands, which are: Living things; Energy and forces; Materials and Environmental awareness and care.

**Strand Unit:** This term, also used in the primary science curriculum (1999a), is a further subdivision of each subject knowledge **strand.** For example, the strand of Materials includes the two strand units: Properties and characteristics of materials and Materials and change.

**Target Child:** This term is used in discussions relating to the structured observation schedule utilised during this study. The schedule was itself developed from the Science Processes Observation Categories (SPOC) of Cavendish et al (1990). In the current research, a Target Child was one selected by the researchers for structured observation according to the schedule (Appendix D). The researchers did not interact with the child as part of the observation, as the child's activities in science class were to be observed in as naturalistic a setting as possible. To this end, the class teachers were not asked to select the Target Child/ren themselves, nor were they aware of the selection made, as this could have inadvertently altered the way in which the teacher interacted with the Target Child/ren during the observed lesson.

**Teacher demonstration:** This involves a teacher conducting an **experiment** using scientific equipment, materials and/ or living things, usually in front of the whole class. In a teacher demonstration, the materials, equipment and so on are exclusively or principally handled by the teacher throughout the entire process. Pupils may be

involved, through teacher questioning or by being called to the top of the class to assist, but even so the work is essentially done by the teacher. Teacher demonstration, in this report, is not regarded as falling within the description of **hands-on science**. Through teacher demonstration, pupils may acquire subject knowledge and indeed some scientific skills may be developed, such as observation, but the types of skills that can be developed are likely to be rather limited. This term *does not* include situations in which a teacher shows or explains a particular procedure or device to pupils, as a prelude to pupils engaging in the hands-on work themselves.

**Topic:** This is used to mean the overall subject matter of a particular lesson. This may simply be a given **strand unit** in the curriculum, such as sound, or, more likely it will be part of the subject area described in a given strand unit, for example habitats. Equally, the focus of a given lesson could be a particular hands-on activity, in which case the topic would be the principal activity, for example, dissolving powders or sorting seeds.

# APPENDIX A

# PUPIL QUESTIONNAIRE

# TEMPLATE PUPIL QUESTIONNAIRE INSTRUCTIONS TEMPLATE ACCOMPANYING TEACHER QUESTIONNAIRE TEMPLATE

# Questionnaire for Pupils

**Ask your teacher if you need help filling this in**

I am a girl ☐ I am a boy ☐ (Please tick)

My age: I am ☐ years old

Class: I am in 3rd ☐ 4th ☐ 5th ☐ 6th ☐ class (Please tick ONE box)

**Colour in the smiley face that is closest to your opinion**

| **What I think about school:** | **Yes** ☺ | **Not sure** 😐 | **No** ☹ |
|---|---|---|---|
| 1. I like school | ☺ | 😐 | ☹ |
| 2. I'm happy at school | ☺ | 😐 | ☹ |
| 3. I work as hard as I can in school | ☺ | 😐 | ☹ |
| 4. I find school interesting | ☺ | 😐 | ☹ |
| 5. I enjoy doing school-work | ☺ | 😐 | ☹ |
| 6. I enjoy working with my friends at school | ☺ | 😐 | ☹ |

| **I enjoy learning about…** | **Yes** ☺ | **Not sure** 😐 | **No** ☹ |
|---|---|---|---|
| 1. Insects and mini-beasts | ☺ | 😐 | ☹ |
| 2. Magnets | ☺ | 😐 | ☹ |
| 3. Saving energy and recycling | ☺ | 😐 | ☹ |
| 4. How the human body works | ☺ | 😐 | ☹ |
| 5. How sound travels | ☺ | 😐 | ☹ |
| 6. Solids, liquids and gases | ☺ | 😐 | ☹ |
| 7. How we heat our homes | ☺ | 😐 | ☹ |
| 8. Materials we use for making things such as wood, metal and plastic | ☺ | 😐 | ☹ |
| 9. Plants and how they grow | ☺ | 😐 | ☹ |

| I enjoy learning about… | Yes ☺ | Not sure 😐 | No ☹ |
|---|---|---|---|
| 10. How machines work and move | ☺ | 😐 | ☹ |
| 11. How to look after the environment | ☺ | 😐 | ☹ |
| 12. What happens when you mix things together | ☺ | 😐 | ☹ |
| 13. Animals from around the world | ☺ | 😐 | ☹ |
| 14. Electricity, batteries, bulbs and switches | ☺ | 😐 | ☹ |
| 15. Inventions and discoveries | ☺ | 😐 | ☹ |
| 16. What happens to things when you heat or cool them | ☺ | 😐 | ☹ |
| 17. How to keep fit and healthy | ☺ | 😐 | ☹ |
| 18. Light, mirrors and shadows | ☺ | 😐 | ☹ |

**Colour in the smiley face that is closest to your opinion**

| What I enjoy in science lessons:<br>I enjoy science when…. | Yes ☺ | Not sure 😐 | No ☹ |
|---|---|---|---|
| 1. I do an experiment by myself | ☺ | 😐 | ☹ |
| 2. I do an experiment with my friends | ☺ | 😐 | ☹ |
| 3. I watch my teacher doing an experiment | ☺ | 😐 | ☹ |
| 4. I plan and do my own experiment | ☺ | 😐 | ☹ |
| 5. I copy from the board | ☺ | 😐 | ☹ |
| 6. My teacher explains things to the class | ☺ | 😐 | ☹ |
| 7. Visitors come in and talk to us about science | ☺ | 😐 | ☹ |
| 8. We go on school science trips | ☺ | 😐 | ☹ |
| 9. We go outside the classroom to do science | ☺ | 😐 | ☹ |

| **What I enjoy in science lessons:**<br>I enjoy science when…. | **Yes**<br>☺ | **Not sure**<br>😐 | **No**<br>☹ |
|---|---|---|---|
| 10. I use computer programmes in science class | ☺ | 😐 | ☹ |
| 11. I use the internet at school to find out about science | ☺ | 😐 | ☹ |
| 12. We watch science programmes at school | ☺ | 😐 | ☹ |
| 13. I fill in my workbook/worksheet | ☺ | 😐 | ☹ |
| 14. I write about something I have done in science class | ☺ | 😐 | ☹ |
| 15. I design and make my own things | ☺ | 😐 | ☹ |
| 16. I read my science schoolbook | ☺ | 😐 | ☹ |

**Colour in the smiley face that is closest to your opinion**

| **What I think about science:** | **Yes**<br>☺ | **Not sure**<br>😐 | **No**<br>☹ |
|---|---|---|---|
| 1. School science is easy | ☺ | 😐 | ☹ |
| 2. School science is interesting | ☺ | 😐 | ☹ |
| 3. I like science better than other subjects | ☺ | 😐 | ☹ |
| 4. I look forward to science lessons | ☺ | 😐 | ☹ |
| 5. I am looking forward to learning science in secondary school | ☺ | 😐 | ☹ |
| 6. When scientists give an explanation about something it is always true | ☺ | 😐 | ☹ |
| 7. Once a science fact is discovered it doesn't change | ☺ | 😐 | ☹ |
| 8. Different scientists can have different answers to the same questions | ☺ | 😐 | ☹ |
| 9. Scientists sometimes use their imaginations to explain things | ☺ | 😐 | ☹ |

Think about **science class in school**. Describe your favourite science lesson.

_____

_____

Why did you enjoy it?

_____

_____

Think about **science class in school**. Describe a school science lesson that you didn't enjoy.

_____

_____

Why didn't you enjoy it?

_____

_____

Think about how your class does **science in school**. Draw a picture of yourself and your class doing science at school.

**Thank you!**

## Teacher Guidelines for Administering Questionnaire

**Please read through these guidelines before giving the questionnaire to your class.**
Read the following instructions in *italics* aloud to your class:

> ***Our school has agreed to complete this questionnaire on primary school science. Children all over Ireland are also completing this questionnaire. It is really important that every question is answered so that we can find out what children like you think about science at school. This information may help us to make school science better.***
>
> ***Please do not put your name on the questionnaire.***
>
> ***We will begin by filling out the first box.***
> ***I am a girl/ I am a boy. Please put a tick in the box next to the correct answer.***
> ***Now fill in your age.***
>
> ***I am in what class. Please tick the correct box, so if you are in 3rd class please tick that box.***

At this point, please check pupils have completed these boxes correctly.

> ***For the rest of the questions, there are no right or wrong answers. Your answer is about what you think.***
>
> ***If you fill in an answer and then change your mind do not rub it out but instead put an x through that answer and fill in what you meant to say.***

It may be necessary to demonstrate this on the board.

**Part 1: What I think about school. I like school-**

***If you think yes, I like school, colour in the first smiley face.***
***If you think I'm not sure, colour in the middle face.***
***If you think no, I don't like school, colour in the sad face.***

**At this stage please check to see if pupils have understood what to do.**

The class may then proceed and complete the questionnaire unaided. However, you may continue reading the questionnaire aloud. This may be useful if there are many children with special needs in your class.

The last page requires children to write answers and also draw a picture. If there are members of your class who you feel may have difficulties here, please feel free to help them. If necessary, you may split the questionnaire for completion into sittings.

**If a child is stuck, please read the question to them. Please do not explain or re-phrase the question. If they are still unsure ask them to '*answer how you think best*'. Please remind them that there are no right or wrong answers to these questions.**

If there is something that child does not want to fill in they can leave it blank.

It is vital that all types of children are represented in this study and we thank you for your time and patience in the facilitation of this study

Thank you for your cooperation

*Primary Science in Schools: National Survey*

## Class Teacher Questionnaire

**Thank you for completing this. Your responses will help us with further analysis of the pupils' questionnaire.**

**Please tick as appropriate:**

1. Are you Male ☐ Female ☐

2. Which class(es) are you teaching this year? ☐

3. How many children are in your class? Total ☐
   Number of Boys ☐
   Number of Girls ☐

4. How many children with special needs are in your class? ☐

5. In what type of school do you teach? Please tick ALL relevant boxes

   a) Location
   Urban ☐
   Rural ☐

   b) Type of school
   Junior school ☐
   Senior school ☐
   Vertical school (all classes to 6th) ☐
   Other Please specify _____

   c) Gender mix
   Boys only ☐
   Girls only ☐
   Mixed gender ☐

   d) Language of instruction
   English ☐
   Irish: Gaelscoil ☐
   Irish: Scoil sa Ghaeltacht ☐
   Other Please specify _____

   e) Is your school involved in the School Support Programme (DEIS)? Yes ☐
   No ☐

6. Does your class use a science textbook? Yes ☐
   No ☐
   If yes please name _____

7. Please tick the strand(s) from the curriculum that your class has met since September
   Living things ☐
   Energy and forces ☐
   Materials ☐
   Environmental Awareness and Care ☐

Thank you for taking the time to complete this questionnaire.

**Please return this with your pupils' questionnaires.**

## Ceistiúchán

**Faigh cabhair ó do mhúinteoir len é seo a chomhlánadh (líonadh) más gá.**

| | |
|---|---|
| Is cailín mé ☐ Is buachaill mé ☐ (Cuir tic sa bhosca) | |
| M'aois: Tá mé ☐ (m)bliana d'aois. | |
| Rang: Tá mé i rang 3 ☐ 4 ☐ 5 ☐ 6 ☐ (Cuir tic i mbosca AMHÁIN) | |

**Dathaigh an aghaidh is gaire do do thuairim.**

| **Cad é mo thuairim faoin scoil:** | **Is ea** ☺ | **Níl mé cinnte** 😐 | **Ní hea** ☹ |
|---|---|---|---|
| 1. Is maith liom an scoil. | ☺ | 😐 | ☹ |
| 2. Tá mé sona ar scoil. | ☺ | 😐 | ☹ |
| 3. Bím ag obair chomh crua agus is féidir liom ar scoil. | ☺ | 😐 | ☹ |
| 4. Tá suim agam sa scoil. | ☺ | 😐 | ☹ |
| 5. Is breá liom obair scoile. | ☺ | 😐 | ☹ |
| 6. Is breá liom bheith ag obair le mo chairde ar scoil . | ☺ | 😐 | ☹ |

| **Is breá liom bheith ag foghlaim faoi …** | **Is ea** ☺ | **Níl mé cinnte** 😐 | **Ní hea** ☹ |
|---|---|---|---|
| 1. Feithidí agus mionbheithigh | ☺ | 😐 | ☹ |
| 2. Maighnéid | ☺ | 😐 | ☹ |
| 3. Ag sábháil fuinnimh agus ag athchúrsáil | ☺ | 😐 | ☹ |
| 4. Conas a oibríonn an corp daonna | ☺ | 😐 | ☹ |
| 5. Conas a thaistealaíonn fuaim | ☺ | 😐 | ☹ |
| 6. Solaid, leachtanna agus gáis | ☺ | 😐 | ☹ |
| 7. Teas inár dtithe cónaithe | ☺ | 😐 | ☹ |
| 8. Ábhair a úsáidimid chun rudaí dhéanamh mar shampla, adhmad, miotal agus plaisteach | ☺ | 😐 | ☹ |

| **Is maith liom bheith ag foghlaim faoi …** | **Is ea** ☺ | **Níl mé cinnte** 😐 | **Ní hea** ☹ |
|---|---|---|---|
| 9. Plandaí agus conas a fhásann siad | ☺ | 😐 | ☹ |
| 10. Conas a oibríonn agus a bhogann meaisíní | ☺ | 😐 | ☹ |
| 11. Conas aire a thabhairt don imshaol | ☺ | 😐 | ☹ |
| 12. Cad a tharlaíonn nuair a mheascann tú rudaí le chéile | ☺ | 😐 | ☹ |
| 13. Ainmhithe ó áiteanna mórthimpeall an domhain | ☺ | 😐 | ☹ |
| 14. Leictreachas, cadhnraí, bolgáin solais lasca | ☺ | 😐 | ☹ |
| 15. Aireagáin agus fionnachtana | ☺ | 😐 | ☹ |
| 16. Cad a tharlaíonn do rudaí nuair a théann tú agus nuair a fhuaraíonn tú iad. | ☺ | 😐 | ☹ |
| 17. Conas is féidir a bheith aclaí agus sláintiúil | ☺ | 😐 | ☹ |
| 18. Solas, scátháin agus scáileanna | ☺ | 😐 | ☹ |

**Dathaigh an aghaidh is gaire do do thuairim.**

| **Na rudaí is maith liom faoi cheachtanna eolaíochta:**<br>Is breá liom eolaíocht nuair a …. | **Is ea** ☺ | **Níl mé cinnte** 😐 | **Ní hea** ☹ |
|---|---|---|---|
| 1. Déanaim triail liom féin | ☺ | 😐 | ☹ |
| 2. Déanaim triail le mo chairde | ☺ | 😐 | ☹ |
| 3. Bím ag féachaint ar mo mhúinteoir ag déanamh triaile | ☺ | 😐 | ☹ |
| 4. Pleanálaim agus déanaim mo thriail féin | ☺ | 😐 | ☹ |
| 5. Cóipeálaim ón gclár bán/dubh | ☺ | 😐 | ☹ |
| 6. Míníonn mo mhúinteoir rudaí don rang | ☺ | 😐 | ☹ |
| 7. Tagann cuairteoirí isteach agus labhraíonn siad linn faoin eolaíocht | ☺ | 😐 | ☹ |
| 8. Téimid ar thurais eolaíochta ón scoil | ☺ | 😐 | ☹ |
| 9. Téimid taobh amuigh den rang chun eolaíocht a dhéanamh | ☺ | 😐 | ☹ |

| **Na rudaí a mbainim taitneamh astu i gceachtanna eolaíochta:**<br>Bainim taitneamh as an eolaíocht nuair a …. | **Is ea**<br>☺ | **Níl mé cinnte**<br>😐 | **Ní hea**<br>☹ |
|---|---|---|---|
| 10. Úsáidim cláir ríomhaireachta sa cheacht eolaíochta | ☺ | 😐 | ☹ |
| 11. Úsáidim an t-idirlíon ar scoil chun eolas a fháil faoin eolaíocht | ☺ | 😐 | ☹ |
| 12. Breathnaímid ar chláir eolaíochta ar scoil | ☺ | 😐 | ☹ |
| 13. Comhlánaim (líonaim) an leabhar saothair/bileog saothair | ☺ | 😐 | ☹ |
| 14. Scríobhaim faoi rud éigin atá déanta agam sa cheacht eolaíochta | ☺ | 😐 | ☹ |
| 15. Dearaim agus déanaim mo chuid rudaí féin | ☺ | 😐 | ☹ |
| 16. Léim mo leabhar scoile eolaíochta | ☺ | 😐 | ☹ |

**Dathaigh an aghaidh is gaire do do thuairim.**

| **Cad é mo thuairim faoin eolaíocht:** | **Is ea**<br>☺ | **Níl mé cinnte**<br>😐 | **Ní hea**<br>☹ |
|---|---|---|---|
| 1. Tá eolaíocht scoile éasca | ☺ | 😐 | ☹ |
| 2. Tá eolaíocht scoile suimiúil | ☺ | 😐 | ☹ |
| 3. Is maith liom an eolaíocht níos fearr ná aon ábhar eile | ☺ | 😐 | ☹ |
| 4. Bím ag súil leis na ceachtanna eolaíochta | ☺ | 😐 | ☹ |
| 5. Tá mé ag súil le heolaíocht a fhoghlaim san iar-bhunscoil | ☺ | 😐 | ☹ |
| 6. Nuair a mhíníonn eolaithe rud éigin, bíonn sé fíor i gcónaí | ☺ | 😐 | ☹ |
| 7. Nuair a aimsítear firic eolaíochta ag am faoi leith, ní athraíonn sí | ☺ | 😐 | ☹ |
| 8. Bíonn freagraí difriúla ag eolaithe éagsúla ar na ceisteanna céanna | ☺ | 😐 | ☹ |
| 9. Úsáideann eolaithe a gcuid samhlaíochta chun rudaí a mhíniú uaireanta | ☺ | 😐 | ☹ |

Bí ag smaoineamh faoin g**ceacht eolaíochta ar scoil**. Déan cur síos ar an gceacht ab fhearr a thaitin leat.

_____

_____

Cén fáth ar thaitin sé leat?

_____

_____

Bí ag smaoineamh faoin g**ceacht eolaíochta ar scoil**. Déan cur síos ar cheacht eolaíochta scoile nár thaitin leat.

_____

_____

Cén fáth nár thaitin sé leat?

_____

_____

Bí ag smaoineamh faoi conas a dhéanann do rangsa **eolaíocht ar scoil**. Tarraing pictiúr díot féin agus de do rang ag déanamh eolaíochta ar scoil.

**Go raibh maith agat !**

**Eolaíocht sa Bhunscoil: Suirbhé Náisiúnta**
**Treoirlínte do Bhainistiú an Cheistiúcháin**

## Léigh na treoirlínte seo a leanas sula dtugtar an ceistiúchán do do rang, le do thoil.

Léigh na treoirlínte seo a leanas os ard do do rang:

***Tá an scoil s'againne tar éis a gheallúint go gcomhlánfaimid (líonfaimid) an ceistiúchán seo faoin eolaíocht sa bhunscoil. Tá páistí ar fud na hÉireann ag comhlanú (líonadh) an cheistiúcháin seo freisin. Tá sé an-tábhachtach go mbeidh freagra ar gach uile cheist chun go bhfaighimid amach céard/cad iad tuairimí páistí cosúil libhse ar an eolaíocht sa bhunscoil. B'fhéidir go gcabhróidh an t-eolas seo linne an eolaíocht sa bhunscoil a fheabhsú.***

*Ná scríobh d'ainm ar an gceistiúchán le do thoil.*

***Tosóimid leis an gcéad bhosca a chomhlánú (líonadh), mar shampla:***
***Is cailín mé./Is buachaill mé. Cuir tic sa bhosca in aice leis a bhfreagra ceart.***
*Anois líon isteach d'aois.*

***Cén rang ina bhfuil mé? Cuir tic sa bhosca ceart, mar sin má tá tú i rang 3 cuir tic sa bhosca sin, le do thoil.***

Ag an bpointe seo, deimhnigh go bhfuil na páistí tar éis tic a chur sna boscaí cearta.

***Maidir leis na ceisteanna eile, níl aon fhreagra ceart nó mícheart. Is é do thuairimse an freagra, is é sin cad a cheapann tusa?***

***Má tá freagra scríofa agat agus má athraíonn tú d'intinn, ná glan amach é. Cuir X tríd, agus scríobh an rud a bhí i gceist agat a scríobh .***

B'fhéidir go mbeidh ort é seo a thaispeáint ar an gclár dubh/bán.

*Cuid 1: Cad é mo thuairim faoin scoil. Is maith liom an scoil-*
*Más é do thuairim, Is ea, is maith liom an scoil, cuir dath ar an gcéad aghaidh shona.*
*Más é do thuairim, Níl mé cinnte, cuir dath ar an aghaidh sa lár.*
*Más é do thuairim, Ní maith liom an scoil, cuir dath ar an aghaidh bhrónach.*

**Ag an bpointe seo deimhnigh gur thuig na páistí cad a bhí le déanamh acu**.

Ansin is féidir leis an rang dul ar aghaidh agus an ceistiúchán a líonadh gan aon chabhair. Is féidir leatsa leanúint ar aghaidh ag léamh an cheistiúcháin os ard, mar sin féin. Cabhróidh sé seo má tá páistí le riachtanais speisialta i do rang.

Ar an leathanach deireanach tá ar na páistí freagraí a scríobh agus pictiúr a tharraingt freisin. Má tá páistí i do rangsa a cheapann go mbeidh deacrachtaí acu leis seo, is féidir leat cabhrú leo. Is féidir leat an ceistiúchán a roinnt ina dhá leath más gá, agus é a fhreagairt ag dhá am faoi leith.

**Munar féidir leis an bpáiste leanúint ar aghaidh, léigh an cheist dó/di. Ná mínigh an cheist le do thoil, agus ná simpligh an teanga. Má tá siad neamhchinnte fós abair leo '*Tabhair an freagra is fearr atá agat.*' Meabhraigh dóibh nach bhfuil aon fhreagra ceart nó mícheart.**

Má tá spás éigin nach dteastaíonn ón bpáiste a líonadh, is féidir leo é a fhágáil folamh.

Tá sé an-tábhachtach go mbeidh réimse leathan páistí sa staidéar seo. Gabhaimid buíochas leat as do chuid ama agus do chuid foighne in éascú an staidéir seo.

Buíochas faoi do chomhoibriú.

**Eolaíocht sa Bhunscoil: Suirbhé Náisiúnta**
**Ceistiúchán an mhúinteoir ranga**

**Ár mbuíochas as é seo a chomhlánú (líonadh). Cabhróidh do chuid freagraí le tuilleadh anailíse a dhéanamh ar fhreagraí na ndaltaí.**

**Cuir tic mar a oireann:**

1. An Fear ☐ nó Bean thú? ☐

2. An rang/na ranganna atá á m(h)úineadh agat? ☐

3. Cé mhéad páistí atá i do rang? Iomlán ☐
   líon buachaillí ☐
   lion cailíní ☐

4. Cé mhéad páistí le riachtanais speisialta atá i do rang? ☐

5. Cén cineál scoile ina múineann tú? Cuir tic sna boscaí cuí GO LÉIR le do thoil

   a) Áit: Cathair ☐
   Faoin tuath ☐

   b) Cineál scoile Scoil shóisearach ☐
   Scoil shinsearach ☐
   Scoil ingearach (gach rang go rang 6) ☐
   Eile Abair cén cineál _____

   c) Meascán inscne Buachaillí amháin ☐
   Cailíní amháin ☐
   Meascán inscne ☐

   d) Meán teagaisc Béarla ☐
   Gaeilge: Gaelscoil ☐
   Gaeilge: Scoil Ghaeltachta ☐
   Eile, Abair cén teanga __

e) An bhfuil aon bhaint agat leis an scéim tacaíochta DEIS, nó an bhfuil tú rannpháirteach inti?
Tá. ☐
Níl. ☐

6. An bhfuil téacsleabhar eolaíochta ag do rangsa? Tá ☐
Níl ☐
Má tá, ainmnigh é, le do thoil. _____

7. Cuir tic leis na snáitheanna ón gcuraclam atá clúdaithe ag do rangsa ó mhí Mheán Fómhair

   Dúile beo ☐
   Fuinneamh agus fórsaí ☐
   Ábhar ☐
   Feasacht agus cúram imshaoil ☐

Buíochas as an am a chaitheamh le comhlánú an cheistiúcháin seo.
Seol ar ais é seo le ceistiúchán na ndaltaí, le do thoil

# APPENDIX B

# CORRESPONDENCE WITH CASE STUDY AND QUESTIONNAIRE SCHOOLS

**Coláiste Phádraig**

**Droim Conrach**
**Baile Átha Cliath 9**

**(Coláiste de chuid Ollscoil Chathair Bhaile Átha Cliath)**

**St Patrick's College**

**Drumcondra**
**Dublin 9**

**(A College of Dublin City University)**

**Children in Primary Science: National Project**

Dear Principal,

Many thanks for your interest in participating in the above project, as discussed in our recent telephone conversation. We would be delighted if you could help us in this important national study of primary school children's engagement with science. We recognise that schools are extremely busy places, and we appreciate the significant contribution that your school would be making to this research.

Please find enclosed some details about this NCCA-funded project and what it would involve for your school. We hope this will answer any initial questions that you may have. We shall be in touch again in due course to discuss the next steps that need to be taken, if you are able to participate in this work.

If you wish to ask further questions about the study, please contact the research coordinators, Janet Varley, Clíona Murphy and Órlaith Veale at St. Patrick's College, Drumcondra, Dublin 9 (Tel: 01 884 2000). Many thanks for your time.

Yours sincerely

Many thanks,

Janet Varley, Clíona Murphy and Órlaith Veale
**Children in Primary Science Project**

**Coláiste Phádraig**

**Droim Conrach**
**Baile Átha Cliath 9**

**(Coláiste de chuid Ollscoil Chathair Bhaile Átha Cliath)**

**St Patrick's College**

**Drumcondra**
**Dublin 9**

**(A College of Dublin City University)**

## Children in Primary Science: National Project

Dear Parent/ Guardian,

We are working on a study funded by the National Council for Curriculum and Assessment (NCCA) to review science in primary schools. We hope to find out about children's engagement with primary school science and what, if any changes need to be made. The (Name of Pilot) National School has kindly agreed to take part in the initial phase of the study. We are writing to seek your permission for your child's involvement in this.

It is hoped that researchers will observe your child's class during science lessons over the next fortnight. They will take notes and may talk to children about what they are doing. Small groups of children from your child's class may also be asked to evaluate a pre-prepared questionnaire. Their comments will be invaluable in the preparation of the follow up national study. Some children may also be interviewed at school to find out what they think about science. Notes taken by the researchers present will be compared and then destroyed.

Each researcher in our team is a qualified, experienced primary school teacher. No child will be identifiable by name, class or school on anything that is written about this study. Only the research team will have access to any notes made.

If you wish to ask further questions about the study, please contact the research coordinators, Janet Varley, Clíona Murphy and Órlaith Veale at St. Patrick's College, Drumcondra, Dublin 9 (Tel: 01 884 2000).

- Your child does not have to participate in the study.
- Your child can choose to withdraw from the study at any time.

Many thanks,

Janet Varley, Clíona Murphy and Órlaith Veale
**Children in Primary Science Project**

---

## Permission Slip. Please sign and return to your child's class teacher by [date]

I agree/ do not agree* that _____can be observed during their usual science class.

I agree/ do not agree* that they can take part in a group interview about science.
(*Delete as appropriate)

Signature of parent/ guardian _____ Date _____

**Coláiste Phádraig**

**Droim Conrach**
**Baile Átha Cliath 9**

**(Coláiste de chuid Ollscoil**
**Chathair Bhaile Átha Cliath)**

**St Patrick's College**

**Drumcondra**
**Dublin 9**

**(A College of Dublin City**
**University)**

# Science in Primary Schools Research Project
# Information for Case Study Schools

**Who is doing this project?**
This project is being carried out by Dr. Janet Varley and Clíona Murphy, who are both primary science lecturers at St. Patrick's College, Drumcondra, Dublin 9. A third member of the research team is Órlaith Veale, who has been seconded from primary teaching for the duration of the project. All three researchers are qualified and experienced primary school teachers.

**What is it for?**
The researchers are interested to find out how children are engaging with science in the primary classroom. They are also keen to find out how pupils' experiences are shaping their views of school science and their attitudes towards science in general. For pupils nearing the end of their time in primary school, we are also hoping to find out what their perceptions of, and hopes for their studies of science at second level might be. This project has been funded by the NCCA as part of a wider project to look at the impact of the revised primary school curriculum for science. Another aspect of our project will gather information via questionnaires to pupils in a much wider number of primary schools, and will include interviews and questionnaires involving pupils in their first year at secondary school. We are hoping to discover the impact that the revised primary science curriculum is having on pupils' interests in, and attitudes towards science.

**When will this take place?**
We would aim to conduct the classroom observations and pupil interviews at mutually convenient dates during October and November 2007.

**What will it involve for my school?**
For each school, we would like to conduct between one and three class observations of pupils during a normal science lesson, and between one and three small group interviews with pupils from the classes selected for observation. This would therefore involve a maximum of three classes in any given school. There would be no more than 4 pupils in any small group interview. The project aims to find out more about pupils' engagement with, and interests in school science. Observations would not focus on, or seek to impact on the teachers' role. The observations and interviews would be conducted by one of the three researchers named above.

We would emphasise that the number and timings of the observations and interviews would be negotiated with participating schools to fit in with existing timetables and daily routines. In the study as a whole, we would like to gather data from all primary age groups, with the exception of Junior Infant pupils, who we recognise will be at a very early stage in their first year at school. However, the classes and pupils involved in any given school would be decided in consultation with school staff.

To provide background information the teachers whose classes are to be observed would also be asked to provide some details about their scheme of work to contextualise the lesson observed.

**What will it involve for the pupils?**
Pupils in participating classes would be observed by one of the researchers named above, during a normal science lesson. Selected pupils from a participating class would be interviewed in a small group, on school premises and in school time. Suitable pupils for the small group interviews would be selected in liaison with the school principal and class teacher, with permission from the pupils, and their parents or guardians also being obtained. The interviews will need to be tape recorded, for ease of data gathering.

**What if I agree to participate then change my mind?**
Your school, or individual classes or pupils can withdraw from the research at any time. We would not use any data collected from withdrawn groups or individuals.

**What will happen to the information collected from my school?**
The names of participating schools and pupils will be confidential and will not be revealed or identifiable in any publications. Any tape recordings of pupil interviews will be destroyed once the information has been transcribed in a suitably anonymous format. The data from this project will be written up and presented in a report to the NCCA. Further publications in academic/ professional journals and at academic/ professional conferences may also be prepared. Most importantly, the researchers aim to write a report for principals, teachers and parents that will summarise the outcomes of the research for this audience. This will be circulated to all participating schools after completion of the project.

**What should I do if I would like my school to be involved?**
We would be delighted if your school could be involved in this important study of primary school science. In the first instance, please contact Órlaith Veale, at St. Patrick's College, Drumcondra, Dublin 9. Her direct line is 01-884 2309 or you can email her at Orlaith.Veale@spd.dcu.ie. It will then be possible to provide more details, ask further questions and organise a formal request for permission to conduct the research in your school. We look forward to working with you.

**Coláiste Phádraig**

**Droim Conrach**
**Baile Átha Cliath 9**

**(Coláiste de chuid Ollscoil Chathair Bhaile Átha Cliath)**

**St Patrick's College**

**Drumcondra**
**Dublin 9**

**(A College of Dublin City University)**

## Children in Primary Science: National Project

Dear Parent/ Guardian,

We are working on a study funded by the National Council for Curriculum and Assessment (NCCA) to review science in primary schools. We hope to find out what children's attitudes towards the new science curriculum are, and what, if any changes need to be made to it. Your child's school has kindly agreed to take part as one of our case-study schools.

Each researcher in our team is a qualified, experienced primary school teacher. As part of this study one researcher will observe your child's class during a science lesson this term. During the lesson they will take notes and they may also talk to some of the children about what they are doing,

Subsequently, a small group of children from your child's class will be interviewed to find out what they think about science. This interview will be tape-recorded so that it can be typed up afterwards. This tape will be destroyed once its contents have been typed up. No child will be identifiable by name, class or school on anything that is written about the study. Only the research team will have access to any notes made.

If you wish to ask further questions about the observation and research, please contact the research coordinators, Janet Varley, Clíona Murphy and Órlaith Veale at St. Patrick's College, Drumcondra, Dublin 9 (Tel: switchboard: 01 884 2000).

- Your child can choose to withdraw from the study at any time.
- Your child does not have to participate in the group interview.
- You can request that your child/ your child's data be withdrawn from the study at any time.

---

**Permission Slip. Please sign and return to your child's class teacher by [date]**

I agree/ do not agree* to allow _____to take part in this research.

I agree/ do not agree* to allow _____ to take part in a group interview about science.

(*Delete as appropriate)
Signature of parent/ guardian _____ Date _____

**Coláiste Phádraig**

**Droim Conrach**
**Baile Átha Cliath 9**

**(Coláiste de chuid Ollscoil Chathair Bhaile Átha Cliath)**

**St Patrick's College**

**Drumcondra**
**Dublin 9**

**(A College of Dublin City University)**

## Children in Primary Science: National Project

Dear Principal,

We are working on a study funded by the National Council for Curriculum and Assessment (NCCA) to review science in primary schools. This study seeks to find out how children are engaging with science in the primary classroom. It is also aiming to find out how pupils' experiences are shaping their views of school science and their attitudes towards science in general. For pupils nearing the end of their time in primary school, we are also hoping to find out what their perceptions of, and hopes for their studies of science at second level might be. We hope to find out what children's attitudes towards the new science curriculum are, and what, if any changes need to be made to it.

As part of this study primary children from 3rd to 6th and 1st year secondary students across Ireland will complete a questionnaire about their attitudes towards science. We would be delighted if your school could be involved in this important study. We are seeking your permission for _____class from your school to complete the questionnaire. Its average completion time is 20-30 minutes. We would ask the class teacher to facilitate the completion of this exercise. A sample of the questionnaire that the children will complete is included. If your school agrees to take part in the study further questionnaire copies will be sent out next week.

Please note that the names of participating schools and pupils will be confidential and will not be revealed or identifiable in any publications.

If you wish to ask further questions about the research, please contact the research coordinators, Janet Varley, Clíona Murphy and Órlaith Veale at St. Patrick's College, Drumcondra, Dublin 9 (Tel: switchboard: 01 884 2000).

Many thanks,

Janet Varley, Clíona Murphy and Órlaith Veale
**Children in Primary Science Project**

**Coláiste Phádraig**

**Droim Conrach**
**Baile Átha Cliath 9**

**(Coláiste de chuid Ollscoil Chathair Bhaile Átha Cliath)**

**St Patrick's College**

**Drumcondra**
**Dublin 9**

**(A College of Dublin City University)**

## Páistí agus Eolaíocht sa Bhunscoil: Tionscadal Náisiúnta

A Phríomhoide, a chara,

Táimid ag déanamh staidéir, maonaithe ag an gComhairle Náisiúnta Curaclaim agus Measúnachta (CNCM), chun athbhreithniú a dhéanamh ar an eolaíocht sa bhunscoil. Tá an staidéar seo ag súil le heolas a fháil faoi cé chomh tógtha is atá na páistí leis an eolaíocht sa seomra ranga bunscoile. Tá an staidéar ag iarraidh a dhéanamh amach cén tionchar atá ag eispéiris na ndaltaí ar an eolaíocht sa bhunscoil, agus ar a ndearcadh i leith na heolaíochta i gcoitinne. Táthar ag súil go gcabhróidh an staidéar seo le forbairt a dhéanamh ar an ábhar sa todhchaí, agus chun tacaíocht a fháil don eolaíocht sa bhunscoil.

Mar chuid den staidéar seo, líonfaidh páistí ó rang 3 go rang 6, agus daltaí ón gcéad bhliain iar-bhunscoile, ceistiúchán gearr faoin eolaíocht ar scoil. Roghnaíodh do scoilse mar chuid de shampla náisiúnta a ghlacfaidh páirt sa staidéar. Bheimis an-sásta dá mbeadh do scoil páirteach linn.

Táimid ag lorg cead do pháistí ó rang _____ i do scoil chun an ceistiúchán a chomhlánú (líonadh). Ba cheart nach dtógfadh sé níos faide ná 20-30 nóiméad. Bheimis buíoch dá gcabhródh an múinteoir ranga lena dháileadh agus lena líonadh. Beimid i dteagmháil leat go luath le fáil amach an bhfuil do scoil in ann páirt a ghlacadh sa staidéar. Ansin seolfar chugat nótaí faoina bhainistiú. Tá ceistiúchán samplach faoi iamh mar eolas.

Bí cinnte go gcoimeádfar na scoileanna atá páirteach sa tionscadal faoi rún, agus nach n-ainmneofar iad féin ná na páistí in aon cháipéis a chuirfear i gcló.

Más mian leat tuilleadh ceisteanna faoin tionscadal taighde a chur, déan teagmháil le comhordaitheoirí an taighde; Janet Varley, Clíona Murphy agus Órlaith Veale ag Coláiste Phádraig, Droim Conrach, Baile Átha Cliath 9. (Fón, malartán an choláiste: 01 884 2000).

Is mór linn an méid a chuirfidh daltaí do scoilse leis an tionscadal náisiúnta seo ar an eolaíocht sa bhunscoil, agus táimid ag súil le labhairt leat go luath.

Míle buíochas,

Janet Varley, Clíona Murphy agus Órlaith Veale

**Páistí agus Eolaíocht sa Bhunscoil: Tionscadal Náisiúnta**

**Coláiste Phádraig**

**Droim Conrach**
**Baile Átha Cliath 9**

**(Coláiste de chuid Ollscoil Chathair Bhaile Átha Cliath)**

**St Patrick's College**

**Drumcondra**
**Dublin 9**

**(A College of Dublin City University)**

## Páistí agus Eolaíocht sa Bhunscoil: Tionscadal Naisiúnta

A Thuismitheoir/Chúramóir, a chara,

Táimid ag déanamh staidéir, maoinithe ag an gComhairle Náisiúnta Curaclaim agus Measúnachta (CNCM), chun athbhreithniú a dhéanamh ar an eolaíocht sa bhunscoil. Táimid ag súil le heolas a fháil ar cé chomh tógtha is atá na páistí leis an eolaíocht sa bhunscoil, agus cé na hathruithe atá le déanamh, más gá. Tá an scoil, ina bhfuil do pháiste, tar éis a rá go mbeidh siad páirteach sa staidéar. Táimid ag scríobh chun cead a fháil uait le go nglacfaidh do pháiste páirt sa staidéar náisiúnta seo.

Déanfaidh taighdeoir amháin **dírbhreathnú** ar rang do pháiste agus iad i mbun cheacht eolaíochta, i rith an téarma seo. Tógfar nótaí, agus b'fhéidir go labhrófar leis na páistí faoi céard atá ar siúl acu.

Cuirfear **agallamh** ar ghrúpa páistí as rang do pháiste le fáil amach céard iad a dtuairimí faoin eolaíocht sa bhunscoil. Déanfar taifeadadh fuaime den agallamh gearr, neamhfhoirmiúil seo chun go mbeifear in ann é a athscríobh. Scriosfar an taifeadadh nuair a bheidh an t-ábhar clóscríofa.

Is múinteoirí cáilithe le taithí iad gach uile bhall den fhoireann taighde. Ní ainmneofar aon pháiste as féin nó de réir a ranga nó a scoile, in aon cháipéis a scríobhfar faoin staidéar seo. Ní bheidh éinne ach na taighdeoirí amháin in ann teacht ar na nótaí a dhéanfar.

Más mian leat tuilleadh ceisteanna faoin staidéar a chur, déan teagmháil le comhordaitheoirí an taighde; Janet Varley, Clíona Murphy nó Órlaith Veale ag Coláiste Phádraig, Droim Conrach, Baile Átha Cliath 9 (Fón: 01 884 2000).

- Ní gá do do pháiste páirt a ghlacadh sa staidéar.
- Is féidir le do pháiste aistarraingt as an staidéar ag am ar bith.
- Is féidir leat iarraidh go n-aistarraingeofar do pháiste/sonraí do pháiste ón staidéar am ar bith.

Míle buíochas,

Janet Varley, Clíona Murphy agus Órlaith Veale
**Tionscadal na bPáistí san Eolaíocht Bunscoile**

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**Duillín ceada. Sinigh é seo agus cuir ar ais chuig múinteoir do pháiste faoi _____**

Aontaím/Ní aontaím* gur féidir mo pháiste _____ a **dhírbhreathnú** i rith an ghnáthcheachta eolaíochta.

Aontaím/Ní aontaím* gur féidir taifeadadh fuaime a dhéanamh de **ghrúpagallamh** faoin eolaíocht, ina mbeidh mo pháiste páirteach.
(*Scrios mar a oiltear)

Síniú an tuismitheora/chúramóra _____ Dáta _____

**Coláiste Phádraig**

**Droim Conrach**
**Baile Átha Cliath 9**

**(Coláiste de chuid Ollscoil Chathair Bhaile Átha Cliath)**

**St Patrick's College**

**Drumcondra**
**Dublin 9**

**(A College of Dublin City University)**

## Páistí agus Eolaíocht sa Bhunscoil: Tionscadal Náisiúnta

A Phríomhoide, a chara,

Táimid ag déanamh staidéir, maonaithe ag an gComhairle Náisiúnta Curaclaim agus Measúnachta (CNCM), chun athbhreithniú a dhéanamh ar an eolaíocht sa bhunscoil. Tá an staidéar seo ag súil le heolas a fháil faoi cé chomh tógtha is atá na páistí leis an eolaíocht sa seomra ranga bunscoile. Tá an staidéar ag iarraidh a dhéanamh amach cén tionchar atá ag eispéiris na ndaltaí ar an eolaíocht sa bhunscoil, agus ar a ndearcadh i leith na heolaíochta i gcoitinne. Táthar ag súil go gcabhróidh an staidéar seo le forbairt a dhéanamh ar an ábhar sa todhchaí, agus chun tacaíocht a fháil don eolaíocht sa bhunscoil.

Mar chuid den staidéar seo, líonfaidh páistí ó rang 3 go rang 6, agus daltaí ón gcéad bhliain iar-bhunscoile, ceistiúchán gearr faoin eolaíocht ar scoil. Roghnaíodh do scoilse mar chuid de shampla náisiúnta a ghlacfaidh páirt sa staidéar. Bheimis an-sásta dá mbeadh do scoil páirteach linn.

Táimid ag lorg cead do pháistí ó rang 4 i do scoil chun an ceistiúchán a chomhlánú (líonadh). Ba cheart nach dtógfadh sé níos faide ná 20-30 nóiméad. Bheimis buíoch dá gcabhródh an múinteoir ranga lena dháileadh agus lena líonadh. Tá clúdach litreach, le stampa agus seoladh air, faoi iamh leis seo. Tá súil againn na ceistiúcháin chomhlánaithe a fháil ar ais uaibh roimh an _____.

Bí cinnte go gcoimeádfar na scoileanna atá páirteach sa tionscadal faoi rún, agus nach n-ainmneofar iad féin ná na páistí in aon cháipéis a chuirfear i gcló.

Más mian leat tuilleadh ceisteanna faoin tionscadal taighde a chur, déan teagmháil le comhordaitheoirí an taighde; Janet Varley, Clíona Murphy agus Órlaith Veale ag Coláiste Phádraig, Droim Conrach, Baile Átha Cliath 9.(Fón, malartán an choláiste: 01 884 2309).

Is mór linn an méid a chuirfidh daltaí do scoilse leis an tionscadal náisiúnta seo ar an eolaíocht sa bhunscoil, agus táimid ag súil le labhairt leat go luath.

Míle buíochas,

Janet Varley, Clíona Murphy agus Órlaith Veale
**Páistí agus Eolaíocht sa Bhunscoil: Tionscadal Náisiúnta**

# APPENDIX C

# SUMMARY OF CASE STUDY SCHOOLS

| School | Language of Instruction | DEIS status | Gender | Single/ split classes | Location | Denomination | Participating Class(es) | ESL pupil(s)* | SEN pupil(s)** | Observation | Group interview | Questionnaire |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| A | English | Not DEIS | Mixed | Single | Urban | Catholic | S.I.<br>1st | Yes<br>Yes | Yes<br>Yes | Yes<br>Yes | No<br>No | No<br>No |
| B | English | DEIS | Mixed | Single | Urban | Multi-D | 1st | Yes | Yes | Yes | Yes | No |
| C | English | DEIS | Mixed Juniors<br>Senior Girls | Single | Urban | Catholic | 1st<br>6th | No<br>Yes | Yes<br>Yes | Yes<br>Yes | Yes<br>Yes | No<br>Yes |
| D | Irish | Not DEIS | Mixed | Single | Urban | Catholic | 2nd | No | No | Yes | Yes | No |
| E | English | Not DEIS | Boys | Single | Urban | Catholic | 2nd | Yes | Yes | Yes | Yes | No |
| F | English | Not DEIS | Mixed | Single | Urban | Multi-D | 2nd | Yes | Yes | Yes | Yes | No |
| G | English | Not DEIS | Mixed | Split | Rural | Catholic | 2nd/3rd mix | Yes | No | Yes | Yes | Yes |
| H | English | Not DEIS | Mixed | Single | Urban | Catholic | 3rd<br>4th | Yes<br>Yes | Yes<br>Yes | Yes<br>Yes | Yes<br>Yes | Yes<br>Yes |
| I | English | DEIS | Mixed | Split | Rural | Catholic | 3rd-6th mix | No | Yes | Yes | Yes | Yes |
| J | English | DEIS | Boys | Single | Urban | Catholic | 4th<br>6th | Yes<br>Yes | Yes<br>Yes | Yes<br>Yes | No<br>No | Yes<br>Yes |
| K | English | Not DEIS | Girls | Single | Urban | Catholic | 6th | No | Yes | Yes | Yes | Yes |

*Indicates classes that contained at least one ESL pupil(s) = pupil(s) with English as a second language.
**Indicates classes that contained at least one SEN pupil(s) = pupil(s) with special educational needs.

# APPENDIX D

# CASE-STUDY CLASSROOM OBSERVATION TIME-FRAME

# CASE-STUDY CLASSROOM OBSERVATION SCHEDULE

# SEMI- STRUCTURED INTERVIEW GUIDE (CHILDREN)

# Primary Science Curriculum Review

## Phase 1

***Case-Study Classroom Observation Time- frame***

**The following guide was used during the observation of both the Target Children and the whole-class science lesson in the case-study schools.**

| Minute | Activity |
|---|---|
| **0-2:** | Adapt to individual classroom setting |
| 2–4: | Observe child 1 |
| 4-6: | Fill in child 1 |
| 6-8: | Observe child 2 |
| 8-10: | Fill in child 2 |
| **10-15:** | **General observation** |
| 15-17: | Observe child 1 |
| 17-19: | Fill in child 1 |
| 19-21: | Observe child 2 |
| 21-23: | Fill in child 2 |
| **23-28:** | **General observation** |
| 28-30: | Observe child 1 |
| 30-32: | Fill in child 1 |
| 32–34: | Observe child 2 |
| 34-36: | Fill in child 2 |
| **36-41:** | **General observation** |

# Case-Study Classroom Observation Schedule

**Class:_____** **Topic:_____** **Date:_____**
**No. pupils: _____** **Time of Obs.:_____** **Target Child ID No 1:___**
**No. boys:____** **Duration of lesson:_____** **No 2:___**
**No. girls:____**

| Category | Code | Description | TC 1a | TC 2a | TC 1b | TC 2b | TC 1c | TC 2c |
|---|---|---|---|---|---|---|---|---|
| **9. Dialogue involving Target Child (TC) in** 1= TC is active participant 2= TC is audience to another child/ person | 9.1 | Discussing observations | | | | | | |
| | 9.2 | Interpretation | | | | | | |
| | 9.3 | Hypothesising/ Predicting | | | | | | |
| | 9.4 | General planning | | | | | | |
| | 9.5 | Discussing specific plans/ procedures | | | | | | |
| | 9.6 | Measurement/Counting | | | | | | |
| | 9.7 | Recording (Discussion about written work) | | | | | | |
| | 9.8 | Raising questions for investigation | | | | | | |
| | 9.9 | Critical reflection | | | | | | |
| **10. Other discussions involving the Target Child** | 10.1 | Recall of previous learning/ experiences | | | | | | |
| | 10.2 | Recap of work done | | | | | | |
| | 10.3 | Read out/discuss instructions | | | | | | |
| | 10.4 | About the meaning of words | | | | | | |
| | 10.5 | Asking for help | | | | | | |
| | 10.6 | Organising task | | | | | | |
| | 10.7 | Non-task | | | | | | |
| **8. Non-talking pupil activity (T.C.)** **Tick if viewed during 2 min observation period** | 8.1 | Making observations | | | | | | |
| | 8.2 | Planning independently | | | | | | |
| | 8.3 | Using measuring instruments inc. counting | | | | | | |
| | 8.4 | Using other materials/ equipment purposefully | | | | | | |
| | 8.5 | Collecting/clearing equipment | | | | | | |
| | 8.6 | Reading book/ worksheet | | | | | | |
| | 8.7 | Recording (not copying) | | | | | | |
| | 8.8 | Copying from a book/ sheet/ board | | | | | | |
| | 8.9 | Waiting for teacher | | | | | | |
| | 8.10 | Waiting for other pupils | | | | | | |
| | 8.11 | Attentive to teacher/SNA | | | | | | |
| | 8.12 | Attentive to other pupils | | | | | | |
| | 8.13 | Non-attentive to task | | | | | | |
| | 8.14 | Not classifiable e.g. leave room/toilet break | | | | | | |
| **11. Teacher talk** | 11.1 | Giving information on task | | | | | | |
| | 11.2 | Giving instructions on task | | | | | | |
| | 11.3 | Comment on pupil's answer (on task) | | | | | | |
| | 11.4 | Asking for account of progress | | | | | | |
| | 11.5 | Non-task | | | | | | |
| **12. Non-talk teacher act.** | 12.1 | Collate pupils' ideas (board/ OHP/Orally) | | | | | | |
| | 12.2 | Demonstrate activity/ what to do | | | | | | |
| | 12.3 | Listening to pupils | | | | | | |
| | 12.4 | Writing on/ correcting/ checking pupils' written work | | | | | | |

| Category | Code | Description | TC 1a | TC 2a | TC 1b | TC 2b | TC 1c | TC 2c |
|---|---|---|---|---|---|---|---|---|
| **2. Seating/ position of target child (T.C.)** **(M*)** | 2.1 | Alone | | | | | | |
| | 2.2 | Same sex pair | | | | | | |
| | 2.3 | Mixed sex pair | | | | | | |
| | 2.4 | Same sex group | | | | | | |
| | 2.5 | Mixed sex group | | | | | | |
| | 2.6 | Whole class | | | | | | |
| | | | | | | | | |
| **4. Audience/interaction** **(M*)** | 4.1 | Individual pupil | | | | | | |
| | 4.2 | Group | | | | | | |
| | 4.3 | Whole class | | | | | | |
| | 4.4 | Teacher | | | | | | |
| | 4.5 | Other (specify e.g. Special Needs Ass) | | | | | | |
| | 4.6 | None | | | | | | |
| | | | | | | | | |
| **5. Teacher** **(M*)** | 5.1 | Monitoring | | | | | | |
| | 5.2 | Involved | | | | | | |
| | 5.3 | Not present | | | | | | |
| | | | | | | | | |
| **13. Use of IT during lesson** | 13.1 | By children/ teacher in classroom (e.g. computer, interactive whiteboard etc) Y ☐ N ☐ | | | | | | |
| **Brief description of lesson:** | | | | | | | | |

*M denotes categories allocated on a majority rule basis. i.e. the code within a given category that was observed for the *majority* of a given 2-minute period was the one marked.

## *Semi- Structured Interview Guide (Children)*

The following interview guide was used during the group interviews of 3-4 children from each class observed in each case-study school. The length of each interview was scheduled for approximately 20-30 minutes depending on class level.

The strategies used for questioning children at different developmental levels are provided below. These included the following strategies used with the younger children.

- Imagining: ask the children to imagine that they had to explain to an alien what they were learning in science class in school. What is science?
- Storytelling: Inviting the children to help the interviewer to create a true picture about science in their classroom. Begin the story by saying "Once upon a time there were # children in X class. They were busy learning science with their teacher and their friends. Some of the important things they were learning about were….

The following areas were focused on during the group interviews. Samples of some of the verbal prompts/ probes used to explore science learning in school are also included.

### Children's Likes/ Dislikes, Successes/ Challenges

**Do you like doing science in school?**

- Why/ Why not?
- What kind of things do you like about science in school?
- What kind of things do you not like about science in school?
- Pretend I am an alien and don't know what science class is like in your class.
    - Could you describe a science lesson to me?
    - What would you be doing?
    - What would your teacher be doing?
    - Would you be reading a book?
    - Would your teacher be reading out of a book? Talking? Writing on the blackboard? Doing an experiment?

### Approaches and methods

**Do you ever do any work in groups?**
**(If Answer Yes)**

- What kind of things do you do in groups?
- Do you ever work in groups for science class?
- Do you like working in groups? Why / why not?
- What kind of things have you done in groups?
- Did you use any equipment/ materials?
- Did you have a special job to do?

## Previous science work

- Last week you did X in science class
- Could you tell me about this lesson?
- What did you like about it?
- Did you learn anything new?
- What did you learn?
- What was your favourite part of the lesson?
- Was there any part of this lesson that you didn't like? Why?

## Use of reading materials in science class

**Do you have a science book?**

- Do you like your science book?
- What do you like / dislike about it?
- Have you done any of the experiments in your science book?
- Did you do the experiment yourself or did your teacher show you?

## Use of ICT in science class

**Do you use computers in science class?**

- Have you ever used computers to do science?
- What kind of things did you do?
- Did you use science programmes?
- Did you record results of experiments on the computer?

## Children's thoughts on future science lessons

**If I were going to be your teacher next year, what kind of things would you like me to do in science?**

- What kind of things would like to do more of in science?
- What kind of things would like to do less of?

## Children's ideas on science in secondary school

**What do you think science will be like in secondary school?**

- Describe what you think science will be like in secondary school
- Do you think it will be easier / harder?
- Do you think you will be doing lots of experiments?
- Do you think you will have textbook?

# Appendix E

# Findings of Combined Observation Schedules From all 15 Case Study Classes Plus Definitions of Category Descriptions

Findings of Combined Observation Schedules From all 15 Case Study Classes:

# Re-Grouped Findings

# Findings of combined observation schedules from all 15 case study classes plus definitions of category descriptions

| Original Category | Code | Description | Definition | Total number of Respones |
|---|---|---|---|---|
| **9. Dialogue involving Target Child (TC)** | 9.1 | Discussing observations | Refers to description of characteristics of objects or situations which children may have directly perceived through their senses | 44 |
| | 9.2 | Interpretation | Drawing a conclusion or inference for which there is some evidence in the children's findings | 15 |
| | 9.3 | Hypothesising/ Predicting | Suggesting an explanation for an event, pattern or finding | 15 |
| | 9.4 | General planning | Relates to the general design of the plan | 14 |
| | 9.5 | Discussing specific plans/ procedures | Discussing specific plans and procedures concerned with carrying out a general plan | 21 |
| | 9.6 | Measurement/Counting | Discussion and description of the measuring process | 8 |
| | 9.7 | Recording (Discussion about written work) | Discussion about writing notes, taking down results or drawing | 13 |
| | 9.8 | Raising questions for investigation | Refers to questions about the subject or content of the activity | 3 |
| | 9.9 | Critical reflection | Discussion whether and how alternative procedures or changes in those used would have improved an investigation | 2 |
| | | | | |
| **10. Other discussions involving the Target Child** | 10.1 | Recall of previous learning/ experiences | Refers to facts, principles etc which do not emerge from current activity but have to be recalled from memory | 26 |
| | 10.2 | Recap of work done | Recap of what was done in previous lesson/ earlier in a lesson | 28 |
| | 10.3 | Read out/discuss instructions | Clarification of the task as described orally by the teacher or given in writing | 6 |
| | 10.4 | About the meaning of words | Discussion of meaning of words and clarification of pupil's suggestions | 2 |
| | 10.5 | Asking for help | Pupil seeks guidance from teacher or another pupil about the organisation of a task | 6 |
| | 10.6 | Organising task | General organisation concerned with doing the task | 28 |
| | 10.7 | Non-task | Any talk not related to the task in any way | 28 |
| | | | | |
| **8. Non-talking pupil activity (T.C.)** | 8.1 | Making observations | The target pupil is observing what happens during an event | 36 |
| | 8.2 | Planning independently | A child writing/ using equipment independently and purposefully in deciding what to do for planning | 4 |
| | 8.3 | Using measuring instruments inc. counting | Actively using a measuring device | 6 |
| **Tick if viewed during 2 min observation period** | 8.4 | Using other materials/ equipment purposefully | Actively using materials or equipment other than for measuring | 27 |
| | 8.5 | Collecting/clearing equipment | Pupil is collecting or putting away equipment | 11 |
| | 8.6 | Reading book/ worksheet | Pupil is reading material related to the task | 11 |
| | 8.7 | Recording (not copying) | Pupil is writing or drawing what they learned earlier – not copied | 3 |
| | 8.8 | Copying from a book/ sheet/ board | The target pupil is copying from a worksheet, book, blackboard etc | 23 |

| | | | | |
|---|---|---|---|---|
| | 8.9 | Waiting for teacher | The target child is waiting to interact with the teacher | 23 |
| | 8.10 | Waiting for other pupils | The target child cannot continue with their task until another pupil has done something/ interacted with the child | 12 |
| | 8.11 | Attentive to teacher/SNA | The target pupil is listening or watching teacher working on a science task | 64 |
| | 8.12 | Attentive to other pupils | The target pupil is listening or watching other pupils working on a science task | 57 |
| | 8.13 | Non-attentive to task | Target child is engaged in activities not related to task | 54 |
| | 8.14 | Not classifiable e.g. leave room/toilet break | | 1 |
| | | | | |
| **11. Teacher talk** (for which target child is in audience) | 11.1 | Giving information on task | Teacher provides facts or information about the content | 37 |
| | 11.2 | Giving instructions on task | Teacher instructions about how to carry out an aspect of the task | 45 |
| | 11.3 | Comment on pupil's answer (on task) | Refers to teachers evaluative remarks about the children's responses/ activities | 52 |
| | 11.4 | Asking for account of progress | Teachers request to pupil/ whole class to say what they have done/ found | 29 |
| | 11.5 | Non-task | | 44 |
| | | | | |
| **12. Non-talk teacher act.** (for which target child is in audience) | 12.1 | Collate pupils' ideas (board/ OHP/Orally) | Teacher is involved in bringing together class ideas | 54 |
| | 12.2 | Demonstrate activity/ what to do | Teacher carries out whole or part of activity to show how to use the equipment | 16 |
| | 12.3 | Listening to pupils | Teacher listens to pupils | 73 |
| | 12.4 | Writing on/ correcting/ checking pupils' written work | Teacher looks at/ corrects pupils' work | 3 |
| | | | | |
| **2. Seating/ position of target child (T.C.)** **(M)** | 2.1 | Alone | Target child is seated alone | 6 |
| | 2.2 | Same sex pair | Target child is seated in a same sex pair | 2 |
| | 2.3 | Mixed sex pair | Target child is seated in a mixed sex pair | 16 |
| | 2.4 | Same sex group | Target child is seated in a same sex group | 11 |
| | 2.5 | Mixed sex group | Target child is seated in a mixed sex group | 36 |
| | 2.6 | Whole class | Target child is seated as part of the whole class group during teaching | 10 |
| | | | | |
| **4. Audience/ interaction (M)** | 4.1 | Individual pupil | Target child is interacting with 1 other pupil | 10 |
| | 4.2 | Group | Target child is interacting within a group | 22 |
| | 4.3 | Whole class | Target child is interacting within the whole class | 9 |
| | 4.4 | Teacher | Target child is interacting with the teacher | 31 |
| | 4.5 | Other (specify e.g. Special Needs Ass) | Target child is interacting with an adult other than the teacher | 0 |
| | 4.6 | None | Target child not interacting with anyone else | 3 |
| | | | | |
| **5. Teacher (M)** | 5.1 | Monitoring | The teacher is monitoring a group of which the target child is a member | 14 |
| | 5.2 | Involved | The teacher is directly involved interacting with the target child/ a group of which the target child is a member | 43 |
| | 5.3 | Not present | The teacher is elsewhere in the class working with other children/ groups other than that of which the target child is a member | 24 |
| **13. Use of IT during lesson** | 13.1 | (e.g. computer, interactive whiteboard etc) | In which target child is participating | 2 |

## Findings of combined observation schedules from all 15 case study classes: Re-grouped findings

| Original Category | Code | Description | Findings regrouped under the following headings | Total number of Responses |
|---|---|---|---|---|
| **9. Dialogue involving Target Child (TC)** | 9.1 | Discussing observations | | 44 |
| | 9.2 | Interpretation | Skills-Analysing | 15 |
| | 9.3 | Hypothesising/ Predicting | Skills- Predicting | 15 |
| | 9.4 | General planning | | 14 |
| | 9.5 | Discussing specific plans/ procedures | | 21 |
| | 9.6 | Measurement/Counting | | 8 |
| | 9.7 | Recording (Discussion about written work) | | 13 |
| | 9.8 | Raising questions for investigation | | 3 |
| | 9.9 | Critical reflection | | 2 |
| | | | | |
| **10. Other discussions involving the Target Child** | 10.1 | Recall of previous learning/ experiences | | 26 |
| | 10.2 | Recap of work done | | 28 |
| | 10.3 | Read out/discuss instructions | | 6 |
| | 10.4 | About the meaning of words | | 2 |
| | 10.5 | Asking for help | | 6 |
| | 10.6 | Organising task | | 28 |
| | 10.7 | Non-task | | 28 |
| | | | | |
| **8. Non-talking pupil activity (T.C.)** **Tick if viewed during 2 min observation period** | 8.1 | Making observations | Skills-Observing | 36 |
| | 8.2 | Planning independently | Skills-Investigating and experimenting | 4 |
| | 8.3 | Using measuring instruments inc. counting | Skills-Estimating and Measuring | 6 |
| | 8.4 | Using other materials/ equipment purposefully | Skills-Investigating and experimenting | 27 |
| | 8.5 | Collecting/clearing equipment | Skills-Investigating and experimenting | 11 |
| | 8.6 | Reading book/ worksheet | Reading/ writing | 11 |
| | 8.7 | Recording (not copying) | Reading/ writing | 3 |
| | 8.8 | Copying from a book/ sheet/ board | Reading/ writing | 23 |
| | 8.9 | Waiting for teacher | | 23 |
| | 8.10 | Waiting for other pupils | | 12 |
| | 8.11 | Attentive to teacher/SNA | | 64 |
| | 8.12 | Attentive to other pupils | | 57 |
| | 8.13 | Non-attentive to task | | 54 |
| | 8.14 | Not classifiable e.g. leave room/toilet break | | 1 |
| | | | | |
| **11. Teacher talk** | 11.1 | Giving information on task | Teacher talking | 37 |
| | 11.2 | Giving instructions on task | Teacher talking | 45 |

| | | | | |
|---|---|---|---|---|
| | 11.3 | Comment on pupil's answer (on task) | Teacher talking | 52 |
| | 11.4 | Asking for account of progress | Teacher listening to pupils | 29 |
| | 11.5 | Non-task | | 44 |
| | | | | |
| **12. Non-talk teacher act.** | 12.1 | Collate pupils' ideas (board/ OHP/Orally) | Teacher listening to pupils | 54 |
| | 12.2 | Demonstrate activity/ what to do | Teacher doing | 16 |
| | 12.3 | Listening to pupils | Teacher listening to pupils | 73 |
| | 12.4 | Writing on/ correcting/ checking pupils' written work | Teacher doing | 3 |
| | | | | |
| **2. Seating/ position of target child (T.C.)** **(M)** | 2.1 | Alone | | 6 |
| | 2.2 | Same sex pair | | 2 |
| | 2.3 | Mixed sex pair | | 16 |
| | 2.4 | Same sex group | | 11 |
| | 2.5 | Mixed sex group | | 36 |
| | 2.6 | Whole class | | 10 |
| | | | | |
| **4. Audience/interaction (M)** | 4.1 | Individual pupil | Collaborative learning | 10 |
| | 4.2 | Group | Collaborative learning | 22 |
| | 4.3 | Whole class | Collaborative learning | 9 |
| | 4.4 | Teacher | | 31 |
| | 4.5 | Other (specify e.g. Special Needs Ass) | | 0 |
| | 4.6 | None | | 3 |
| | | | | |
| **5. Teacher (M)** | 5.1 | Monitoring | | 14 |
| | 5.2 | Involved | | 43 |
| | 5.3 | Not present | | 24 |
| | | | | |
| **13. Use of IT during lesson** | 13.1 | (e.g. computer, interactive whiteboard etc) | ICT Use | 2 |

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