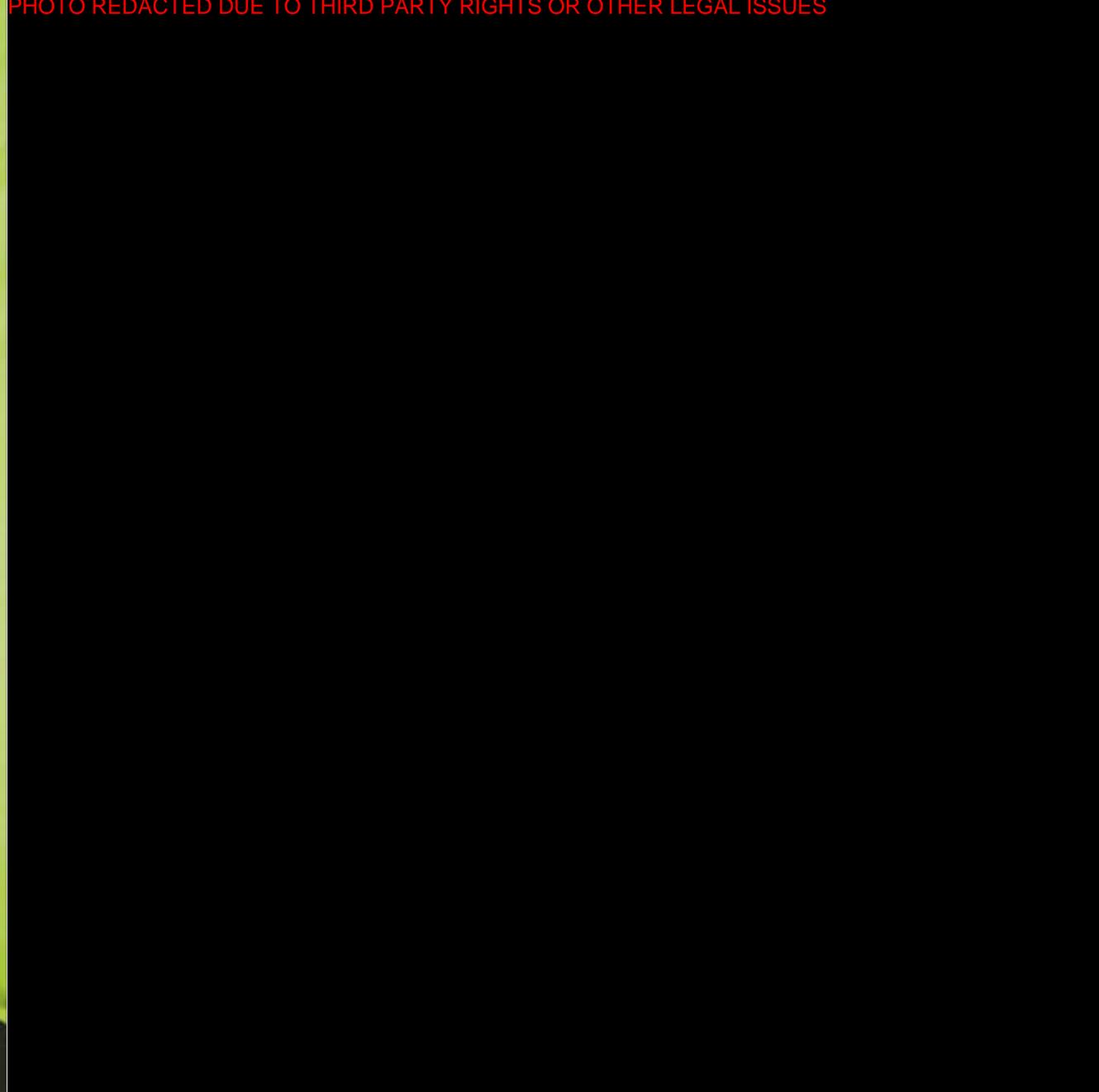


REVIEW OF THE CONTRIBUTION OF THE SCOTTISH SCIENCE CENTRES NETWORK TO FORMAL AND INFORMAL SCIENCE EDUCATION

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REVIEW OF THE CONTRIBUTION OF THE SCOTTISH SCIENCE CENTRES NETWORK TO FORMAL AND INFORMAL SCIENCE EDUCATION

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FOREWORD

In 2002, HM Inspectorate of Education (HMIE) carried out a review of the contribution of the Scottish science centres to formal and informal science education as part of a broader review of all science centres in the United Kingdom. Scottish Ministers subsequently agreed to provide funding for the science centres, a proportion of which was for collaborative educational activity among them. In 2006, the Scottish Executive's Enterprise, Transport and Lifelong Learning Department (SEETLLD) asked HMIE to carry out a second review of the four remaining science centres.

This report identifies many strengths in individual centres and across the network. It is clear that the centres have improved in line with our previous recommendations. They have better accommodation and resources, and the staff have become increasingly skilled at communicating with, and enthusing, young people and adults about science. Links with school education personnel and staff in initial teacher education have also improved as has outreach work with schools and contributions to teachers' continuing professional development. Cross-centre collaboration is better, including sharing of resources, ideas, and best practice.

Our report also highlights good practice in each centre and the network more generally. It is important for centres to continue to work cooperatively and with other agencies to provide more high quality professional development for teachers, including newly qualified teachers and those in initial teacher education. This would help teachers keep up to date with subject developments including those associated with *A Curriculum for Excellence*, develop their skills in communicating science ideas and concepts, and motivate young people. The centres also have the potential to showcase local research and developments in higher education and industry.

Finally, we have set out a clear agenda for improvement, both for individual centres and for the network. The centres have important roles to play in complementing and supporting education in schools, colleges and universities, and more widely through raising the profile of science across the nation and by enthusing those in local and broader communities. It is important that the Scottish Executive continues to support and challenge the Scottish Science Centres Network so that they can make an even greater contribution to the social and economic prosperity of Scotland in the 21st century.

Graham Donaldson

HM Senior Chief Inspector of Education, March 2007



Science has never been so important to Scotland's future. Science education is critical if we are to inspire and nurture our next generation of scientists, innovators and entrepreneurs, all of whom are vital to the development of our knowledge economy.

Since 2004 the Scottish Executive has invested significantly in our four science centres, creating a Scottish Science Centres Network. Annual funding of over £3.5m has been provided, recognising the contribution that the centres make to science education for people of all ages, including improving scientific literacy across Scottish society. This has meant that Glasgow Science Centre, Edinburgh's Our Dynamic Earth, Sensation in Dundee and Aberdeen's Satrosphere Science Centre have been able to substantially improve their education facilities, develop new activities and refresh their exhibitions. As a result, the centres have a much more viable future and the potential to play a central role in complementing and enhancing the science curriculum, particularly the emerging *Curriculum for Excellence*. In addition, the centres are now better positioned to support lifelong learning and help people, whatever their age or background, find out more and engage effectively with contemporary scientific matters.

This report, based on a detailed and independent evaluation by HMIE, is a valuable assessment of the quality of the education service across the Scottish Science Centres Network. The report identifies many significant strengths, both in individual centres and collectively across the network. It also indicates where improvements should be made. Addressing areas where progress has been limited since the last assessment by HMIE in 2002 will be a priority for the Scottish Executive as we look to the future development of the science centres within the context of the wider science engagement strategy.

I look forward to working with the Scottish Science Centres Network and a wide range of other organisations to raise the profile of science in Scotland and to promote Scotland's scientific successes internationally. Regular engagement with the science centres will help ensure that as many people as possible have the opportunity to experience science through a variety of thought-provoking, exciting and innovative activities.

Professor Anne Glover FRSE, FAAM

Chief Scientific Adviser for Scotland, March 2007

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SECTION ONE: BACKGROUND TO THE REVIEW

- 1.1** In 2002, HMIE carried out a review of the contribution of the Scottish science centres to formal and informal science education as part of a broader review of all science centres in the UK. The HMIE report summarised provision in each of the five Scottish science centres and identified specific areas for future development by the centres and for consideration by Ministers.
- 1.2** In 2006, SEETLLD asked HMIE to carry out a second review of the four remaining science centres. These were Glasgow Science Centre, Our Dynamic Earth in Edinburgh, Satrosphere Science Centre in Aberdeen, and Sensation Science Centre in Dundee. The fifth Scottish centre (The Big Idea), located in Irvine, closed in August 2003.

The review was to be comprehensive and include the following key areas.

- Progress made by the centres since the 2002 HMIE report.
 - The quality and range of educational resources (including activities, exhibits and facilities) available across the centres.
 - Existing education and outreach services provided by the centres.
 - The strategic links the centres had made with the academic community and with local businesses.
 - Any relevant comments on commercial, staffing or marketing issues.
- 1.3** Funding responsibility for the science centres has since transferred from SEETLLD to the Scottish Executive's Office of the Chief Scientific Adviser (OCSA), as part of its remit to promote science and support the science engagement sector in Scotland. Policy for the formal aspects of school science education, including the curriculum and continuing professional development (CPD) for teachers, remains the responsibility of the Scottish Executive Education Department (SEED).

SECTION TWO: RELATED DEVELOPMENTS BETWEEN 2002-06

2.1 *The Jura Report*

In November 2003, the Scottish Executive appointed Jura Consultants to review the operations of the science centres with a view to considering their future and whether the concept of a National Science Centre was feasible. Alongside this, consideration was given to possible ongoing financial support from the Scottish Executive, and how the centres could best support the Executive's science objectives.

The Jura Report concluded that the four centres would not be able to operate without long-term continued revenue funding – and that a National Science Centre would bring minimal efficiency savings and would lead to poorer performance from the four centres if 'merged'. The report also recommended fundamental changes in the operations of the centres, including the physical infrastructure, to enable them to move towards being part of a more financially sound collaborative network.

In June 2004, Scottish Ministers decided to provide a £5.1m funding package over two years (2004-06) for the four science centres, including £1m for collaborative education activity among the centres. The Transition Programme (2004-05) provided for capital investment and an element of revenue support. For the period thereafter, the Spending Review, announced in the autumn of 2004, set a baseline budget of £3.7m per annum, from 2006-07 onwards, for SEETLLD to support the four centres, subject to annual Budget Act approval in Parliament (and any in-year amendments).

In December 2005, the Scottish Executive published a four year strategy *The Scottish Science Centres Network: 2005-09* which had been developed in partnership with the four centres. This set out annual strategic objectives and strategic principles to ensure delivery of the objectives.

2.2 SEETLLD reviews

In 2006, SEETLLD commissioned two further reviews of the Scottish science centres.

The first of these reviews had the following two purposes.

- To consider the extent to which the current science centre provision could deliver CPD activities to support science teaching in Scotland.
- To identify the additional resources and mechanisms required to support these activities.

The second review, carried out by Learning and Teaching Scotland (LTS), focused on educational resources and their impact on the quality of educational experience that children, young people, teachers and schools received from science centres.

Draft versions of both reports were made available to HMIE and provided helpful background information for this review.

SECTION THREE: CONDUCT OF THE REVIEW

In March 2006, HMIE briefed education managers from the four science centres about the review process. The review took place between mid-September and mid-November 2006 with science centre staff deciding the most suitable timing for the review of individual centres.

Staff at each science centre drew up a week-long programme to include the following activities.

- Examination of all relevant accommodation, facilities and resources.
- Meeting with key individuals, including chief executive officers (CEOs), education managers and other staff as appropriate.
- Meeting with key individuals from the academic world, business/industry and any partner agencies.
- Discussion with visitors, including members of the public and school groups.
- Discussion with pre-school, primary, secondary and special school staff who had used the centre.
- Observing interactions between staff and visitors, including during guided tours and delivering specific programmes for children, young people and teachers, both in the centre and as part of outreach.
- Examining relevant documentation, including systems for collecting, analysing and evaluating responses from visitors, marketing and publicity, centre web sites and procedures for health and safety.

At the end of each review the inspection team gave an oral report to the chief executive, education manager and other staff nominated by the centre. The oral report identified strengths and weaknesses under the following five main headings.

Resources

This included: the sufficiency, range and appropriateness of all accommodation, facilities and resources; the organisation, accessibility and use of resources; and the provision, experience, qualifications and expertise of staff.

Programmes and activities

This included: the development and marketing of programmes to meet the needs of all user groups, both in the centre and as part of outreach; the extent to which the provision supported and complemented the 3 -18 school curriculum, including the four purposes of *A Curriculum for Excellence* (ACE), namely the development of successful learners, confident individuals, responsible citizens and effective contributors; the contribution to initial teacher education (ITE)

and the CPD of teachers; and the extent to which key aspects such as social inclusion, scientific literacy and careers in science were being promoted.

Ethos

This included: the culture of the organisation; staff morale, working relationships and team-working; the reception of visitors; and the extent to which effective partnerships had been developed with a range of key bodies, including education authorities, higher education, industry, other relevant agencies and local communities.

Quality assurance

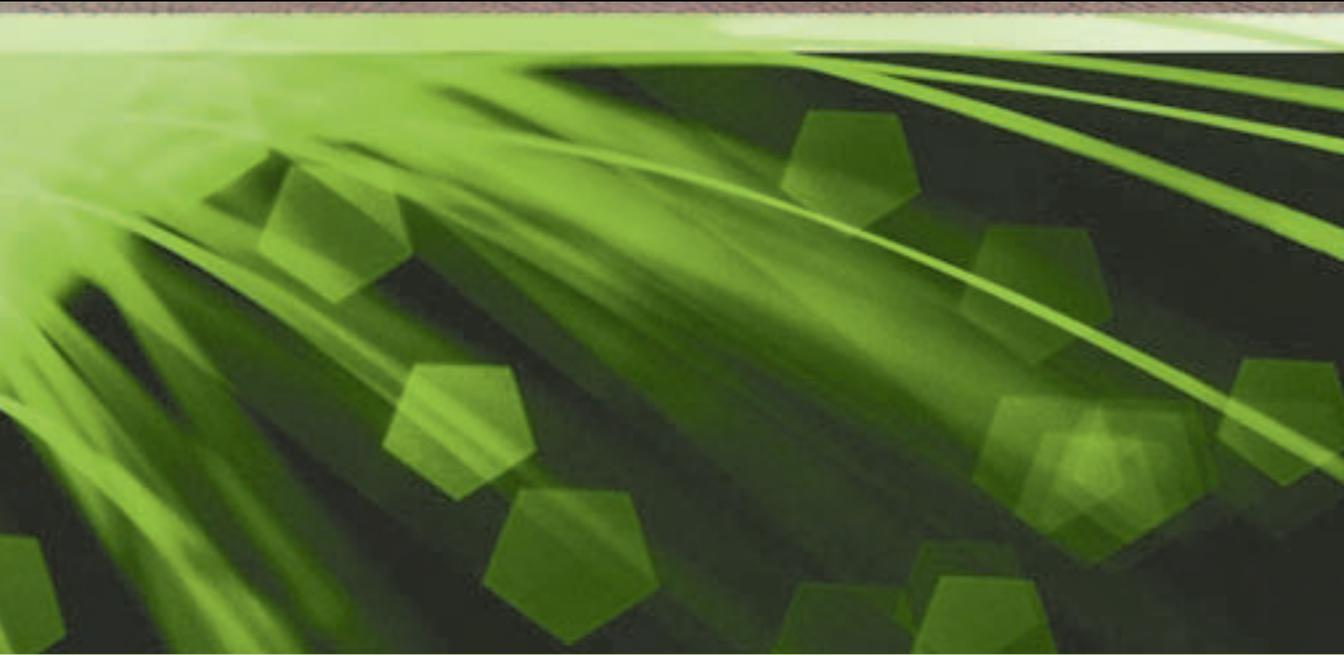
This included: the clarity and appropriateness of aims; the creation of a culture of systematic self-evaluation; the collection and analysis of views from different visitor groups; the systematic monitoring of the effectiveness of individuals and teams; the identification and sharing of best practice; and the extent to which the priorities for improvement were appropriate and implemented.

Learning and teaching

This included: the planning and preparation for programmes and day-to-day activities; the range and appropriateness of teaching approaches, including the degree of interaction with individuals and groups; the use of praise to build confidence and recognise achievement; the extent to which the environment stimulated and motivated individuals and groups; the degree of active involvement in learning and the promotion of personal responsibility and independent thinking; and the extent to which choice of tasks, activities, resources and language met the needs of different audiences.

In addition, the inspection team identified a number of main areas for improvement in each science centre. Summaries of the key strengths and weaknesses and the main areas for improvement reported to each centre are provided in the following sections 4-7.

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SECTION FOUR: REVIEW OF GLASGOW SCIENCE CENTRE

Established in 2001, Glasgow Science Centre (GSC) was part-funded by the Millennium Commission with additional sponsorship coming from a number of sources, including Scottish Enterprise Glasgow and Glasgow City Council. GSC remains an independent subsidiary of Scottish Enterprise Glasgow, and is located on a five acre site at Pacific Quay on the south bank of the River Clyde. Built at a cost of around £75m, the facility is a purpose built science centre comprising three principal attractions, a science mall with general science learning exhibits, Glasgow Tower and an IMAX cinema. This review is limited to the activities in education-related areas supported by the Scottish Executive, namely the science mall which also houses the planetarium. Activities at the IMAX cinema and Glasgow Tower are outwith the scope of Scottish Executive support and therefore not included in this review.

4.1 RESOURCES

Strengths

- The high quality accommodation and facilities, all accessible to those with disabilities.
- The extensive range of practical resources and equipment, including information and communications technology (ICT).
- The attractive and exciting learning environment created by the exhibits, lighting and display.
- An extensive range of up-to-date, well-presented and clearly-labelled interactive exhibits.
- Refreshment of exhibits and exhibitions which encouraged return visits.
- The centre's clear external and internal signage.
- Skilled, experienced and very well-qualified education staff.
- Rigorous and effective induction procedures for all staff.
- The wide-ranging and appropriate programme of training and development for all centre staff.

Weaknesses

- The limited range of suitable resources and exhibits for pre-school children.
- Limited pre- and post-visit resources for teachers and pupils on the centre website.
- The bareness of the centre's external environment.
- Poor acoustics in some of the dedicated teaching areas.

4.2 PROGRAMMING AND ACTIVITIES

Strengths

- Clear and attractive promotional materials including those on the centre website.
- The range of access modes throughout the day, evening, weekends and holidays.
- The centre's good start to marketing its provision within the community.
- Free visits for teachers and other school staff.
- A wide range of shows and workshops covering all aspects of the sciences.
- The extensive range of programmes for pre-school, primary and secondary pupils.
- High quality provision for S3-6 pupils through debates/dialogue on current scientific issues.
- Discovery-based exhibit trails supported by science communicators provided focused learning.
- The range of community and family programmes and lecture programmes on topical science.
- The provision of CPD programmes for teachers accredited by the General Teaching Council for Scotland (GTCS).
- The broad outreach programme for teachers, pupils and parents.
- The centre's support for further and higher education courses.

Weaknesses

- Whilst the ACE purposes permeate shows, workshops and CPD for teachers they have not yet been systematically identified, highlighted or audited.
- Many schools' lack of awareness and use of the centre's website.

4.3 ETHOS

Strengths

- The extent to which visitors felt welcome and the positive working environment in the centre.
- Schools' high regard for the professionalism, credibility, responsiveness and helpfulness of the centre's staff.
- Staff's commitment to the centre and their pride in all aspects of their work.
- The high staff morale and strong team ethic.
- The positive, creative and supportive culture where effort and initiative was encouraged, recognised and rewarded.
- Very good links with higher education, industry and a wide range of other science providers.
- Use of teacher secondments to produce themed exhibition trail guides.
- Links established with key education authority science education personnel.
- The staff's hard work in supporting a broad range of community and corporate events.

Weaknesses

- The limited links with a broader range of education authorities at an appropriate strategic level.

4.4 QUALITY ASSURANCE

Strengths

- The culture of evaluation and improvement which reflected the high quality of leadership.
- The clear statement of appropriate aims and objectives in the centre's corporate plan.
- Regular and purposeful science team meetings where ideas/suggestions were valued.
- Staff's clarity about their roles and the roles of others in the science team structure.
- The comprehensive and accurate evaluation of provision in the science team report.
- The external Wellcome Trust evaluation of exhibits.
- The thorough evaluation strategy used for the *Alice through the Looking Glass* exhibition.
- Very effective staff peer evaluation to rate live performances and provide feedback.
- Extensive use and detailed analyses of, and response to, teacher questionnaires.
- The plans to set up focus groups for programme development by April 2007.
- The range of staff development activities, linked to the appraisal process.
- The CEO's plans to seek quality accreditation for the centre.

Weaknesses

- Lack of information on, and targeting of, areas which provided few visitors to the centre.

4.5 LEARNING AND TEACHING

Strengths

- Carefully planned shows, presentations and workshops which met young people's needs.
- Helpful advice to teaching staff on the structure and content of presentations and workshops.
- The skill of teaching staff in capturing the interest of audiences and involving them throughout.
- Staff's interaction with audiences and use of questioning to engage them and seek their ideas.
- Staff's use of praise to reward contributions and promote the achievement of young people.
- The brisk pace of science shows to sustain interest and variety.
- The skilful use of effective learning and teaching strategies and resources, including ICT.
- Workshops for teachers and senior pupils on practical DNA profiling and related ethical issues.
- Engaging interactive sessions in the Planetarium enjoyed by audiences of all ages.
- The extent to which audiences enjoyed and were motivated by presentations and workshops.

Weaknesses

- The limited confidence of a few science communicators at engaging with and extending the understanding of visitors when interacting with exhibits.

4.6 AREAS FOR IMPROVEMENT

Glasgow Science Centre should:

- develop a suitable range of resources which can be downloaded from the centre website and which can be used to prepare groups for visits to the centre and to carry out associated follow-up work on return to their school;
- continue to develop and extend the already successful CPD programme for pre-school, primary and secondary teachers (including those in training) to take account of how best to develop the ACE principles and purposes in the context of the emerging science curriculum;
- identify client groups who do not currently visit the centre and find ways of engaging them;
- further publicise the centre website and its contents; and
- take forward plans to gain a quality standard for science education provision at the centre.

SECTION FIVE: REVIEW OF OUR DYNAMIC EARTH, EDINBURGH

Opened in 1999, Our Dynamic Earth was part-funded by the Millennium Commission with further sponsorship coming from Edinburgh City Council and Scottish Enterprise Edinburgh and Lothians. It is the centrepiece of a major urban regeneration plan, named the Holyrood project. Built at a cost of £39m on the site of the former Scottish and Newcastle Brewery and British Gas, the land was gifted to the people of Edinburgh on the condition that it would be used to create a landmark building to host an exhibition that was in the public good. The exhibition was designed as a series of 13 walk-through galleries telling the story of the formation and evolution of planet Earth.

5.1 RESOURCES

Strengths

- The wide range of high quality multi-purpose spaces and facilities.
- Attractive permanent exhibits offering multi-sensory experiences and provision of audio guides in several languages.
- Appropriate access to all areas of the building for those with disabilities.
- Effective use of the external environment to extend the theme of the centre into the local area.
- The extensive range of practical resources, equipment and specimens, including ICT.
- The team of well-qualified education staff, effective induction procedures for new staff and encouragement of staff to participate in professional development activities.

Weaknesses

- Small, often congested, teaching classrooms which limit teaching and learning approaches.
- The absence of dedicated space, including appropriate laboratory facilities, for open-ended investigative work.
- The limited range of suitable resources and exhibits for pre-school children.
- The currently limited pre- and post-visit resources for teachers and pupils on the website.
- Too few interactive exhibits to engage visitors in some of the galleries.
- Some hard to read text in the galleries due to presentation, lighting or damage.
- Sound interference in some galleries, making it difficult to hear guides or audio tapes.
- The small size of the education team, which limited the range of programmes on offer and restricted the amount of absence cover.
- Insufficient use of some front-of-house staff to extend the work of the education team.
- No long-term secondments to help develop centre programmes.

5.3 ETHOS

Strengths

- The welcome staff provided for visitors in all areas of the centre.
- High staff morale, and positive and supportive relationships amongst staff.
- The extent to which staff were committed to the centre and enjoyed their work.
- The quality of team work, and the lead and support given by managers.
- The strategic links with some higher education institutions.
- Links with a range of other science providers.
- Some use of short-term teacher secondments to test and review gallery guides.

Weaknesses

- Insufficient links with personnel at a strategic level in local education authorities.
- Limited links with focal individuals in key agencies to promote and extend the centre's work.
- Under developed links with local community groups to target areas that send few visitors.

5.4 QUALITY ASSURANCE

Strengths

- Well-established culture of self-evaluation where staff sought improvement and high standards.
- An effective staff appraisal system.
- Effective use of visitor feedback forms, and pupil and teacher feedback questionnaires with detailed analyses of responses including individual comments from visitors.
- Overall positive evaluations from pupils and teachers.
- Education officers' occasional evaluations of, and feedback on, each other's presentations.

Weaknesses

- The lack of systematic and rigorous evaluation of presentations.
- Limited identification or targeting of areas which provided few customers to the centre.

5.5 LEARNING AND TEACHING

Strengths

- Well-planned classroom activities and outreach workshops with effective use of resources.
- Staff's generally clear explanations and answers to pupils' questions.
- Some effective use of ICT, including graphics and video clips, to engage pupils' interest.
- Use of praise to reward pupils' contributions and promote their achievement.
- Education staff's calm and pleasant manner when engaging with pupils.
- Pupils' attentiveness, motivation and enjoyment in presentations and workshops.

Weaknesses

- Restricted space in classrooms and overcrowding made staff/pupil engagement difficult.
- Too little use of open-ended questioning to make pupils think and answer at length.
- Presentations not always matched to pupils' knowledge, understanding or attainment.
- Too few opportunities for pupils to investigate or to work on group problem-solving activities.
- Spelling errors in presentations, worksheets and in public displays.
- Some factual errors made by staff in presentations.

SECTION SIX:

REVIEW OF SATROSPHERE SCIENCE CENTRE, ABERDEEN

Satrosphere Science Centre was founded in 1989 and is the longest established science centre in Scotland. In March 2001, the centre relocated to its present site, adapted former ‘tramsheds’ in the Aberdeen beach area. The building, which is leased from Aberdeen City Council, contains a number of educational facilities, including an exhibition hall with interactive exhibits, a show theatre and a laboratory. The centre had not benefited from a Millennium Commission start-up grant but received support from a number of public and private sponsors.

6.1 RESOURCES

Strengths

- Accommodation and facilities for exhibits, corporate events and some learning and teaching.
- The appropriate access for those with disabilities and attention to health and safety.
- Well-presented and clearly-labelled exhibits enabling visitor interaction and understanding.
- Exhibits which were regularly refreshed to encourage return visits.
- The use of exhibit trails to help focus visitors' attention on specific themes.
- Provision of practical resources and equipment, including ICT.
- Well-qualified staff to deliver the current range of science programmes.

Weaknesses

- Poor external sign-posting on, and to, the centre.
- Well-appointed but insufficient laboratory space for practical work by secondary pupils, teachers and technicians.
- Limited partitioning in much of the exhibition hall limited dwell time at exhibits.
- The lack of exhibits with information technology (IT) interfaces.
- Limited range of suitable resources and exhibits for pre-school children.
- Insufficient pre- and post-visit resources currently available on the centre website.
- The lack of exposure to best practice for some inexperienced presenters.
- Insufficient attention to staff induction.

6.2 PROGRAMMES AND ACTIVITIES

Strengths

- Clear, attractive and informative promotional materials.
- Range of access modes including at weekends, holidays, summer camps and school clubs.
- Range of shows and outreach activities for primary pupils, aligned to the 5-14 curriculum.
- The centre's broad 'catchment area' which included the Highlands and Islands.
- Teachers' free visits to the centre prior to bringing their classes.
- Accessible and attractive website.
- Use of teacher secondments to map the centre's presentations to the 5-14 curriculum.
- CPD for teachers on Satrosphere's provision and pupils' investigative skills, and to train local science coordinators.
- Promoting awareness of science through weekend events, lectures and science festivals.
- The wide range of shows, outreach topics and themed events at weekends and holidays.
- Increased pupil visits through fee subsidies from local councils and Scottish Executive.

Weaknesses

- Too narrow a range of CPD for teachers, including those in training.
- Limited focus on outreach for secondary schools.
- Too few presentations relating to secondary school science, particularly science in S1/S2.
- Schools' lack of awareness of Satrosphere's website.
- Limited focus on promoting careers in science.

6.3 ETHOS

Strengths

- The welcoming environment for visitors, including corporate groups and users of the cafeteria.
- Effective links with a wide range of other science providers.
- The use of teacher secondments to produce a range of support materials.
- Links with key science education personnel, particularly in Aberdeen City Council.
- Support for a range of community and corporate events.
- Effective Science, Technology, Engineering and Mathematics (STEM) partnership with Sensation and SETPOINT North to deliver outreach.

Weaknesses

- Insufficient attention to the continuing development of staff morale and teamwork.
- Few strategic links with education authorities to help inform schools about the centre's provision.
- Limited availability of careers information for young people in the centre and on the website.
- Little provision of information in the centre on local success stories in science and technology.
- Limited showcasing of current research in local higher education institutions.

6.4 QUALITY ASSURANCE

Strengths

- Detailed analyses of teacher evaluation forms which were positive overall.
- Positive visitor evaluations of holiday and weekend events, and of summer schools.
- Use of a Junior Board where children provided constructive feedback on aspects of provision.
- The recently-introduced supportive staff appraisal system.

Weaknesses

- The absence of a clear statement of aims, prepared in consultation with staff, against which to measure the centre's performance.
- The sometimes limited involvement of staff as a whole in rigorous quality assurance and continuous improvement.
- Staff's limited involvement in developing strategy and policy.
- The lack of a clear focus on what young people had learned in pupil and teacher evaluation proformas.
- Little use of explainers to review, evaluate and improve exhibits, shows and outreach.
- The perception of staff that there are too few opportunities to meet in teams or for communication among teams.
- Minutes of Board and team meetings are not available to staff.
- The limited contact of some staff with the CEO and a perception that he is remote.
- Lack of representation of the school education sector in membership of the Board.

6.5 LEARNING AND TEACHING

Strengths

- Advice given to staff on the presentation and content of shows and workshops.
- Lively introductions to well-paced shows and workshops which engaged pupils' interest.
- Staff engagement with pupils through asking open-ended questions and seeking their ideas.
- Highly participative shows and workshops where young people were ready volunteers.
- Use of praise to reward pupils' contributions and promote their achievement.
- Effective use of resources, including interactive whiteboards, to enrich presentations.
- Attentiveness and enthusiasm of young people in the presentations and workshops.

Weaknesses

- Presentations not always well matched to pupils' prior experience and attainment.
- The currently limited provision of pre- and post-visit materials for teachers and pupils.
- The limited range of hands-on investigative workshops for pupils.

6.6 AREAS FOR IMPROVEMENT

Satrosphere Science Centre should:

- explore ways of improving external signage and review the partitioning of the exhibition hall;
- extend CPD programmes for teachers to include presentational skills, communication of scientific ideas, promotion of ACE principles and purposes and development of citizenship skills;
- make use of secondees to revise teacher materials, shows and outreach activities in line with ACE, to give broader application in the primary and secondary sectors;
- make further use of the centre to showcase local research and developments in industry and higher education;
- improve teamwork, communication and morale across all staff through further opportunities for them to meet, influence policy, evaluate provision and suggest ideas for improvement;
- prepare a clear statement of aims which embodies the views of staff and partners, and further develop more rigorous and systematic procedures for self-evaluation and continuous improvement; and
- review the Board membership to ensure that it is consistent with taking forward the aims and meeting the needs of the next stage in Satrosphere's development.

SECTION SEVEN: REVIEW OF SENSATION SCIENCE CENTRE, DUNDEE

Sensation Science Centre opened in July 2000 at a cost of around £5m. It was part-funded by the Millennium Commission with other funding coming from a number of sources, including the Wellcome Trust, Gannochy Trust, Scottish Enterprise Tayside and Dundee City Council. Sensation is located on a 1.5 acre site near to the centre of the city. The main theme of the centre is life sciences with a particular focus on the senses.

7.1 RESOURCES

Strengths

- Sensation's central, easily accessible and well sign-posted location.
- Appropriate access for those with disabilities.
- Suitable teaching and exhibition space for the current range of activities.
- The visual display which promotes interest and creates an attractive learning environment.
- The careful attention to health and safety, and to risk assessment for visiting groups.
- A wide range of pre- and post-visit resources available on the attractive centre website.
- Interactive exhibits, several with WOW! factor.
- Suitably-qualified teaching staff with a good blend of subject and communication skills.
- The focus on training which ensured that Centre staff were kept up to date.

Weaknesses

- Teaching classroom is only suitable for around 15-20 primary pupils.
- No suitable laboratory space for secondary school pupil, teacher or technician practical work.
- Too little space to train primary or secondary teachers in science content and communication.
- Some dated exhibits, some not working and some not clearly labelled.
- The poorly developed outside area in front of the centre.
- Limited resources and exhibits for pre-school children.
- Limited refreshment of exhibits discouraged repeat visits.

7.2 PROGRAMMING AND ACTIVITIES

Strengths

- The improved programmes produced by the new education team.
- Attractive promotional material publicised the centre to a wide range of interest groups.
- Staff meeting customer needs well and offering access to provision by a variety of means.
- A satisfactory start to providing outreach activities for primary schools.
- Programmes related well to pre-school and primary curricula.
- Free visits for teachers prior to bringing their classes.
- Increased pupil visits through subsidies from local councils and the Scottish Executive.
- Effective promotion of careers in science through presentations to S1 pupils.
- The effective programme which introduced P7 pupils and their parents to the challenge and excitement of science.
- The inclusion of children and young people from disadvantaged areas.

Weaknesses

- Too little use of outreach programmes, particularly to secondary schools.
- Insufficient focus on key aspects of science which teachers had helped centre staff to identify.
- Limited linkage with the secondary science curriculum, particularly at S1/S2.
- Limited CPD for primary and secondary teachers including those in initial teacher training.
- Insufficient publicity for the website, especially the teachers' and pupils' materials.
- Little use of facilities and programmes to promote ACE principles and purposes and science for citizenship.

7.3 ETHOS AND PARTNERSHIP

Strengths

- The welcome which visitors received and the extent to which their contributions were valued.
- The very good staff morale, teamwork and commitment.
- The positive and supportive culture in the centre.
- Links with higher education and industry through the Sensation Science Centre Board.
- Links with other science providers, colleges and education authority science personnel.
- Use of the Junior Board to take young people's views.
- The use of teacher placements to produce support materials for workshops.
- Contributions to a broad range of community and corporate events.

Weaknesses

- Under-developed links with education authorities at an appropriately strategic level.
- Limited promotion of local success stories in science and technology.
- Insufficient use of the centre by higher education including teacher education.

7.4 QUALITY ASSURANCE

Strengths

- The clear and ambitious business plan which indicated continuous improvement.
- The pervading culture of self-evaluation where staff readily identified and effected improvements.
- Teaching staff's identification of best practice in their own and other science centres.
- Staff involvement in developing policies and practices.
- The careful analysis of teacher evaluations and the action taken on problems identified.
- The extent to which improved exhibits and presentations had increased customer satisfaction.

Weaknesses

- Insufficiently systematic, rigorous or outcome focused self-evaluation.
- Teacher evaluation forms gave too little attention to what pupils had learned.

7.5 LEARNING AND TEACHING

Strengths

- Well-planned, paced and suitably-resourced teaching and learning episodes.
- Presentations that are well matched to the needs of different client groups.
- Lively and effective introductions to workshops to capture pupils' attention and interest.
- Staff interaction with pupils and very good use of praise and questioning.
- Presenters' skill in engaging disaffected pupils.
- Effective use of resources including ICT.
- The motivation and enjoyment of children and young people.
- The range of opportunities for pupils to participate, take responsibility and work collaboratively.

Weaknesses

- The excessive use of closed questioning involving one-word answers.
- Occasions when the pace of presenters' talking gave pupils too little thinking time.
- Sessions for teachers gave too little time for them to contribute and interact with each other.

7.6 AREAS FOR IMPROVEMENT

Sensation Science Centre should:

- examine ways of extending CPD in pre-school and primary, and providing CPD for secondary, including probationer teachers and those in initial teacher education;
- increase the range and frequency of outreach programmes in negotiation with stakeholders, focusing on science for citizenship and the use of science to promote ACE principles and purposes;
- examine further ways of using the centre to showcase current research in higher education;
- increase stakeholders' awareness of the centre's provision through publicising the website and class materials available on it, and developing appropriate education authority contacts; and
- develop a more systematic and rigorous system of quality assurance which focuses on outcomes and impact for stakeholders.

SECTION EIGHT: PROGRESS MADE SINCE THE 2002 HMIE REPORT

The HMIE Report published in 2002 identified the following areas for development. This section evaluates the progress made with each of the action points and includes some examples of the best practice which had been adopted across the network. Overall, the science centres had made good progress in addressing the action points although uncertainties about future financial support and the modest remuneration of some education team members had led to a high staff turnover which inhibited continuous improvement in the quality of provision.

8.1 Establish a more systematic network of contacts with school education personnel in order to publicise the centres' facilities and get advice on the development of materials and presentations for schools.

Overall, the science centres had made good progress with this action point. All centres had developed productive links with some teachers and schools or with middle managers in some of their 'catchment' education authorities (EAs). Often the links were not at a sufficiently strategic level to gain support from, or influence practices across, all schools in that EA. Mail shots and other publicity materials from the centres often failed to reach the intended or most effective points of contact, particularly in secondary schools. Few of the centres had senior education authority managers on their Boards of Management. Some EAs had supported teacher placements or secondments to a particular centre. This had been useful in providing up-to-date advice on developments in the school curriculum, pre- and post-visit materials for teachers and pupils and themed exhibition trail guides.

Best practice included:

- Aberdeen City Council's support for the long-term secondment of a teacher to Satrosphere Science Centre;
- a local authority education manager serving on the Board of Management at Sensation Science Centre; and
- Glasgow Science Centre's close liaison with a local EA science adviser and a quality improvement officer.

8.2 Provide further support for science courses and units at the middle and upper secondary stages.

Only limited progress had been made across the Science Centres Network with this action point although there had been some significant successes. In common with all school sectors, many secondary schools found transport and entry costs prohibitive. In addition, centres had difficulty attracting visits from middle and upper secondary pupils due to the need to release teachers and pupils from other timetabled school commitments. Most centres had continued to focus effort and attention on pre-school children, young people in primary school and those with additional support needs. Centres continued to support the 5-14 curriculum, including the provision of activities and programmes designed specifically to engage pupils in the first two years of secondary school. However, there continued to be only a limited range of suitable programmes for the middle and upper secondary stages. One centre, working in partnership with other agencies and bodies, had been very successful in developing provision which both complemented the school curriculum and challenged senior pupils at an appropriate level. The centre ran practical workshops and organised debates on a range of contemporary scientific issues.

Best practice included:

- staff at Glasgow Science Centre, working in partnership with scientists from the Medical Research Council Virology Unit, to deliver a series of practical workshops on DNA technology to Advanced Higher Biology pupils and teachers from across Scotland; and
- staff from Glasgow Science Centre and Our Dynamic Earth working together with lecturers and researchers to plan, pilot and deliver a series of interactive workshops and debates on genetic modification of crops for senior pupils.

8.3 Make contributions to programmes for initial teacher training and continuing professional development, with particular reference to the demand which exists in primary schools. Teacher secondments might also be considered.

The centres had made good progress with this action point. Most centres had developed productive working relationships with key personnel in local teacher education institutes. Student teachers following BEd and post-graduate certificate/diploma in education (PGCE/PGDE) courses visited their local science centre to gain first-hand experience of the facilities and the work which went on there. All centres were making contributions to the CPD of teachers, mainly in the primary sector, although some centres had successfully extended their provision to include teachers in pre-school centres and secondary schools. In some centres, much of the CPD on offer helped teachers to gain a better understanding of what was available in the centre and how this could complement the work of the formal school curriculum. Some centres also focused attention on the provision of workshops which would help teachers address specific areas of the school curriculum, including the teaching of investigative skills, the use of puppets with young children and understanding earth and space. All centres made use of short- or long-term secondments which provided effective professional development for teachers as well as allowing them to carry out projects which benefited the centres.

Best practice included:

- local science coordinators and probationer teachers in their first year of teaching visiting Glasgow Science Centre and Satrosphere to learn about the work of the centre and to develop specific knowledge and skills;
- Glasgow Science Centre's provision of GTCS-accredited courses for teachers; and
- all centres encouraging school staff to carry out free familiarisation visits to the centres as part of their professional development so that they were better prepared to bring their classes at a later time.

8.4 Provide outreach facilities including local presentations to schools which are remote from the centres, and training opportunities for teacher groups in their own localities.

All centres had made good progress with the provision of outreach facilities for schools. Centres offered outreach provision mainly to pre-school centres and primary and special schools very widely across their 'catchment' areas. Staff delivered a range of interactive workshops which were much appreciated by teachers and pupils, particularly in remote schools and more disadvantaged communities. Most outreach focused on primary schools with workshops and related activities which were carefully chosen to complement class topics within the 5-14 science curriculum. Outreach staff and headteachers generally encouraged class teachers to attend workshops with their pupils so that they could benefit from the associated staff development in science. Outreach staff had made a start to delivering some training opportunities for teachers, either to individual schools or more commonly on a local authority basis.

Best practice included:

- a member of staff from Satrosphere Science Centre taking hands-on exhibits to primary schools in remote mainland and island communities;
- Sensation Science Centre's extensive input to STEM partnership outreach activities for primary schools;
- Our Dynamic Earth, working in partnership with the Scottish Seabird Centre, to coordinate the work of a recently appointed Schools' Communicator in delivering outreach programmes to primary pupils and teachers, mainly in Edinburgh and the Lothians; and
- staff from Glasgow Science Centre offering a broad range of outreach programmes which benefited pupils, teachers, parents and members of local communities, including those who found difficulty in accessing the in-house programmes.

8.5 Work more closely with each other to strike a balance between competition and cooperation through, for example, exchanging ideas, good practice, staff, exhibits and presentations. This could include the development of links with UK Science centres outwith Scotland.

The centres had made very good progress with this action point. In 2002, the extent to which the centres cooperated with each other was outweighed by the extent to which they competed (*HMIE Review*, November 2002). In all centres, there was now ample evidence of cross-centre collaborative activity and a determination to share resources and ideas, and to learn from best practice wherever it was found. Funding from SEED in 2004-05 had been used effectively to provide additional educational resources in key areas such as ICT, pre-school education, and interactive equipment for upper primary and secondary pupils. As well as improving provision in individual centres, some of these resources had already been shared across centres so that more young people could benefit from a wider range of experiences. Education staff from the four centres met together regularly to learn about developments in each centre, discuss how best to resolve matters of common interest and join in shared staff development. Staff also visited other science centres in Scotland and in other parts of the UK, and had developed productive working relationships with staff at these centres.

Best practice included:

- staff from all four centres participating in a number of joint staff development events on topics such as working with young people with additional support needs, improving ICT skills, and developing thinking skills.

Ministers were also asked to consider the following.

8.6 Establish an overview body to promote a common sense of purpose across the science centres, and to encourage cooperation through the sharing of ideas, good practice, exhibits and presentations. Membership of the body should include representatives from each science centre, the range of educational sectors, the business world and the public.

Scottish Ministers agreed to provide funding for the four science centres on the condition that they worked more effectively as a collaborative network. In order to facilitate more cooperative activity, science centre chief executives met with representatives of the Scottish Executive, culminating in the publication by Scottish Ministers of the Scottish Science Centres Network Strategy in December 2005. In addition, a Science Centres Network Education Group was formally established building on earlier meetings of the centres' education managers. In January 2006, the Royal Society of Edinburgh (RSE) established a Science and Society

Steering Group to provide independent advice to the Scottish Executive on the distribution of funding for the science centres for 2006-07, and to consider if and how the RSE might be involved in future years. However, with the appointment of the Chief Scientific Adviser for Scotland to the Executive in August 2006, her office became the natural focal point for the cross-portfolio work in science, especially public engagement activity. The RSE's Steering Group was asked to stand down, and responsibility for science and society policy, including the funding of science engagement activities and science centres, now lies with the Scottish Executive's Office of the Chief Scientific Adviser.

8.7 Provide funding to cover the cost of school visits and transport to the science centres. This would ensure that no schools are excluded from using the centres by reason of location or finance, and would strengthen the centres financially.

In 2005-06, the Scottish Executive provided each centre with £7,500 which was used to subsidise the cost of transporting pupils to and from the centres. Centres consulted with appropriate education authorities about how best to target this funding. A few education authorities provided some additional funding, either to subsidise transport or entry to the centre. This was a very popular and effective scheme and enabled visits from schools which were more geographically remote or served more disadvantaged communities. Many schools which had never visited a science centre took good advantage of this support and pupils benefited greatly from the experience. Feedback from teachers in pre-school, primary and secondary schools strongly indicated that the high costs of transport and entry to the science centres were major disincentives to their use. This was particularly true for pre-school and primary teachers, many of whom lacked confidence in their ability to teach science. They were conscious of the impact that a visit to a centre had on the learning of their pupils, both in terms of new knowledge and skills acquired and in enthusing them about the importance of science to their lives. Because of the success of this initiative in improving access to the centres for socially, economically or geographically disadvantaged communities, the Scottish Executive agreed to provide a further £10,000 to each centre for 2006-07.

Best practice included:

- staff at Sensation Science Centre developing effective working relationships with a number of local education authorities through involving them closely in the selection of the most appropriate schools to benefit from transport subsidies; one education authority provided free admission for pupils from the chosen schools which visited in pairs to share transport costs and promote cooperative working.

SECTION NINE:

OVERALL RECOMMENDATIONS FOR THE SCOTTISH SCIENCE CENTRES NETWORK AND THE SCOTTISH EXECUTIVE

9.1 The Scottish Science Centres should:

- continue to work together, both as a network and in cooperation with key partner agencies and individuals, to share exhibits, ideas, presentations, opportunities for staff development, and to learn from best practices both in Scotland and in other science centres across the world;
- work together and with key local and national agencies, particularly the Scottish Schools' Equipment Resource Centre (SSERC), to deliver high quality CPD to all teachers of science, including probationers and those in initial teacher education. This should allow teachers to keep up to date with developments in their subjects especially those associated with the delivery of a *Curriculum for Excellence*, and to develop their skills in communicating science ideas and concepts, and in motivating young people;
- improve links with key personnel in local education authorities in order to gain support from, and influence practices across, all schools in that authority;
- develop a suitable range of materials for downloading from centre websites to complement the school curriculum, and to prepare pupils for visits to the centres and to carry out associated follow-up work on their return to school;
- make more extended use of seconded teachers to revise teacher and pupil materials, the content of shows and outreach provision in line with *A Curriculum for Excellence*;
- more systematically identify client groups who do not visit the centres and devise ways of attracting them; and
- make more extensive use of centre facilities to showcase local research and developments in higher education and industry.

9.2 The Scottish Executive should:

- provide a commitment to funding centres over a more extended period so that they can operate in a more financially-secure environment, engage in longer-term budget planning and take account of the need to secure improved continuity of staffing in education teams;
- provide further subsidies to cover the cost of school visits and transport to the science centres, including additional funding to target pupils from socially, economically or geographically disadvantaged areas; and
- use the Scottish Science Centres Network to provide peer evaluation and support for each centre.

SECTION TEN: WHAT HAPPENS NEXT?

Each science centre has been asked to prepare an action plan indicating how it will address the main areas for improvement identified in sections 4 to 7 of the report and to share that plan with HM Inspectorate of Education and the Scottish Executive's Office of the Chief Scientific Adviser for Scotland, which took over funding of the science centres from SEETLLD in August 2006. The Scottish Science Centres Network has similarly been asked to prepare and submit an action plan indicating how the centres intend to address the main recommendations identified in section 9 of the report. HM Inspectors will consult with individual centres about their action plans and will undertake a follow-through inspection of each centre, within 18-24 months of the publication of this report, on the extent of improvement which has been achieved.

HOW CAN YOU CONTACT US?

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