London Schools Excellent Fund LSEF059

'Understanding Science through Art'
Wandsworth Council

Final report

Image from Project Exhibition: Semiconductor, 2015

Contact Details

educationprogramme@london.gov.uk

Evaluation Final Report Template

Introduction

The London Schools Excellence Fund (LSEF) is based on the hypothesis that investing in teaching, subject knowledge and subject-specific teaching methods and pedagogy will lead to improved outcomes for pupils in terms of attainment, subject participation and aspiration. The GLA is supporting London schools to continue to be the best in the country, with the best teachers and securing the best results for young Londoners. The evaluation will gather information on the impact of the Fund on teachers, students and the wider system.

This report is designed for you to demonstrate the impact of your project on teachers, pupils and the wider school system and reflect on lessons learnt. It allows you to highlight the strengths and weaknesses of your project methodology and could be used to secure future funding to sustain the project from other sources. All final reports will feed into the programme wide meta-evaluation of the LSEF being undertaken by SQW. Please read in conjunction with Project Oracle's 'Guidance to completing the Evaluation Final Report'.

Project Oracle: Level 2
Report Submission Deadline: Round 2 - 30 September 2015
Report Submission: Final Report to Rocket Science

Project Name: 'Understanding Science Through Art'
Lead Delivery Organisation: Wandsworth Council
London Schools Excellence Fund Reference: LSEF059
Author of the Self-Evaluation: Davina Salmon
Total LSEF grant funding for project: £91,950
Total Lifetime cost of the project (inc. match funding): £113,400
Actual Project Start Date: September 2014
Actual Project End Date: July 2015

1. Executive Summary

This should be a brief summary of what information is included in the report, the evaluation methods and analysis used and a summary of the key findings from your project evaluation. (maximum 500 words)

This final report for the LSEF project 'Understanding Science through Art' provides a detailed evaluation of the project exhibition at the Pump House Gallery which ran for three weeks from 23rd April 2015, the writing and piloting of an associated teaching and learning pack through a collaboration between teacher, artists and scientists, and the resulting benefits for the core schools involved in the in-depth development process.

The report details the innovative development stage of this project; the facilitated action learning groups whose professional conversations lead to a shared understanding of selected science topics in the new curriculum. It describes a qualitative evaluation of that journey and the benefits to working in a cross disciplinary groups. The appendices attached include examples of these benefits and how the process shaped the project exhibition and the teaching and learning pack.

Data regarding the outcomes for pupils, schools and the wider community can be found in section 8 and reflections on all the project activity and themes in section 9.

2. Project Description

Much of the detail for this section can be drawn from your Stage 2 funding application. Please note that if you do copy this information from your original application, funding agreement, or interim report, be sure to update it as appropriate (e.g. including tense change).

Provide a full project description (approximately one side of A4), in particular:

- *Why was the project set up? / What need was it seeking to address? (e.g. because teachers lacked confidence in their subject knowledge? Because pupil attainment was lower in this subject area in this borough/cluster/school/than in other boroughs/clusters/schools?).*
- *What were the circumstances into which it was introduced (e.g. existing networks of schools/ expert partner offering a new approach etc.)?*
- *What project activities have been put in place?*
- *Where has the project been delivered geographically?*
- *Who delivered the project?*
- *Who were the target beneficiary groups of the project and why?*

The 'Understanding Science Through Art' programme engaged artists, scientists and teachers to create an exhibition exploring the new primary science curriculum topics of light, sound and forces &magnets children in for years 3 and 4. The exhibition provided ways into traditionally challenging areas and was complemented by dynamic school resources and an action learning programme for participating teachers.

The three selected themes were chosen as particularly challenging areas of the curriculum for less confident teachers and students. By exploring these with professionals we created an exceptional resource providing alternative cross-curricular entry points for teaching and learning for the new curriculum.

The programme has involved teachers from six primary schools in Wandsworth, three scientists from Imperial College London and three professional artists who have formed 3 working groups rigorously explore the three curriculum themes excavating pedagogical, scientific and artistic challenges and opportunities to create an exhibition. The groups have worked with an Action Learning facilitator and specialist consultants develop science teaching and learning pack responding to the new science curriculum and exhibition.

A key aim of the programme was up skill the core KS2 teachers, increasing their knowledge, skills and understanding in science through the wider professional partnership working. The resulting exhibition and teaching and learning pack was made widely available to firstly an extended group of local schools and is now available to all London schools as part of the exhibition and as an online resource.

The six week exhibition at the Pump House Gallery in Battersea Park opened on 23rd April 2015. It engaged teachers, children and the wider community in dialogue, and raise awareness, about contemporary science practice and education. Schools and the general public engaged with the exhibition through tours, workshops and access to resource pack. In addition, the gallery's weekend participation programme attracted visitors and families from diverse backgrounds.

2.1 Does your project support transition to the new national curriculum? Yes

If **Yes**, what does it address?

The lower Key Stage 2 science curriculum for Forces & Magnets, Sound and Light.

2.2 Please list any materials produced and/or web links and state where the materials can be found. Projects should promote and share resources and include them on the LondonEd website.

The focus point of the project was an exhibition at the Pump House Gallery:

3 Branches of the Same Tree is a project and exhibition exploring areas of science that are often difficult to comprehend and how the subject is received in educational settings.

Three artists Semiconductor, Lyndall Phelps and Alistair McClymont have been commissioned by Pump House Gallery to work alongside scientists and local schools to create an exhibition of works to open out scientific knowledge and offer a new way of seeing the world. Further information about the exhibition can be seen on the Pump House Gallery website:

http://pumphousegallery.org.uk/exhibitions/3-branches-of-the-same-tree-art-science-and-education

Alistaire McClymont: One should never mistake pattern….for meaning (Function Generator) 2015

The project activity also resulted in the development of a teacher's resource pack for KS2 students. It focusses on curriculum topics Forces & Magnets, Light and Sound. The pack is available to all teachers and schools from the Pump House Gallery website.

http://pumphousegallery.org.uk/things-to-do/schools-programme/resource-pack-archive

The pack is also available on the science pages of the Primary National Curriculum wikispace:

http://primarynationalcurriculum2014.wikispaces.com/Science

3. Theory of Change and Evaluation Methodology

Please attach a copy of your validated Theory of Change and Evaluation Framework.

Throughout the report it would be useful if you make reference to these documents. Where appropriate we would also encourage you to include any assumptions you have made from previous research.

The Theory of Change (Appendix A) and Evaluation Framework (Appendix B) can be found in the attached appendices.

3.1 Please list **all** outcomes from your evaluation framework in Table 1. If you have made any changes to your intended outcomes after your Theory of Change was validated please include revised outcomes and the reason for change.

Table 1- Outcomes

Description	Original Target Outcomes	Revised Target Outcomes	Reason for change
Teacher Outcome 1	Improved teacher knowledge, skills and understanding in science.		
Teacher Outcome 2	Teachers to have a developed understanding of cross curriculum learning through working with experts from arts and science disciplines.		
Teacher Outcome 3	Improved teacher confidence in teaching science		
Pupil outcome 1	Increased attainment and progress in science in years 3 and 4		
Pupil outcome 2	Increased enthusiasm about science from pupils		
Wider system outcome 1	Sustainable networks established between local art establishment, science centres and schools.		
Wider system outcome 2	Increased profile of science within core schools		

3.2 Did you make any changes to your project's activities after your Theory of Change was validated? Yes/

If **Yes**, what were these changes (e.g. took on additional activities?)

The

3.3 Did you change your curriculum subject/s focus or key stage? /No

If **Yes**, please explain what changes you made, why, and provide some commentary on how they affected delivery.

3.4 Did you evaluate your project in the way you had originally planned to, as reflected in your validated evaluation plan?

Consider changes to evaluation tools/methods, sample sizes, and anticipated outcomes. If applicable, please explain what changes you made and why, and provide some commentary on how they affected your evaluation.

The status of evaluation methodology which has required amending is as follows:

1. *Pre-project subject knowledge questionnaire was carried out for each of the three science topic areas for teachers and artists. All groups submitted a completed questionnaire. 11 individual teacher questionnaires were submitted. The project administrator chased up the missing questionnaires but was not successful in attaining them. Consequently, post project subject knowledge questionnaires have been analysed for groups and for individuals with baseline data. These have been completed during the end programme interviews in addition to emailed questionnaires to gather as many as much information as possible.*
2. *The three focus group evaluations of the teaching and learning resource pack were supplemented by a large scale evaluative exercise involving the science subject leaders from a further 29 schools at a CPD event. Feedback from the focus group sessions and the wider CPD session has led to improvements in clarity and 'teacher' friendliness of the packs.*
3. *It has not been possible to collect data to evidence the increased attainment and progress in science in years 3 and 4* . Changes in the National Curriculum and testing arrangements made this impossible. During this period of transition from the old curriculum to the new schools were focussing on adopting and developing assessment systems fro English and mathematics, and were not required to gather information about science attainment at this level. The project team explored the possibility of asking the project schools to collect this data additionally; however the changes in curriculum meant that not all project schools had covered the science topics being addressed. This has led to a situation where no pupil attainment has been available for measuring impact.

The status of evaluation methodology which has remained the same as the plan is as follows:

4. *Feed back about the exhibition and the teaching and learning pack will be collected at the gallery through feedback forms for teachers, pupils and other visitors. Visitor number data will also be collected.*
5. *Registers of attendance will provide evidence of engagement for Action Learning sessions and dissemination CPD sessions.*
6. *Data to evidence increased enthusiasm about science will be collected in end of project interviews and exhibition feedback forms.*

4. Evaluation Methodological Limitations

4.1 What are the main methodological limitations, if any, of your evaluation?

This can include data limitations or difficulty in identifying a comparison group. In order to get a realistic idea of the strength of your evaluation, and identify possible improvements, it is essential that you reflect on the strengths and weaknesses of your evaluation.
You should address limitations of the evaluation only, not the project itself - *Every evaluation has limitations, so please be honest. This could include limitations relating to:*

- *The kinds of data you could/ could not collect (and the response rate for surveys)*
- *The size of the sample/ group you are evaluating*
- *The extent to which you felt able to assess the impact of activity on beneficiaries (what changes in attitudes/behaviours/attainment were caused by the intervention and what has been caused by other factors)*
- *Also include mitigating actions for methodological limitations where possible* ***–*** *e.g. alternative approaches or solutions and also how these limitations will affect the evaluation of the project (particularly pupil and teachers outcomes).*

The main methodological limitations of the current evaluation processes in place include:

The 7 Action Learning sessions were evaluated through a series of written reflective tasks. The collated tasks tell the story of each groups' journey towards a greater understanding of the science topic chosen and the application of this to the exhibition and the teaching and learning resource packs. An unplanned change of Action Learning facilitator for some of the sessions resulted in a change in the recording methods of the session evaluations. This has been compensated by adjusting the questions in the end of programme evaluation.

As reported above, it has not been possible to collect data to evidence the increased attainment and progress in science in years 3 and 4 . Changes in the National Curriculum and testing arrangements made this impossible. During this period of transition from the old curriculum to the new schools were focussing on adopting and developing assessment systems fro English and mathematics, and were not required to gather information about science attainment at this level. The project team explored the possibility of asking the project schools to collect this data additionally; however the changes in curriculum meant that not all project schools had covered the science topics being addressed. This has led to a situation where no pupil attainment has been available for measuring impact.

4.2 Are you planning to continue with the project, once this round of funding finishes? Yes

If **yes**, will you (and how will you) evaluate impact going forward?

Due to the delay in producing the teachers pack it was not possible to trial and evaluate the resources in a greater number of schools as originally planned. With agreement to use the project grant underspend (£6000), the Teacher's Resource Pack will be introduced to a greater number of KS2 teachers and primary science subject leaders. Evaluations on the

quality of teaching resources and pupils attainment will be collected and analysed at this time.

5. Project Costs and Funding

5.1 Please fill in Table 2 and Table 3 below:

Table 2 - Project Income

	Original[1] Budget	Additional Funding	Revised Budget [Original + any Additional Funding]	Actual Spend	Variance [Revised budget – Actual]
Total LSEF Funding	£70,500		£70,500	£64,211.40	£6288.60
Other Public Funding					
Other Private Funding					
In-kind support (e.g. by schools)	£21450		£21450		£21450
Total Project Funding	£91950		£91950		£27,738.60

List details in-kind support below and estimate value.

In-kind support was provided by Wandsworth Council who took on some of the costs of management, administration, training, publicity and marketing to the approximate value of £21450. Additional in-kind support was provided by schools with the provision of teachers' time and venues for events and meetings.

Table 3 - Project Expenditure

	Original Budget	Additional Funding	Revised Budget [Original + any Additional Funding]	Actual Spend	Variance Revised budget – Actual]
Direct Staff Costs (salaries/on costs)	£30,550	0	£30,550	£41389.12	-£10839.12
Direct delivery costs e.g. consultants/HE (specify)	Included above	0			
Management and Administration Costs	£9,050	0	£9,050	£5547.72	£3502.28
Training Costs	£5,900	0	£5,900	£5725.38	£174.62
Participant Costs (e.g. Expenses for travelling to venues, etc.)	n/a	0			
Publicity and Marketing Costs	£24,500	0	£24,500	£11,349.18	£13150.82

[1] Please refer to the budget in your grant agreement

Teacher Supply / Cover Costs	n/a	0			
Other Participant Costs	n/a	0			
Evaluation Costs	£500	0	£500	£200	£300
Total Costs	£70,500	0	£70,500	£64211.40	£6288.60

5.2 Please provide a commentary on Project Expenditure
This section should include:

- *commentary on the spend profile*
- *budget changes that have occurred, including the rationale for any changes*

(Maximum 300 words)

.

Due to the timeline of the exhibition and the standard process for contracting artists, a greater proportion of the budget necessary moved to the final claim. Rocket Science were made aware of this through regular communication with Ned McConnell, the Exhibition Manager.

Some budget changes between budget strands was necessary:

- The production of the Teacher Resources pack involved the need for greater spend on consultancy days.
- Funds shifted to a series of events that were promoted across London to create more opportunity to access the exhibition

6. Project Outputs

Please use the following table to report against agreed output indicators, these should be the same outputs that were agreed in schedule 3 of your Funding Agreement and those that were outlined in your evaluation framework.

Table 4 – Outputs

Description	Original Target Outputs	Revised Target Outputs *[Original + any Additional Funding/GLA agreed reduction]*	Actual Outputs	Variance [Revised Target - Actual]
No. of schools	6 core schools 34 through dissemination and exhibition		6 Core 35 through dissemination and exhibition	1
No. of teachers	34		44	10
No. of pupils	180 core school 600 through dissemination and exhibition		180 core school 110 through dissemination and exhibition	Met core school target -480 through dissemination

				and exhibition
Creation of a pack resource pack and dissemination to 100-200 teachers.	Teacher's resource pack created and made available online and in hard copy to 100-200 teachers		Teacher's resource pack created and made available online and in hard copy to approx. 200 Year 3 and 4 teachers directly. Also openly available online.	
7 action learning sessions for teachers	7 action learning sessions for teachers		6 action learning sessions for teachers	
Creation of education focussed exhibition	Creation of education focussed exhibition		Education focussed exhibition - 23rd April 2015 to 31st May 2015	
Pupil engagement with off-site exhibition	Pupil engagement with off-site exhibition – target 20 class visits		Pupil engagement with off-site exhibition – 8 class visits	-14 classes

7. Key Beneficiary Data

Please use this section to provide a breakdown of teacher and pupil sub-groups involved in your project.

Data must be provided at project level. However, if you wish to disaggregate data by school then please add additional rows to the tables below. Please also confirm at what point this data was collected.

Please add columns to the tables if necessary but do not remove any. N.B. If your project is benefitting additional groups of teachers e.g. teaching assistants please add relevant columns to reflect this.

7.1 Teacher Sub-Groups (teachers directly benefitting counted once during the project)

Please provide your definition for number of benefitting teachers and when this was collected below *(maximum 100 words).*

11 teachers participate in the full programme, engaging in all the developmental action learning sessions and being involved in creating and trialling resources and teaching. These are from the first 6 schools in the table below.

8 further teachers engaged in the exhibition and received the teacher resource packs

An additional 25 attended a science CPD event to disseminate the resources

Table 5 – Teachers benefitting from the programme

	No. teachers	**% NQTs *(in their 1st year of teaching when they became involved)***	**% Teaching 2 – 3 yrs *(in their 2nd and 3rd years of teaching when they became involved)***	**% Teaching 4 yrs + *(teaching over 4 years when they became involved)***	**% Primary (KS1 & 2)**	**% Secondary (KS3 - 5)**
Project Total						
School 1	*3*			*100%*	*100%*	
School 2	*2*	*50%*	*50%*		*100%*	
School 3	*3*		*33%*	*66%*	*100%*	
School 4	*1*			*50%*	*100%*	
School 5	*1*			*50%*	*100%*	
School 6	*2*			*100%*	*100%*	
School 7	*1*			*100%*	*100%*	
School 8	*1*			*100%*	*100%*	
School 9	*1*			*100%*	*100%*	
School 10	*2*			*100%*	*100%*	
School 11	*2*		*100%*		*100%*	
School 12	*2*			*100%*	*100%*	
School 13	*1*			*100%*	*100%*	
School 14	*1*		*100%*		*100%*	
School	*1*		*100%*		*100%*	

15						
School 16	*1*			*100%*	*100%*	
School 17	*1*			*100%*	*100%*	
School 18	*1*			*100%*	*100%*	
School 19	*1*			*100%*	*100%*	
School 20	*1*			*100%*	*100%*	
School 21	*1*			*100%*	*100%*	
School 22	*1*		*100%*		*100%*	
School 23	*1*			*100%*	*100%*	
School 24	*1*			*100%*	*100%*	
School 25	*1*		*100%*		*100%*	
School 26	*1*			*100%*	*100%*	
School 27	*1*			*100%*	*100%*	
School 28	*1*			*100%*	*100%*	
School 29	*1*			*100%*	*100%*	
School 30	*1*			*100%*	*100%*	
School 31	*1*		*100%*		*100%*	
School 32	*1*			*100%*	*100%*	
School 33	*1*		*100%*		*100%*	
School 34	*1*			*100%*	*100%*	
School 35	*1*			*100%*	*100%*	

7.1.2 Please provide written commentary on teacher sub-groups e.g. how this compares to the wider school context or benchmark *(maximum 250 words)*

The teachers involved in the project were mostly responsible for leading science in their schools. This has led to there being a greater percentage of more experienced teachers (4 years and above) than you would expect in a typical sample of class teachers from the same locality.

7.2 Pupil Sub-Groups (these should be pupils who directly benefit from teachers trained)

Please provide your definition for number of benefitting pupils and when this data was collected below *(maximum 100 words)*

Tables 6-8 – Pupil Sub-Groups benefitting from the programme

	No. pupils	**% LAC**	**% FSM**	**% FSM last 6 yrs**	**% EAL**	**% SEN**
Project Total	*416*		*28%*		*51%*	*20%*
School 1	*49*		*37%*		*76%*	*18%*
School 2	*77*		*34%*		*64%*	*29%*
School 3	*28*		*11%*		*11%*	*7%*
School 4	*54*		*26%*		*31%*	*17%*
School 5	*28*		*29%*		*68%*	*32%*
School 6	*21*		*43%*		*38%*	*10%*
School 7	*26*					
School 8	*23*		*47%*		*30%*	*17%*
School 9	*54*		*13%*		*76%*	*26%*
School 10	*56*		*13%*		*63%*	*20%*

	No. Male pupils	**No. Female pupils**	**% Lower attaining**	**% Middle attaining**	**% Higher attaining**
Project Total	*216*	*200*			
School 1	*16*	*33*			
School 2	*42*	*35*			
School 3	*13*	*15*			
School 4	*31*	*23*			
School 5	*17*	*11*			
School 6	*8*	*13*			
School 7	*13*	*13*			
School 8	*13*	*10*			
School 9	*32*	*22*			
School 10	*31*	*25*			

	% Asian I	**% Asian P**	**% Asian B**	**% Asian A**	**% Black C**	**% Black A**	**% BlackAnyOth**	**% Mixed W**	**% MixedWh**	**% MixedWh**	**% MixedAn**	**% Chinese**	**% Anyoth**

	ndian	**akistani**	**angladeshi**	**ny Otherbackground**	**aribbean**	**frican**	**erBackground**	**hite & Black Caribbean**	**ite & Black African**	**ite & Asian**	**y OtherBackground**		**erethnic group**
Project Total	*1%*	*5%*	*2%*	*6%*	*10%*	*18%*	*5%*	*4%*	*1%*	*2%*	*6%*	*0%*	*4%*
School 1	*0%*	*0%*	*8%*	*1%*	*4%*	*37%*	*8%*	*4%*	*2%*	*0%*	*8%*	*0%*	*2%*
School 2	*0%*	*7%*	*3%*	*6%*	*10%*	*36%*	*8%*	*2%*	*0%*	*1%*	*7%*	*0%*	*4%*
School 3	*0%*	*0%*	*0%*	*4%*	*0%*	*4%*	*7%*	*0%*	*0%*	*0%*	*7%*	*0%*	*0%*
School 4	*4%*	*4%*	*2%*	*2%*	*4%*	*6%*	*2%*	*4%*	*2%*	*7%*	*7%*	*0%*	*8%*
School 5	*0%*	*13%*	*3%*	*3%*	*13%*	*18%*	*5%*	*5%*	*3%*	*0%*	*5%*	*0%*	*6%*
School 6	*0%*	*10%*	*0%*	*5%*	*14%*	*10%*	*0%*	*0%*	*0%*	*0%*	*10%*	*0%*	*10%*
School 7													
School 8	*0%*	*0%*	*0%*	*4%*	*26%*	*13%*	*0%*	*9%*	*0%*	*0%*	*4%*	*0%*	*0%*
School 9	*2%*	*0%*	*0%*	*9%*	*7%*	*20%*	*19%*	*4%*	*2%*	*4%*	*2%*	*0%*	*6%*
School 10	*7%*	*11%*	*2%*	*23%*	*14%*	*15%*	*0%*	*5%*	*0%*	*2%*	*7%*	*2%*	*4%*

	% White	**% White**	**% White**	**% White**	**% White**

	British	**Irish**	**Traveller of Irish heritage**	**Gypsy/ Roma**	**Any Other Background**
Project Total	*17 %*	*0%*	*0%*	*0%*	*10 %*
School 1	*8%*	*0%*	*0%*	*0%*	*2%*
School 2	*11 %*	*0%*	*0%*	*0%*	*2%*
School 3	*21 %*	*0%*	*0%*	*0%*	*7%*
School 4	*28 %*	*0%*	*0%*	*0%*	*22 %*
School 5	*8%*	*0%*	*0%*	*0%*	*23 %*
School 6	*29 %*	*0%*	*0%*	*0%*	*5%*
School 7					
School 8	*35 %*	*0%*	*0%*	*0%*	*0%*
School 9	*9%*	*0%*	*0%*	*0%*	*17 %*
School 10	*2%*	*0%*	*0%*	*0%*	*8%*

7.2.1 Please provide a written commentary on your pupil data e.g. a comparison between the targeted groups and school level data, borough average and London average *(maximum 500 words)*

Useful links: London Data Store, DfE Schools Performance, DfE statistical releases

8. Project Impact

You should reflect on the project's performance and impact and use **qualitative and quantitative** data to illustrate this.

- Please complete the tables below before providing a narrative explanation of the impact of your project.
- Please state how you have measured your outcomes (e.g. surveys) and if you are using scales please include details.
- Please add graphical analysis (e.g. bar charts) to further demonstrate project impact on each teachers, pupils, wider system outcomes etc. If you use graphs, please ensure that all charts are explained and have clear labels for the axes (numeric data or percentages, for example) and legends for the data.

Please add columns to the tables if necessary but do not remove any. N.B. If your project is collecting data at more than two points and may want to add additional data collection points.

8.1 Teacher Outcomes

Date teacher intervention started: September 2014

Table 9 – Teacher Outcomes: teachers benefitting from the project

The 1st Return will either be your baseline data collected before the start of your project, or may be historical trend data for the intervention group. Please specify what the data relates to.

Target Outcome	Research method/ data collection	Sample characteristics	Metric used	1st Return and date of collection	2nd Return and date of collection
e.g. Increased Teacher confidence	*e.g. E-survey*	*e.g. 100 respondents from a total of 200 invites.* *The profile of respondents was broadly representative of the population as a whole.*	*e.g. Mean score based on a 1-5 scale (1 – very confident, 2 – quite confident, 3 neither confident nor unconfident, 4 - quite unconfident, 5 – very unconfident)*	*e.g. Mean score- 3.7, collected September 2015*	*e.g. Mean score- 4.5, collected June 2015*
Improved teacher knowledge, skills and understanding in science.	*Baseline and end of project 'questionnaire'*	*11 participating teachers from 6 schools in developmental phase of*	*Percentage accuracy across questionnaire.*	*52% September 2015*	*Not able to collect end data. Comparisons made with subject*

		project			*knowledge used to create resource pack.*
Teachers to have a developed understanding of cross curriculum learning through working with experts from arts and science disciplines.	*Baseline and end of project questionnaire/ interview*	*11 participating teachers from 6 schools in developmental phase of project*	*Self reported scaled score related to understanding of cross curricular learning*	*Mean score on self evaluation scale (One low 10 high) is 4,3* *September 2014*	*Mean score on self evaluation scale (One low 10 high) is 8,3* *April 2015*
Improved teacher confidence in teaching science	*Baseline and end of project questionnaire/ interview*	*11 participating teachers from 6 schools in developmental phase of project*	*Self reported scaled score related to* Teacher confidence in teaching science	*Mean score on self evaluation scale (One low 10 high) is 6* *September 2014*	*Mean score on self evaluation scale (One low 10 high) is 7.4* *April 2015*

Table 10 – Comparison data outcomes for Teachers *[if available]*

Target Outcome	Research method/ data collection	Sample characteristics	Metric used	1st Return and date of collection	2nd Return and date of collection
e.g. Increased Teacher confidence	*e.g. E-survey*	*e.g. 100 respondents from a total of 200 invites.* *The profile of respondents was*	*e.g. Mean score based on a 1-5 scale (1 – very confident, 2 – quite confident, 3 neither confident nor unconfident, 4*	*e.g. Mean score*	*e.g. Mean score*

		broadly representative of the population as a whole.	*- quite unconfident, 5 – very unconfident)*		

8.1.1 Please provide information (for both the intervention group and comparison group where you have one) on:

- Sample size, sampling method, and whether the sample was representative or not
- Commentary on teacher impact (please also refer to table 5 re impact on different groups of teachers)
- Qualitative data to support quantitative evidence.
- Projects can also provide additional appendices where appropriate.

(Minimum 500 words)

Data was collected for the small group of 11 teachers from the six schools involved in the developmental stage of the project leading to the creation of the exhibition and the teachers' resource pack. The schools and teachers who got involved at this stage were self – selected because of their interest and enthusiasm for science, or because science was a focus on the school development plan.

The teachers who completed both baseline and final questionnaire reported an average of a three point increase in subject knowledge on a self reported scale. The detailed questionnaire completed at the beginning of the project by each group (see Appendix C). Baseline evaluation demonstrated a 52% accuracy on the teachers' baseline questionnaires completed, with the 'maybe' option being used in 26% of the questions. Reasoning was given to justify 63% of responses. Unfortunately we were unable to collect a significant number of end of project questionnaires to make direct comparisons. However the quality of scientific reasoning and subject knowledge required to design the activities in the final resources pack provides supporting evidence that the self reported increase in subject knowledge. The accuracy of science knowledge can be seen in the classroom activities planned for the development of the teacher resource pack (Appendix D and E)

8.2 Pupil Outcomes

Date pupil intervention started:

Table 11 – Pupil Outcomes for pupils benefitting from the project

The 1st Return will either be your baseline data collected before the start of your project, or may be historical trend data for the intervention group. Please specify what the data relates to.

Target Outcome	Research method/ data collection	Sample characteristics	Metric used	1st Return and date of collection	2nd Return and date of collection
e.g. Increased educational attainment and progress in Writing	*e.g. Pupil assessment data*	*e.g. Characteristics and assessment data collected for 97 of 100. The profile of respondents matches that initially targeted in the Theory of Change.*	*e.g. mean score or percentage at diff National Curriculum Levels or GCSE grades*	*e.g. Mean score- 3.7, collected September 2015*	*e.g. Mean score- 4.5, collected June 2015*
Increased attainment and progress in science in years 3 and 4	*Teacher assessment against new NC*	*Percentage of pupils meeting age related expectations*	*Percentage of pupils meeting age related expectations*	*Unable to collect this data – schools participating not TA against new curriculum*	*Unable to collect this data – schools participating not TA against new curriculum*
Increased enthusiasm about science from pupils	*Teacher reported on baseline and end of project questionnaire / interview*	*11 participating teachers from 6 schools in developmental phase of project*	*Self reported scaled score related to* enthusiasm about science from pupils	*Mean score on self evaluation scale (One low 10 high) is 7.8* *September 2014*	*Mean score on self evaluation scale (One low 10 high) is 7.8* *April 2015*

Table 12 - Pupil Outcomes for pupil comparison groups *[if available]*

Target Outcome	Research method/ data collection	Sample characteristics	*Metric used*	1st Return and date of collection	2nd Return and date of collection
e.g. Increased educational attainment and progress in Writing	*e.g. Pupil assessment data*	*e.g. Characteristics and assessment data collected for 97 of 100. The profile of respondents*	*e.g. mean score or percentage at diff National Curriculum Levels or GCSE grades*	*e.g. Mean score- 3.7, collected September 2015*	*e.g. Mean score- 4.5, collected June 2015*

		matches that initially targeted in the Theory of Change. *Please find detailed analysis of the profile of respondents in Section 7.2*			

8.2.1 Please provide information (for both the intervention group and comparison group where you have one) on:

- Sample size, sampling method, and whether the sample was representative or not Commentary on pupil impact (please also refer to table 6-8 re impact on different groups of pupils)
- Qualitative data to support quantitative evidence.
- Projects can also provide additional appendices where appropriate.

(minimum 500 words)

Data was collected from two groups of pupils:

- Year 3 and/or 4 pupils from the six school participating in the development stage of the project.
- All pupils visiting the gallery exhibition

The original plan in the evaluation schedule was to collect data about pupils attainment in relation to the new curriculum being explored.

However, changes in the National Curriculum and testing arrangements made this impossible. During this period of transition from the old curriculum to the new schools were focussing on adopting and developing assessment systems fro English and mathematics, and were not required to gather information about science attainment at this level. The project team explored the possibility of asking the project schools to collect this data additionally; however the changes in curriculum meant that not all project schools had covered the science topics being addressed. This has led to a situation where no pupil attainment has been available for measuring impact.

The second target outcome written into the evaluation framework has also led to a dead-end. The levels of enthusiasm for science amongst project schools was reported as high - with teachers reporting that on a scale of 1 – 10 the level of average level of enthusiasm for science was 7.8. This remained the average score in the end of project interviews. The

common reason teachers gave for there being no change was the consistently high profile of science in their schools – one of the factors in deciding to participate in the programme. In addition to this the final Teachers' resource packs were delayed and not available to schools until the end of the term.

Anecdotally, the interest of the pupils on the teachers' resource activity testing days in school was reported to be very high. Teachers' reported the level of interest in pupils when engaging with the project artists and scientists in their classrooms. The children were very enthusiastic about carrying out science activities 'with real scientist'!

8.3 Wider System Outcomes

Table 13 – Wider System Outcomes

Target Outcome	Research method/ data collection	Sample characteristics	*Metric*	1st Return and date of collection	2nd Return and date of collection
Sustainable networks established between local art establishment, science centres and schools.	*Increase in numbers of teachers Participating in education projects at the Pump House Gallery* *Increase in number of school visitors for exhibition*	*Attendance at gallery CPD and exhibition*	*average number of teacher attendees over the course of the project and in comparable timeframe the previous year*	*Previous exhibition visitors – 881* *Previous workshop participants – 282* *Previous attendance by school parties – 0 April 2014*	*Project exhibition visitors – 1234* *Project workshop participants – 201* *Project attendance by school parties – 140 April 2015*
Increased profile of science within core schools	*Raised profile of science within the school and school community*	*Interview responses*	*Baseline and end of project questionnaire/ interview*	*Science on school development plan (reason for taking part in project)*	*No difference reported*

8.3.1 Please provide information on *(minimum 500 words):*

- Sample size, sampling method, and whether the sample was representative or not
- Commentary on wider system impact qualitative data to support quantitative evidence.
- Projects can also provide additional appendices where appropriate.

The number of schools, teachers, pupils and other visitors to the gallery increased during the project exhibition in comparison to the number engaging in a similarly timed exhibition the previous year.

However, visitor and school workshop numbers for engagement in the exhibition were disappointing, project targets set at the beginning of the project were not met despite an

extensive marketing campaign. The visitor statistics however do demonstrate increased numbers compared to a comparable exhibition in the same month of the previous year (see Figure 1)

3 Branches of the Same Tree: Art, Science and Education ***(****23 April 2015- 31 May 2015)*
1234 visitors
201 participants
140 school children attended school workshops at gallery

The Garment Project **(***26 April 2014- 25 May 2014)*
881 visitors
282 participants
0 school children attended school workshops at gallery
Figure 1. Pump House Gallery Visiting Data

The second wider system target outcome written into the evaluation framework was an increase in the profile of science within school. Again due to the self selecting process of the original 6 schools the baseline for science profile was already high, and no change was reported. The common reason teachers gave for there being no change was the consistently high profile of science in their schools – one of the factors in deciding to participate in the programme. In addition to this the final Teachers' resource packs were delayed and not available to schools until the end of the term.

8.4 Impact Timelines

Please provide information on impact timelines:

- At what point during/after teacher CPD activity did you expect to see impact on teachers? Did this happen as expected?

The project team expected to see an increase in the understanding od the focus scientific concepts through out the developmental stage leading to greater confidence in designing learning activities. This was found to be the case.

- At what point during/after teacher CPD activity did you expect to see impact on pupils? Did this happen as expected?

The impact on pupil attainment was expected once the pupils had visited the exhibition as an initial stimulus for learning, then gone on to engage in the planned activities back in school. With the delay in the teachers' resource pack it was not possible to gather this data formally.

- At what point did you expect to see wider school outcomes? Did this happen as expected?

Wider school outcome were expected following the exhibition and engagement in other project activity. This was reported as consistently high in the project schools.

- Reflect on any continuing impact anticipated.

With the availability of the Teachers resource pack freely online on both the Pump House Gallery website, and the Council curriculum website, it is expected that Year 3 and 4 teachers will be able to plan and use well planned resources and activities for the new science curriculum.

9. Reflection on overall project impact *(maximum 1,500 words)*

In this section we would like you to reflect on:

- The overall impact of your project
- The extent to which your theory of change proved accurate
- How your project has contributed to the overall aims of LSEF
- Whether your findings support the hypothesis of the LSEF
- What your findings say about the meta-evaluation theme that is most relevant to you

Please illustrate using the key points from the previous detailed analysis.

All the evidence should be brought together here (achievement of outputs and outcomes, and the assessment of project impact) to produce well informed findings, which can be used to inform policy development in a specific area as well as the meta-evaluation of the LSEF.

The London Schools Excellence Fund (LSEF) is based on the hypothesis that investing in teaching, subject knowledge and subject-specific teaching methods and pedagogy will lead to improved outcomes for pupils in terms of attainment, subject participation and aspiration.

The aims of the Fund:
I. Cultivate teaching excellence through investment in teaching and teachers so that attention is re-focused on knowledge-led teaching and curriculum.
II. Support self-sustaining school-to-school and peer-led activity, plus the creation of new resources and support for teachers, to raise achievement in priority subjects in primary and secondary schools (English, mathematics, biology, chemistry, computer science, physics, history, geography, languages).
III. Support the development of activity which has already been tested and has some evaluation (either internal or external), where further support is needed to develop the activity, take it to scale and undertake additional evaluation.
IV. In the longer term, create cultural change and raise expectations in the London school system, so that London is acknowledged as a centre of teaching excellence and its state schools are among the best in the world.

The Developmental Stage – Action Learning

The seven Action learning sessions, involving facilitated meetings with the scientist, artists and teachers, was designed to enable the separate disciplines to come to a shared understanding of the three science topics. The interactions and resulting activity from these sessions formed the shared understanding from gallery exhibition and the supporting teachers' resource pack were created. The journey through the sessions to the outcome was by nature unpredictable and dependent on the interaction between the three disciplines. This resulted in rich outcomes that were influenced by all involved, scientists artist and teachers, it is clear that the exhibition and teacher resource pack benefitted from the interactions in this developmental stage.

The sessions however varied in quality and usefulness to the outcomes. Each expert group had their own opinions on various aspects of science knowledge, creativity, and teaching.

The challenging was to shape these individual opinions and ideas to bind together or change and develop as the project went forward.

Three groups were established to work on the three science topics chosen, a facilitator role provided an independent, experienced, effective and enthusiastic structure to the meetings. The meetings were staged in a range of venues to reflect the three areas of expertise – a school, the gallery and the science museum – this was to allow all participants to have experience of the others' working environments. Attendance across the meetings was generally high, 88% across all groups, however due to the small number involved the absence of a particular 'expert' in the group had a particular impact on the dynamics of the group. On two occasions the absence of the 'scientist' from a group when that expertise was need, or the teacher when the activity involved planning suitable learning experiences was frustrating. In hind sight involving a larger group of experts would have reduced the impact of any absence. The flow of the developmental stage was further interrupted by the unavoidable change in circumstances of the expert facilitator half way through the sessions. She was replaced immediately, however the inconsistency added to the challenges appearing in keeping the diverse working groups together. At this stage in the programme the open ended outcomes in terms of what the artists will deliver, as the resource packs were dependant on the continued strong communication between disciplines. Difficulties were also arising from a conflict between the working practises of the tree groups involved, the teachers and scientist felt the need to know the direction of the artists' work and thinking for the forthcoming exhibition, the artists' plans were still in a developmental stage. There was a risk that the resulting work and resource packs were in danger of diverging from each other too far. At this stage the school sessions took place in each school to test out the successfulness of the activities planned for the teacher resource pack.. It was a challenge for the teachers and scientists and artists to manage their diaries to find a time slot to suit everyone, but in the end they all managed to do this. The evaluation of activity at this stage was critical in the final stage of pack development.

Impact on Teacher Subject Knowledge and Pedagogy (Cross Curricular Learning)

In the end of project evaluation teachers reported that involvement in the development stage of the project had increased their understanding of cross curricular learning, in particular the use of art in supporting scientific understanding:

'It (the project) has made me think more carefully and reflect on how I can teach science in a more cross curricular way, looking for opportunities to teach science in different ways..

Participating teachers were asked to rate their confidence in their subject knowledge in the specific science topics being covered. The teachers who completed both baseline and final questionnaire reported an average of a three point increase in subject knowledge on a self reported scale. The detailed questionnaire completed at the beginning of the project by each group (see Appendix C). Baseline evaluation demonstrated a 52% accuracy on the teachers' baseline questionnaires completed, with the 'maybe' option being used in 26% of the questions. Reasoning was given to justify 63% of responses. Unfortunately the team were unable to collect a significant number of end of project questionnaires to make direct comparisons. However the quality of scientific reasoning and subject knowledge required to design the activities in the final resources pack provides supporting evidence that the self reported increase in subject knowledge. The accuracy of science knowledge can be seen in

the classroom activities planned for the development of the teacher resource pack (Appendix D and E)

The Teacher Resource Pack

The planning, development, evaluation and editing of the teacher resources pack was far more involved, complex and time consuming than had been planned for in the original project plan and budget.

The final ideas and activities for the resource, which was also to be used as a stand alone resource pack following the exhibition, were worked through by each of the three subject specific development groups. The activities were then trialled in the classrooms of the participating teachers and further refined using feedback from a group of 29 primary science subject leaders. An example of the feedback, improving and editing process can be seen in Appendix E. The final resource is available online (see details above in section 2.2). Due to the time involved in creating the resource, including the quality assurance processes, it was not available to schools until the end of the summer term. Due to this delayed timing the impact on the effectiveness of the teaching resources in classrooms has not been evaluated.

The Exhibition

The Pump House Gallery collected a range of evaluative feedback from the exhibition using questionnaires for visiting teachers, targeted interviews, email and visitor boob comments. The feedback received was on the whole positive. With the average visitor rating for the exhibition being 3.25. (Out of a scaled score 1-4 with 1 being poor and 4 being excellent).Examples of feedback received include:

Here are a sample of comments collected from the Teachers' Feedback about the exhibition:

- *The sound exhibition was the most helpful for making subject knowledge more accessible – the children could really feel the vibrations sitting by the large speakers.*

- *The activities were enjoyable and relevant to gain knowledge in the subject. The leaders explained the concepts clearly. The art work gave every child opportunities to experiment.*

- *The sound exhibition was best for building science concepts as it was the most interactive.*

- *The children experimented with the different sounds they could make using various resources. The cloud photographs were interesting but I don't think the children gained a lot of knowledge from the activity.*
- *The activities were structured, had good questions for children to work on. Many opportunities for children to handle, talk and discuss.*

- *Hands on meant children experienced it better.*

Comments from the Visitors' Book were similaryly positive:
"Great exhibition. Interesting and want to know more, see more."
"I loved the clouds – seeing something so familiar – but different – the earth getting on without us. ''Two planes on collision wowza! Right In the middle of the frame."
"inspiring
Exciting
Challenging
Wonderful to see how art and science can cross over and make the learning experience more invigorating"

How the project contributed to the overall aims of the LSEF Fund

Cultivate teaching excellence through investment in teaching and teachers so that attention is re-focused on knowledge-led teaching and curriculum.
The programme has provided a detailed focus on the science concepts in new primary science curriculum for pupils in Year 3 and 4. It has focussed on the science concepts to be taught and examined them in a new, interesting cross curricular way which provides a way in to understanding through art. The unique teacher resource pack will give teachers across London practical ways in to teaching the new science curriculum. The resulting exhibition, 3 Branches of the Same Tree: Art, Science and Education , at the Pump House Gallery provided the opportunity for the new curriculum and the teaching and learning of it on a new and public platform.

10. *Value for Money*

A value for money assessment considers whether the project has brought about benefits at a reasonable cost. Section 5 brings together the information on cost of delivery which will be used in this section.

10.1 Apportionment of the costs across the activity

Please provide an estimate of the percentage of project activity and budget that was allocated to each of the broad activity areas below. Please include the time and costs associated with planning and evaluating those activity areas in your estimates.

Broad type of activity	Estimated % project activity	£ Estimated cost, including in kind
Producing/Disseminating Materials/Resources	30%	£12,000
Teacher CPD (face to face/online etc)	20%	£9,000
Events/Networks for Teachers	20%	£9900
Teacher 1:1 support	n/a	n/a
Events/Networks for Pupils	10%	£9600
Exhibition including Publicity and Marketing	20%	£23,500
TOTAL	100%	£ 64,000

Please provide some commentary reflecting on the balance of activity and costs incurred: Would more or less of some aspects have been better?

10.2 Commentary of value for money

Please provide some commentary reflecting on the project's overall cost based on the extent to which aims/objectives and targets were met. If possible, draw on insight into similar programmes to comment on whether the programme delivers better or worse value for money than alternatives.

It is difficult to make judgements on the value for money of this particular project due to the unique nature of the content and delivery. The exhibition was a one off event, comparable in cost to other exhibitions at the same venue and of the same timeframe. The more sustainable legacy resource; 3 Branches of the Same Tree: Art, Science and Education – A teachers' resource pack is freely to all teachers online. Offering an up to date curriculum resource for the new science National Curriculum.

10.3 Value for money calculations

Note: This section is only required for projects with control or comparison groups

In order to demonstrate the cost effectiveness of the project we would like those projects who had control or comparison groups to provide some value for money calculations. Further guidance will be issued to support projects with this.

11. Reflection on project delivery

This section is designed to allow for a discussion of wider issues relating to the project. (maximum 1,500 words)

Please include reflection on the following:

11.1 Key Enablers and Barriers to Achievement

- *Were there internal and/or external factors which appear to have had an effect on project success, and how were these responded to (if applicable)?*
- *What factors need to be in place in order to improve teacher subject knowledge?*

11.2 Management and Delivery Processes

- *How effective were the management and delivery processes used?*
- *Were there any innovative delivery mechanisms and what was the effect of those?*
- *Did the management or delivery mechanisms change during the lifetime of the project and what were the before or after effects?*

11.3 Future Sustainability and Forward Planning

- *Do you have any plans for the future sustainability of your projects?*
- *What factors or elements are essential for the sustainability of your project?*
- *How have you/will you share your project knowledge and resources?*

The 'Understanding Science through Art' was a new and innovative programme. The success of the project depended on partnership working and communication between education, science and arts' institutions. Although the project outcomes were realised, on reflection a greater amount of resources placed on facilitating the partnerships, and time given to this activity would have been beneficial. This was realised early in the project, extra recourses were and time were allocated, however die to external factors (personnel, sickness of key members of team) this was not realised to full effect.

The timings of the programme could also have been improved enable teachers and pupils to engage in the development stage and programme. The exhibition was staged at a time of year that is prohibitive of teachers taking classes out on trips. Many schools limit visits out during the assessment phase which happens in the first few weeks of the summer term. This limited the numbers of schools who could engage in the exhibition.

The delay of the recourses pack, due to additional time being necessary to ensure a top quality publication, prevented the distribution of the teaching recourse at a time when it could be used and finally evaluated for impact. An extension of the project to allow this stage would make that possible.

The elements of the project which enabled the improvement of teacher subject knowledge were; the opportunity to have structured tome and space allocated for CPD; access to experts in the field and the transference of that knowledge back into the classroom through the creation of appropriate age related activities for the resource pack.

Going forward the activities from The Teacher Resources Pack will be included in the programme of CPD for Primary Science Subject Leaders in Wandsworth. The resource is

available online to download from the Pump House Gallery website and from the science pages of the Primary National Curriculum wikispace.(See section 2)

12. Final Report Conclusion

Please provide key conclusions regarding your findings and any lessons learnt *(maximum 1,500 words)*.

Alongside overarching key conclusions, headings for this section should include:

Key findings for assessment of project impact

- *What outcomes does the evaluation suggest were achieved?*
- *What outcomes, if any, does the evaluation suggest were not achieved or partly achieved?*
- *What outcomes, if any, is there too little evidence to state whether they were achieved or not?*

Key findings include:

Engaging in cross disciplinary discussions leading to the creation of an exhibition and teachers' resource pack has led to a greater understanding of the concepts with the new National Curriculum for teachers.

The facilitated, rich cross disciplinary discussions and 'action learning' led to the creation of a successful three week 'exhibition; 3 Branches of the Same Tree; Art, Science and Education exploring the theme Understanding Science through Art'. They also resulted in a well thought out teachers' resources which is available to all teachers across London.

There is not sufficient pupil data to show impact of the project on pupil attainment or enjoyment od science learning, however qualitative feedback from schools that have participated suggest that this will be the case.

Key lessons learnt for assessment of project delivery

- *What activities/approaches worked well?*
- *What activities/approaches worked less well?*
- *What difficulties were encountered in delivery and how could they be mitigated in the future?*
- *Were there any additional or unintended benefits (e.g. increases in student attendance as a result of an intervention aimed at teachers)?*

The activities and the approaches that worked well include:

- Giving space and time for experts from connected field to work on curriculum related projects.
- Involving an 'Action Learning' facilitator to structure conversations and activity across the fields.

- The 'Quiz' used to assess teachers' subject knowledge (Appendix c) worked particularly well to explore understanding of scientific concepts. The requirement to give a reason allowed participants to demonstrate understanding, but also unearthed some misconceptions.

The activities which worked less well:

- The timing of the resulting exhibition and completion of the resource pack did not work with the school calendar. The exhibition should have been places earlier or later in the school year. Schools need a full year to use and evaluate resources as they do not all teach the same topics at the same time within the yearly timetable.
- Ideally the project resources would have been trialled in additional schools at the developmental stage, giving the greater opportunity for user feedback and further improvement.

Informing future delivery

- *What should the project have done more of?*
- *What should the project have done less of?*
- *What recommendations would you have for other projects regarding scaling up and/ or replicating your project?*

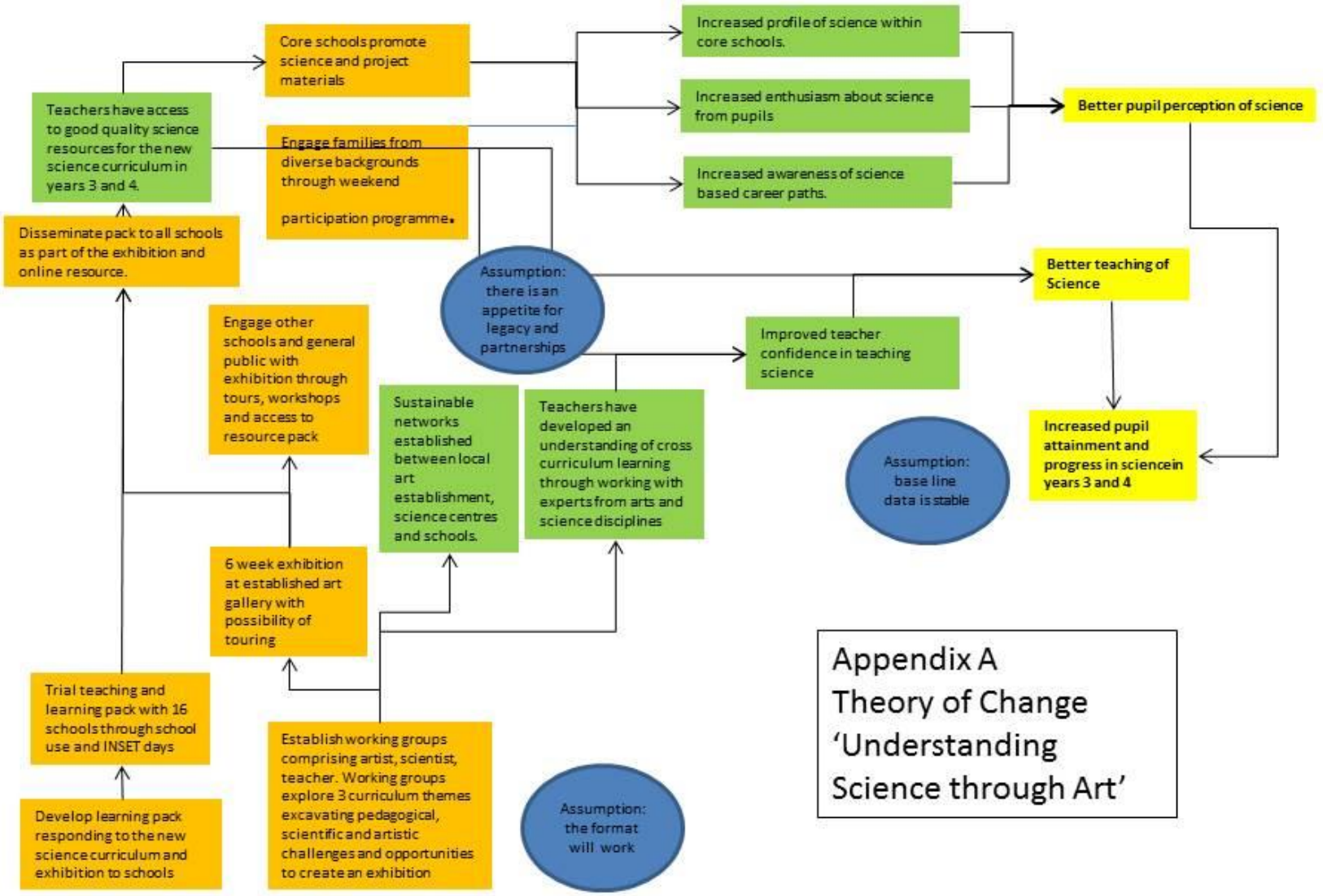
Lesson learned and recommendations:

- It would have been useful for the action learning sessions to be longer, and to have been earlier in the day; although twilight session suited everyone's busy diaries they did not allow the time necessary for the task required. This resulted in additional consultancy time being spent on the completion of the resource.
- The artists involved in the project were not local. Involving local artists would have created further possibilities for engagement and interaction between action learning sessions.
- The amount of time needed for facilitating communication and information gathering across three expert groups from different disciplines and working practises was underestimated. Any similar project should building in additional time to support effective communication.

London Schools Excellent Fund
LSEF059

‘Understanding Science through Art’
Wandsworth Council

Final report
Appendices



Appendix A
Theory of Change
'Understanding Science through Art'

Appendix B

'Understanding Science Through Art'
Evaluation Plan

Outputs	**Indicator of output**	**Baseline data collection**	**Impact data collection**
Creation of a pack resource pack and dissemination to 100-200 teachers. (Access to good quality science resources for the new science curriculum in years 3 and 4).	Resource packs for science topics 'light', 'sound' and 'forces and magnets' created by science consultant in collaboration with artists and teachers Resources created, printed and distributed.	N/A	Feedback from pupils and users to evidence number of users. Feedback forms for school testing of resource pack beyond core schools
7 action learning sessions for teachers	Action learning sessions to facilitate sharing of knowledge and expertise across three disciplines - education, science and arts. Generating new understanding	Registers detailing attendance from experts from each discipline	Registers evidence attendance
Creation of education focussed exhibition	Exhibition created, marketed and opened – Records of visitors – schools and general public collected	N/A	Attendance data –vistor data collected daily, comparison data available from previous periods
Pupil engagement with off-site exhibition	Exhibition marketed directly to schools and residents	N/A	Attendance and marketing data. Record of number of schools approached and take up of exhibition Post exhibition evaluations – completed by lead teacher for each school group

Teacher Outcomes	Indicators of Outcomes	Baseline data collection	Impact data collection
Improved teacher knowledge, skills and understanding in science.	From pre project questionnaire to end of project questionnaire increased subject knowledge in physics elements of the new science curriculum.	Pre project group and individual subject knowledge assessments for each science area covered. • around subject knowledge, (September 2014)	• Post project group and individual subject knowledge assessments for each science area covered. • Qualitative evaluation of subject knowledge development stage from action learning sessions (completed by facilitators for all groups) • Formal evaluation by interview for 6 core schools using an interview template • Three focus group evaluations of resource packs created involving experienced primary science subject leaders. (April 2015)
Teachers to have a developed understanding of cross curriculum learning through working with experts from arts and science disciplines.	Increased awareness od benefits of cross-curricular learning	Pre project group and individual subject knowledge assessments for each science area covered. • understanding of cross curricular learning, (September 2014)	Post project interview with 6 core schools to include questions about learning from cross curricular elements of the project. (April 2015)
Improved teacher confidence in teaching science	Increased teacher confidence in teaching science topics covered	Pre project group and individual subject knowledge assessments	Post project questionnaire and interview with 6 core schools.

	in programme	for each science area covered. • Confidence (September 2014)	(April 2015)
Pupil Outcomes	**Indicators of Outcomes**	**Baseline data collection**	**Impact data collection**
Increased attainment and progress in science in years 3 and 4	Increased attainment and progress of year 3 and 4 pupils. Measured through teacher assessment against new National Curriculum Programme of Study.	Teacher assessment data for pupils in current and previous years 3 and 4. (September 2014)	Post project teacher assessment in core schools. Measured by using teacher assessment for present cohort. Historical data for previous cohorts will be measured against the old NC (July 2015)
Increased enthusiasm about science from pupils	Increased enthusiasm of years 3 and 4 for science lessons	Data regarding pupils' enthusiasm of science reported by teachers in baseline questionnaire (September 2014)	Data regarding pupils' enthusiasm of science reported by teachers in end of project questionnaire (July 2015)
School System / 'Culture Change' Outcomes	**Indicators of Outcomes**	**Baseline data collection**	**Impact data collection**
Sustainable networks established between local art establishment, science centres and schools.	Increase in numbers of teachers participating in education programmes at the Pump House Gallery Increase in number of school visitors for exhibition	Numbers of teachers attending comparable networks over 12 months previous to intervention • CPD programme • Gallery visiting data prior to exhibition	Numbers of teachers attending comparable networks over 12 months previous to intervention • CPD programme • Gallery visiting data during exhibition (April 2015)
Increased profile of science within core schools	Raised profile of science within the school and school community	N/A	Post project interviews by core schools head teachers about profile of science in school and the school community.

			Gallery comments book and number of wall displays in school.

APPENDIX C

Subject knowledge questionnaire

Light

Light travels at $300x10^6$m/s.	Yes	No	Maybe
	Reason		
A shadow is the same shape as the object	Yes	No	Maybe
	Reason		
A shadow is black because all the light has been blocked	Yes	No	Maybe
	Reason		
All objects reflect light	Yes	No	Maybe
	Reason		
The shadow of an object is not dependent on the light source	Yes	No	Maybe
	Reason		

Light travels in straight lines	Yes	No	Maybe
	Reason		
In a dark room you see nothing	Yes	No	Maybe
	Reason		
A shadow will be bigger when the object causing it is closer to the light source	Yes	No	Maybe
	Reason		

Sound

Sound travels at 343m/s	Yes	No	Maybe

	Reason		
We hear less well when underwater	Yes	No	Maybe
	Reason		
When you close the door, the sound gets quieter as the it cannot travel through the wood so easily	Yes	No	Maybe
	Reason		
Amplitude, volume and loudness mean the same thing	Yes	No	Maybe
	Reason		
The pitch of a sound depends on its vibrations	Yes	No	Maybe
	Reason		
All noises are sounds	Yes	No	Maybe
	Reason		
We can hear all sounds	Yes	No	Maybe
	Reason		

All animals can hear	Yes	No	Maybe
	Reason		

Forces and Magnets

Objects move because there is a force acting on them	Yes	No	Maybe
	Reason		
All magnets have two poles	Yes	No	Maybe
	Reason		

Metals are magnetic	Yes	No	Maybe
	Reason		
Magnetism and gravity are forces that act on an object in the same way	Yes	No	Maybe
	Reason		

APPENDIX D

Group + Activity Name (activities in black have been tested in schools) (activities in orange are ideas to develop)	**The Science Concepts/Ideas What is the NCKS reference?**	**How art is being used to convey those ideas ? What is the artists thinking? Include art references here**
Light – Shadow Maker	• That light casts shadows, and that the light source placement causes shadows to change.	• Drawing the shape of the shadow created by an object, at different distances from the light source. • Manray
Light – Lightbox build a box, and use torches and mirrors to reflect light in the box, and coloured lenses to mix light..	• Looking at how light is reflected from different surfaces.	• Using coloured lenses to 'mix' light and make colours
Light - Reflections	• light is reflected from surfaces such as water, mirrors etc.	• find the reflections in the outdoor/indoor environment and draw the reflections, e.g go to the lake next to the gallery and observe and draw the reflections.
Light – reflections – build a kaleiedocscope	• looking at how light reflects, the mirror image is the opposite of the original	• use of mirrors to create symmetry and patterns, such as making a kaleidoscope • http://www.howtodothings.com/hobbies/how-to-make-a-kaleidoscope

Light – shadow theatre	• how objects can be manipulated to create shadows	• make a shadow theatre, making cutout shapes and using sticks/strings to created a shadow puppet theatre.
Light – Build a perisope	• Concept of light being reflected.	• Build a periscope, One idea the groups did not try but had listed was a periscope • http://www.pitara.com/art-craft-for-kids/craft-activities-for-kids/make-a-toy-periscope/

APPENDIX E

Sound resource pack development notes; working group meeting on 26 February 2015

Facilitator

Artist; Pump House Gallery Officer

Teachers from 2 core schools

Scientist

Meeting objectives:

- Breadth of subject covered in activities
- The children's journey and learning experience offered by the activities
- To ground the activities in the science behind them; to anticipate the further knowledge teachers may need and how to reflect this in the final Resource Pack

General feedback from meeting in February with working group teachers:

- The order of activities is good
- Great visual elements across all activity stages

Working group teachers suggestions:

- FAQ section
- Guidance to teachers on the practicalities of having a carousel of four simultaneous activities
- Offer teachers options to do in activities (if time and resources available vary)
- Include a template 'investigation sheet' for children

- List of website resources
- Include simple diagrams that illustrate sound

Actions taken from subject leaders' feedback :

- 'Teachers' notes' added to activity instructions offering further knowledge or explanation in anticipation of certain questions/reactions that students may have during activity
- Glossary included to answer any 'FAQ's on subject knowledge
- 'Follow on' activities were included to offer extension learning for students if needed
- Website resources and diagrams included in activities

Overview of how Sound developed from that meeting and resource pack development:

Scientist advised that the activities should incrementally build up simple concepts, and reinforce students' understanding of the scientific concepts by keeping returning to them. The initial idea was that the activities would be stand alone, however on discussing with the group the resource pack is developing more into a scheme of work.

This was supported by Teacher 1, who said it is best to teach sound it has to be as a scheme and needs to be taught in steps.

Activity 1:

This activity was inspired by an activity the artist and scientist did in the school – of testing out how to make sounds through materials and also how you can feel it in your body. Ahead of this meeting the activity was shaped to explore how we see and feel sound. Using simple activities like plastic straws, we also found artists that explore how sound vibrates.

Positive feedback, but more focus is needed on the definition and explanation of vibration.

Teacher 1: Resources need clarification.

Teacher 2: There should be as many opportunities as possible for the children to experiment and ask questions.

Outcome: These resources were specified in final version. Teacher's notes' added to offer answers to potential questions students may have. We also then worked with an additionally arts teacher to really focus on the questions to ask, to really encourage students to think and explore.

Activity remained the same, however simplified to focus on how you can feel sound vibrating. This is now an entry level activity, so further the Science consultant specifically addressed the feedback on needing more explanation through a separate activity later on. Also, diagrams on sound vibrating, as sourced by scientist in group.

Activity 2:

This activity was suggested by the science consultanti, and looks at how to measure sound from a sound source.

Scientist: This activity explores tricky ground in that volume and pitch are two separate things. Pitch and frequency is what makes instruments' sounds unique, so if looking at differences it would be best to start with very simple variables.

It was concluded that it would be best to make only one instrument, or offer teachers a couple of different instruments to choose to make.

Artistic references of Picasso and Paolozzi were thought not to be relevant to the activity. Whilst the work was beautiful and the marks and patterns visually stunning, it felt that it distracted from the science knowledge and would therefore run the risk of being an 'add on'.

Outcome: The complication around pitch and frequency was addressed by creating only one type of instrument – a shaker - in the activity, simplifying variables but also adding opportunity to experiment with variety of fillings made with different materials. It has been hard to emphasis the link between art and science in this activity, particularly as the Picasso and Paolozzi were removed as a reference, so emphasis was placed on the artist selected and the playful nature of his work. Emphasis was also placed on how to document the information from the datalogger, and therefore can you use this visual data to know what the sound will be.

Activity 3:

This activity was suggested again by science consultant after activities in the classroom using slinkies to visualise how sound travels and how far it goes.

This activity was very much shaped by the discussions in the room, and suggestions to introduce a game that tests how far a sound reaches through a large space. Could it be measured using colour paper? Could it be photographed and documented in different ways. At the first meeting it was felt that there was not a strong art link.

Outcome: The was the challenge of finding the meeting point between art and science, and in the end this activities also more to activity four as the pack started to work more like a scheme of work. Through working back with Hazel this activities looked more at the questions that were asked and also ways their experiments can be visually documented – so through fading colours to mark distance, colour charts and how to visually communicate their ideas.

Activity 4:

This activity was initially developing the work tested in schools around different sound, building on activity one.

Aleks: Whereas previous Activity 2 should only make one instrument, Activity 4 is a suitable opportunity to introduce new materials to explain how they produce different pitches. It was noted that similar activities that explore different concepts need to be spaced sufficiently as not to confuse students' learning, again on how to break down the knowledge.

Outcome: There was a lot of discussion around this activity, and where to place it. It was only after meeting the additional 23 schools and through discussing it with the core team and Hazel that this activity focused the artist Picasso, and was moved to Activity 3. This then really emphasised the art, whereas before it was placed as an extension activity.

Activity 5:

This activity was inspired by the work that Aleks and Alistair were doing looking at how we perceive sound. They tested out this idea in the classroom, and got a good response.

When meeting back with the working group teachers, this was felt to be a suitable activity to introduce how we perceive and experience sound, rather than merely how it is produced. Should provide information in the appendix about the anatomy of the ear and how it changes with age – should offer access to supplementary background knowledge for teachers should they need it, but do not need to include this information in the main activity instructions.

Outcome: This activity stayed quite similar throughout, however focus on how to visually communicate your experiments were added by Hazel at the end. This focus on the questions asked and how to display the worked helped to find the link between art and science. Also a diagram was included as a Teacher's note alongside the activity and supplementary information was included in the Glossary.

Activity 6:

This was an activity inspired by the working group sessions, looking at mark making and drawing sound.

This was a popular activity with Scientists commenting on our cultural associations affect the emotions induced by sound. Liked by all.

Outcome: This activity again stayed the same, however with a lot of details added on how to make those marks and to encourage students to think about the marks they are making. At the session with the additional 29 schools it was suggested that this activity was activity one, however it was kept at activity 6 because it was felt by the core team that this worked well to help consolidate knowledge.