Operation Earth

A National Strategic Science Engagement Programme for families

Final Report

January 30th 2019

UK Association for Science and Discovery Centres

Executive Summary

The UK Association for Science and Discovery Centres has been delighted to work in partnership with the Natural Environment Research Council (NERC) to create and deliver an exciting new national STEM programme 'Operation Earth'.

The vision of this national programme was to engage inspire and involve families with school-age children across the UK with the amazing stories, science and people of NERC's world-leading environmental research, highlighting the relevance of contemporary environmental science issues to people's daily lives and to society's future.

In partnership with NERC, the Natural History Museum, Dynamic Earth and Eden Project and a wide range of other experts from across academia and the NERC research centres, ASDC created, developed and delivered an inspirational suite of hands-on activities, experiments and demonstrations for families to be delivered in Science Centres and Museums, including a bespoke wearable 'Earthy suit'. ASDC also created a new interactive 'Operation Earth' family show and a series of busking activities, a meet the expert format and introductions to environmental scientists, a website, social media channels, project branding and a set of marketing assets along with a bespoke training handbook.

ASDC then selected, trained and equipped eleven Science Centres and Museums in England, Scotland, Wales and Northern Ireland to deliver the full Operation Earth Programme. This included bringing their staff together for a two-day Training Academy to learn all aspects of the programme including running the shows and activities, using and maintaining the equipment, training on the latest environmental science, and a guide to behavioural psychology as it relates to climate conversations. ASDC continued to support the Centres during their delivery period, answering questions and introducing them to experts.

ASDC also ran a similar national training academy for over 40 environmental researchers which took place at the Natural History Museum.

Operation Earth launched in UK Science Centres and Museums on February 10th 2018, and delivery continued across the summer until the October half-term 2018. Overall the programme began in January 2017, and completed in January 2019 with an aim to reach 100,000 children and adults in family groups.

In total, **201,639 children and adults** participated in the Operation Earth activities and programmes for families. Of these, **89,742** participated in the Operation Earth family show, and **37,145** met and talked to one or more environmental scientists in 'meet the expert' events.

ASDC also created a website www.operationearth.co.uk which contains all the resources and training materials.

Throughout Operation Earth, we aimed to create a step-change in the way Science Centres and Museums deliver the latest science around the environment, making the science more cutting-edge and engaging, building relationships with researchers and helping centres to embrace more challenging topics around climate and other global issues with members of the public who may not be initially receptive to this science.

The programme evaluation was undertaken by an independent academic with a specialism in informal Science Learning in environmental science, who analysed the responses of 1,130 children and 665 adults (1,795 people in total) who had taken part in The Operation Earth shows and activities.

The key findings are summarised below:

- 83% of children and 77% of adults said they were more interested in environmental science after the Operation Earth show or activities.
- 81% of children and 67% of adults said their understanding of our environment and the current issues faced had increased after watching the Operation Earth family show or taking part in the activities.
- 79% of children and 63% of adults said that their understanding of the range of people who study the environment had increased after watching the Operation Earth family show or taking part in the activities.
- 91% of children and 96% of adults said they thought environmental science is 'very important' after watching the family show or taking part in the activities.
- 87% of children and 92% of adults said that sharing the latest environmental science in this way was 'very important' after watching the family show or taking part in the activities.
- Children were slightly more positive in their answers than adults, this was a small but statistically significant difference.
- Girls (86%) were more likely to say they were more interested in environmental science than male children (80%). This was a small but statistically significant difference. Overall, there was no other difference in response to the questions due to the gender of children.

Centres unanimously reported that the programme had benefited their centre. It had been a key part of many centres' programming and had attracted large audiences whenever it was put on. Feedback from Science Centres and Museum staff indicate they and their visitors enjoyed and valued this STEM programme sufficiently that they delivered to considerably more families than their collective target of 100,000 people.

1. An Overview of Operation Earth

Introduction

As a nation and as a global society we have some major challenges ahead, especially in relation to climate, energy, water and the other finite resources of our planet. Now, more than ever we need our young people to be inspired by science and engineering and to see it as something innovative they can be part of to make the world a better place.

This programme aimed to make a step change in this area of science by training 11 science centres and museums across the UK to deliver an inspirational and exciting national hands-on environmental science programme. We wanted to stimulate conversations in family groups as well as inspiring children and adults to explore the science so they can together ask questions about the latest evidence, and discuss matters and policies that will have a big impact on their lives.

The UK Association for Science and Discovery Centres (ASDC) is the national charity that brings together the UK's major science engagement organisations to play a strategic role in the nation's engagement with science. Within our membership are over 60 of the nation's largest publicly accessible Science Centres, Discovery Centres, Science Museums and Scientific Bodies. Every year in the UK, 20 million people of all ages and backgrounds choose to get involved with science at one of the UK's Science and Discovery Centres or Science Museums. This equates to 385,000 people every week who come to our member centres to explore and discuss science in an involving and personal way.

This programme was directed and project managed by The UK Association for Science and Discovery Centres who have considerable experience managing national strategic, multi-partner science engagement programmes. The content has been created in partnership with NERC scientists, researchers and academics as well as the project team made up of environmental engagement experts from the Eden Project, Dynamic Earth and the Natural History Museum.

The Vision: To engage, inspire and involve families with school-age children across the UK with the amazing stories, science and people of NERC's world-leading environmental research, highlighting the relevance of contemporary environmental science issues to their daily lives and to society's future.

The Mission: To deliver an inspirational and exciting national hands-on environmental science programme celebrating the science of the natural environment, the latest research and the scientists who make it happen, through activities and experiments for families and the wider public delivered through the successful infrastructure of the UK's Science and Discovery Centres and Science Museums.

2. The Programme Key Goals

The seven key goals for this national programme, in order of importance, were as follows:

1. To inspire and intrigue children and their families nationally with a new sense of curiosity, questioning and interest in our planet and the future of the environment.
2. To bring alive the areas of NERC science that have the greatest impact on all of us, as individuals who will need to make choices and as societies who need to make changes.
3. To inspire children and their families to explore, test, experiment and discuss the amazing range of science and engineering needed to understand planet Earth, and to understand better, how this evidence is collected.
4. To inspire both schoolgirls and schoolboys to consider careers in science, especially in the physics, engineering and mathematical modelling side of NERC's work.
5. To build family science capital, given we know 67% of young people feel they get most careers advice from family, and that family science capital is the biggest predictor of whether students will study science (and 80% of a schoolchild's waking time is spent out of school).
6. To increase the public engagement opportunities of NERC environmental scientists and engineers (especially women), enabling the public to meet them in informal settings.
7. To train science engagement professionals embedded in ASDC member organisations across the UK to engage the public with the latest and potentially difficult or contentious areas of NERC science, empowering them to continue to engage their visitors into the future, providing a national educational legacy for this programme.

3. The Key Audiences

The key audiences for this national programme were:

1. Children aged 6-11 to explore how science goes about collecting evidence to uncover what is happening. The focus was on children aged 6-11, as the ASPIRES academic report has shown how vital it is to engage younger children for longer-term interest and engagement.

2. Parents and families of these young people so they are equally inspired and can continue to inspire and encourage their children's science learning and career aspirations long into the future, seeking out other related activities to involve their children with.

3. NERC researchers and scientists to give them the confidence and motivation to share their excellent research with the public by showcasing great activities and methods to engage the public.

4. Science Centre and Museum staff who will ensure these NERC-focussed science shows and activities, and relationships with environmental scientists continue into the future as catalysts for future science learning programmes focussing on UK science and engineering.

5. Political and other stakeholders so they can better understand the range of world-leading environmental science and expertise that NERC has, and to see that Science Centres are engaging the public in discussions around contentious areas of environmental science.

4. The Outputs of Operation Earth

This project set out to deliver (and delivered) the following:

1. A highly adaptable family show for use by Science Centres and Museums across the UK. This had a focus on whole family groups (not just children) with a particular focus on engaging 6-11 year olds.

2. A suite of additional activities to add to the show or other events to extend and adapt the stories and latest science that could be covered.

3. An exceptional set of hands-on equipment and resources for each Science Centre to use with families and the wider public to explore the latest NERC and natural environment-related science and research, focussing on areas of personal significance.

4. A national training academy for 20 Science Centre staff from the selected Science Centres and Museums across the UK to enable them to run the entire programme.

5. A meet-the-expert session format and guidance for event days and activities for families with introductions to guest NERC scientists, or those working in NERC-related areas.

6. A training academy for at least 20 NERC-funded researchers to help them explore the best and easiest ways to engage with the public around contentious areas of research and those that have personal meaning to the public (In fact we trained 40 scientists).

7. A one-day Charette*, bringing together professionals from across the UK with the very best experience in hands-on activities to engage families with the science around the natural environment, with academics and researchers in this area. (*A charette brings together experts with different backgrounds to come up with creative ideas to solve a problem or create a leap

forward in a field. ASDC has created an inspirational one-day Charette format and used this successfully at the start of many national projects.)

8. A simple website with all the resources that Science Centres and Museums need to run the full programme, and a place where all public participants who have visited Science Centres and Museums can find out more.

9. An online and digital strategy, including social media opportunities, to help Science Centres and Museums reach their thousands of followers via Facebook, twitter and other channels.

10. Easy access for Science Centres and Museums to NERC images and videos to facilitate the latest imagery being used in multiple formats.

11. Specific guidance on using NERC-related science as an opportunity to inspire girls with the physical sciences (including areas of mathematical modelling) and to help all families explore STEM careers with their children.

12. A 'Press and Marketing Pack', with images/video, project, partner and NERC logos, sample press releases and approved copy for web, as well as social media resources (twitter cards etc.), developed in collaboration with the NERC press team and delivered in a flexible manner for Centres to celebrate NERC research.

13. An 'Advocacy Guide and Resource Pack' to help Science Centres and Museums approach MPs, political stakeholders and to inspire Centres to give evidence in select committee inquiries showcasing the great public engagement work they are doing around NERC environmental science and science learning more widely.

14. A summary of the latest approaches from research by environmental psychologists and behavioural scientists, showing the very best way to engage people with climate science.

15. An Evaluation Programme, the design of which was agreed between ASDC and NERC at the outset of the programme. This includes assessing the impact on the families (both the children and adults) and the Science Centre and Museum staff.

5. The Steering Group

The Steering Group for Operation Earth was responsible for the programme governance and strategic direction. This board met twice at the start of the programme for the kick off meetings to shape the initial programme direction, and then quarterly across the programme. Several members of the Board were also present at the Charette. The board also advised though email discussions in between meetings where required. The Chair of this Steering Group was Dr James Pope, Climate Modeller and Polar Scientist from the British Antarctic Survey.

Name	Organisation
Dr James Pope (Chair)	British Antarctic Survey
Dr Hannah Collins	Natural Environment Research Council
Hannah King	Natural Environment Research Council
Dr Felicity Perry	John Innes Centre
Dr Penny Fidler	ASDC, CEO and Programme Director
Andy McLeod	ASDC Project Manager (from February 2018)
James Summers	ASDC Project Manager (until February 2018)

6. The Project Team

This programme was directed and project managed by the UK Association for Science and Discovery Centres who have considerable experience managing national strategic multi-partner science engagement programmes. The programme was delivered in collaboration with three expert content partners:

1. Natural History Museum, London
2. Eden Project, Cornwall
3. Dynamic Earth, Edinburgh

The Project Team was responsible for all the content development and deliverables of the programme, reporting to the Programme Director. It was led by ASDC with expertise and contributions from everyone listed below. Additional expertise came from the academic and engagement experts present at the Charette.

Name	Organisation	Role
Dr Penny Fidler	ASDC	Programme Director
James Summers	ASDC	Project Manager (From the start and across the content development phase until February 2018)
Andy McLeod	ASDC	Project Manager (from February 2018, when science centres were delivering)
Dr Hermione Cockburn	Dynamic Earth	Scientific Director
Conor Ellis	Dynamic Earth	Science Engagement Officer
Gus Grand	Eden Project	Head of Policy
Robert Lowe	Eden Project	Publications Manager
Kat Nilsson	Natural History Museum	Head of National Public Programmes
David Urry	Natural History Museum	Science Communicator

7. The Overall Impact and Geographical Reach of Operation Earth

We are delighted to report that The ASDC Operation Earth programme reached **201,639** children and adults between February and October 2018. This is double original target of 100,000 people.

Of these **201,639** children and adults, **89,742** participated in the Operation Earth family show, and **37,145** met and talked to one or more environmental scientists in 'meet the expert' events. The remaining 74,752 children and adults took part in Operation Earth at outreach events, special one day events, and drop in family activity sessions in science centres.

We are delighted with this result and have been told on numerous occasions this over delivery is due to the high quality of our resources, combined with the flexibility we champion for delivery of ASDC programmes by each science centre. Our approach specifically builds on and celebrates local knowledge and relationships, especially with Universities and research facilities.

We know from ten years running some of the nation's largest STEM programmes that we can't simply increase the required delivery numbers at the start and raise our target, as centres tell us they would not be able to commit to such high numbers in advance. However, once trained, when they truly love the content and the programme, and can see it working so well with visitors the staff champion it, and find more opportunities to use the show and activities, and the numbers exceed those we have agreed.

Many of the activities at Science Centres were delivered in conjunction with experts from NERC research centres and with environmental scientists from local Universities. Working with local academics and experts on this programme has been extremely valuable for Science Centres and Museums, building relationships and maintaining existing networks to enrich families' experiences through Operation Earth. Families tell us they love meeting experts, especially if they are local and can talk about how they got into environmental science or discuss research happening at local sites.
As just one example, experts from the Soil Security Programme participated in the Scientist Training Academy in February and have engaged with several Science Centres and Museums to deliver events in the 'Meet the Expert' format provided.

Operation Earth inspired children and families through Science Centres and Museums across the UK and used the family show and family-based activities to engage, involve and inspire family groups learning together in a manner we hope will build family science capital for years to come.

As with all ASDC programmes, the kit and equipment is given to the Science Centres and Museums, and remains their property after the delivery period has ended. They then have the opportunity to integrate Operation Earth activities into their science centre programmes and outreach activities into the future.

8. The Selected Delivery Partners

Selecting the partner Science and Discovery Centres

ASDC sent out an invitation to participate document in July 2017, along with an application form to all ASDC members. We sought ten partners for delivery.

ASDC also held a bidder's conference call in August 2017 where all Science Centres and Museums interested in applying had the opportunity to dial in, hear about the programme from the ASDC CEO and Project Manager, have their questions answered and hear the responses given to others who would be bidding. This open framework has been used in all previous ASDC programmes, to answer questions and give clarity over what Centres need to deliver, schedules, audiences, grants, budgets, and reporting before each Centre applies.

The map of the selected centres is shown overleaf

The selection panel

ASDC received 15 applications from members to take part in Operation Earth. The applications were reviewed by the Selection Panel, which met on August 17th 2017 and included staff from ASDC and NERC.

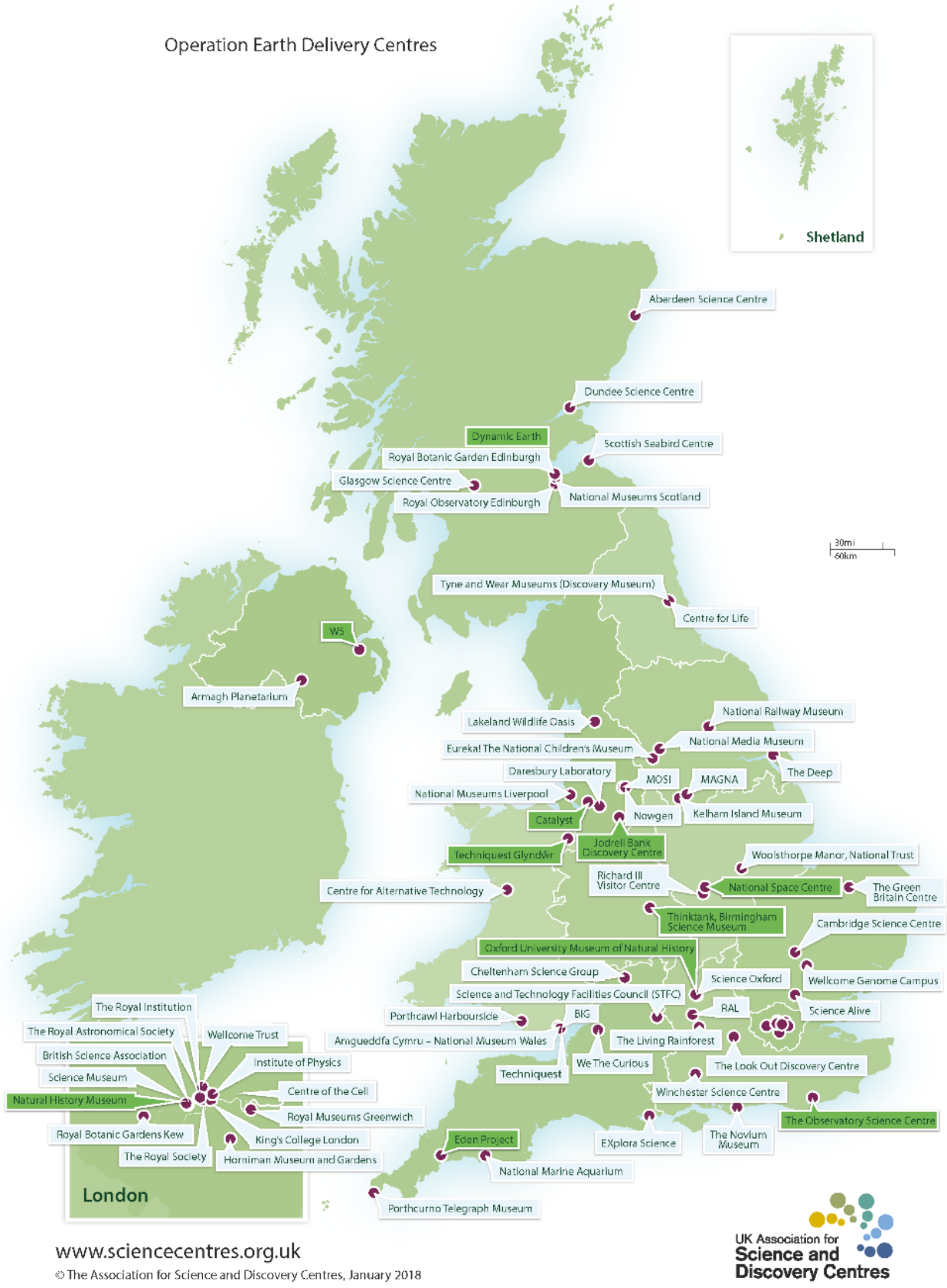
The selected Science Centres and Museums

The following Science Centres were selected to deliver Operation Earth:

1. Dynamic Earth
2. Eden Project
3. Jodrell Bank Discovery Centre
4. Natural History Museum
5. National Space Centre
6. Observatory Science Centre
7. Oxford University Museum of Natural History
8. ThinkTank, Birmingham Museums Trust
9. W5, Belfast
10. Techniquest Glyndŵr (joint with Catalyst Science and Discovery Centre)*
11. Catalyst Science and Discovery Centre (joint with Techniquest Glyndŵr)*

* We were delighted to have a joint application from Techniquest Glyndŵr and Catalyst Discovery Centre, and therefore contracted both centres to reach half the number of participants, with half of the grant. These two Centres also shared one set of Operation Earth kit and resources between them in a manner organized by them. The equipment belongs to Catalyst Discovery Centre, who are the lead Centre in this arrangement.

The UK Science and Discovery Centre Network



9. Equipment and Activities for each Science Centre

ASDC understands that all ASDC members are different. They have different strengths and existing partnerships, different audiences and unique academic relationships. We want to enable every Centre to play to their strengths and run slightly different activities and events dependent on their local expertise and needs.

We also know that each Centre needs freedom over how they choose to run activities with their visitors if they are to do their very best work. We always fully endorse this approach and indeed ASDC designed all elements of this project to maximise this flexibility. Recognising this passion and expertise is what leads to centres delivering more than we have contracted them to deliver. Our goal was that selected Centres had the freedom to evolve and adapt the Operation Earth content, to take advantage of their expertise and existing relationships and to adapt and update their offer as the programme progressed.

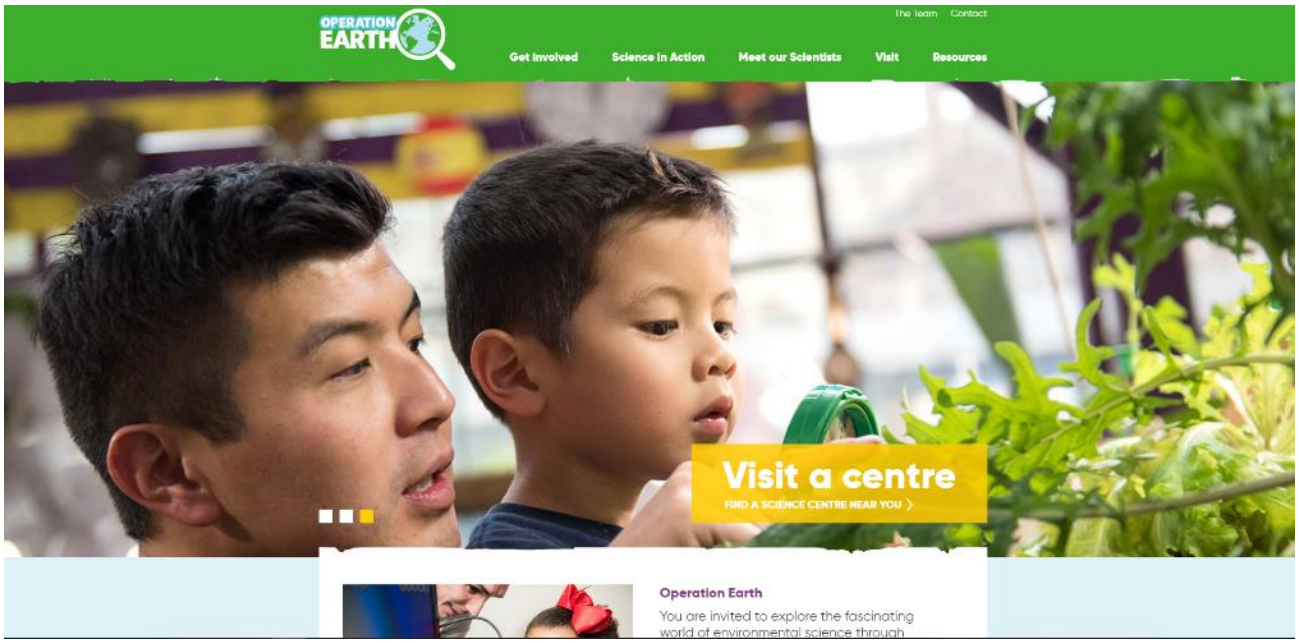
ASDC also welcomed a joint bid between two member Science Centres, Techniquest Glyndŵr and Catalyst, where the one set of kit was shared between the two Centres, working flexibly around their own schedules. Each Centre was contracted by ASDC to reach half the amount of participants and given half the amount of the grant.

ASDC provided an approved script for the family show along with slideshow and videos, and Centres were also free to use the activities for busking and to run breakout sessions. The ocean acidification activities and biodiversity mat have been phenomenally successful at engaging children and families in this way.

The eleven selected Science Centres were given the following:

1. A set of adaptable hands-on equipment including a bespoke Earth costume, a set of USB Digital Microscopes, a custom-designed ‘air testing machine’, a ‘biodiversity mat’, and a host of other activities (detailed in later section).
2. A brand new interactive family science show with full script.
3. Full and detailed training on how to use all the equipment, the hands-on experiments and all the related science for the research and key content areas.
4. Places for two Science Centre staff to attend a two-day residential Operation Earth training academy at Eden. All travel, food and accommodation were provided.
5. An excellent bespoke new Training Handbook for all staff involved.
6. Adaptable and flexible activities and demos to add to the family show for children and their parents.
7. A £4,000 grant to assist with running the programme.
8. All branding material, including newly commissioned illustrations of various NERC-related equipment (Halley Research Station, Earth observation satellite, RSS Sir David Attenborough), project banners and materials showing all of this.
9. A full marketing pack, including logos, sample press releases and text for the family show marketing.
10. Evaluation forms and instructions for the project evaluation programme.
11. Advice and on-the-phone support from ASDC and the project team throughout on any issue to maximise delivery, and to support staff working with new techniques and equipment.

The full set of project materials are available on request and are also available on the Operation Earth website: www.operationearth.co.uk .



10. The Content Development in Operation Earth

The Project team worked together to create a lively, entertaining, interactive and flexible show for families, that Science and Discovery Centres and Museums could run at weekends, holidays, and special events.

Throughout the development, the project team focussed on the vision and mission of the programme to ensure they were delivering a programme that 'engaged, inspired and involved families with school-age children across the UK with the amazing stories, science and people of NERC's world-leading environmental research, highlighting the relevance of contemporary environmental science issues to their daily lives and to society's future'.

A key factor in the success of all ASDC programmes, is that the equipment and activities we give to the Science Centres are flexible, allowing them to focus on specific content for particular audiences and occasions. This flexibility is critical to the success of our programmes, not least because the Centres we select to take part have their own expertise in specific areas and work locally with university and other experts who contribute and enhance what is delivered. These local connections are important in bringing the content alive and making it relevant to children and families. Recent academic evidence from Professor Louise Archer's team working on science capital, also shows that local relevance is even more important in engaging those who do not usually engage with science.

The content development process for Operation Earth began in February 2017. The process was led by ASDC and involved the ASDC CEO and project manager and team, along with a host of external experts.

Below is the ASDC content development process used for this programme.

Phase 1: Content Research

This phase involved broad-based research to identify all the relevant hands-on and interactive activities from and around the UK in order to inform the projects content outputs. The outputs of this phase included The Content Research Document (an internal document), a potential equipment list, a list of experiments and running the Project Charette (see later section for details on this event and the Content Research Document).

Phase 2: Content Definition

This phase involved planning and deciding on the specific content of each of the project outputs, based on the research carried out in phase 1. The main output is the equipment, activities and the family show, for use in Science Centres and targeted at 6-11 year olds and their families. Also, the Handbook Plan and a Piloting Plan, to test out new activities at Centres.

Phase 3: Piloting and Content Finalisation

This phase involved piloting some of the experiments and activities with target audiences and finalising the training handbook pages for each activity. The pages were edited internally by ASDC, with input from NERC. This phase also involved gathering citizen science projects and 'try this at home' activities to feature on the Operation Earth website. The outputs of this phase included the finished training handbook and the project website and all the kit and activities.

Following discussions in the Project Team and wider Steering Group, it was decided that the content focussed on would be grouped into:

1. Land biodiversity
2. Air pollution
3. Ocean pollution and acidification.

It was decided with the board more specific issues such as fracking and neonicotinoids, would not feature directly in the handbook, and could be discussed during activities as they come up in conversation with delivery partners.

11. The Ideas Charette

How ASDC created this national programme

Across the UK, there are a number of people from a variety of academic and research backgrounds who have considerable knowledge and experience in the subject area of this programme, as well as those with expertise in engaging families with the great stories and science in this area.

At the start of the programme, ASDC ran an 'Ideas Charette', which efficiently and cost-effectively brought together these people from different backgrounds for a one-day Charette to share inspirational ideas, and knowledge that could be incorporated into the project.

ASDC have run a number of Charettes for other programmes and each has proven to be absolutely key to ensuring inspirational, new and highly engaging content for the project. The day was led by the ASDC CEO,

Dr Penny Fidler, and was structured to ensure that collective knowledge and ideas were shared, with plenty of space for creative and innovative thought.

The Charette took place on Tuesday 25th April 10:30am – 4:30pm in the Flett Lecture Theatre at the Natural History Museum, London. The full programme is in Appendix 1.

Participants were arranged in to groups and had the opportunity to share and see lively new demonstrations and experiments, and to use equipment to help inspire and stimulate new creative ideas and experiments.

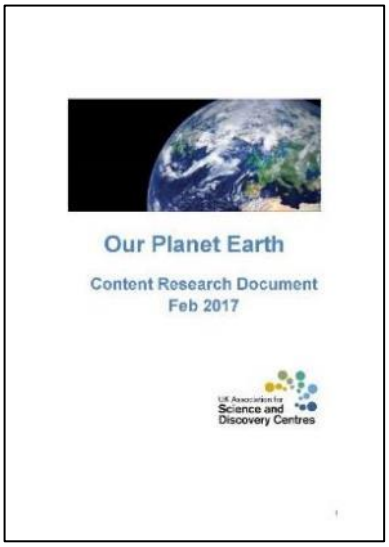
ASDC were delighted to have had such an exceptional group of participants, the full list of delegates is included overleaf.

Participants at the Operation Earth Charette

Name	Company	Job Title
Dr Penny Fidler	ASDC	CEO
Shaaron Leverment	ASDC	Deputy CEO
James Summers	ASDC	Special Projects Manager
Dr Kathy Fawcett	We The Curious	Education Manager
Dr James Pope	British Antarctic Survey	Climate Modeller
Ailsa Napier	British Geological Survey	Intranet Manager
Alison Clayton	British Geological Survey	Communications Co-ordinator
Dr Tom August	Centre for Ecology and Hydrology	Computational Ecologist
Dr Hermione Cockburn	Dynamic Earth	Scientific Director
Conor Ellis	Dynamic Earth	Science Engagement Officer
Gus Grand	Eden Project	Head of Policy
Robert Lowe	Eden Project	Publications Manager
Lucy Wood	Invisible Dust	International Projects Producer
Dr Felicity Perry	National Centre for Atmospheric Science	Communications Manager
Dr Rosie Leigh	National Centre for Earth Observation	Centre and Engagement Manager
Marie Hobson	Natural History Museum	Learning and Audience Research Manager
David Urry	Natural History Museum	Science Communicator
Kat Nilsson	Natural History Museum	Head of National Public Programmes
Dr Hannah Collins	NERC	Head of External Affairs
Hannah King	NERC	Public Engagement Officer
Alison Robinson	NERC	Director of Corporate Affairs
Dr Tamsin Edwards	Open University	Lecturer in Environmental Sciences
Dr Robert Philips	Royal College of Art	Senior Tutor
Amina Abbas-Nazari	Royal College of Art	Research Fellow
Dr Catherine Muller	Royal Meteorological Society	Head of Public Engagement
Isla Watton	Soapbox Science	Soapbox Science Coordinator
Karen Brunyee	STEM Learning Ltd	Professional Development Leader
Angie Bual	Trigger	Director
Dr Enda Hayes	University of the West of England	Associate Professor

The Content Research Document

All the ideas, content and activities from the Charette and wider research were collated by the Project team and put into a research report. This is a working document and ASDC is happy to make it available to NERC at any point. It is not in publishable format, rather a collation of all the ideas some of which were developed and used in this programme and others that could be developed in future programmes.



12. The Training Handbook

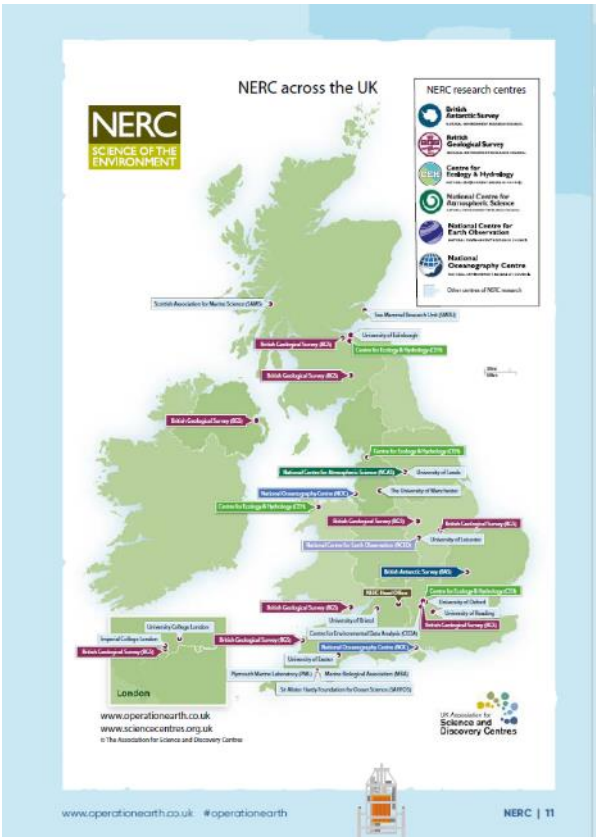
The project team wrote and created a vibrant, engaging and informative training handbook, some pages of which are shown below. The handbook is 130 pages long, in a bespoke A4 ring binder and has been hugely well received.

A printed copy was given to all delegates at the Training Academy, so they could learn all the different areas of the programme and remind themselves during delivery, as well as train their wider staff back at their centres to run the entire programme.

The handbook contained the following information:

- The family show and full script
- Detailed information on all the activities, and equipment
- Experiments to try
- Further ideas and information
- An advocacy guide for Centres looking to engage with policy makers
- Marketing information, branding and PR
- Evaluation guidance
- Health and safety

This was originally intended as a shorter manual, but due to the volume of fantastic ideas yielded by the creative development process, and the desire to share as many of these as possible with the wider delivery team, the handbook grew considerably.



Natural Environment Research Council

NERC
SCIENCE OF THE ENVIRONMENT

The Natural Environment Research Council (NERC) was created in 1965 when a number of environmental research organisations and surveys were brought together.

What is NERC?

NERC is the UK's largest funder of independent environmental science delivered through universities and research centres in the UK. They advance the frontiers of knowledge by funding new research, infrastructure, innovation and training that delivers valuable scientific breakthroughs. Their science explores the physical, chemical and biological processes on which our planet, life and economy depends – from safe food and water to energy and minerals, from air quality and flooding to long-term changes in our environment and climate.

They invest public money in world-leading science, designed to help people sustain and benefit from natural resources, predict and respond to natural hazards and understand environmental change. They work closely with policymakers, industry and society to make sure their knowledge can support sustainable economic growth and wellbeing in the UK and around the world and deliver solutions to UK and global challenges.

NERC is supported mainly by the Department for Business, Energy & Industrial Strategy (BEIS), but their activities and funding decisions are independent of government.

NERC invests in environmental science across the UK, supporting:

- 3,000 scientists and 1,000 PhD students.
- 1,000 research projects and 60 UK or international programmes.
- 55 universities and 20 research institutes.
- UK research capability including four ships, seven aircraft, six polar stations, six data centres and 32 research community facilities.

What NERC does?

NERC's vision

To place environmental science at the heart of responsible management of our planet.

Understanding our changing planet is fundamental to our future wellbeing and economic prosperity. People no longer live in a natural world - there is virtually no part

Earth suit

Overview:
Dress up as Planet Earth and engage audiences with environmental science as they investigate the Earth's surface, wear the polar cap and find out where Autosub Long range, FAAM and other NERC research vessels are working.

Programme use:
To engage audiences by becoming planet earth.

What is included with the suit?

The suit is made up of 4 main parts:

- An inner northern hemisphere containing 4 hoops and 2 shoulder pads
- An inner southern hemisphere containing 1 hoop
- An outer printed layer showing the map
- A northern polar cap

In addition to this there are 4 magnetic soft toys including:

- Autosub Long Range (Boaty McBoatface)
- RRS Sir David Attenborough
- The FAAM aircraft
- An Earth observation satellite.

How to set up the suit:

The suit can be set up by one person however, it is easier and quicker if two people are available.

1. Inside the northern hemisphere are a series of velcro tabs. Using these tabs, secure each of the 4 hoops in place. The smallest and strongest hoop is used near the neck of the hemisphere to support the weight of the suit on the shoulders.

2. Attach the shoulder pad using the pads velcro tabs to the small hoop ensuring that they are in line with the two hand slots in the northern hemisphere.

3. Attach the remaining small hoop to the southern hemisphere using the velcro tabs.

4. Zip the northern and southern hemisphere together.

5. Climb into the suit through the base of the southern hemisphere and rest the suit shoulder pads on your shoulders. Your head should come out of the northern hemisphere.

6. Put your hands through the hand holes and ask your colleague to place the outer printed layer onto the suit with the large zip at the rear.

7. Ensure the hand slots of the inner layer and the neck line matches the outer layer then zip the outer layer together.

8. Ask your colleague to place the polar cap on the costume wearer's head.

9. The soft toys can be fixed onto the suit with the magnets provided.

How to remove and store the suit between use:

If the suit is going to be used regularly and you wish to keep the suit together, follow these instructions:

1. Remove the polar cap.

2. With the help of a colleague lift the entire suit off over your head.

3. Place the suit in the protective cover provided and store in a safe location.

4. To use the suit again, ask a colleague to help place the suit over the wearer's head and support the suit until the wearer is happy to hold the weight of the suit.

If you are storing the suit for longer periods of time, the suit can be dismantled and stored in the provided box and bag.

1. Unzip the outer layer, fold carefully and store in the box.

2. Unzip the two hemispheres and remove all of the inner hoops and shoulder pads.

3. Carefully fold the two hemispheres and store in a box with the shoulder pads and polar cap.

4. Store the hoops in the protective bag provided.

Suggestions for engagement:

- Ask audiences if they would like to wear the polar cap.
- Ask audiences to identify and find the NERC research equipment.
- Ask audiences to identify features on Earth's surface.

Health and safety ⚠

Hazard | Precaution

Overheating - Take regular breaks and alternate who wears the suit.

Trip, fall - The person wearing the suit should be supervised at all times.

Knocking into visitors/equipment - The person wearing the suit should be supervised at all times.

Risk - Medium.

Maintenance and troubleshooting

See care instructions provided with the suit.

13. The Training Academy for Science Centre Staff

The training programme is fundamental to the success of this programme and considerable resource is put in to achieving excellence. Professional staff who are enthused and fully confident to impart the latest knowledge to their colleagues, children and family visitors back in their part of the UK are the key to success in all ASDC programmes.

The Operation Earth two-day residential National Training Academy took place at the Eden Project on November 27th – 28th 2017.

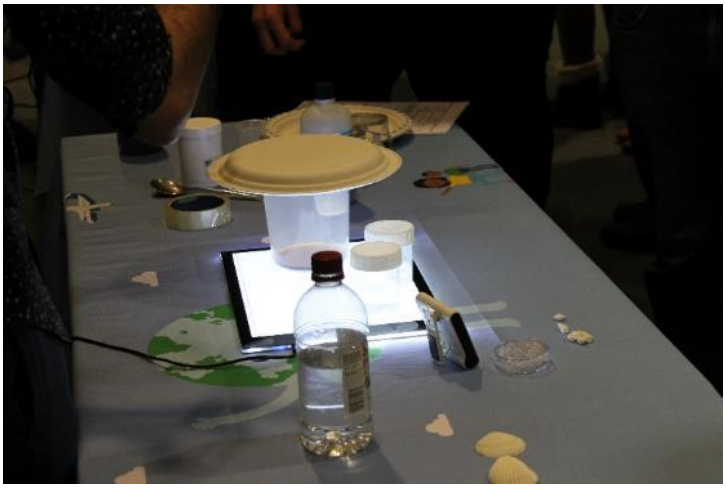
Thirty-two people took part, including two members of science engagement staff from each selected Science Centre and Museum (and one from each of Catalyst and Techniquest Glyndŵr, who were sharing the delivery commitments). They were trained in how to use all the equipment, resources and in the latest knowledge as well as hearing from a host of speakers including the British Antarctic Survey, NERC, and Eden, The Natural History Museum, Dynamic Earth, ASDC, and an environmental behavioural psychologist from the Centre for Neuroimaging at Kings College London. The project paid for Science Centre and Museum staff's travel, accommodation, food and training at the academies.

Topics covered included:

- An introduction to Operation Earth
- An introduction to the research and work of NERC and affiliated Research Centres
- How to run all the experiments and hands-on science activities
- Advocacy and contacting local MPs
- How to use all the equipment and maintain it
- How to run the Operation Earth family show and each of the activities
- Health and safety surrounding the handling of equipment and chemicals
- Evaluation and reporting
- A full review of the project branding and logo usage
- Resources, images, videos and more
- Ideas to engage children from disadvantaged areas and gender equity
- Social media strategy and resources online

The full programme for the Training Academy can be found in the Appendix.



14. The Training Academy for Scientists and Researchers

In addition to training Science Centre and Museum staff on the Operation Earth programme, ASDC ran a separate Training Academy for scientists and researchers affiliated with NERC who wanted to get involved in Operation Earth and engaging the public with their research.

Fifty people representing twenty-six institutions took part in the Operation Earth Scientist Training Academy, which was a one-day event held at the Natural History Museum in London on Tuesday 6th February 2018. A full programme is available in the Appendix.

15. Equipment and Activities for each Science Centre and Museum

Every selected Science Centre and Museum was supplied with an innovative set of equipment as part of Operation Earth, including a bespoke planet Earth costume. The equipment supplied allowed Science Centres to deliver the family show, activities, experiments and demonstrations. The handbook was produced in a format that explored the stories and science behind the land, air and sea, with activities related to each of these areas found within the relevant section.

Land: The stories and science

Operation Earth wanted to highlight the work that NERC scientists are involved with around monitoring the impact humans and human behaviour on the land. Land is comprised of a patchwork of unique habitats and environments, and the key to understanding this area is through exploring ecology and biodiversity.

'Earthy' The Earth Suit

The Earth Suit provided to each Centre is a custom designed, bespoke costume, commissioned by ASDC and produced by a professional costume designer. It was created using satellite images and comes complete with a 'Polar Cap'

Presenters can wear the suits during the show and this is the suggested presentation format, with one presenter playing 'Earthy' and the other playing 'the Doctor'. They can also be used as busking costumes and are fantastic at gathering crowds for Operation Earth activities.

The biodiversity mat

The biodiversity mat provided to each Centre is a specially designed floor mat, featuring ten different insects and creatures and an array of diverse botanical features. The mat can be used as a biodiversity hunt, with participants searching for each species, ticking them off as they go on a provided species list.

This activity has proved hugely popular and it has been suggested that it would be good to produce a similar activity of the ocean, for example showing a coral reef.

Pollinator activity

The pollinator activity is a set of insect costumes, beautiful giant flowers and other equipment to demonstrate the power of pollination. In this interactive activity, volunteers from the audience don the insect costumes and then must collect as many pieces of pollen as they can in the time allowed, before adding them to the 'Biodiversity Tube'. This provides a visual indicator to the audience of the power of a range of insects (not just bees!) and the role they play in pollination and biodiversity.

Air: The stories and science

Operation Earth also aims to raise awareness and understanding of what is in our atmosphere. Working with air pollution experts and researchers involved with the FAAM plane (Facility for Airborne Atmospheric Measurements), the project team developed an interactive activity to examine the level of particulate matter in the air that we breathe, using a custom-built air tent.

Air pollution tent

The air pollution tent is used to engage participants with what makes up the air around us. After a basic introduction to the chemical make-up of the air focussing on nitrogen, oxygen, carbon dioxide and particulate matter, the challenge is to 'catch' as many flying particles as possible in the time allowed. The collected particles are then analysed as an 'air sample'. This is an extremely popular activity with young children and adults alike. When used in the family show, the 'air sample' collected links to a cough, provided by Earthy.

Air visual node

The Air Visual Pro is a superb piece of technology designed for use in the home and elsewhere. It utilises cutting-edge laser technology to count PM 2.5 particles at the microscopic level which are considered air pollutants. It also measures carbon dioxide levels and other environment measurements such as temperature and humidity. Operation Earth activities using the Air Visual Pro include introducing this technology to family audiences and observing levels in the space they are in compared to other given spaces, and what this may mean for the air we are all breathing.

Oceans: The stories and science

As all the rivers in the world lead to a sea, anything that enters the waterways of the world, living or otherwise will end up in one of the worlds' oceans. An understanding of how essential these oceans are to our way of life is one of the main aims of Operation Earth.

Plastic pollution and the oceans

Operation Earth has an emphasis on the use of plastics around the world in everyday life. Simple things like using drinking straws and plastic bags can have long-term impacts on the health of the oceans. This is explored in the family show, examining a 'water sample' from Earthy and with breakout activities using nurdles (small plastic pellets) and other props.

Ocean acidification

The oceans of the world act as carbon sinks, and the more carbon dioxide in the air, the more carbon dioxide that can dissolve into the oceans. This causes the water to become slightly more acidic which can have serious impacts on the biodiversity of the oceans. Operation Earth looks at two activities including the effect of acidic liquid on shells and the effect of carbon dioxide on the pH level of a liquid using a Universal Indicator.

In addition to the activities outlined, there are several smaller scale experiments and activities in the Operation Earth handbook and website, with ideas for further exploration, messages to explore with audiences and links to additional resources.

Photos of the equipment and activities

16. Other events and activities with NERC Kit

ASDC provided two sets of kit to NERC for their own outreach and that of their Centres. The NERC sets of Operation Earth kit have been very successfully used, with 17 instances of the kit being used by researchers and other colleagues to engage audiences. Organisations such as the British Geological Society, the Centre for Ecology and Hydrology and Universities with NERC-affiliated researchers have all used the Operation Earth Kit to engage a range of audiences with environmental science activities. More detail on the audiences engaged with these kits will be in the Final Report.

Developing new relationships

The Operation Earth National Training Academy for scientists was to encourage and facilitate researchers to engage families with their great science. It was also to offer opportunities for them to come to the science centres and use the environmental science activities to share what they do and their research with the wider public.

Several Science Centres and Museums have reported forming lasting partnerships with NERC-related organisations met through the programme. This includes Dynamic Earth with The University of Edinburgh, ThinkTank with the Canal and Rivers Trust and The National Space Centre with the National Centre for Earth Observation.

Activities with The Soil Security Programme

Staff from the soil security programme, who participated in the Scientist Training Academy have engaged with Operation Earth activities at four different delivery Science Centres to date, with others planned for later this summer. They have engaged with Eden Project, ThinkTank, Oxford University Museum of Natural History and the Natural History Museum, and reported favourably to NERC about the quality and messaging of the resources Operation Earth has to offer audiences.

The Festival of Nature

On 9th and 10th June, ASDC borrowed a set of NERC kit, and presented activities from Operation Earth at the Festival of Nature, in Bristol Harbourside. This was a chance to engage with families in the South West, and ASDC worked with Graphic Science and the STEM Ambassador Network who provided researchers to help present the activities over the course of the two days. Overall, this festival engaged with around 20,000 people over the weekend and around 800 people came and spoke with the Operation Earth team. Our thanks to our fabulous volunteers from local Universities, who donned the Earthy suit for a bit of extra publicity for the Operation Earth activities.

Techniquest Cardiff

One other science centre has borrowed a set of NERC kit for Operation Earth - Techniquest in Cardiff. Techniquest is a long-standing member of ASDC, though not originally a partner in Operation Earth (they applied but weren't selected originally). The ASDC project manager for Operation Earth recently took up a new job at Techniquest and was keen to run Operation Earth in his new role in Cardiff. He therefore was able to ask to borrow the kit from NERC and run the programme at Techniquest. Owing to his close association with the programme and knowledge of all the activities and equipment, ASDC and NERC readily agreed.

Techniquest Cardiff are showcasing Operation Earth, using the NERC set of kit as part of their summer programme 2018 and will engage with families and children in the same demographic as the overall project. The audience reach will be included in reporting to NERC and will be assessed separately.

17. Advocacy and Engaging with Policy Makers

The Scottish Parliament

During the project development phase, ASDC worked with NERC to showcase activities that would feature in the programme at a reception at Holyrood, the Scottish Parliament. At the time we wrote 'John Scott, MSP for Ayr was in attendance at this Reception in November 2017. John Scott is the Deputy Convenor of the Environment, Climate Change and Land Reform Committee, and sits on Cross-Party groups looking at a range of environmental issues. The Scottish Minister for Further Education, Higher Education and Science, Shirley-Anne Somerville, was invited and attended another Operation Earth preview at the 'UnEarthed' showcase run by Dynamic Earth in October 2017.'

Operation Earth at Number 10 Downing Street

ASDC were also invited to deliver Operation Earth at 10 Downing Street, as part of the inaugural Green Great Britain and Northern Ireland Week, in October 2018.

ASDC were delighted showcase Operation Earth at 10 Downing Street, presenting to the Rt. Hon Claire Perry MP, Minister of State for Energy and Clean Growth and Dr Therese Coffey MP, Parliamentary Under Secretary of State for the Environment Private Secretary.

Three primary schools were invited to enjoy the Operation Earth show and activities, which were presented as part of Green Great Britain and Northern Ireland Week 2018.

The events on the day were filmed, and appeared on social media through the official 10 Downing Street channels: https://bit.ly/2WpyjmJ

ASDC partnered with the National Space Centre to present the Operation Earth family show and activities including the air pollution tent, the biodiversity mat and the ocean acidification experiment with the invited school children, teachers and the Ministers. The schools that attended were Freshford Church School, Ravens Wood School and Hayes School.

18. Advocacy by Science Centres and Museums

Many areas of NERC-funded environmental science are clearly of great interest to MPs and Policy-makers and ASDC worked to help science centres engage with their local politicians. The Operation Earth Training Academy for Science Centres and Museums included a talk by Dr Penny Fidler of ASDC and Dr Hannah Collins of NERC on how to engage with policymakers to showcase the great environmental science and how they were sharing this with families and helping them to explore the issues. The ASDC CEO also wrote an advocacy guide as part of the Operation Earth training handbook.

In addition ASDC worked with NERC to produce a set of letter templates for Science Centres and Museums to use to invite local MPs to Centres and engage with Operation Earth. Science Centres and Museums have used this to invite MPs, and several Centres were successful in arranging visits from parliamentarians and local elected figures.

Below are reports from the individual centres.

Science Centre	Reported advocacy activity
Dynamic Earth	The Royal Society of Chemistry's 17th annual Science and the Parliament event took place at Dynamic Earth on the 14th of November 2017. Designed to foster close relationships between policy makers and scientists, Science and the Parliament is organised by the Royal Society of Chemistry on behalf of, and in cooperation with, the Scottish science and engineering community. Dynamic Earth Learning Officers hosted a display of our public engagement programme in the event foyer to showcase Operation Earth as a prime example of our efforts to boost science capital of families from all backgrounds all over Scotland. The event was well attended by Members of Scottish Parliament including Richard Lochhead MSP (Minister for Further Education) and Clare Adamson MSP (member of the Education Committee at the Scottish Parliament).
National Space Centre	The Operation Earth press release was circulated among local journalists and Leicestershire council members to make them aware of our Operation Earth activities during February half-term. We were excited to present the Operation Earth programme at Number 10 Downing Street, with an audience of MPs and school groups for Green GB Week, as this presented a good opportunity for conversations about the importance of environmental science and how science centres can play a role in engaging the public. (See below for further information on this event).
Eden Project	No communication with local politicians during this programme.
Jodrell Bank	As the bulk of the Centre's Operation Earth delivery took place during the summer holidays, when MPs are on their summer break, there was no advocacy during this project.
Catalyst	At Catalyst we have a good relationship with our MP Derek Twigg, he visited us last November but since then has had ill health. We invited him in, suggesting a breadth of

	dates, during the periods we had the resources but unfortunately, he was unable to attend.
Natural History Museum	There were plans to have a ministerial visit to launch Operation Earth with Sam Gymiah but this plan fell through. The NHM has talked about the value of Operation Earth in a variety of high-level settings including by the NHM Director at the VIP dinner in front of hundreds of funders and senior members of the civil service and other VIP guests. NHM also regularly mention it at the National Funders forum (as does ASDC) with representatives from the Government and Scottish and Welsh Governments).
Observatory Science Centre	Huw Merriman (MP for Bexhill and Battle) visited our Centre on 22nd August 2018. He watched the Operation Earth show and visited our drop-in activities. He was very excited to see what we were promoting to our visitors about the things they could do to help Earthy. The following week he visited our centre once again this time in the capacity of a parent bringing his daughter with him.
Oxford University Museum of Natural History	The Museum wrote again to our local MP, Annalise Dodds, and invited her to visit our Operation Earth stand at Templars Square shopping centre. Annalise did attend the event but unfortunately, we did not get the opportunity to meet her. The Museum is planning to invite her to future events and she has expressed an interest in doing so.
Techniquest Glyndŵr	Techniquest Glyndŵr invited local Members of Parliament and community councillors to the Operation Earth events. Ian Lucas MP was able to drop in to one of the pop-up shop events where Operation Earth activities were taking place and he promoted the event through his social media.
ThinkTank Birmingham	Thinktank approached Roger Godsiff who is a Labour MP for Hall Green and invited him to attend the BioBlitz at Sarehole Mill on the 31st August. Roger arrived in the afternoon with one of his assistants. He was shown around the site and had a chat with Laurence Butler (Learning and Access Team Leader) about what Operation Earth is, why we were taking part, and the importance of the environmental messages we were delivering to families. Roger also took time to meet some of the families on site and ask them what they were doing. In addition, he spoke with the RSPB team about how they were involved in the project. Roger seemed very keen to recreate the insect houses that the RSPB were talking about both, in his own garden, and at schools and community centres in the Hall Green area. Roger and his assistant both took away a copy of the NERC magazine, Planet Earth, which featured lots of Information about Operation Earth.
W5	The unique situation of the breakdown of the Northern Ireland devolved government has left Northern Ireland without a functioning executive since January 2017. As such the opportunities for advocacy directly with Stormont MLAs has been non-existent; therefore we have no advocacy activities to report.

Advocacy by ASDC

The CEO of ASDC has highlighted and celebrated Operation Earth including its goals, aims and ambitions, along with the world-leading NERC research to the following groups in 2018:

1. The National Funders Forum with representatives from the Government in Westminster and the Scottish and Welsh Governments, Wellcome, UKRI and more
2. Other research councils, UKRI and the Space Agency
3. Learned societies, e.g. The Royal Society, Institute of Physics, The Royal Institution
4. The 150 delegates at both the 2017 and 2018 ASDC Conference
5. The guest speakers at the ASDC National Conference, eg Lord Puttnam, Lord Willetts
6. The ASDC Board members (15 CEOs of science centres) and ASDC members at the ASDC AGM
7. The Energy Minister at Number 10, and Dr Therese Coffey in individual conversations.
8. In our European Collaborations as the UK lead partner, eg CIMULACT and HYPATIA,
9. Dept for Education and BEIS though our own conversations
10. Other UK environmental consortia and groups, including BIAZA, BNHC
11. Other NERC funded engaging environments groups

19. Gender Equity, Underserved Families and Discussing STEM Careers

ASDC published a report commissioned by BIS (now BEIS) about how Science and Discovery Centres attract wide audiences across the UK www.sciencecentres.org.uk/reports/underserved

The project manager and CEO have celebrated opportunities across the breadth of the programme to ensure Science Centres and Museums are considering inclusion in everything they do. ASDC is also the UK leading partner for the EU programme Hypatia, to increase gender equity in STEM. All the findings from Hypatia were included in the training academy to ensure all the learning from across the EU in Hypatia was within this programme.

20. The Operation Earth Website and Social Media

Operation Earth used the following channels and addresses:

- www.operationearth.co.uk
- Twitter and Facebook @Operation_Earth
- #operationearth

The Operation Earth website is a dedicated project website, developed specifically for this programme. The website served two functions:

1. The website acts as an easy place where the public can go after an event at a Science Centre or Museum, to find out more and link to more content and research, including details of around 20 citizen science projects that they can get involved in. There are also interactive features such as 'Try this at home' activities with instructions, and updated news stories, linking with the latest NERC research.

2. The website acts as a resource for Science Centre and Museum staff and other professionals. The website includes equipment lists, training handbook, consumables information, show formats and scripts, all the logo and marketing guidance, brand assets and guidelines, as well as a host of links to other areas of research. It is central to what we do that our resources are open and usable by everyone, to provide maximum impact in everything we do. It also allows access from all other Science Centres and Museums across the world who want to view the materials, ideas and resources. The training handbook is available on the website in the different sections relating to the different content areas of the programme: Land, Air and Oceans.

Social media

The Operation Earth social media channels are designed as a tool for both audiences and practitioners involved with Operation Earth to share images, videos, messages and stories about the experience. The @Operation_Earth handle has 130 followers and the #OperationEarth hashtag has been used by external collaborators, delegates at events, Science Centres, Museums and funders to share news, developments and experiences involving Operation Earth. In addition to these dedicated platforms, there were several other mini-campaigns run on Twitter such as the #onepieceaday campaign, which was used extensively by ThinkTank to highlight one of the key messages of their Operation Earth show. Other Centres used Twitter to advertise their activities featuring campaigns such as 'capturing' Earthy to take part in the show.

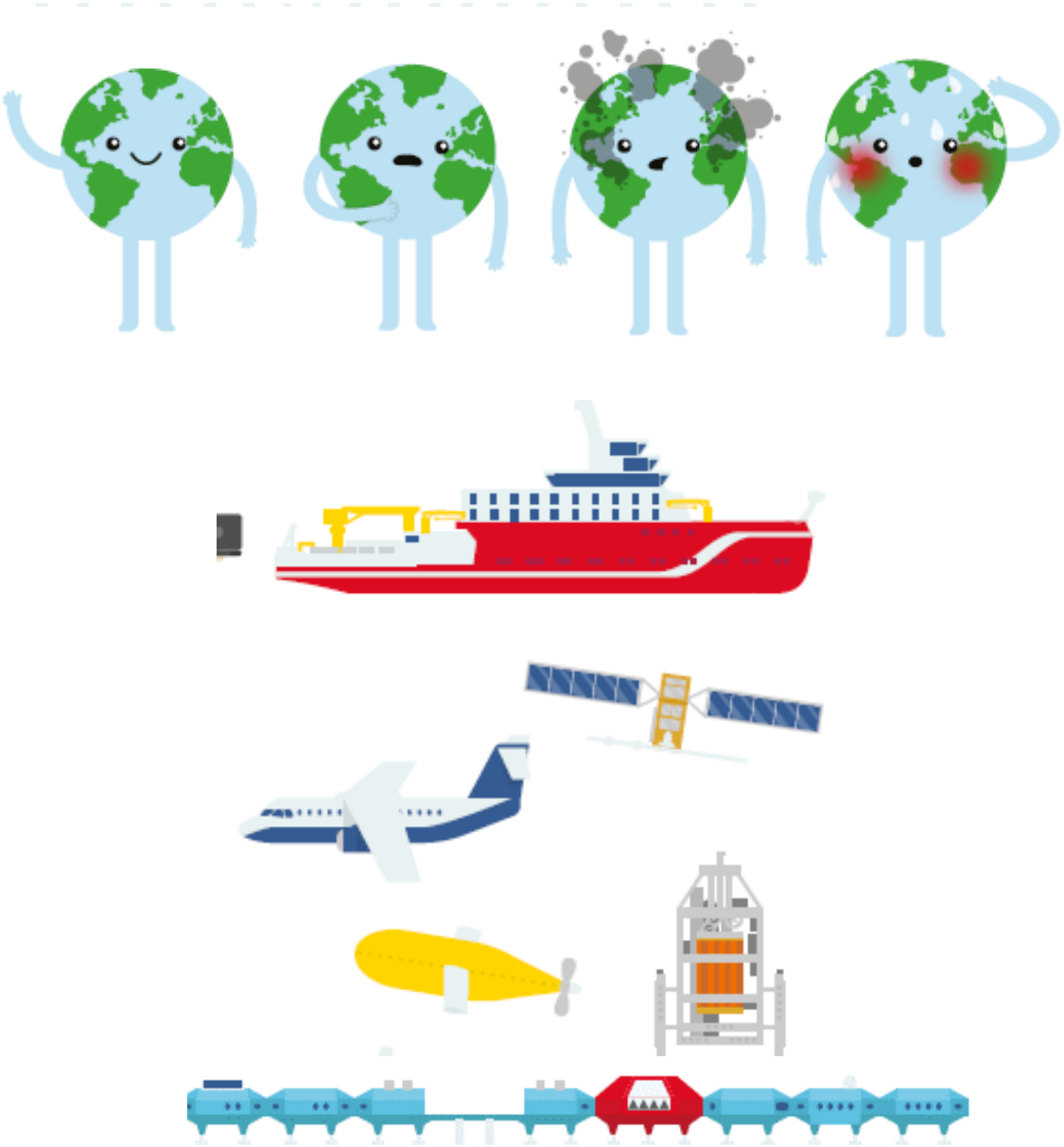
21. An Overall Identity and Marketing Pack

ASDC worked with a graphic design company to create a brand for the programme including logos and colour palettes based around the name 'Operation Earth'.

We also created some illustrated characters to bring the brand alive, together with a range of brand assets (created by the graphic design company with ASDC and NERC) to represent a range of people, jobs and NERC equipment. In the example below, the RSS Sir David Attenborough, the Autosub long range (Boaty McBoatface), the FAAM plane, Earth Observation Satellites and the RD2 55m Rockdrill can all be seen.

ASDC created a marketing package to assist learning teams and marketing professionals to market the activities easily and time effectively to families. This consisted of:

- Logos and all the brand assets
- Development of new illustrations
- Sample press releases, including standard descriptors of all the partners.
- Sample copy describing the shows and activities for use in flyers and online.
- Guidance on identity and logo usage and how to credit all partners.
- Images and their credits for Science Centres and Museums to use in flyers and on websites.
- Illustrations and characters that Centres can use to enliven their artwork (see below).



22. Evaluation of Operation Earth

Methodology

The evaluation for this national programme was undertaken by Professor Justin Dillon and his team at Bristol University and then at Exeter University.

Professor Justin Dillon is currently the Professor of Science and Environmental Education at Exeter University, President of the National Association for Environmental Education and former president of the European Association for Research in Science Education from 2007-11. He undertook the major large scale evaluation for ASDC's National STEM Programmes Explore Your Universe funded by STFC, and Destination Space funded by The UK Space Agency.

The evaluation instruments for Operation Earth were designed with input from ASDC and NERC. ASDC relies heavily on independent academic evaluation to assess the impact of what we do and to find ways to improve our work and advance the field. We have evaluated every national programme we have delivered and have created and delivered some of the largest studies in the world in informal science learning.

We have found Interviewer-led surveys to be an effective and pragmatic means of gathering insights from audiences. A mixture of open and closed questions was used in the design, in order to yield both quantitative and semi-qualitative data.

Centres were required to complete 50 family surveys, and input the data online for analysis by Professor Justin Dillon's team. The evaluation programme analysed responses from 665 adults and 1,130 children drawn from across all 11 participating centres.

This was of course just a sample of the 201,639 people who participated in events at 11 science and discovery centres across the UK.

We also wanted to explore the impact on science centre staff and tease out areas of good practice to share. All participating centres were asked to nominate one or more staff to take part in an interview by Skype or telephone with Professor Dillon which took place in November 2018. The interviews, which were all recorded and professionally transcribed, lasted between 25 minutes and 50 minutes. The interviewer on each occasion was Professor Justin Dillon.

Metrics Data

Overall, **201,639** children and adults participated in Operation Earth engaged. The breakdown by each Science Centre and Museum is shown below:

Science Centres and Museums delivering Operation Earth

Science Centre or Museum	Overall Programme Reach
Catalyst	7,251
Dynamic Earth	49,164
Eden Project	28,500
Jodrell Bank	11,970
Natural History Museum	16,813
National Space Centre	12,483
Observatory Science Centre	18,162
Oxford University Museum of Natural History	15,695
Techniquest Glyndŵr	8,758
ThinkTank	20,760
W5	12,083
Total	**201,639**

Science Centres committed to reaching a minimum of 10,000 children and families each, with the exception of Techniquest Glyndŵr and Catalyst, who committed to reaching 5,000 children and families each. All exceeded their targets.

Type of engagement

Science Centre or Museum	Family Show	Meet the Expert	Other (eg Drop-in or Outreach events)	Total
Catalyst	1,802	5,449	-	7,251
Dynamic Earth	4,410	5,137	39,617	49,164
Eden Project	27,900	600	-	28,500
Jodrell Bank	7,105	415	4450	11,970
Natural History Museum	4,253	12,560	-	16,813
National Space Centre	5,348	235	6,900	12,483
Observatory Science Centre	17,965	197	-	18,162
Oxford University Museum of Natural History	2,428	762	12,505	15,695
Techniquest Glyndŵr	4,326	2,122	2,310	8,758
ThinkTank	2,710	9,080	8,970	20,760
W5	11,495	588	-	12,083
Total	**89,742**	**37,145**	**74,752**	**201,639**

Science Centres and Museums were asked to deliver Operation Earth in a way that worked for their Centre, and each centre outlined their plans and delivery models in their individual proposals submitted to ASDC in August 2017.

For further details on what each individual science centre or museum delivered, please see their summaries in a later section of this report.

Overview of findings from family survey (Quantitative data)

- 83% of children and 77% of adults said they were more interested in environmental science after the Operation Earth show or activities.
- 81% of children and 67% of adults said they thought their understanding of our environment and the current issues faced had increased after watching the Operation Earth family show or taking part in the activities.
- 79% of children and 63% of adults said that their understanding of the range of people who study the environment had increased after watching the Operation Earth family show or taking part in the activities.
- 91% of children and 96% of adults said they thought sharing the latest environmental science is 'very important' after watching the family show or taking part in the activities. 9% of children and 4% of adults said they thought it was 'a little important'.
- 87% of children and 92% of adults said that sharing the latest environmental science was 'very important' after watching the family show or taking part in the activities.
- Children were slightly more positive in their answers than adults, this was a small but statistically significant difference.
- Overall, there was no difference in responses to the questions due to gender of children. There was one small but statistically significant difference where female children (86%) were more likely to say they were more interested in environmental science than male children (80%).

Summary of findings from family survey (Qualitative responses)

- The activities achieved the goal of engaging children and adults. Children put great value in their participation of the activities. In the same way, adults appreciated and enjoyed children's active participation in the activities.
- The delivery of the show and activities were highly praised by children and adults. Positive comments about *Earthy, humour, engagement, staff* were common in the answers.
- The activities achieved the goal of raising the awareness of environmental issues in children and adults. Particularly about plastics, insects, and air pollution.
- The activities achieved the goal of putting forward accountability for environmental issues in children and adults. There were many comments about stopping the use of plastic (straws, bags), using alternative products (bamboo toothbrush, fabric bags), reducing the use of cars (walking more, cycling more), #OnePieceADay.
- The delivery and the activities seemed to foster a more empathetic way of relating with environmental issues. In particular, the personification of the Earth as someone sick, and that is possible to help *them* with the actions was well received by children and

adults. As one child answered - ‘acid rain down, ozone up, thing that we have done that have helped so don’t give up’.

- Participants were enthusiastic about the show, activities, and their willingness to share their experience with friends and family. Also, they were keen to recommend visiting the centres and participating in the show/activities.

The following information is taken directly from Justin Dillon’s evaluation report.

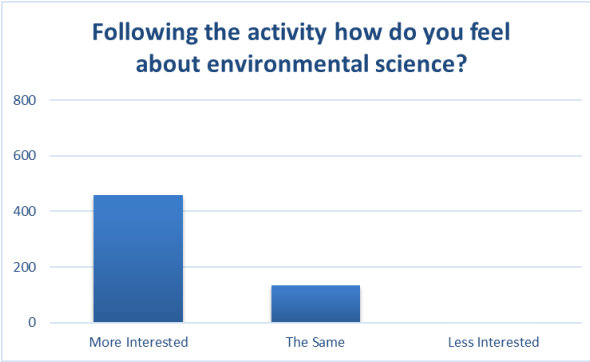
Individual findings from family questions

Question 2: Following the show/activity, how do you feel about environmental science?

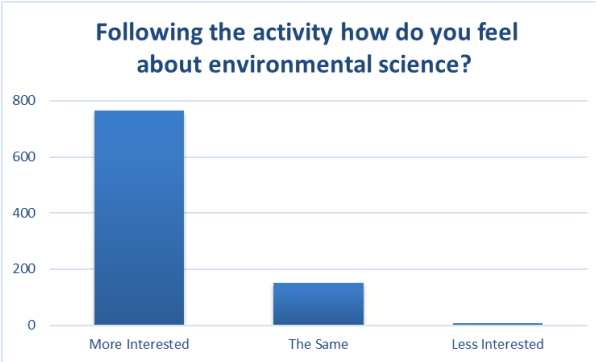
83% of children and 77% of adults said they were more interested in environmental science after the Operation Earth family show or activities.

This question was answered by 1,515 people (594 adults and 921 children).

Adult responses (n = 594)



Child responses (n = 921)



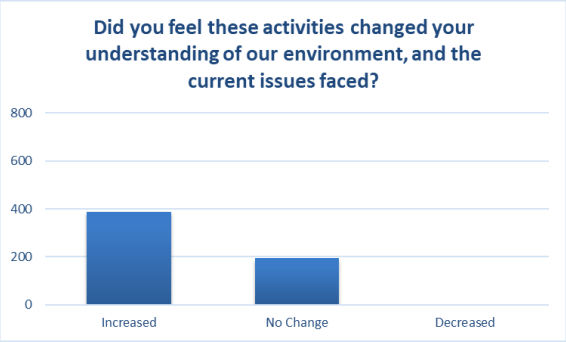
Question 5a): did you feel these activities changed your understanding of our environment, and the current issues faced?

81% of children and 67% of adults said they thought their understanding of our environment and the current issues faced had increased after watching the Operation Earth family show or taking part in the activities.

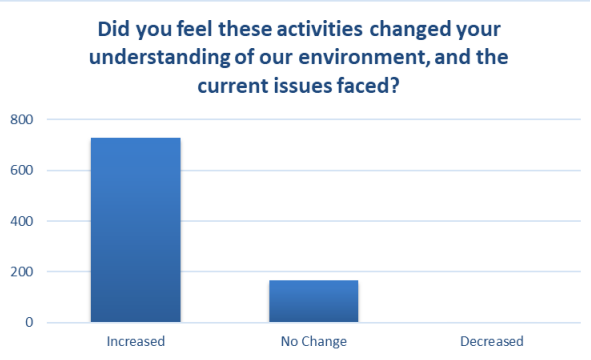
This question was answered by 1,480 people (582 adults and 898 children).

The graphs below show the overall distribution of the responses.

Adult responses (n = 582)



Child responses (n = 898)

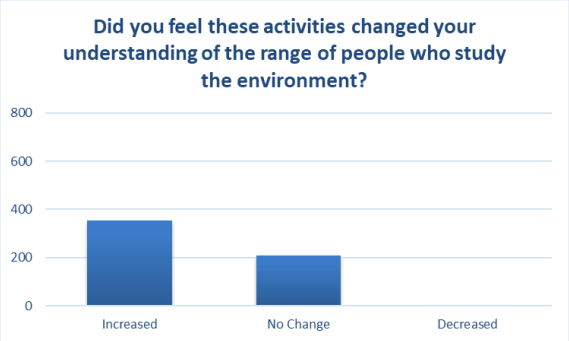


Question 5b): did you feel these activities changed your understanding of the range of people who study the environment?

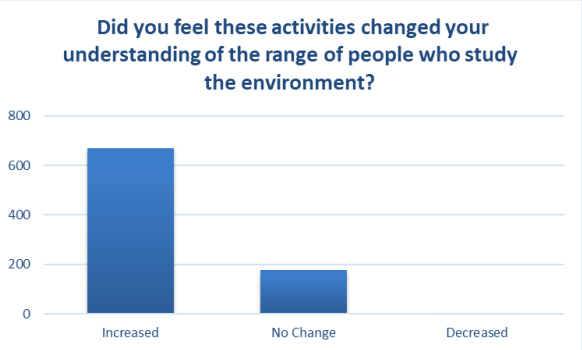
79% of children and 63% of adults said that their understanding of the range of people who study the environment had increased after watching the Operation Earth family show or taking part in the activities.

This question was answered by 1,411 people (561 adults and 850 children). The graphs below show the overall distribution of the responses.

Adult responses (n = 561)



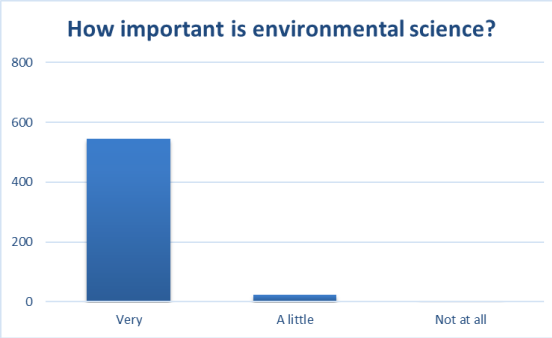
Child responses (n = 850)



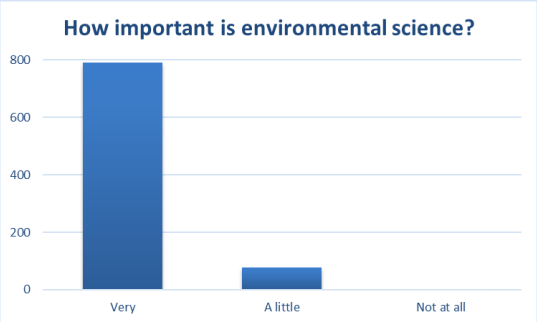
Question 6a): how important is environmental science?

This question was answered by 1,437 people (568 adults and 869 children). The graphs below show the overall distribution of the responses.

Adult responses (n = 568)



Child responses (n = 869)

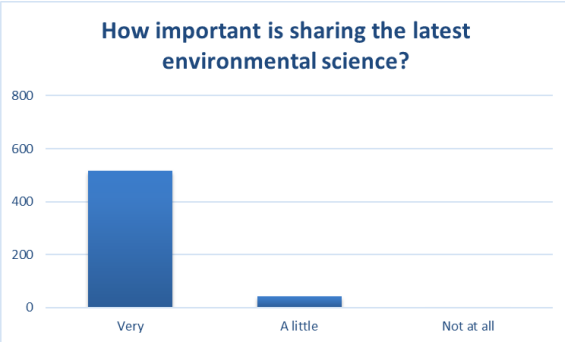


Question 6b): how important is sharing the latest environmental science?

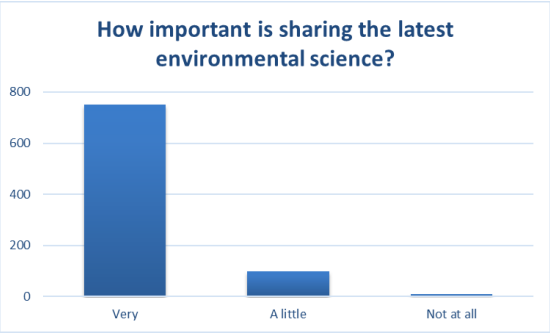
91% of children and 96% of adults said they thought sharing the latest environmental science is 'very important' after watching the family show or taking part in the activities. 9% of children and 4% of adults said they thought it was 'a little important'.

This question was answered by 1,417 people (559 adults and 858 children). The graphs below show the overall distribution of the responses.

Adult responses (n = 559)



Child responses (n = 858)



Findings from open-ended questions in family survey

This section gives the results of the analysis of the responses to the open-ended questions from adults and children. There were three open-ended questions, which were:

Q.3) What did you most enjoy, and why?

Q.4) Did anything surprise you? (which was a general question)

Q.7) Is there anything you found out today that you would tell your friends or family about?

Question 4) is a general question, while Q.3 and Q.7 offered distinct places for children and adults to respond separately. Thus, the analysis considered all the responses from each question given by both groups (children and adults). This analysis focused on the recognition of patterns by the researcher across the data set, which were important for understanding the answers to the question in relation to the programme.

The analysis will be presented as follows: for each question, there is a description of what the respondent groups provided. Then, a description of the themes that emerged from the thematic analysis is offered, along with some representative examples of those themes. Finally, a summary of the findings is provided.

Question 3: What did you most enjoy, and why?

This question was answered by 1,059 people (528 children and 531 adults). Most of the respondents were enthusiastic and very positive about the activities.

The analysis of child answers

Overwhelmingly, children's answers indicated that they had fun and loved being part of the activities. No negative responses were found.

The main themes that can be recognised were:

1) *Interactivity of the activities*; children value and enjoy being part of the activities directly.
2) *raising awareness and learning about what children can do to help environmental issues*
3) the delivery of the activities
In all of the answers it can be seen that the delivery of the activities is engaging, emotionally speaking and physically.

What did you most enjoy, and why? Some representative responses are:

1) **Interactivity of the activities**
    - 'taking part and being picked'
    - 'being involved and taking part in the show'
    - 'Answering questions, being a volunteer and the pollination game'
2) **Raising awareness and learning about what children can do to help environmental issues**
    - *'I think we're learning all this to keep Earth clean'*
    - *'Interesting - you got to think about what's wrong with the man in the suit'*
    - *'I enjoyed learning about looking after the environment'*
    - *'I enjoyed learning about how we can help the earth and what we can do'*
    - *'learning about all the problems about the plastic and what was wrong with earthy'*
    - *'I like how they are trying to help the earth'*
    - *'I might do a charity sale to save the earth'*
3) **The delivery**
    - *'It was funny - the man in the Earth suit'*

- *'Planet Earth - a bit like David Attenborough'*
- *'Interesting - you got to think about what's wrong with the man in the suit'*
- *'They do lots of audience participation'*

The analysis of adults' answers

Adults that attended the activities also had very positive responses. A total of three themes emerged from these answers.

1) *Activity design and delivery*; this was the most present theme in the responses, adults valued and recognised how well designed and carried out the activities were

2) Enjoyment of children; many answers indicated how much enjoyment was had because their children were having fun

3) Awareness of environmental issues; adults indicated that they enjoyed learning new things about environmental science and how this new information relates with their lives.

What did you most enjoy, and why? Some representative responses are:

1) Activity design and delivery
    - *Showed complicated things in an easy way.'*
    - *'Worked for all members of the family, jokes for adults and kids'*
    - *'Enthusiastic helpers'*
    - *'Brought grandson to show but equally enjoyed it.'*
    - *'Humour about a serious subject. Practical demonstrations - getting the children involved'*
    - *'excellent visual aids, very current with the issues'*
    - *'Making scientific concepts real'*
    - *'Amusing delivery'*
2) Enjoyment of children
    - *'Seeing my daughter engage in science'*
    - 'Learning about the work being done in Environmental Science i.e. collecting and samples'
    - 'Learning flies have a use'
    - 'Information about how research boats work'
    - *'All the experiments had Child participation'*
    - *'watching the children interact'*
    - *'All children were involved of all ages'*
3) Awareness of environmental issues
    - 'Certainly gives a lot of food for thought. Most informative'
    - 'Hearing more ideas - didn't know about the wash bag.'
    - 'Good information. Didn't know about microfibres.'
    - 'Earthy as a patient - was a good idea'

Question 4: Did anything surprise you?

There were a total of 479 replies to this question, and we were unable to distinguish between adult and child responses. Although around 100 responses indicated 'no' to this question, with some citing 'because it is all currently in the news' or 'I watch environmental programmes on the TV', there were a few common trends among the responses that are worth highlighting.

1) awareness of environmental issues, around 90 responses include some aspect of the impact of conservation issues

2) Awareness of the role of insects in pollination; more than 60 responses mentioned some kind of demystification about flies and wasps

3) Operation Earths representation of the earth, as Earthy; around 40 responses indicated surprise and delight about how the earth was represented as Earthy, and the impact this had in the show.

Did anything surprise you?

1) Awareness of environmental issues
    - *'That plastic based clothing is putting tiny particles into our water'*
    - *'So much plastic in the ocean. Our clothes are making Earthy sick'.*
    - *'Amount of plastic and particulate matter in our environment'.*
2) Awareness of the role of insects in pollination
    - *'Flies are needed for pollinating cocoa plants. Wasps are general pollinators.'*
    - *'Didn't know flies are pollinators.'*
    - *'Not to swat flies as I didn't know they were so important.'*
    - *'That wasps aren't evil!'.*
3) Earth representation
    - *'An earth with a voice!'*
    - *'the outfits and earthy were an unexpected great touch and added humour to the show'*
    - *'earthy himself - liked the costume'*

Question 7: Is there anything you found out today that you would tell your friends or family about?

This question was answered by 701 people (363 children and 338 adults)

The analysis of child answers

There were a total of 363 child responses to this question. There were some common take away messages from the children.

1) Awareness of the impact of plastic and recycling, around 60 responses mentioned about plastic use and waste

2) 'No flies can mean no chocolate'; many children commented about the role that flies have in chocolate, which really surprised them and resonated with their love of chocolate.

3) Awareness and enacting of environmental issues; general concern for the state of the earth and wanting to encourage people to protect it better.

1) Awareness of the impact of plastic and recycling
    - *'Remember to recycle. Start to say no to straws, and recycle plastic'.*
    - *'Don't use plastic - no more plastic in the ocean'.*
    - *'Stop using plastic straws!'*
    - *'Use less plastic'*
2) No flies can mean no chocolate
    - *'Flies pollinate cocoa plant used to make chocolate'.*
    - *'Without flies we wouldn't have chocolate'.*
    - *'No flies = no chocolate'*
    - *'Don't kill flies. #OnePieceADay'.*
3) Awareness and enacting in environmental issues
    - *'it's important to take care of the earth'*
    - *'there are changed happening on the earth that we can alter'*
    - *'#OnePieceADay'*
    - *'acid rain down - ozone up, things we have done that have helped so don't give up'*
    - *'how they want to look after earthy'*
    - *'don't use plastic/straws'*
    - *'Pick up a piece of litter to prevent it getting in the ocean'*

When these answers were looked at as a whole, and considering the answers of the multiple choice question, the data suggests that children got involved and were aware of environmental issues, but it also seemed to be a call to action about those issues.

In this sense, it might be useful to evaluate the programme with a later evaluation programme to find out whether the show and activities developed long-lasting engagement with these issues.

The analysis of adult answers

Is there anything you found out today that you would tell your friends or family about?

There were a total of 338 adult responses to this question. There were a number of common trends amongst the responses,

1) Impact of plastic; many answers (about 76) mentioned facts about plastic used and some of the substitutes for common plastic utensils (such as straws)
2) Pollinating insects; as well as children, adults were surprised for the role of flies and wasps in pollination
3) Action about environmental issues; even though plastics had a prominent place in these answers, over all, there was a sense that they could do much more for the environment, and
4) Recommendations; there were also a number of very positive comments about the event indicating that they would have definitely been recommending it to other people.

1) Impact of plastic
    - *'Made me think about what I use plastic for and how I can use less'*
    - *'Give up using single use plastic bottles'*
    - *'Plastic straws, we'll not buy them again'*
    - *'bamboo toothbrush, guppy bag'*
    - *'Do not use as much plastic. Use other stuff if possible'*
    - *'Microfibre absorber - how many fibres are released in machine washing'.*
    - *'Fleeces - I didn't know about fibres shredding'.*
2) Pollinating insects
    - *'80% of our food is pollinated through insects!'*
    - *'plant flowers, we need more insects'*
    - *'tell people about not swatting flies and I want to build a pond'*
    - *'Flies- Coffee and chocolate'*
3) Action about environmental issues
    - *'#onepieceaday + other'*
    - *'Citizen science project'*
    - *'Do more cycling instead of driving'*
    - *'Good reminder of transport and how to be environmentally friendly'*
    - *'how to help pollinators'*
    - *'pick up litter'*
    - *'Recycling reused'*
    - *'I'm going to try one of those balls for the washing machine'*
4) Recommendations
    - *'My other grandchildren should see the show'*
    - *'recommend the show to others, and discuss the ideas presented in the show with the children more'*
    - *'Yes, this show and the museum'*
    - *'Recommend a visit'.*
    - *'We have encouraged other families with children to visit. This is our second visit'*
    - *'Would highly recommend the presentation. Easy steps to help the environment'*

Findings from telephone interviews with Science Centre staff

As part of the evaluation, participating centres were asked to nominate one or more staff to take part in a remote interview by Skype or telephone. The interviews were organised by the ASDC project manager and took place in November 2018. The interviews, which were all recorded and professionally transcribed, lasted between 25 minutes and 50 minutes. The interviewer on each occasion was Professor Justin Dillon, and the ASDC project manager was not present for these independent interviews with Science Centre staff.

The questions focused on the initial training, the kit, the show's delivery, the impact of the programme on the centre and visitors' reactions to the show and the activities. Interviewees were sent questions for discussion in advance of the interview (see Appendix 4). Respondents answers were recorded and transcribed, and are therefore included verbatim in this report, in italics.

The Training Academy at Eden

The training academy, which took place at the Eden Project, was run by ASDC staff and partners All respondents, with a single exception, were very positive about this event and very much enjoyed the opportunity to see the show delivered and to meet colleagues from other centres.

> *It was good. There was a lot of training on how to do a two person show, that's how it was written. There was a lot of training on the resources that you could use alongside the show, and there was some training on pupils … I think it was the behavioural things, and sort of people's attitudes towards an environmental topic – it was good, I really enjoyed it.*

The Equipment

Popular items

Respondents were very enthusiastic about the kit provided.

> *Everybody loved the Earthy costume, that was very popular, and I think probably featured on Instagram quite heavily because we had quite a lot of nice opportunities for people to have their picture taken with Earthy after the shows, so that went down well.*

Most centres reported that the biodiversity mat was hugely popular and two centres reported ordering another version for future use.

> *We got invited to [a local] Hospital, a dementia ward, because they'd seen the biodiversity mat at another outreach event, and they thought it would be fantastic for their patients – and it was, it was a really, really good resource, yeah. [it] took them back […] and they were talking about all the different flowers and the different species of insect and … they were talking about all sorts of stuff like … even from picking up dandelions to wetting the bed … you know stuff that they might remember.*

Other pieces of kit were also valued including the hand-held microscopes which could be linked to large screens so that members of the public could examine their own skin, hair, clothes, etc.

Audience response

Centres reported very positive responses to the show. The timing of Operation Earth, following as it did the Blue Planet II series made it highly topical. Audiences recognised the issues the show was addressing and were eager to learn what they could do. Some centres reported that audience members were quite knowledgeable about the content and were already doing a lot.

All centres were very positive about the content. No centre reported any adverse comments about the content of the show or about its delivery.

> *kids that have visited as well have been really engaged with the plastics issues and talked about setting up their own beach cleans and also … we've had a couple of conversations with kids from different schools where they've talked about the fact that they get plastic straws with their milk every day, and just doing like you know back of the envelope calculations together while they've been there and said oh this must be this many straws every day, and it's this every week. I guess you can't tell, you can't follow up whether*

they've done it, but they were talking about going in to school to start a campaign to get rid of the straws. So I think that's nice, I think there's lots of instances … because the way that Operation Earth was set up to offer solutions and things that we can all do, I think there was lots of instances where kids were talking about things that they could do in their lives to make changes. So I think yeah, I hope it has had some impact and perhaps empowered them or given ideas of things that they can do themselves. Yeah, I hope it had some impact.

The role of scientists in Operation Earth

Some centres were far more successful in engaging with scientists than the others. A major factor here was the proximity of universities or other science-rich institutions although that did not always guarantee that scientists could be recruited.

NERC received praise from centres for their willingness to help identify possible contributors. The scientists that did take part ranged from relatively inexperienced PhD students to leading experts in the field.

We had four PhD students from the University of Manchester came to be our experts. We used them on outreach actually rather than in-house because we knew we'd be able to get a lot more people if we did it outreach. So we took them to Manchester Science Festival, we did two events for Manchester Science Festival and we took them to Big Bang in Liverpool, which was really popular – we met an awful lot of people. It was really good, I liked the idea that they contacted us, because that again is time consuming for me to find somebody who might want to come in … and be faced with lots of brick walls. But the fact that they contacted us, they'd been on the NERC training, they wanted to be part of it … and we had, a team of four, and they all helped in one or more than one … and they're interested in helping again in the future. We built up a good relationship with them really actually.

Impact on participating centres

Respondents unanimously reported that the programme had benefited their centre.

Operation Earth had been a key part of many centres' programming and had attracted large audiences whenever it was put on. The kit was seen as being a hugely valuable addition to the centres' resources and the off-the-shelf nature of the programme saved most centres significant planning and preparation time.

They did point out plastics in the café, they did point out … some people did mention straws, because we had a straw in the fish tank. So they did say about the straws in the café, but then we put up signs showing our straws in the café are biodegradable ones.

Conclusions and recommendations from evaluation report

All the centres benefitted substantially from the project funding which allowed them to acquire popular and, in most cases, robust kit which was very popular with visitors including the Earthy suit and the biodiversity mat.

Overall impact of the different modes of delivery

As with previous ASDC programmes, participant feedback was very positive with regards to the family show, break-out activities and the programme content. The vast majority of visitors said they were more positive about environmental science after the show.

The majority of the children (81%) indicated that they thought their understanding of our environment, and the current issues faced, had increased after taking part in the activities. Similarly, 67% of adults said that they thought their understanding had increased and 33% said their understanding had stayed the same. The majority of the children (79%) stated that their understanding of the range of people who study environmental science had increased while 21% said that it had stayed the same. A total of 63% of the adults reported an increase in understanding with 37% stating that their understanding had stayed the same. The majority of the children (91%) stated that they believed environmental science is 'very important' with 9% responding that it is 'a little important'. The majority of the children (87%) and adults (92%) agreed that sharing the latest environmental science information is 'very important'. A further 12% of children and 8% of adults said that it is 'a little important'.

For most of the outcomes, the impact of the programme seemed to be greater in children than adults.

A summary from Justin Dillon related to NERC and ASDC

- NERC's visibility to the general public will have benefited from their support of Operation Earth.
- Stronger links now exist between most of the participating centres and NERC and its' scientists.
- There is increasing public interest in the environment and centres reported high levels of visitor knowledge and commitment to sustainable practices.

Recommendations for alterations for future programmes from Professor Justin Dillon

1. Future programmes should have both a one- and two-person show.

2. All items supplied to centres must be robust and fit for purpose.

3. Greater time should go into issues of sustainability when choosing apparatus, bearing in mind time and budget considerations.

4. Any videos produced need to be high quality and matched to the desired audience, or not included if the budgets are not sufficient.

5. The evaluation of future projects needs to go into more depth in terms of measuring impact.

23. Programme Schedule

The programme began in January 2017 and started with the project planning, research and development, and kick off meeting. ASDC then reviewed of all the stakeholders and held specific meetings with NERC to explore options.

Between March 2017 and May 2017, the project manager also collated and developed the content to create the research document and find out what other partners and stakeholders are doing and what activities they have that we might use or develop.

In July 2017, ASDC created an invitation to participate and received applications from Science Centres and Museums. In August 2017 we selected eleven Science Centres and Museums, and later contracted them (with Techniquest Glyndŵr and Catalyst being separately contracted for half the delivery commitments).

The training academy was held in November 2017 and Centres could begin delivery in time for February Half Term 2018.

Science Centre delivery schedule

Delivery of family shows and school's activities in Science Centres and Museums was from February Half Term 2018 until November 2018. Final reports from Centres were submitted to ASDC in November 2018.

Science Centres and Museums specified in their proposal which of the half terms, holidays (Summer and/or Easter) and weekends they would be running the show and activities. families and the wider public across the UK new and exciting opportunities to discover, discuss, question and explore the latest environmental research.

Key dates of Operation Earth programme 2017 - 2019	
2017	
Monday 27th and Tuesday 28th November 2017	Training Academy for two members of staff from each Science Centre and Museum.
2018	
Saturday 10th February 2018	Delivery period begins by Science Centres and Museums (February Half Term in Scotland).
Wednesday 28th February 2018	Grant claim for £2000 from Centres to ASDC.
Friday 6th July 2018	Interim report submitted to the ASDC project manager.
Tuesday 6th November 2018	All evaluation data submitted by Science Centres and Museums to ASDC.
Friday 16th November 2018	Final Reports from Science Centres and Museums to ASDC.
2019	
January 2019	Completion of the programme. Final report from ASDC to NERC.

24. Reports from Science Centres and Museums

Catalyst Science and Discovery Centre

Catalyst Science Discovery Centre were raring to go with our Operation Earth programme. Fully enthused after an enjoyable two days training, we launched our programme at the earliest possible moment. Thanks to ASDC, we promptly received our resources and set off to our first outreach event 'Science under the Stars' on 25th January 2018.

Following this success we were ready to launch this new programme at Catalyst Science Discovery Centre. We held in-house training for five members of staff and opened the Operation Earth show in February half term 2018.

Catalyst Science Discovery Centre is a smaller science centre enjoying the opportunity to work in partnership sharing resources with Techniquest Glyndwr. We hosted Operation Earth at differing points in the year in order for both centres to maximise our impact and resources.

As a small team, delivering Operation Earth as a two-person piece proved a challenge. However, time was spent during the first period editing the script to ensure it could be effectively delivered single-handedly. Our focus during this initial period was therefore on perfecting the show for one presenter and our presentation was adapted to best support this.

When the resources returned to Catalyst for our second period, our focus then shifted onto maximising the opportunities. We took the time to put together a family workshop which introduced audiences to NERC's equipment and getting hands on with the technology. The science show and our family workshop were at the heart of our Operation Earth offer.

We were delighted that Catalyst Science Discovery Centre exceeded our engagement target of 5040 and **were extremely proud to engage a total of 7251 visitors.**

Summer weekends and holidays were relatively quiet: we put this down to a spell of lovely weather. In an effort to keep on track we took Operation Earth on the road, maximising all opportunities available to us.

Despite almost doubling the number of shows at Catalyst, show participation was low. The main proportion of engagement was offsite. Efforts were made to take the show on the road and a school in Altrincham were very keen, but it didn't work out. The majority of our engagement was through 'meet the expert' events utilising show props and exploring creative opportunities for outreach. We built on our success at 'Science under the Stars' and attended 'Salt Sunday', 'Burnley College Science and Technology Festival' 'Didsbury Gardens' and 'Warrington hospital'. Our outreach aim was quality engagement with interested and receptive audiences who hadn't or weren't able to get to Catalyst. We worked with just 26 people on the Dementia and Children's wards at Warrington Hospital, the impact was tremendous and very well received.

The key messages on how the Natural Environment Research Council help us understand the world around us, and how the public can make a positive impact, have been sang from the rooftops at Catalyst Science Discovery Centre and beyond. We are very proud they have been heard and echoed by **7251** voices in the North West.

Dynamic Earth

Dynamic Earth is the UK's only science centre dedicated to Earth and environmental sciences and our mission is to engage audiences in the story of Planet Earth. Throughout this year Operation Earth has been at the core of our in-house public engagement and family outreach programmes and has proved to be a valuable representation of our centre's aims and ethos. The programme aligns well with both our permanent exhibition and our learning services and offers an exciting way of connecting our audiences with the UK's world-leading research at NERC.

The programme has been a huge success at Dynamic Earth. Throughout the delivery period the overwhelming majority of feedback we received was entirely positive. Many of our visitors told

us that after taking part in the shows and activities they felt more aware of the issues facing our planet and felt empowered to make positive changes to counteract them.

Since we began delivering Operation Earth in February this year, we have reached almost 50,000 people. **Our final reach was 49,164 children and families.** Not only does this number dwarf the minimum requirement of 10,000 engagements, it also greatly exceeds our own target of 30,865.

As well as the core Operation Earth programme, we have also provided several opportunities for our visitors to meet experts working at the cutting edge of environmental science. We were thrilled to invite guests from the Universities of Edinburgh, Liverpool and Heriot Watt as well as hosting amazing science showcases by the Centre for Ecology and Hydrology and Asthma UK Centre for Applied Research. We are very proud that these events represent the broad diversity of people working in STEM careers. More than 50% of the scientists taking part in our public engagement programme this year were women or represented another minority group.

As well as a fantastic engagement opportunity for our audiences, Operation Earth has also provided several opportunities for staff development and progression within the company. Throughout the delivery period several of our staff had the opportunity to take on roles where they were able to develop science communication and management skills. We involved many of our science communication staff, not only in delivery, but in the continued development of the programme throughout the year.

Overall, Operation Earth at Dynamic Earth has been a resounding success. The programme allowed us to engage with audiences all over Scotland in a variety of exciting and innovative ways and we look forward to sharing these with you in the rest of this report. While the delivery period is officially over we have several ideas of how to ensure that Operation Earth leaves a strong legacy here at Dynamic Earth, integrating the concepts and activities into our learning and public engagement programmes for the future.

Eden Project

Eden Project ran Operation Earth for 18 days in total, in this period we have reached over our 10,000 people requirement. Overall, we reached **28,500 children and families.** The show and breakout activities were received warmly by our visitors and integrated nicely into our live programme over Easter. So much in fact that we had messages of complaint about it not being on after it had finished!

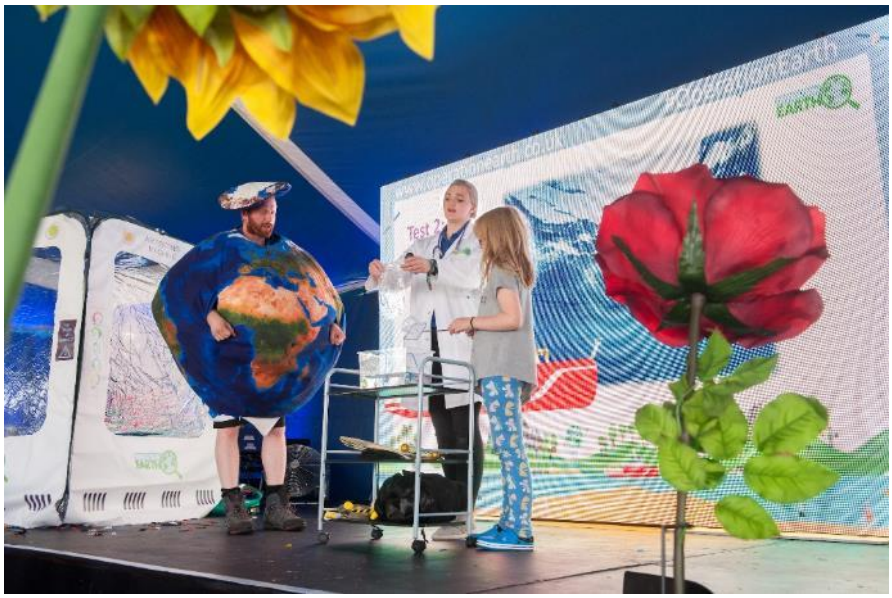
We had an entire weekend (10-11th March) devoted to Operation Earth. This weekend was marketed on local radio and digital media platforms. The family show including 'Earthy' on these days attracted over 200 people each time, the show ran 4 times each day. For the dedicated weekend we invited the Soil Security Programme from NERC to chat to our visitors after the show about latest projects that they were doing.

We ran Operation Earth all the way through the Easter period (24th March – 15th April), 16 days in total, 2 family shows a day, still managing to attract around 200 people per show.

We used our entire site to accommodate Operation Earth activities and our visitors loved making pots and getting involved with the other breakout activities like looking for nurdles with the digital microscopes and spot the difference with satellite images.

Doing Operation Earth has highlighted for us that we need to do many more activities like this, the feedback and evaluation has really brought this to our attention and we'll certainly weave aspects of Operation Earth into our future live programme. The Eden Project is starting to embed this programme into its general science communication programme. The kit is being used in the development of future events and practical sessions. We intend to run several science-themed activities over the next five years and aspects of Operation Earth will play a part of these. The ocean acidification activity is now an on-going part of the new Invisible Worlds lab offer.

Jodrell Bank Discovery Centre



Operation Earth formed the centrepiece of Jodrell Bank Discovery Centre's summer holiday delivery programme in 2018. A number of Operation Earth themed activities were delivered in the lead-up to summer, as well as at the Bluedot science and music festival. **Overall the Centre engaged with 11,970 people**. An overview of the Centre's activities can be found below:

- Hands on activities: These were delivered at the Centre for a total of 44 days (9 during the May half term, and 35 over the summer holidays). These were delivered in the Centre's 'Events Space'. Additional activities and set dressing were developed to make this an engaging and immersive space. These included environmental themed bunting made from recycled plastic, posters highlighting the Centre's own efforts at improving its sustainability, and the 'Planet Pledge Wall', where visitors were invited to write and submit an action they'd take to help the environment. We estimate around 9,900 people engaged with the hands-on activities in total.

- Science shows: 53 Operation Earth science shows were delivered at the Centre; 50 during the summer holiday and 3 during the Bluedot science and music festival. Feedback from the shows was very positive. In total, approximately 7,100 individuals saw a show at the Centre.

- Meet the Expert: During the summer holidays, 5 Meet the Expert sessions were delivered by NERC funded researchers from the University of Manchester's School of Earth and Environmental Sciences. These were held once a week over the 5 weeks of the summer holiday delivery period. There were 306 attendees across these events.

- Girls Night Out: An Operation Earth themed evening event was delivered at the Centre in October. This was part of the 'Girls Night Out' series, which aims at getting more young women and girls interested in STEM subjects. The evening featured a talk on climate change from Professor Alice Larkin (The University of Manchester's Professor of Climate Science and Energy Policy) as well as a number of early-career researchers from the University of Manchester's School of Earth and Environmental Sciences, delivering outreach stands on their areas of research.

As a result of Operation Earth, the Centre's café no longer sells plastic drinks bottles. All straws and takeaway packaging is paper/cardboard, and disposable cups are supplied by vegware. All food suppliers for the café have been consulted on where their food is sourced. This process is ongoing however a map will be produced, showing visitors what local sources their food comes from. The suppliers were also asked to stop packaging ingredients in plastics. For instance, the butcher now supplies meat wrapped in paper and the chips are brought in a reusable bucket. A number of members of staff have also made positive environmental changes in their personal lives as a result of this project, such as taking part in 'one piece a day'.

These changes are part of ongoing actions the Centre has taken to improve its sustainability over recent years. These include the introduction of an apiary, bird boxes, bug hotels, and wild flower gardens in the arboretum. Plus at the Bluedot science and music festival there is no bottled water sold, and no disposable cups given out (instead reusable cups and bottles are used).

Natural History Museum

Operation Earth has been delivered to great effect and very positive responses at the Natural History Museum. We took the Operation Earth show and the Learning team, and Science Educators worked hard to modify and tailor the show, to build upon the excellent premise and content, and create a show that would have the greatest impact when delivered at the Natural History Museum. The resulting show is slick, humorous fun and informative, and has been seen by over 4000 people, the large majority of which are family audiences. The show has primarily been delivered during holiday periods, to maximise on the numbers in the museum and guarantee good audience sizes.

The NHM also took our version of the show to the NERC offices in Swindon where it was very positively received by the staff, including those who commissioned the show.

In addition to the delivery of the show, the Museum made the decision to theme an entire Family Festival over May half term, as an *Operation Earth Festival* (28 May– 1 June). The rationale behind this was that it would enable us to create the biggest buzz around the programme possible, and to maximise on the large numbers of crowds attending during half term and provide a coherent theme for a week of activities, enabling families to enjoy a whole day of Operation Earth and environmental science activities at the Museum. A suite of activities has been created to supplement the show, inspired by and utilising the resources and equipment provided and all sharing the same core themes and aims present in the Operation Earth programme. These have also been used outside of the festival.

The festival itself was visited by over 13 000 people, and over **6**500 engagements were recorded at specific Operation Earth activities. Overall, we reached **16,813** children and families with Operation Earth.
We were delighted to deliver 11 'meet the expert' activities, delivered in our Nature Live Format, where visitors were able to hear more about the Operation Earth project, while also meeting a NERC scientist in an informal setting and hear more about a particular area of environmental science research. Most of the researchers involved were form the Museum, but we also involved external scientists from NOC (Southampton), Imperial College, the Soil Security Programme and the University of Hull. PHD students from the University of Hull and the Soil Security Programme were also present for three days each as part of the Operation Earth Festival, meeting the public and engaging them with their research.
One thing that we have been constantly struck by is the willingness for the younger members of the audience to suggest how we can improve the state of the planet, from increased research, to day to day actions. There is no shortage of enthusiasm or ideas for the task. When delivering the show, we have the sense that some of our key message are hitting home, largely due to the repetition and the fact that a few key issues have been focussed on, separated into land, Ocean and Air, but it is hard to know just how memorable these messages are. Therefore, when we do receive confirmation that some key messages have been absorbed, and more importantly stuck, then it is a real treat.

National Space Centre

The National Space Centre delivered Operation Earth between February and October 2018, **reaching 12,483 families and schools with Operation Earth activities**.

The primary dates of delivery were February half term, between 10-25 February 2018, when Operation Earth was the theme of all live activities in the Centre. During these 16 days, the Family Show was delivered 3 times per day and drop-in demonstrations were run for 4 hours per day. During February half term alone, over 10,000 visitors took part in an Operation Earth activity.

Earth observation and climate science is a topic of huge importance at the National Space Centre – not least because of our close connections with NERC's NCEO in Leicester.

One of our galleries, 'Orbiting Earth' is dedicated to how we understand Earth's environment from space. We continue to make use of Operation Earth activities such as the Satellite Imagery, the Microscopes, and the Wildflower Mat on a regular basis, as a way of bringing this gallery to life on the weekends.

The Ocean Acidification demo is a popular and now regular activity in both our public and school activities.

On the strength of renewed NCEO connections thanks to Operation Earth, we are exploring more Meet the Expert and other outreach sessions, specifically highlighting how satellites help us monitor and protect the Earth. This closer link with cutting-edge Earth Observation research happening down the road came out of our Operation Earth work with NCEO.

The Operation Earth show and equipment will allow us to celebrate Earth Day annually in future years with relevant and engaging activities in a way that we have not been able to previously. We've also noticed a lot of interest in the activities from local festivals that celebrate well-being and the environment, including the Lunar Festival on 27-29 July 2018. We see this appetite as an unexpected long-term legacy of Operation Earth, and a good example of its relevancy today.

Observatory Science Centre

At the Observatory Science Centre we ran the Operation Earth family show with a single presenter. We adapted the script to include all the main points of the original show. The presenter performed as the doctor character and we had Earthy visible throughout the show. By presenting this way we were able to run this show three times a day throughout the show period.

Our Operation Earth launch was on the 10th of February 2018. Over the February half term week we delivered the Operation Earth show on 8 days which included one home educator's day.

For British science week we held an Operation Earth weekend which included the delivery of family shows which were run alongside some Operation Earth drop in activities and we also had 1 day of Meet the expert sessions.

Over the May half term we ran Operation Earth drop in sessions for 10 days including 1 home educator's day. These were run throughout the day, from 11am – 5pm, with a member of staff providing additional information and assistance during the entire day.

We launched the summer programme of Operation Earth on the 21st of July. We delivered 3 family science shows each day. We also had the Operation Earth drop in hands on activities available two days a week, with the Earth observation posters, biodiversity mat and Citizen Science posters available every day for visitors to explore independently.

We had the pleasure of inviting Huw Merriman (MP for Bexhill and Battle) to our Centre on 22nd August 2018. He visited in the afternoon and explored our drop in activities and watched the Operation Earth show. He was very excited to see what we were promoting to our visitors about the things they could do to help planet Earth.

At the Observatory Science centre we delivered the Operation Earth show to 18,162 people.

Oxford University Museum of Natural History

At Oxford University Museum of Natural History we have delivered the Operation Earth project in a variety of ways, theming the majority of our family learning programme events in 2018 around the topic of environmental science. The Museum has been delivering the family show and 'Meet the Expert' sessions in partnership with Oxford based scientists.

The Museum was very excited about the prospect of hosting a family show. As we mentioned in our application, this was not something that we had done before so we wanted to find out more about how this could work and how we could fit it into our regular programming. Many of our family visitors enjoyed the family science show format. It has been a great opportunity to engage with both the children and the adults at the same time as they are both a captive audience in this scenario. One of our strategic goals is to inspire the next generation of scientists and their parents/carers can have great influence on this.

For the delivery of the family show the Museum recruited eight scientists to present as the characters of Doctor and Earthy. The show format has been really popular with family audiences and there has been very positive feedback about it, from the content to the delivery style which is interactive and fun. The shows have had continued interest and we have received many enquiries from school teachers as well as parents who would like the show to come to their children's school.

At the Museum we have incorporated a lot of the themes from the Operation Earth training and handbook into our regular family programming. The school holiday activities in 2018 have focused on environmental science and we used the collections to bring these stories to life for our visitors, from bees to polar bears and penguins. For us it has been a fantastic opportunity to address a strategically important topic in our family programming; the challenges facing our changing planet due to human impact. It is a topic that we will continue to feature in our programming and having the Operation Earth kit will make this much easier for us to achieve.

The project has helped the family learning team to consider new ways of delivering our programme and how to cover sensitive scientific topics and to enthuse visitors effectively about them. **Overall, we reached 15,695 children and families.**

Techniquest Glyndŵr

Techniquest Glyndŵr **reached 8,758 people from February to October 2018 with the Operation Earth programme**. The equipment is shared with Catalyst Science Discovery Centre, so activities mainly took place at set times through the year when the equipment was with Techniquest Glyndŵr.

Operation Earth launched in March, with the public show running in the science centre for the Easter holidays of England and Wales (three weeks in total) plus the remaining two weekends in April. The Operation Earth show and accompanying hands-on activities were also offered as a special event for annual pass holders. During this time over 3,400 engagements took place.

Techniquest Glyndŵr and Catalyst Science Discovery Centre shared the cost of purchasing a second biodiversity mat and magnifying glasses set to enable both centres to deliver hands-on Operation Earth activities throughout the year. Over 2,300 participants used the biodiversity mat, bug hunt activity and newspaper origami plant pot activities at special events including Techniquest Glyndŵr's pop-up science centre in Wrexham town centre, Greenfield Valley Park and during Techniquest Glyndŵr's 15th birthday celebrations.

Techniquest Glyndŵr will continue to work in collaboration with Catalyst Science Discovery Centre. Although Catalyst will be the main holder of the equipment, Techniquest Glyndŵr plans to utilise the Operation Earth family show again in late 2019 or early 2020 as part of our rolling public programme and will liaise with Catalyst over availability.

The Operation Earth family show returned for the first two weeks of the summer holidays, reaching over 700 people. Earthy was very popular and evaluation data shows families engaged with the important messages in the show.

"Meet the Expert" events were organised in conjunction with RSPB Cymru, Bangor University and Chester Zoo. They were held at Techniquest Glyndŵr's pop-up science centre alongside Wrexham PlayDay and at Chester Zoo's Wildlife Connections Festival, engaging over 2,000 people.

Operation Earth has been a refreshing change for Techniquest Glyndŵr; inspiring both families and our staff through thought-provoking explorations of environmental science.

ThinkTank, Birmingham Science Museum

Thinktank launched Operation Earth in February 2018 during the half term holiday for Birmingham schools. Operation Earth was delivered as the museums theme for the whole season for the museum; running until the end of the May half term holiday (which finished on the 3rd June in Birmingham). **Overall, we reached 20,760 children and families with Operation Earth.**

To make the most of the Operation Earth equipment and messages Thinktank delivered the Operation Earth show at least once a day during the holidays and on special events during the season. We also delivered science busking on gallery using the equipment provided by the project at weekends and during school holidays. This included the microscopes and monitors, the biodiversity floor mat, and the air node sensor for measuring air quality both inside the museum and around the world.

To ensure the messages from the project were as inclusive as possible for the younger visitors who come to Thinktank we also ran interactive storytelling and arts and crafts activities, every weekend and school holiday. The story telling sessions linked to plastic pollution on land, in rivers, and oceans, as well as the importance of biodiversity. The arts and crafts focused on biodiversity and recycling plastics. All of the activities Thinktank delivered were free to ticket holders.

We have also worked closely with different expert groups to run a variety of 'Meet the Expert' events at Thinktank over the project. We have created a strong relationship with the RSPB who have been talking to visitors about: plastic pollution in water ways, and the best ways to increase biodiversity in outdoor areas local to visitor's homes, such as their gardens.

Thinktank ran a very successful Brownie and Guide takeover day themed around Operation Earth, which was attended by over 200 girls and 25 leaders. They all engaged with the family show and took part in a workshop full of activities including: the origami plant pots; the digital microscopes; the biodiversity mat; and even a tree survey of the park outside the museum.

Over the summer holiday we ran an Operation Earth road show across the other Birmingham museum sites including: Weoley Castle, Aston Hall, Sarehole Mill, Blakesley House, Birmingham Museum and Art Gallery, The Museum of the Jewellery Quarter, and Soho House. The road show enabled us to engage with audiences, who may not come to Thinktank, but would be interested in learning about the project. The roadshow provided an opportunity for us to mix elements of: the family show; the science busking; and activities we ran for the Brownies and Guides take over day. We also ran two BioBlitzes at Weoley Castle and Sarehole Mill; these shared the messages about the importance of biodiversity, and collecting evidence, whilst linking to real surveys supported by local ecologists and experts.

During the Thinktank Operation Earth season the learning team tweeted every day to share ideas of how we are supporting the #onepieceaday campaign. This campaign encourages everyone to pick up one piece of rubbish every day to prevent it entering the water ways. We consecutively tweeted on 72 days; these tweets made 36,817 impressions and had 838 engagements.

W5

Delivery of the Operation Earth Programme by W5 began in early February 2018. The various elements of the programme were delivered throughout the spring, the summer and into the autumn of 2018. The programme message and materials were directly presented to the public through the media of interactive family shows and opportunities to try-out activities themselves during hands-on public engagement sessions. The programme was supported by opportunities to meet & interact with professionals who work in environmental science-related industries. Advertisement and regular-updates of information pertaining to programme events were made via W5's website and social media presences on such platforms as Facebook and Twitter.

Overall, we reached **12,083 children and families with Operation Earth.** W5's delivery commitments as outlined in programme proposal were exceeded both in terms of the total number of events delivered, and in the total number of participants engaged by the programme. The ongoing – unusual – circumstances of Northern Ireland's Executive has limited the opportunities for W5 to engage in advocacy of the programme with governmental figures, however.

The Operation Earth shows & activities will continue to be delivered at key events throughout the specified legacy period running until November 2019. As a number of Operation Earth materials have now been incorporated into our regular repertoire of public engagement activities, we expect the impact and message of Operation Earth to be carried well-beyond that date. We intend also to maintain and foster the links we have established with industry experts to deliver further "Meet the expert" events covering the same subject matter in the future.

W5 has taken advantage of the opportunities provided by the large public (such as the Balmoral Show) and educational (Eco-Schools Conference and BT Young Scientist Primary Science Fair) festivals which we have attended in order to present a range of the public engagement materials as-supplied by the ASDC. We have run in-house events presenting these same materials to W5's visitors throughout June, July and August. In addition we have taken the Operation Earth materials out to engage with community groups and special schools as part of summer schemes and in conjunction with the CREST award programme.

The Operation Earth floor show remains in our repertoire in both the original and adapted-for-our-Lecture-Theatre formats. We will endeavour to deliver performances at opportune times over the coming year. W5 has a temporary exhibition focusing on Earth scheduled for the February half-term. This coincides with the anniversary of the first delivery of the Operation Earth programme at W5 and the Northern Ireland Science Festival, so should provide an ideal opportunity to reinforce the messages of the programme.

We will also continue to use the materials and equipment supplied by the ASDC to illustrate and support the aims of the Operation Earth programme as part of our outreach and in-house public engagement activities.

25. Appendices

Appendix 1: The Ideas Charette

Our Planet Earth

The Ideas Charette

Tuesday 25th April 2017

10:30 am – 4:30 pm

Natural History Museum, Cromwell Road, London SW7 5BD

The Flett Lecture Theatre - use the side entrance of the NHM

10:30 – 11:00	**Registration with coffee and pastries** **Introducing participants to one another**	
11:00 – 11:15	**Welcome** **Introduction to the project and Goals of the day**	**Dr Penny Fidler (Chair)** ASDC CEO
11:15 -11:20	**Welcome from NERC**	**Alison Robinson (NERC)** Director of Corporate Affairs
11:20 – 11:30	**Introduction to the project team and all the Charette participants**	**All** **Dr Penny Fidler**
	Some great ideas and hands on activities	
11:30 – 12:15	Engaging audiences with climate science	**Dr Tamsin Edwards (Open University)**
	Using VR and AR to engage audiences	**David Urry (Natural History Museum) and James Summers (ASDC)**
	How drones can be used to engage audiences with climate science.	**Dr Hermione Cockburn and Conor Ellis (Dynamic Earth)**
	Engaging visitors with the importance of rainforests.	**Robert Lowe and Gus Grand (Eden Project)**
12:15 – 1:00	**Round table Discussion:** • What are the most important stories to tell? • What are the best activities and pieces of equipment to share these stories?	**Dr Penny Fidler** **and the project team**

	• For this session, you will be working in small groups	
1:00 – 1:45	**Lunch and opportunity to look at equipment**	
1:45 – 2:15	Some Ideas to engage families with air quality	**Dr Enda Hayes (University of West of England)**
	BAS standard kit – how it can be used to engage and catch the attention of young audiences Online Climate modelling	**Dr James Pope (British Antarctic Survey)**
2:15 – 3:15	**Your amazing hands-on kit list ideas** We want this project to use brilliant existing ideas and create some fabulous new activities for families and children to inspire them with the many roles of environmental scientists and how their work is helping us understand the world and tackle the issues around environment and climate change. We want ideas and activities to get families thinking about and questioning how the environment affects them and how they themselves can make a difference. In this session, we are asking you to share ideas to bring alive the stories and science behind NERC's environmental science including climate change. In groups with participants from different backgrounds, we will ask you to play with ideas, think creativity and freely and to find new ways to help people understand how we know what we know and how to share NERC's great research. The output of this session will be your ideas and those of your group written on the cards supplied. The last 10 minutes will be a chance to hear ideas from other groups.	**Chaired by Dr Penny Fidler, this will be a combination of individual and group work**
3:15 - 3:30	**Coffee**	
3:30- 4: 00	**You really shouldn't miss ….** In this session, we will ask you to tell us about remaining excellent ideas, demos, websites, apps, experiments, social media, people, projects and equipment you would love to see play a part in the wider project. From air quality monitors to great citizen science projects, what shouldn't we miss as we create our kit?	**Chaired by Dr Penny Fidler, this will be a combination of individual and group work**
4 00 - 4:30	**Sharing all the ideas that you all have, cross-pollinating, and the next steps** • How would you like to be involved?	**Chaired by Dr Penny Fidler**
4:30	**Close**	

Appendix 2: The National Training Academy for Science Centres

The Training Academy
November 27th - 28th 2017

Day 1: Monday 27th November

10:30 - 11:15am	**Registration with coffee and pastries**	
11:15 - 12:45	Welcome Introductions to the Project Team	Dr Penny Fidler, CEO of ASDC
	Welcome to Eden	Dr Robert Lowe, Publications Manager, Eden Project
	Introductions by all the participants	All Delegates
	An overview of Operation Earth (including the project vision, mission, a broad overview of the equipment and resources, grants and your delivery timeframes).	Dr Penny Fidler, CEO of ASDC
	Familiarising yourself with the training handbook	
	Health and Safety across the project and your responsibilities	
	A welcome from the Natural Environment Research Council and introduction to NERC centres and facilities	Hannah Collins, Head of External Affairs, NERC
	Introducing Earthy	James Summers, Special Projects Manager, ASDC
12:45 – 1:45	**Lunch**	Joined by Dr Mike Maunder, Director of Life Sciences, Eden Project
1:45 - 2:45	Introduction by Dr Penny Fidler	
	Engaging audiences with environmental science: Using the latest evidence from behavioural psychology to understand the way people think.	Dr Kris De Meyer, Research Fellow, Centre for Neuroimaging Sciences King's College London
	Understanding the evidence – how to best interpret environmental data in a world of media misrepresentation.	Dr James Pope British Antarctic Survey
2:45 - 3:15	**The Hands-on Equipment Training Part 1: The Earth suit** 1. Setup and storage 2. Methods of engaging audiences 3. Health and Safety	James Summers, Special Projects Manager, ASDC Conor Ellis, Dynamic Earth, Edinburgh

3:15 - 3:30	**Coffee Break**	
3:30 - 5:45	**Introduction to the environmental topics covered in the show and related NERC science**: 1. Increase in CO_2 , climate change 2. Biodiversity loss 3. Changing oceans 4. Air pollution / air quality 5. Melting ice caps and sea level rise 6. Earth observation Any questions and discussion	James Summers, ASDC
	The Hands-on Equipment Training Part 2, Additional activities: 1. Microscopy 2. Biodiversity 3. Ocean acidification 4. Earth observation 5. Air pollution 6. Health and Safety 7. Any questions and discussion	James Summers, ASDC Conor Ellis, Dynamic Earth, Edinburgh David Urry, Natural History Museum, London
5:45 - 6:45	**Tour of Eden Biomes**	Mike Smith and Nathan Mansbridge, Eden Project
6:45	**Close**	
7:00	Taxis back to the hotel	
7:45 for 8:00pm	**Dinner in the hotel dining room**	

Day 2: Tuesday 28th November

Time	**Session**	
8:30 - 8:45am	**Taxis leave hotel**	
8:45 - 9:15	**Coffee and arrivals at Eden Project**	
9:15 - 11:30	Welcome back and overview of both days	James Summers
	A full run through of the family show	David Urry and James Summers
	The Hands-on Equipment Training Part 3: Activities from the show: • Biodiversity demo • Air quality demo • Ocean pollution demo • Melting ice caps (additional activity) • How to set up your show • PowerPoint	James Summers Conor Ellis and
	Any questions about the experiments, activities and the show	All Delegates
11:30 - 11:45	**Coffee break**	
11:45 - 1:00	Engaging audiences with environmental science	Dr Hermione Cockburn

	Focussing on the positive: Discussion around behavioural science and entrenched ideas	Dr Penny Fidler
	Guide to citizen science: Encouraging family science capital	David Urry
	Guide to advocacy and raising the project profile with local MPs and policy makers	Dr Penny Fidler and Dr Hannah Collins NERC
	Questions and answers	All Delegates
1:00 - 1:45	**Lunch and team photo**	
1:45 - 3:15	Your evaluation commitments, contractual commitments, Health and Safety.	Dr Penny Fidler
	Meet the Expert sessions and where to find the experts	ASDC and NERC
	The marketing resources and website	Dr Penny Fidler
	Reaching wider audiences and gender equity	Dr Penny Fidler
	Training your staff and ensuring quality and accuracy of the content Any Questions on the activities	James Summers
3:15 - 3:30	**Coffee**	
3:30 – 4:00	Final questions and your next steps	All Delegates
4:00	**Close**	
4:15pm	**Taxis to the train station**	

Information for Training Academy Delegates

1. Please ensure you bring with you a copy of your proposal so you are clear what your Centre needs to deliver and we can clarify any points you need.

2. Please remember, after the Training Academy that you, on behalf of your Centre, will be responsible for all Health and Safety, risk assessments, running the programme and meeting the deliverables you outlined in your proposal. Please therefore ask all the questions you need during the Academy - we are here to help. Likewise, if there is something you do not understand, please ask us.
3. We want you to meet and speak to all other delegates, therefore at each break or meal, please introduce yourself to at least two people you do not already know.
4. Please sit on different tables each day to mix people around.

Reading in advance of the Academy (e.g. on the journey to the Academy)

Ensure you have read what your Centre proposes to do, and you know when and how you will deliver this programme at your Centre.

On your way to the Academy please read:

- Online copy of 'Planet Earth', NERC's free magazine
- Find out what PPM stands for and what does it mean?
- Consider what positive stories you can think of regarding successes of environmental science?

Appendix 3: The National Training Academy for Scientists

The Scientist Training Academy

February 6th 2018

The Flett Theatre, Natural History Museum, London
(Please use the side entrance on Exhibition Road)

9:30 – 10:00am	**Registration with Coffee and Pastries**	
10:00 – 10:10	Welcome & introductions to NERC and the project team	Dr Penny Fidler, CEO of ASDC
10:10 – 10:15	Introduction to the national network of Science Centres	Dr Penny Fidler, CEO of ASDC
10:15 – 10:35	Introductions by all the participants	All Delegates
10:35 – 10:50	An overview of Operation Earth (including the project vision, mission, a broad overview of the equipment and resources available) Familiarising yourself with the training handbook	Dr Penny Fidler and James Summers, Project Manager for ASDC
10:50 – 11:00	A welcome from the Natural Environment Research Council (NERC)	Hannah Collins, Head of External Affairs, NERC
11:00 – 11:50	**The Hands-on Equipment and Activities** 8. Introducing Earthy 9. Air quality demos 10. Ocean pollution demo a. Plastic pollution b. Ocean acidification 11. Biodiversity demos a. Biodiversity identification activity b. Biodiversity show demo 12. Digital microscope activity 13. Earth observation activity 14. Health and Safety	James Summers, Project Manager, ASDC David Urry, Science Communicator for NHM
11:50 – 12:05	**Coffee and Biscuits**	
12:05 – 1:00	How to contact your preferred Operation Earth Science Centre or Museum	James Summers, Project Manager, ASDC
	Engaging Audiences with Environmental Science Using the latest evidence from behavioural psychology to understand the way people think.	Introduced by Dr Penny Fidler Dr Kris De Meyer, Research Fellow,

		Centre for Neuroimaging Sciences, King's College London
1:00 – 1:45	**Lunch**	
1:45 – 2:15	Hands-on session: Exploring the equipment Air, Sea and Earth-related activities	Consider how you would bring areas of environmental science and your research alive with families, using these activities.
2:15 – 2:30	Guide to advocacy and raising the project profile with local MPs and policy makers	Dr Penny Fidler, ASDC Dr Hannah Collins NERC
2:30 – 2:50	A fast masterclass in Public Engagement: • Who are you engaging? • Making it fun and interesting for the public • What do you find difficult? • Reporting your impact for your department	Dr Penny Fidler
2:50 – 3:45	**Bringing the Science Alive: Creating your demo** During this session, you will work in groups to develop a way of engaging families with an area of environmental science using the Operation Earth equipment and activities. Each group will be asked to present their ideas after the break.	Guided by James Summers, ASDC David Urry, Natural History Museum, Hannah King, NERC Heather Lampard, ASDC Andy McLeod, ASDC
3:45 – 4:00	**Coffee and Cake**	
4:00 – 4:45	Scientist presentations (5 minutes per group)	Chaired by Dr Penny Fidler
4:45 – 5:00	Citizen Science: A researcher's perspective.	Dr John Tweddle, NHM
5:00 – 5:20	Short discussion led by NERC: How will you get involved in Operation Earth activities?	Led by Hannah King, Public Engagement Officer, NERC
5:20 – 5:25	Evaluation Forms**:** NERC and ASDC really want to know what you thought of today. Please fill in the evaluation forms and leave in the box on your way out.	
5:25 – 5:30	Questions, answers and next steps	All Delegates
5:30	**Close**	

Social media

Please share your experiences and photos of the day on social media using the following twitter handles:

@operation_earth @sciencecentres

@NERCscience #OperationEarth

In advance of the Academy

Before the Academy please:

1. Read the attached summary of Operation Earth so you know more about this National Programme, which will engage over 100,000 people with environmental science.

2. Make a short plan for how you will share what you learn at the Operation Earth Training Academy (e.g. at you meetings, workshops).

3. Make a short plan for how you can get involved in Operation Earth activities (e.g. at your local Science Centre, at your University or in your local community). More details will be given at the Academy.

4. Complete the attached Profile Questionnaire and return to James Summers (james.summers@sciencecentres.org.uk). These profiles will be used on the Operation Earth website to show the range of jobs and areas you all work in (a bit like these profiles, used for a similar ASDC programme called Explore your Universe).

Appendix 4: The Operation Earth Kit List

Equipment	units
Show Props	
stethoscope	1
clipboard	1
lab coat	2
IR thermometer	12
Earth suit	1
Biodiversity demo	
Giant Rose (white)	1
Giant Daisy	1
Giant Rose (Red)	1
Giant sunflower	1
flower stand	4
insect costumes - 2 x bee, 1 x fly, 1 x butterfly	1
Pollen ping pong balls	1
Buckets	8
Gloves	4
Bubble lamp	1
Velcro dots	1
Air quality demo	
pop up greenhouse	2
leaf blower + spare battery	1
Tissue paper cutter	1
tissue paper air particles	4
face mask	1
goggles	2
collecting net	1
Ocean pollution	
trolley with brake	1
Medical screen on wheels	1
microfibers on slide (50 pack)	1
plastic trays	2
bag of Nurdles	
Plastic bag	
Fish Tank	1
small net	1
Table top demos	
Ocean Acidification	
Bromothymol Blue 500ml 0.04%(aqueous)	1
shells	1
500ml plastic beakers	2
100ml plastic beakers	2
Light box	1
Stop clock	1

Vinegar	1
baking soda	1
Sample pots	2
Ecology/biodiversity	
Soil (peat free)	1
wildflower seeds (no toxic plants e.g. foxglove)	1
Paper bags	1
Jumbo magnifiers	1
paper plant pot maker	1
trays	2
Microscopy	
Phone macro lens	2
HDMI microscope	2
21 inch HDMI screen	2
Slides	1
Air Quality	
Atmospheric Sensor	1
Printing /graphics	
graphics for air demo	1
Biodiversity mat	1
table cloth	2
Earth observation images (laminated)	1
Really useful box - green	3

Appendix 5: The Operation Earth Families Evaluation Survey

Ask one of the adults Hello! My name is … and I work for [name of your Centre]. Thanks for watching/taking part in Operation Earth; we'd love to know what you all thought. Would you and your family be willing to help us – it will only take about three minutes?

1. **Did you find the show fun?**

Yes	Don't Know	No

2. **Following the show / activity…**

		More Interested	The Same	Less Interested
How do you feel about environmental science?	Adult			
	Child 1			
	2			
	3			

3. **What did you most enjoy, and why?**

Children's responses

Adult's responses

4. **Did anything surprise you?**

5. Did you feel these activities changed your understanding of…

		Increased	No change	Decreased
Our environment, and the current issues faced?	Adult			
	Child 1 2 3			
The range of people who study the environment?	Adult			
	Child 1 2 3			

6. How important is …

		Very	A little	Not at all
a) Environmental science?	Adult			
	Child 1 2 3			
b) Sharing the latest environmental science?	Adult			
	Child 1 2 3			

7. Is there anything you found out today that you would tell your friends or family about?

Children's responses

Adult's responses

8. What are the ages of your children? (Interviewer can estimate).

	Gender (interviewer please indicate)	**Age**
Child 1		
Child 2		
Child 3		

THANK YOU FOR YOUR TIME TODAY

Additional Information for the interviewer

TODAY'S DAY and DATE…… CENTRE ……..

Appendix 6: Science Centre staff interview schedule

Questions for discussion

Operation Earth Family Show and Kit

- What did your audiences think of the Operation Earth kit? What was the best piece?
- Did you change/adapt the Operation Earth family show? If so, how and why? (show specifically)
- Were there any activities/items of kit that you did not use in your delivery? If so why?
- Were there any items of kit that you felt were hugely successful at engaging audiences?

Operation Earth Delivery

- Were there any further areas you felt you could have received more training on prior to delivery?
- Did you need to change anything about the programme, such as any of the activities along the way in order to make the programme a success?
- To what extent have Science Centre staff kept up with the latest environmental research, and how?

Operation Earth in your Centre and beyond

- How many Science Centre staff trained in your Centre, and at what level of seniority?
- What did your staff gain from being involved in the delivery of Operation Earth?
- What did your Science Centre gain from being involved in the delivery of Operation Earth?
- Did the programme help you make city/region-wide relationships?

Operation Earth and NERC

- Were there any challenges related to working with NERC Scientists in event delivery? If so, could you provide details/ideas for how this could be improved for future programmes?
- If you did work with NERC scientists, what level of seniority were the scientists who got involved in delivery, and how many scientists did you work with?

Impact of Operation Earth

- Have partnerships or networks been made with other organisations such as universities, industry, other Science Centres and museums since the Training Academy in November 2017? Please give any relevant examples
- Has being involved with Operation Earth changed anything in your Science Centre and staff operations? For example, has your recycling policy been looked at?
- Why was it successful? Do you have any top tips for others running the programme in the future?

Thank you from ASDC and the Project Partners