STEPS

Science and Technology Enrichment for Primary Schools

Evaluation report

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Executive summary

Introduction

The STEPS project was delivered by the Science Communication Unit at the University of Liverpool and funded by the Engineering and Physical Sciences Research Council (EPSRC). It worked with schools in Greater Merseyside and North Wales during 2007 and 2008. The content was focused on forces and transport, areas of the curriculum that primary school teachers often seek support in. The broad aims of the project were:

- To help young people appreciate how science gives us an understanding of the world around us;
- To promote engineering as a creative and imaginative process in which scientific understanding is used to solve problems.

The project consisted of three sets of activities targeted at Years 1&2, Years 3&4 and Years 5&6. The general format was an interactive presentation followed by a series of challenge workshops. Some students also participated in the activities in museums, and some showcased their work to parents and families.

Evaluation methodology

All the activities were evaluated at the pilot stage. During the rollout phase, students and teachers completed questionnaires during follow-up evaluation sessions. Focus groups were also conducted with students.

Delivery metrics

The project reached over 6100 young people with shows, workshops, museum visits, showcases or combinations of these activities. The target set in the proposal was 5550 young people, so this has been exceeded by a considerable margin.

Key findings

Overall the activities were very well received by students and teachers. Of the 311 students that took part in school-based activities:

- 84% agreed they liked the interactive presentations;
- 72% felt they developed their teamwork skills;
- 83% agreed they learned lots from the day;
- 75% agreed the day taught them what scientists and engineers do;
- 82% said the day made them like science more.

> *It made me feel more interested and made me feel like a scientist*
>
> (student)

> *They learnt about space, forces, gravity etc and because of the way they were involved they enjoyed the team work and learnt a lot more.*
>
> (teacher)

Conclusions

Overall, feedback on the project from students and teachers was very positive. It appears that the activities addressed the project objectives well. The following broad conclusions were drawn:

- **Piloting** the events and gathering feedback at an early stage helped ensure the activities that were rolled out to larger numbers of students were well received.
- The students appeared to have positive **experiences** with the project activities. Including activities that intentionally used a range of learning styles encouraged engagement with the project.
- In terms of **learning**, students appeared to gain a great deal from the activities. The main learning points could be summarised as '*about forces'*, '*about science demonstrations'* and '*about scientists and engineers'*. These tie in with the project objectives and indicate that the messages were effectively communicated to students.
- Students reported gaining a range of **skills** from participating in STEPS. These included communication skills (especially for the showcases) and teamworking.
- It appears that the project had a strong positive impact on students' **attitudes** towards science and engineering. Most agreed that they liked science more after the activities.
- Another clear success factor with the project was the **presenter**.

Recommendations

The future of the project was discussed with the project team and the following recommendations are made:

1. The project was very successful and there is much goodwill among teachers who would like to see it continue. Therefore **means to extend the impact of the project should be sought**.
2. Consider **continuing with other presenters** with schools covering the costs.
3. One possibility is to **alter the format of the activities**, so a show is delivered to students, then teachers are trained in delivering the challenge workshops during lessons.
4. The activities and booklet could be used a the basis of a **teacher training activity**. In this way, a session working with teachers would cascade the activities into their schools.
5. Further **dissemination within the interactive science community** could allow other public engagement practitioners to incorporate the activities into their work.
6. **Making the materials publicly available free of charge** and publicising this as widely as possible will encourage their use by others.

1 Introduction

The STEPS project was delivered by the Science Communication Unit at the University of Liverpool and funded by the Engineering and Physical Sciences Research Council (EPSRC).

'STEPS' stands for Science and Technology Enrichment for Primary Schools; the project worked with schools in Greater Merseyside and North Wales during 2007 and 2008. The content was focused on forces and transport, areas of the curriculum that primary school teachers often seek support in.

1.1 Project aims

The broad aims of this project were:

- To help young people appreciate how science gives us an understanding of the world around us;
- To promote engineering as a creative and imaginative process in which scientific understanding is used to solve problems.

In order to meet these aims the project had the following specific objectives:

- To entertain, inform and enthuse primary school students about Science and Engineering in the context of forces and transport;
- To provide coverage and enrichment of the appropriate parts of KS1 and KS2 of the National Curriculum;
- To raise awareness of what it is like to be a scientist or an engineer;
- To develop students' communication, imagination, creativity and other transferable skills;
- To engage participating children's carers with science and engineering and to highlight the possibility of their children pursuing careers in these areas;
- To encourage students and their teachers to explore new ways of presenting scientific material.

These objectives were addressed through core activities consisting of interactive presentations and challenge workshops, and wraparound activities which included museum visits and whole school showcases

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1.2 Project delivery

1.2.1 Core activities

The core activities delivered as part of the project are described in the table below.

Topic / level	Interactive presentation	Challenge workshop
Years 1 and 2 ***We Invented the Wheel***	• Story-telling and role play session based on the idea that the wheel could have been invented by a group of children in the early Bronze Age; • Problem solving using scientific principles is the underlying theme.	• Drama: wheel and spoke physical theatre and role play of life in the Bronze Age; • Artwork activity to make a wheel; • Card sort and 'feely bag' activities on transport and materials.
Years 3 and 4 ***Balloons And Blast-Off***	• Balloons and rockets to help introduce ideas about forces.	• Make a balloon-powered car; • Story writing activity based on a trip into space in a rocket; • Making and decorating a rocket.
Years 5 and 6 ***Forces Everywhere***	• Presentation based on forces in relation to various forms of transport and solving engineering problems; • The roles of scientists and engineers in association with Transport and Forces.	• Physical theatre workshop to represent a form of transport; • Make a model of a futuristic form of transport in groups, then present to the class; • Making and racing hovercraft.

1.2.2 Museum visits

The project also planned to collaborate with local museums. Adapted versions of We Invented the Wheel and Forces Everywhere were delivered and combined with museum trails.

1.2.3 Showcases

Schools were supported by the project team to put on a version of the show for parents and carers, displaying the work they had done during the project.

In addition, a number of schools took part in a Super Showcase event at the end of the project. This was held at the University of Liverpool and allowed students to present their work to students from other schools that had participated in the project. Students also took part in a series of challenges throughout the day.

2 Evaluation methodology

The evaluation had three stages:

- Pilot
- Audience and teacher surveys
- Qualitative work

2.1 Pilot

This qualitative work involved the evaluator attending a pilot event for each of the three core activities. Observation and group interviews with students were used to explore which aspects of activities are the most effective in order to maximise impact for the remainder of the project. Teachers were also interviewed where possible.

2.2 Student and teacher evaluation

This part of the evaluation collected information from a large sample of participants. Three similar questionnaires were developed to collect quantitative and qualitative feedback from students. An evaluator visited sample schools within a week or so of the activity to go through the questionnaire with the class. This helped reduce bias in the sample, especially with young children who may not have been able to read some of the questions. It was also important that the evaluator was not part of the team that delivered the activities, so could encourage students to be as honest as possible in their feedback.

A similar set of indicators was used in each of the questionnaires:

- Experiences (fun, exciting etc.)
- Knowledge and awareness-raising
- Skills
- Attitudinal change

Teachers were also asked to complete questionnaires at the follow-up visits.

2.3 Showcase evaluations

The evaluator attended one school showcase and the Super Showcase held at the end of the project. At the school showcases, parents were asked to complete short open questionnaires which had three questions in speech bubbles.

At the Super Showcase, students and teachers completed questionnaires then used them to make paper airplanes which they threw towards the front of the lecture theatre.

2.4 Qualitative work

To build on the large amount of data collected via questionnaires, focus groups were conducted with students that participated in the project.

3 Delivery metrics

Forty schools were involved in the core activities, five took part in activities at museums and a further thirty-three took part in shows or workshops at science events or festivals. Seven schools delivered a showcase (some put on more than one) or attended the Super Showcase.

The breakdown of activities is given in the tables below:

Total delivery - activities	
We Invented the Wheel	19
Balloons and Blast Off	40
Forces Everywhere	29
TOTAL (target: 80)	**88**

Schools audiences	**Shows**	**Workshops**
Y1&2	1084	826
Y3&4	2022	1362
Y5&6	2134	1160
TOTAL (target: 4800 for shows, 2400 for workshops)	**5240**	**3348**

NB No student participated in a workshop without seeing a show.

Museum / festival shows	**Museum**		**Festival**	
	#	*Audience*	#	*Audience*
Y1&2	1	35	-	-
Y3&4	1	89	9	389
Y5&6	4	3	9	410
TOTAL (target: 15 events, 750 participants)	**6**	**127**	**18**	**799**

Showcases	**# delivered**	**Student audiences**	**Family audiences**
We Invented the Wheel, Y1&2	2	97	51
Balloons and Blast Off, Y3&4	6	273	256
Forces Everywhere, Y5&6	3	194	70
Super Showcase	1	122	0
TOTAL (target: 10 events)	**12**	**686**	**377**

The project reached over 6100 young people with shows, workshops, museum visits, showcases or combinations of these activities. The target set in the proposal was 5550 young people, so this has been exceeded by a considerable margin. In addition, it was originally anticipated that half of all students that saw the show would participate in workshops. It was possible to adjust the running order of events so that almost two-thirds of students that saw a show also participated in workshops.

However, while overall audience figures exceeded the targets, fewer activities were delivered in museum venues than anticipated. Unfortunately some partner venues that had initially pledged support for the project were unable to host events. The link with Llangollen Motor Museum was effective and some activities were also delivered at science festivals.

The target number of parents and families was higher than that achieved, although more showcases were delivered than anticipated. This was due to flexibility in the nature of the showcase events. Initially, it was envisaged they would take the form of a performance to a large audience. However it became apparent that this was not appropriate for all schools and some ran smaller, more interactive sessions instead.

4 Evaluation sample

Twelve schools were included in the evaluation sample, three at the pilot stage and nine as part of the project rollout. This was in line with the evaluation proposal, which planned to include nine research schools.

A total of 360 student questionnaires were collected for the schools and museums activities. The original plan was to collect 500 questionnaires; however this was based on collecting 50-60 per school which was not possible in every school given the sizes of the schools and numbers of students that had participated in activities. 20 teacher questionnaires were collected and 60 parents and family members returned questionnaires at three schools showcases.

An additional 112 student and 10 teacher questionnaires were collected from students that participated in the Super Showcase event.

Seven focus groups were conducted at six schools. Of these schools, two had participated in core activities, one had participated in a showcase and three had participated in museum visits.

5 Pilot

All activities were piloted. The evaluator attended a pilot session for the three sets of activities and interviewed participating students and teachers. Observations and timings for the activities were also recorded. A pilot report for each activity was produced (available separate to this report) and a number of changes to the activities were made in response to the feedback. The recommendations from each of the pilot reports are summarised in this section.

5.1 We Invented the Wheel

- Some students found it difficult to distinguish acting in the story from reality, which led to anxiety in some cases. Perhaps the **characteristics of a story** or pretending could be discussed at the start of the session to clarify this.
- An explanation of why **poking a fire** is important should be included in the story.
- During the **bowling game** consider giving the students that have had their turns something to do (perhaps keeping score for the group) to prevent them becoming distracted and disruptive.
- Despite discussions about **scientists and engineers** being included in the activities, students weren't able to define them in their own words. Perhaps it is too much to expect such young students to do this, however the definitions could be further reinforced throughout the sessions.
- The workshops were successful so few changes are recommended. Some more **interesting items** could be included in the feely bag for the sorting workshop, and students that complete all of the activities in the wheel-making workshop could be given a **further task**, perhaps drawing a scientist or engineer.
- For discussion-based workshops, it could be useful to lay down some **ground rules** that help all students listen and behave.

5.2 Balloons and Blast Off

- **Vocabulary** is an issue at KS2. This could be helped by having some of the key words displayed during the show. Key words to include were prediction, push, pull, force, gravity, air resistance. Using large flashcards or pegging the words on to a washing line were suggested.
- Include a **clearer definition** of both scientists and engineers.
- The **outputs** from activities like the creative writing are a great starting point for follow-on work in other lessons. Suggestions or support for this could be included as part of the project.
- **Teamwork** (or lack of it) was a problem for the rocket making and balloon powered car activities. This could be addressed in different ways. Either group sizes could be reduced to two (perhaps for the rocket making) or team members could be assigned roles. For the balloon powered car activity roles could be measurer, recorder, pilot, engineer etc.

5.3 Forces Everywhere

- The presentation works well and teachers and students agreed that the **cards and arrows** were useful. However there is some room for improvement in the way the cards and arrows are used:
    - The cards add useful **structure** to the presentation. Perhaps this could be further reinforced by telling the group what they are going to learn at the start of the presentation. Then each

section could start and end with the words, and finish with a force/arrow game for the types of transport included.
    - The cards need to be used **consistently** every time key words are introduced. All cards should be used.
    - Teachers and students felt it would be helpful to **separate** the cards and the arrows as it is difficult to see which way the arrow is pointing when it's only printed on one side. Using a card in the shape of an arrow could be a better way to overcome this.
    - Using the arrows to show the **forces on the plane** worked well and was fun when done quickly the second time. This could be developed into a game and repeated at the end of each section of the talk (as suggested above).

- A few small points or suggestions related to some of the **individual demonstrations:**
    - The **glove** needs to be more firmly attached to the push/pull stick
    - A track for the scooter should be **cleared in advance** of the presentation
    - Two of the **remote control cars** didn't appear to work
    - The **paper** sheet / ball throwing demo worked well.

- Students found the **drama workshop** challenging. Suggest using an **individual warm-up activity** first to familiarise them with the idea of physical theatre and to get them moving. When in teams, it would be useful to spend some time **explaining** how different forms of transport work, or what the main parts are. It may be useful to prepare some key words to display here. This would help reinforce the learning as well as making the activity more accessible to the students.

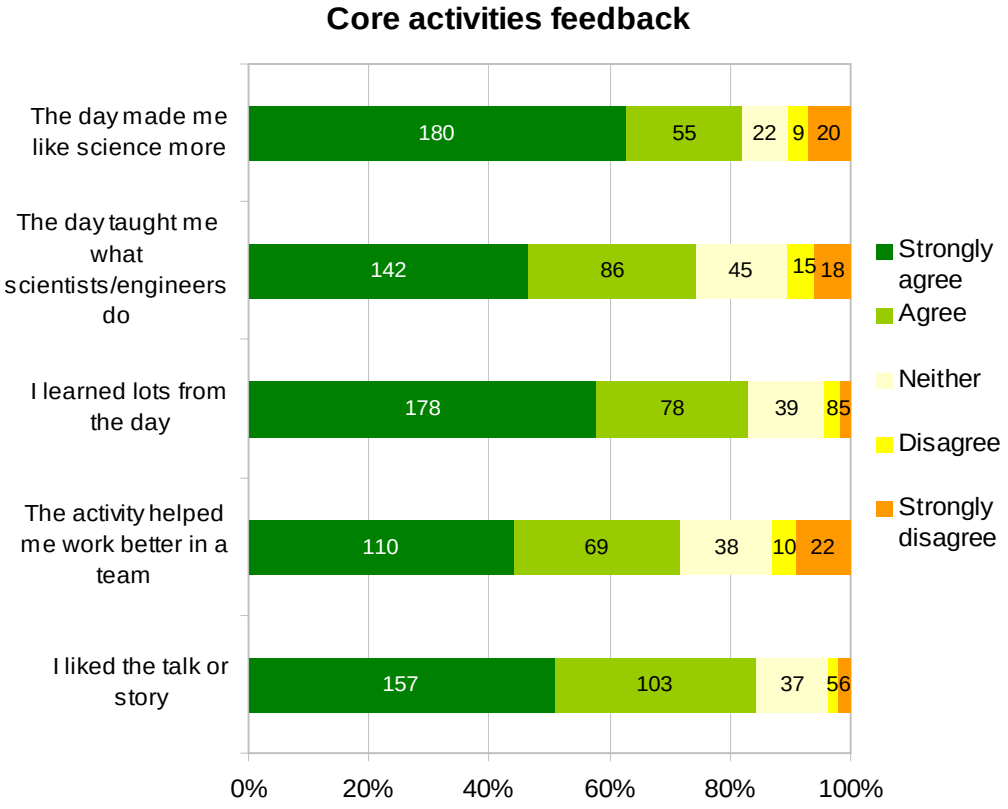
- Students enjoyed designing their own forms of transport and the shop was a real success. Some **instruction sheets** on the tables might help the groups focus on the task, especially when it comes to preparing the presentation and the poster. They would also help teachers to support the students by clearly outlining the aims of the activity.

- The students were fascinated by **hovercraft** so they enjoyed making their own during the workshop. However some confused a sail with a flag so an example craft with sail would have been helpful. Several students also asked if they could keep their hovercraft; perhaps a **handout** with instructions for how to make one at home / in class would go down well.

- In the hovercraft workshop, students should be provided with pumps to inflate their balloons and should be supervised if possible when using the hairdryer.

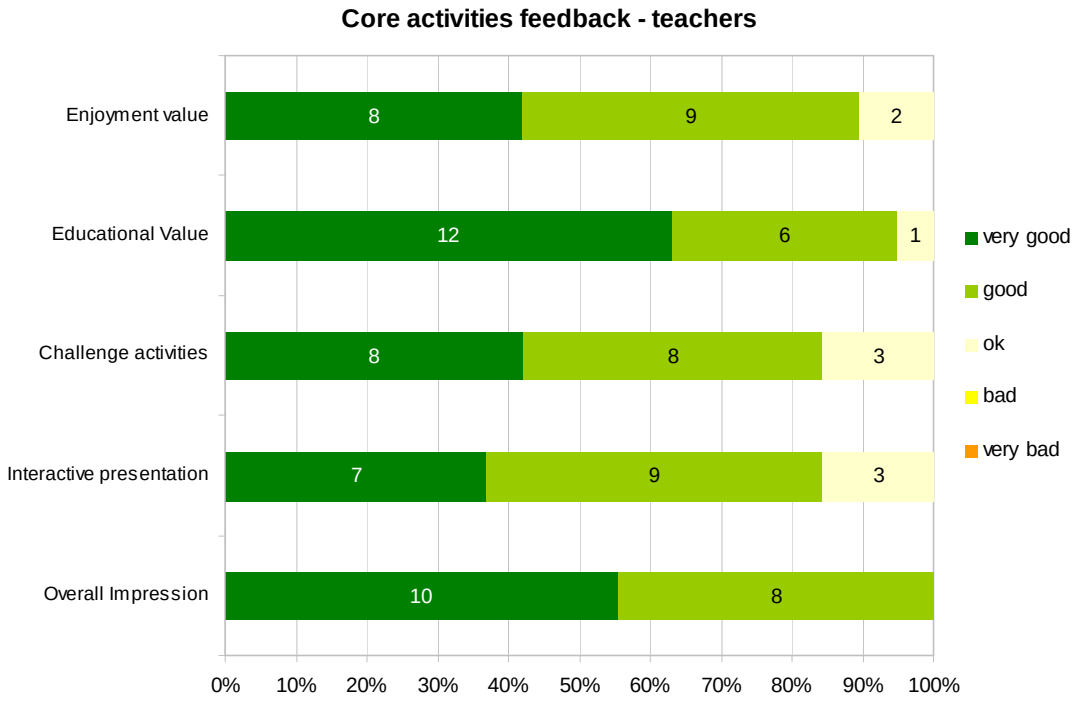
6 Findings - Core activities

The graph below summarises the quantitative data collected from students about all three core activities:



Overall, these findings are very positive, especially that over 80% of young people said that the day made them ‘like science more’.

Teacher feedback on all of the core activities can also be combined:



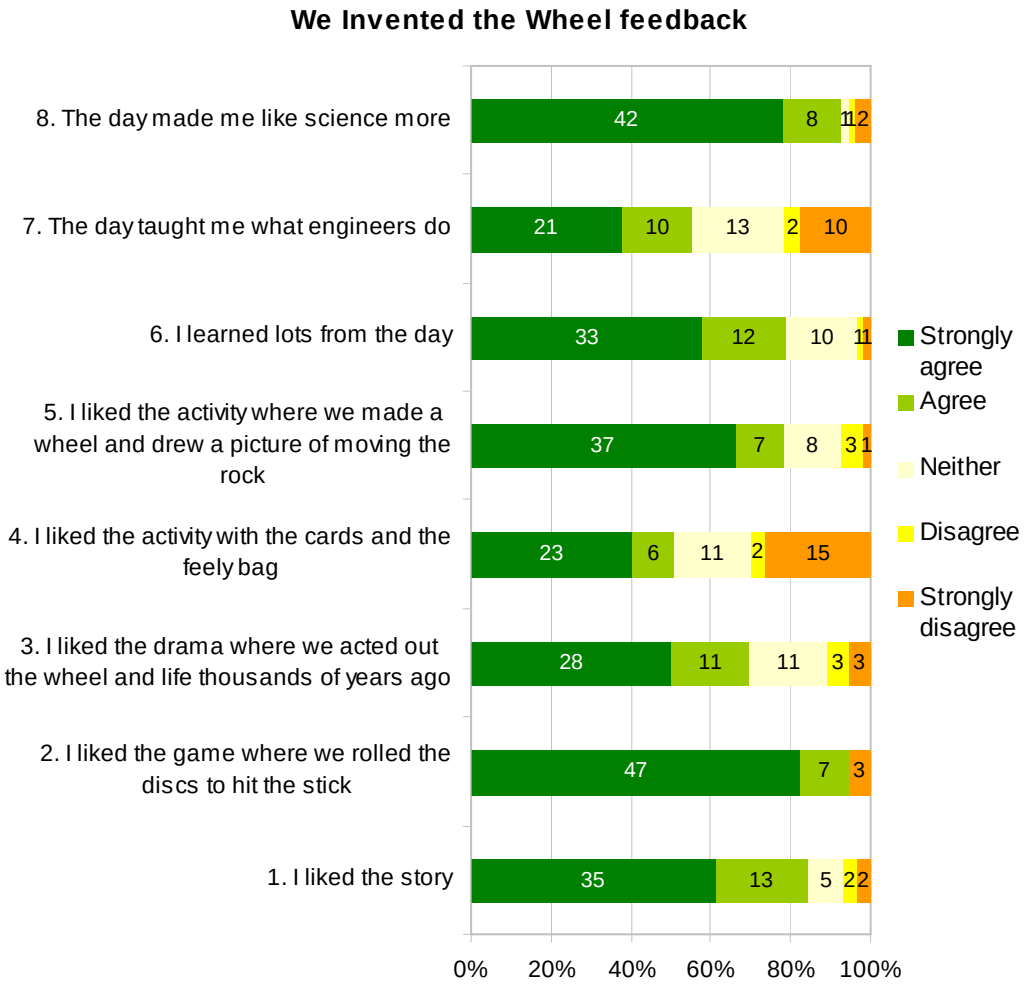
Teachers rated the activities very highly: 100% said their overall impression was ‘good’ or ‘very good’, and over 80% rated all other aspects as ‘good’ or ‘very good’.

The next sections look at each activity separately.

7 We Invented the Wheel

7.1 Students’ questionnaire feedback

The quantitative feedback from students is presented in the graph below:



Results here are positive overall, especially that over 90% felt that the day made them like science more. The story, game and wheel making were the most popular activities, while the drama and card sort activities were the least popular. Over half of the students felt that the day helped them understand what engineers do.

The students were asked to draw a picture and write some words about how they felt during the day. By far the most common response was to write 'happy' or draw a smiley face. Many students also described the day as 'exciting'. Some students drew children trying to move the rock. A few students said they felt a little scared at first, or wrote a mixture of positive and negative words, but overall the responses were very positive.

Typical comments (including spelling mistakes!) included:

I felt happy

It was fablous So lovley and exciting

I liked it but I didn't like the bit where you put the fury cote on.

I loved it was the most nise thing eng has done

I liked the bit where I pushed the rock and the bit where we put out the fire it was very good I liked the siyense and the trasport I liked the Iliked everyfink

Good fantastic cool a bit Bad fwn thrilling threataning fandabbydosea I was scared at first

It was good and fun and a big day for me I liced playing the games

7.2 Teacher feedback

Teachers were very positive about the event. Their responses to the quantitative part of the questionnaire are summed up in the table below:

We Invented The Wheel	Very good	Good	OK	Bad	Very bad
Overall impression	3	2	-	-	-
Interactive presentation	3	2	-	-	-
Challenge activities	3	2	-	-	-
Educational value	5	-	-	-	-
Enjoyment value	3	1	1	-	-
TOTAL	**17**	**7**	**1**	**0**	**0**

7.2.1 Impressions of the activities

All of the teachers rated their experiences of the activities highly:

Very interesting and informative, gave all the children a chance to interact.

Great resources, lovely activities.

They felt that the interactive nature of the presentation engaged students and that the hands-on challenges helped reinforce learning:

Children were engaged throughout [the presentation] *and all activities were fully inclusive of abilities.*

Very informative and child friendly.

Children enjoyed the challenge activities due to their kinaesthetic nature.

Great fun, children gained more knowledge through taking part [in challenge activities].

7.2.2 Learning and science content

All of the teachers surveyed agreed that the science was pitched at an appropriate level. One commented that they had covered the topics in class so the activities helped reinforce this. Another mentioned the combination of science and history as a success factor.

The pulling and pushing forces aspect was good although children enjoyed historical facts also.

Yes, we have covered these topics in school and the activities consolidated a lot of learning.

When asked what they felt the students had learned, teachers mentioned forces, the role of engineering in transport and historical facts:

Historical facts - construction of wheel engineering terms i.e. cars etc.

How the wheel was invented. Properties and uses of a variety of materials.

7.2.3 Other impacts

Teachers were asked whether they felt activities like STEPS made science more exciting for their students. They agreed that they did:

Yes. Better resources than we have in school.

Yes because the children were actively involved in their learning

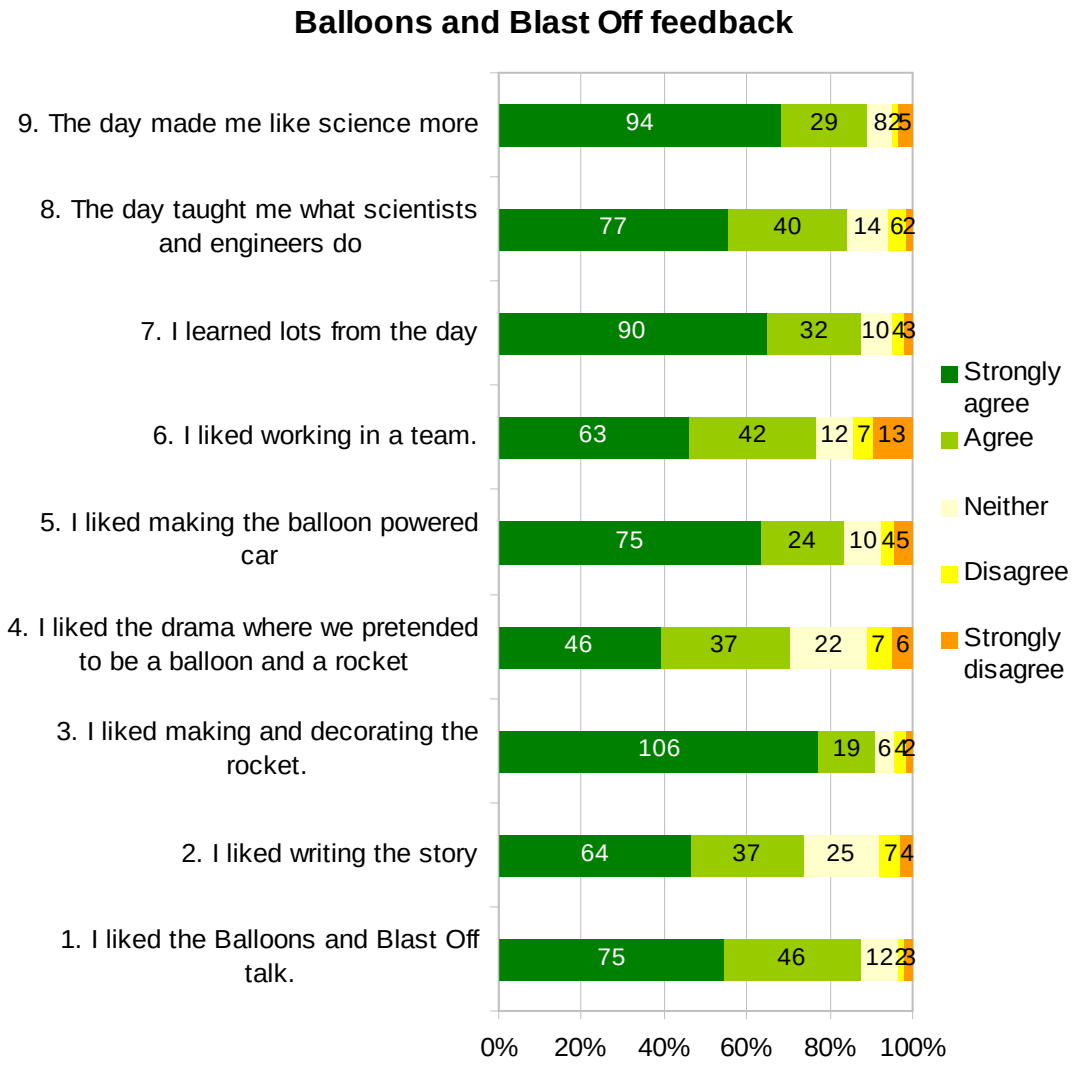
"Hands on" experiences are more memorable for children.

When asked how the activity could be improved, one teacher suggested further activities and another suggested smaller group sizes.

8 Balloons and Blast Off

8.1 Students' questionnaire feedback

The quantitative feedback from students is presented in the graph below:



These results show that students responded positively to the activities. Least popular (although over 70% still rated them 'good' or 'very good') were the drama and writing activities.

The responses to the question about teamwork are the most strongly polarised here: from observation and discussions during the focus groups, some students had issues with team members and found this aspect of the work particularly challenging.

8.1.1 Impressions of the activities

Students were asked to write down some words to describe what they thought about the show. The most popular words were 'fun', 'useful', 'nice', 'cool', 'clever' and 'exciting'. A few students included a mix of positive and negative words (such as 'boring') which indicated they enjoyed some parts more than others. Some students included 'too easy' in their feedback.

8.1.2 Learning

Students were asked to write down one thing they had learned from the day. Their responses are grouped into categories and are summarised in the table below:

Category	# responses
About balloons, incl. making kebabs	25
About rockets	22
About what scientists and engineers do, or what they are like	16
Not much or nothing or forgotten	13
That science is fun	9
About forces or gravity	7
About planets (including the rhyme)	6
How to float a ball using a hairdryer	4
General learning	3
Other	2

The most popular learning points related to balloons, rockets and scientists / engineers. Example quotes from each category are:

You can put something sharp in a balloon without popping it.

About Rockets how they blast off

Anyone can be a scientist

I learnt that scientists don't have to wear white jackets

That being a scientist or an engineer is FUN!!

Scientists are people who work hard

8.1.3 Attitude change

Students were asked whether the day had changed how they felt about science, and if so to explain how. The results are summarised in the table below:

Category	# responses
Yes	72
No	19
Student unsure	2
Not possible to tell from response	15

Most students felt the day had changed how they felt about science. Of those that gave an explanation, it appeared that all of the changes were positive. Of those that reported no change, only a few qualified this. Some said they already liked science, and some said they still found it boring. It was not possible to tell what students meant by some of the responses.

Comments included:

At first I hated science now I like it.

It made me like science by seeing how fun it is.

When we finished the show I felt more confidensed about since

I didn't like science to start with but Siân made me like it.

The show made me more happy about science.

Yes it made me feel more interested and made me feel like a scientist.

No, always loved science.

It hasn't changed my mind but I loved doing the science

I feel the same I don't like science.

8.2 Teacher feedback

Teachers were positive about the event. Their responses to the quantitative part of the questionnaire are summed up in the table below:

We Invented the Wheel	Very good	Good	OK	Bad	Very bad
Overall impression	5	2	-	-	-
Interactive presentation	2	5	-	-	-
Challenge activities	3	4	-	-	-
Educational value	5	2	-	-	-
Enjoyment value	3	4	-	-	-
TOTAL	**18**	**17**	**0**	**0**	**0**

8.2.1 Impressions of the activities

Overall, teachers rated the activities highly. They felt that the presentation was engaging with the right amount of science content:

Very lively - just enough theory so that the children retained their interest. Liked the surprising activities.

Good pace, the right level of info and ideas shown / explained with props.

Very good - lots of children were involved, the main basic principles of forces were covered and demonstrated clearly in practical situations.

Again, the hands-on element of the challenge activities was praised, although some teachers would have liked a greater level of science content:

It followed on from the presentation clearly and was accessible to all the children incl. special needs

The children really enjoyed this and found making the rockets and cars very interesting. By being hands on and making things, it kept their attention.

Balloon powered rockets were great fun. Really enjoyed this. Also making the paper rocket (30) - showed great group cooperation with most groups.

Fun. Good cross-curricular links but I would have liked more science based activities.

8.2.2 Learning and science content

Six of the seven teachers that responded to the survey felt the science was pitched at an appropriate level but one felt there could have been a little more scientific detail. Teachers identified learning points related to gravity and forces. Also mentioned was the effectiveness of the teamwork aspect and a potentially greater impact on girls:

About gravity + forces - something I'm not confident in!

They learnt about space, forces, gravity etc and because of the way they were involved they enjoyed the team work and learnt a lot more.

Perhaps more of how something works especially for girls who may not be bothered about how it works just that it does!

The comment from the teacher that is not confident in teaching forces is interesting and highlights the reason why this topic was chosen as the focus of the project.

8.2.3 Other impacts

When asked whether the activity made science more exciting for students, all respondents agreed that it did. They identified the hands-on aspect and involvement of external speakers as success factors. Some also indicated that STEPS took a different approach to teaching than one that would be used in the classroom:

Definitely - the children paid more attention, when they were able to re-enact things e.g. the popping balloon.

Yes - hands on / practical is always the best way to deliver.

They were all involved and saw and felt the forces in action.

Definitely - visiting scientists make learning more exciting. Resources used were not available in school - e.g. rockets.

In addition, teachers were asked if they felt the activities had any other impacts on students. Several points were raised, including stimulating an interest in science, improving home-school links (through showcase events) and transferable skills such as teamwork and communication:

Events like this help the children to understand science as it is taught in a very interesting way. It also helps to make them want to learn more about science.

It was good for group work.

Enhances home/school links. Public speaking improved, confidence building, working in teams, co-operation etc.

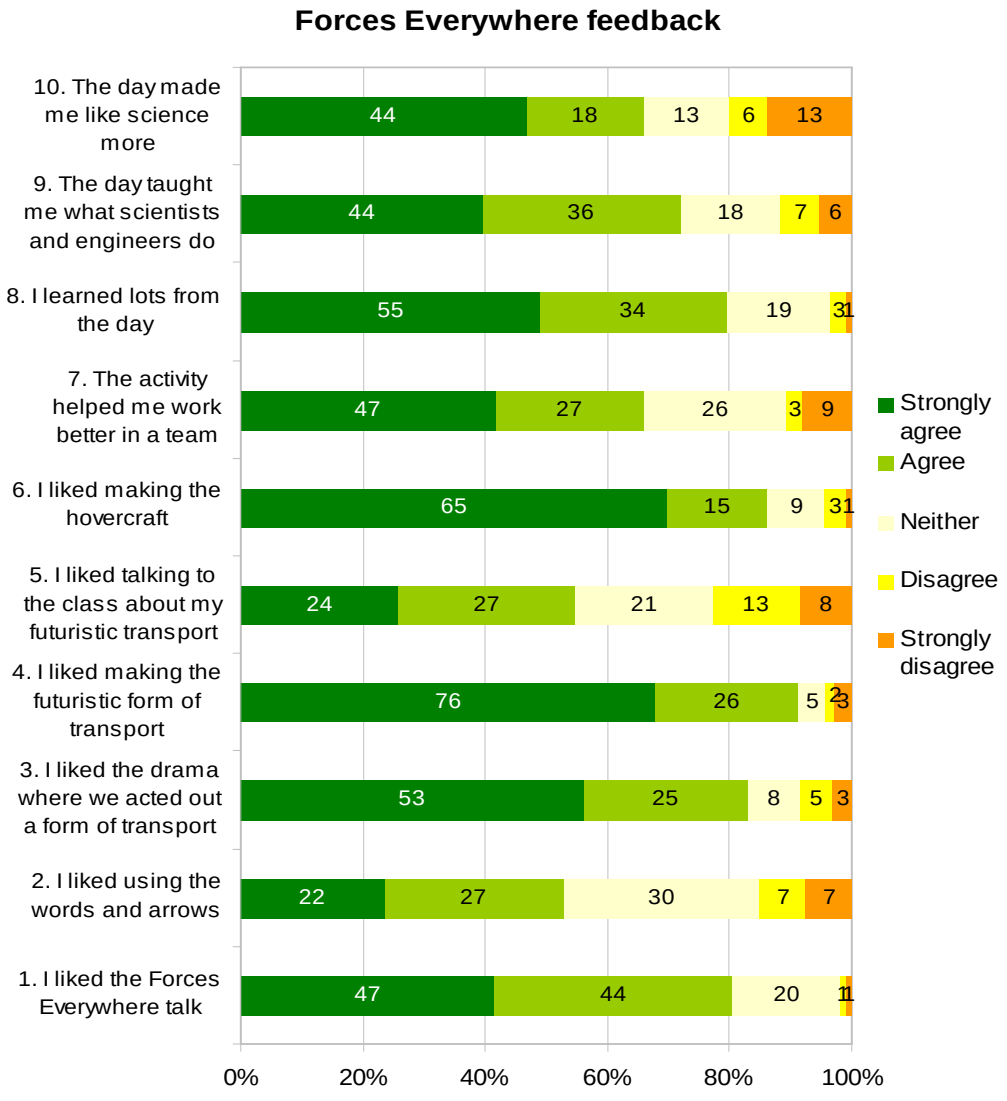
It makes them enjoy science - they didn't have to worry about writing things down - they could just have fun.

Finally, teachers were asked to suggest improvements to the activities. Including a greater level of science content was raised again and one teacher suggested providing more staff to facilitate the different groups.

9 Forces Everywhere

9.1 Students' questionnaire feedback

The quantitative feedback from students is presented in the graph below:



The most striking thing about this graph is the generally less positive ratings than for the activities targeted at younger students. This could reflect either the activity itself or the fact that older students are more discerning.

The most popular elements of the day were the talk, the drama, making the form of transport and making the hovercraft. Least popular were the words and arrows (printed on cards that the students held up to describe different forces throughout the talk) and presenting their form of transport to the class.

80% agreed that they learned lots from the day and two thirds said it made them like science more.

9.1.1 Impressions of the activities

When asked to describe what they thought of the activities, the responses were overwhelmingly positive. Students used words like 'fun', 'exciting', 'amazing', 'interesting' and 'helpful'. A few students felt that some aspects of the day were boring but these were in the minority.

9.1.2 Learning

As with Balloons and Blast Off, students were asked to write down one thing they had learned from the day. Their responses are grouped into categories and are summarised in the table below:

Category	# responses
About forces	29
About making the hovercraft	19
About rockets	9
About scientists and engineers	7
Nothing / can't remember	7
That science can be fun	5
Making things	2
Not sure	2
Other	5

The most popular learning points related to forces, hovercraft and rockets. Comments included:

> *I learned how to make a hovercraft so I could make one at home.*
>
> *There are a lot more forces than push and pull*
>
> *When something rubs on the floor is friction*
>
> *That engineers build models that are helpful in the future and that science not boring*
>
> *I learned that you can never be wrong in a scientists mind.*

9.1.3 Attitude change

Students were asked whether the day had changed how they felt about science, and if so to explain how. The results are summarised in the table below:

Category	# responses
Yes	55
No	23
Not possible to tell from response	15

Most students felt the day had changed how they felt about science. Of those that gave an explanation, it appeared that all of the changes were positive. Of those that reported no change, several said it was because they already had a strong dislike for science and some said it was because they already knew about forces. It was not possible to tell what students meant by some of the responses in the third category. Comments included:

It made it more exciting and fun

Yes because I learnt lots of scientific things and made much more fun than I thought

Yes because I really like learning about science now.

Yes because it used to be boring and dull but now I know how to do it properly.

Yes, because it made science more fun, with good equipment.

No because I already know about forces

No, I will always hate science!

I learnt a lot but I wouldn't be an engineer.

9.2 Teacher feedback

Teachers were positive about most aspects of the event. Their responses to the quantitative part of the questionnaire are summed up in the table below:

We Invented the Wheel	Very good	Good	OK	Bad	Very bad
Overall impression	3	4	-	-	-
Interactive presentation	2	2	3	-	-
Challenge activities	2	2	3	-	-
Educational value	2	4	1	-	-
Enjoyment value	2	4	1	-	-
TOTAL	**11**	**16**	**8**	**0**	**0**

The teachers' ratings for these activities were slightly lower than those for activities targeted at younger age groups, echoing the student feedback.

Reasons for this were explored in the open questions and are described below.

9.2.1 Impressions of the activities

Teachers had positive overall impressions of the STEPS activities:

> *Allowed the children's knowledge and understanding to develop from simple ideas to more complex subject knowledge.*
>
> *Brings a lot of fun into learning. Children benefit greatly from it. All children were involved.*
>
> *Very enjoyable - the children got a lot out of the session. It was nice to see them smiling about science.*

They also spoke highly of the interactive presentation:

> *Pupils tend to remember things better when it is hands on activity, so I think it was good.*
>
> *The children enjoyed this session. Listened well and benefitted from all the practical demonstrations.*

However feedback on the challenge activities was mixed. The group work and problem solving aspects were seen as successful, but it appears from the feedback that for this age group teachers would have liked to see some more scientific activities, possibly using equipment that would not usually be available to them in primary schools. Interestingly, the crossover with DT was seen in a negative light. Comments included:

> *The activity involved all the children including SEN children, it enabled them to discuss, predict, evaluate and reconstruct their models.*
>
> *Most of the challenge activities were good, especially the making of the hovercraft, not too sure about the vehicle of the future this seemed to be more of a DT topic than science.*
>
> *I was disappointed in these activities. Although the children enjoyed the activities, they were things I could have done myself. I was hoping for more scientific input and exploration (perhaps using materials / equipment not normally found in a primary school).*

9.2.2 Learning and science content

All of the teachers felt that the activities were appropriately pitched apart from one, who felt the presentation was at the right level but not the challenge activities.

The main learning points identified by teachers related to forces and how they apply in everyday life. One Year 6 teacher didn't feel the students gained any new knowledge from the activities.

9.2.3 Other impacts

All of the teachers felt that activities such as STEPS help make science more exciting for children. Most said that this was due to the practical nature of the sessions:

> *Yes the children all participated with a great deal of enthusiasm and were talking about it for the rest of the day.*
>
> *Yes as it keeps them interested and focussed especially when they could experiment.*
>
> *Yes. They enjoy interactive things and being creative and getting out of the classroom.*

Some teachers identified other impacts on students, including confidence, fostering an interest in science and transferable skills such as presenting and teamwork:

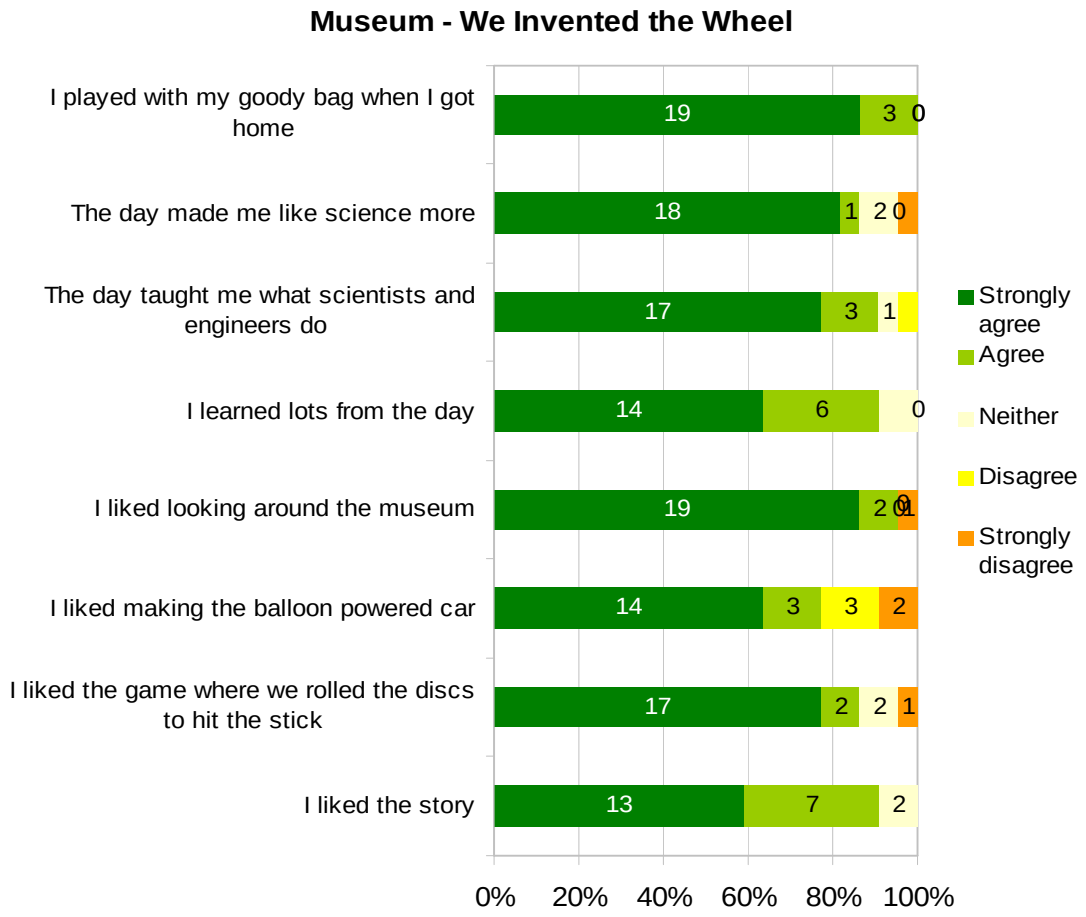
> *Provides children with confidence to understand that their ideas are valued.*
>
> *It may make them have a desire to find out more and do follow up experiments at home.*
>
> *Can help with children's social skills e.g. standing up and talking to a group and working as a team.*

10 Museum events

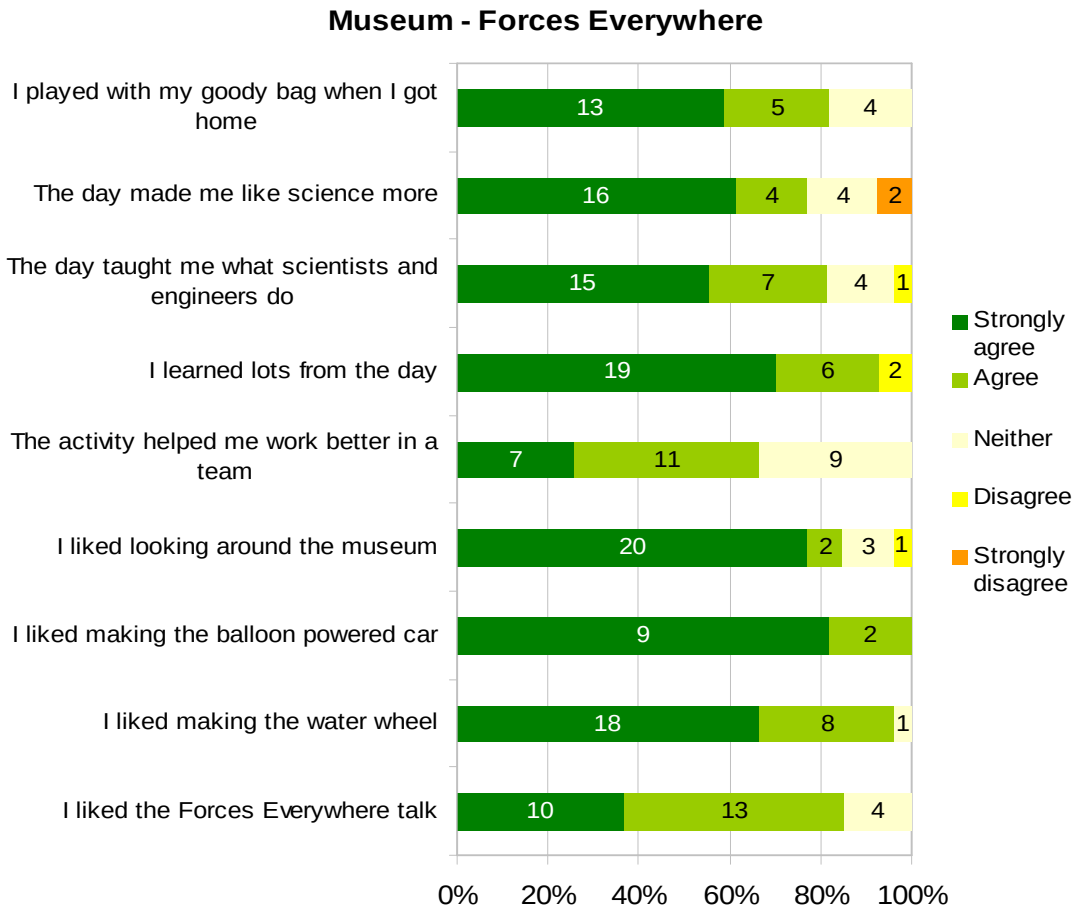
Events were held at the Llangollen Motor Museum over five days. Adapted versions of the We Invented the Wheel and Forces Everywhere activities were delivered, along with interactive presentations. The day-long events also included two sessions within the museum itself; the first was an unstructured session that allowed children to explore the museum. Later in the day, students completed a quiz trail around the museum.

10.1 Quantitative feedback

Twenty-two questionnaires were collected from students that took part in the We Invented the Wheel activities. Twenty-two students that participated in Forces Everywhere also completed questionnaires. The quantitative feedback is summarised in the graphs below:



The museum was clearly the most popular aspect of the day for Year 1 and 2 students. They also liked the story and the game. The card activity came out least popular, reflecting the results for the schools' evaluation.



It is interesting that more students 'strongly agreed' with the statements related to impact (learning, scientists and liking science more) after the museum events than after the events held in schools.

The results for Forces Everywhere delivered in the museum appear more positive than those for Forces Everywhere delivered in school, possibly because the age range was wider (Years 3-6) and some Balloons and Blast Off activities were incorporated.

10.2 Qualitative feedback

10.2.1 Goody bags

We Invented the Wheel students were asked to draw a picture of their favourite item in the goody bags. Results are summarised in the table below:

Item	# responses
Parachute	8
Aircraft	4
Car/s	3
Unidentifiable	6

In some schools, the goody bags were used by teachers as the basis for a series of forces-related activities in class, so not all of the students played with everything in their goody bags straight away.

10.2.2 Favourite activity in the museum

Older students were asked to draw a picture of their favourite thing in the museum. Their answers are summarised in the table below:

Item	# responses
Generic car	7
Bubble car	5
Old fashioned car	3
Rocket car	3
Motorbike	4
Other vehicle (e.g. caravan)	5
Rocking horse	1
People playing	1
Unidentifiable	1

It appears that the cars were favourites for most students, specifically the bubble car and rocket car.

10.2.3 Impressions of the activities

Students of all ages were asked to leave their impressions of the day's activities. Most of the Year 1 and 2 students commented that they 'liked' or 'loved' the day. Two described is at 'OK' and one said that he would definitely visit the museum again:

> *It rocked man I'm definaly coming again*

The older students gave more descriptive answers. They described the day as 'brilliant', 'interesting', 'fun', 'cool' and 'exciting'. Some also mentioned the favourite museum exhibits that they had drawn. Comments included:

> *Fun, exiting, cool, interesting, very good.*
>
> *It was cool and some bits were awsome*
>
> *I liked it when I went in the BuBBle car and I liked when I played with the prams. I liked it when we did the quiz.*
>
> *It was fun and good*

10.2.4 Learning

The older students were asked what they thought they had learned from the day. The largest number of responses (10) related to rocket science:

I learned about the water rocket and I think that was the best thing because it landed in the tree.

I lernt about a rocot gouse up and the air gouse down

That rocket science is not as hard as people say.

Five students said they learned how to build a hovercraft and four said they learned about aeroplanes or how to make an aeroplane:

I learned how to build a Hovercraft

How helicopters and aeroplanes fly.

I learned how to make aeroplanes go up in the air.

Some students also said they learned about gravity (3) or friction (1). Interestingly, three students said they learned about what engineers do:

How the engineers and scientists make things and invent things.

Two comments couldn't be categorised:

I learnd How it was like in the olden times

It made me know more about science and now I think its better

10.2.5 Changing attitudes towards science

The older students were asked whether the day had changed how they felt about science, and if so, in what way. Fifteen students said that the day had improved their feelings about science:

It made me like it more and it was more interesting

I like it even more than I use to because I lerned about tires and old cars like rocket car

It made me like it more, because Siân made it fun, she let us do things too - not just listen.

I liked science more because I now know that science can be fun. When you do fun experiments

Five other students gave positive responses, but it was not clear whether their perception of science had changed. Two students said their perception had changed but were unsure or did not describe how. Three students said the day hadn't changed how they felt: two said they already liked science and one said it was because the toilets needed cleaning!

No because I all Ready liked it. It didn't change my mind.

Sometimes because the old cars and motorbikes really helped me

I am not sure really but I did understand a bit more about science than I already knew!

11 Findings – showcases

11.1 Feedback from parents and families

Sixty questionnaires were collected from family members at three showcases. The questionnaires were very simple and asked what they thought of the showcase, whether they learned anything and what could be improved.

11.1.1 Impressions

Unsurprisingly given that the showcases starred their children, family members had very positive impressions of the events:

> *I thought the way it was presented really encouraged the lads to take part + they obviously enjoyed it*
>
> *Fantastic! What a lovely way of making science interesting and fun! The children all seemed to enjoy it and learnt a lot.*
>
> *Really interesting for the children, science wasn't like this when I was at school!! Superb progress*
>
> *Very good. Children seemed to enjoy the event + enjoyed taking part and showing what they had worked on.*
>
> *Excellent! Great to see children learning with smiles & laughter.*

11.1.2 Learning

Family members were asked whether they had learned anything from the day. Some described learning some science:

> *Yes, air goes down, rockets go up and that's Rocket science*
>
> *Yes, I learnt how the different forces are able to do things*

Many family members described learning about specific demonstrations, particularly the balloon kebab or the water rocket:

> *Balloons don't always go pop.*
>
> *Never "kebabsied" a balloon before*
>
> *Water / Air Mixture is more potent than air alone*

Some respondents said that it was useful as a reminder of the science their children were studying:

> *A little reminder of what I learnt 25 years ago!*
>
> *I am able to understand what the children are working on.*
>
> *It was a great reminder about forces and gravity so we can help the children understand more.*

11.1.3 Improvements

Finally, respondents were asked how the event could be improved. Many respondents felt unable to suggest improvements. Some (notable from the same school) felt that the show could have been shorter. Others felt that more prior notice or information would have helped a greater number of parents attend. Several respondents also suggested holding other events for other topics:

> *Let the parents know how long the event will be. We were under the impression it was for about 20mins. But it was worth it in the end.*
>
> *The event was well presented. No need for improvements. Thank you.*
>
> *Brilliant!! A little more notice before the event would have meant both Mum + Dad could have attended.*
>
> *Do it more often Wider range of topics.*

11.1.4 Teacher feedback

Few teachers commented on the showcase in their questionnaires. However the role of the showcase activity in improving home-school links was highlighted by one teacher.

11.2 Super Showcase

98% of the 112 students that participated in the Super Showcase rated it as 'good' or 'very good'. 80% said it was 'very good'. When asked why they thought this, students identified a number of factors:

- They liked the challenges
- They enjoyed the science magic show
- The day was fun
- They enjoyed working together in teams and making friends
- Because it was educational

However several students commented that they didn't like their lunch!

> *It was fun, we had never done it before.*
>
> *Because I loved the clay, water wheel an rockets*
>
> *The magic show was great and all the activiers were really fun*
>
> *Because there where lots of cool things to do and watch.*
>
> *Because it gives you a chance to meet new friends and lots of fun.*
>
> *I really liked today but it could have been better and we could have some more in our lunch.*
>
> *Because it was fun and it still taught us a lot about forces.*
>
> *I thought it was very good because I liked the fun activeties.*

Most of the students said that they felt fine or happy about their performances, although some said they were shy or nervous:

A little shy but excited

A bit nervous at the start but then it was ok.

I was a bit shy but it was very fun.

I wanted to do it again because it was so good!

Really scared

I was nervous at first but it was great.

Good because we did very good and we were confident.

I felt scared nervos and happy too.

One concern in organising the Super Showcase was how receptive the young people would be to watching others' presentations. The feedback from the questionnaires indicated that they found this very enjoyable. Some comments indicated that students found it interesting to see how others had responded to a task that they too had been set:

They were really good and I wanted to see what they did

I thought they were boss! Especially the last!

Fun watching what other pepol has in mind

Very good because the other prople watched our performantes.

Proud because they tried there best

I felt amazed by how good thay was.

I felt really excited.

I liked waching the other Peoples Performenses

However two students felt disappointed because they said their performance was poor by comparison.

Students were asked how they felt about visiting the University of Liverpool. A range of responses were received:

- Many students said they felt excited
- Some used the response space to describe the day, saying it was fun or interesting
- Several students revealed that they were slightly apprehensive prior to the visit
- Several commented that they would like to come to the University again

Comments included:

The visit was exciting boastable.

Very privlegsed

It was great fun

I want to come here!

I was good because now I know what university looks like.

I fort it wounld be boring but in the end it was'nt.

I had buterfliys in my tummy.

I felt excited and curious

In the final part of the questionnaire, students were asked how they felt about the whole project. A list of the different elements of the project was provided to act as a reminder. Despite this, some of the students only answered about the Super Showcase day. One school came on board just for this event, so the responses were understandable for them. However a number of students from the other schools also answered in this way. Therefore, where students have not specified whether their answer is about the Super Showcase or the whole project I have not included their responses in this section.

All of the students had good things to say about the project. Some of their comments are given below:

It was great I loved all of it.

The performences were okay the Rockets quite good the balloons and forces good Todays activities made it realy good

I liked it when they came in our school and did forses I liked watching a science workshop and all of the challenge.

It was extremly fun when dominick and Siân came to our school and made rockets with us.

12 Comparing activities

12.1 Analytical statistics

Data were analysed to compare differences in responses between boys and girls, between students that saw the different shows and between students that participated in activities in school and in the museum.

The Mann-Witney-U test was used because it is a nonparametric test that is appropriate for comparing means of ordinal data sets such as Likert scale responses. Exact significances for two- and one-tailed distributions are presented.

12.1.1 Gender

Statistically significant differences in boys' and girls' opinions were explored for each of the three schools shows. Results are summarised in the tables below.

We Invented the Wheel	Mean (m)	Mean (f)	Exact sig. (2-tailed)	Exact sig. (1-tailed)
1. I liked the story	1.79	1.58	.606	.303
2. I liked the game where we rolled the discs to hit the stick	1.05	1.47	.117	.061

3. I liked the drama where we acted out the wheel and life thousands of years ago	2.16	1.86	.646	.315
4. I liked the activity with the cards and the feely bag	2.05	2.95	.061	.030*
5. I liked the activity where we made a wheel and drew a picture of moving the rock	1.26	1.84	.083	.041*
6. I learned lots from the day	1.68	1.68	.872	.452
7. The day taught me what engineers do	1.84	2.78	.043*	.021*
8. The day made me like science more	1.68	1.23	.189	.081

NB smaller means denote a stronger tendency to agree with the statement
** denotes significance at the 95% confidence interval*
***denotes significance at the 99% confidence interval*

The sample contained 19 males and 38 females. The strongest trend in these data was that girls were more likely to agree that the day taught them what engineers do. Girls also appeared to be more likely to respond well to the activity with the cards and the feely bag, and to agree that they liked making the wheel and drawing the pictures.

Balloons and Blast Off	**Mean (m)**	**Mean (f)**	**Exact sig. (2-tailed)**	**Exact sig. (1-tailed)**
1. I liked the Balloons and Blast Off talk	1.60	1.68	.421	.212
2. I liked writing the story	2.10	1.71	.023*	.011*
3. I liked making and decorating the rocket	1.45	1.29	.446	.225
4. I liked the drama where we pretended to be a balloon and a rocket	2.12	2.02	.779	.780
5. I liked making the balloon powered car	1.44	1.87	.009**	.005**
6. I liked working in a team	2.26	1.76	.066	.033*
7. I learned lots from the day	1.69	1.41	.054	.027*
8. The day taught me what scientists and engineers do	1.73	1.62	.749	.375
9. The day made me like science more	1.67	1.36	.109	.055

NB smaller means denote a stronger tendency to agree with the statement
** denotes significance at the 95% confidence interval*
***denotes significance at the 99% confidence interval*

The sample contained 70 males and 69 females. Several significant differences emerged from this data set. Girls were more likely to enjoy writing the story and boys were more likely to enjoy making the balloon-powered car, both of which support gender stereotypes. Females were also more likely to agree that the day helped them work better in a team and that they had learned lots from the day.

Forces Everywhere	Mean (m)	Mean (f)	Exact sig. (2-tailed)	Exact sig. (1-tailed)
1. I liked the Forces Everywhere talk	1.88	1.73	.535	.269
2. I liked using the words and arrows	2.93	2.30	.321	.161
3. I liked the drama where we acted out a form of transport	2.02	1.44	.025*	.012*
4. I liked making the futuristic form of transport	1.64	1.32	.017*	.008**
5. I liked talking to the class about my futuristic transport	2.73	2.51	.125	.063
6. I liked making the hovercraft	1.54	1.44	.770	.386
7. The activity helped me work better in a team	2.30	1.91	.160	.080
8. I learned lots from the day	1.84	1.67	.346	.174
9. The day taught me what scientists and engineers do	2.04	2.07	.860	.430
10. The day made me like science more	2.22	2.20	.908	.454

NB smaller means denote a stronger tendency to agree with the statement
** denotes significance at the 95% confidence interval*
***denotes significance at the 99% confidence interval*

The sample contained 57 males and 56 females. Girls responded more positively (on average) to all of the statements apart from 'The day taught me what scientists and engineers do'. The differences were significant for enjoyment of the drama activity and the transport-making activity.

12.1.2 Difference between schools' activities

The two schools activities with the largest sample sizes, Balloons and Blast Off and Forces Everywhere, were compared. Results are presented in the table below.

BBO / FE comparison	Mean (BBO)	Mean (FE)	Exact sig. (2-tailed)	Exact sig. (1-tailed)
I liked the talk	1.64	1.81	.038*	.019*
The activity helped me work better in a team	2.01	2.11	.350	.175
I learned lots from the day	1.55	1.76	.014*	.007**
The day taught me what scientists and engineers do	1.68	2.05	.005**	.003**
The day made me like science more	1.51	2.21	.000**	.000**

NB smaller means denote a stronger tendency to agree with the statement
** denotes significance at the 95% confidence interval*
***denotes significance at the 99% confidence interval*

There were significant differences between the impacts reported for Balloons and Blast Off and Forces Everywhere. Younger students that saw Balloons and Blast Off were more likely to agree with all of the statements except the one about teamwork. This could indicate that Balloons and Blast Off was a stronger set of activities, or it could be that older students are less amenable to change.

12.1.3 Difference between school and museum activities

The responses for activities delivered in school and in the museum were compared.

School / Museum comparison	Mean (sch)	Mean (mus)	Exact sig. (2-tailed)	Exact sig. (1-tailed)
I liked the talk / story	1.70	1.65	.870	.433
The activity helped me work better in a team	2.06	2.07	.294	.147
I learned lots from the day	1.65	1.45	.149	.073
The day taught me what scientists and engineers do	1.96	1.72	.011*	.005**
The day made me like science more	1.72	1.60	.384	.193

NB smaller means denote a stronger tendency to agree with the statement
** denotes significance at the 95% confidence interval*
***denotes significance at the 99% confidence interval*

For all the items apart from the one about teamwork, students that participated in museum activities were more likely to agree or strongly agree (on average). However the difference was only significant for the statement about the role of scientists and engineers.

12.2 Focus group findings

A wealth of information was collected during the seven focus groups. It is organised here under three broad themes: students' experiences of the activities, their thoughts about learning and their attitudes towards science and engineering.

12.2.1 Experiences

Students of all ages responded positively when asked about their experiences of the activities. They described the activities as **fun and exciting**. The following excerpt is from a discussion with Year 4 and 5 students that had taken part in 'Forces Everywhere' in their school:

> *Boy1: Because I just liked them, that was the best thing I've ever done and I'd like to do it again.*
>
> *Facilitator: Ok, why did you like it?*

Boy1: Because the science was excellent, how they explained it and done it in a fun activity.

Facilitator: Ok, cool, so what about you then Girl1? Was there a bit that you didn't like?

Girl1: No, because you just didn't know that science would be that fun.

Facilitator: Ok, do you not normally like science that much?

Girl1: No, but when she came in it was fun.

Boy: When you get to use stuff it's fun isn't it.

Group: Yeses.

Boy: And take part in stuff.

Girl: What you didn't expect. You thought it was going to be a science lesson, bored out of your head, but then you seen [all talking over her] *and then she asked who wanted to do it and like everyone shot their hands up.*

The **interactive** or 'playing' element that the students mention above was a strong success factor for those that participated in activities at the Motor Museum.

Facilitator: All right, what about the museum then, when you went into the museum?

Girl: That was good because you could see all the old cars and there were things you could touch and do as well.

Girl: Yeah.

Girl: Instead of just walking around just looking.

Girl: There were activities you could do there too.

Facilitator: Ok, what kind of things did you do?

Girl: Umm… you could like put pieces of paper over one of the badges and then colour them in.

Girl: There was a tyre you could blow up.

Girl: Yeah, you could blow up a tyre.

Girl: And you could have a go on the horn.

Girl: You could try on the hats.

Girl: Yeah you could try on some hats and things.

The students liked the fact that they were able to **explore** the museum by themselves as well as completing the quiz. Some asked for a longer time at the museum so they could find out more about the exhibits:

Y4 Girl: I just like how we got to explore everything.

Facilitator: Yeah, why was that? What did you like about that bit do you think?

Y4 Girl: We got to try everything out where if we were doing activities we wouldn't definitely get to try everything out.

Y4 Boy: I was thinking maybe we might be able to have maybe a bit longer than this because, you know, we had these like little treasure hunt map things and really I was hoping we might be able to do it, like, because you know some of the boards actually note the history of it and it was find out the history of the chung chung chungster mobile thing, or whatever, so maybe like that.

Y4: I also liked the bridges that were already built.

Facilitator: Ok, Y4 Boy, tell me a bit about what you thought of the bit in the museum. Was it good to just go in and do what you wanted or did you think that you didn't really know what to do or look at?

Y4 Boy: Umm… It would have been better if we could have learnt more about stuff in there.

Four of the focus groups were with students that had been to the museum as we were especially interested in exploring the impact. It was striking from those discussions how **memorable** the museum exhibits were compared to the other activities on the day:

Y4 Boy: I think really like we're remembering all this because um, most people usually remember great experiences so and I think this would be one of them so I think that's why most of us remember stuff like the Austin Chummy.

Students also enjoyed the **historical** aspects of the museum:

Y3 Girl: I liked it because they actually had the old cars from the olden days so it was quite interesting

When prompted, the students said that they would have much preferred to take part in the activities at the **museum** than do them in school:

Facilitator: What do you think it would be like if it was in school without the museum?

Y3 Boy: It wouldn't be as good because it's real life that you get to see old things and everything. And you don't see them usually, it's quite nice.

One of the focus groups was with students that had participated in a showcase event. The students enjoyed **sharing their work with parents and families**, and described their responses:

Y3 Boy: Me Dad started laughing when we sang the song and when I got out to the front, when I was sitting down me Mum was looking forwards and me Dad kept pointing at me and then she found me and when we got out at the front doing the hot air balloon she was really excited because she never saw any of it before.

Y3: My Mum and Dad wasn't there, but my Nan and Grandad were there with [sibling]*, when we were watching it me Nan kept laughing at all the things that we were doing and she thought that Siâny was doing it was very… science because she explained it really well and coz me Nan wasn't very good at science coz um Siân explained it very well, me Nan understood it.*

However some felt disappointed if their parents were unable to attend:

> *Y3 Girl: I thought it was quite disappointing coz my Mum or Dad couldn't make it coz they were in work and they promised me that they would come to the parents' evening this year but they never.*

12.2.2 Learning

The extent to which students had grasped the key scientific concepts related to the activities was explored during the focus groups. Most of the focus groups involved students in Years 3 and 4, and their levels of understanding of the science varied widely.

Many of the students talked about **rocket science** during the focus groups. Newton's third law, that every action has an equal and opposite reaction, is not usually taught until GCSE. It was clear from the discussions that most of the students hadn't fully grasped the principle, which is actually rather counterintuitive:

> *Y3: And we done a bit about rocket science because it's a bit like a rocket coz a rocket pushes fuel out and the fuel pushes it up into the air and it goes up so much that there's no gravity so it goes up into the air.*
>
> *Y5 Boy: Um, like the gravity pushes, like, um, when it takes off like, or, like water comes out from it, no, air resistance pushes it up, that's how it makes it goes up and gravity is like pushing it down so, like…*

However some groups were able to work out an explanation between them:

> *Y4 Girl: Well, like, rockets go up, like the air pushes them and then all the air comes out at the bottom with gravity pushing it, gravity pushes it down.*
>
> *Facilitator: Ok, so how does it ..? Y4Boy1, are you understanding this explanation or do you think they need to be a bit clearer for you?*
>
> *Y4 Boy1: Yes.*
>
> *Facilitator: Go on then Boy2*
>
> *Y4 Boy2: Coz, like when the water went up, the air and the gravity was like fighting and it was like the gravity won, it pushed it right back down.*
>
> *Facilitator: Ok, so, yeah, fighting against gravity. Y4 Boy3, do you want to have a go at explaining how it worked to Y4 Boy1?*
>
> *Y4 Boy3: When the water goes down, air goes up and then it's a rocket.*

Of all of the students from Years 3 to 6, a Year 3 boy gave the best explanation:

Y3 Boy: Coz all the water went down and the rocket goes up, then it comes down because gravity takes it down with it.

With prompting, the students were able to describe how **gravity** acted on the rocket:

Girl1: The water goes down and when it's used all the water it starts going down.

Facilitator: Why is that?

Girl1: I don't know.

Facilitator: Can anyone help Girl1 about why the rocket comes back down? Boy1?

Y4 Boy: The water goes down and that's rocket science.

Facilitator: Why does it come back down when the water comes out?

Y4: I do remember, but I've forgotten.

Facilitator: Does anyone know what it's called?

Y4: When it comes down…

Y4: Gravity!

Students also described some more general learning points about gravity:

Y3: Coz I never knew that gravity was holding us down, and it learns you lots of stuff.

At the museum, students also harnessed the force of gravity to make their **water wheels** turn. With prompting, the students made this link:

Facilitator: Ok, so with the water wheel, who wants to tell me how the water wheel works? What was making the water wheel spin round?

Y4 Girl: The water was pushing it down.

Facilitator: And what was making the water fall down?

Y4: Is it gravity?

Students were also able to describe the concepts of **friction** and **air resistance** by relating them to various demonstrations. Some students described using rollers to reduce friction:

Y4: Well, really, obviously umm, friction stopped the ball and I don't blame Siân for stopping because I wouldn't exactly want to start pushing against the ball.

Y4 Girl: But with [classmate], *she got her in the bucket and used, like rolling pins and …*

Y4: Rolling pins?

Y4 Girl: Yeah and it looked a bit like a little train but it was the Egyptians that used to use it.

[children digress and talk about a book]

Facilitator: Ok. So why do you think that the Egyptians or Siân, whoever put the rollers down, what was it about the rollers?

Y4 Girl: It was easier to push them on the wheels.

Facilitator: And why was that?

Y4 Girl: I don't know.

Y4: It was easier to roll them.

Facilitator: Yeah and why is that?

Y4 Boy: Umm, there's not as much friction on the ground as there would be if you're pushing a giant like sand brick, I mean, you wouldn't exactly be able to push that up a pyramid, would you.

Y4: And up the stairs.

Facilitator: So why is there less friction? With the rollers, why is that?

Y4: Because there's less surface.

The students mentioned air resistance when talking about the Bernoulli experiment with the hairdryer and ping pong ball. Another interesting example was a student that spoke about the **parachute**:

Y5 Boy: Um, we learnt about parachutes as well, because if you have a smaller parachute, then you'll die if you fall like off a building. If you have a big one, there's more like air resistance, innit, so like when you're jumping off a building or something and you've got a parachute, like on San Andreas, on the game, there's that big building, like, it's slower like when you hit the ground.

This is a particularly interesting comment because the student has clearly taken the learning about air resistance and applied it in a new context – jumping off a large building like the one in his computer game. He has also linked the size of the parachute to the amount of air resistance and the speed at which you would hit the ground.

Another demonstration involving air resistance was the 'throwing competition' where a flat sheet and scrunched up ball were thrown together to see which travelled the furthest. One student described **trying this out at home** with his grandmother:

Y5 Boy: I wanted to do an experiment but Siân did with, um the girls and the boys, with me Nan, and ...

Facilitator: What happened?

Y5 Boy: Um, the ball went further, coz, um, the paper went further.

Facilitator: Cool, what did your Nan think of that?

Y5 Boy: And me Nan thought how the paper goes further than the ball coz there's less air resistance in the ball than paper.

Y4/5: Don't you mean the other way round?

Y5 Boy: The ball goes farther than the paper coz there's more air resistance in the paper than the ball.

Sharing the demonstration with a family member indicates that the student was confident in his new knowledge. The notion of **confidence** was raised by the students in the focus group that had participated in a showcase.

> *Y3 Boy1: It made me more confident of what I knew.*
>
> *Facilitator: Ok, tell us a bit about why that is.*
>
> *Y3 Boy1: Well, when we did the balloon thing with our hands and* [classmate] *and* [classmate] *had to go like that and we had to go (he blows) without stopping, it was quite hard though.*
>
> *Facilitator: Yeah? So, Y3 Boy1said it helped him feel a bit more confident. Does anyone else agree with that? Or disagree?*
>
> *Y3 Girl1: I agree.*
>
> *Facilitator: Go on Y3 Girl1, tell us what you think.*
>
> *Y3 Girl1: I think coz what we all done was, or our half done was we all put this big ?? and we all had to go pop and we all started running as fast as we could.*
>
> *Facilitator: Ok, so why did that make you feel a bit happy about the science.*
>
> *Y3 Girl1: Coz I got more confident, coz before I didn't have much confidence.*
>
> *Facilitator: And who else picked up on that point? Y3 Boy2?*
>
> *Y3 Boy2: I think the same as Y3 Boy1and Y3 Girl1because when, when we did it in here you feel more confident because it's a bit like, explained it a bit more, we got more confident, in year groups.*
>
> *Facilitator: Ok, go on Y3 Girl2.*
>
> *Y3 Girl2: When we were in year 1 I didn't understand that well because I didn't understand the words that she was saying but now, when I'm in year 3, I understand all the words because we've been working on science and the big words.*

These students also gave a good explanation of the science behind the **balloon kebab** that they had explained to the showcase audience.

> *Y3 Boy2: Coz, when you blow a balloon up there's like a dark bit at the top, well you just have to like squeeze it and you get like a kebab stick and you put it through the bit and where the knot ties at the bottom, you had to put it through there.*
>
> *Facilitator: So, Y3 Boy3, why is it that the balloon doesn't pop? Do you know?*
>
> *Y3 Boy3: Coz the top of the balloon is not that like stretched and the bottom of the balloon is not stretched so it just goes through.*
>
> *…*
>
> *Y3 Girl3: Because, um, because where the part wasn't stretched it wouldn't just like pop but on the stretched part it would because it's more stretched so when she put it in the part where it wasn't stretched it wouldn't just pop it would just go in slowly.*

The students described how learning science in a fun way helps them remember the facts:

> *Y5 Girl: I think I learnt more because, I'm not saying Miss is boring and that coz Miss is really, really fun, but that was even funner, so it's kind of stuck in my brain more. So fun things stick in your brain, boring things normally don't.*

As well as learning about science, the hope was that students would have the opportunity to develop **team working and problem solving skills**. One of the groups in particular picked up on this, talking about the futuristic transport activity. One team had argued:

> *Y4/5: No, ours caused arguments coz* [classmate], *he's on our table, he was like, I'm not happy with that design but he came up with it afterwards didn't he.*

However most of the teams worked well together and described taking a group approach to the task they had been set:

> *Y5 Girl1: I enjoyed it because it like gave us a chance to use our minds again, because, I was in* [lists classmates] *group, so then it was like we were all having ideas and [*classmate] *couldn't write them down fast enough. So then we all pitched in,* [classmate] *thought of the price, I thought of the … and* [classmates] *writing it down as fast as you could and* [classmate] *was like making up the song…*

The students went on to describe how they enjoyed the workshop activities because they allowed them to '**use their minds'**:

> *Y5 Girl1: …science is always using your mind but we didn't use our minds like half of the time in the first part but we used it loads in the second part, because we had to think what we had to get, we had to think of the design, we had to think of the … We had to draw it, we had no backup plan, no stuff like that, we just had to use our minds to do it.*
>
> *Facilitator: Do you prefer to do that than to listen to the talk then, do you think? Would you say that bit was more….?*
>
> *Y5 Girl1: Yeah, I'd say that bit was more educational.*
>
> *Facilitator: Ok, Why do you think that is?*
>
> *Y5 Girl1: Coz it's letting us use our minds.*
>
> *Facilitator: Cool. Right, Y5 Boy, what do you have to say about this?*
>
> *Y5 Boy: I think it's like letting us use our minds but not in a boring way but the most fun way they can do it.*

It appears that the activities helped students learn about various science concepts, but that they were also valuable in developing teamwork, communication and problem-solving skills, especially among the older students.

The students that participated in the showcase described how useful it is for their **parents to see what they are learning**, so they can offer support if necessary:

> *Facilitator: Why do you want them to come and see your work?*
>
> *Y3: Because it's really good and it's important for them and it's really good because they get to see what you've done and whether it's good or not.*
>
> *Y3: It's better if your parents do come because they can see if you're struggling on something and they can like do it with you at home or something.*

12.2.3 Attitudes

Students were asked about their opinions of science in school. Unsurprisingly, opinions were mixed:

> *Y5 Boy: I love science*
>
> *…*
>
> *Facilitator: So how about you Y3 Girl? Did you like science before?*
>
> *Y3 Girl: No, I thought it was boring, boring, boring, boring, boring, boring, boring, boring, boring, boring.*

Interestingly, some students said that their interest in science had increased as they had got older and been allowed to carry out **investigations in class**:

> *Y3 Boy: I wasn't very confident with science but that was back, that was when… We did loads of like investigations, like paperwork investigations and that's when I started liking science. It got more different as the year's gone by and it made it better.*

Many of the students in the focus groups echoed the questionnaire findings, saying they thought science was **more fun** after taking part in STEPS:

> *Y4 Boy: Because in school sometimes it's not like that interesting. When we done it like the rockets and that it was interesting and all that and it went on for longer and that.*
>
> *…*
>
> *Y4 Girl: Yeah, science changed because I didn't really like it at first then when I saw how fun it could be with all the stuff I changed my mind.*

A few students already liked science, so didn't feel their attitude had changed:

> *Y5 Girl: I think science was, I like science anyway so it stayed the same.*

In terms of lasting impact, there was some disagreement among students. Some felt that **science would go back to being boring**…

> *Y4 Girl: Oh, yeah, I don't normally like science because it's not fun but then when Siân came in I changed my mind because I thought it*

was fun. But then when you normally do science now it's going to be boring again.

Y3 Girl: And then when Siân came, when she was talking more about science and letting us do the experiments I found out that science was more fun and it wasn't just writing things down, it was acting out and doing fun stuff with her. And now, when we go back to doing normal science I think it would be boring again.

However a few thought it might be a **lasting change**:

Y4 Boy: I feel that science is good, well, quite good but doing that it's more exciting and I reckon science is better now coz I never knew like that it was that exciting and that.

Facilitator: Ok, so do you think that that will, when you go back to normal science lessons you'll stay excited about science or do you think it was just exciting when Siân came in and then you'll go back to normal or do you think you'll stay excited?

Y4 Boy: I might stay excited.

Facilitator: Ok, we'll have to wait and see won't we. Don't know yet do we! Y4 Girl, what do you want to say?

Y4 Girl: I agree with Y4 Boy coz he said it used to be quite good and as he said when Siân came in it got more exciting and I felt the same way and when he like said it and when Siân went and we did science in class coz you've still got more exciting things in mind.

…

Y3 Girl: I think it changed because before I thought [science] *was boring but now I think it's fantastic, so it's changed. It's got to be at the top with what my favourite stuff is.*

Facilitator: Ok, so do you think that will stay changed? Or do you think it'll go back to being boring?

Y3 Girl: I think it will, coz I like science now and I think it's much more better now I know more stuff about science.

As well as describing the STEPS activities as more fun than lessons, students talked about how they helped them **understand the science** better:

Facilitator: Ok, has anyone else got a thought about that? Comparing doing those activities with learning in lessons. Is it better or worse or is it similar?

Y4 Girl: It was better.

Facilitator: Why was that?

Y4 Girl: Because it was exciting and we didn't know all that stuff but now we do, what we've learnt from it.

Facilitator: Yeah? Go on.

Y4 Girl: It was better because we got to do all different ones, all different things.

Facilitator: Right.

Y4 Girl: I agree with Y4 Girl because teachers don't learn us what she learnt us and it was better and that, so I agree with Y4 Girl.

Facilitator: Y4 Boy?

Y4 Boy: When we went into the hall we just saw a whole load of stuff on the table. It looked exciting coz you thought "this is going to be good" with all the stuff on the table.

13 Conclusions and recommendations

This section will begin by revisiting the project objectives, then some more general conclusions will be drawn. Recommendations for the future of the project are also made, informed by discussions with the project team.

13.1 Project objectives

The project had the following broad aims:

- To help young people appreciate how science gives us an understanding of the world around us;
- To promote engineering as a creative and imaginative process in which scientific understanding is used to solve problems.

Objective 1: To entertain, inform and enthuse primary school students about Science and Engineering in the context of Forces and Transport.

I feel that the project effectively met this objective. Teachers rated the activities as both enjoyable and educational. Students were able to explain what they had learned during the focus groups and the questionnaire data point strongly to positive impacts on their interest in science.

Objective 2: To provide coverage and enrichment of the appropriate parts of KS1 and KS2 of the National Curriculum

Teachers commented that the project was useful because 'forces' can be a difficult topic to teach. Interestingly, the focus group discussions revealed that some concepts were more easily understood by students than others. However the aim of the project was to enrich rather than replace the curriculum and the activities appear to have been a useful introduction to the topic.

Objective 3: To raise awareness of what it is like to be a scientist or an engineer.

Many students said they had learned about scientists and engineers in their questionnaire feedback, so awareness was certainly raised here. However, this was easier for the older students to grasp as their challenge activities were more closely related to problem solving. I think that the Key Stage 1

students learned something about what scientists and engineers do, but perhaps they didn't get such a sense of what it is like to work on science or engineering problems. So this objective may be better suited to slightly older children.

Objective 4: To develop students' communication, imagination, creativity and other transferable skills.

Students in the focus groups described a range of transferable skills they had developed during the activities. As well as creativity, they talked about teamwork and feeling more confident about science. The visit to the motor museum was a good opportunity for students to use their imaginations. They described how they could imagine what life was like in the 'olden days' and enjoyed interacting with the exhibits. The showcase events were particularly effective in developing students' communication skills and although some were nervous, they enjoyed performing and watching others' performances.

Objective 5: To engage participating children's carers with Science and Engineering and to highlight the possibility of their children pursuing careers in these areas.

Parents and carers enjoyed the showcase events and felt they were particularly useful to understand what their children were learning in science, which would allow them to offer additional support. Students also mentioned this as a benefit from the showcases. Another conclusion from the project team was that schools required more support than anticipated to put on a showcase and that flexibility in offering different formats for the showcase made this element of the project more accessible to different schools and year groups.

Objective 6: To encourage students and their teachers to explore new ways of presenting scientific material.

Some teachers at the upper end of Key Stage 2 wanted more science content in the workshops, specifically the inclusion of apparatus not available at primary schools. This is an interesting issue because the project objective was to use materials that would be easily accessible to teachers in order that they could incorporate the demonstrations or activities into their lessons should they wish. Communicating this objective with schools as clearly as possible will help manage teachers' expectations of the project. Interestingly, during the focus groups several students described trying out some of the demonstrations with members of their families. A teacher handbook following on from the project has been published which will further address this objective.

13.2 General conclusions

Overall, feedback on the project from students and teachers was very positive.

Piloting the events and gathering feedback at an early stage helped ensure the activities that were rolled out to larger numbers of students were well received. Identifying partner schools that were willing to come on board from the start and offer feedback at this stage was valuable.

The students appeared to have positive **experiences** with the project activities. Including activities that intentionally used a range of learning styles encouraged engagement with the project. Holding activities within a museum environment appeared to enhance students' experiences. The fact that they could play inside the museum and interact with the vehicles and other exhibits was a strong success factor. Probably the most mixed experience that students reported related to teamwork. At Key Stage 2 their team working skills were not always well developed and disagreements during group work meant the activities were less enjoyable for some students.

In terms of **learning**, students appeared to gain a great deal from the activities. The main learning points could be summarised as '*about forces'*, '*about science demonstrations'* and '*about scientists and engineers'*. These tie in with the project objectives and indicate that the messages were effectively communicated to students. During museum activities, students also said they learned about history. In fact the museum activities were so memorable that they appeared to have taken some of the focus away from science and engineering in favour of the historical aspects.

Students reported gaining a range of **skills** from participating in STEPS. As mentioned earlier, these included communication skills (especially for the showcases), teamworking skills in the Balloons and Blast Off and Forces Everywhere activities and creativity and problem solving in all activities but especially those at Key Stage 2.

It appears that the project had a strong positive impact on students' **attitudes** towards science and engineering. Most agreed that they liked science more after the activities. However it was interesting to note that a significant minority were already so disillusioned with science they felt nothing could change their opinion, especially in Years 5 and 6. During the focus groups, some students said they were enjoying science more as they moved higher up primary school because they were able to do more interesting experiments. Of those who said STEPS had made science seem more exciting, some felt it would be boring again in normal lessons while others felt it would make normal lessons more exciting too.

Another clear success factor with the project was the **presenter**. It is clear from the quotes in this report how many of the students remembered Siân by name and they all had good things to say about her. A competent and charismatic presenter is essential to the success of a project such as this.

13.3 Recommendations

Unfortunately given the last conclusion above, Siân will no longer be at the University of Liverpool after the end of the project. The future of the project was discussed with the project team and the following recommendations are made:

1. The project was very successful and there is much goodwill among teachers who would like to see it continue. Therefore **means to extend the impact of the project should be sought**. Unfortunately there is no further funding for a post such as Siân's and the Science Communication Unit itself is becoming less active as a research group. So alternative methods for sustaining the project's work were discussed.

2. Consider **continuing with other presenters**. Several other presenters have been trained to deliver the activities as part of the provision for science festivals, so it is possible that activities could continue to be offered to schools, with costs being covered by the schools.

3. One possibility is to **alter the format of the activities**, so a show is delivered to students, then teachers are trained in delivering the challenge workshops during lessons. This would allow the project to reach more students without requiring a full-time officer.

4. The activities and booklet could be used as the basis of a **teacher training activity**, perhaps in partnership with the Science Learning Centres or the Specialist Schools Trust. In this way, a session working with teachers would cascade the activities into their schools.

5. Further **dissemination within the interactive science community** through events such as the British Interactive Group conference and publishing the materials on the project website could allow other public engagement practitioners to incorporate the activities into their work.

6. **Making the materials publicly available free of charge** and publicising this as widely as possible will encourage their use by others.

Appendices

- Appendix 1: example student and teacher questionnaires
- Appendix 2: quantitative results
- Appendix 3: qualitative category analysis

What do you think about Balloons and Blast Off?

We would like to know what you think about the Balloons and Blast Off! day that you took part in. Please tell us what you think by answering these questions.

Please write your name……

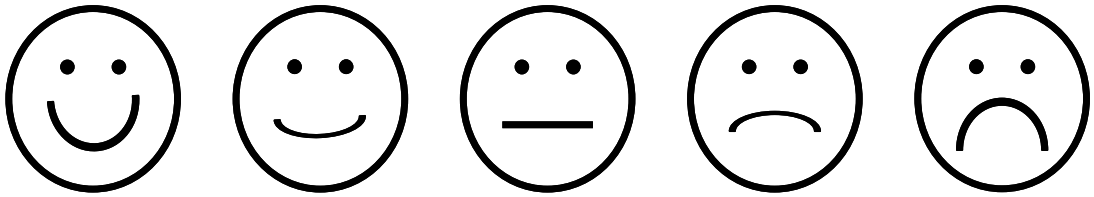
Circle one: are you… male female

Please write your year group ……..

Please write your age …….. years

For the questions, colour in the smiley that shows what you think.

Practice: I like eating ice cream

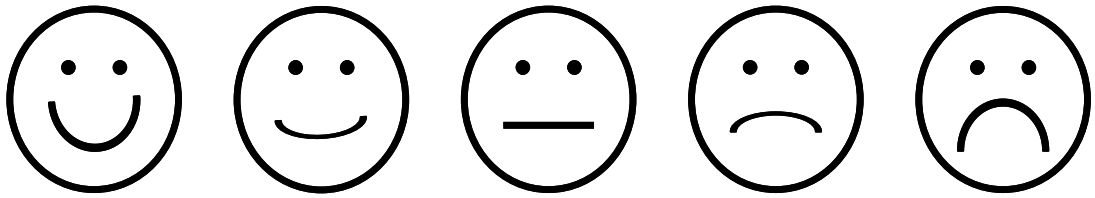


Strongly agree | Agree | Neither agree nor disagree | Disagree | Strongly disagree

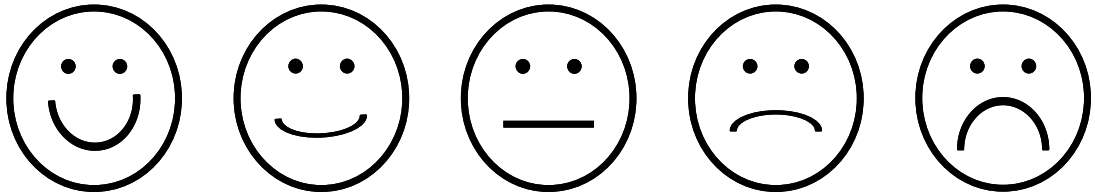
Now for the questions!

These questions are about the Balloons and Blast Off! activities. Colour in the smiley that shows what you think.

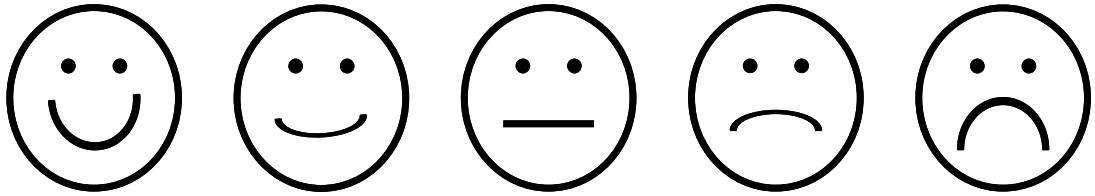
1. I liked the Balloons and Blast Off! talk



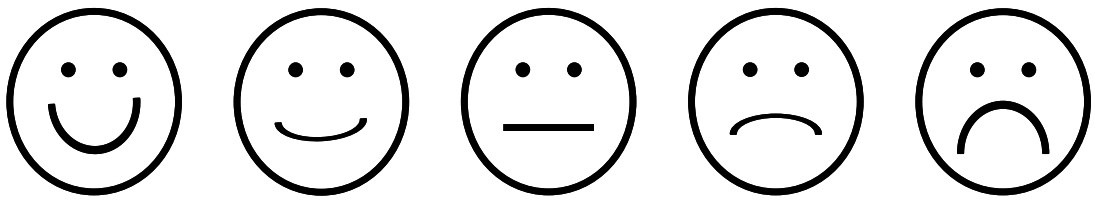
2. I liked writing the story



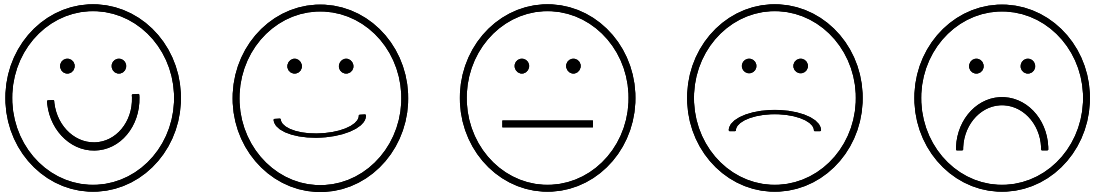
3. I liked making and decorating the rocket



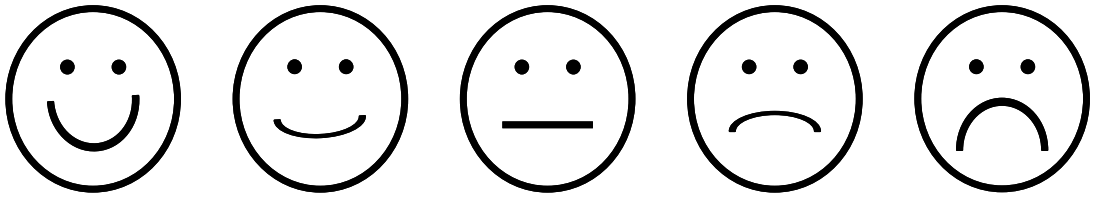
4. I liked the drama where we pretended to be a balloon and a rocket



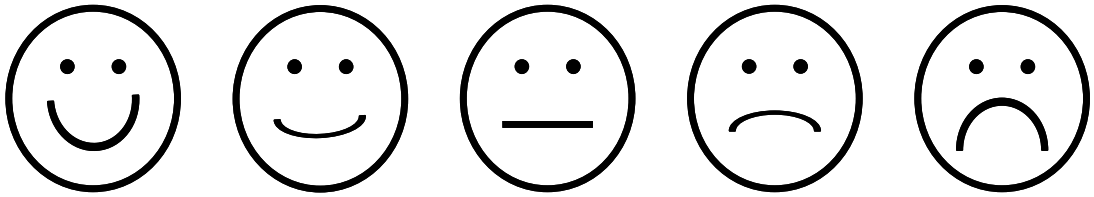
5. I liked making the balloon powered car



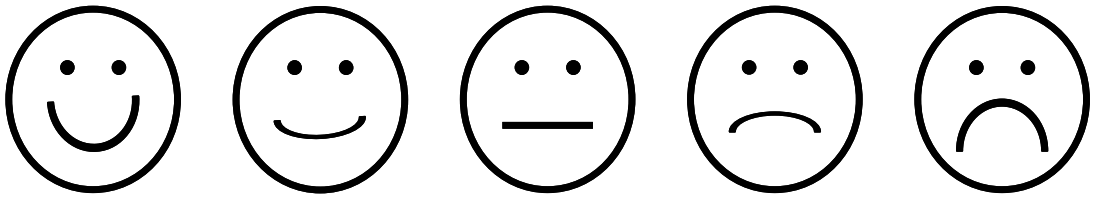
6. I liked working in a team



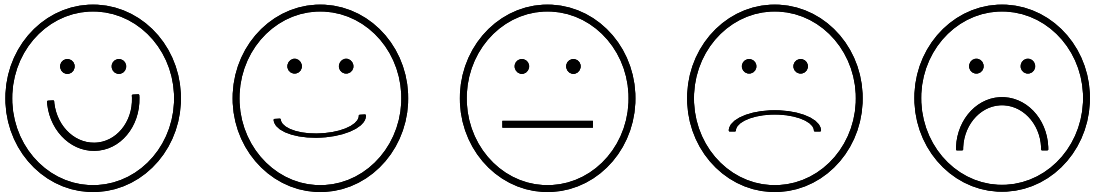
7. I learned lots from the day



8. The day taught me what scientists and engineers do



9. The day made me like science more



Here are some **words about the show.**

Circle the ones you agree with:

useful fun

silly

nice cool

clever too hard

boring

exciting dull

too easy weird

Write some more words if you like:

……

……

……

Please tell us something you think you learned from the show:

……

……

Did the show change how you feel about science? If so, how?

……

……

Thanks!

Teachers – what do you think about STEPS?

We are interested in your thoughts about the science and engineering activities your class recently participated in. We value your feedback and will use your comments to help tailor future activities more closely to your needs.

Please tick the relevant box or write your comments in the spaces provided – thanks!

Student year group ……..…….

School ……

Which activity did your class take part in?

☐ We Invented the Wheel (Years 1 and 2)

☐ Balloons and Blast Off! (Years 3 and 4)

☐ Forces Everywhere (Years 5 and 6)

1. Overall, ***what did you think*** of the day?

	Very good	**Good**	**OK**	**Bad**	**Very bad**	**Don't know**
Overall impression	☐	☐	☐	☐	☐	☐
Interactive presentation	☐	☐	☐	☐	☐	☐
Challenge activities	☐	☐	☐	☐	☐	☐
Educational value	☐	☐	☐	☐	☐	☐
Enjoyment value	☐	☐	☐	☐	☐	☐

2. What did you think about the **interactive presentation**? Please tell us why you think this.

3. What did you think about the **challenge activities**? Please tell us why you think this is.

4. Please describe your **overall impression** of the STEPS activities?

PLEASE TURN OVER →

5. Do you think that the **science** was pitched at an appropriate level for your students?

6. What, if anything do you feel that your students **learned** from STEPS?

7. Do you think that events such as this make science **more exciting** for the students? Please tell us why you think this.

8. Do you think events such as this have **any other impacts** on students? Please tell us why you think this.

9. Did you participate in a **showcase event**? If so, please comment on it here.

10. Did you participate in a **museum visit**? If so, please comment on it here.

11. How could we **improve** the activity?

12. Do you have **any other comments**?

Thanks!

Quantitative data

Data for all core activities - students

Statement	n	Valid %				
		SA	A	N	D	SD
I liked the story/talk	308	51.0	33.4	12.0	1.6	1.9
The day helped me work better in a team	249	44.2	27.7	15.3	4.0	8.8
I learned lots from the day	308	57.8	25.3	12.7	2.6	1.6
The day taught me what engineers do	306	46.4	28.1	14.7	4.9	5.9
The day made me like science more	286	62.9	19.2	7.7	3.1	7.0

Data for all core activities - teachers

Statement	n	Valid %				
		SA	A	N	D	SD
Overall Impression	18	55.6	44.4	0.0	0.0	0.0
Interactive presentation	18	38.9	50.0	16.7	0.0	0.0
Challenge activities	18	44.4	44.4	16.7	0.0	0.0
Educational Value	18	66.7	33.3	5.6	0.0	0.0
Enjoyment value	18	44.4	50.0	11.1	0.0	0.0

Student data – *We Invented the Wheel*

Statement	n	Valid %				
		SA	A	N	D	SD
I liked the story	57	61.4	22.8	8.8	3.5	3.5
I liked the game where we rolled the discs to hit the stick	57	82.5	12.3	0.0	0.0	5.3
I liked the drama where we acted out the wheel and life thousands of years ago	56	50.0	19.6	19.6	5.4	5.4
I liked the activity with the cards and the feely bag	57	40.4	10.5	19.3	3.5	26.3
I liked the activity where we made a wheel and drew a picture of moving the rock	56	66.1	12.5	14.3	5.4	1.8
I learned lots from the day	57	57.9	21.1	17.5	1.8	1.8
The day taught me what engineers do	56	37.5	17.9	23.2	3.6	17.9
The day made me like science more	54	77.8	14.8	1.9	1.9	3.7

Student data – *Balloons and Blast Off*

Statement	n	Valid %				
		SA	A	N	D	SD
I liked the Balloons and Blast Off talk	138	54.3	33.3	8.7	1.4	2.2
I liked writing the story	137	46.7	27.0	18.2	5.1	2.9
I liked making and decorating the rocket	137	77.4	13.9	4.4	2.9	1.5
I liked the drama where we pretended to be a balloon and a rocket	118	39.0	31.4	18.6	5.9	5.1
I liked making the balloon powered car	118	63.6	20.3	8.5	3.4	4.2
I liked working in a team	137	46.0	30.7	8.8	5.1	9.5
I learned lots from the day	139	64.7	23.0	7.2	2.9	2.2
The day taught me what scientists and engineers do	139	55.4	28.8	10.1	4.3	1.4
The day made me like science more	138	68.1	21.0	5.8	1.4	3.6

Student data – *Forces Everywhere*

Statement	n	Valid %				
		SA	A	N	D	SD
I liked the Forces Everywhere talk	113	41.6	38.9	17.7	0.9	0.9
I liked using the words and arrows	93	23.7	29.0	32.3	7.5	7.5
I liked the drama where we acted out a form of transport	94	56.4	26.6	8.5	5.3	3.2
I liked making the futuristic form of transport	112	67.9	23.2	4.5	1.8	2.7
I liked talking to the class about my futuristic transport	93	25.8	29.0	22.6	14.0	8.6
I liked making the hovercraft	93	69.9	16.1	9.7	3.2	1.1
The activity helped me work better in a team	112	42.0	24.1	23.2	2.7	8.0
I learned lots from the day	112	49.1	30.4	17.0	2.7	0.9
The day taught me what scientists and engineers do	111	39.6	32.4	16.2	6.3	5.4
The day made me like science more	94	46.8	19.1	13.8	6.4	13.8

Student data – *We Invented the Wheel (museum)*

Statement	n	Valid %				
		SA	A	N	D	SD
I liked the story	22	59.1	31.8	9.1	0.0	0.0
I liked the game where we rolled the discs to hit the stick	22	77.3	9.1	9.1	0.0	9.1
I liked looking around the museum	22	86.4	9.1	0.0	0.0	4.5
I learned lots from the day	22	63.6	27.3	9.1	0.0	0.0
The day taught me what engineers do	22	77.3	13.6	4.5	4.5	0.0
The day made me like science more	22	81.8	4.5	9.1	0.0	4.5
I played with my goody bag when I got home	22	86.4	13.6	0.0	0.0	0.0

Student data – *Forces Everywhere (museum)*

Statement	n	Valid %				
		SA	A	N	D	SD
I liked the Forces Everywhere talk	27	37.0	48.1	14.8	0.0	0.0
I liked making the water wheel	27	66.7	29.6	3.7	0.0	0.0
I liked looking around the museum	26	76.9	7.7	11.5	3.8	0.0
The activity helped me work better in a team	27	25.9	40.7	33.3	0.0	0.0
I learned lots from the day	27	70.4	22.2	0.0	7.4	0.0
The day taught me what scientists and engineers do	27	55.6	25.9	14.8	3.7	0.0
The day made me like science more	26	61.5	15.4	15.4	0.0	7.7
I played with my goody bag when I got home	22	59.1	22.7	18.2	0.0	0.0

Qualitative feedback: category analysis

Learning - *Balloons and Blast Off*

About balloons
about balloon caBaBs
how out a Balloon not pop when put it frew the senter
blowwen cerbabs
You can put something sharp in a balloon without poping it.
you can put a pin in a blown
I learned that you could make ballon cabbabs
When you blue the bloon up big and put a nail through it will pop and if you blue it up
small it never popped.
about the ballon when they burst
How to be a baloon.
I learnt that blonnens do not go stright
You can mac a can using a ballon
That a balloons static can push and pull a can.
That ballons go up hgh.
only how the air goes down an up on a ballon
I learned we are the bloone flys
I learned about baloons can make loud noisy sound wen you let go of it.
how to put a balloon down the wire
I lernt more about bloons
? A can move on a balloon.
The baloon cars and the rocket when we went outside
I learned about static from balloon's
I lint about the strike(?) on Baloons
In learned that balloons can go in straight line
ballon karts rockets gravety

About rockets
When we did the Wheit Rocit
About Rockets how they blast off
I learned a lot of rocket scince.
I learned about Rockets
I lernt Abutn rocke
that you can make a rocket out of a bloon
Sian showed us how the rockets worced
how to make the rocit gow on a string to make a (?) go
I learned lots about rockets / balloons
we learnt thata rockets have to be (?)
I learnt how to make rockets.
The rockets were fun and exciting!
How Ballons and rockets set off!
I learned about Rockets
Those little rockest whent high
That rocket's are fun to lern about. It was fun!
well some rockets were better than others

I learned about the water rockets.
Lots of different planets and rockets. Different planets have different type of gravity.
Rocets need to be very light.
I liked the rocket it was fun.
that one shad of paint will bring a rocket down.
I learned where the ear come out the rokit

What engineers and scientists do, or what they are like
all people cant be scientisit..
I learned how to be a science person
Anyone can be a scientist
I learned sience is very very very clever
I learned that engineers make things
I learnt that sientists don't have to wear white jackets
an Engineer makes things
That being a scientist or an engineer is FUN!!
what sciences do
that if you're a scientist you don't need to be crazy
What sinsitists do and what enginears do.
Scientists are people who work hard
I learned that scietist and what they do.
I have learnt the difference between scientists and engineers.
I learned that sinsters can be cool
That I did not no that enginer + illegiable response

Not much or nothing or forgotten
did learn something but fgot it
not sure
I don't no
I've forgotten
I don't now I didn't learn anything
I didn't learn anything because I aready knew.
I didn't learn enything
I can't remember.
I did not learn anything.
I did'nt learn much
I didn't lent much
I didn't learn
Nothing much

That science is fun
Science can be fun
I learned that scinse ca be fun
I learned that scinse ca be fun.
I realised science is fun.
science is better than I incped
that science is fun Yes it made me feel more about how much I like it!
we learned that science was cool!
we learned that science was interesting cool!

I learned science can be fun.

Forces or gravity
gravity weaker or stronger on over planets
I learned about forces.
the ball gets pulled to the centre of the erath
I learned the way that gravity.
that gravity can pull things down.
about the Gravety and water(?)
that when u put presshur on it it moves.

Planets
The rime what heps you to (?) nthe pant
all the names of the plantes
? The plans where calld
the planets that are very small are very weak a big planets are strong with gravity.
It will take a you a year to get to mars
The rym about planets.

How to float a ball using a hairdryer
How to float a ball using a hairdryer
When The hair driyer blown up the ball
I think I learned that you can float a ball.
keep a ball in the air with a hair dier

General learning
I gess so.
I learned lots of stuff
I learned a few things.

Other
I lernd that sianc isant about fun it is about learning
I learned to be more creative.

Attitudes – *Balloons and Blast Off*

Did the activity change how you feel about science?

Yes
yes it did
It really Did change how I felt
yes
The show made me like science more because it is not just work.
It made me more interested
I make me like sience a Bit more.
yes!

Fandabie dosie yes
it made me feel better about siants
not fily but I like it more
yes
At first I hated science now I like it.
I like science more because of the show
It has made me change my mind a bit
I thought it was boring but now I quite like it
It made me like science by seeing how fun it is.
When we finished the show I felt more confidensed about since
I thought it helped me understand sience
I like science more.
I like science more because It made think it its fun.
I do like science now
yes yes yes they did
at the start it was boring but atf the show it was Quit exciting, good and boss
Ithin so
I fink so
it made me like science more than I did.
I didn't like science to start with but Sian made me like it.
The show made me more happy about science.
The show made me like science even more than I enjoy it.
It made me like science more than I used to.
Yes it made me like science
Yes it did because I love rockets
it changed a lot when miss penington told
I like it more now.
When the first time I thoughtb it was boring but now I like it.
It made me like it more.
I liked it more than miss pennigton said it was
It made me love science
it makes science better.
I liked it very much.
yes because I learned lots of cool stuf
more fun
It made me like more science.
It was realy fun but some other science lessons ar'nt fun that's why.
A bit because it was fun after the talking.
yes because since can be fun
I did not thing science was fun but now I quite licked it
Yes
It made me a lot interested in it and I am glad I want to see it
Yes because it's fun more smiley faces.
Yes it made me feel more interested and made me feel lik a scientist.
YES!
YES!
YES!
Yes I thort that siancs was boring but it's fun.
yes it is more than I expected
it was so much better than we do because we do?

I would like to do more science.
It did because I didn’t no you could get dfferent kinds of rocket science.
The show made me like science more
after the show I wanted to do more science.
Yes I learned how to make a car move using a balloon.
Yes… now in know science is fun.
No yes it did Becos I always Thoght it was Baring but its Fun
I now think it's fun befor I did not
Yes it made me change my mind a lot because Shorn made it fun.
I like it now.
I haytid science but now I like it
It made me change my mind about science because it was fun.
Yes the show Did make me like sianc more
Yes because it was fun and it showed me that sience can be fun if you want it to be
yes

No
I like scients and I still do
I felt the same
no
it was less no
It still hasn't changed the way I think about sciense.
No, always loved science.
No
It hasn't changed my mind but I loved doing the science
no
I feel the same I don’t like science.
I felt the same
it did not chang how I felt about science?
no no no no!
Nothing
No! it did not.
No!
Not really because I love science !!!
no not that much
not really Because we did it last year.

Student unsure
not shor.
I don’t no Im not sure.

Not possible to tell from response
Science is fun.
It was a great day and I learnent a lot of thing like working as a team is Important and we had fun.
The show was great at start and finish.
It was hard but fun
I did not like science that much she helped me
well yes I like science

Sciencve is fun.
Because the baloon car maid me laghe
I liked to Do the Rocket powerd car Because its cool
it was gud
I feel That I love it
I loved (clay thing??) they are so good
I luved it.
Come back soon you

Learning – *Forces Everywhere*

About forces
There are a lot more forces than push and pull
That frecon rube on two surfaces.
and how different surfaces created more friction
I learned about forces more
I learned about different forces.
I laernt different forces
I learn't a bit more about forces and what they can do
I learned about friction.
When something rubs on the floor ios friction
I've learnt that there is lots of forces in the world
forces and motion.
Pushes an polls eir resistance foreses gravity
Forces and airecistance
Air restance, Gravity.
I learned about the Forses gravity
More than 1 thing gravity upthrust air resistance
Push, pull, air rezistance, gravity
I learned about forces.
air restance
Push and pull / forces Gravity air resistance
I learned that friction slows objects down if the object moves. While friction is there.
pull, push and forces
I mostly learnt about forces, like air resistance.
I inent about fuse
all about grathity and up a frust.
We all leant about Forces pushing and pulling it was a fun day.
grabty. And pull and pusk
air resistance gravity puis push
When you push air from a balloon push's so the car go's

About making the hovercraft
The hovercrafta white the hier driyer.
I learnt that you can make a home made hover craft.
how the hovercraft travelled across the ground.
how the hovercrafts move across the ground.

I learned how to make a hovercraft
I learned how to make a hovercraft out of a cd, bottle top and balloon
how to make a hovercraft & friction.
I didn’t know that you could use those materials to make a hobercraft.
I learned how to make a hovercraft so I could make one at home.
A balloon gcan be dragged across the floor with a disc.
how to make a hovercraft.
You can make a hovercraft out of a CD and a baloo
How to make a hovercraft
how to make a hovercraft and
how to make a hovercraft.
Shan taught me that hovercraft was harder steering than a remote con troll car.
When Sain should us how a hover craft worked!!!
She showed us how to make a Hovercraft.
making hover crafts

About rockets
I leaRd that how to make water Roket
The rocket was grat see
The rocket wos grat because wen it shot up in the sky.
I lend that water can lift a bootl
I have learned that planes and rockets have wheels and they can fly with (wheels?)
about the rockiet
Thatb engineers have to work really hard to make rockets.
That you can buy the rocket thing from a rocket shop.
how fun the rockets set off and all of the forces.

About scientists and engineers
That engineers build models that are helpful in the future and that science not boring
I've learnt what a engineer does + sctist does
that scientists is not boreing
I learned a lot about what science and engineers do.
and what engineers do
What a enginner is different whan a scientist
I learned that you can never be wrong in a scientists mind.

Nothing / can’t remember
I Can not rember.
Can't remember
I Can not remer.
I can't remember nothing
I Don't think I learned anythink
I can't Remember
I didn't learn anything:

That science can be fun
Science can be enjoyable but very serious

that science is really fun
I learned it is funif you get into it.

Making things
I learned to make a modul
That it is harder to design and make transport than you think

Not sure
not sure.
not shore

Other
That you can make a ball flout in the air with a hair dryier
I learnt that you can yous chip pan fat in sted of oil.
I learned they rolse
You can freeze ballons
Doing the Prentaion for Made up car's

Attitudes – *Forces Everywhere*

Did the activity change how you feel about science?

Yes
Yes because It was a good change
I like science more.
Yes because It was a good change
Yes because we got to see how to dowe the a experiment
Yes because we got to see how to dowe the a experiment
Yes because we got to see how to dowe the experiment
I liked science more becaues it was fun
Yes because it made science fun.
A little bit because I liked all the experiments
It made it more exciting and fun
Yes I think I made me think that it was more interesting.
Yes that science is enjoyeble
Yes because Now I know that science is more interesting
yes it is more fun
The day did change how I feel about science a little bit because now I know science can be fum
I have changed my mind about science I really like science.
Yes because I learnt lots of scientific things and made much more fun than I thought
so.
It did because we did a bt of fun things to do with science.
Yes because it makes science more fun
a bit because science can be more fun than you think
Yes because I really like learning about science now.
Yes because it was exciting and most parts where fun
A bit because I didn't think science was good but now I do because of the fun

experimence you can do
It did because it shows what you can do with every day items.
Yes a learn things
Yes, because I didn't know scientists made transport for the future.
I liked it before but she made it even better because she went through with us.
Yes because I didn’t like science at first and when I saw the show I liked science
I felt a bit better liking science because I thought it was boring at the beginning
Yes because at first I thought it was boring but when Sain should us I loved it.
Yes, because I did not like science now I do
yes because it showed me that science can be fun!
Yes to go out and try / do things.
Yes it made science look fun and now I really like science.
Yes I realised how complicated science is
YES
Yes because it used to be boring and dull but now I know how to do it properly.
Yes because it told me how interesting science can be.
It was great fun and it taugght me that scince Is great!
Yes because it made me realise that there are more things in the world to use for some
forces.
I like it a lot more because theirs lots of fun and interesting facts and subjects.
Yes because science is about experamenting and doing chemistry in cenior school.
Yes because it was very exciting and fun.
Yes because that was the best leasin
Yes Because it is fun but I already enjoyed Since
Yes it was good and exciting the activities were fun!
Yes Just because it was fun and I liked science first.
Yes, because I know how fun to be a sientits.
yes because I learnt more about science.
Yes, because it made science more fun, with good equipment.
I ingoyed science all ready but now I ingoy it more.
The day was fun and it was good to lean in school about push and pull.
The science was good
Yes we could see how we use science every day.
Quite a lot I would like to be an angenie
more intresit

No
not very much.
not that much.
no because I already know about forces
no because I know about forces a little bit. I don't need to learn more. I already no about forces.
no
no
no I will always hate science.

No, I will always hate science!
No cause I hate science
not really because I know I am not good at science and it can be fun but I am not really the science person.
No because we do a lot of activitys like that in school anyway
Not really because I used to like science and still do.
No because I liked science anyway.
No. because I already love Science:::
Not really because I still don't like science and I still think the same.
Not much because I like science some times but most of the time no
No because I knew everythingexept for the hovercraft any way
no because I new most of the finges
No because it was ruind by my team
No because I knew most of the stuff Sian taught us.
no because everything she said I either knew already or was not very interesting
not really no

Not possible to tell from response
I thought science wasent as good as other subjects but the day was fun the way you could many objects using science.
Kind of because I really really like science anyway.
The day was quit good and in another it was bad tata see ya soon.
Sort of, because I don't really like science
I think that theb science fair was a great sucses.
I learned more.
The day made me feel happy because I like doing art.
I was very interesting.
I new mosely everythink
It is fun I was really happy I wish it could come to me.
I really enjoyed the science lesson it was fun.
I liked science but I didn't line very much.
I Good fun
I liked science but I didn't line very much.
I learnt a lot but I wouldn't be an engineer.